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Preface

On November 18th and 19th 2022, School of Engineering, RK University, Rajkot organized ICSET 2022 - a two-day international conference in collaboration and sponsorship with AICTE. The basic objective of the conference was to bring together academicians and experts from different parts of the country and abroad to share various innovations and information. This conference provided an in-depth analysis of subjects and updated the knowledge of the participants from academic/industry/research institutions. The broad objective was to provide a forum to share information and experiences between Researchers, Academicians, Manufacturers, Consultants, Authorities in the field of Engineering, Technology, Sciences, and other multidisciplinary relevant areas. The objective of knowledge sharing was achieved through: Technical & Panel Discussions, Interaction with Industries Experts, Keynote Speeches, Paper Presentations, etc. This conference succeeded to bring together the scholars, academicians, scientists and industrialists from all over the world to the wide spectrum of relevant fields to a common platform for discussing the ongoing research in various fields and hence to foster research relations between the academia and the industries. The delegates were benefited with the scientific and technological issues addressed by recognized global experts who are up to date with the latest developments in their areas. This conference has provided an opportunity to national and international experts and industry leaders to share their experiences and success stories. 250+ participants have attended the conference from various regions. Best paper presentation awards were given away in all different tracks of the conference.

Through this event, School of Engineering, RK University made a small contribution to the nation for research and knowledge exploration in the field of engineering. The event would not have been possible without the involvement of management of RK University who actively led from the front, especially Shri. Denish Patel - Executive Vice President - RK University and Shri. Mohit Patel - Vice President - RK University, as well as support from faculty members and staff of various departments of School of Engineering and RK University and support from different committee members across the globe. The present volume of the conference proceedings has selected full papers that were discussed in the conference and that went to a rigorous review process. We hope you find the published papers interesting and useful.

Dr. Amit Lathigara
Conference Chair
ICSET 2022
Director - School of Engineering
Dean - Faculty of Technology
RK University

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Review on Just In Time

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ABSTRACT. Due in part to its success in the Japanese sector, just in time (JIT) operations have become increasingly popular. Several advantages, including less inventory, increased operational efficiency, and quicker reaction. Before the intended result is attained, JIT implementation may require a succession of incremental stages and errors. Customers must consider the product's quality, delivery schedule, and price. JIT must thus be successfully implemented for various businesses. Implementing JIT increases performance by reducing inventory levels, decreasing quality costs, and improving customer response. In this essay, the function of a company's resources will be examined. A literature evaluation of a small manufacturing company that changed its resource configuration from a producer-consumer connection separated by a buffer to a simultaneity constraint is presented in this paper. The conclusion of this paper demonstrates that the elimination of the buffer system enhances the demand for mix flexibility in the production system and shows that the JIT system is successful. Using the JIT system may provide the case firm with a number of benefits.

Keywords: *JIT, Resource configuration, Set-up Time Reduction.*

INTRODUCTION

By obtaining the proper amount of raw materials and processing the proper amount of products at the proper location at the proper time, the Just in Time (JIT) manufacturing philosophy aims to reduce sources of industrial waste. The Just-in-Time (JIT) principle has been used extensively in the Japanese automotive and electronics sectors, while it is finding increasing use in a wide range of global businesses. All production systems in the modern, fiercely competitive global business environment strive for long-term survival. Producing the required item in the required quantity at the required time is an eternal diver of production and operations management, according to the JIT philosophy.The capacity of a manufacturing business to create the greatest quality product at the lowest cost, in the shortest amount of time, and with the shortest lead time is crucial to its survival in a market that is becoming more and more competitive.

Just in Time (JIT) manufacturing refers to producing only what is required, when required, and in the required quantity. For instance, a thorough production plan that covers components acquisition is required to effectively produce a significant number of vehicle parts, which can contain about 40,000 pieces. By providing what is required, when it is required, in accordance with this production plan, waste, consistency issues, and unreasonable demands may be resolved, increasing productivity.

The Just in Time (JIT) manufacturing approach from JA seeks to boost company return on investment by reducing in-process inventory and associated carrying costs. Japan developed the Just in Time (JIT) approach to operations management in the 1950s.

HISTORY OF JUST IN TIME

JIT is a Japanese management style that has been used in many Japanese industrial enterprises since the early 1970s. In order to satisfy customer requests with the fewest possible delays, Taiichi Ohno originally created and honed it within the Toyota production facilities. The term "father of JIT" is widely used to refer to Taiichi Ohno.

Toyota was able to overcome the growing obstacles to survival by taking a strategy that was centred on people, plants, and systems. Toyota came to the conclusion that JIT would only be effective if every employee in the company participated in it, if the facility and processes were set up for maximum output and efficiency, and if the quality and production schedules were scheduled to precisely match demand.

When correctly fitted to the organisation, JIT manufacturing has the potential to significantly increase the organisation's competitiveness in the market by decreasing wastes and enhancing product quality and production efficiency.

Strong cultural influences may be seen in the rise of JIT in Japan. These ideas are part of the Japanese work ethic.

- Employees are extremely driven to continually seek improvements to what currently exists. Even if there are now high standards being reached, there are still greater requirements to reach.
- Companies emphasise teamwork, which entails merging abilities and sharing information, skills for solving problems, ideas, and the accomplishment of a common objective.
- Work itself takes priority over downtime. Working 14-hour days is common for Japanese employees.
- Employees frequently stick with the same employer for the duration of their careers. This offers individuals the chance to continuously improve their skills and talents while providing multiple advantages to the business.

These advantages show themselves as a company's goals being achieved, minimal turnover costs, and loyal employees.

JIT PURPOSE

Because JIT manufacturing aims to reduce waste, it may improve inventory management, product quality, and overall financial and operational processes. The major goal is to have the production time to be less than or the same as the lead time specified by the client. A Just-in-Time production and inventory management system is used by businesses to boost productivity and cut expenses. Only when a demand is generated by consumer orders, as per the system, must producers make purchases. To guarantee that parts arrive at the site in time to create items for the client request, businesses must establish relationships with their vendors. Businesses only create inventory in response to confirmed consumer orders. The technology prevents the company from creating or holding extra inventory

Fig.1 JIT

Because JIT manufacturing aims to reduce waste, it may improve inventory management, product quality, and overall financial and operational processes. The major goal is to have the production time to be less than or the same as the lead time specified by the client. A Just-in-Time production and inventory management system is used by businesses to boost productivity and cut expenses. Only when a demand is generated by consumer orders, as per the system, must producers make purchases. To guarantee that parts arrive at the site in time to create items for the client request, businesses must establish relationships with their vendors. Businesses only create inventory in response to confirmed consumer orders. The technology prevents the company from creating or holding extra inventory.Just-in-Time solutions are effective in both big and small businesses that manufacture goods or provide services. Just-in-Time production and inventory management concepts may be applied to any industry with a few minor modifications.

The aim for ongoing production process improvement is the list of seven wastes.

Fig.2 Seven Wastes Of Lean

Transportation

When resources (materials) are moved yet the transfer doesn't improve the result, this form of waste occurs. Inefficient material movement might cost your company money and compromise product quality. You may frequently be required to pay extra for time, space, and equipment when using transportation.

Overproduction

Eliminate by speeding up setup, coordinating quantities and timing across operations, condensing layout, improving visibility, and so forth. Just what is required at the moment.

Waiting

Eliminate as much as feasible by synchronising job flow, and balance unequal loads using adaptable personnel and tools.

Processing itself

Consider factors other than scale or speed, such as why the item or product should be produced at all, and then the need of each step in the manufacturing process.

Stocks

Reduce by speeding up setup and lead times, coordinating production flows, enhancing worker capabilities, and even adjusting for swings in the product's demand. Stocks waste is decreased by reducing all other wastes.

Motion

Examine motion for consistency and economy; consistency increases quality and economy increases productivity.

Making defective product

Create a production method that stops mistakes from being produced to do away with inspection. Accept no flaws, and don't introduce any during each procedure.

LITERATURE REVIEW

Angappa Gunasekaran et al.(1999) [1] Selecting local suppliers and placing small orders, which lowers a supplier's workload each period, the JIT purchasing idea seeks to shorten the lead time for replenishment. The JIT purchasing concept places a strong emphasis on innovative ways of working with suppliers and a clear understanding of the proper role of purchasing in the creation of company strategy. Instead of being seen as external rivals, suppliers should be seen as "outside partners" who might benefit the buying company in the long term. The main initiatives are efforts to lower ordering costs and replenishment lead times.

Rosemary R. Fullerton et al. (2000) [2] While strong market rivals have developed, utilising superior manufacturing processes such as just-in-time (JIT) and continuous process improvement, the US manufacturers have faced expanding trade deficits and outsourced operations. Despite the numerous advantages of JIT adoption, its acceptance rate in the US has been somewhat cautious. This study makes use of survey responses from executives at 95 JIT-practising companies to learn more about the advantages that companies have reaped from adopting JIT and to determine if a more thorough implementation is desirable. The study's findings show how following the JIT philosophy's quality, continuous improvement, and waste reduction strategies may boost a company's competitiveness.

Maria Rosário Mota Oliveira Alves Moreira et al. (2008) [3] In the 1980s, in addition to various studies in the United States and the United Kingdom, there were articles on the deployment of Just-in-Time in West Germany and Hong Kong in 1988. The majority of research published in the 1990s were done in industrialised nations such as Australia, Canada, Italy, Korea, Spain, and Sweden. Similar studies in developing nations (China, Egypt, India, Mexico, Turkey, and so on) are more recent, with the majority of them taking place in the twenty-first century. The majority of the papers given provide empirical data on Just-in-Time implementation and practices.

Sihle Mankazana et al. (2018) [4] This section discusses the theoretical literature of the Just-In-Time research in connection to the Inventory Management system in South Africa. The key components addressed include JIT ideas as well as related concepts and pertinent theories linked to the research.

Swapnil S. Dange et al. (2016) [5] "**A Systematic Review on Just in Time (JIT)**", JIT is a system that emphasises waste reduction and continual improvement in order to attain operational excellence. JIT in manufacturing refers to a production system in which the pieces necessary to complete final goods are created or supplied at the assembly site as needed. Hundreds of journal papers on JIT manufacturing research have been published during the previous three decades. The great majority of these publications praise the benefits of using JIT processes, such as enhanced performance in terms of manufacturing costs, quality standards, delivery timeliness, and flexibility.

Mu Chena et al. **(**2016) [6] Just in time (JIT) manufacturing is one of the primary approaches used to improve manufacturer competitiveness by reducing inventory and lead time. However, there are several problems to adopting JIT, such as a lack of needed information exchange or communication between stakeholders, an insufficient sound action or planning framework, and so on. The Internet of Things (IoT)

technology has the potential to be utilised for real-time data and information acquisition to support dynamic JIT production.

T. Friedli : M. Goetzfried et.al. (2010) [7] Pharmaceutical businesses gained control of their formerly poor asset utilisation and improved the effectiveness of their quality systems; nonetheless, they are still a long way from having any type of "continuous flow," seamless production scheduling, or make-to-order manufacturing. It might be claimed that the majority of businesses are still focused on effectiveness rather than efficiency. Improve your grasp of the industry's real implementation of Total Productive Maintenance, Total Quality Management, Just-in-Time Delivery, and Effective Management System. Investigate the relationship between the installation of the aforementioned systems and key performance metrics.The information utilised in this study was taken from surveys that the University of St. Gallen in Switzerland performed from 2004 to 2009. Brand-name, generic, and contract manufacturing enterprises from the pharmaceutical and biologic industries made up the participating firms. Companies ranging in size from small to medium-sized to giant organisations are included in the research sample. The data obtained includes data for the whole production site because the survey was completed by representatives of the firms' manufacturing facilities.

Cem Canel et al. (2000) [8] Faced with the challenges of aggressive rivalry, organisations that focus more on the demands of consumers to enhance product quality and customer service have long been aware of the need to decrease waste as a method of reducing costs and improving product quality. Just in time (JIT), the structured waste reduction procedure, has established a firm footing in the industrial industry. The service industry, on the other hand, has been slower to grasp the benefits of JIT.Services, like manufacturing, involve procedures that add value to the fundamental inputs required to generate the end product. JIT focuses on the process rather than the product. Customers' expectations for complete satisfaction with the products and services they purchase have grown in response to growing worldwide competition, rising new technology, and enhanced communications. As a result, many manufacturing and service organisations have been challenged in recent years to improve their attention on customer happiness and product and service quality. Faced with the challenges of global competition, businesses throughout the world are obliged to discover methods to cut costs, enhance quality, and fulfil the ever-changing wants of their customers. One of the numerous just-in-time (JIT) production systems. JIT manufacturing systems, which involve several functional areas of a corporation such as production, engineering, marketing, and buying. JIT was established in Japan in the 1950s and later enjoyed significant success at Toyota. JIT is a successful approach that has been the adoption of an operational model meant to eliminate waste (Chase et al., 1998 ; Hernandez, 1989 ; Krajewski and Ritzman, 1999 ; Schlesinger and Heskett, 1991). Waste is defined as everything other than the bare minimum of equipment, resources, components, space, and workers' time required to add value to the product or achieve significant success at Toyota. JIT is an acronym for just-in-time delivery.

Kwasi Amoako-Gyampah et al. (2001) [9] The key question addressed in this research is how businesses who claim to have invested in JIT production systems vary from enterprises that do not claim to have invested in JIT production systems. We'd like to know if claims of JIT investments are compatible with initiatives such as staff education and training, setup time reduction, cellular production, continuous quality improvement, and supplier partnerships. That is, in a developing nation like Ghana, when a company states it has invested in JIT. Does it follow procedures that support that claim?The response to this question is significant because it indicates if Ghanaian businesses have a strong knowledge of what JIT involves. The remainder of this study (in separate sections) discusses the Ghanaian economic environment, aspects of JIT production systems, research hypotheses, research methodology, results, and conclusions.

Adeniran Busari Ganiyu et al. (2019) [10] The influence of Just in Time on efficiency, product quality, and flexibility was evaluated using primary data obtained from 82 surveys conducted in the food, wood and furniture, metals, and nonmetals industries in South Africa. The Spearman Correlation Coefficient technique was used to conduct the analysis, and the results showed that most manufacturing firms among small and medium enterprises were not adopting Just in Time. It was also discovered that some factors are responsible for SMEs' non-application of Just in Time, such as a lack of a reliable supplier network, insufficient capital, and a lack of information on the benefits of Just in Time adoption. However, it was advised

that small and medium-sized businesses be informed about Just in Time, how to implement it, and the advantages associated with doing so. Using primary data collected from 400 operations managers in the cement industry, just in time management in Pakistan's cement industry was empirically analysed to determine its components and to learn what advantages it has over its competitors. The link between the parameters of the linear functions was investigated using factor analysis, and the results show that adopting Just in Time principles into their manufacturing process significantly boosts the competitiveness of the cement sector in Pakistan. Although the study acknowledged the challenges that Just in Time components in the production processes faced.

John F. Kros et al. [11] This study draws three significant conclusions that are highlighted. First, it appears that inventory management procedures and their outcomes do not appear to be uniform throughout the three sectors analysed, as shown by the inconsistent findings of the data analysis. Second, as the lump in the snake metaphor implies, it appears that certain manufacturers in the automobile sector are pressuring suppliers to hold inventories that they have previously held, and that the location of stockpiles has merely changed. This shows that the automobile sector may not have integrated upstream links to the level previously assumed, therefore more study is required to confirm this significant prospective result.Third, it appears that the JIT systems used in each of the studied industries may have been modified somewhat due to the sheer number of units being produced in order to achieve greater efficiencies, given the differences between the studied industries and the differences due to the focus on made-to-stock (auto and electronics) and made-to-order (aircraft) production. This is a significant discovery from a management standpoint since little study has been done that focuses on how JIT systems may be adjusted to fit the demands of various sectors.

Fengjia Yao (2020) et al. [12] To improve the correctness of the digital representation of the FMS under examination, the system makes advantage of IoT-enabled manufacturing data. A series of rescheduling techniques are automatically released by the system in the case of a manufacturing disruption in order to maximise just-in-time delivery performance and reduce AGV energy usage. AGVs are forced to wait inactively in an early city, yet output is lost when machines and people are forced to temporarily wait. It takes an optimal dispatch time of AGVs that takes precedence relation limitations into account as well as the start time of operations for tasks at each machine in the production phases to solve this difficulty.The prior literature came to the conclusion that the choice of dispatching and routing systems, as well as the overall integration of the AGV and machine schedules, have a significant impact on the effectiveness of AGV fleet management.

Kaneko Jun (2008) et al. [13] It is vital for the vehicle manufacturer and the components suppliers to work together in a JIT-based manufacturing system in order to further improve the efficiency of JIT. Particularly in JIT, long-term business ties are preserved and information is closely exchanged with a select group of suppliers who have been chosen based on factors like good quality, competitive pricing, and on-time delivery. In terms of revenues produced by lower transaction costs and a learning effect brought on by the accumulation of manufacturing expertise, this offers advantages that may be reaped by both suppliers and assemblers (Monden, 1998).

Alireza Goli (2019) et al. [14] All machines in a flow shop are arranged according to operational duties in a production system. The Flow Shop Scheduling (FSS) issue, which includes figuring out the best schedule for work processing on machines, has long been a standard in research. In collaboration with several objectives, optimization techniques for two- and three-machine flow shop issues have been created. All precise, heuristic, and meta-heuristic solution techniques aim to reduce overall completion time because the majority of FSS issues are NP-hard, or problems with non-polynomial run time.

Vijay R. Kannan (2004) et al.[15] Alternative methods for enhancing the efficacy and efficiency of an organisation's operations function include JIT, TQM, and SCM. Although they have occasionally been presented as different and independent due to distinctions in their motivations and goals, it is naive to assume that they are unconnected. Both JIT and SCM aim to increase quality; the former does so by streamlining production processes, the later does so by fusing the supply chain's development and production processes. JIT implementation success depends on suppliers providing high levels of service in terms of both product

quality and delivery dependability. Production schedules must also be coordinated with supplier deliveries.For this, it's necessary to establish tight ties with suppliers and incorporate their intentions into manufacturing. Although the three strategies have certain distinguishing traits, it can be inferred that they are all constituent parts of an integrated operations strategy.

ACKNOWLEDGEMENTS

Warm thanks to the researchers for preparing the platform in such a fantastic method to understand the Just in time characteristics of the process, which allows us to make the paper more efficient.

CONCLUSION

Just-In-Time production is a manufacturing concept that entails creating the needed things, at the required quality, and in the appropriate quantities, at the exact time they are required. Just-In-Time manufacturing is a problem-solving system that is enforced. As everyone knows, having to exert significant effort is highly unpleasant, and the system is known as imposed. JIT manufacturing requires quality since the JIT will fail if it does not have a quality programme. As a result of its statistical process control, JIT implies good quality at the source and the Plan, Do, Check, Action cycle. Techniques are also quite significant. JIT is a pull approach rather than a push method, with the goal of not creating items until they are required.

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Artificial Intelligence its Branches and Applications - Review

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Abstract. Artificial Intelligence today has become a very popular concept and has entered all scientific and technical fields, including the humanities. Smart phones in our hands and smart TVs in our homes are the best proof of that. It has become natural today to acquire smart devices and deal with smart programs. The science of machine intelligence itself is not a new science in the academic world, not even in the commercial world, but the need for it today allowed its circulation as a new concept, and this was increased by the spread of connected digital devices and the phenomenon of Big Data, where human has become even if he was not a computer specialist talking about Artificial Intelligence and usually linking it to innovative technological devices, although not everything innovative is inevitably linked to the ability to self-thinking.

Artificial Intelligence is technically the result of two scientific fields: behavioral and neuroscience and computer science, or as it is recently called informatics. Artificial Intelligence by definition is the science that includes all algorithms and methods, both theoretical and applied, that are concerned with automating the decision-making process in the place of the human being, whether in a full or partial way, with the ability to adapt, quote or predict. Usually, a program is intelligent if it automatically performs unprogrammed behavior in which it can make new decisions on its own to adapt to its condition and the condition of its surroundings over time. The characteristics of artificial intelligence, including automatic behavior, self-development, and automatic machine learning, suggest the idea of the absolute freedom of the machine to make decisions in the near future, and from it the fears that are currently rising in the media and academic arenas. But the technical reality and the ethical and technological obstacles say otherwise, and this is what we will try to prove through this paper. The ethical problem of information programs and smart machines is not new, and it has been raised from the beginning and continues to accompany technological development. Rather, it has created a new branch in informatics and law that specializes in this field.

In this paper, we will try to give the foundations of artificial intelligence, its characteristics, and some of its examples without going into its technical details in order to shed light on the reality of its developments and ambitions between what it has actually reached and what it hopes to achieve. Our aim in this study is to clearly depict the horizon of the growing smart technologies in the academic community so that they can pursue accurate studies on this subject.

Key-Words: Intelligence, Artificial Intelligence, Machine Learning, Big Data

INTRODUCTION

"Every human being is in the process of transforming into a machine. Rather, it is more correct that the machine is in the process of evolving into a human being." This is what the French philosopher Valery Paul said in his famous notebooks at the beginning of the nineteenth century [1]. This saying was the first proposition Due to the problem of the future of the machine in its coexistence with humans, and thus this question recorded the first question in the field of non-biological intelligence, or what is also known as machine intelligence, or the most used today "Artificial Intelligence". Since then, what are the actual developments that the machine has reached at the present time? What is its future role? What is its relationship to humans? Is the machine really transformed or will turn into a human? All these questions have been raised by many studies to analyze and address them, whether by researchers specializing in machine programming and its behavior, or by scientists in other related fields.

It is no secret to any researcher today that Artificial Intelligence has become one of the topics that attract the most coverage in all academic fields due to accelerating technological reasons on the one hand and purely economic reasons contrived by companies on the other hand, which have been enhanced by the emergence of Big Data in the last years [2]. The future of Artificial Intelligence and its applications took a serious turn in the scientific community after a conference was held at the White House in the United States at the end of 2016, where it addressed a sensitive issue related to the future of Artificial Intelligence applications and its ethics [3]. Before talking about the future of Artificial Intelligence applications, it is worth referring to its history, which gradually formed during Almost 130 years ago, but serious talk about it as a scientific breakthrough that occurred to mankind began during the last two decades only due to the superior skills and achievements that have become resulting from it in various fields in medicine [6], logistics [5], industries [6], economic management [7], natural language processing [8], and stock trading in markets [9], security systems in image analysis and voice discrimination [10] and others.

As for the concept of Artificial Intelligence in its contemporary form today, it is considered one of the fields of computing science, but its beginning was at the hands of neuroscientists and psychology [11]. But it is classified as such because it has become associated with technological developments with computing systems and algorithms and combines all techniques that aim to simulate the mental capabilities of humans and animals and their working patterns without prior programming for that behavior, and the most important of these characteristics are: the ability to infer [12], and machine self-learning [13].

In the scientific arena and public opinion, we read that the fears of Artificial Intelligence developments include two forms, the first of which concerns the threat to human jobs [14]. As for the second, it is the transfer of control over things to the machine, and the person loses control [15]. What is truly terrifying is the thought of the fate of human in a world in which machines perform many functions and are very sensitive. In addition to what the world is witnessing today from a technological invasion and a plurality of jobs that require interaction with the machine, which makes the future of human beings ambiguous as well as very difficult to predict [16]. It is worth noting here that the developments witnessed by self-learning machines in their unprogrammed behavior contradict what science has known in laboratories throughout history, where the researcher was well aware of the goal and behavior of his invention, and he could easily intervene when needed.

As for Big Data, the field of informatics is currently witnessing a great confusion between its concept and the concept of artificial intelligence, especially field and applied sciences that link intelligence to the concept of Big Data intuitively despite the complete separation of the two fields [17]. If the data contributes to feeding intelligent algorithms, this does not mean that these intelligent algorithms are directly linked to the information-intensive field. As for the field of Big Data Analytics, the matter is completely different, as it was derived from the use of Artificial Intelligence with Big Data, and with time it began to take its course to create a new branch in the field of technological sciences [18].

OVERVIEW

The Concept "Intelligence"

In 2006, a group of American researchers published a very important scientific article for their experimental research [19]. The article states that there is a contradiction when trying to make a significant thought effort in front of a complex situation, which is in the end "less intelligent" than the result of the same complex situation when making

a quick and spontaneous decision. This study itself challenges many of the current definitions of the intelligence model. Then, research continued around the world to confirm that intelligence is not directly related to mental effort [20] nor to the size of the case [21] nor even to the complexity of the case itself [22] (Figure 1). in fact; Building an (A577) aircraft that can accommodate 500 passengers today requires less intelligence than digging a small tunnel 200 meters long that crosses the road in a flooded area of the city.

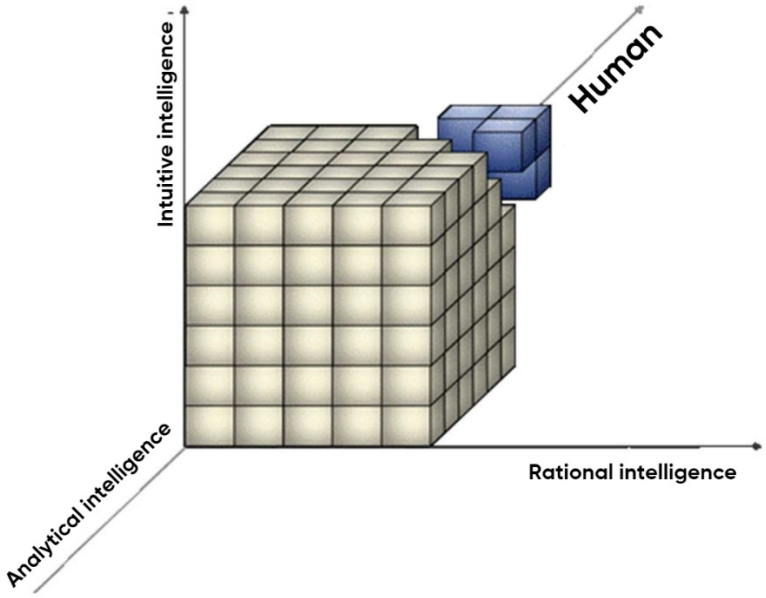

Figure 1. Division of human intelligence

Etymological Study

Etymology, the term “intelligence” means the ability to be understood [23], but in the scientific arena, where there are many disciplines and fields, we find it difficult to find a unified definition of the term “intelligence” and academic researchers agree on it. For example, the concept of intelligence among philosophers is not the same as that of mathematicians nor psychologists. On the other hand, intelligence is often summarized in the human brain despite the existence of primitive creatures that can perform very complex tasks that do not have biological brains such as ants, bees and bacteria colonies in bodies [24]. Here is a historical narrative of some of the scientific facts that helped form a scientific concept of intelligence:

* In 1904, Hans the horse of the German mathematician Wilhelm Von Austen was able to respond to find the product of any simple arithmetic addition by hitting the ground with his hoof [26]. Was Hans intelligent?

* In 1964, the rats of the American psychologist Edward Chase Tolman were able to train to explore a complex maze in his laboratory experiments until they were able to find the exit directly and in a short period of time. The researcher described this as rats use what he called mental maps for navigation [25]. The question posed here; Were Tolman's rats intelligent?

* In 1997, the computer Deep Blue managed to defeat the famous Russian chess player Garry Kasparov in a world match [27]. Was Deep Blue smarter than Kasparov?

"Intelligence" Throughout History

Philosophy

The concept of intelligence among philosophers was hostage to a lot of fluctuations and changes over time, but the majority of them linked intelligence to the individual’s ability to think [28], as the old concepts were very close to everything that contradicts the instinct that is more suitable for reactions than for thinking. However, the concept soon changed and developed with the progress of the ages and philosophers under the influence of scientific fields and other

currents, so that instinct prevailed as well [29]. The British psychologist, Burt Cyril, defined intelligence as a general innate ability to perceive [30], while David Wechsler, the American psychologist, stated that intelligence is the complete and complex ability of the individual to make an effort for a specific purpose and to think rationally in response to the state of his surroundings in which he is located. Prior to these, the famous philosopher Plato gave a brief definition, but more familiar with all sciences, as he said that intelligence brings together all kinds of mental activities that an individual can acquire, and thus separates him from instinct, as Burt Cyril did centuries later [30]. As for Aristotle, who lived with pre-Christian philosophers, he did not give a clear definition, but he classified intelligence as a feature separate from decision and logic [29]. One of the most interesting concepts for modern philosophers is the one given by Ibn Khaldun, where intelligence included several aspects of Tactical (operational), experimental, theoretical and even political and social intelligence [28].

Finally, in order to group concepts towards a unified summary within the framework of philosophy, we can say that philosophical intelligence is built on 4 pillars: acquiring ideas, preserving them, transforming them and then transferring them.

Psychology

The concept of intelligence is closely related to psychology, as the first theses linked it to the human brain and its behavior, and we mention among them the Swiss psychologist Jean Piaget who proved through his studies that intelligence is generated by the individual's adaptation to his environment and he differentiated between functional intelligence and studied intelligence [31]. In 1905, the French psychologist Alfred Binet developed the so-called intellectual quotient, which is an arithmetic quotient measure to compare human intelligence, which is obtained through a series of tests in various fields such as logic, memory, reasoning, etc. [32]. As for its formulation, it is calculated by dividing the average mental age by the historical age of the individual within a group. And the mental age, is calculated based on the results of the tested individual's answers to the questions, and then the value is arranged within the scale of results for the group.

Intellectual quotient = (mental age / historical age) /100

As we see this test is relative and relates to humans only, add to this the same questions that have sparked and continue to raise great controversy in the academic community, despite its continued use on a large scale today. The subject of the intellectual quotient has become a subject of dispute between associations and organizations that demand to change its name from the intellectual quotient to the academic quotient. Continuing in an in-depth study of the intellectual output and its relationship to intelligence outweighs the framework of this article, and we are satisfied here with the model curve inspired by [32] in (Figure 2).

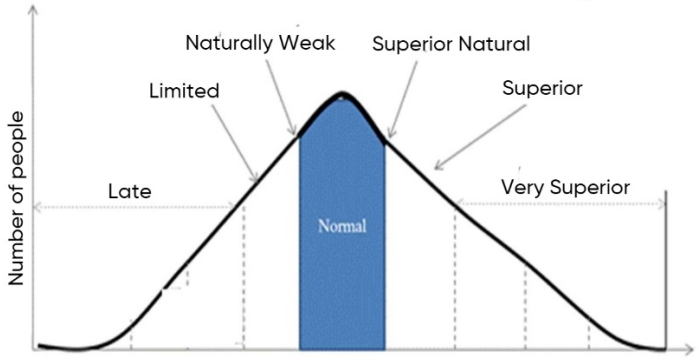

Figure 2. Model of the Intellectual Quotient (IQ) Analytical Curve

ARTIFICIAL INTELLIGENCE

Starting and before giving a specific concept of Artificial Intelligence, it should be noted that the basic principle on which the science of Artificial Intelligence is based does not lie on solving problems more quickly, or in processing more data, or in preserving the largest number of information that is drawn from the human mind, but rather the correct principle on which it is built. This field is, in fact, the principle of processing information, whatever its nature and size, in an automated or semi-automatic manner, in an appropriate manner and compatible with a specific objective

[14]. We point out here that the word semi-automated means user (human) involves in the processing. Let us mention, for example, the intelligent semi-automated systems specialized in piloting aircraft (Auto Pilot).

Artificial Intelligence Concept

Despite the differences of academics, philosophers and scholars in defining the concept of intelligence itself, as we discussed the topic in the previous chapter, the consensus in the concept of Artificial Intelligence has been in place since the emergence of early research in the early 1950s.

Artificial Intelligence is the scientific and technical path that includes methods, theories and techniques that aim to create machines capable of simulating intelligence [6]. Specialists in machine science and informatics consider this definition clear and familiar with their field as explained by [16], [3], [28] and [25]. While others point out that this text is not clear as a complete definition due to its nature itself as a science of the modern era dependent on innovation and change as stated in [34].

The follower of the research and developments of Artificial Intelligence often notices its classification as a cognitive science and not as a technical science due to its history as it began with research work for a group of researchers in computational neuroscience and mathematical logic before transcribing it as a branch of computing science [29] due to the generalization of the use of algorithms. But what everyone agrees on is that its primary role is based on the search for ways to solve problems of high logical, computational or algorithmic complexity [25]. Prior to the emergence of Big Data, which we will give an introduction to it and its relationship to Artificial Intelligence in one of the chapters below, the ambition of Artificial Intelligence techniques was satisfied with imitating humans in certain applications of their cognitive functions, but with the remarkable acceleration and escalation in Big Data, the ambitions of these technologies exceeded the limits of human and even biological imitation, hoping access to more power extracted for different uses [35]. But this last point, which began to raise many concerns, interpretations and expectations, which were expressed in scientific publications and articles, as well as conferences around the world.

Machine intelligence consists of two concepts that are combined, but are conceptually separated and develop in an environment to adapt behaviour:

Memory: represented by storage, a form of intelligence also called passive intelligence [34].

Inference: It is the ability to analyse with awareness of the relationships between objects and concepts in order to understand facts, and that is through the use of memory, logic and other means derived from mathematical sciences [25].

As for the scientific product of research on Artificial Intelligence throughout history, when we browse through its articles, we notice the density of articles that try each time to give a new or renewed framework for its concept.

Artificial Intelligence Throughout History

Historically, the starting point is found in the 1950s in the work of the famous logician and mathematician Alan Turing, who in the beginning of his research questioned whether a machine could “think” in his famous article [36]. Turing is famous for his experiment, which is considered the reference in the machine intelligence test (Figure 3), where this test puts two human persons and a machine (computer) in a closed environment while concealing the identities of the two persons and the machine. If the tested person cannot, through a verbal or written speech, differentiate between the machine and the other human person, we can say that this machine (computer) is intelligent.

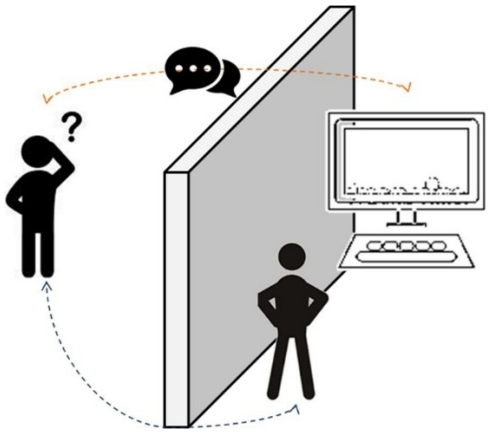

Figure 3. Turing test

Through the Turing test, we conclude that we are in front of a forgotten concept of Artificial Intelligence, meaning that the latter is related to human capabilities only and does not include other forms of intelligence of other creatures such as ants and fungi, and this is completely different from the recent developments in the field of social and participatory intelligence deduced from biology.

As we note on (Figure 4), in 1950 the emergence of Artificial Intelligence began, and in 1956 the features of the modern science of Artificial Intelligence began to become evident when the first conference was held at Dartmouth College in the United States. After that, the academic and professional work took a balanced and moderate course in devising new methods and techniques in the next twenty years, branching into computational neural tradition such as Artificial Neural Networks [39] and statistical computational research such as Support Vector Machine [40] in different applications in Industry, security systems, medicine, and others. Research of the early 1980s also saw new interest due to the temporary commercial success of expert systems that simulate skills and rely on the analytical knowledge of one or more human experts. But it quickly slowed down for years due to the slowdown in electronic technological development and its inability to follow the progression of advanced algorithms, as the latter are very voracious in terms of storage space and speed of calculation, and because electronics could not provide for their needs at that time [3]. But soon the world began to witness an increase in computer electronic technologies (the power of computational) and large storage areas to show new forms of algorithmic techniques that are revolutionizing today on the widest scale, including deep machine learning, which has become beyond human capabilities today. It is the era of Big Data that we are witnessing since the beginning of the second millennium [35].

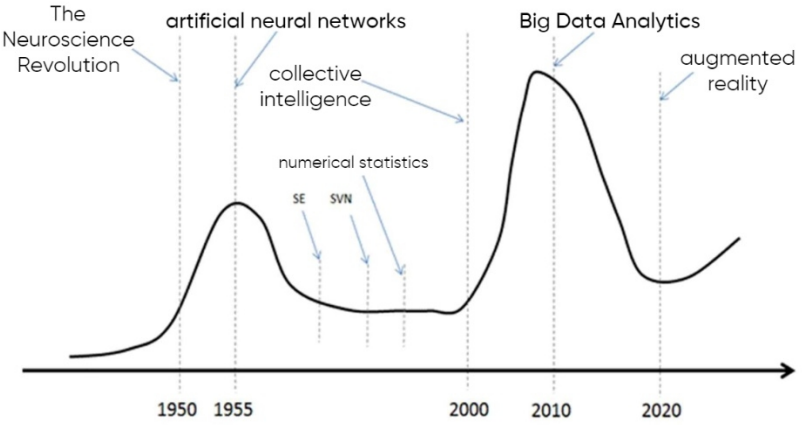

Figure 4. History of Artificial Intelligence

Artificial Intelligence Design

There are two types of AI design:

Central: inspired by nerves in the human brain. In this type of design, the task of the algorithm is to find the optimal solution. However, in most cases, the algorithm is obligated to consider all procedures because the number of possible solutions increases exponentially according to the number of elements, and this greatly increases the complexity of the self-learning process [38]. The well-known example of this form of machine intelligence is artificial neural networks, especially deep learning networks, which for many years suffered from the problem of limited computational capabilities of the machine due to the incompatibility of the electronic development of machines in designing powerful computing and storage devices [45]. However, the currently witnessing explosion of Big Data and the acceleration in the manufacture of huge areas of information storage centers (Data Centers) allowed a strong return to this technology recently [6].

Decentralized form: a level of bio-inspired intelligence, including simple organisms such as ants, where these very simple organisms without complex brains and in a participatory manner can perform very complex tasks such as searching and excavating and building bridges to get food. Researchers of this scientific path believe that intelligence appears as a result of interactions of shared molecules and not in a complex computational way, as is the case in the central form of intelligence [43]. These systems are based on primitive entities that have the ability to pursue one or more individual or common goals. A well-known example of this form is multi-agent systems based on imitation of the social intelligence of ant communities in rapid and spontaneous adaptation, as well as the superior ability to self-organize without central rule. Intelligence is defined as an outcome of participation and interaction between these entities and their environment.

Branches Of Artificial Intelligence

After studying the references that we reviewed in this research, we collected in (Table 1) a summary of the main branches of artificial intelligence, giving a brief description and the foundations of each branch, as well as a sample of its most important pros and cons and some of its applications:

Branch	Description	Foundation	Cons	Pros	Some Applications	Example	References
Expert Systems	Imitation of human logic	On the basis of logic and predicates	Too heavy and memory consuming	It gave field-recommended and used results so far	Medicine and petrochemistry	SE Medical	[36]
Knowledge representation and reasoning	Focus on the environment, ontology and knowledge	based on modeling	It does not apply to all areas	It's still in use and making a comeback because of big data	Biomedicine, documentary research and library science	Shirka Language	[41]
Computer Algebra	Non-numeric symbolic computation	based on computational science	Difficult modeling and programming	It is still present in several systems, especially those related to IBM's automated programs	Accurate scientific research	Maple	[42]
Machine Learning	Predicting future states, discovering hidden patterns, and	On the basis of experience and continuous adaptation	It requires a large amount of information to be effective	Very powerful and effective to a large extent when dense and correct	Economic and strategic management systems and automated systems in	Kount	[10]

	complex classification			data is available, and this explains the strong return of machine learning with the emergence of big data	industrializatio n		
Natural Language processing	Moral and semantic understandin g of language	Ontology and dynamic dictionaries	Very sensitive to language developments. With the difficulty of branching the language culturally	The need for it is urgent, and its use is permissible, despite its disadvantages	Security systems and the paramedical field for the disabled and those with special needs	Google Assistanc e	[44]

Table 1 The most important branches of Artificial Intelligence across the studied references.

MACHINE LEARNING

When we present a small colored pencil to a baby of a few months and we call it “pencil”. Then we draw a line with a pencil in front of it. Then we repeat this process two or three times. The child's brain will create a model in his brain of something called a "pencil" with the "line-drawing" property or task. Then later we offer a cigarette to the same child. Of course, cigarettes don't look like pencils because we adults can distinguish between the two bodies, but to a child, his brain will bring that cigarette close to the pencil in an attempt to draw a line. This example describes exactly the mechanism of human learning, which is also based on the principle of automatic machine learning.

Machine learning is a set of software techniques that allow a machine to adapt behaviour to its environment without human or partial human intervention [10]. Technically, it is the design of algorithms capable of making independent decisions without prior programming [3].

Machine Learning is divided into three types based on its designs and objectives (Figure 5):

- Supervised Learning: If the classifications of objects are predetermined and the examples are known, the system learns to classify according to a model provided to it by the user; This is called supervised learning (or discriminant analysis). It is used to solve the problems of classification, regression, and self-organization [14].
  Example: According to the discovered common factors with the symptoms of other known patients (examples), the system can classify new patients in light of their medical analyses in estimating the risk (likelihood) of developing this or that disease.
- Unsupervised Machine Learning: When a designer has only examples, but no labels for things beforehand, we are talking about unsupervised machine learning. In this case, the algorithm has to discover on its own the hidden data structure in one form or another in order to extract the classifications from it. The most famous problem that calls for this type of learning is the problem of clustering [39].
  Example: In epidemiology, which aims to study liver cancer victims and tries to prove explanatory hypotheses, a computer with an unsupervised machine learning algorithm can distinguish different groups from itself and relate them to different explanatory factors such as geographical origins, genetics, habits, food, exposure to toxic factors, and others.
- Reinforcement Learning: An algorithm that learns behaviour by observation and then adaptation, as it receives the result from its environment, and continuously tries to improve in its future steps [23].
  Example: Simulated war strategies where virtual soldiers learn moves and decisions based on losses or gains during simulated battles.

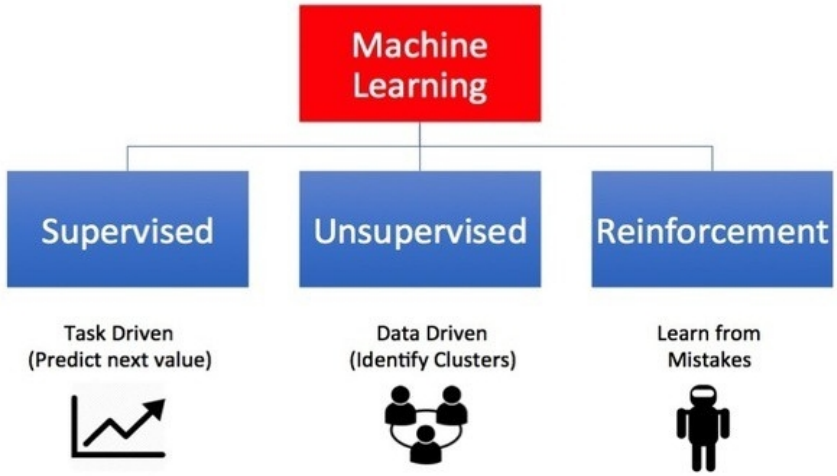

Figure 5. Design methods for artificial intelligence.

Why Does a Machine Have to Learn?

We also know that the obvious problem with human learning is that it is terribly slow as it takes one decade to learn and specialize in a concept. It only took all of us six years to start entering the school system, and then twenty years to become a computer science major. So, the human race is terribly slow. In addition, the system makes us maintain expensive and long-term educational systems that are supposed to make daily operations simple and efficient, yet those processes remain slow and difficult. So human learning is a long and slow process. This is what prompted the specialists and continues to push them to always search for learning in the fastest way and with the least effort by designing the same learning methods for machines whose arithmetic and storage capabilities exceed human capabilities today. On the one hand, and on the other hand, the main motive lies in the design of intelligent predictive algorithms, which are considered the second building block of machine learning, in the strong demand for them by decision makers who urgently need to predict in the conduct of their affairs, whether in the economy, politics, or others. Because the best way to make decisions is to look forward and plan to the future, even if the available data are incomplete.

The best example of this is what the whole world witnessed when using predictive self-learning in running the election campaign of former US President Barack Obama [4].

THE REALITY AND FUTURE OF ARTIFICIAL INTELLIGENCE

The predictions of Artificial Intelligence scientists predict that within the next ten years, a machine will be able to perform 80% of repetitive or difficult tasks, and in many cases, it will have to make choices, making it the most difficult task facing humans. In the following, we will try to present the current reality of artificial intelligence, which has taken a new direction under the shadow of analytical Big Data, and then some live models of its applications.

Big Data Analytics:

There is no doubt that one of the biggest obstacles hindering Artificial Intelligence is the incomplete data, which is the main problem in the feature of learning and self-prediction, and it is one of the problems that have received the attention of the largest number of researchers in recent years [45]. To clarify the matter from the technical side, the learned algorithm needs the largest number of data to adjust its behaviour in order to be more accurate in prediction and the more data is provided, the greater the accuracy [39]. When the feed data is lacking, the algorithm becomes like solving a puzzle of an incomplete picture cut in the dark that needs probability weights in anticipating and visualizing what is in the image. But with the invasion of abundant data and the entry of the era of large and intensive data, these algorithms became more saturated with data and thus more accurate and more efficient, to emerge a new

path under the shadow of Artificial Intelligence called Analytical Big Data, which is in fact a harmony between smart algorithms and Big Data [35]. The field of Big Data, which is a branch of informatics, which is concerned with storing, compiling and organizing data, is often confused with the field of Big Data Analytics, which is a branch of the science of artificial intelligence, which is concerned with analysing huge amounts of data and providing Recommendations and assistance to users based on the results.

In the context of talking about the analytical Big Data as an enlarged image of the concept of contemporary artificial intelligence, we review the following a brief study of some field applications that have not yet been completed. We will try in a non-depth way to describe its future between the difficulty of acceptance in the public sphere and the complexities of technical construction as well as the ethics of its use.

Field Case Studies

Despite the global rush to smart applications, the technological reality remains conservative and confirms that the full and fully automated achievements are almost non-existent, with most applications recording success rates that do not exceed 80%, according to what was published by patience studies and results surveys for Gartner magazine [46] and summarized in (Table 2).

Full automation	Existing applications
75%	Computers that recognize questions and answers.
65%	Self-driving cars that can adapt to road and traffic conditions.
80%	Computers that can recognize the face and learn to identify criminals from video surveillance cameras.
95%	Computer programs that display websites or advertisements on a browser.
45%	Computers that analyse medical records to help diagnose patients.
35%	Robots capable of making their own decisions and that can be used by the armed forces
32%	Robots that take care of the elderly
65%	Computers that can invest in stocks by adapting to the financial market

Table 2. Automation percentages “Some AI applications according to [46]

Smart Marketing:

Thanks to digital marketing techniques, today's large stores can predict a pregnant woman customer, so the marketer adjusts his sales to add materials that suit her situation in order to increase his sales, such as clothes for pregnant women without more information about the month of pregnancy or the gender of the foetus. This type of targeted marketing has been around for a few years thanks to customer purchase cards that store the history of purchases in that store. But with Big Data analytics, we are entering a new era of Artificial Intelligence where the marketer will be able to get more information about the baby’s gender and birth date by using more data: Facebook data, medical test data, genetic data and the ethnicity of the couple and so on. The available data allow the marketing department to predict and know the new-borns of its customers, and thus plan to increase its sales, as more accuracy in forecasting inevitably means better planning and management for that.

Smart Drones

Automated flight devices, unmanned and without humans on board, are considered one of the most sold and traded things in the last two years, as sales exceeded all expectations, with an increase of +30%. These devices are able to fly at significant distances with the ability to photograph, record and send real-time information. In fact, they have

been used for a long time in the military field, but they entered the arena of civilian use only a few years ago (Figure 6).

Often when we mention self-guided aircraft, we associate their use for bad or dangerous purposes, for example, espionage, or their use as a weapon, but in fact, civil applications for good purposes multiply and multiply over time, such as remote first aid, security control in smart cities, and natural disaster management through Providing safe humanitarian aid through it. The reality of the industrial development of these devices puts first-generation remote-controlled aircraft at the forefront of sales, but second-generation aircraft that are operated with behavioural self-adaptation, learning and self-report are still being tested in research centers where drones are designed for natural disasters that will be Able to spot people who need help and go get them food, medicine and help. But all this is still in the initial prototype and design stage so far.

From the ethical side, the world has witnessed a severe framing and legalization of the use of self-guided aircraft, especially in Europe, where it is prohibited to use them for bad and non-civilian purposes, noting that these laws affect the use of the aircraft and not the possession of it.

Figure 6. Smart Drones

Smart Self-driving Cars

A self-driving car is a road vehicle that is capable of driving without any human user intervention. This technological innovation aims to develop and produce cars that can truly work in traffic without any human intervention in order to save lives on the roads, as well as to achieve economic goals in logistics and transportation (Figure 7).

Partial self-driving cars with a human driver on board are present in the market and in various uses, such as Tesla cars, which were very popular in the United States of America despite the occurrence of a fatal traffic accident for a driver on board in 2016. But the last generation cars are fully autonomous and saturated the freedom to report by Artificial Intelligence goes beyond the capabilities of cars and ranks scientifically in the field of mobile robotics in which many actors are involved. This type of robot, despite the conflict of many technical and legal issues around it, is still being tested for reasons of technical complications on the one hand, and the problem of insurance in the event of an accident. However, Waymo has come up with an experimental solution by partnering with Wal-Mart stores where when a customer places an order on the store's website, a self-driving car takes them to their pick-up. Experts and researchers believe that there will be fewer accidents when smart cars are used, but before that, you will still need to meet many other road users, including human drivers who drive classic cars, pedestrians and cyclists, which increases the risk factors in using them.

Figure 7. Typical shape of smart self-driving cars

Augmented Reality

Augmented reality is the overlay of actual live reality with other virtual elements such as sounds, 2D and 3D images, and video clips in a harmonious way. He can go further by adding stimulus perceptions such as touch and audio stimuli. Until today, the field of video game development and the field of cinema have acquired this type of technology that has not yet risen to smart or automatically learned technologies, but the applications today that experts work on in research centers go beyond that to an augmented reality with an intelligent virtual world that can develop quickly and directly by reading and analysis of real data. In this type of technology, algorithms will be able to take decisions automatically and in real time, and the first beneficiaries will be industries such as design and maintenance, as well as the medical field such as detection and surgery.

Sophia Humanoid

Sophia is a humanoid robot that has been socially evolving since 2016, designed by Hanson Robotic (Figure 8). Sophia differs from classic robots in that it is imbued with intelligent algorithms that learn from the society in which it has come to evolve and is able to display more than 50 facial expressions automatically as well as exchange conversations with humans naturally and determine their answers by themselves. Technically, this robot can analyse faces, analyse the natural language of humans, and understand it to some extent, as well as run intelligent classification processes to install logical answers that compete with human answers. Despite the extensive coverage by the media around the world about Sophia's participation in many interviews, researchers and experts remind that the marketing and media goals outweigh the technological reality and they are reluctant to rush to think that the world of tomorrow will be full of robots like Sophia.

Figure 8. Sophia humanoid robot

CONCLUSION OF DISCUSSION AND ANALYSIS

Despite the media rush to Artificial Intelligence that it has reached high levels of superhuman capabilities, from news about companies that have turned all their workforce into machines, and about algorithms that defeat doctors in diagnosing diseases, and greater claims that suggest that the computer is capable of solving all problems and problems, no matter how complex, the reality of Artificial Intelligence Scientific and technical say otherwise. Undoubtedly, one of the biggest obstacles facing Artificial Intelligence today is its applied framework, which suffers from the difficulty of technological follow-up on the one hand, and the huge remote and unclear investment on the one hand, in addition to the fears of public opinion and even academic circles about its uncertain future, especially the fate of humans in the machine world tomorrow.

Concerning the AI academia, one familiar with the publications finds that scientists in this field fall into two parts: The first section claims that intelligent technologies do pose a threat to the human race and that humanity must accept this since the benefits outweigh the costs. Despite the unconvincing scientific evidence, they continue to drive innovations frighteningly beyond the capabilities of the machines themselves today by pouring large capital into industrial and academic research, with companies (Amazon, Facebook, Apple, Google) leading the way.

As for the second section, it tends to focus on caution and transparency in dealing with these technologies. They demand the establishment of an international body to monitor and legalize scientific research and innovations in this field. They are also interested in studying the transformations of the labor market as a result of automation. But here, too, evidence is needed, and research work remains unconvincing, as the Massachusetts Institute has issued a comparative study, the output of which was that the number of jobs destroyed by automation left room for creating new jobs in the field of mechanisms and Artificial Intelligence outnumbering the previous jobs. They go further than that, asserting that the labor market will experience a large deficit in the fields of statistics, automation and informatics.

From this brief analysis of the real situation and future predictions of the impact of artificial intelligence, we think that humanity is in the process of living an inevitable transformation in which the human being will be part of his system in the future and not a master of his system as is the case today. We also think that the pattern of human societies will follow a new trend towards new societies that coexist with machines and are compatible with them. Let us mention here that this transformation has begun with smart cities, smart homes and the Internet of Things. Thus, we rule out a future case of destruction of the human race because of the machine, as some exaggerators say, and we also exclude the independence of the machine completely as a result of its learning and its autonomy. A fundamental difference between performance and creation: the robot is able to beat the best chess player in the world, but it is not able to invent the rule.

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Composting of Biobased or Biodegradable Plastic: A Review

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Abstract. Plastic is widely used nowadays and hence become a required part of our life. During the last 5 decades, the use of plastic-based products has increased by more than 20 times. Production of any commodity involves pollution; this is the case with plastic as well. In addition, the end-of-life of plastic is not at all a sustainable event. Biodegradable plastics are the promising ray against this conventional polymer plastic pollution. However, the word biodegradable is always mistaken to understand hence, this review discusses the possibility of so-called biodegradable plastic for composting. The discussion indicates that composting is the sustainable option for this new variety of plastic but it is specific to the type of raw materials used in the manufacturing of the same. Further, the maintenance of favorable composting conditions is also a prime variable to achieve an efficient process.

Keywords: composting; biodegradable plastic; biobased plastic; PLA; PBAT; PHA

INTRODUCTION

Plastic-manufactured items are included in our daily routine and with an increase in the population, the demand for plastic is also increasing. It is an undeniable reality that our mother earth is fully surrounded by overwhelming amounts of plastic waste. [1] Conventional plastic is not degradable and remains the same after several years [2]. Plastic creates problems in the water, soil, and atmosphere, and health risks to humans, animals, and aquatic lives/plants [3]. Plastic pollution is a global challenge. Therefore, alternative plastic is required to reduce the impact of plastic. Bioplastic is a newly innovated material for the replacement of plastic and it is available in different varieties. Bioplastics are applicable in a wide spectrum. That is agriculture and horticulture, textiles, packaging, and so on. However, the term bioplastic is new to the world. It is necessary to understand it, in-depth starting from its structure to its characteristics and from its biodegradability to its ultimate disposal [4].

The polymer is made up of small molecules of chemical compound arranged in a simple repeating structure to make a long chain. These polymers are modified or mixed with other additional substances or filler chemicals to attain a specific demanding material called plastic, which can be flexible, strong, waterproof, etc. [4]. Thus, the difference between polymer and plastic is very important to understand the biodegradation possibility for plastic.

On the other hand, biopolymers are polymers that are derived from the biosphere rather than petroleum as the source. Additionally, plastic can also be said to be “bio-plastic” when there is a possibility for its degradation via microbial activity. Thus, bio-plastic is made from organic biomass as a source, unlike conventional plastics which are made of petroleum. [4].

Conventional plastic is not degradable because of the polymers, which are made up of fossil fuel [2]. The enzymes in the microorganism that break down biodegradable materials do not recognize the bonds that hold polymers together. Eventually, polymers in plastic may break down, but it takes hundreds of years. The time taken for the degradation of plastic is very long, by and the environment is being polluted [2]. To strengthen the plastic, chemicals or fillers are added to the plastic, which is not degradable and does not even change its characteristics. So, it also leads to a serious problem for the degradation of plastic. Therefore, the polymer is quite simpler than plastic because of its composition. It is much easier to break down polymers than plastics because polymers do not have the added chemicals, so researchers always focus on the destruction of polymers and not plastics [4].

Biopolymer and bioplastics, for both these terms "bio," refers to two situations: either the polymer is derived from biomass and/or the plastic is biodegradable by microorganisms [4]. But it should be noted that neither all bio-based plastics are biodegradable, nor all biodegradable plastics are bio-based [3]. Biodegradable plastics are a part of the larger group of materials called bioplastics. Unfortunately, there is still much confusion about the word "bioplastics." There is a common (incorrect) belief that if something is derived from biomass, then it must also be biodegradable. However, the use of bio-feedstocks does not necessarily mean that the finished product will be biodegradable. There are biobased plastics that are not biodegradable [5] e.g., bio-polyethylene (PE), bio-poly (ethylene terephthalate) (PET), bio-poly (tri-methylene terephthalate) (PTT) on the other hand some are obtained from biomass or fossil fuels, which are categorized into three groups, and they are biodegradable; natural polymers-starch, cellulose and lignin, polymers from biomass-poly (lactic acid) (PLA), polymers from fossil fuels-poly butylene adipate-co-terephthalate (PBAT), and poly (ε-caprolactone) (PCL). Poly (butylene succinate) (PBS) is obtained from both biomass feedstock and petroleum. Most demanded and produced biodegradable plastics are PLA and starch-based. Biodegradable polymers or plastics, without regarding the manufactured source, have a wide spectrum of end-of-life possibilities [4]. End-of-life options available for biodegradable plastic are given below in Fig. 1. Reuse, recycling, recovery, to disposal is the waste hierarchy principle. And according to that, looking at Fig. 1 it is evident that the reuse of biodegradable plastic seems to be a little less possible compared to the other four options. Biodegradable plastics are defined as materials whose physical and chemical properties undergo deterioration and completely degrade when exposed to microorganisms, into carbon dioxide as in aerobic processes, and methane as in anaerobic processes with a specific time limit. The time required to decompose completely depends on the material, environmental conditions such as temperature and moisture, and the location of decomposition. Compostable plastics are a group of plastics that can be degraded by microbes into humus, with an absence of toxic metals. [1].

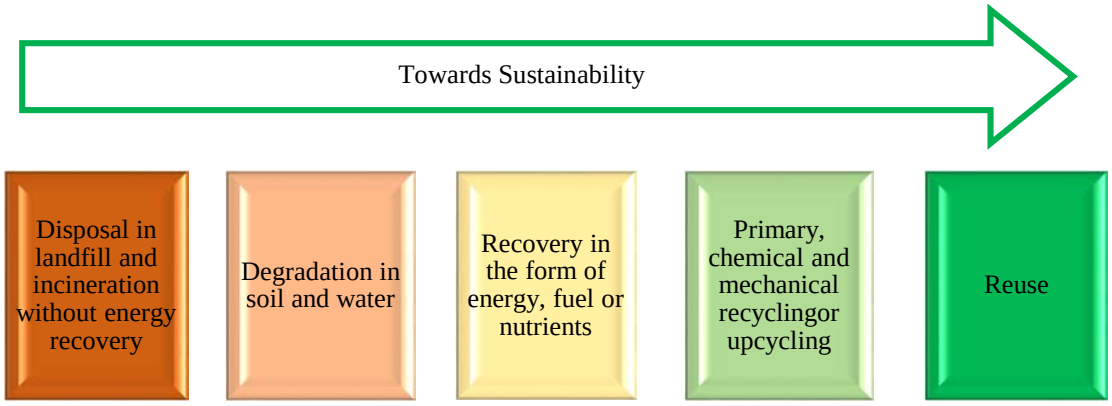

FIGURE 1. Available End of life options for biodegradable plastic [Adopted from 4].

Biodegradable plastic indicates plastic degradation due to naturally available fauna or microorganisms like algae, bacteria, and fungi. The biodegradation of plastic comprises two stages: primarily the long chain polymer gets fragmented into monomers or oligomers and then mineralization of these monomers/oligomers by microbes to ultimate stable form like CO_2, H_2O, and CH_4 the final stable form along with the development of new biomass [4]. Biodegradation is naturally possible everywhere; may be in the marine environment or soil, but various factors affect the efficiency and quality of biodegradation. Biodegradation may be either aerobic or anaerobic thus presence of oxygen directly affects the type of biodegradation. Sunlight affects algal and fungi growth. Microbial activities are always pH and temperature specific. Additionally, the types of microbes and available enzymes are also among the governing parameters for the biodegradation process. Variations in the degradation environment

can affect the rate of degradation for similar kinds of polymer. Additionally, there are no “Standard Methods” available to us unlike for aqueous sample analysis.

The biodegradable plastic can be used further for other purposes once the initial purpose is fulfilled (considered as garbage by the first user). Biodegradable plastic can easily be used as vegetation mat or agricultural mulching material but its removal after use is not that easy and also involves the removal of topsoil along with fragmentation of plastic may cause contamination of the soil. It is also worth noting that the disposal of biodegradable plastic in the environment is not at all advisable because there is a misconception that the one which is “biodegradable” gets easily disappears from the environment [4].

With this context, it is also very necessary to stop the deposition of “oxo-biodegradable” plastic in the environment. The marketing policy says that it is a “sustainable”, “green”, and “eco-friendly” option against plastic. But the fact is that it is petro-derived plastic aided with chemicals that enhance the fragmentation in presence of UV rays, sunlight, and oxygen. The words “photo-degradable” and “oxo-degradable” are derived due to the enhanced fragmentation of such material in presence of UV rays and oxygen. The fragmentation does not ensure complete removal of the material instead it converts the material into tiny pieces that are not recoverable and eventually contaminate the soil.

The promising option at this stage is composting. The ASTM D6400 standard specifies the properties of the plastic product to be compostable with a comparable biodegradation rate with other conventional compostable materials [ASTM International]. Industrial composting ensures 10 % residual fragmentation with > 2 mm fragment size within 3 months duration. Sequential stages of industrial compositing comprise pre-treatment of material, kick start of biological process, thermophilic phase (55-60°C), maturation phase (1-2 months), sieving, and preparation of the final product.

A faster reduction in moisture content during the thermophilic phase has been reported by several researchers. Additionally, during this phase demand for oxygen will be comparatively more. Therefore, track on waste material moisture content is very much necessary. As we all know, the concentration of any gas is always inversely proportional to the temperature hence the availability of required oxygen would be comparatively less at such a high temperature (60°C). Thus, necessary aeration is also very much mandatory to achieve quality composting. Failing to track the moisture content and aeration may lead to failure in composting. During the thermophilic phase, degradation would be faster compared to the maturation phase. The maturation phase stabilizes the degradable matter in presence of mineral acids.

The meaning of “biodegradation” word is different as far as plastic and other biodegradable waste are concerned. For plastic waste “biodegradation” ensures the fragmentation of plastic into oligomers and/or monomers to fasten the availability of the plastic to the degrading agencies (microbes/worms etc.). Whereas, for biodegradable material, “biodegradable” means conversion of complex organic matter into simple, and stable substances like CO_2, H_2O, CH_4, and biomass. This final product is called compost which can be used as a soil conditioner or manure depending upon the final available nutrient concentration.

Industrial composting can absorb bioplastic only if that material falls under the category of compostable material according to various standards developed by Europe, the US, Australia, and France [4]. Whereas, home/domestic composting can be done on yard waste to reduce municipal solid waste generation. It is not possible to maintain strict operating conditions in the case of home composting as it is done by a layman and normally followed the basic knowledge one can have about composting.

Thus, the concept of recycling or upcycling plastic seems a comparatively good option. But recycling plastic after its first use involves proper management in terms of collection, sorting, and segregation.

The Near-Infra-Red (NIR) technique is an emerging one that recognizes the composition of plastic flakes and sorts out plastic mechanically. Natureworks LLC is an international company that manufactures bioplastics that uses NIR and has reported sorting PLA-based plastic bottles with 97.%% accuracy. Sorting of PLA from PET is necessary to achieve a better quality of recycled PET. Hollstein and others [6] have reported NIR as an efficient way to sort starch-based polymers, PCL, and PLA.

Triboelectric sorting is another method that involves the application of electrical charge on the mixture of polymers. Different polymer behaves differently against the applied electrical charge that may induce friction among them. The electrostatic force is then used to separate these charged particles [7]. PLA, PHBV, and PCL are in the triboelectric series [8].

Considering the above facts, it is necessary to understand the possibilities for recycling, upcycling, and composting of bioplastic and define the end-of-life strategies for them. Biodegradable plastic and starch-based plastic will be the focus of this review.

COMPOSTING POSSIBILITIES

There is a variety of biobased plastics available as given in Table 1 below [5].

Table 1: Types of biobased biodegradable plastics

Type of Plastic	Ingredient
PLA	Polylactic Acid based plastic
PHAs	PHB-Poly-hydroxybutyrate based
	PHBV- Poly(hydroxybutyrate-co=valerate)
PBAT	Polybutylene adipate terephthalate based
Starch Based	Thermoplastic starch polymers (TPS)

Apart from plastics mentioned in the above table 1, protein, starch, and cellulose are other materials used in biobased plastic manufacturing.

Pla

High temperature, enough moisture, and specific microorganisms are certain requirements to ensure composting of PLA. Chemical hydrolysis is the initial phenomenon that occurs during the thermophilic phase that leads to a reduction in the molecular weight of PLA. Assimilation of lactic acid oligomers is the succeeding reaction performed by microorganisms to achieve energy. PLA requires enough temperature (>55 °C) to ensure flexibility in the polymer chain. This flexibility eventually leads to possible chemical and/or biodegradation. PLAs showed 90% degradation within 120 days when composted at around 60°C [4,9]. Hence, maintenance of thermophilic temperature is the prime factor that ensures fragmentation of PLA and thus home composting of PLA seems difficult. Near-neutral pH is another requirement for PLA composting. PLA being polylactic acid-based plastic generates a higher amount of lactic acid during composting resulting in pH reduction. This condition is again unfavorable for microbial activity. Even the ratio of 70:30 of garden waste: PLA has been reported as inefficient due to lactic acid accumulation [4,10]. Hydrolytic degradation of PLA can be enhanced by the addition of either catalytic or hydrophilic compounds. According to Tsuji [11], the molecular weight and crystallinity of plastic affect degradation. Higher molecular weight enhances the degradation rate of PLA. On the other hand, an increase in crystallinity adversely affects hydrolysis. Amorphous materials are more prone to hydrolysis when compared with crystalline materials. Thus, XRD analysis of plastic is necessary to understand the type of material. Another important variable is the thickness of the plastic because Ruggero and others [12] reported complete prevention of degradation even after 60 days for 500µm thick PLA.

Pbat

Composting of PBAT is reported to be tough due to the presence of the terephthalate group. Polyesters PET or poly (butylene terephthalate) were reported to be resistive to hydrolysis and microbial attack. On the other side, aromatic chains and aliphatic compounds make it more susceptible to microbial degradation. Hydrolytic degradation, microbial assimilation, and mineralization are the hierarchical stages in PBAT biodegradation. Biodegradation of the amorphous portion of PBAT occurs in the presence of microbial enzymes. The degradation rate of this amorphous portion is faster at a higher temperature. Whereas, in absence of enzymes, a reaction occurs between water and carbonyl groups that lead to the breakage of ester links. This induces the generation of oligomers and monomers which eventually generate energy, CO_2, H_2O, and new microbes [4,12].

The cross-linking of polymers can reduce the biodegradation rate of PBAT. Thermophilic bacteria like actinomycetes are reported to be effective in breaking the ester bonds at temperatures as high as 60°C. on the

other side mesophilic bacteria like proteobacteria or firmicutes were reported to be slow in PBAT degradation at temperatures around 30°C [4,13,14,15].

The fillers are used as an additive while manufacturing PBAT to increase the biodegradation rate of plastic. The hydrophilic bacteria degrade fillers thus enhancing fragmentation. Further, increased fragmentation increases the polymer matrix porosity which eventually fastens the biodegradation of the material [16]. Certain literature reports around 75% reduction in PBAT/PLA blend material after 90 days of composting. The addition of fillers in the blend of PBAT+PLA can enhance the biodegradation rate.

Ruggero and others [17] report that the microbes first attack the biodegradable fillers, this leads to the generation of porosity and an increase in surface area. Such conditions are favorable for biodegradation. It is worth noting that PBAT is a complex material and takes a much longer duration to get transformed into a simple and stable form. Biodegradation of PBAT is reported to be very much temperature and moisture sensitive. A longer thermophilic phase is a favorable condition for PBAT degradation [12,17].

Pha

PHA-based plastics are manufactured from plant-based starch. Microbial fermentation is the core process employed for its manufacturing. Thus, PHA-based plastics are very similar to polyethylene/polypropylene/polyester as far as their physical and chemical characteristics are concerned [1,18].

Certain literature reports that polyhydroxyalkanoates are natural aliphatic polyesters, synthesized through the fermentation of sugar and lipids (glucose, sucrose, vegetable oils, even glycerine from the production of biodiesel) by a wide variety of bacteria, as an intercellular carbon and energy reserve, when the cells grow in stressful conditions.

The polyhydroxy butyric acid (PHB) and polyhydroxybutyrate/polyhydroxy valerate (PHV) or even poly-3-hydroxybutyrate co-valerate (PHBV) are the main groups used in PHA in manufacturing [1]. PHAs are reported to be compostable only under controlled process conditions. Literature reports enzymatic degradation of PHB or PHBV within 50 days with 80% degradation [4,19,20].

Margaert and others [21] have observed an increase in biodegradation from 6-17 to 67% of PHBV with an increase in valerate concentration from 10 to 20%. Weng and others [22] report that PHBV biodegrades faster when compared with PHB due to more content of valerate monomer. This may be due to lesser crystallinity in the material that eases enzymatic degradation. Whereas hydrolytic degradation can be enhanced by adding a hydrolytic compound because Freirer and team [23] have reported that adding a hydrophobic compound reduces the rate of PHB degradation.

Composting of PHA in controlled process conditions like industrial composting is reproducible. But similar results are difficult to obtain in the case of domestic/home composting due to variations in the process conditions. The moisture content, temperature, and pH are the prime process variables responsible for reproducible results. Attainment of thermophilic temperature during the composting process helps in achieving early maturation of composting. During home composting, 50% PHB degradation has been reported within 84 days with a temperature as high as 66°C with 74-89 % moisture content [24]. On the other hand, only 4% degradation of PHB is reported within 151 days at 5-30°C temperature [21].

Starch-based Materials

The first starch-based bioplastic was manufactured using corn starch with the trade mane EverCornTM by Natureworks. A blend of corn starch polymer and the petrochemical polymer was used in its manufacturing [25]. The manufacturing process of such plastic involves higher temperatures and the use of plasticizers to induce structural modification in the starch granules. Potato, tapioca, and wheat are other sources of starch. The only advantage of starch-based bioplastic is that it helps in the disintegration of plastic polymer. On the other side, the residues of non-biodegradable polymers can cause soil contamination.

Starch is compostable material. Degli-Innocenti and team [26] reported 100% degradation of corn starch after 44 days under aerobic degradation. On the other side, it was also reported that a sufficient concentration of starch is also necessary to maintain the enzymatic reaction.

According to Torres and others [27] starch-based plastic biodegradation initially involves the leaching of plasticizers with almost 30% weight reduction. Biological activity was reported to be prominent during 2nd stage of degradation with a total 90% weight reduction within 20 days.

Oxo-biodegradable Plastic

As discussed, oxo-biodegradable plastics are fossil-based polymer plastic. The only difference in its manufacturing is the addition of additives to speed up the fragmentation process. It is worth noting that this fragmentation needs heat or light. The additives used are inorganic metal salts, required to initialize fragmentation in presence of oxygen and speed up the same when light is available.

Oxo-biodegradable plastic does not meet the standards (EN 13432) of either home or industrial composting [5]. Inorganic metal salt additives are not reported in helping biodegradation. It is evident from the literature review that oxo-biodegradable plastic only gets fragmented over time and converted into small pieces, that remain in the environment for a prolonged period and sound completely non-sustainable. European Parliament (for marine litter) in March 2019, banned all products prepared from oxo-biodegradable plastic [28]. Even, the Commission to the European Parliament and the Council had stated that oxo-biodegradable plastics are found to be non-reactive for any kind of aerobic or anaerobic microbial degradation [5].

CONCLUSION

High temperature, enough moisture, and specific microorganisms are certain requirements to ensure composting of PLA. PLA requires enough temperature (>55 °C) to ensure flexibility in the polymer chain. Composting of PBAT is reported to be tough due to the presence of the terephthalate group. Polyesters PET or poly (butylene terephthalate) were reported to be resistive to hydrolysis and microbial attack. For PBAT plastic biodegradation of the amorphous portion of PBAT occurs in the presence of microbial enzymes. A longer thermophilic phase is a favorable condition for PBAT degradation. Composting of PHA in controlled process conditions like industrial composting is reproducible. But similar results are difficult to obtain in the case of domestic/home composting due to variations in the process conditions. Starch is compostable but starch-based plastic is actually fragmentable because starch helps in fragmentation and thus helps the polymer part of plastic in fragmentation, which is not sustainable. Oxo-biodegradable plastic does not meet the standards (EN 13432) of either home or industrial composting.

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Design and Development of stationary plastic shredder machine

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Abstract: Plastic is currently one of humanity's most valuable assets. Plastic is widely used in both the water and food packaging industries. But our environment's air, water, and land quality are still in danger due to plastic. Plastic does not decompose in any way. So Environmental waste disposal now demands a systematic plan related to the issue of plastic garbage pollution. Reusing is a priority due to the various benefits that it provides. As a result of the numerous associated benefits, plastic recycling takes center stage. Rural residents require better instruction and awareness of how to properly dispose of plastic garbage, thus improvements in this area are needed. With smoother disposal management, plastic is broken up into little shreds by a device called a plastic bottle crusher. This is what we're working on crusher to be used for the recycling of the plastic waste in Colleges/Universities, industries, public places, and scrap collectors. very pricy and big. In conclusion, for our task, we chose to design and construct a simple, modestly priced plastic crusher. The goal of this project is to treat plastic waste as efficiently as practicable by eliminating waste where it is produced to decrease labor costs. This study seeks to address the issues regarding the disposal of plastic litter in public locations. We developed and constructed a plastic cutting machine for this study. The machine's main parts are the feeder unit, the shredding chamber, the drive shaft, the framework, the V-belts, and the electric motor.

Keywords: Waste recycling, plastic waste control, stationary shredder machine, environmental waste management

INTRODUCTION

Plastic garbage is an inorganic waste that cannot decompose naturally. If it is not properly managed, it can harm the ecosystem by polluting the air, water, and soil, upsetting the food chain, causing animal deaths, and many other things. To address this issue, a plastic shredder machine will be created to aid in the recycling process, which turns plastic waste into products like vases, paving stones, and other items.

Nowadays, there are five main types of plastic: Lightweight polyethylene, Polycarbonate, High - density polyethylene, and High-density polyethylene. The vast volumes of such plastic products that are now being offered will eventually end up in landfills [1]. Owing to the huge volume of garbage it produces, its non-biodegradability, and rapid environmental destruction because of its limited supply chain, this is contributing to problems with waste products [2]. It also uses more materials during manufacture, which increases the quantity of waste it produces. Open dumps include 11% or so plastic water bottles, which has detrimental environmental effects [3]. Over 62% of all solid waste from municipalities generated worldwide is made up of plastic garbage,

of which 26% was collected and 80% was discarded. [4]. The process through which plastic waste materials that would normally become solid garbage are gathered, segregated, processed, and put back to use is known as recyclable plastic or preprocessing [5]. A waste plastic crusher is a device that breaks down used plastic bottles into microparticles, so they are easier to transport and are more ready for use in new products.

Since its invention more than a century ago, plastic has evolved into an indispensable component of our daily lives and the materials that are most commonly utilized globally., plastic is also frequently employed in places where paper would normally be used. Plastic is currently used in a significant percentage of products since it is a lightweight, affordable, and durable material. Plastics are utilized in a variety of applications, including packaging, toys, water bottles food packaging, electronics manufacturing, and more. In addition to being challenging to recycle, plastic costs a lot of money, and creating a machine to do it is challenging as well. By shredding plastic into smaller grains that may be delivered to recycling facilities in bulk and at a lower cost, we hope to lower the cost of plastic transportation.

Reprocessing, commonly referred to as recyclable material, is the process of gathering, sorting, and using plastic debris that might otherwise end up in the solid waste stream. The purpose of a waste plastic crusher is to reduce the size of old plastic water bottles so that they are more portable, simple to use, and ready for incorporation into new products.

The design concept for this device was inspired by the antiquated practices of employing scissors to decrease materials and the scratching motion employed by rabbits when digging or tearing. In this machine we are using the belt drive instead of a gear mechanism, so we are using a v-belt and the pully construction which is driven by the motor of 1Hp and 1500 rpm, but the rpm is going to reduce with the help of a gearbox, it will reduce the rpm near about 60rpm.

Hazards and problems of plastic:-

1. Since plastic cannot biodegrade, it accumulates in our environment for a long period of time.
2. Human health issues like cancer, lowered immunity, and birth deformities can be brought on by plastic.
3. Plastic causes groundwater to become contaminated.
4. The use of plastic draws several types of contaminants.
5. Plastic costs billions to abate and many more.

A plastic shredder machine is made up of several functioning components that all work together to recycle plastic by shredding it into smaller pieces. Multi blade cutters, M S shafts, gears, a motor, and a hopper are the components of a plastic shredder machine.

LITERATURE REVIEW

Atadious David et al describes about *Design and construction of a Plastic Crusher for Plastic Waste Recycling and Management. It seeks to focus on the problems with plastic waste disposal in impoverished countries. For this study, they constructed and designed a plastic shredder machine. The feeder unit, the cutting mechanism, the output shaft, the framework, the V-belts, and the motor controller are the machine's necessary aspects.* Large solid objects can be broken down into smaller bits or a smaller volume using a shredding machine. Materials are typically reduced in size and shape using shredding machines so they can be used effectively for their original purpose. Mechanical advantage improves the distribution of a force through some kind of material made of molecules that link together more closely and resist distortion better than those present in the material being destroyed that described as shredding, just like crushing. [6]

Nuri Aryani, Dede Buchori, and Albertus Budi *Setiawan Design of Plastic Shredder Machine Plastic shredders* can be used to manage plastic garbage and turn it into tiny flakes so that a prototype of the machine can be made. The process of designing comes first. The blades or cutter, a transmission component in the form of a spur gear, an electric motor, and the machine's body make up a plastic shredder. Waste plastic should be either LDPE, HDPE, PP, or PS. Based on the design of the plastic shredder machine, a small flake with dimensions of approximately 10 mm long and 1 mm broad can be produced. [7]

Plastic trash may be recycled to retrieve the material, which is then utilized to create new plastic goods such as particle boards, planks, and vessels. To prepare it for shipment and subsequent transformation, the waste must first be shredded into tiny little pieces. The unit frame, electrical transmission unit, feeder, and shredding unit all work together to balance out the crusher. The performance of the waste plastic shredding machine further demonstrates that the machine might be very helpful when significant quantities of plastic need to be shredded. It also demonstrates that the machine is effective while shredding huge sizes. Therefore, it is advised that small and medium-sized business owners who work with recycled plastic use the machine. [8]

Construction and Design of a Cost-Effective Plastic Shredders Machine by Briggs M. Ogunedo and Beneth C. Chukwudi, this project concentrated on developing a plastic shredding device that will help small- and medium-sized business owners in the plastic recycling sector. The machine uses 3.7kW of mechanical work to generate 28.49Nm of torque and 1466.5N of crunching force. Within that force, this can destroy 150 kg of plastic with something like a 97.8percent of overall effectiveness in 6.98 mins. Considering this well-known reality, huge manufacturers are the principal target audience for the majority of processing facilities. It is clear that all major players must participate in plastic waste management given the threat presented by plastic waste pollution and littering. [9]

Jaypalsinh Rana et al. define the *Design and Fabrication of a Plastic Bottle Shredder* The shredding machines that are available are excessively expensive and hefty. Therefore, in our work, we decided to create and construct a plastic shredder machine that is affordable and low in weight. Therefore, the overall goal of this project is really to treat plastic garbage as inexpensively as possible by decreasing where it is produced in order to decrease labor requirements and, ultimately, costs. The experiments with plastic bottle-crushing machines and the examination of the mechanisms employed in the machine are both included in this research. To make trash handling simpler, plastic may be sliced into little pieces with a plastic bottle cutter. This project will serve as a prototype for recycling plastic waste in the home and commercial environments, along with in industries and for junk receivers.[10]

IDENTIFICATION OF NEED

The current shredders are large and heavy, and they are frequently employed in large factories and manufacturing plants to shred things such as vehicles, stones, metal parts, etc. These shredders are also hydraulically and pneumatically powered, making them practical when very strong cutting forces are needed to shred a material. These high-end shredders are not necessary for small recycling facilities and are out of most people's price range because they require constant power and maintenance that entails hydraulic fluid or compressor kits, among other things. It needs to be well maintained because the hydraulic fluid must be changed often and continually. Additionally, skilled manpower is needed to operate it.

RESEARCH OBJECTIVES:

• A project's goal is to recover plastic in order to cut down on burning solid plastic trash and reduce the pollution.

• To develop more labor-efficient, cost-effective shredder machines.

• Instead of using belt drives, gear drives provide more safety and more effective, very compact power transmission.

• With increased efficiency, this machine will be able to shred various sorts of plastic garbage.

PROCESS FLOW

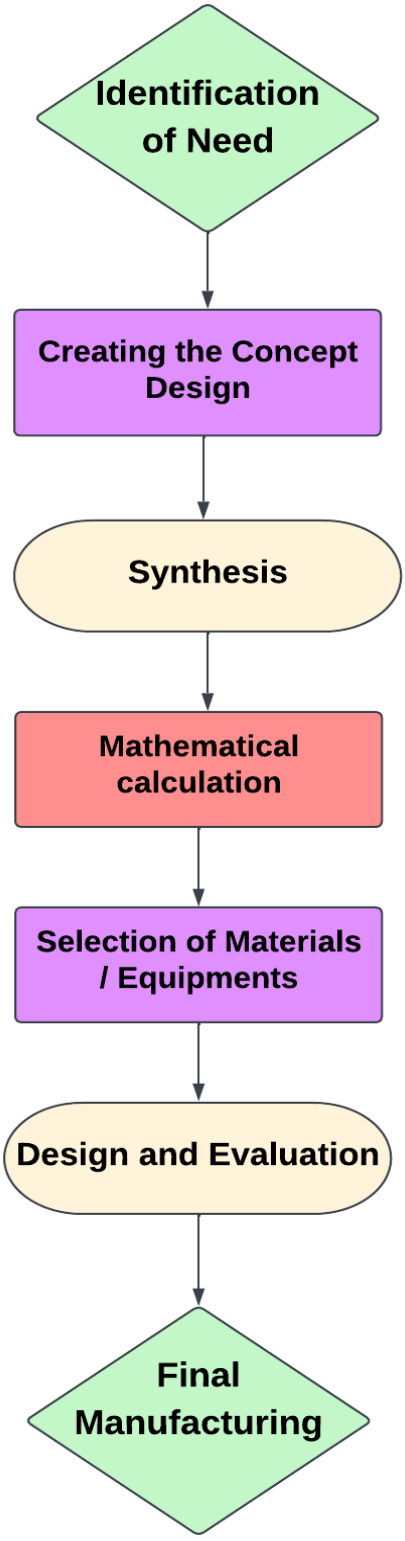

Fig: 1 Process flow of machine manufacturing

MATHEMATICAL CALCULATION

Motor Horsepower Calculation:

1. Cutting area made by edge of the blade:
   Area = Width × Thickness
   Area = 9 mm × 6mm
   Area = 54 mm^2
   Area = cutting area made by the edge of the blade.

2. Force acting on edge of the blade:
   Shear strength of HDPA material = 37 MPa.
   Shear strength = Force ÷ Area
   Force = Area x Strength
   Force = 37 × 54
   Force = 1998 N.

3. Torque exerting on the blade as well as shaft:
   Torque (T) = Force × perpendicular distance
   Torque = 1998 × 60
   Torque (T) = 119880 N mm
   Torque (T) = 119.8 N m

4. Power required:
   Required speed, N = 60 rpm
   $P = (2 \times \Pi \times N \times T) \div 60$
   $P = (2 \times 3.1415 \times 60 \times 119.88) \div 60$
   P = 690.4388 watt
   P = 0.753 kW

   We know, 1 HP = 1.341 kW

   So, Power required in HP = 1

Considering Factor of Safety:

Cutter Material: mild steel ultimate shear strength = 580 N/mm^2

Considering FOS= 3

Working Shear Strength = Ultimate tensile shear strength / FOS

Working shear strength =580 / 3 = 193.33 N/ mm^2 it is higher than the HDPA's strength.

Hence design is safe.

CAD MODEL OF MACHINE

Before fabrication of machine, we had prepared the CAD model of plastic shredder machine. In general, this machine consists of major part of the machine is a cutter. In this machine we used a pair of shafts on every shaft

there were 5 cutters are attached. The sample design of cutter or blade is showing in fig: 2 and 3. The Assembly of the machine is shown in the fig: 4.

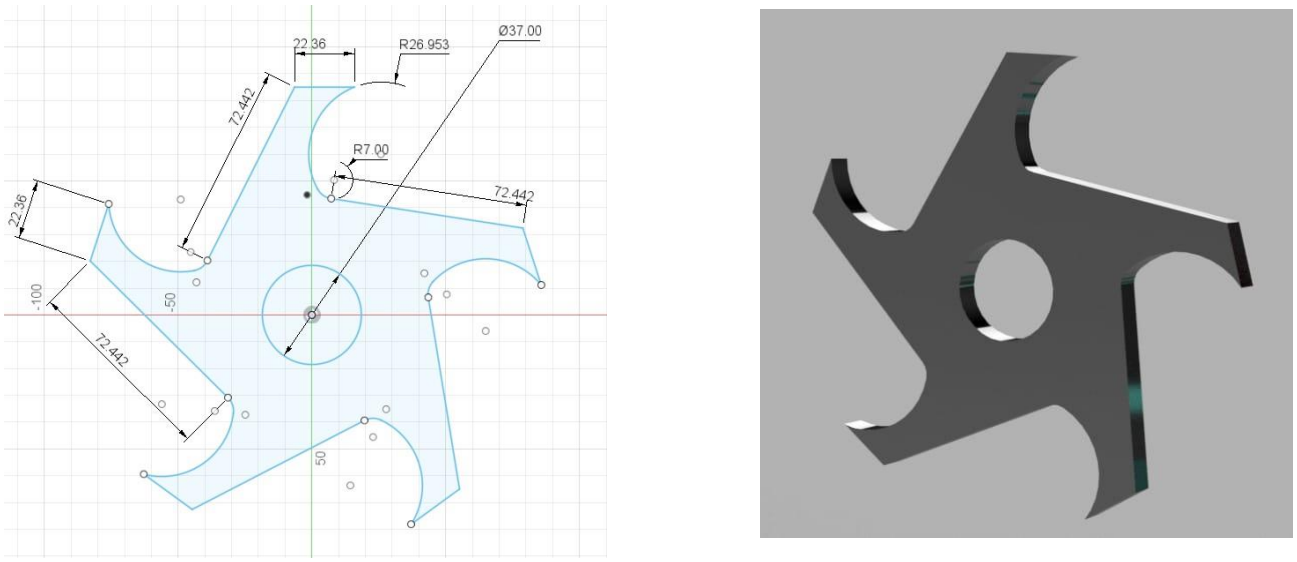

Fig: 2 Dimensional and CAD drawing of cutter

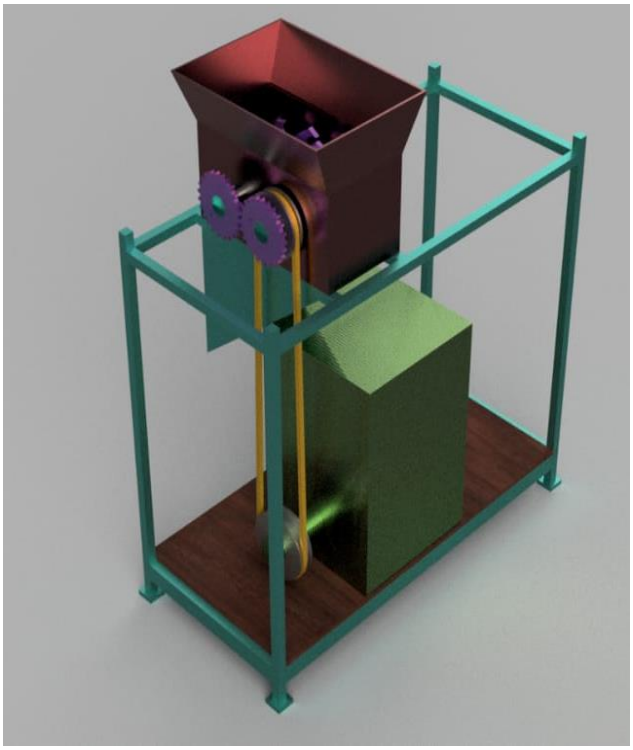

Fig: 3 Tentative model of machine

MATERIALS / EQUIPMENTS

The plastic crusher is made up of the following components:

Cutter: - In our plastic crusher the main role to cut the plastic is of "Cutter" so we have decided to make the cutter of some high strength material. The material we have selected is MS – Mild Steel (Fe300). Mild steel is an alloy of iron and cementite, which does not contain carbon, and contains between 0.05% and 0.3% of cementite by weight. We have made 10 cutters for crushing.

Fig:4 motor attached gear box

Shaft: - As we know that the saft is required to transmit the power so as we have selected the cutter of MS so the weight of 10 cutter is 9 kg. so, the length of saft we have decided is of 280mm and the diameter is 36mm where the cutter is fixed on saft. The shaft's material is MS (Fe350).

Crushing chamber: - The crushing chamber is made up of 3 components that is Cutter, Saft, Plates. Thick, strong mild steel is used to construct the shredding chamber of 12mm plate. All 4 plates are jointed with welded joint. It is also designed in such a way that plastic waste that has become stuck that can easily remove. The distance between both two cutter is about 14mm so the proper and small particles of plastic can be carried out.

Motor with Gearbox: - The motor we have used is 3-phase Motor of 1HP with 1500rpm. But the 1500 rpm is very high for the plastic crusher, so we have attached the gearbox to reduce the rpm. By attaching the gearbox, we get around 60-70 rpm.

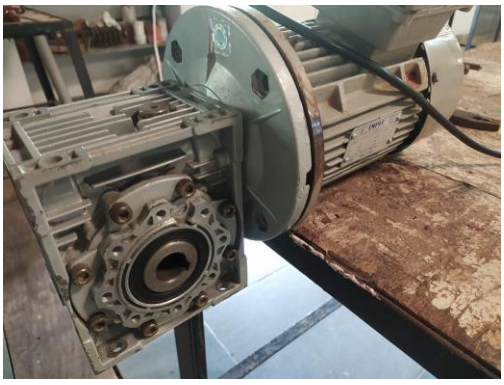

Fig:5 Motor attached gear box

Pulley and Belt: - As we are using the belt and pully drive to rotate the cutters so the pully which is attached with the saft of the crushing chamber is ID-28mm and OD-52mm. The dimension of the pully which is attached to the motor output is ID-20mm and OD-35mm. We have used V-Belt.

Main Frame: - A mild steel angle bar sized 3mm x 20mm x 20 mm is applied to manufacture the original structure. To make the skeletal frame, the pipes are jointed with the help of welding.

Fig:6 motor attached gearbox

Hopper: - Mild steel of thick sheet metal plate is used to make the hopper. While shredding is taking place, this equipment collects and holds waste plastic. Angle bars serve as the stiff structure for the top portion. It is the machine that feeds plastics into the shredding chamber. Its form resembles a truncated cone.

CONCLUSION

We may sum up by saying that this plastic shredding machine is a fantastic resource for managing plastic waste. With the increased use of plastic in today's environment, this machine will show to be quite useful in managing plastic waste. Additionally, this equipment is reasonably priced. The fundamental benefit of this machine is that there is no belt, which eliminates the possibility of a belt slide and ensures worker safety. Furthermore, because belt changes over time are not necessary, the cost of maintenance is decreased. Overall, this gadget will aid enterprises in effectively recycling plastic.

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A Review study of Microsimulation Analysis of Traffic and Car Following Model: A Case of Aroma Circle

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Abstract. Along with society's accelerated economic development and the accelerating urbanization process, the number of motor vehicles and traffic demand is both increasing. Traffic congestion has emerged as the most critical problem in India. The speed and traffic flow patterns at which cars operate on roadways are the main elements impacting the Road User Costs (RUC), which in turn impact fuel consumption and other cost components per unit of distance traveled. The development of unique speed-flow equations and the need for multi-lane highway capacity stemmed from these extreme changes in the road network and radical developments in vehicle technology, which have led to large variances in speed-flow characteristics. The research, planning, and development of traffic networks and systems frequently employ the traffic simulation method. A range of traffic simulation models was discovered in tests and applications from the literature study with the intention of simulating real traffic operations. The three types of traffic simulation models are microscopic modeling, macroscopic modeling, and mesoscopic modeling. The use of each model depends on the intended use of the research. The choice of the appropriate model for the study's objectives is a crucial first step in the solution to the traffic problem.

Keyword: Traffic Flow Model, Car Following Model, Microscopic Simulation

INTRODUCTION

Transportation engineering applies technology and scientific principles to the planning, functional design, operation, and administration of facilities for any mode of transportation to assure the safe, swift, comfortable, convenient, inexpensive, and environmentally friendly movement of people and commodities.

The area of transportation engineering known as traffic engineering deals with the planning, geometric design, and traffic operations of roads, streets, and highways as well as their networks, terminals, and connections to other forms of transportation.

The purposes of traffic engineering:

Safety	Each year, traffic accidents claim the lives of more than 40,000 people. The public can be kept safe by using beneficial programmes, ethical behaviour, information, and correct technique.
Speed	Though it leaves much to be desired, travel speed is constrained by the state of the art in transportation, the nature of people, and the requirement for safety. (Faster travel equals less time spent in transit. Long-distance travel is encouraged by interstates.)
Comfort	Involves how our perception of safety affects the physical properties of vehicle and roads.
Convenience	The ease with which travels can be taken and the capacity of transportation networks to meet all travel requirements.
Economy	Try to offer the most effective systems you can for the money. In modern transportation systems, there isn't anything that can be considered "affordable." Massive building, maintenance, and operating costs are

	associated with highway and other transportation networks; the majority of these costs are covered by general and user taxes and fees. But every engineer, regardless of field, is expected to deliver the most effective solutions for the money.
Compatibility with the Environment	Establish environmentally friendly transportation methods. All forms of transportation have some detrimental effects on the environment. All of them make use of priceless land resources and some of them contribute to air and noise pollution.

FLOW OF TRAFFIC

The study of traffic flow includes monitoring how individual drivers and vehicles move between two points and interact with one another. Because it is impossible to predict a driver's behaviour, analysing traffic flow is exceedingly challenging. Traffic streams, on the other hand, tend to have some decent regularity and can be substantially mathematically represented because drivers often behave within a reasonably consistent range.

The traffic flow characteristic displays the major transition at various points during the day. Although non-linear traffic flow is complex, it may be predicted and regulated to some extent because drivers typically follow the regulations of the road.

The challenge is that this is only accurate to infinite precision if the factors on which their representation depends. The difficulty here is in finding out how to handle these varying, various traffic issues. Defining and understanding the traffic variable conditions is a critical topic that forms the basis of various strategies. The key factors that can affect the way the traffic road system functions will be defined and their relationships will be presented in the next section.

It is essential to understand the two primary streams of interrupted and uninterrupted traffic flow that the traffic flow theory classified the network's traffic movement into.

Uninterrupted flow is described as "all flow determined by vehicle-vehicle interactions and interactions between the vehicle and the roadway," such as traffic on a roadway.

- **Here are a few key attributes:**
- There is not any limited access,
- Congestion on freeways and broad sections of rural roadways,
- There don't exist any road signs (stop points),
- Stream characteristics are impacted by geometry, vehicles, and other variables.

Interrupted flow: A traffic signal, for example, is used as an external control for all flows.

- **Here are a few key attributes:**
- Traffic signals may be used,
- Stopping and restarting points,
- Platoons may happen.

TRAFFIC FLOW PRIMARY VARIABLES

When describing, simulating, and researching the dynamic behaviour of traffic, a wide range of factors are essential. The three most crucial factors in our situation are speed,

flow, and density. They will be described below and are crucial for planning, assessing, and controlling the transportation systems:

Speed	The distance travelled in one unit of time is "the rate of change of its position." Typically, it is measured in miles per hour (m/h) or kilometres per hour (km/h). The speed is represented by the (v) symbol, and the free flow speed is shown by (V_{max}). One of the most crucial factors that can gauge how well various types of roads operate is speed.
Flow	The volume of traffic that passes a location, lane, or roadway over a predetermined period of time. The maximum flow is denoted by the symbol (q), and the flow is (q_{max}). It is measured by how many vehicles are on the road at any one moment. $$q = \frac{3 \quad N}{t:}$$ N : no.of Vehicles
Density	It is "The quantity of cars using a certain length of a lane or route at any given time". It is measured in terms of the quantity of vehicles per km. The density sign is (k). $$K = \frac{N}{L}$$ K = Density, N = no.of Vehicles L = Length of Roadway

LITERATURE REVIEW

This research aims to examine how mixed traffic affects the intercity roadway system's capacity in Bangladesh's Khulna metropolitan area. The predicted capacity values for various combinations of the conventional car and one of the other four vehicle classes in the traffic stream are determined using the speed-flow curves. Three alternative approaches were used to determine the capacity of this segment: modelling, survey data, and formulas specifically developed for this project. Finally, data from speed-flow charts and simulation results are combined to produce a general model that forecasts highway capacity for mixed traffic. Comparing computed capacity to simulated capacity and field capacity, respectively, revealed errors of 4.5% and 4.9% [1].

Modern city road network planning presupposes the use of transport models. The microscopic model permits information provision and decision-making with respect to, for instance, emissions, traffic organisation, intersection geometry, and traffic control system. The development of a thorough approach used to conduct research on the design of the geometrical characteristics of the roundabout is described in this article. The method entails creating guidelines for formulating solutions for roundabout performance evaluations utilising a microscopic simulation model and the VISSIM programme. By 2034, this facility will be offering services at the IV level. At this intake, the average time losses in each prognostic horizon are decreased by about 40 (s/veh.). This predicament was brought on by an increase in traffic on the roundabout envelope. The case study of the Gdask roundabout served as the basis for the application of the suggested technique [2].

In the case of the Intelligent Driver Model (IDM), only the dynamic behaviour of the vehicles and drivers is defined; the Velocity-Density law (VD) actually implemented by this dynamic

system is not. The conclusions of the theoretical model are helpful, and this study is crucial for practise in the area of hybrid control. In this research, a novel method for Velocity-Density Model (VDM) synthesis is presented. By using an interpolation approach in the produced map of velocity-density, the safety time headway (a microscopic parameter) from this study can be determined from microscopic data. In one specific instance, that speed was 50 km/h, which is typical of metropolitan traffic. The density and velocity models are combined to create a new, generalised VDM [3].

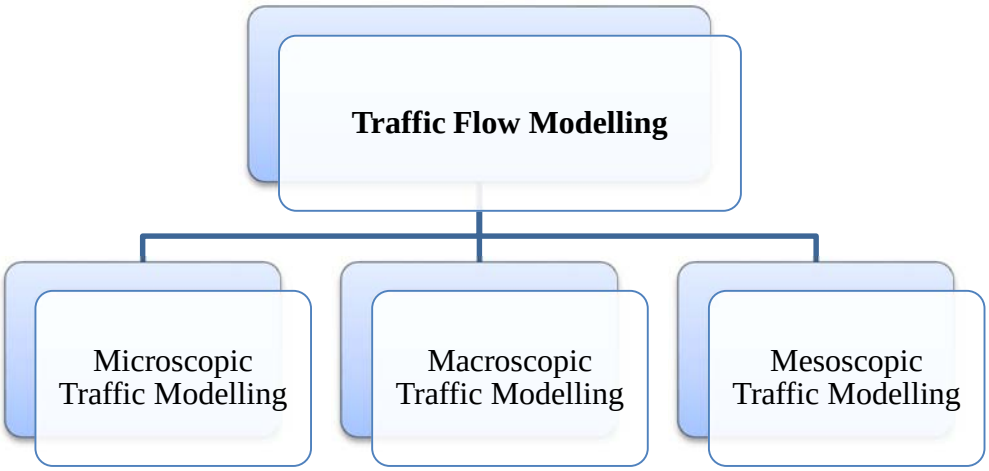
Thus, in order to enhance the realism of microscopic traffic tools and assist safety and other applications that are sensitive to it, an understanding of the effects of distraction on driving behaviour is crucial. Using data gathered from an experiment run in a driving simulator, the parameters of the well-known GM and intelligent driver model are evaluated under various distracting conditions. Impacts are more pronounced at faster speeds. When compared to the control case, the variations in the time fractions are statistically significant (p-value 0.001) for all speed ranges of 20–40 km/h or higher for acceleration and all speed ranges of 40–60 km/h or higher for deceleration (no texting drivers). As performance indicators for traffic flow and safety, the average speed, coefficient of variation of speed, acceleration noise, and acceleration and deceleration time fractions were utilised. The simulation's findings indicate that texting and, to a lesser extent, talking on the phone negatively affects traffic flow: average speeds are lower and the coefficient of variation of speeds is larger [4].

The degree of traffic operations at the unsignalized junctions has a significant impact on the performance of an urban corridor made up of urban roadways and signalised and unsignalized intersections. After calibration with real-time video data, field service delays from 13 chosen intersections in India were estimated and validated using PARAMICS. Based on a microscopic field examination of the driver journey time under diverse driver behaviours, the mean service delay for turning movements is studied. An extensive statistical analysis revealed that the conflict technique can forecast 52% of field estimated service delays with a sensitivity of as little as 3 seconds per car per lane for different traffic streams. Engineering professionals can use the service delay, driver turning time, and queue length models to assess intersection capacity and level of service of turning motions for improved traffic operational management [5].

Previous research concentrated on the microscopic details of the contraflow network configuration, journey time, and quantity of evacuated vehicles. In order to analyse the traffic features and the consequences of coach moving bottlenecks, data on traffic were gathered from highway portions where trucks were prohibited under both regular and contraflow situations. The findings show that due to the limited cross section and unfamiliar driving environment, contraflow lanes have lower capacity and flow speed than conventional lanes. The pace of passenger car platoons was also decreased by the moving bottlenecks by roughly 5 to 20 km/h. For the purpose of reducing the impact of truck moving bottlenecks, Vissim devised and tested four distinct contraflow strategies [6].

SIMULATION OF TRAFFIC FLOW

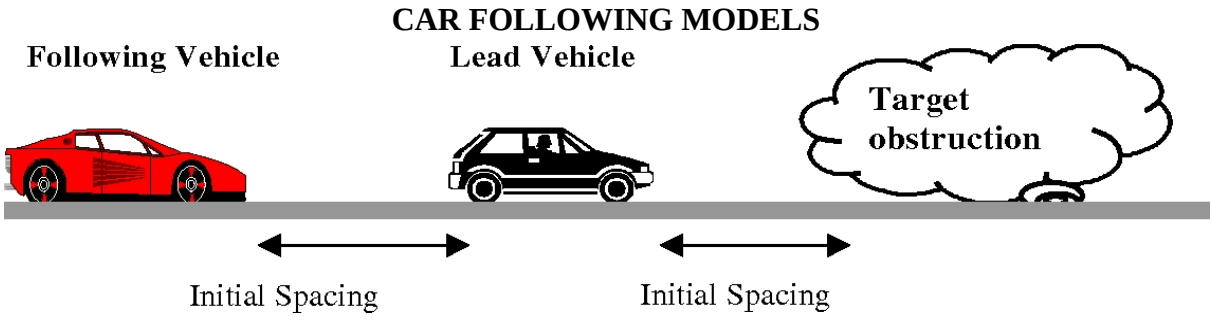
- Three categories can be used to group the foundations of traffic flow theory and its applications:



MICROSCOPIC TRAFFIC MODELLING

Microsimulation models offer the capacity to simulate the behaviour of each individual vehicle in a network. These models, in principle, offer a more accurate and "pure" representation of actual driving behaviour and network performance. These models focus on a single vehicle's movement within a traffic system, including its journey time, speed, and driver movement.

The car-following model, lane-changing model, and gaps of the individual drivers were the basis for the characteristics of microscopic modelling methods.

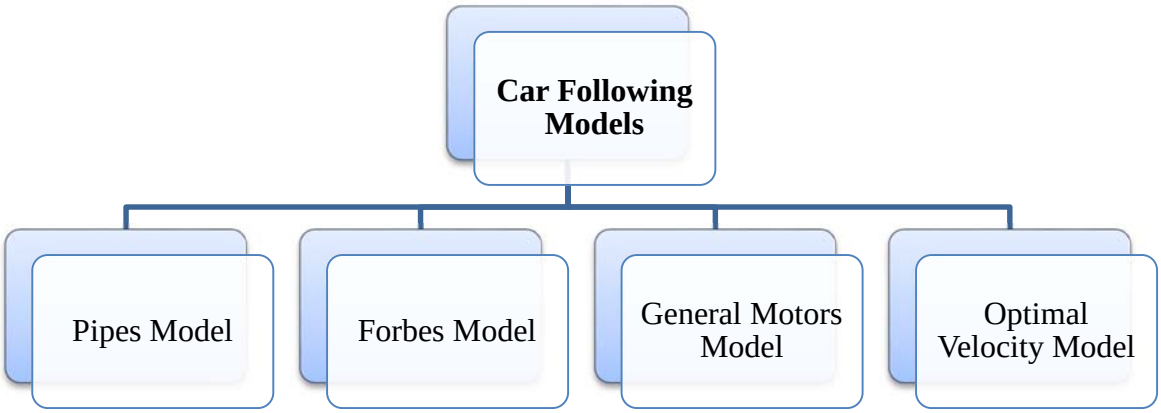


Visualization Car following model

The concept that a driver should understand and follow a lead vehicle at a slower pace was developed by these algorithms. This can be compared to being unable to change lanes while driving in a platoon of cars. The relationship between the lead vehicle and the following car was usually determined by the following car algorithm [8].

At times, it was a function of acceleration, speed, and spacing. The reaction of the following vehicle to the leading vehicle is more sensitive the closer it is to the leading vehicle. With speed, this sensitivity also rises. This is due to the fact that if the primary vehicle is driven at a slower speed, the follow vehicles will also slow down. This led to the formation of car platoons and traffic jams [8].

Headway (h) is the horizontal separation between two cars in the abovementioned layout. The distance between the rear bumpers of the following and leading vehicles as they pass at a particular interval of time is known as the spacing (s). The time gap between succeeding cars crossing at the location is known as the time headway. The movement of individual vehicles and their relative time and space are the foundation for microscopic modelling [8].
To illustrate how a driver responds to changes in the relative locations of the car in front of them, various models have been developed.



Types of Car following Models

Pipes Model

The fundamental principle of this model is that, for every ten miles per hour of speed that you are travelling at, you should give yourself at least the length of a car between your automobile and the vehicle in front of you. The minimal safe distance headway rises linearly with speed, according Pipe's car-following model. The minimal headways suggested by the theory at low speeds are significantly smaller than the equivalent field data, which is a drawback of this approach.

Forbes Model

This model takes into account the duration of time required for the following vehicle to understand the need to slow down and apply the brakes. In other words, the reaction time should always be larger than or equal to the time difference between the leader's rear and the follower's front. The reaction time (minimum time gap) and time needed for the lead vehicle to go a distance equal to its length are therefore equal to the minimum time headway. Similar to Pipe's approach, this concept has the drawback of having a significant variance between the minimum distance headway at low and high speeds.

General Motors' Model

Because of the following factors, the General Motors model is the most popular of the car-following theories:

- Agreement with empirical data; simulation models built using General Motors' car-following models exhibit strong agreement with empirical data.
- Mathematical connection to macroscopic model; General Motors Car Following Model can be used to create Greenberg's logarithmic model for speed-density relationship.

In car-following models, each vehicle's movement is controlled by an equation similar to Newton's Laws of Motion. According to Newtonian mechanics, acceleration is the particle's reaction to a force stimulus, which can include both external forces and forces generated by interactions with all other particles in the system. The most popular model will be covered later in more detail.

GENERAL MOTOR'S CAR FOLLOWING MODEL

Fundamental Theory

The fundamental principle of the car-following model is adopted from Newtonian mechanics, according to which an object's acceleration can be seen of as its reaction to a stimulus in the form of a force it experiences by interacting with other objects in the system. Consequently, the equation below can be used to sum up the fundamental philosophy of car-following theories.

$$[R \quad]_n \alpha [S \quad]_n$$

For vehicle n^{th} (n=1, 2...). The only way a motorist may react to the surrounding traffic is to accelerate or decelerate his car. As was already indicated, various hypotheses on car-following have developed as a result of divergent viewpoints on the stimulus's nature. The stimulus may consist of the vehicle's speed, relative speeds, distance travelled, and other factors; as a result, it is a function and can be expressed as,

$$a\,^{t}_{n} = f_{sti}\,(V_{n,}\,\Delta x_{n,}\,\Delta V_{n})$$

Where, f_{sti} is the stimulus function that depends on the present vehicle's speed, position, and speed in relation to the car in front of it.

Optimal Velocity Model

The principle behind this model is that each driver aims to reach an optimum velocity based on the separation from the vehicle in front of them and the speed difference between them. Recently, other options for car-following models were investigated.

The calculation is predicated on the idea that the intended speed Vn_d is dependent on the n^{th} vehicle's headway over the distance.

Specifically, $Vn_d \quad t = V^{opt}\,(\Delta x\,_n{}^t)$,

Where, V_{opt} is the optimal velocity function,

$\Delta x\,_n{}^t$ is the instantaneous distance headway. As a result, $a\,^{t}_{n}$ is provided by.

$$a\,^{t}_{n} = [1/\tau]\,[V^{o} \quad (\Delta x\,_n{}^t) - V_t^n]$$

Where, $\frac{1}{\tau}$ is called as sensitivity coefficient.

Using microscopic models has several benefits. Below, we've listed them in bullet form:

- When operating urban transportation networks, where system complexity and uncertainty are on the rise, micro-simulation models are highly helpful,
- The microscopic models are based on a few traffic parameters that can control how each individual vehicle moves inside a transportation network,

- Microscopic simulation models may assess several traffic management options to find the best answer for every traffic situation and provide visualisation for the problem being investigated,
- Since traffic data is rarely consistent and repeatable, numerous dependable solutions for various traffic issues, such as congestion and incident management, could be recommended.

MACROSCOPIC TRAFFIC MODELLING

Providing an aggregated model of demand, often represented in terms of total flows per hour, is what traditional transport models (also known as TTMs) are defined as. In other words, they discuss features of the particular road section.

MESOSCOPIC TRAFFIC MODELLING

Mesoscopic models contain microscopic and macroscopic methods to effectively describe all important aspects of the route. When drivers choose to change lanes, for instance, they are making a microscopic decision; yet, this choice should be based on the density and speeds determined by a macroscopic model.

STUDY AREA

The Aroma circle, which is located at the crossroads of SH 41 and NH 27 in Palanpur city, is chosen as the study location in the current effort. Figure 1 illustrates the locations of the study area and the Aroma circle, respectively. Heavy vehicle through traffic between NH 27, which connects Palanpur to numerous significant cities in Rajasthan state, and SH 41, which connects Ahmedabad to Palanpur city, is the primary cause of congestion at the Aroma crossroads.

Fig.1. Google images of Aroma Circle

TRAFFIC VOLUME DATA AND ANALYSIS

Counts done by observers stationed at the side of the road are the most basic way to measure traffic levels. The majority of manual count applications call for a sample of data from each site. When videography and mechanised equipment are not necessary, manual

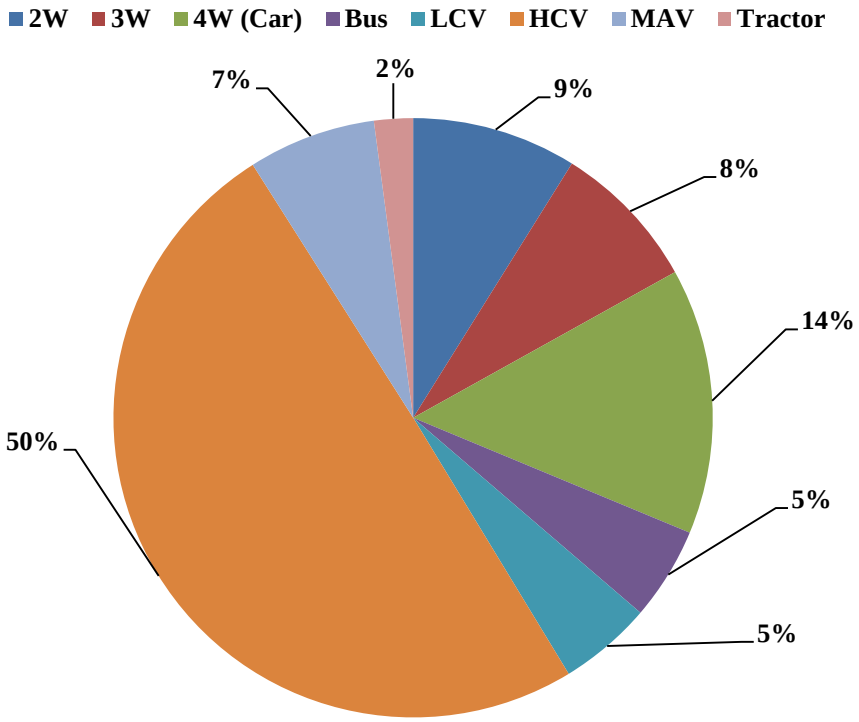
counting is done. When vehicles are to be categorised with a number of moves recorded independently at an intersection, this kind of data collection can be costly in terms of manpower, but it is also typically required. At intersections, it is important to count and track each lag's traffic independently for each movement. It is crucial that traffic on highways with more than one lane be counted and categorised according to the flow of traffic.

For 24 hours, a road classified volume count survey is conducted in the research area and at the intersection. The data extraction revealed that a significant part of PCUs are made up of LCV, HCV, and MAV. The Table displays the breakdown of traffic in PCU/day figures.

Total vehicle in terms of PCU/day

Vehicle Types	Towards Ahmedabad	Towards Abu Road	Towards Deesa	Towards Palanpur City
2W	3900	3987	2320	4445
3W	3525	3357	4440	2934
4W (Car)	6300	8300	3220	4236
Bus	2200	1235	2000	3210
LCV	2204	2300	6224	1236
HCV	21812	15670	14050	1200
MAV	3026	4626	2336	208
Tractor	922	1009	1100	906
Total	43889	40484	35690	18375

Traffic Volume PCU/Day



SUMMARY

At the Aroma crossroads in Palanpur city, there is an excessive amount of delay and fuel usage. As a result, the line extends one kilometre from the intersection. Additionally, it has been noted that most commercial cars headed for Mumbai originated in Rajasthan and Uttar Pradesh. It includes the greatest percentage of all cars.

The purpose of a simulation model is to present a dynamic representation of an actual traffic situation. For application in traffic engineering, three simulation models macroscopic, microscopic, and mesoscopic are available.

The focus of microscopic traffic flow modelling is on the smallest details of the traffic stream, such as vehicle-to-vehicle interaction and individual vehicle behaviour. They aid in the analysis of minute alterations in the flow of traffic through time and space. One such model that makes use of the stimulus-response theory is the car-following model. Simulator models and optimal models were briefly covered.

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A Technique for decreasing the SSD's GarbageCollection overhead using ML techniques

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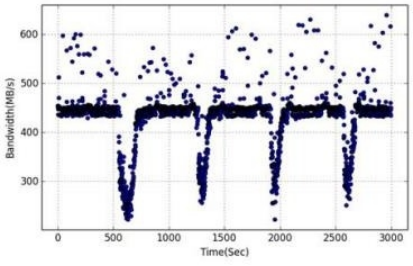
Abstract: In this article, we try to control Garbage Collection over head at the OS level in this work. In our this work method, we first develop a Garbage Collection detecting mechanism at the OS level using a ML technique, and then we demonstrate how using this mechanism may minimize performance variation often found on SSDs. We created Garbage Collection detector that looks for SSD Garbage Collection and asks TRIM operations when it does. When employing the Garbage Collection detector, experimental findings demonstrate higher average bandwidth and reduced performance variation.

Keywords: NAND Flash, SSD, TRIM, Garbage Collection,ML Algorithm

INTRODUCTION

In contrast to hard disks drives, which require the head's actual movement, SSDs using NAND flash memory are utilized extensively in computers and smartphones since the input and output is quick & uses less electricity. Although SSD provides the aforementioned benefits, its use in data centers is constrained by its greater cost than hard disk [4]. The rate of utilization in the data center is, however, progressively rising as a result of the development and price reduction of the technologies of Multi-layer cell and Triple Layer Cell, which store multiple bits per cell, the lowest storage unit for data in the NAND flash memory [1] [12]. These SSDs cannot be overwritten, therefore the FTL is necessary to work with NAND flash memory's abilities to do block-by-block erase operations as well as the traditional interface at the block level. The Flash Translation Layer manages firmware to be able to enable compliance with the interface at the block level, including wear levelling, mappingtable maintenance, and other tasks. NAND flash memory includes a characteristic that prevents overwriting, therefore updating the data requires a "erase before writing" action [2]. This erase prior write action generates a significant amount of overhead, which FTL handles by managing the mapping table. An invalid page is produced during this operation. Rearranging the erroneous pages and switching back the appropriate page is important to protect the storage space when the amount of in the flash memory chip's available area runs out. Garbage collection is what we call this. The SSD performs I/O operations improperly and consumes a significant amount of overhead, which decreases Fig. 1. Garbage Collection I/O speed causes a rapid loss in bandwidth.

Fig. 1. Garbage collection causes a rapid bandwidth drop



The SSD is displayed in Figure 1 together with bandwidth measurements and continuous writing. The 4 bandwidth decreases brought on by garbage collection are shown in Figure 1. When GC happens, as in Fig. 1, the OS's bandwidth suddenly decreases. As a result, it is challenging to deliver QoS in the data center, which leads to issues including the failure to forecast system response times in real time [5], [6], and [7]. Studies have been done on optimizing the garbage collection algorithm and lowering the impact of GC by modifying the over-provisioning area, a designated area assigned to the Solid state Drive [5] [6] [7]. Such a research, however, focuses on improving the efficiency of garbage collection rather than addressing the sudden bandwidth drop brought on by garbage collection at the OS level. As a result, it cannot be argued that the issue of garbage collection is entirely resolved.

Fig. 2. Garbage collection procedure

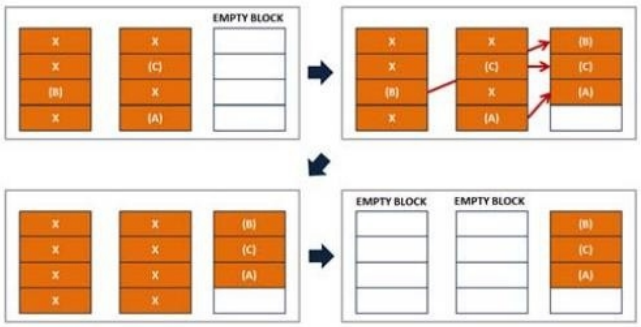
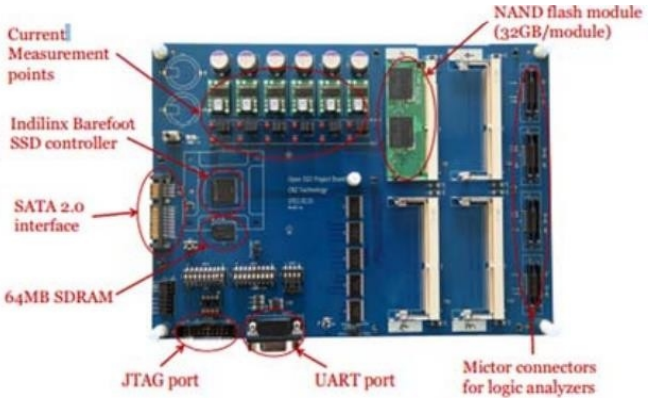


Fig. 3. OpenSSD Objects Model [20]



This document outlines a technique to lessen the effect garbage collection has on the OS. In order to address this issue, we first identified the SSD's Garbage Collection job at the OS level. It is hard to determine with accuracy whether garbage collection occurs at the OS level since the SSD's garbage collection function is carried out by the SSD firmware. In order to determine whether to undertake garbage collection, we thus utilized an approach that involved analyzing SSD status information data that may monitored at the OS level using an ML algorithm. An ML algorithm is a technique for learning from data. In this work, we used a machine learning method to analyze, the information on when waste collection does place and the information on when it does not ultimately obtaining information on GC [9].

In this article study, we apply decision trees among ML methods to forecast the SSD garbage collection utilizing the rapid prediction speed and low overhead C4.5 algorithm [11,12]. The structure of this essay is as follows. Machine learning methods and garbage collection are covered in background section. The SSD's state information is gathered and analyzed by the ML algorithm in Section 3 [8]. The GC detector for delivering TRIM Function tasks to the Solid state drive for which GC has been identified is described in Section 4 together with the Garbage Collection detection for multiple SSDs [3]. In Section 5, we investigate if using the GC detector lessens the effect of garbage collection.

METHEDOLOGY

GARBAGE COLLECTION

NAND flash memory properties and compatibility with conventional block level interfaces necessitate FTL for SSDs. There are numerous pages and a block of pages in the NANDflash memory. NAND flash memory also has limitations on data overwriting, performs read/write operations in page units, and performs erase operations in block units. The overhead for updating the page is significant due to both of these characteristics. For instance, you must first conduct the page wipe operation since overwriting is not feasible in orderto copy alternative data to a page that holds valid data [1, 2].Since the erase operation is carried out block-by-block, it is essential to duplicate the block's valid pages to another block, update the copied page, and then copy the updated copied page once again. The FTL makes use of a mapping table to resolve this issue. When a specific page is modified, the mapping table is updated to decrease cost associated with the update and the existing page is invalidated after sending datato another page. If these actions continue, invalid pages will build up and the flash memory chip's available space will runout. When data is stored to a flash memory chip to reclaim storage space, garbage collection operations for collecting invalid pages start when the free space falls below a certain threshold. The process of garbage collection is depicted in Figure 2 as follows. (1) Decide which victim block will haverubbish collected there. (2) Copies the page to the chosen block after choosing the block to which the victim block should be moved. 3) Run an erase operation on the block that was the victim. The write operation's bandwidth is decreased as a result of this operation's significant overhead on the SSD. Because garbage collection recovers invalid pages as much as possible when a write operation is conducted, this garbage collection procedure will continue to occur from the momentgarbage collection begins. As a result, Beginning with garbage removal at the operating system level, the write operation's bandwidth is gradually decreased. Running a TRIM command to secure storage space on the SSD will fix this problem [3].

MACHINE LEARNING

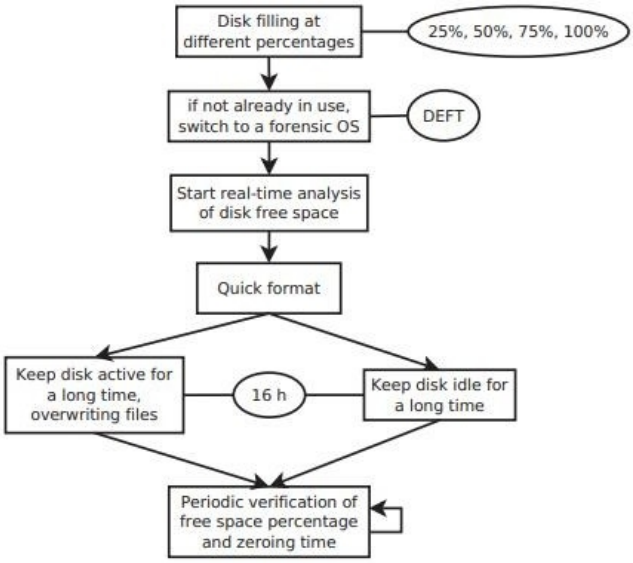
Finding specific information from data is the work of machine learning algorithms [4-6]. The following is the sequence in which the machine learning algorithm works. (1) Gathering learning data; (2) training the algorithm; and (3) testing the algorithm (4) Application Instructional learning and non-learning learning are both incorporated into machine learning algorithms. A technique employing labelled data is map learning. The acquired data reveals whether or not the collected data is spam mail, much as the aforementioned email spam filtering system. Decision trees, naive bayes, andneural networks are examples of algorithms for learningmaps. The most popular strategy is the decision tree method [6].

The decision tree approach uses a decision tree to classify the data after training an algorithm using learning data. A straightforward decision tree that may be utilized for spam categorization is shown in Figure 3. The decision tree approach has the advantages of being used once the decision tree is formed, the classification speed being quick due to the lack of procedures, and the classification result being simple to grasp. The C4.5 technique is utilized in this work to assess both garbage collection and non-garbage collection scenarios[11–13]. In contrast to map learning, unsupervised learning employs unclassified learning data. One of the categories of non-visual learning is clustering. By classifying the data anddetermining how similar they are, it produces new information. K-Means is an algorithm that uses a representative method to divide data into k groups that are comparable to one another [12]. The K-Means technique may categories data based on how similar unclassified data is, butit has the drawback of taking a long time to classify because of the numerous operations required to average out the relevant data at the time of classification.

DETECTION OF GARBAGE COLLECTION

This article explains how to use a ML technique to find garbage collection (GC) on an SSD. We applied the decision tree C4.5 method to find garbage collection. These activities are performed in a manner that is quite similar to the spam screening mechanism for email example from section 1.2 ML Algorithm. The OS-level SSD data that may be gathered is first gathered as learning data, and after that, the algorithm istrained using the learning data that was gathered [10]. The algorithm test phase evaluated the classification method's accuracy based on the results from the algorithm training stage. In the end, the GC sensor was created and the ML algorithm's findings were used.

Fig 4. Garbage collection test flow.



learning how to collect data The OS's disk state characteristics are gathered when the disk is being written toin order to gather the training data needed to train the algorithm. The benchmark programs FIO and File-benchwere used to produce Solid state drive write requests [7], [8]. Persistent write requests were generated using the Micro benchmark using the FIO benchmark. The FIO benchmark was utilized to complete the 512K block random write [17]. In order to create a workload that was representative of the existing circumstances, we also employed the macro benchmark File-bench. Where file write requests were most often made, we employed the fileserver and varmailworkloads. To gather information for various scenarios, File-bench and FIO, two benchmarking programs, were employed [18]. Data about SSD state was gathered using Iostat if a write request is made [9].

Iostat is a disc monitoring programmer that continuously tracks several metrics, including storage input and output information [13] [19]. Iostat has 17 properties in total. We gathered an overall 17 characteristics in a single second, andwe added the average variation of each attribute's 50 total cumulative values to the data. From the 34 qualities gatheredthrough this approach, we eliminated the attributes that were superfluous. First, the CPU-related properties describe the system's overall I/O-related CPU utilization. Since each Solidstate drive utilized in the same system has the same value andthis is not a value for an attribute specific to each Solid statedrive, determining if the trash from each SSD is removed and not stored with the data is not possible. We also got rid of theread/write bandwidth feature. The read operation has noimpact on the garbage collection, while the write operation's bandwidth is likewise influenced by outside variables like does not and block size accurately reflect the GC condition. The data did, however, provide the standard deviation of thewrite operation's band-width fluctuation.

The data gathered using the aforementioned technique is used to train the machine learning algorithm. When X data is input by a learning system, map learning classifies the data by supplying information on both A state and B state. Machine learning is an appropriate solution for this issue since the Solid state drive GC detection problem corresponds to the aforementioned scenario [11] [15]. As a result, the data was labelled as having been obtained under particular circumstances (GC or non-GC). The use of a commercial Solid state drive for GC could not be correctly determined at the OS level, though. To address this issue, we employ OpenSSD [10]. The experimental board known as the OpenSSD, which may be used to create and implement SSD firmware, is seen in Fig. 4. The Flash Translation Layer of OpenSSD may be changed, and different SSD state details can be seen at the OS level. To output the debugging code while GC takes place, we updated the Flash Translation Layer and applied it to OpenSSD [20]. When the code for debugging is displayed, this enables you to confirm that Garbage Collection has been carried out at the OS level. We were able to classify the type of data (GC or non-GC) that was being gathered using iostat thanks to this information [14].

RESULT & EXPRIMENT

The results of the first experiment, which tested the SSD's bandwidth for 3000 seconds without the use of a garbage collection detector, are shown in Fig. 5. The SSD's average bandwidth in the first testing was 449 MB/s, and two bandwidth decreases were noted. SSD bandwidth is anticipated to increase once again as a result of the OS performing the TRIM command when not in use. This is because of Garbage Collection, lower bandwidth, and automated TRIM setting. The band-width speed has decreased lower than 400 MB/s 137 times, which indicates that 3000 seconds of the bandwidth have been impacted by garbage collection.

As a consequence, it was determined that even when automated TRIM is enabled, input and output are still conducted on the SSD, and the GC effect is produced if there is never any downtime. In the second experiment, a garbage collection detector-like environment was used to assess the SSD's bandwidth over the course of 3000 seconds. This led to the measurement of the bandwidth depicted in Fig. 6. The second experiment's average SSD bandwidth was 462 MB/s, which is 13 MB/s more than the first experiment's. Like the previous experiment, the second experiment demonstrated two occurrences of bandwidth decrease. However, the duration assessed as 66 seconds with a band-width of 400 megabyte per second or less in the second trial as opposed to 137 seconds in the first experiment. By getting less than 52% of the impacts of garbage collection compared to when the first GC detector wasn't running, it can be said that the GC detector lessens the impact of GC.

Fig. 5. The Garbage Collection detector should be used before

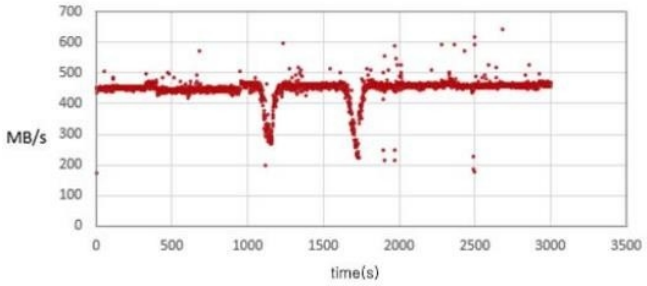
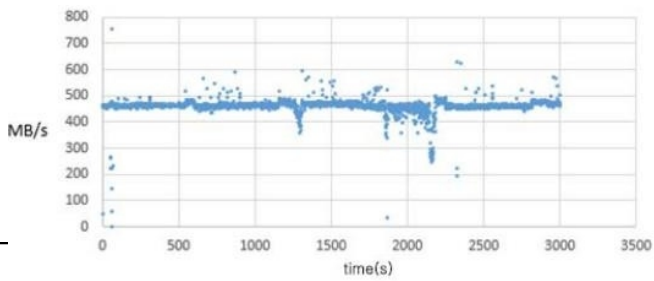


Fig. 6. Following use of the garbage detector



CONCLUSION

By the use of Solid state Drive status information and ML Technique methods that may be seen at the OS level, we have discovered SSD garbage collection in this research. In order to safeguard the SSD's storage space and lessen the impact of the Garbage Collection, the TRIM function command is also carried out on the identified Solid state drive. As a result, Garbage Collection's bandwidth loss is decreased and average SSD bandwidth is raised.

ABBRIVATION

MLC –Multi Layer Cell TLC – Triple Layer Cell QoS – Quality of Service SSD – Solid state drive
FTL - Flash Translation LayerML – Machine Learning HDD – Hard disk drive

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Improve Prediction Accuracy using Automating Decision Process for Overnight Patient

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Abstract

In this paper, a novel step of probability-based decision support system is to be introduced while comparing the performance of the classification models. As of process here the thought is to train a neural network for getting the probability of a class on a given input rather than predicting the class itself. Then, this define a new decision support system for these probabilities by considering various thresholds for the classes. The new DSS provides better results because of the varying threshold on probability. This provides an extra edge to improve precision as well as recall so that overall performance of the model is improved by minimal loss to accuracy. The improved classification algorithm outperforms previous algorithms in terms of correctly identifying whether the patient is in-care. The improved algorithm provides better results and can further improve the decision-making process in hospitals and other medical care units.

Keywords

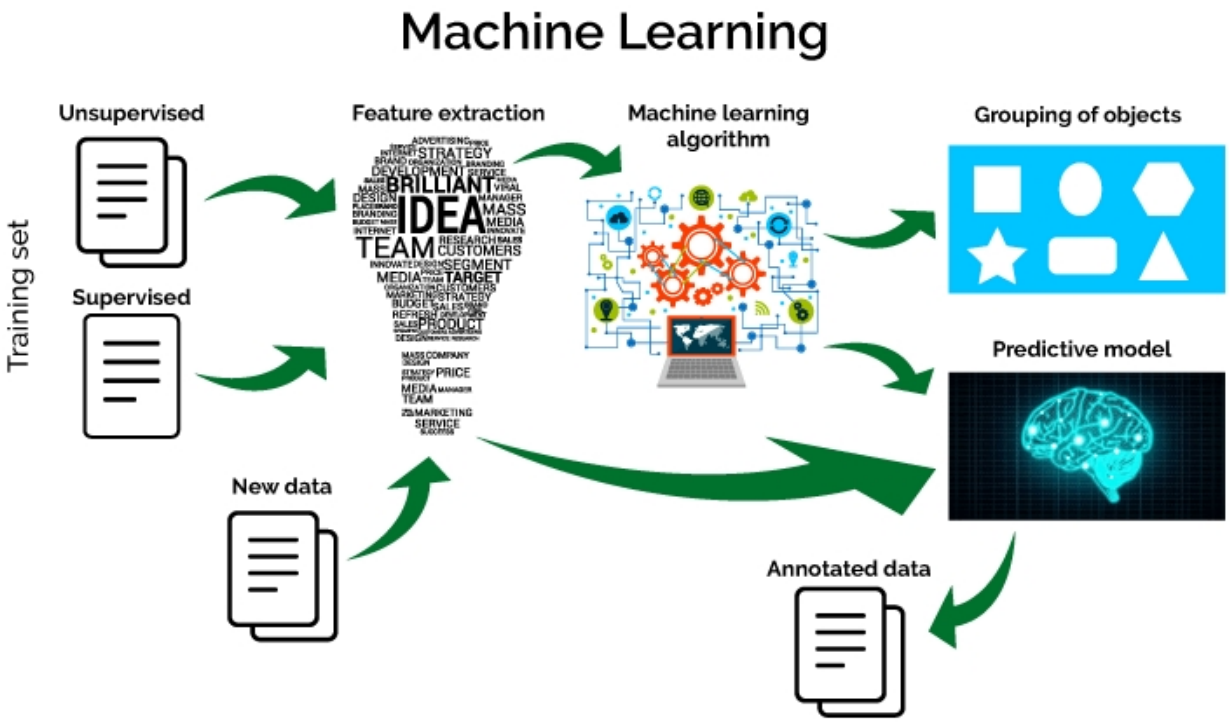
Machine learning, Classification, Hybrid, Neural Network, DSS, Stacking Ensemble

I Introduction

Man-made intelligence is a subfield of programming which incorporates the examination and improvement of computations that can acquire from and make assumptions on data. Initial, a model is worked from a preparation set of information perceptions with the goal that the expectations can be information driven and afterward AI calculations works on test information for producing the anticipated result. Here exacting static program directions are not followed. Rather verifiable information is considered for making the forecast there are some machine learning algorithms .

Information Mining and Machine Learning Algorithm

The Data Mining and the Machine Learning Algorithms are utilized for the expectation of Disease in the Project. There are various Data Mining and Machine Learning utilized to address and assessing the dataset and afterward testing the dataset based on train score and the grade of the ML model.



Machine learning Model for Information

II Literature Summary

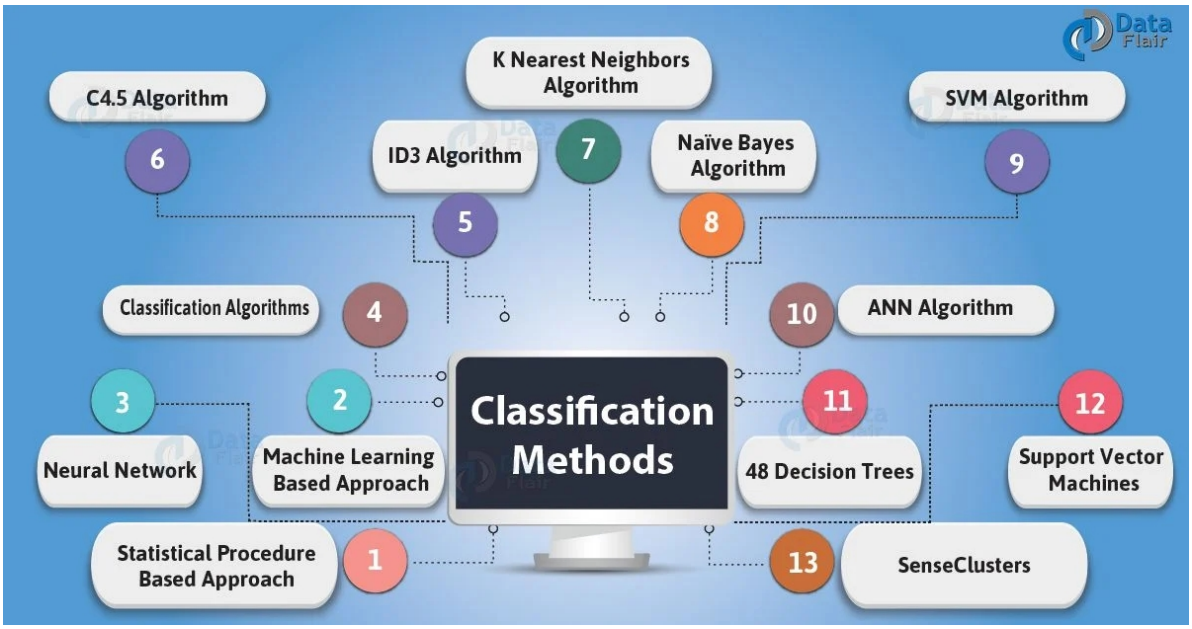
Data Mining

The Data Mining is a cycle where crude information is ready and organized from the unstructured information as to take significant data from the information which can be utilized in the task. Undertaking of making information coordinated and intelligent about information is to method for getting what this data does the information contains in it and what it doesn't have in it. There are such countless various kinds of strategies in which individuals can utilize information examination. It is basically extremely simple to utilize information during the investigation stage and get to a

few certain ends or a few plans. The examination of information is a course of reviewing, cleaning, changing, and demonstrating information with the target of featuring valuable data, recommending ends, and supporting dynamic which are useful to the client. Information examination has numerous aspects and approaches, enveloping assorted procedures under a variety of names, in various business, science, and sociology spaces.

Data Mining is the discovery of unknown information found in databases, data mining functions has some different methods for clustering, classification, prediction, and associations. In the data mining important application is that of mining association rules, association rules was first introduced in 1993 and are used to identify relationships among a set of items in databases these different properties are not based on the properties of the data, but rather based on cooccurrence of the data items. The Data mining helps in giving new and different perspectives for data analysis the main role of data mining is to extract and discover new knowledge from data. In the past few years, different methods have been coined and developed about the capabilities of data collection and data generation, data collection tools have provided us with a huge amount of data, data mining processes have integrated techniques from multiple disciplines such as, statistics, machine learning, database technology, pattern recognition, neural networks, information retrieval and spatial data analysis. The data mining techniques have been used in many different fields such as, business management, science, engineering, banking, data management, administration, and many other applications.

Presently, there are far too many data mining algorithms. We'll talk about each of them individually. These are some instances where the task of data analysis is Data Mining Classification Algorithms



Data Mining Algorithms

2.1 Background Information

In information mining, the characterization approach predicts the gathering participation for information models. The characterization strategies are for the most part used to arrange information. The environment on a specific day can be delegated by the same token "bright", "blustery" or "overcast" by the characterization methods. This cycle is done in two stages. These means are define as:

a. Model Construction: A lot of predefined classes can be presented through the improvement of the model. A property named class mark concludes every model associated with a predefined class. To make the planning set model, a couple tuples are required. In different designs, these tuples are tended to.

b. Model utilization: Model use is the resulting stage in the game plan cycle. Model use is generally utilized for organizing future and unidentified substances. The known characteristic of the test is taken a gander at using the plan outcome of the model. Testing and getting ready sets are independent in nature [8].

III Tools Machine Learning Algorithm

Machine Learning algorithm is an evolution of the regular algorithm. It makes your programs "smarter", by providing them to automatically learn from the data you provide. The algorithm is mainly divided into Training Phase and Testing phase. Lots of machine learning algorithms used to improve business progress on which few of them are:

- Decision Trees: A decision tree is a decision help contraption that uses a tree-like graph or model of decisions and their typical outcomes, including chance-event results, resource costs, and utility.

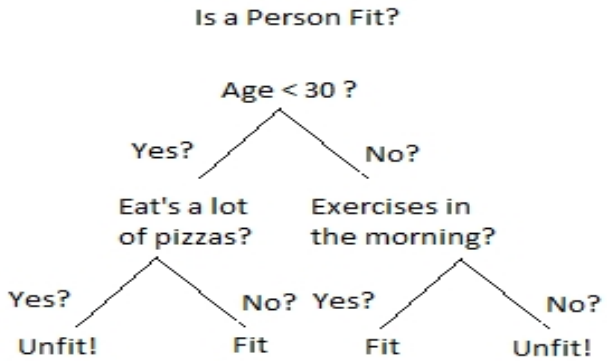


Fig 2 : Example of Decision Tree

- Linear regression: Is at demand from fitting a straight line through a lot of core interests. There are different expected strategies to do this, and "standard least squares" framework. Straight Regression is a technique for showing the association between something like one let loose factors with the end goal that they meet to shape a fundamental catalyst for the ward numerical variable.
- Logistic Regression: Logistic backslide is a fantastic verifiable technique for exhibiting a binomial outcome with no less than one instructive variables. It gauges the association between the outright ward variable and something like one independent elements by surveying probabilities using an essential limit, which is the total determined dispersal. It is customarily used to expect an event class, where we have a predefined and known characterization of events.

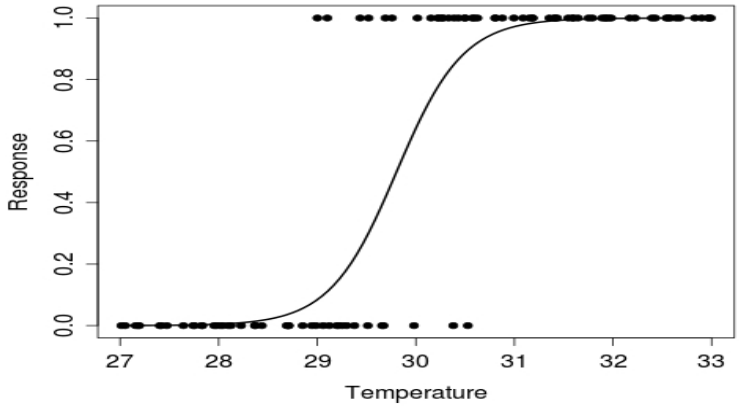


Fig 3 : Example of Logistic regression

K-nearest Neighbor Algorithm Pseudo code

Programming languages like Python and R are used to implement the KNN algorithm. The following is the pseudo code for KNN:

1. Load the data
2. Choose K value
3. For each data point in the data:
    - Find the Euclidean distance to all training data samples
    - Store the distances on an ordered list and sort it
    - Choose the top K entries from the sorted list
4. Label the test point in light of most of classes present in the chose focuses
5. End

Decision Tree Classifier:

Decision tree classifier is yet another simpler forms of classification models that follow a flowchart like tree structure. Each node of the tree is an attribute and the leaf nodes are the target variables. The branches are the decision rules that direct the decision-making process for each data point.

The basic idea behind any decision tree algorithm is as follows:

1. Select the best attribute using Gini index to split the records.
2. Make that attribute a decision node and breaks the dataset into smaller subsets.

3. Starts tree building by repeating this process recursively for each child until one of the condition will match:
    a. All the tuples belong to the same attribute value.
    b. There are no more remaining attributes.
    c. There are no more instances.

IV Methodology

Data Set Information:

The dataset is Electronic Health Record Predicting collected from a private Hospital in Indonesia. It contains the patients laboratory test results used to determine next patient treatment whether in care or out care patient. The task embedded to the dataset is classification prediction.

Attribute Information:

Given is the attribute name, attribute type, the measurement unit and a brief description. The number of rings is the value to predict: either as a continuous value or as a classification problem.

Name / Data Type / Value Sample/ Description

HAEMATOCRIT /Continuous /35.1 / Patient laboratory test result of haematocrit

HAEMOGLOBINS/Continuous/11.8 / Patient laboratory test result of haemoglobins

ERYTHROCYTE/Continuous/4.65 / Patient laboratory test result of erythrocyte

LEUCOCYTE /Continuous /6.3 / Patient laboratory test result of leucocyte

THROMBOCYTE/Continuous/310/ Patient laboratory test result of thrombocyte

MCH/Continuous /25.4/ Patient laboratory test result of MCH

MCHC/Continuous/33.6/ Patient laboratory test result of MCHC

MCV/Continuous /75.5/ Patient laboratory test result of MCV

AGE/Continuous/12/ Patient age

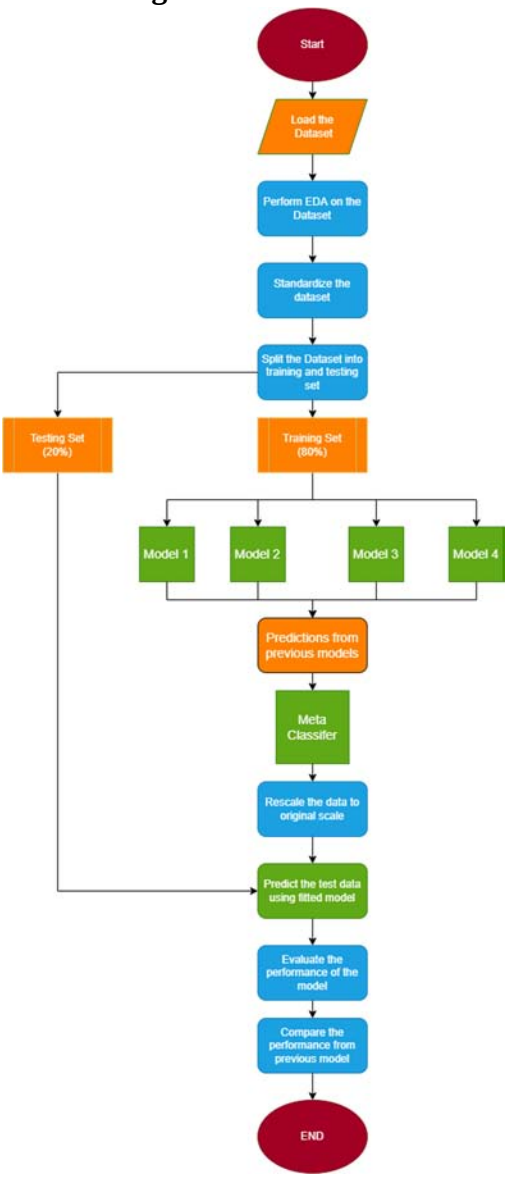
SEX/Nominal – Binary/F/ Patient gender

SOURCE/Nominal/ {in,out}/The class target in.= in care patient, out = out care patient

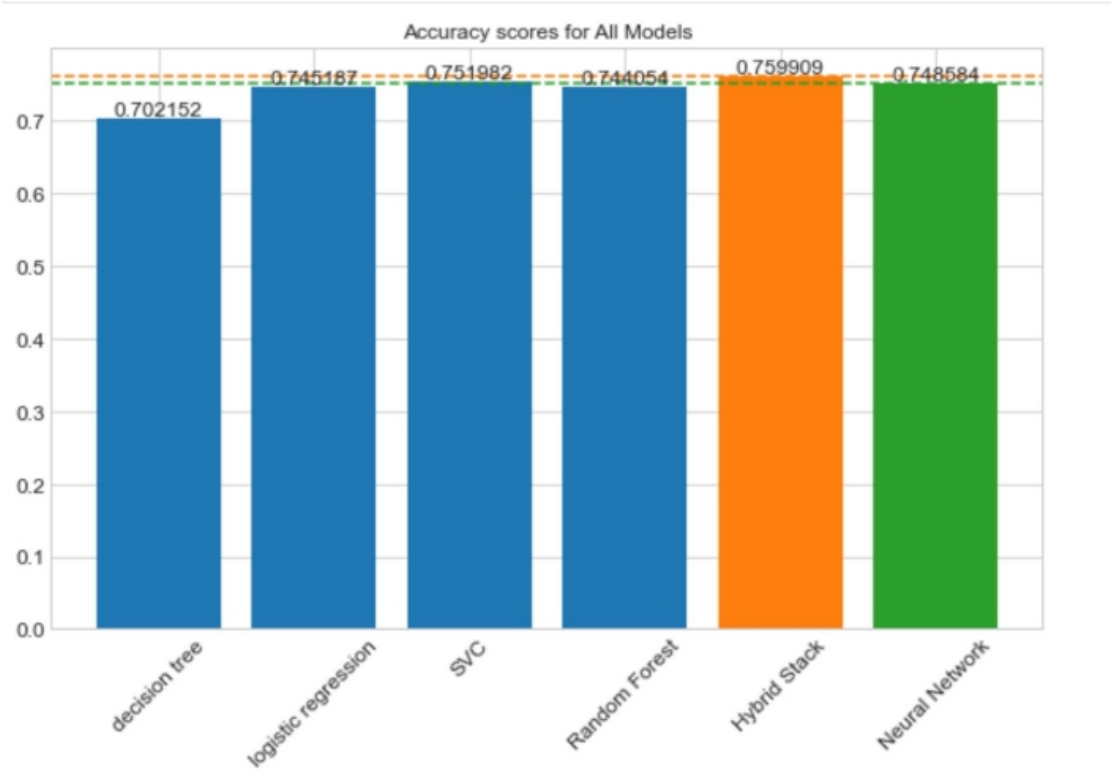
Neural network in general can be considered as a machine learning algorithm that has capability to learn, recall and generalise results from a process called 'learning'. In technical terms, Artificial neural networks are set of non-linear computing mechanism that trains by minimising the loss metric in a layered format. In today's world, neural networks are considered to be one of the most powerful algorithms that can practically perform any task for given dataset. Today, they are used in facial recognition, vaccination formulations, stock market analysis, etc. The robust nature and efficient learning mechanism makes this algorithm highly desirable and versatile for any use case. In this project, we use the neural network to calculate the probability of a patient being in-care based on the input variables. Following this, we have developed our own decision support system that converts the probabilities into the classes based on various thresholds. For our new DSS, we have taken a range of threshold starting from 0.2 to 0.9. for each threshold, we check the precision, recall, accuracy, and f-score on the validation data. The threshold with best performance is finally chosen to predict the test data.

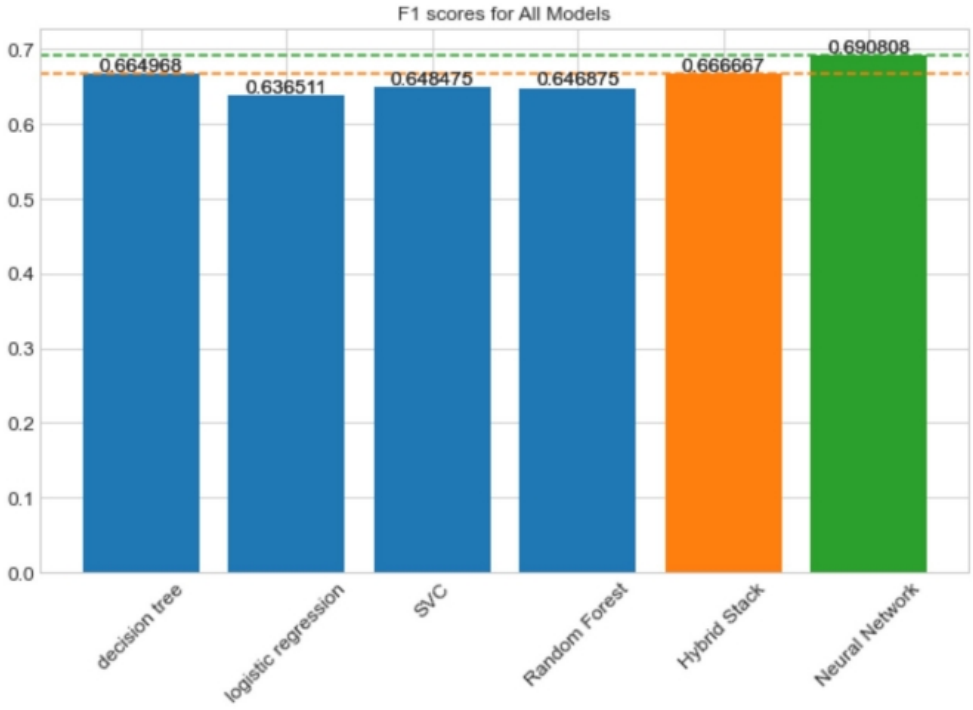
With our new DSS, we find that the variable threshold provides better precision, recall and F-score for test data as compared to Base algorithm (KNN) and stacked algorithms.

Stacked Algorithm



V Result


Accuracy scores for All Models
0.702152
0.745187
0.751982
0.744054
0.759909
0.748584
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
decision tree
logistic regression
SVC
Random Forest
Hybrid Stack
Neural Network



VI Conclusion

This paper successfully implements a novel decision support system for predicting in-care patients in the hospitals. It is observed that this novel approach not only provides class prediction, but also the likelihood of the decision. By focussing on the precision instead of accuracy, we further improve the performance of the decision process. This is very helpful to the on-duty staff for making the right choices. The approach will provide better aid and can further improve the decision-making process in hospitals and other medical care units.

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Symbiosys of Data Science and Software Engineering

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[b)]*shivangi.patel@rku.ac.in*

Abstract. In the age of big data, data science is an essential skill that should be equipped by software engineers, practitioners, developers, and researchers who want to understand the state of the art in using data science for software engineering (SE). It can be used to forecast useful information about new projects based on previous projects. Different fields/areas/branches of Software Engineering and Computer Science have a pretty wide and immense scope of Data Science for the purpose of improvement of available or research for new technologies, algorithm and mining, manipulating or clustering of Data. As Data Science is being used in almost every application, programs or systems, Data Science has become the basic and fundamental element for Computer Science and Software and Engineering. With the time the demand of innovation and updating of software is increasing with that requirement of Data Science for Software Engineering is increasing simultaneously.

This paper will discuss the tasks involved in deploying machine-learning algorithms in organizations, followed by discretization, clustering, dichotomization, and statistical analysis.It will address issues such as how to adapt data from other organizations to local problems when local data is scarce. When privacy concerns prevent access, how can data be privatized while still being mined? When working with data of questionable quality, how do you prune spurious information? How to simplify data mining results when data or models appear to be overly complex. Methods for generating predictions when data is insufficient to support complex models. What to do when the world changes and old models need to be updated. When the effect is too complex for a single model, how do you reason across ensembles of models? [1,16,17,18,19,20]

Keywords: Software Engineering, Data Science, Data science and Software Engineering, Symbiosis of Data Science and Software Engineering, relation between Data Science and Software Engineering, Organizational Concerns, Data Issues, Characteristics, application of Data Science.

INTRODUCTION

This article discusses data and model issues in Software Engineering, as well as machine learning algorithms for dealing with these issues. In the era of Information and Technology, there are numerous Software which provides a commodious amount of raw data which can be metamorphosed into beneficial, productive and accessible fact, information or materials with the help of Data Science and its applications. A search on Amazon.com reveals dozens of new data science texts that have been published in the last two years. However, the majority of those texts are overly concerned with the specifics of individual data miners.Data mining approaches should be usable by industrial practitioners as decision support tools, allowing for the prediction of useful information on new software projects based on completed projects. For this, industrial practitioners and researchers require a higher-level view of data mining than (for example) how to build a Naive Bayes classifier, while also taking into account the specificities of software prediction tasks. Martin Shepperd's recent work demonstrates how much user expertise can influence the conclusions reached by a data miner. His work clearly demonstrates that even ostensibly skilled researchers can misuse these tools. As a result, it is time to take a closer and more in-depth look at these tools.The overarching goal of this paper is to list the requirements for better data mining by more skilled software engineers. [1,16,17,18,19,20]

The following list is a repetition of the abstract which are the essential questions should be answered: [1,16,17,18,19,20]

(1) Discusses the system tasks that must be completed before running data mining algorithms in an organization.

(2) How to adapt data from other organizational sources to local problems when there is a lack or scarcity of local data.

(3) How to privatize data while retaining our ability to mine it when privacy concerns prevent access to it.

(4) How to prune erroneous attributes and examples when working with poor-quality data.

(5) How to simplify data mining results when data or models appear to be overly complex.

(6) Case-based reasoning methods for forecasting when data is insufficient to support complex models.

(7) How to handle updates when the world changes and models must be updated.

(8) Introduces methods for reasoning across ensembles of models when the effect under investigation is too complex for a single model.

CHALLENGES OF SOFTWARE ENGINEERING

- ### Customer Experience

In order to get going, you should think about the following issues:[8,21]

- What information do you need to collect?
- Do you currently own that information or will you need to invest in additional tech to gain access to that info?
- If you do own the necessary data, is it integrated into a centralized location?
- Can you verify its accuracy?
- What channels will you need to gather data from?
- How will you route that information back to the development team?
- How will insights be used to improve the experience?
- How will you know if your efforts were a success?

- ### Data Privacy

Data privacy rules must be taken into consideration during the creation process rather than being an afterthought by organizations. Although this has always been crucial, the regulatory environment is getting increasingly complicated. Customers are beginning to pay close attention to how businesses use their information and make money from it at the same time.The difficulty is exacerbated by the regulations' constant change and severe penalties for non-compliance. [8,9,21]

California recently established stronger rules for how consumer data is handled, extending the protections outlined in the CCPA, and Europe's GDPR has been in effect for a few years. More states have laws moving through the pipeline, and Virginia recently passed its own legislation.[9,21]

- **Data Literacy**

In order to assess and take action on big data insights, businesses previously required to recruit data scientists with extensive expertise in SQL, R, Python, big data analysis, data extraction, and standardization. AI, ML, NLP, and other technologies are widely used in 2021. They're integrated into the business tools we use every day and are more readily available, more affordable, and generally easier to use.

While it's no longer necessary to be a data scientist to run a report, many businesses are still unsure of how to effectively deploy these tools and use AI-driven insights. A Harvard Business Review study found that participants' difficulties were caused by inadequate problem-solving abilities rather than a lack of technical knowledge.[8,9,21]

- **Big Data**

As the size of the datasets handled by software grows, it's past time for software to benefit from the intelligence extracted from large sets of information such as software source code, commits and forks, bugs, warnings and notifications, issues from backtracking systems, logs of any kind, commits, demographics, coding patterns, and so on.[8,9,21]

THINGS ARE CONCERNS TO ORGANIZATION

1) Understand your domain
    - Get the basic idea and requirement of the domain[2,3]
2) Pay heed to the experts
    - Actually listen and understand what expert advises[2]
3) Be skeptical of your data
    - Be sure of the data integrity and authenticity[2,4]
4) Select the Correct Data
    - Create Predictive and Optimizing Models
    - Obtain the required IT assistance[2,3,4]
5) Create Predictive and Optimizing Models
    - "What is the simplest model that would improve our performance?" should be repeated several times[2,4]
6) Capabilities must be transformed
    - Make applicable analytics that can be used
    - Integrate analytics into simple front-line tools[2,3,4]
7) Explore Various Data Sources
    - Source internal and external data in novel ways
    - Improve IT architecture and infrastructure to facilitate data merging[2,3,4]
8) Models for Prediction and Optimization
    - Concentrate on the most important performance drivers
    - Create models that strike a balance between complexity and usability[2,3]
9) Transformation of an Organization
    - Create simple, understandable tools for front-line workers
    - Improve processes and capabilities to enable tool use[2]
10) Data collection is cyclical[2,3,4]

ISSUES FOR DATA

1) How to deal with a lack or scarcity of local data: There are various methods for using cross data, within company data, and NN (nearest neighbor) filtering data as well as defect predictor. [4,5,6,10]
2) How can data be pruned in a more efficient and intelligent manner?
    - The most popular and effective method of data pruning is Feature selection[4,5]
3) How to advance simple CBR methods?
    - The California bearing ratio test (CBR test) is defined as the ratio of the test load to the standard load, expressed as a percentage for a given plunger penetration[7]
    - Different principles and methods to prune the data in simpler way[8,10]
4) How can you keep your data safe?
    - Various techniques to keep the data safe and secure[5]
5) Data Science employs the latest hardware, coding languages, and algorithms to address data-related issues. It is Software Engineering's foreseeable future. We can sum up what data science is all about as follows:[4,5,6,7,8,10]
    - Using the right inquiries and raw data analysis.
    - Modeling the data using a variety of sophisticated and effective algorithms.
    - Using data visualization to have a clearer understanding.
    - Understanding the facts to improve decisions and determining the outcome.

MODEL RELATED ISSUES

- SE model flaws: What flaws has the accumulation of decades of model introduction revealed? [11,12,13,14,15]
    - Inconsistency in effort
    - Inconsistency in defects
    - Inconsistency in process
- Solutions: Methods to handle instability of models [11,12,13,14,15]
    - Envy-based learning
    - Ensembles
- Static [11,12,13,14,15]
    - Temporal
    - GAC-based

CONCLUSIONS

The goal of this study was to examine the Symbiosis between Data Science and Software Engineering. It also provides a brief overview of how Data Science is essential to practically solve every issue, difficulty and advancement in Software Engineering. Large and diverse data sets that contain information about processes, products, and projects are produced during the development, operation, and maintenance of software systems. As the complexity of software systems and the processes used to create them grows, software engineers, development teams, and engineering managers must rely on data-driven decisions to solve problems that arise from system conception to system maintenance. Because of the volume and richness of the data available, techniques based on

machine learning and optimization are especially well suited in this situation and have numerous practical applications. Applications include requirement specification generation, automatic code documentation, cost estimation for software projects, software quality prediction, semi-automatic refactoring, requirement and defect prioritization, automatic bug assignment, and test case generation.

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Iot And Bluetooth-Based Wireless Irrigation Automation System With A Scheduling Mechanism.

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Abstract: The automated provision of sufficient water from a reservoir to fields or home crops during all agricultural seasons has been made possible by an automatic irrigation control system. Looking at ways to eliminate human management from irrigation while still maximizing water consumption is one of the goals of this effort. To determine if to assess whether irrigation is required and how much water the land needs, a method of continuous soil moisture monitoring is used. The required quantity of water is delivered to the soil by a pumping mechanism. A modest ac-operated motor was used to build the centrifugal self-priming water pump that makes up the pumping subsystem. The suggested design also includes the following features: The suggested design also includes elements that enable the system to be wireless with the aid of GSM. Mobile devices provide user control of the system from any location. GSM is used for global wireless communication. After transmitting the message via a mobile device, the motors automatically stop when the dirt exceeds the user-determined upper threshold value. The basic function of solenoid valves is to control the water flow. The solenoid valve is controlled by electrical current flowing through a valve. using a kit for an Arduino, the solenoid valve is controlled. Sand, Silt, organic and inorganic waste, as well as ordinary soil particles, may all be filtered out using screen filters. The project's main benefits are avoiding water waste, allowing scheduling for irrigation, allowing plants to flourish to their full capacity, and reducing the likelihood of mistakes because of lower labour costs.

Keywords: Solenoid Valves, Scheduling Irrigation, Self-priming pump, GSM Module, Wireless transmission, Soil Moisture Sensor, Temperature Sensor.

INTRODUCTION:

Irrigation is crucial for ensuring high-quality agricultural production and aids in a nation's economic growth. Agriculture is seen as one of the main sources of economic progress in various nations. The development of agriculture directly affects the income of many nations. One of the most important tasks in agriculture is irrigation. Watering the crops according to their needs is crucial. Crops can be harmed by either little irrigation or excessive watering. A farmer cannot determine the soil's moisture content with the current irrigation system. Testing the soil's condition before delivering water to the agricultural field is a novel approach to conserving every drop of water. Therefore, it is possible that the watering required is sometimes greater than what the crop needs, and that water occasionally does not reach the roots of the plants. Both water and labour will be wasted in this. The development and profitability of the plant will be directly impacted if water cannot reach the roots of the plant. The conventional irrigation system needs labour. It is therefore vital to take action to improve the convenience of irrigation. To automate the traditional irrigation system, the Automatic Drip Irrigation System project was developed. It is a simple system that automates irrigation and crop watering using Arduino. Utilizing a solenoid valve that is powered by an electric source increases the system's flexibility.

There are further techniques that are based on climatic data and use a smart controller to plan irrigation water as well as irrigation being a real-time application. Use the next technique to irrigate using these strategies..

- Internet based Monitoring utilising Servers, GPRS modems, etc. with different approaches.
- GSM-SMS protocols using GSM module individually or in combination with Internet Technologies.
- Monitoring using Wireless Sensor Networks.

- Wireless sensor network with irrigation valve control.
- Wireless Monitoring using Bluetooth, Wi-Fi, Zigbee and RF.
- The range of applications has been enormous, including biomedical applications, agriculture, environment, reservoirs, bridge health monitoring, etc.

BASIC METHODOLOGY:

The essential components of this system are an ESP32TTGO Circuit Board, a GSM module, a solenoid valve, a soil moisture and Temperature sensor, a filter, and a pump. The ESP32TTGO in the proposed system is specifically configured to monitor any changes in sensor parameters, hence reducing the human component. In our system, when we press the number 1 on our smartphone, the Inbuilt GSM sends a signal to the ESP32TTGO, which then turns the motor on following the software stored in the ESP32TTGO kit. Additionally, when the engine is turned on, water will start to flow down the pipeline and into the plot, which we'll call 1. The proposed system consists of two distinct agricultural plots, each of which has a unique electrical kit that includes an ESP32TTGO Circuit Board, and a sensor. We will install a soil moisture sensor in plot 1 to measure the amount of moisture in the soil. When the soil's capacity to absorb water has been reached, the sensor will send a signal to the Arduino to turn off the valve, and the ESP32TTGO Circuit Board will then use the associated inbuilt GSM module to relay the signal back to the smartphone. The soil moisture in this system has a sensor with a set threshold value that will if the value entered associated with ESP32TTGO is accurate. the motor will remain as-is if the threshold value is less than that. updating the user via the inbuilt GSM module and if the real value is higher than the predetermined value threshold value, it will also send the user a message. using inbuilt GSM. As plot 1's ability to absorb water increases To complete, we must simultaneously turn on valve #2. Using a smartphone, we must deactivate valve 1. Once more, the identical sensor is present in plot number 2. In this manner, the user will be operated as plot number 1. With a smartphone, this method from anywhere. The suggested system would employ the screen filter to remove sand, Silt, and other small soil particles, as well as organic and inorganic trash.

LITERATURE REVIEW:

Temperature and soil moisture sensors are used in this research. in the plant's root zone, and the gateway unit controls the sensor data to a web application, as well as transfer information. One algorithm was created to determine the threshold values of sensors for both soil moisture and temperature encoded into a microprocessor to regulate the amount of water. Photovoltaic panels were utilized for power. Another relevant fact An Internet-cellular interface was utilized to see the data. and web-based programming for the irrigation scheduling page.

By **Kyada P.M**. in 2001. A study on the Relationship Between Pressure, Discharge, and Wetting patterns in a Drip Irrigation System is being proposed. It was evident that when operating pressure increased, the discharge from various drippers of all ratings increased. For a 20 lph dripper rating, the co-efficient of manufacturing variations was at a minimum of 0.86% and reached a maximum of 7.95% for a 2 lph dripper rating. Water may be applied using two lph drippers for 1, 2, 3, 4, and 5 hours, respectively, to produce wetted bulbs with maximum radii of 21 cm, 27 cm, 36 cm, 41 cm, 52 cm, and 55 cm.

The selection of irrigation methods for agriculture: drip/micro irrigation was proposed by **C.M. Burt** in 2005. Drip/Micro irrigation refers to several irrigation techniques that use emitters to provide water directly to tiny regions. The emission devices are placed close enough together for each plant's root zone to receive water through soil capillary action. Chemigation is frequently required to prevent obstruction brought on by bacterial growth and/or chemical precipitation in the laterals and emission devices.. Although labour costs are reduced by the use of drip irrigation systems, capital costs are significant.

Venturi metres built using pipe fittings were proposed as an underutilised option for measuring agricultural water in 2011 by **Tom Gill**. For a variety of applications, venturi metres made of pipe fittings can be a useful way to measure flow with dependable precision. Most of the time, there is very little actual head loss through a venture metre. It is commonly acknowledged that pipe venturi metres are a measuring device in piped systems that offers a high level of accuracy while incurring a very modest head loss.

The automated water level control system was created by **Mukthaet** al. (2013) to turn off the tank's engine in a home. With the use of a block diagram, the automation of pumps has been covered in this work. "Wireless Automatic Water Level Control System" is the name of the proposed system. It is made up of a level sensor and a metal strip that conducts electricity, and it operates on the idea that water has the ability to conduct electricity. This kind of machinery lessens the burdensomeness and the waste of water resources to some amount. Only one concept for household tank water monitoring has been suggested and examined in this work. There hasn't been a presentation of the real construction of an autonomous system with electronic circuits that is applicable to its application in agriculture.

T. Veeramani Kandasamy proposed a remote monitoring and closed-loop control solution for agricultural systems based on GSM and Zigbee in 2014. GSM was employed in this system for wireless communication and modernization. GSM allows users to control the system from any location. For connecting the GSM module and microcontroller, they utilised RS232. For improved wireless data transfer in this system, the irrigation control centre uses Zigbee technology. The key benefits of this technique include the ability to conserve manpower and the 20% and 30% reductions in water and electricity usage compared to the conventional approach. Zigbee technology has a restricted wireless data transmission range, making it impossible for users to use this system across large distances.

For an efficient water management system, **Jagtap and Shelke** (2014) describe automated irrigation based on WSN and GSM. With the help of this device, farmers can monitor and operate their irrigation systems from a distance. The ZigBee module is used to facilitate communication between the soil moisture sensor and controller. The motor and valves were controlled remotely by an Android smartphone via SMS commands. To connect with the Android phone, a GSM module has been interfaced with the controller. If the soil moisture falls below a predetermined level, the motor will turn on, and vice versa.

Professor **R.R. Jadhav** proposals for three-phase motor control via GSM was made in 2015. The technology guarantees that the motor is protected from overloads, overheating, and phase imbalances. If normal circumstances are restored, it also offers automated restarting. Due to the system's remote control via cell phone capabilities and alerts for any abnormal circumstances, farmers whose pump sets are located far from their houses find it to be a tremendous help.

An approach for creating a smart environment to track the irrigation parameter over the entire field was addressed by **Angel and Asha** (2015). Crop field monitored using a variety of nearby sensors to gauge soil moisture and temperature. The proposed system discusses the entire field, which is covered with sensor nodes, including soil moisture sensors, humidity sensors, soil pH sensors, controller nodes, solar panels, irrigation sprinklers, and control valves. The system will decide to open the valves if the moisture value and humidity value are below the predefined threshold.

The Automatic Irrigation System, created by **Geoffrey** et al. (2015), pumps 240 liters of water each day from a depth of roughly 8 metres for a small area. The water level in the tank is detected using an IR sensor in this system. According to the explanation in the paper, when an IR transmitter emits a light beam to an IR receiver, this indicates that there is nothing in their path. When the water level rises, it creates a barrier between the IR transmitter and receiver, lowering the input pin of the microcontroller and lowering its output. To determine the irrigation, they have put soil moisture sensors in the field.

Gulhane (2015) investigated the design and implementation of a multi-tank monitoring system for autonomous water level control and monitoring using low-power ZigBee wireless communication technology. There are two microcontrollers: one at the motor pump and one at the tank. The transmitter module at the specific tank is linked to the valve there, but communication between that transmitter and the reception module is wireless. If the controller finds that the tank is empty, it opens the valve that supplies water to the tank and sends a signal to the receiver module to start the motor. This automatic tank water monitoring system is designed for use in both residential and commercial settings.

Kavitha (2015) created a microcontroller-programmed algorithm with temperature and soil moisture threshold values. In the root zones of the plants, a dispersed wireless network of soil moisture and temperature sensors has been installed. A soil-moisture probe, a temperature probe, and a microprocessor for data gathering were all linked to each sensor node. When the temperature and soil moisture thresholds are met, the microcontroller allows watering to be automated. When the water level drops below 50%, the PIC notifies the phone that "Water level low" is the current state, stops the timer, and turns the LED off. The author created a programmable irrigation control system utilising Li-Fi, which primarily consists of wireless sensor networks and a monitoring centre. Li-Fi employs LED light sources to transfer data wirelessly.

The prototype automatic plant watering system was created and developed by **Archana and Priya** in 2016 using a soil moisture sensor. This paper discusses an Arduino-based device that regulates the water flow to plants and the irrigation area. In their project, they employed an Atmega328p microprocessor. The plant's soil moisture sensors won't start working until there is water on the plant field. When a plant becomes dry, soil moisture sensors detect the amount of dryness and watering is initiated. For testing purposes, a single plant in a pot was used. It was merely a concept, tested on one unit, using a prototype.

In their 2016 publication, **Chate and Rana** described a smart irrigation system for farms utilising Raspberry Pi. For the sake of automation, they employed the Python programming language. The technology includes an automated motor ON/OFF mechanism and lives crop broadcasting via Android smartphones. With this technology, Wi-Fi live crop photos may be captured. The moisture sensor was utilised to gauge the soil's moisture level. To measure the amount of moisture in the soil, copper electrodes were employed. The three-phase induction motor will switch off if the soil moisture level exceeds a specified threshold. Additionally, the relay will turn on the motor if the moisture level falls below a certain threshold. LDR sensor was utilised to regulate lighting at night. The light will turn on automatically so that we may use a mobile phone to view our farm at night.

Date (2016) interfaced the microcontroller with a variety of sensors, including temperature, soil moisture, light sensor, and water level sensor. The automated watering system has been suggested in this research. When the soil moisture sensor detects a dry situation, the relay is turned ON and the water pump is subsequently started automatically. In the suggested system, ZiggBee Module has been employed for communication.

Francis (2016) displayed a system that included sensors, a motor, a relay, an ARM microprocessor, and a GSM module. The irrigation system is based on the monitoring of soil moisture. The relay, which manages the motor's functioning, is turned on by the microcontroller. Based on the information provided by the microcontroller, the motor pumps water into the soil. When the sensor detects a very low moisture level, the motor starts. When the soil moisture level drops, GSM was utilised for communication to inform the farmer by sending the current moisture and temperature levels.

A robotic system created by **Jadhav and Hambarde** (2016) uses data from temperature and soil moisture sensors to autonomously adjust the water flow to plants. It carries a camera and uses information from plant image processing to apply fertiliser. They have put their theory to the test in the lab on a modest scale for this publication. They haven't created a fully functional system for the agricultural sector. It is a moving device with a mechanism that inserts electrodes for soil moisture sensors into the soil to monitor the moisture content. Based on readings from sensors measuring soil moisture and temperature, irrigation is administered through the pump.

In 2017, Ateeq Ur Rehman suggested a GSM-based solar autonomous watering system using moisture, temperature, and humidity sensors. This uses the YL69 soil moisture sensor. It detects the soil's moisture content. Soil moisture is essential for controlling the exchange of water and heat energy between the land surface and the atmosphere through the evaporation of plant transpiration. The main advantage of this system is that it conserves energy and water, making it more economically advantageous. With the use of the soil moisture sensor YL69, a user may quickly determine the soil's ability to absorb water. Cost is the primary determinant of any system, hence the downside of solar is that farmers cannot afford it due to its high cost.

Kriti Taneja proposed an Arduino UNO-based automatic irrigation system in 2017. In this method, a soil moisture sensor is utilised to measure the soil's moisture content or water-sucking ability. Water level sensors were also utilised. For the purpose of displaying the soil moisture content and tank water level, an LCD is linked to an Arduino board and the whole sensor. The major benefits of this technology are that it helps with irrigation in low-water locations and promotes sustainability. This system requires little upkeep, is extremely unstable, and may be easily modified to accommodate different kinds of crops. In addition to lowering costs, this effort contributes to the preservation of water, a necessity for life. This system's limitation to home farming prevents users from using it at higher levels of agriculture, which is a drawback.

Irrigation Management System with Micro-controller Application Proposed by **Prateek Jain** in 2017. To reduce labour costs and maximize water resource usage in agricultural applications, the suggested system is based on micro-controller-based automation. Functional parts like a moisture sensor and a motor load make up the system, which is built on the Arduino platform. A moisture sensor measures the soil's humidity level. The specified range of soil temperature and moisture is established specifically for the needs of individual plants, and the system is run by that range. The system does not provide the field's current state.

R. Nandhini proposed an Arduino-based IOT-based smart irrigation system in 2017. This smart irrigation system's major goal is to improve upon the present system by being more creative, user-friendly, time-saving, and effective. The pump will be linked to the driver circuit, which aids in switching the voltage, if the measured value exceeds the threshold values established in the program. The GSM module will inform the farmer of the present state of the field. The farmer may use this method to get information regarding the state of the field whenever and wherever they are. Plot count is not calculated using the system.

CONCLUSION:

Agriculture uses electronics in a variety of ways to conserve input resources and cut back on labour. Since the invention of electronics, we have been able to utilise a variety of automated and control systems to accurately apply fertiliser and water, which has enhanced agricultural output and reduced resource use. With little to no human involvement, the automatic watering system is used when it is necessary. For farmers, a necessary answer is provided by sensor-based automated irrigation systems.

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Removal Efficiency of Chromium Contamination using Peanut Shell Ash in Geosynthetic Clay Liner

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Abstract. Heavy metal contamination is a significant threat to human health. One of the causes for soil and ground water contamination is municipal solid waste dump sites. Leachate is the liquid produced by anaerobic decomposition solid waste in landfills. This leachate comprises of organic, inorganic and heavy metals. Ground and surface water contamination due to leachatedisposal is the major concern in the developing countries. Total chromium (TCr) is one of the carcinogenic heavy metals. In this study, leachate sample was collected and tested for its physical composition. The concentration of TCr in the sample was found as 0.178 mg/l. An attempt is made to reduce the TCr concentration in the sample by using modified geosynthetic clay liner (GCL). The modified GCL was developed by adding peanut shell ash (PSA) with encapsulated sodium bentonite (Na-B). The objective of this study is to determine the optimum proportion of PSA to reduce the Cr contamination in leachate generated from municipal solid waste dump site. The PSA was added by 5%, 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45%, 50% with Na-B. The experimental results reveal that TCr contamination was at the lowest level in leachate when 40 % of peanut shell ash was added in GCL.

KEY WORDS

Chromium, Contamination, Geosynthetic clay liner, Leachate, and Peanut shell ash.

INTRODUCTION

The explosive growth of municipal solid waste is especially worrying for everyone in the world. The average amount of waste produced daily per person worldwide is 0.74 kg, however individual country waste output rates can range from 0.14 to 4.54 kg (Dixit et al., 2022). Unregulated and non-engineered waste disposal is one of the leading causes of ground water contamination, air pollution, and land pollutions, posing health risks to humans, organisms, and ecosystems (Dixit & Srivastava, 2015). In many nations, a substantial rise is observed inboth municipal and industrial solid waste output along with improved standards of existing andsustained industrial and commercial development (Renou et al., 2008).

The largest amount of waste produced daily in Kanpur is 1500 tonnes. Every year Kanpur municipal corporation has 48% of its total budget on solid waste management (Dixit et al., 2022; Singh & Francis, 2017).

Leachate is a type of polluted liquid that can be generated through decomposition of organic solid waste, collecting impurities, and spreading into beneath areas. Massive amounts of organic matter may be present in leachates. The fundamental parameters COD, BOD, the ratio BOD/COD, pH, suspended solids (SS), ammonium nitrogen (NH_3-N), total Kjeldahl nitrogen (TKN), and heavy metals can typically be used to indicate the properties of leachate (Renou et al., 2008). The leachate contains heavy metals like Chromium, Nickle, Copper, Zinc, Cadmium, Lead etc. Leachate migrating from landfills poses a significant risk to groundwater resources (Maiti et al., 2016). In some cases, identifying the exact nature of groundwater contaminant sources may be impossible (Datta & Singh, 2014). Groundwater is particularly vulnerable in areas with a high population density (Singh & Datta, 2021; Zahra etal., 2021). Some common causes of groundwater pollution, such as unauthorized and uncontrolled contaminant injection into the aquifer, may also pollute groundwater (Datta & Singh, 2014).

Heavy metals are metallic chemical elements that are hazardous or toxic even at low concentrations and also have a comparatively high density. Assessing health risks is the method of recognizing potential risks to human health associated with environmental exposures. Lung, liver, bladder, and kidney cancer may result from prolonged exposure to TCr. It also caused skin damages and respiratory disease. The chemical compound Cr is mutagenic, genotoxic, and carcinogenic in its hexavalent form (Dixit & Roy, 2016).

In recent decades, the accumulation of heavy metals has elevated a massive environmental risk on a global scale. TCr, a substance that damages the environment on a massive scale and is increasingly understood to be neurotoxic, enhances the risk for several cancers. The removal of hazardous metals from contaminated environments depends heavily on a variety of plants and microbes. The person consumes TCr and its metabolites, especially chromates. Ingestion, skin absorption, and inhalation are the three main ways that people have been exposed to TCr (Dixit et al., 2016; Sharma & Kumar, 2021)

In waste containment applications, geosynthetic clay liners (GCLs) are effective barrier materials for lining and covering systems (Scalia et al., 2018). Due to its low hydraulic conductivity, which helps to stop contamination leaching into groundwater, and ease of installation, geosynthetic clay liners (GCLs) are being used frequently in landfill disposal facilities (Yu et al., 2021, De Camillis et al., 2016; Kong et al., 2017; Ozhan, 2018; Sari and Chai, 2013; Xie et al., 2018). The GCLs are created as hydraulic barriers, consisting of two geotextile fabrics and a layer of bentonite (Yu et al., 2021). Numerous research have examined how penetration with leachate from municipal solid waste landfills affects the hydraulic performance of GCLs (Wang et al., 2019).

MATERIALS & METHOD

Site selection

The research area Kanpur is India's 11th most densely populated city, bordered on the north by the Ganga River and on the south by the Pandu River (Yamuna). The city is located betweenthe longitudes of 79°31′ and 80°34′ east and the latitudes of 25°26′ and 26°58′ north (Dixit et al., 2022). The highest and lowest recorded temperatures are 33.3 °C and 3.7 °C respectively.The average rainfall is 820 mm, the average relative humidity is 78.13%, and the wind speed is 0.936 km/h (Mishra et al., 2021). The leachate sample was collected from municipal solidwaste dumping site (26º27'12"N, 80º14'19" E) (Fig.1).

Fig.1 Leachate generation at municipal solid waste dump site, Kanpur.

Psa

Peanut shells were collected from small shops and the domestic waste disposal area. The shellsthat have been collected were cut into small pieces. The PSA was produced through pyrolysiswith a controlled oxygen supply. The method is used as recommended by Murad et al., 2022.

Gcl

The procured GCLs is made of needle-punched granular sodium bentonite sandwiched between a woven (carrier) and non-woven (Fig.2a). The woven geotextile with a density of 125 g/m^2 and a non-woven (cover) geotextile with a density of 200 g/m^2 is used in the study. The initial thicknesses of GCL is 6 mm. The peanut shell ash used in this study presented in Fig.2b.

Fig.2a Procured GCL sample

Fig.2b PSA sample

Experimental setup using psa

The heavy metals, including Iron, Nickel, Zinc, Chromium, Arsenic, Cadmium, and Lead, were found in leachate. These toxic metals are extremely hazardous for human health. The GCL specimens of size 8x8 cm were cut from GCL rolled sheet. Modified GCL specimens were developed by adding PSA with Na-B in GCL at room temperature (27°- 30°). The proportions addition of PSA with Na-B was 0%, 5%, 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45%, 50%. The synthetic leachate wasprepared by adding 0.178 mg/l TCr contamination in distilled water.

RESULT AND DISCUSSION

The experimental results show (Fig.3) that the Total Chromium (TCr) concentration in the effluent synthetic leachate from GCL (Geosynthetic Clay Liners) was lowest at 40 % PSA (Peanut Shell Ash).

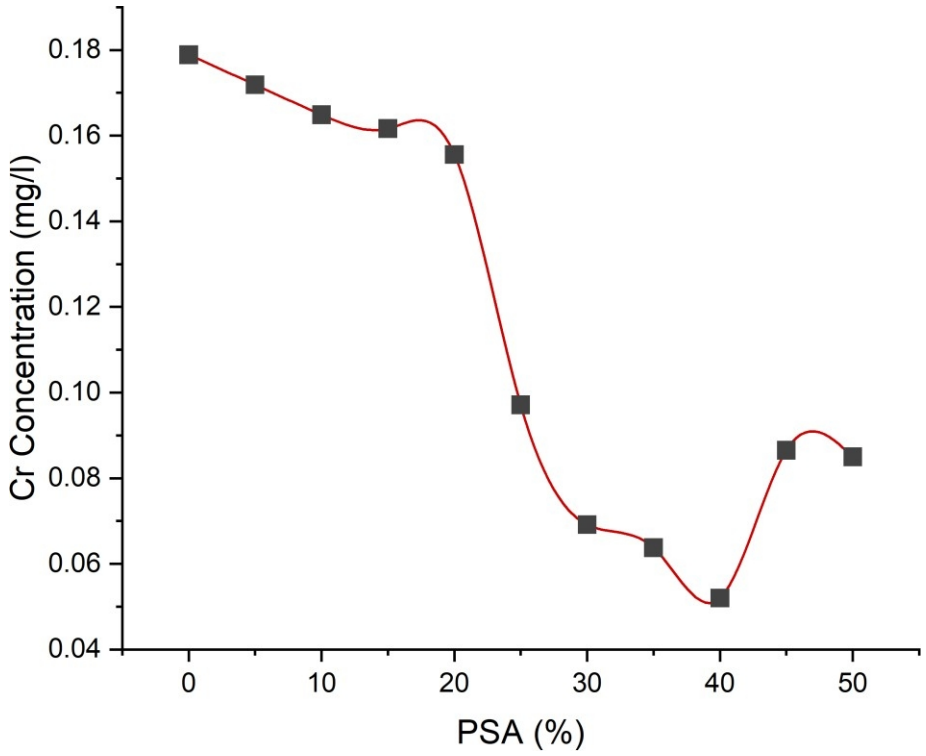

Fig.3. Variation in TCr concentration with % PSA capsulated in GCL.

From Fig.3, it is clear that the concentration of TCr in synthetic leachate reduced upto 0.0520 mg/l and was found lowest among all effluents obtained from GCL. This shows that the absorption capacity of PSA against TCr is maximum at 40 % of Na-B addition in GCL.

CONCLUSION

Based on the finding of the study, it can be concluded that peanut shell ash is an organic wasteby-product and available with low or no cost and it can be utilized as better absorbent for total chromium contaminated leachate. The application of PSA with GCL improves the reduction capacity of TCr concentration at 40% addition proportion. So, it is recommended that PSA can also be used in GCL at the locations where leachate is contaminated by high concentration of TCr. In case of failure the self-healing property of GCL blended with PSA will reduce the chances of ground water contamination with TCr.

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BigQuery: Big Data Storage and Analytics at Scale in Cloud Computing

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Abstract: The IT sector is concerned about Big Data and Cloud Computing, two extensively utilised technologies. A huge amount of information is collected daily from many sources. Traditional processing tools cannot handle this data since it is so large. In addition to being large, this data is also dynamic and diverse. It focuses on providing the technology that makes such operations feasible while saving time and money. Many industries are striving to leverage the potential of big data, including small and major businesses, healthcare, education, and others. Big Data is used in the healthcare sector, for example, to reduce treatment costs, anticipate the onset of pandemics, prevent sickness, etc. We start out by giving a brief overview of big data, the amount of data produced every day, and its characteristics. The subject of big data analytics follows, where we go through things like the analytics process, analytics benefits, and how big data analytics on the cloud caused a paradigm change from the ETL to the ELT. We pick Google's Big Query as a case study since it is a highly scalable, cloud hosting database server that enables scalable processing over petabytes of data. Querying with ANSI SQL is possible using Platform as a Service (PaaS). We do a number of tests using the software on different dataset sizes, including average reading, average computation, and average writing.

Keyword: Big Data, Analytics, Cloud Computing, BigQuery

INTRODUCTION

The age of data is now. We now see them everywhere because of the enormous technological breakthroughs that have taken place recently. Digital information societies are currently being discussed appropriately since the rate of digitization has substantially grown. It originates from a broad range of sources, including our cellphones, data centers, sensing devices connected to the Internet of Things, media platforms, etc.

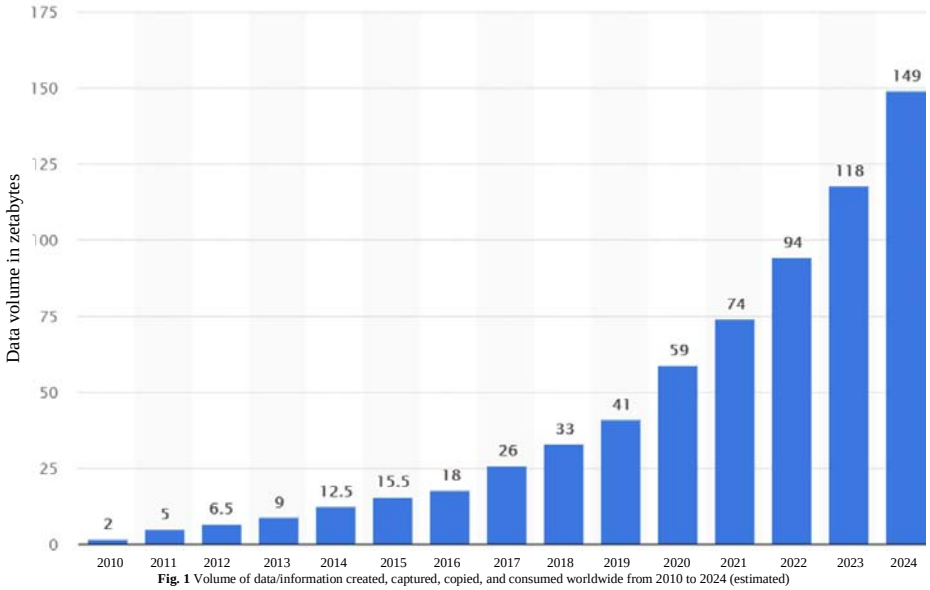

Fig. 1 Volume of data/information created, captured, copied, and consumed worldwide from 2010 to 2024 (estimated)

To get a feel of the amount of data collected everyday, let's take a look at some of the data produced by those various platforms. We have access to a wealth of knowledge via the Internet. Every time we use our search engines

to look for information, we add to the stockpile. More than 500,000 searches are currently made on Google every second, making 3.5 billion queries every day. This number must have changed after this post was written! On the other side, social media generates a tonne of data. Users send 456,000 messages to Twitter, view 4,146,6000 videos on YouTube, share 527,760 photographs on Snapchat, and upload 46,740 photos to Instagram per minute. Facebook is still the most popular social networking platform, with more than 1.3 billion images shared daily, more than 22 million opinions left, and 3.2 million status changes made each minute. There are benefits and challenges associated with the growth in the number and volume of data, as traditional methods for handling relational databases and other data have trouble processing and analysing this volume. For all of these uses, processing of data, analysis, and storage have been made simpler by cloud computing.

PURPOSE OF STUDY:

The main goal of this study is to explain why big data analytics are performed using cloud technologies. That we can perform using Google's Big Query platform, a machine learning-enabled serverless data warehouse. This is quite effective and offers a tonne of tools to aid in the insights of various quantities & types of information.

What Is Big Data?

The term "Big Data" has been attempted to be defined by a number of authors and organizations. According to, "Big Data describes information quantities in the exabyte and beyond range." "Big data" refers to a set of databases that are so huge and intricate that utilising database management software or traditional data processing technologies, they are hard to analyse. Data collection, storing, searching, exchange, transmission, evaluation, and visualizations are among the processes' problems. Data that is petabyte-scale and comes from several resources is considered to be "too large". Big data has other meanings as well, but we think these are adequate to give you an understanding of what it implies.

Features and Characteristics Of Big Data

Scholars have struggled to provide an answer to the topic of what may be referred to as "big data." The three traits that does indeed exist for the data to be referred to as "big data" are volume, velocity, and diversity, says industry expert Doug Laney from Gartner. Volume, a quality or attribute that is often represented in Terabytes or Petabytes, determines the amount of data. Social media platforms like Facebook, for instance, store user images alongside other content. Due to its enormous user base, Facebook is estimated to have over 1.2 trillion photographs and more than 1.5 billion postings from its users. There is a huge amount of information that has to be processed and saved. The amount of "big data" is its main distinguishing feature. The meanings of each of the three Vs are shown in Figure 2.

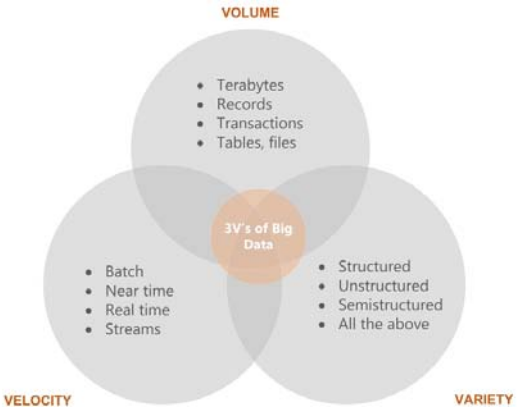

Fig. 2 3V's of Big Data

Velocity is the second quality or feature. This is a term to the amount of data produced or the rate where that needs to be analysed to make a determination. As instance, Facebookers upload about 1.1 billion pictures

daily, or 104 pictures per second. In order to present this information to users in real time, Facebook will then need to analyse, preserve, and extract it. The data in Figure 3 shows how quickly data is produced across various sources.

Processing of data comes in two flavours: batches and streaming. Large chunks of data that have been saved over time are handled via batch processing. Processing large amounts of information will frequently take far time. The ideal framework for batch data acquisition is Hadoop MapReduce. That approach is effective if it is necessary to analyse vast amounts of data but not when genuine analytics are required. On the other hand, actual data processing & analyze greatly benefit from stream processing. Data can be processed as it comes in thanks to stream processing. The findings are created instantly because this data is supplied right away into the analytics software. A number of circumstances, including real-time fraud detection, which searches for abnormalities that suggest fraud, might benefit from such an approach. Another use for real-time processing would be in online stores, where it would enable them to compile vast histories of engaging customers and real-time recommend new investments to customers.

The third characteristic is variety, which relates to diverse data kinds that are generated from various sources. The three primary categories into which "Big Data" is commonly separated are structured data (transaction - oriented data, spreadsheets, sql data, etc.), semi-structured data (Based On Xml, web application logs, etc.), and unstructured data (social-media posts, audios, image, videos etc.). Now 4th type in the research is known as meta-data, or information about information. This is also seen in Fig. 4. Currently, unstructured data account for 80% of all data.

ANALYTICS OF BIG DATA IN CLOUD COMPUTING

In order to provide flexible resources, speed up innovation, and achieve economies of scale, cloud computing is the delivery of computing services such as hosts, data stores , communication, applications, statistics, etc. through the Internet. Utilizing the cloud it has changed how computer infrastructure is used and abstracted. Cloud concepts now cover everything that may be considered a service. The flexibility, earn or remuneration business model, minimal initial investment, and other benefits of cloud computing has make this an appealing and useful choice for big data analysis and management.

Fig. 4 Main categories of data variety in Big Data

Many organisations and sectors already view big data as critical, therefore service providers like Amazon, Google, and Microsoft are already providing their respective big data platforms at competitive prices. These solutions may be scaled to fit enterprises of all sizes. As a result, the phrase Analytical as a Service (AaaS) has become more well-known as a quicker and more effective way to connect, convert, and visualise various kinds of data analytic.

Process of Big Data Analytics

Within most configurations, modeling design & database design are developed following data analysis. Figure 5 depicts the procedure for big data analysis. It starts with gathering data from numerous systems, files, senses, as well as the Web, as may be shown. Then, this data is stored in a system known as the "launch site," which has the capacity to handle the volume, variety, & speed of input.

Paradigm Shift from ETL to ELT

The process of extracting information from a source, applying any required modifications, and then loading that into a warehouses so that it can be utilised in reporting and query is known as ETL (Extract, Transform, Load). This paradigm or approach has the drawback of requiring a lot of I/O activities, string parsing, variables updating, and data processing.

Extraction, Loading, and Transforming, or ELT, is the process of moving the most computationally intensive activity—transformation—to the cloud as opposed to an on-premises service that is already under strain from performing daily transactions. Because data warehousing solutions are utilised for a kinds of data, including structure, semi-structure, unstructured, & raw information a, there is no requirement for data staging. The notion of "data lakes," which differ from OLAP data stores in that it don't require data transformation prior to loading, is utilised in this technique. The contrasts between the two paradigms are depicted in Figure 6. As can be seen, the primary distinction is the location of the transformation process.

ELT is superior to the conventional ETL paradigm in many ways. The ability to immediately consume data in any format is the most important, as was already mentioned. Another is the restriction on data transformation to that which is necessary for analysis. The whole ETL pipeline as well as the OLAP data structure may need to be changed if the previous design doesn't really enable new kinds analyses. According to some benefits of big data analytic, businesses across a range of industries are utilising big data to support informed choices. Along with the technology industry, big data is also used and well-liked in the medical, administration, commerce, logistics management, and universities. Big Data analytics offers several advantages, some of which are listed in:

• Information gathering from a range of sources, such as the Internet, e-commerce sites, social networks, datasets, outside 3rd sources, etc.

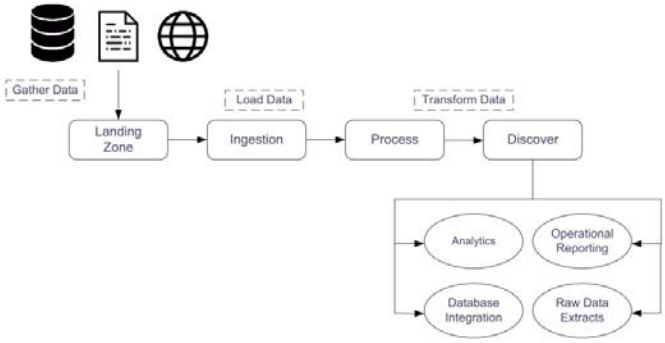

Fig. 5 Flow in the processing of Big Data

Locating important information that is concealed inside massive datasets to affect business choices.

• Real-time detection of problems with systems and business procedures.

• Enabling the delivery of services or goods in a way that satisfies the customer expectations.

• Instantaneous resolution of client complaints, questions, and requests.

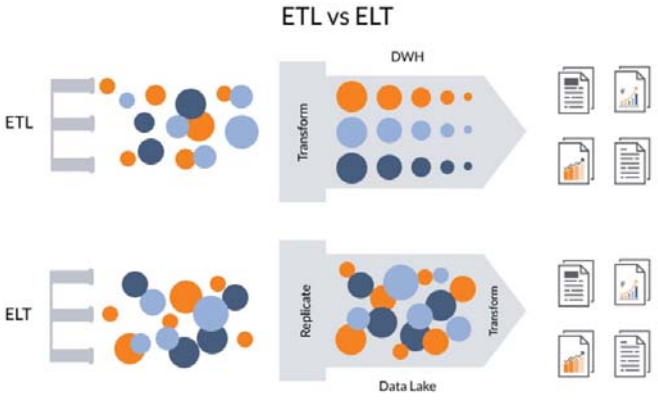

Fig. 6 Differences between ETL and ELT

Other Advantages are

Cost savings - Due to the processing, storing, and analysis of massive volumes of data, one of the main benefits of Big Data technologies like Hadoop or Sparks is allow enterprises to save money**.** The findings demonstrated how cost reductions from Big Data may be achieved using the logistics sector as a case study. The cost of product returns in this industry is two and a half times higher than the actual cost of delivery. Companies may cut costs connected with returned products by preparing for returned goods. The firms may then take the appropriate actions to reduce losses from returning by identifying which products are most likely to be retrieved.

Increases in efficiency - Big Data might greatly improve effectiveness. Big data technology may amass a significant amount of useful consumer data by communicating with clients and soliciting their feedback. The underlying significant trends in this data, such as customer taste and preference, purchase behaviours, etc., may then be analysed and understood. This in turn makes it possible for firms to create specialised or customised goods and service.

Innovation - Big Data insights may be utilised to adjust corporate plans, create new goods and services, boost productivity, and more. All of these may encourage more innovation.

BIGQUERY FOR ANALYTICS AND DATA PROCESSING AT GOOGLE

On the Google Cloud Platform, a variety of big data processing and analysis services are offered. This article has described and analysed the architecture of Big Query, of the GCP's most popular big data processing tools. Big Query is standard processing over enormous volumes of data and is a fully managed cloud hosting data warehouse.

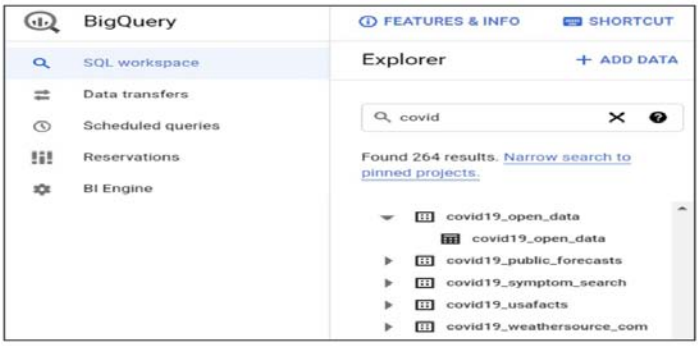

Fig. 7 BigQuery Interface

The Platform as a Service makes ANSI SQL query easier. Additionally, it has incorporated machine learning capabilities. It has gained enormous popularity ever since release in 2011, and several important firms have adopted it for their data analytics. Big Query offers an easy-to-use user interface that may be accessible in a variety of ways based on the user's requirements. Fig. 7's graphical online interface is the most user-friendly method of interacting with this application. Using cloud console or Big query APIs are two little more challenging but quicker methods. From Fig. 7, the Big query web interface gives you the choice of adding new datasets or selecting ones that already exist, scheduling and building searches, or transferring data and displaying results.

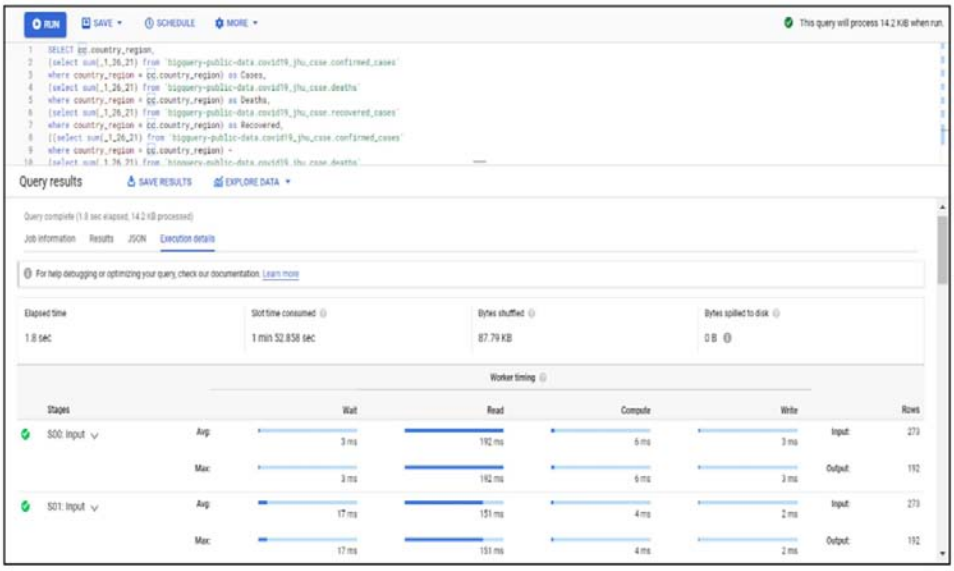

Fig. 8 BigQuery execution details

Big query works with sql datasets with clearly formed, containing table with particular columns and type, and offers a comprehensive SQL-like vocabulary for calculate & analyse big data set. The execution details of a simple query construction syntax are shown in Figure 8. The details shown below the query results include a list of the key performance indicators for the executed query, starting with the time taken, the volume of data handled, and the maximum and average wait, writing, and calculate time. The report deaths, and recovery from much more than 190 nations between 2021 and 2020 are covered by the three different datasets combined in the query presented in Fig. 8. Because Google Big Query offers flexible, you may quickly and easily utilise and combine various datasets depending on your objectives. A wide variety of public datasets are available to you, and you may create, modify, and import your own.

Elapsed Time (s)	Slot Time Consumed (s)	Average Read (ms)	Average Compute (s)	Average Write (ms)	Number Of Rows	Size Of The Dataset
0.3	0.043	22	1.048	2	61,900	0.0175 GB
72	828.547	355	2.3	28,599	41,340	1.2 GB
3.3	3.663	945	4.6	109	1,00,000	2.3 GB
2.1	2.424	118	6.7	77	30,646	2.9 GB
1.6	1.506	237	18.9	145	1,00,000	3.6 GB

Table 1 BigQuery performance tests

CONCLUSION

Big Data isn't a novel invention, however it has lately gained attention from the general public owing to the enormous vast volume of data that are generated each day from several source. This research showed how big data is expanding swiftly, offering advantages and also challenges. The ideal method for processing, storing, and analysing big data is cloud computing. Big Data management is made easier by the public services provided by businesses like Amazon, Google, and Microsoft. We learned through the investigation that big data analytics has several advantages for a variety of industries, such commerce, academia, and medical. Researcher have observed that the handling between big data and cloud computing has changed how data is handled and analysed. ETL is utilised in conventional settings, whereas ELT is employed in big data environments. As we saw, the latter offers

definite benefits over the former. Our case study taught us that Big Query is best at solving complex analytical problems, thus there is no benefit in action that just collect or filter data.

Heavy queries, or those that act on large sets of data, are appropriate for Big Query. The dataset's performance is more likely to improve the larger it gets. In contrast to conventional relational databases, Big Query uses a variety of parallel schemas to speed up processing. BigQuery dislikes joins, and combining data into a single table speeds up processing. Due to its built-in cache, it is suitable for situations where data does not change frequently. Big Query offers a variety of choices and configurations to enhance query performance, therefore it may also be used to lessen the stress on relational databases.

AKNOWLEDGMENTS

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Experimental Investigation of Effect of Combined Nano-Silica and Nano-Alumina on Compressive Strength of Concrete

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Abstract: In this modern era, urbanization growth becomes very fast and also increases the development of the infrastructure. So, the use of concrete is increasing day by day. All the activity related to concrete shows a huge negative impact on the environment. Therefore, it is required to reduce the negative impact and for that, as per today's requirement, we also need to improve the property of concrete. Nowadays attention towards nano-materials is more for their characteristics to improve the properties of normal concrete. So for that, the comprehensive program is taken up to study the nano-materials in concrete. In this, two nano-materials (nS- nano silica and nA-nano alumina) were used to improve the mechanical properties of concrete.

Keywords: special concrete, nano silica, nano alumina, mechanical properties.

INTRODUCTION

Concrete is the most widely used construction material all over the world because of its strength, durability and structural stability. In engineering, cement is used as a cementitious material. Mortar and concrete are the most common cement-based materials. Concrete is a predominantly used material in the construction industry. Rapid advancements in concrete technology in the past three decades are outmoded every day. Nano-technology also played its role in aggravating the mechanical and durability properties of concrete. Concrete produced by replacing a certain percentage of cement with nano-material is called nano concrete. The nano-particle augments the properties of conventional concrete. The mechanical behavior of concrete material depends on the phenomenon that occurs on a nano-scale. For example, the structure of the fundamental calcium-silicate-hydrate (C-S-H) gel which is responsible for the mechanical and physical properties of cement pastes, including shrinkage, creep, porosity, permeability and elasticity, can be modified to obtain better durability. It is these "nano-effects", however, that ultimately determine all the properties that we are familiar with at our "macro-scale" and this is where the power of nano-technology comes in. If we can manipulate elements at the nano-scale, we can affect the macro-properties and produce significantly new materials and processes. For truncating the intake of cement and elevating the mechanical and durability characteristics of concrete, there is an urge for pozzolanic and cementitious nano-materials.

The applications of nano-technology in Civil Engineering are many. Owing to the many unique characteristics of nano-technology-derived products, newly developed nano-based products can significantly reduce current civil engineering problems. Nano-technology is an enabling technology that opens new possibilities in construction sustainability. Construction deals with high-tech materials and processes that have been used in construction. Hence, there is huge scope to apply nano-technology in construction materials, which can exhibit, probably one of the most prominent, societal impacts. Crack Resistance Capacity of Nano Concrete 3 Knowledge at the nano-scale of the structure and characteristics of materials (otherwise known as characterization) will promote the development of new applications and new products to repair or improve the properties of construction materials. Nanomaterial which has unique properties and broad application in engineering fields. Many properties of cement-based materials, such as strength, durability and workability can be improved by introducing nanomaterial. In recent times, much research are going on to improve the properties of concrete for strength, durability, and performance as a structural material. There are many nano-materials like SiO_2, Al_2O_3, TiO_2, Fe_2O_3, Cr_2O_3, $CaCO_3$, CuO, etc.

The comparative study on the nano silica and nano alumina on mechanical and durability properties of cement-based materials shows a reduction in setting time, give good compressive strength and reduced permeability in terms of durability [1]. The effects of alumina nano-fiber are investigated on the mechanical performance of ultra-high performance fiber reinforced concrete and their efficiency in enhancing the durability of the composite when exposed to extremely aggressive conditions. Results show that the superior performance of the mix with alumina helps in controlling the cracking process in concrete [2]. Compressive strength increases as NS content increases up to 3%. If dosage exceeds 3% or more, may alter the engineering properties like high porosity, microcracking, lower compressive strength, etc [3]. Nano alumina is used as a replacement for binder material to some extent. The result shows that the high early strength of nano-alumina is achieved with the addition of 1% of nano-alumina for M30 and M40 grade of concrete and with further addition of alumina more than 1% has little effect on strength [4]. Nano alumina and micro alumina has been added to the concrete mix with the proportion of 1%, 1.5%, 2%, 2.5%, and 5%, 7.5%, 10%, and 15% respectively in the grade of M40 and M50 of concrete. Based on the experiment study nano alumina with 2% has shown better distribution along the matrix of concrete and is also efficient in terms of improved compressive strength, split tensile strength, and flexural strength [5].

0.5% CNT by weight of cement was incorporated in concrete mixes having water-cement ratios 0.40, 0.45, 0.48, and 0.50. Results show that 0.45 water cement ratio compressive, split tensile and moment of resistance was greater by 8.89%, 28.9% and 5.33% [6]. M40 grade concrete is prepared as per IS to study the effect of polyvinyl alcohol, sodium bentonite, nano silica and rice husk ash on the self-healing ability of concrete. This study is carried out by varying polyvinyl alcohol in the proportions of 0.5%, 1%, 1.5% and 2% with optimum proportions of rice husk ash, nano silica and sodium bentonite as 10%, 1% and 6% respectively. The result shows the application of Nano silica and RHA was found to increase the compression strength. At the same time, the presence of PVA and Sodium bentonite decreased the compression strength due to the high-water retaining ability. Application of PVA resulted in higher Flexure strength compared to mixes without PVA. The crack width closure is highly noticeable in SHC 2 and SHC 1.5 which was evident from the image processing technique and direct observation. Hence 1.5% and 2% PVA are recommended dosages to be used in self-healing concrete [7]. Compressive strength was improved by adding nano-silica, and high content of fly ash with moderate fineness is the benefit to the compressive strength growth in the later stage. Nano-silica promotes the hydration process of cement and provides conditions in a high alkalinity environment for fly ash in a later stage [8]. Microstructure analysis of the nano-material used in concrete. As various issues occur due to environmental hazards. In this condition, the nano-materials give advanced results in various studies. Literature shows various durability checks like acid attack, sulphate attack, and permeability parameters give good results with the use of nano-materials. It also shows that it required specific requirements to perform the durability tests. So, most of the problems are created as the concrete is a porous material and the pores are reduced by using nano-materials. These types of issues are solved by using nano-materials using in the construction field [9].

EXPERIMENTAL PROGRAM

In the experimental program, two different nano-materials nS-nano silica and nA-nano alumina were used and try to find out the best mix proportion which can give the best result. Concrete mixes with nS and nA and without nano-materials have been prepared for comparison. Also, other materials characterization has been done for better mix design. The below-mentioned materials have been used.

Cement: 53-grade ordinary Portland cement

Aggregate: Fine aggregate used for all specimens was complying with IS 383-1970 and from Bhadar river region of Saurashtra. The coarse aggregate used was broken stone drawn from an approved quarry from the Junagadh region.

Water: potable water was used for the better quality of concrete.

Nano silica: Average particle size is 20 to 50 nm. (adnano technology PVT. LTD.)

Nano alumina: Average particle size is 20 to 50 nm. (adnano technology PVT. LTD.)

The design of M40 grade concrete has been prepared on the base of the above-mentioned materials and a proportion is obtained **1:2.08:3.92: 0.45**.

TEST RESULTS

Table no.1: Convectional Concrete and Concrete with nS and nA (1%) at the end of 7 days

Sr.No.	7 days strength of conventional concrete(N/mm^2)	7 days strength of concrete with nS (N/mm^2)
1	31.75	39.55
2	32.05	40.30
3	31.15	40.00

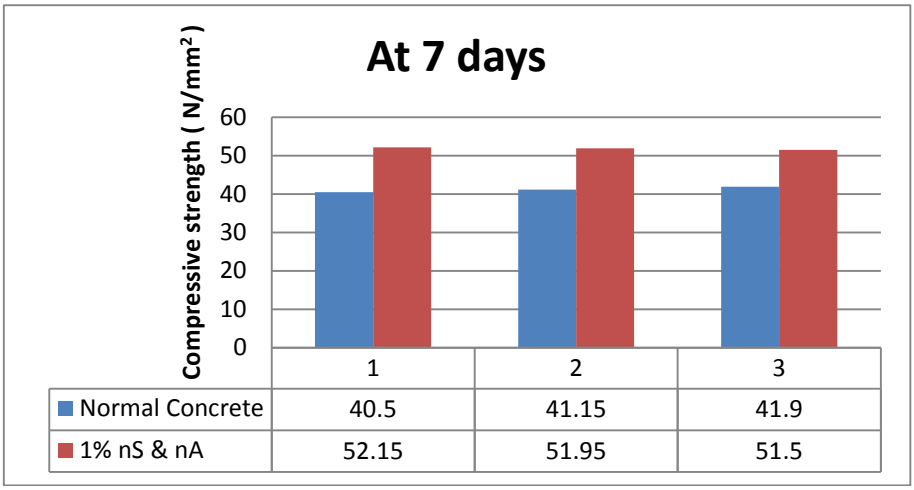


Table no.2: Convectional Concrete and Concrete with nS and nA(1%) at the end of 28 days

Sr.No.	28 days strength of conventional concrete(N/mm2)	28 days strength of concrete with nS (N/mm2)
1	40.50	52.65
2	41.15	50.95
3	41.90	51.75

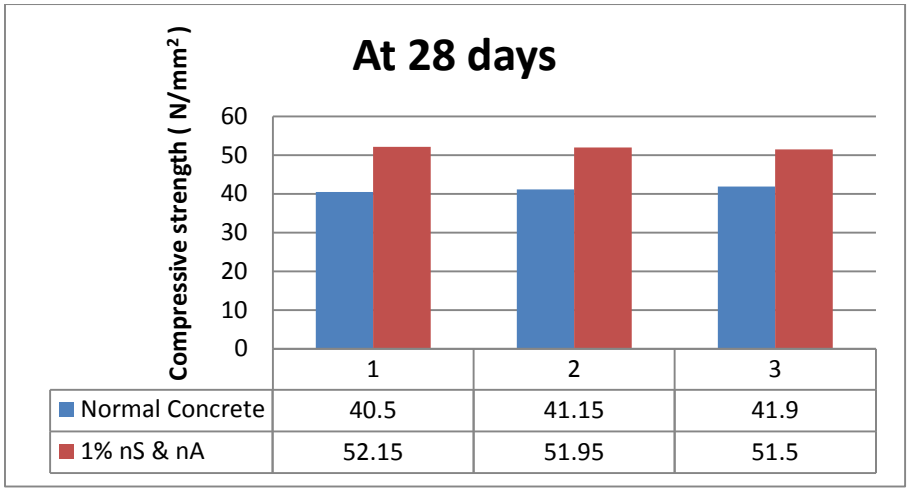


Table no.3: Convectional Concrete and Concrete with nS and nA(1.5%) at the end of 7 days

Sr.No.	7 days strength of conventional concrete(N/mm^2)	7 days strength of concrete with nS (N/mm^2)
1	31.75	41.55
2	32.05	42.30
3	31.15	41.95

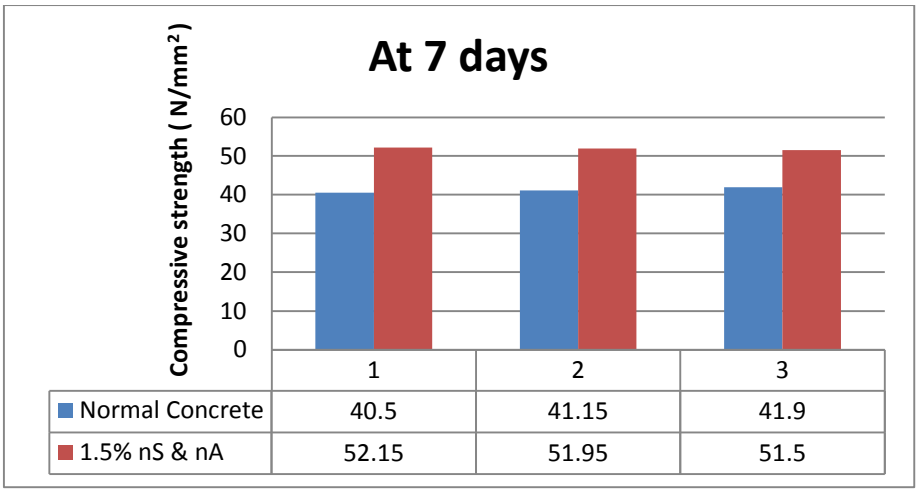


Table no.4: Convectional Concrete and Concrete with nS and nA(1.5%) at the end of 28 days

Sr.No.	28 days strength of conventional concrete(N/mm^2)	28 days strength of concrete with nS (N/mm^2)
1	40.50	54.65
2	41.15	53.95
3	41.90	53.75

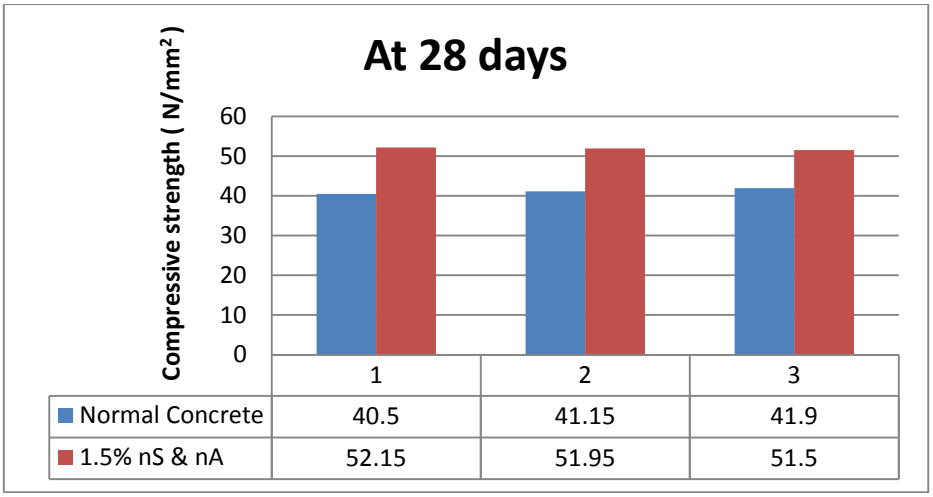


Table no.5: Convectional Concrete and Concrete with nS and nA(2%) at the end of 7 days

Sr.No.	7 days strength of conventional concrete(N/mm^2)	7 days strength of concrete with nS (N/mm^2)
1	31.75	41.55
2	32.05	42.30
3	31.15	41.95

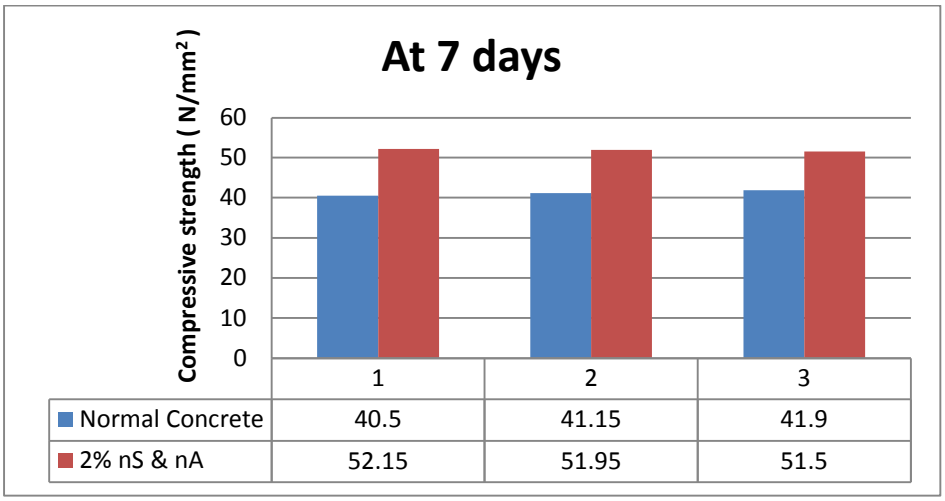
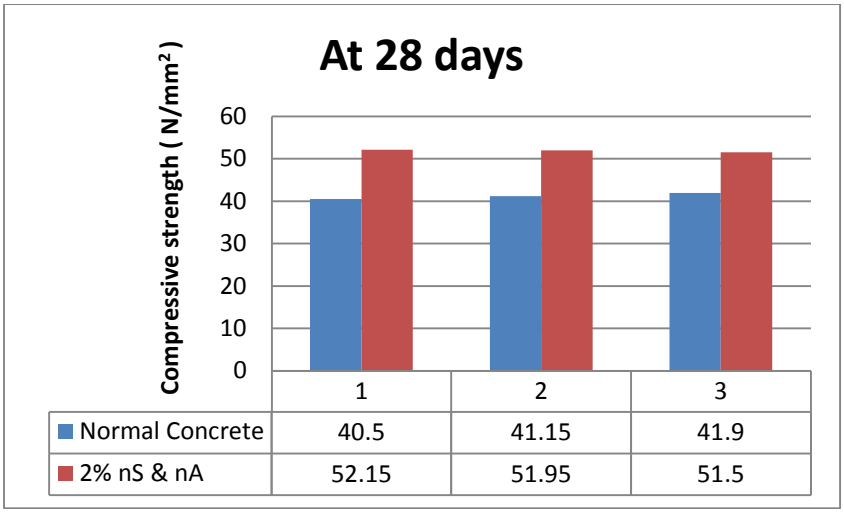


Table no.6: Convectional Concrete and Concrete with nS and nA(2%) at the end of 28 days

Sr.No.	28 days strength of conventional concrete(N/mm^2)	28 days strength of concrete with nS (N/mm^2)
1	40.50	52.15
2	41.15	51.95
3	41.90	51.50



CONCLUSION

This study represents the compressive strength of concrete with the use of nano-silica and nano-alumina. In that, 7 days and 28 days strength has been investigated by varying both the nano-materials with different dosages. Results show that 2% use of nS and nA gives good compressive strength with more homogeneity and less pervious concrete.

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Impact of EV chargers on Power System: A Review

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Abstract: As electric vehicles gain popularity in India today, EV charging station infrastructure will need extensive future development. The quality of the grid power will be significantly impacted by the massive number of EV charging stations incorporated into the power infrastructure. When EV charging stations are connected to the grid, issues like fluctuating power consumption and inconsistencies in the maximum and minimum quality of the power supply arise. Because the price of conventional fuel is rising daily, electric vehicles (EV) may have a chance to gain popularity in India. As a result of the grid's ability to refuel a lot of vehicles, capacity for power generation, transmission, and distribution will also rise. This essay reviews electric vehicles (EVs) and how they affect electricity quality.

Keywords: Electric Vehicle (EV); Charging; Discharging; Voltage imbalance; power quality; V2G.

INTRODUCTION

Now a days large greenhouse gas emissions is observed in the world, due to this we faced the problem of climate change, global warming and deterioration of environment. So many countries are involved in the new carbon reduction policies for control of greenhouse gas emissions. Introduction of electric vehicles can reduce the greenhouse gas emissions, reduce noise, reduce our dependence on conventional fuels and reduce air pollution and improve the quality of the environment [1].

The difficulty and complexity of connecting an increasing number of electric vehicles to the electricity grid. The cost, security, and dependability of the live power system are the main issues. The first issue is the rising demand for electricity brought on by the connection of electric vehicles to the power system during periods of high load. This will widen the gap between supply and demand and result in an excess load on the electrical grid. The way electric vehicles charge and how each of their drivers behaves personally varies from user to user. The electricity grid must be kept in a stable and reliable condition despite its unpredictable behaviour. [2].

The electrical grid connections for electric vehicles are currently very complicated and problematic. The three main problems with the live power system are cost, security, and dependability. The increase in power usage brought on by electric car connections to the power grid at times of heavy load is the first problem. As a result, the gap between supply and demand will expand even more, putting more strain on the electrical system. Users of electric vehicles exhibit different charging patterns and distinctive driving styles. This erratic behaviour makes it harder to maintain a stable and reliable electrical grid. [3].

EFFET OF ELECTRIC VEHICLE CHARGING

Researchers and explorers from different engineering fields have explains various effects on the grid in five main class: first, extended load capacity of live power grid; second, inspecting and exploring the EVs integration to the grid related to quality of power; third, EVs access to the grid calculation changes; and fourth, EVs effects on environment; lastly, EV charging impacts on existing distribution system. This can explained by the below Figure 1:

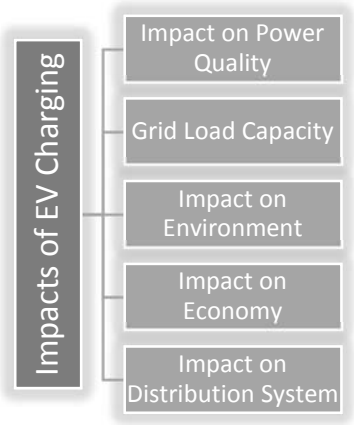

Fig. 1. Effects of Electric Vehicle Charger

Effects on the load capacity of power grid

To determine if the current power capacity or reorganised power capacity for the future is capable of meeting the increasing power demand of EV charging stations, many institutions have invested a significant amount of money and valuable time. Uncertain charging behaviour will increase the maximum load demand on the power grid, according to academics from many colleges and fields, which will necessitate additional spending to upgrade the current capacity of the power system. [4].

Impacts on atmosphere and environment

The large number of entry of EVs in our regular routines will have a positive effect on atmosphere and environment and is usually welcomed by our society to reduce greenhouse gas emissions. Many researchers from China found out that the interconnection of electric vehicles into the power grid decreases 1-6% greenhouse gas emission [1].

Impact on the dependability and quality of electric power

The penetration of EV chargers will generally have two effects on distribution systems: an increase in load demand, and a deterioration of system voltage. Consideration should be given to the relationship between the beginning of charging and the peak summertime night load, which varies depending on the user and the country's states.

Variations in the dependability and quality of the power system are used to explain the impact of EV charging on the power grid. The unpredictable charging and discharging patterns of electric vehicles will have a number of negative effects on the power system, including changes in the voltage of the distribution system, a decrease in the quality of the power, an increase in line damage, a reduction in the quality of transformers and other equipment in the distribution system, distortion that can be seen, and a large increase in fault current. Below is a brief description of a few consequences.

Voltage Unbalances

Although it is anticipated that the number of EVs connected to the grid will increase daily, their individual levels of integration with the grid and associated connection points remain stable. Residential locations will have single phase EV chargers because they have single phase loads. Due to this, the power system's voltage unbalance is seen. [2].

Harmonics

A signal or waveform is considered to be harmonic if its frequency is an integral (whole number) multiple of the fundamental frequency. Harmonic distortion is a reduction in the sinusoidal wave form of the current or voltage wave. Power semiconductor switches are frequently used to transfer power from an alternating current to a direct current form, which is typical for nonlinear loads like rectifiers. The supply voltage may decline if distorted currents are integrated into the distribution system. The IEEE 519 standard specifies the maximum amount of harmonic current that should be permitted in a given system. The standard places the burden of controlling the harmonic content in a specific system on the electrical user.

According to IEEE 519, the maximum permitted current distortion for a specific system is determined by the acceptable levels for total harmonic distortion. The total harmonic distortion that a consumer introduces into the system should be limited to a certain level at any point in the system.

EFFECTS OF HARMONICS ON DISTRIBUTION SYSTEM

The effects of harmonic distortion on power distribution equipment, in particular transformers, power cables, capacitors, meters, and switch gear, are covered by IEEE 519.1992. Additionally, surrounding important loads, particularly motors and power electronics, might suffer from harmonic distortion. Below is a discussion of some of this equipment's effects.

Transformers

Power transformers may be negatively impacted by current harmonics. I2R losses are one example of the losses brought on by a system's high harmonic content. Higher-order current flows in the transformer windings cause these losses to occur. Eddy current losses in the transformer core are another issue when harmonics are present. The device's windings see an unusual temperature increase as a result of these currents. Since both losses are frequency-dependent, transformers are particularly vulnerable to higher-order harmonics.

Power Cables

The higher I2R losses of harmonics result in more frequent cable heating. This led to the discovery of the proximity effect and skin effect, both of which depend on frequency, conductor size, and spacing. Additionally, corona and voltage stress on the system's wires could cause the insulation to fail.

Switch Gear, Metering and Relaying Equipment

Relay devices may operate slowly due to harmonics, which could result in unexpected behaviour. Fuse timing may be impacted by harmonic heating of the I2R. Harmonic currents can also shorten the useful life of an asset by causing core saturation losses, eddy currents, and increased heating in CTs and PTs.

Capacitors

A nonlinear load's harmonics may have an impact on nearby capacitors. Negative reactances of capacitor banks can combine with critical positive reactances of distribution cables, transformers, and loads to produce extremely high voltages and currents at resonant frequencies. In resonance capacitors, I^2R heating and higher voltage stress may reduce their useful lives.

EFFECTS OF DISCHARGE OF ELECTRIC VEHICLE

The supply of conventional diesel or thermal power plants and the demand for electricity are currently permanently out of balance. Despite the fact that disconnecting electric vehicles from the power grid conforms with the regulation of power supply and the equilibrium of electricity demand, the main cause of this problem is the unpredictability of renewable energy sources. Electric vehicles should be connected today so they can be used for charging in the future when the grid's electricity consumption is low. By connecting to the grid to discharge its battery during times of high load demand, it can serve as an energy storage device and feed the energy back into the system.

V2G Theory

Using the V2G Concept, EVs are equipped to return power to the grid. The interface between electric vehicles and the power grid identifies them as energy sources. The regulation and management of the grid can be greatly aided by the use of a charging and discharging cycle. By contrasting fossil fuel power generation with V2G, substantial grid integration of erratic renewable energy sources (such as wind and solar) and establishing their capacity to supply significant amounts of electricity are made possible.

V2G Impact on Power System

Recent studies by academics in various domains study the impact of EVs being discharged with the electrical grid and are categorised into four types.

• To provide assistance with the control and administration of the electricity grid.

• Correlate the creation of electrical equipment with the charging, discharging, and renewable energy sources.

• Impacts on the electricity grid's financial health.

• Affects on battery life as well as overall system protection, stability, and dependability.

SUMMARY

According to research on electric vehicles conducted by numerous researchers from various colleges, the distribution network is the area of the electrical power system that is most negatively impacted by EV integration. It can have an impact up to the level of generation and transmission in some specific situations. Voltage imbalance and total harmonic distortion are the two most significant research areas in power quality. Increases in various sorts of losses and voltage imbalance at various levels are some enlightening issues. Researchers from many universities and institutions have discovered that increased levels of integration of electric vehicles have an impact on electricity quality. In general, EV charging has an impact on the grid's economy, the quality of the power, and environmental issues.

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Group Technology in Design of Manufacturing Systems -A Review

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ABSTRACT. From a "Industrial Engineering" standpoint, group technology has been widely explored (layout, workflow, scheduling,, etc.), while organisational design has received less attention. This essay has evaluated research on the effects of group technology. It has been noted that five more examples were taken from an archive search to strengthen the validity of conclusions made from the examination of these empirical cases. The coding of components was not used in order to arrange machines and workers into production cells; instead, cluster analysis and product flow analysis were used. Additionally, the findings show that group technology adoption often satisfies changes in performance criteria brought on by competitive pressures, notably flexibility and responsiveness, even though the organisations only explored group technology when under pressure of 'poor' business performance. Group technology does not, however, always address issues that businesses face. An actual instance demonstrates that defunctionalization and scheduling with virtual groups were more advantageous. However, group technology also enables businesses to explore assigning responsibility for production planning and scheduling to lower levels of the hierarchy and semi-autonomous groups as an alternative to "complicated" software programmes where it is practical to do so (a socio-technical approach). While the current study provides some insight into the connection between group technology and organisational structure design, more investigation into the design of these structures and their connection to group technology is required.

Keywords: GT, Manufacturing Cells, Socio-technical Approach.

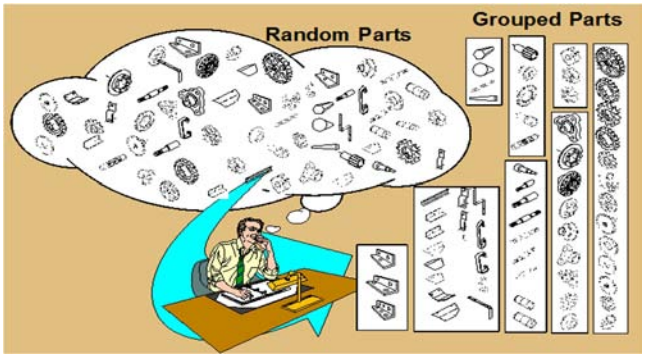
INTRODUCTION

Group technology is a manufacturing method in which a few machines or processes are used to produce items that are similar in shape, manufacturing process, or functionality. A single solution to a set of problems may be found by grouping comparable problems, which can save time and effort. This is the basic tenet of group technology. Many problems are similar.Part families are collections of related components, while machine cells are collections of machines used to process a single part family. Every machine in the associated machine cell does not have to process every part in a part family.Cellular manufacturing refers to this process in which a machine cell produces a component family. Employing GT often improves manufacturing efficiency since the necessary procedures may be contained within a small cell, eliminating the need to transfer items that are still being processed. Group technology is a strategy that makes use of the commonalities in design and manufacturing

by identifying and grouping together comparable pieces. Part families can be created by grouping parts together based on similarities.

GROUP TECHNOLOGY IN MANUFACTURING

Manufacturing benefits greatly from group technology. The quantity and diversity of pieces are decreased. Planning the procedure for the remaining components is simpler and more reliable. CAPP, or computer-aided process planning, is a crucial instrument for this. It plans consistently, standardised, and precisely estimates expenses using the coded commonalities. It then allocates the component to a GT production line. Cells utilising group technology shorten throughput times and work-in-process. They streamline scheduling, save down on travel, and make oversight easier. Improved setups and tooling costs are some of the more notable and obvious reductions. Lower lot sizes and smaller lines result from reduced setup times, which leads to quicker throughput, shorter lead times, and less inventory. gt can occasionally replace the need for pricey NC machinery. When paired with NC, GT makes programming simpler.



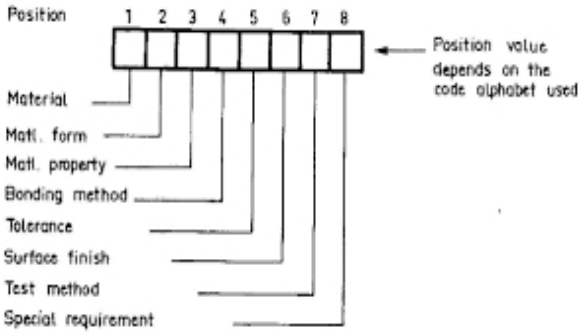


Figure 1 Group Managing System In Group Technology
Figure 2 Coding System In Group Technology

WAYS TO IDENTIFY PART FAMILIES

- Visual inspection - based on the components or photographs of the parts, using best judgement to classify the parts into suitable families.
- Production flow analysis - putting things into categories based on the data on route sheets.
- Part classification and coding - using a coding system to relate parts by pointing out their similarities and differences.

HISTORY OF GROUP TECHNOLOGY

R. Flanders from the United States delivered a talk on organising manufacturing at Jones and Lamson Machine Company in 1925, and it was during this presentation that the original concept for GT originally emerged. A. P.

Sokolovski of the USSR proposed in 1937 that components with comparable configurations and features, all other things being equal, should be produced using a standardised technological and manufacturing method. Then, also from the USSR, S.P. Mitrofanov developed this idea and introduced GT. Design uniformity and simplicity, according to Mitrofanov, are essential for a successful GT programme. In 1937, the same year Sokolovski released his article, a firm in the United States disclosed a technology in their manufacturing system.Swedenamed A. Korling gave a presentation in 1949 on "group production," which is a batch manufacturing application of production line principles. In his presentation, he explained how the job was separated into groups, each of which had equipment and tools for specific tasks.

Similar to the implementation at Forges et Ateliers a few years prior, GT was used in 1963 at Hopkinsons Ltd. in Huddersfield, England. In 1963, GT was also deployed at a Springfield, Vermont, facility that made machine tools. In 1966, Mitrofanov's writings were published in both German and Russia. The first ever international conference on classification and coding took place in 1966 in Fort Lauderdale, Florida, in the United States. The Waldorf-Astoria hosted the Second Conference on Classification, Coding, and Group Technology in 1967.

The International Labour Organization held a meeting in Turin, Italy, in 1969, with the major focus of the conference being on the definition of GT. A machine shop that was conventionally organised was converted into "family of part" lines by the Langston Division of Harris-Intertype in New Jersey, USA, also in the same year. The adoption has shortened lead times to days rather than weeks while increasing production by 50%.

The simplification and standardisation processes that emerged at the start of the 20th century form the foundation of the GT idea. It first appeared as a single machine idea designed to speed up setup. This idea was developed further by grouping items with comparable machine specifications and fully processing them within a machine group or cell. Part family creation is the result of a procedure that groups like parts together or divides them based on specified characteristics. Therefore, this procedure should be viewed as a requirement for the effective grouping of components into units and other benefits of production. The design properties of parts, such as component shape, size, surface texture, material type, and raw material estate, may be used to divide them into different categories.According to design characteristics, such as component size, surface texture, material type, and raw material estate, or manufacturing characteristics, such as operations and sequences, batch sizes, processing times, or level of production, parts can be grouped. Design engineers can obtain old drawings using the first method in order to assist new component design standardisation and conduct precise cost estimation. The second one results in setup time reduction, uniform process planning, and enhancements to the control process.

The concept of using part similarities to address the scheduling problem has been adopted by several writers, with the majority of the applications starting in the metal processing industry; nevertheless, there is no reference to the tile business to be discovered. In this instance, setups are not insignificant in these productive systems, and each stage of production has some resource availability. The "hybrid flow shop problem with dependent setup times on the sequence" is what this is known as. An estimation of setup times is required in order to optimize setup times. There aren't many studies on these issues, however one that uses statistical regression is in In order to facilitate the sequencing of jobs in a single machine, the researchers are looking towards minimising total setup time. A method based on the breakdown of setup time in a computer numeric control (CNC) environment is described, however it is not applicable to more complicated systems since it is reliant on the geometry of the components.

Literature review

Andrew Kusiak (1988)[1] This work presents the EXGT-S knowledge-based solution for resolving the generalised group technology challenge. Constraints relating to machine capacity, material handling system capabilities, machine cell dimensions, and technological needs are included in the formulation of the group technology issue. It was created for a production system that is automated. The tandem system design described in Kusiak is the foundation of EXGT-S. (1987). It takes various machines and different designs into account. The advancements in expert systems and optimization are utilised by EXT-S. Two key elements of the knowledge-based system are discussed: the expert system and the heuristic clustering approach. The expert system evaluates each partial solution produced by the clustering algorithm before changing the program's search directions.

Rob Dekkers (2018)[2] From an "industrial engineering" standpoint (layout, scheduling, workflow, etc.), group technology has been widely explored, whereas organisational design has received less attention. In three empirical situations, the technique of applied systems theory for the design of organisational structures was employed as the framework for analysis to examine this consequence of group technology. Five more instances were taken from an archive search to strengthen the validity of the conclusions gained from the examination of these three empirical cases. The coding of components was not used in order to arrange machines and workers into production cells; instead, cluster analysis and product flow analysis were used. Additionally, the findings show that group technology implementation generally satisfies changes in performance requirements brought on by competitive pressures, particularly flexibility and responsiveness, even though companies only gave group technology a second thought when faced with pressure from "poor" business performance. Group technology does not, however, always address issues that businesses face. An actual instance demonstrates that defunctionalization and scheduling with virtual groups were more advantageous. However, group technology also enables businesses to contemplate assigning responsibility for production planning and scheduling to lower levels of the hierarchy and semi-autonomous groups as an alternative to "complicated" software applications when their introduction is practical (a socio-technical approach).While the current study provides some insight into the connection between group technology and organisational structure design, more investigation into the design of these structures and their connection to group technology is required.

Norani Nordin et al. **(**2010)[3] An exploratory study of the use of lean manufacturing in Malaysia's automotive sectors is presented in this report. To investigate the degree of lean manufacturing application, a questionnaire survey is performed. This essay also looks at the forces and obstacles affecting the adoption of lean manufacturing. Sixty Malaysian companies that manufacture car components participated in the survey. The responders were selected from among people who have direct experience with lean manufacturing techniques, such as members of the production and quality teams. The results demonstrate that the majority of respondent companies are categorised as moving toward lean manufacturing practices. For each of the five areas of lean manufacturing practices, these in-transition companies have mean values that are modest.Additionally, it has been shown that these businesses give internal areas like administration and operation more attention and funding than they do to their exterior interactions with suppliers and clients. These companies contend that the goal to put the customer first and achieve continuous improvement inside the company are the driving forces behind the adoption of lean manufacturing. The results of this study also identified the key obstacles to or bottlenecks in the implementation of lean. The attitude of shop floor personnel and a lack of knowledge of lean ideas are the biggest obstacles to establishing a lean manufacturing system.

Christopher M. McDermott et al. (1998)[4] Using information acquired from a sample of 97 manufacturing facilities, we examine the relationship between organisational culture and results related to the implementation of advanced manufacturing technology (AMT). Many item measures are developed and adapted from a range of literature sources to measure managers' views of organisational culture, AMT benefits, and implementation outcomes like operational benefits, organisational benefits, satisfaction, and competitive success. To examine the correlations between these variables, regression analysis is performed. The findings imply that cultural traits as outlined by the competing values model are strongly associated with the success of AMT adoption. We finish by talking about how these effects may be managed.

Arash Shahin et al. (2010)[5] Although Group Technology (GT) has a significant impact on key aspects of lean production such production wastes, setup times, quality, and inventory management, the literature has not fully explored the link between the two topics. The implementation of Group Technology (GT) in lean production systems has been suggested as a conceptual paradigm for increasing productivity in this study. The model incorporates GT dimensions and how they relate to lean manufacturing objectives. The suggested model's relationships have been investigated using statistical analysis and a questionnaire. Managers from two industrial businesses were included in the statistical population. The findings support the strong association between the model's component parts in both businesses.Additionally, the variance analysis's findings show that, except from two questionnaire items, there is no difference between the two firms' responses to the other questions.

K.Arun Prasath et al. (2015)[6] In order to accomplish a significant improvement in production output, we have intended to present a full evaluation of group technology (GT) and its application concept in the area of cellular manufacturing in this article. The development of a cellular manufacturing system has proven to be a crucial step for batch, job shop, and to some extent process industries. Group technology has been a key element

in this process.With the principle of group technology acting as a traditional concept, it continues to play an important role in new manufacturing concepts like just-in-time manufacturing, total quality management, and technologies like computer integrated manufacturing in manufacturing systems. Group technology helps to reduce setup time, inventory levels, and logistics of goods while also providing effective control of production.

SanJeet Kumar1etal.et al. (2013)[7] Finding a group of families of integrated byproducts with commonalities has been one of the key goals in the current manufacturing system optimization of the industries. Production managers would benefit from this categorization by being able to eliminate unnecessary activity on the shop floor, changeover time, production delays, and total cost. The fundamental idea of "exploiting commonalities," which comes from the Group Technology (GT)philosophy, has been utilized to come up with a novel solution to the issue. Implementing the GT technique, which involves forming product and machine groups and streamlining material flows, is one way to do this.This study has already been put to use in the context of a real case, with largely favourable outcomes in terms of setup and production costs, better planning and short-term scheduling, more precise setup time estimations for new items, etc. The synergy between GT and PFA is shown to provide advantages in the article. Eventually, a suggested solution was obtained by combining the use of material flow simplification based on PFA with the application of some good common sense and judgement.

Orchida Dianita et.al (2019)[8] The Indonesian furniture market is expanding quickly, with an average annual growth rate of US$1.627 trillion in 2017. Given Indonesia's huge potential for the furniture business, a strategy to boost production and efficiency is essential. To attain its prior goal, group technology in cell manufacturing is employed as a method to enhance the production layout. The Hollier technique and RankOrder Clustering (ROC) are used to categorise the equipment and procedures in the production layouts. The layout change is effectively lowering the overall journey time by up to 24.6% and the total travel distance by up to 16.1%, according to the Discrete Event Simulation (DES) used as a validation tool.

Christopher Risandy Anak Rimes (2009)[9] The project is an investigation of the use of group technology in regional manufacturing. Group Technology (GT) is a manufacturing concept that holds that if several issues are similar, they may be grouped together to find a single solution, saving time and effort. The GT idea stresses minimising the scope of the circumstance that has to be managed. The factory is separated into smaller cells instead of being functionally built out, with each cell having all the tools and machinery required to finish a certain family of components.In order to accomplish the project's goals, 48 samples received a postal survey. Only 8 of the 48 firms responded. For this study, a single business was chosen as the case study. The business is situated in the DemakLaut Industrial Park and is active in food processing. During the visit to the firm, observations and interviews were conducted to determine whether the GT idea could be implemented and integrated in terms of production procedures and plant architecture. Based on the observations made during the factory inspection and interview, a new plant layout was created to be presented to the corporation. The research's and the proposal's goals have been met. Recommendations Due to the need for more study, the project's area of focus will be expanded.

D Ernawati et al. (2012)[10] One of the design issues is the facility layout problem, which involves placing facilities (such as machines or departments) in a planar area (such as a plant) in order to achieve goals like minimising the cost of anticipated interactions between facilities or maximising closeness ratings, among others. The effectiveness of production systems is significantly affected by layout. The layout design issue in this study is resolved using the cellular manufacturing system. The choice of this technique was made possible by the flexible option provided by cellular manufacturing tools, which are sophisticated and automated production equipment. The overall distance and component movement can be minimised. Similar components are recognised and grouped in cellular manufacturing systems to capitalise on similarity, according to their ideology. Manufacturing cell grouping minimises overall distance, according to the study's findings.Similar components are recognised and grouped in cellular manufacturing systems in order to capitalise on commonality. According to study findings, combining production cells decreases overall distance from 411.51 m to 335.14 m.

U Tarigan et al. (2018)[11] ABC is a woodworking business that uses rubber wood as its primary raw material to create home items including chairs, tables, waggons, shelves, and laundry hangers. According to the findings of the observations performed on the firm, it was known that the production process in the company still contained a lot of non-value added activities, such as delays and long distance transportation activities, which caused the production process' lead time to increase.By employing Value Stream Mapping to identify operations

that add value and those that don't, the lean manufacturing technique is used to eliminate non-value contributed activities as a result of challenges that the organisation is experiencing. It uses the 5W and 1H concepts. Following the reduction of non-value-added operations, the Group Technology Layout technique is used to create three different layouts with the goal of reducing the distance between stations. Through manufacturing process simplification and layout redesign to save production time, this research seeks to minimise non-value added operations. According to the study's findings, this strategy reduced the manufacturing lead time from 19237.4 seconds in the beginning to 14340.3 seconds.

Emad Rabiei Hosseinabad et al. (2020)[12] Over the past two decades, lean manufacturing applications have significantly influenced both academic and industry contexts. However, case studies have been the extent of the use of lean techniques in cellular manufacturing. A summary of the lean evolution in cellular manufacturing was required, as were critical remarks on strategies that addressed some of the early deficiencies in the lean application in cellular manufacturing. This project will create a distinctive framework for scholars, academics, and professionals by connecting the lean trends in cellular manufacturing and connected lean research partnerships. They are anticipated to get a better understanding of how lean has evolved in cellular manufacturing, both conceptually and in terms of how it is used inside an organization, as well as identify potential future study areas.

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Andrew Kusiak et al. (1988)[13] One of the most important elements to increase the productivity of production systems is group technology, or GT. The fundamental concept behind GT is to put together components that call for comparable actions and the machines that perform these processes. See Fazakerley (1974), Ham et al. (1985), and Gallagher and Knight for a thorough analysis of GT and its benefits (1986). A machine-part incidence matrix [a,,] with "1" (empty) entries that signals that machine I is employed (not used) to process the party is one of the often used representations of the GT issue. Clusters of machines and parts are often invisible when a machine-part incidence matrix [a,,] is built. The original incidence matrix can be transformed into a structured (perhaps block diagonal) form using a clustering technique. Take a look at the machine-part incidence matrix to demonstrate the clustering technique to GT.

G. Harhalakis et al. (1987)[14] The challenge of identifying a useful breakdown of the production system into manufacturing cells that may be assigned to part families is dealt with in this work. Presented is a straightforward two-step heuristic approach that can solve industrial applications with plausible dimensions while limiting the inter-cell material flow. The bottom-up aggregation technique is the first phase of the suggested heuristic, which aims to reduce "Normalized Inter-Class Traffic". The second stage is an improvement-seeking process where the value of a machine to a cell is verified.

Kamal Khanna et al. (2014)[15] One of the biggest changes in the global economy over the last few decades has been the transfer of control over defining market demand from producers to consumers. Manufacturers must continually adjust to market changes given the intense competition they face to stay in business. The focus on flexibility and responsiveness in manufacturing system design has changed as a result of the pressure of competitive price, quick delivery times, and high customisation. It has made outdated concepts of technical and managerial advancements to the point where traditional production processes are no longer optimal. To address these contemporary manufacturing issues, a variety of more recent production system paradigms have arisen over time. Group Technology, the management tenet of solving issues collectively, has taken centre stage in most of these paradigms.The goal of the current study is to give a three-part, concise assessment of the literature on this subject. The first section reviews the flaws in several traditional production system paradigms. The development of numerous contemporary manufacturing system paradigms is historically explored in the second section in the context of the shortcomings of traditional paradigms. The second section will also make an effort to demonstrate how Group Technology has come to serve as the foundation for each of these paradigms.An extensive assessment of the research on component categorization (and/or machine group formation) utilised in various current production systems is offered in the third section of the study. Literature is categorised both chronologically and in accordance with different methodologies, including coding and classification, clustering, knowledge-based systems, heuristics, soft computing, simulation, and others. The study also makes an effort to categorise the literature according to the criteria employed, the aims taken into account, and the emphasis orientation. It concludes with a vision for further study in this field. Group technology and manufacturing systems are key words.

Nancy Lea Hyer et al. (1989)[16] 53 US users of group technology were surveyed for this paper's findings (GT). Medium-sized to big metalworking and electronics businesses made up the respondent installations. They produced a lot of finished goods and/or component parts mostly through fabrication operations. These companies used GT in the following areas: design, process planning (including NC programming), sales, purchasing, cost assessment, tooling, scheduling, new equipment size, and tool selection. Most of the time, businesses applied GT using categorization and coding systems as tools. Although users noted technical and management challenges that must be solved for GT to be applied successfully, considerable and diversified operational and strategic advantages have been realised. The majority also believed that GT will play a crucial role in future CAD/CAM operations at their facility.The experiences of the respondents support the utility of GT, which is extremely wide. They also imply that by failing to comprehend GT as a universal concept and instead viewing it as a tool or equating it with a particular usage, possibilities to increase manufacturing efficiency may be lost. The experiences these manufacturers have had with cellular manufacturing are described in a second article that is based on the same survey data.

CONCLUSION

The majority of the research has focused on the machine and parts into cells with component families, so this study draws attention to the necessity of building the cellular manufacturing system with GT for maximum performance. In order to succeed in group technology, it is urgently necessary to design models that identify the ideal number of groups and the ideal production mix, taking into account technological and logistical limitations.The development of more effective tools that allow manufacturing system designers to achieve optimal solutions in reasonable processing times is necessary. We have also produced a better productive system with the help of the group technology principle. The application of GT in advanced manufacturing systems improves the design and operational efficiency of a system. We have also incorporated lot sizing and some flexible manufacturing systems with the production activities of a system. And the primary motivation for this paper's creation was to demonstrate GT's excellence in cellular manufacturing to both the small- and large-scale process industries.

ACKNOWLEDGMENTS

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Analysis of R.C.C. Framed Building With Monolithic Tunnel Formwork Structure

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Abstract. Now a day population increase rate is faster in India compare with the previous two decade require for batter life of human one of the basic necessities is house planning. For this purpose, the construction industries are faster growing and improve new technology to give batter and cost economic house planning. In this study, Analysis and behavior of G+13 story building with the partition shear wall with a monolithic tunnel formwork technology. We are Analysis both the Building in E-Tabs. Tunnel formwork is a fastest construction formwork technology to save up to 38% of the time Consumption than the conventional construction formwork. Pradhan Mantri Aawas Yojana – Urban As a part of this Yojana Government has taken the Global Housing Technology Challenge-India six Light House Project (LHP). One of the Technologies is Tunnel Formwork Monolithic Construction Technology is in Rajkot, Gujarat.

Keywords. Monolithic Building, R.C.C. Framed Building, Tunnel Formwork, E-Tabs.

GENERAL

R.C.C. framed building some partition wall is they're because of the previous and the divided the whole building into a different purpose of uses. Temperature and environmental long-term effect are accursed on the building. Due to the Long-Term Effects partition wall joint may be chances of the cracking, creeping, Deflation.

Monolithic construction the wall and slab are casted at a time. So, there is a hardly needed to a partition wall. The monolithic construction is a batter long-term performance then the R.C.C. Framed building construction.

Tunnel Formwork Technology

Tunnel Formwork is a special type of formwork which is Box type steel fabricated. LHP tunnel formwork show in Fig.1 it is capable to wall and slab are casted in a one single operation. The main Component of this system is R.C.C. wall (Shear wall) and flat plate slab. They are able to cast every floor in 24-48 hr of each time period.

Figure1. Light House Project Tunnel Formwork

Tunnel Formwork is a give most precise work and within a very short period of Time, that's why this Technology is very popular in many countries like a Japan, Italy, Turkey, etc.

Initial investment of the Tunnel Formwork is higher than the normal conventional formwork. They are not use in a different dimension size of the other building.

Tunnel Formwork is there is a heavy initial investment, and after this much of heavy investment they are not Reusable in a different size and planning of the others building.

Monolithic Concrete Construction System At Rajkot, Gujarat.

Monolithic structure using high precision, re-usable, fixed room sized, steel forms or moulds called tunnel form. This system intends to replace the conventional R.C.C. beam-column structure which uses steel/plywood as a shuttering Formwork. Tunnel form system uses customised engineered steel form work consisting of two half shells which are placed together and then concreting is done to form a room size module.

Objective of Research

- Analysis of Monolithic R.C.C. structure using E-Tabs.
- Analysis of parameters likes a story drift, story displacement etc. by Response spectrum Method.
- Differentiate the Monolithic structure design with R.C.C. Framed structure design.
- Construction cost analysis between monolithic and R.C.C. framed structure.
- Examine the construction period between monolithic and R.C.C. framed structure using MS Project Software.

METHODOLOGY

The R.C.C. Framed building and Monolithic building are G+13 stories building. Both building has a same carpet area and same Architectural Planning. General information data about the building is in Table 1 given bellow.

The story height is 3m for every story in Framed as well as Monolithic building.

Follow R.C.C. IS: 456-2000 Design Code. As per the IS code IS: 875-1987 Part I, II Live load on typical floor is 2 KN/m^2 in General and Passage and Stair it will be 3 KN/m^2 and Floor finish are 1.5KN\m^2.

Material And Section Details of Structure Input Data

Table 1. Building General Input Design Data

Items	Description
Beam Size	230mmx450mm, 230mmx600mm
Column Size	300mmx600mm, 300mmx750mm
Slab Thickness	150mm
Partition Wall	230mm Thick Brick Wall
Shear Wall	230mm In R.C.C. Framed, 160mm In Monolithic Structure
Design Code	Is: 456-2000, Is:875-2015(Part I To III), Etc.

Earthquake Zone	Zone-III (Rajkot, Gujarat)
Grade Of Concrete	M25and M40
Reinforcement Bar	HYSD 500

Given data in Table 1 is based on the LHP on site result and other data is adopted from the review of the expert.

Architectural Building Plan

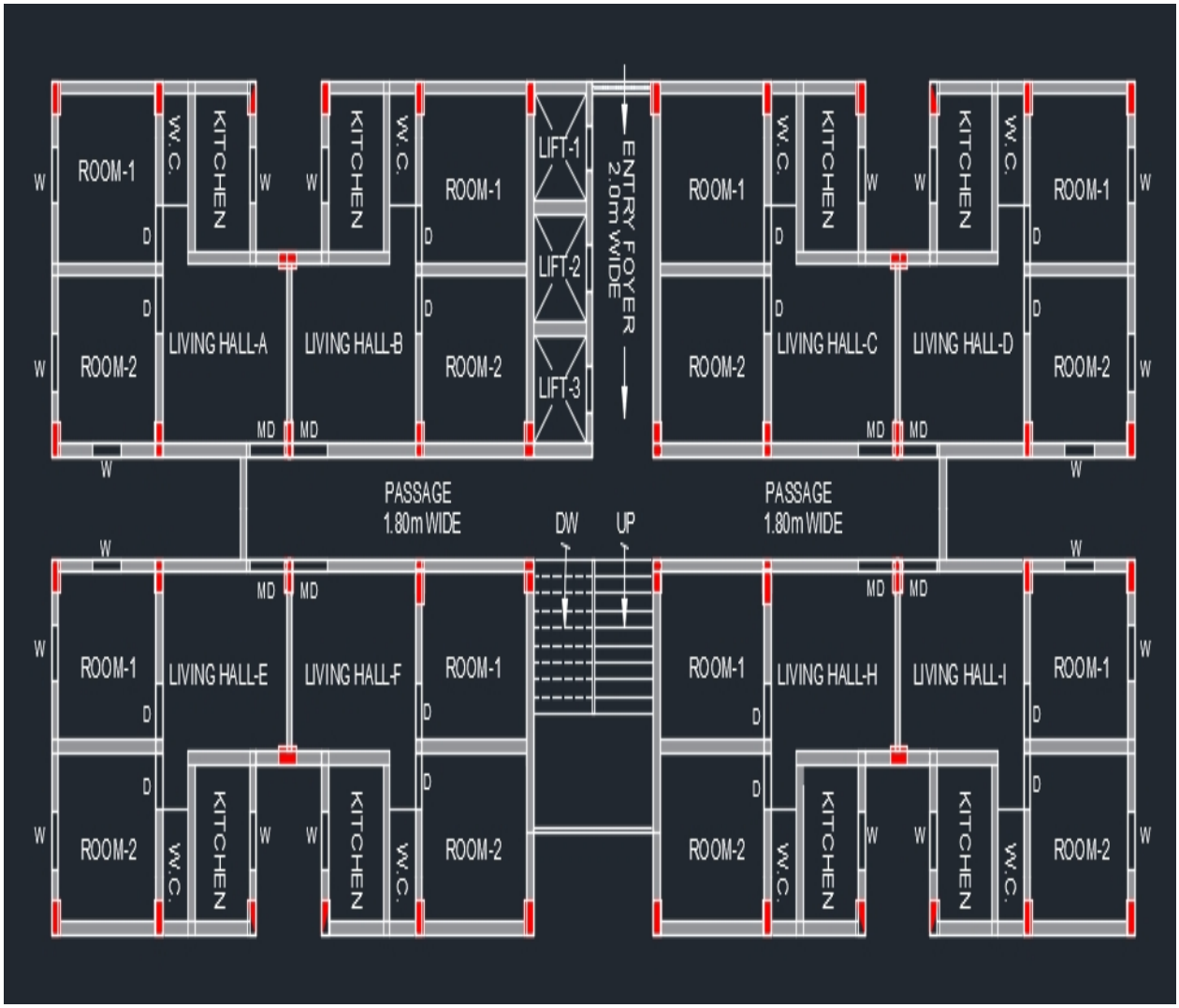


Figure 2. Framed Building Architecture Plan with Column Location

Framed building and Monolithic building architecture plan will show in bellow Fig.2 and Fig.3 respectively.

Both R.C.C. framed building and monolithic structure building architecturally planning are same. In the Fig.3 red line will be show the R.C. shear wall of the monolithic building. Also in Fig.2 will be show the Column location of the R.C.C. framed building

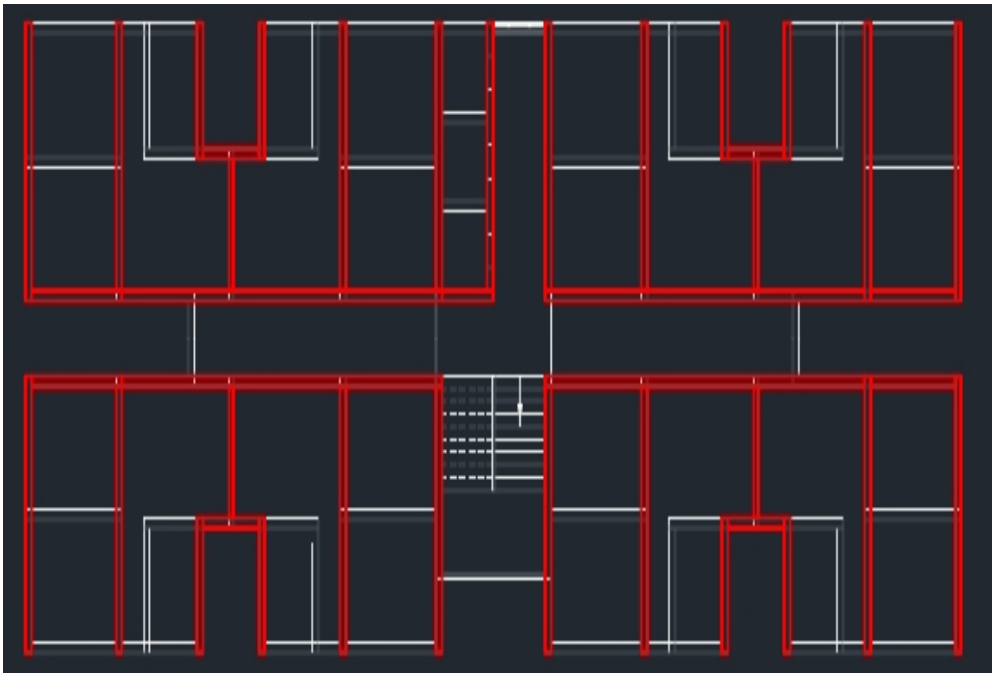
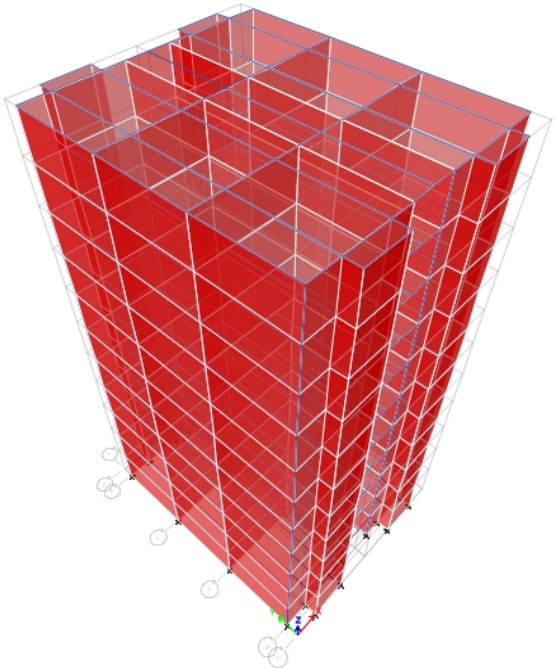


Figure 3. Monolithic Building Architecture Plan with R.C.C. Wall

Model In E-Tabs

Open the e-tabs file and set-up the unit system and design code. Import the floor plan from AutoCAD DXF file format



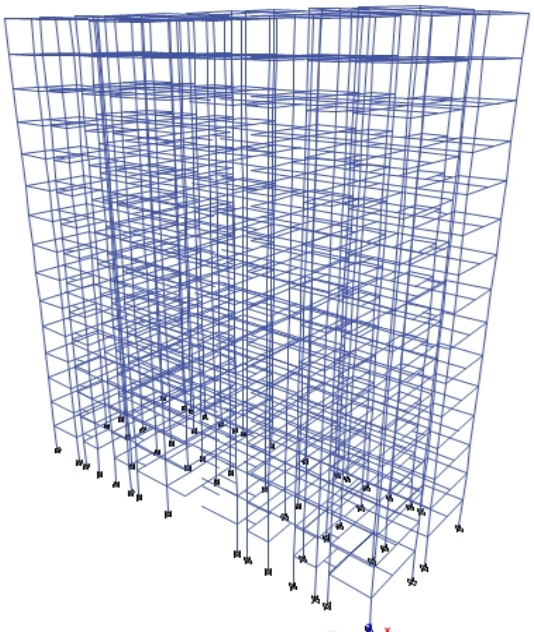


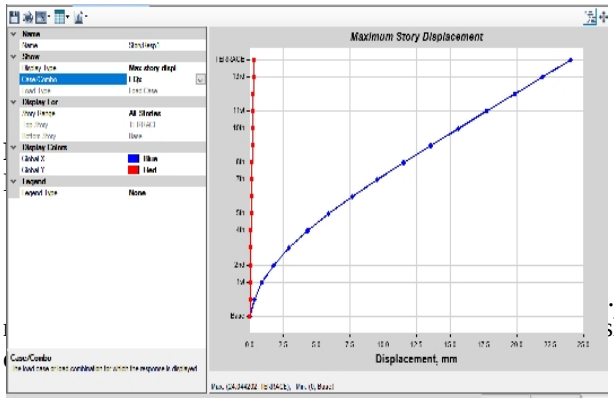
Figure 4. E-Tabs Monolithic Building Model

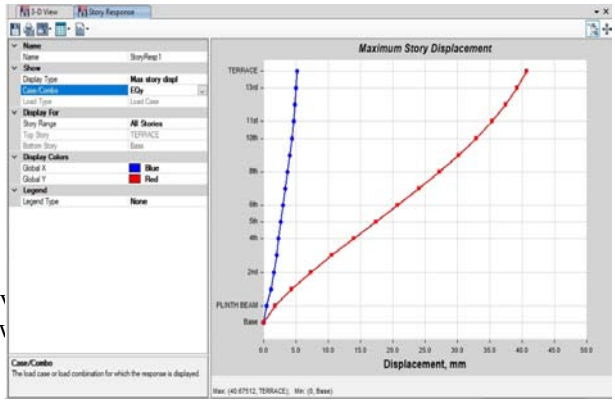
Figure 5. E-Tabs Frame Building Model

Fig.4 and Fig.5 Show the Monolithic and R.C.C. framed building in E-Tabs model respectively.

As per IS: 1893-2015 Part-I code for the earthquake analysis of building structure. We are using Response Spectrum Method (Linear dynamic analysis) for the analysis of the both the building in against of horizontal earthquake force.**BUILDING ANALYSIS AND RESULT**

Lateral Displacement of Monolithic and Frame Building





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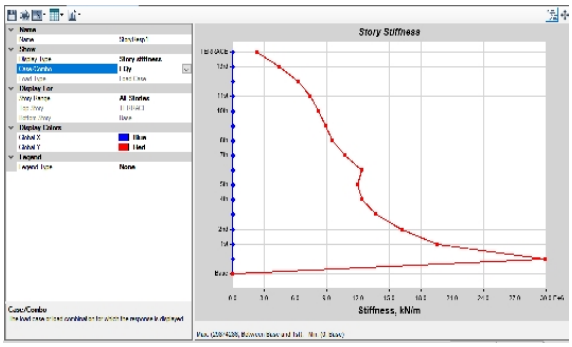
Story Stiffness of Monolithic and Frame Building



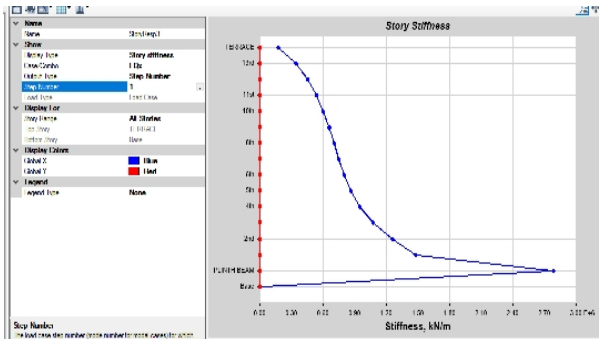


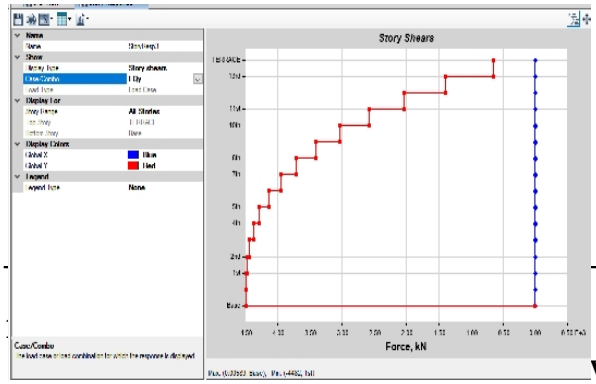
Figure 8. Monolithic Building Max Story Stiffness Eq-X

Figure 9. R.C.C. Framed Building Max Story Stiffness Eq-Y

Monolithic building max stiffness is at ground story show in Fig.8 the value is $30x10^6$ KN/m it will Y axis of the building.

R.C.C. framed building max stiffness is at ground story show in Fig.9 the value is $2.8x10^6$ KN/m it will X axis of the building

Story Shear of Monolithic and Frame Building



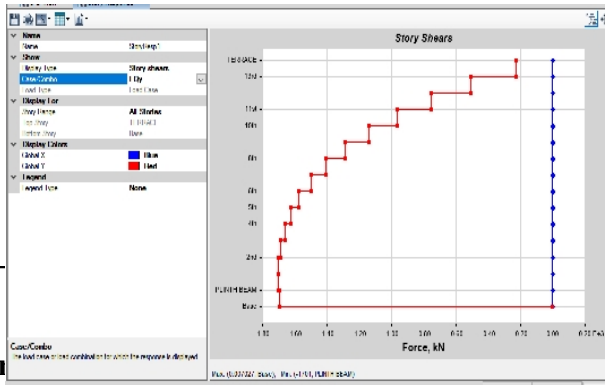


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Figure 10. Monolithic Building Max Story Shear

Figure 11. R.C.C. Framed Building Max Story Shear

Monolithic building max story shear force is at a base story show in Fig.10 its value is $4.5x10^3$ KN R.C.C. framed building max story shear force is at a base story show in Fig.11 its value is $1.7x10^3$ KN.

Building has a self-stiffness in the Y-direction then the X-direction of the building, because of the building architecture planning.

So, Building has a Max displacement is meant respect to X-direction of the building, vice-versa the max stiffness is in the respect to Y-direction of the building. Monolithic and R.C.C. building both are nearly same behavior in the Earthquake but the monolithic are the stronger then the R.C.C. Framed building its carry more lateral load.

APPROXIMATE MATERIAL QUNTITY AND COSTING

Table 2. Material and Labor Cost of The Monolithic Building

Resource Name	Price/Unit	Total Quantity	Total Cost
M40 Grade Concrete	Rs. 7500.00	3900 Cum	Rs. 29,250,000.00
Total Steel	Rs. 65,000.00	1092 Tons	Rs. 70,980,000.00
Total Brick	Rs. 5.00	481200 Nos.	Rs. 2,406,750.00
Masonry And Plastering Cement	Rs. 310.00 Per Bag	2180 Nos.	Rs. 675,800.00
Masonry And Plastering Sand	Rs. 700.00 Per Tons	565 Tons	Rs. 395,500.00
Labor Cost	---	---	Rs. 1,533,700.00
		Total Cost =	Rs. 105,241,750.00

Approximately 472 Days Taken for the Construction and finishing of the full Building. We are considered the general activates to the project.

Table 3. Material and Labor Cost of The R.C.C. Framed Building

Resource Name	Price/Unit	Total Quantity	Total Cost
M25 Grade Concrete	Rs. 4,000.00	2766 Cum	Rs. 11,064,000.00
Total Steel	Rs. 65,000.00	154 Tons	Rs. 10,010,000.00
Total Brick	Rs. 5.00	2022750 Nos.	Rs. 10,113,750.00

Masonry And Plastering Cement	Rs. 310.00 Per Bag	7105 Nos.	Rs. 2,202,550.00
Masonry And Plastering Sand	Rs. 700.00 Per Tons	2025 Tons	Rs. 1,417,500.00
Labor Cost	---	---	Rs. 3,866,400.00
		Total Cost =	Rs. 38,674,200.00

Approximately 472 Days Taken for the Construction and finishing of the full Building. We are considered the general activates to the project.

We are approximately schedule of the whole building activates in the M.S. Project and assign the labor and their charges of per day.

After this analysis we are concluded the labor cost and the approximate time line of the building construction. This Project Material Cost Calculation is a Base on the E-Tabs Design Report. Material wise cost will be show in Table.2 and Table.3 respectively monolithic and R.C.C. framed building.

This is an Approximately Calculation of the material and labor cost; it's don't include profit margin of the builder and the site waste of the material. Rate of Per Items will be considered as per the Local Market Analysis.

CONCLUSION

Monolithic Structure gives batter performance in the earthquake compare to the R.C.C. Framed structure i.e., story stiffness will Higher 10.68 times in monolithic structure and max story Displacement will be 1.7 Time than the R.C.C. framed structure.

As the high-performance materials are required in the monolithic construction, the material costing will be Approx 33.56% higher than the Conventional R.C.C. Framed building.

As Conventional formwork system requires stipulated time to achieve the proper strength of the frame structure, monolithic tunnel formwork reduces it Approx 25.85% than the R.C.C. Framed building.

In Monolithic construction, fewer labors are required and hence it saves up to 39.67% labor cost than the R.C.C. framed structure

FUTURE SCOPE

Monolithic Tunnel formwork is a very strong formwork, standard repetition is 500 time. In a any high-rise building very low chances to use any formwork to much of repetition. To modify the tunnel formwork and it make it usable to the other different size of the building.

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MediaPipe: Yoga Pose Detection Using Deep Learning Models

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Abstract: In this contemporary lifestyle human beings choose a healthy lifestyle and one of them is yoga. Yoga focuses on physical and mental and spiritual well being. It requires discipline in order to perform, in fast paced life people prefer self-taught, however beginners are not able to recognize their incorrect posture during the initial stage and consequences lead to one's physique and brain injuries. For that reason, it is mandatory to have proper body alignment from the beginning. Using Deep learning algorithms, a technique to detect inappropriate yoga postures of a user. The first real-time multi-person system,Open pose, transformed the area of estimating a human body stance.With minimal latency, the proposed algorithm estimates and categorizes yoga positions into five main groups. Its intention is to act as a source for both academics and industry researchers looking into different Yoga position identification technologies. We evaluated the most recent and promising deep learning algorithms for Yoga stance monitoring and recognition.Using the media pipe and the OpenCV library, the input is preprocessed as an image, the object is recognised, and the core of the human body are identified. Training and testing logistic regression models.Media pipe and the OpenCV library are used to identify any photos that have been preprocessed as an input form.At the end of the paper, barriers and future developments are discussed. This survey can help researchers better understand current systems and propose new ways by solving the stated difficulties.

INTRODUCTION

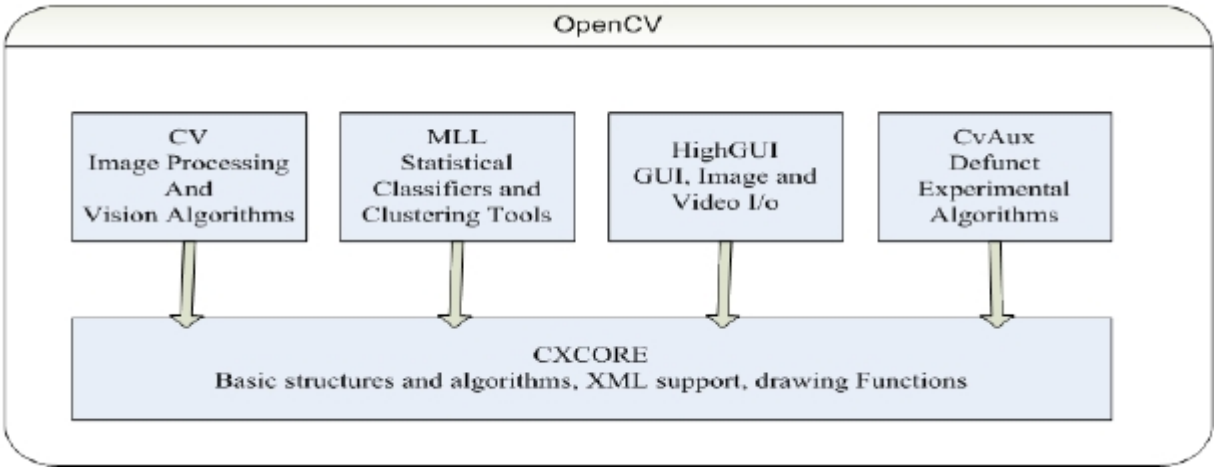
Human posture identification is a challenging and time-consuming operation in the field of computer vision.It is concerned with the localisation of human joints in a photograph or video in order to create a skeleton representation. Finding a user's activities in a photograph may be difficult since it depends on a number of factors such as image scale and determination, lighting fluctuation, backdrop confusion, venture variations, and human contact with the environment. The concern with yoga is that, like any other workout, it is critical to perform it correctly, since any wrong posture during a yoga session is generally ineffective and sometimes harmful. As a result, an instructor must be present to monitor the session and maintain good posture.

Human posture estimation has improved immensely from machine learning in recent years, with huge improvements in accuracy. This study aims to gain understanding by researching various approaches to yoga position categorization. This project includes referrals from unpublished articles, technical reports, and newspapers. The second section discusses cause estimation and extensively covers many types of cause estimate methods, going one level deeper to explain statistical formulas. Different methods for cause extraction are then discussed in combination with machine learning-based models Like logistical regression and python libraries like MediaPipe, OpenCV for cause estimate.

PROPOSED METHODOLOGY

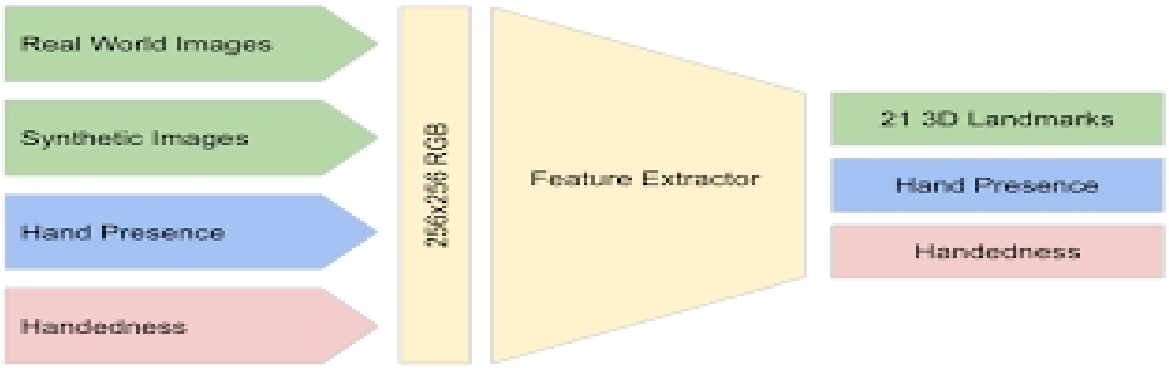
OpenCV

OpenCV is written in the Python open-source library used for computer vision in applications such as artificial intelligence, machine learning, and face recognition. It performs upon each picture frame. It includes library files that are used to compute angles. It operates a camera that detects the difference between a genuine image and an unknown one.



MediaPipe

MediaPipe Posture is a machine learning technique for high-fidelity body pose tracking that uses RGB video frames to infer 33 3D landmarks and a background segmentation mask over the entire body. The pipeline initially locates the human region-of-interest (ROI) inside the frame using a detector. Following that, the tracker masks within the ROI uses the cropped picture as input MediaPipe. Pose may be used to generate a full-body segmentation mask.



Requirements

```
pip install mediapipe
pip install keras
pip install tensorflow
pip install opencv-python
pip install numpy
```

```
for i in os.listdir():
        if i.split(".")[-1] == "npy" and not(i.split(".")[0] == "labels"):
                if not(is_init):
                        is_init = True
                        X = np.load(i)
                        size = X.shape[0]
                        y = np.array([i.split('.')[0]]*size).reshape(-1,1)
                else:
                        X = np.concatenate((X, np.load(i)))
                        y = np.concatenate((y, np.array([i.split('.')[0]]*size).reshape(-1,1)))

                label.append(i.split('.')[0])
                dictionary[i.split('.')[0]] = c
                c = c+1


for i in range(y.shape[0]):
        y[i, 0] = dictionary[y[i, 0]]
y = np.array(y, dtype="int32")


y = to_categorical(y)

X_new = X.copy()
y_new = y.copy()
counter = 0

cnt = np.arange(X.shape[0])
np.random.shuffle(cnt)
```

```
for i in cnt:
        X_new[counter] = X[i]
        y_new[counter] = y[i]
        counter = counter + 1


ip = Input(shape=(X.shape[1]))

m = Dense(128, activation="tanh")(ip)
m = Dense(64, activation="tanh")(m)

op = Dense(y.shape[1], activation="softmax")(m)

model = Model(inputs=ip, outputs=op)

model.compile(optimizer='rmsprop', loss="categorical_crossentropy", metrics=['acc'])

model.fit(X_new, y_new, epochs=80)


model.save("model.h5")
np.save("labels.npy", np.array(label))
```

IMPLEMENTATION

Image Capture

In the beginning stage, use an RGB camera to capture the image.
The RGB camera is used to collect colour and depth pictures. The camera is installed and fixed on a tripod with a suitable frame that centres the person executing the yoga positions. The camera and the user are kept at a distance of 4 to 5 metres.

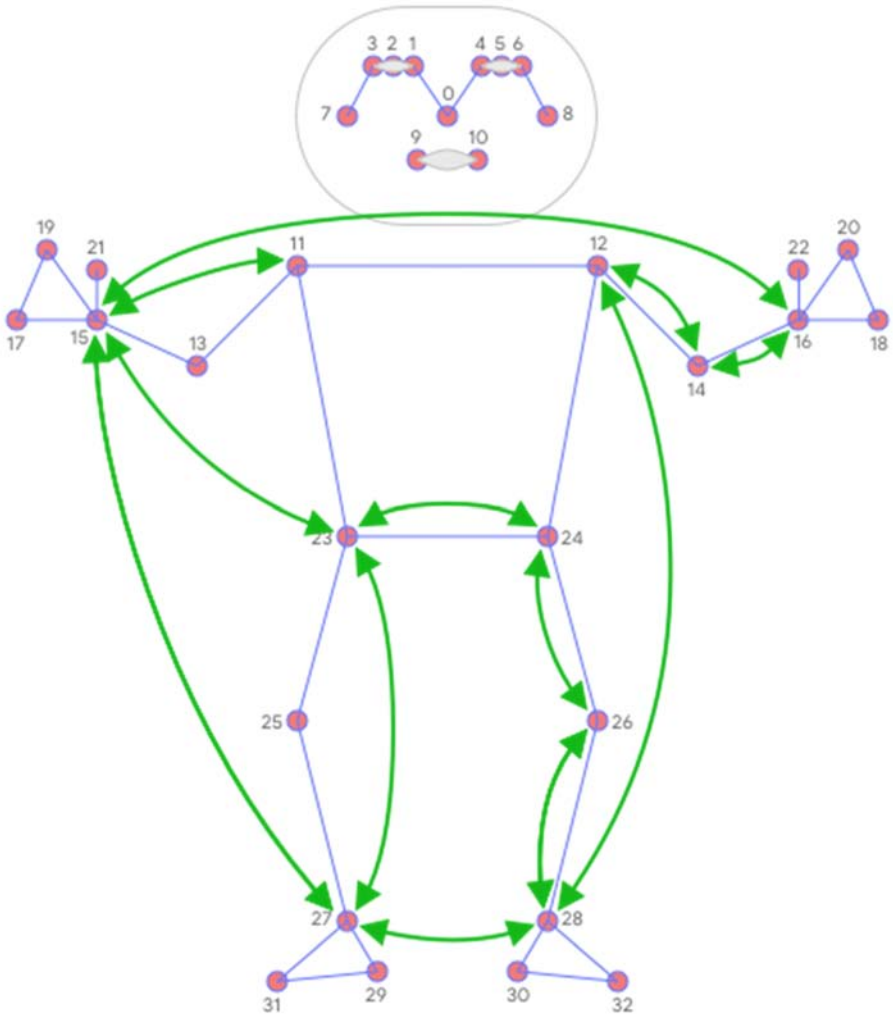
View Image

In the second step, use the function to take a sample image. Opencv will be used to read the picture.

Carry out Landmark Detection

In the third step, a human skeleton of the human practicing the yoga positions is created using mediapipe, and the findings are presented as 33 basic essential points:

Following the pose identification, a total collection of thirty-three points identifying the main person's body joint positions in the image is generated. Each landmark contains:
x: The picture width normalizes the landmark x-coordinate to [0.0, 1.0].
The picture height normalizes the landmark y-coordinate to [0.0, 1.0].
z: The z-coordinate of a landmark adjusted with the same level as x. It represents the depth of the landmark, with the origin being the halfway of the hips, therefore the lesser the number of z, the near the position to the camera.



Pose Classification with Angle Heuristics

Classify various yoga positions using estimated angles of various joints in the fourth step.
The first point is the starting point of the first line, the second point is considered as the ending point of the first line as well as the starting point of the second line, and the third point is the ending point of the second line.

Pose Classification

Finally, the stance can be categorized based on a different combination of body part angles. Initialize the pose's label. At this point, it is not recognised as 'Unknown Pose.' Measure the necessary angles, and if the stance is properly identified, change the color with which the caption will be printed on the image.

Modeling and analysis

Our method seeks to detect the user's Yoga asanas from real-time footage. The procedure is divided into four major phases. First, data collection is undertaken, which is a real-time procedure that occurs concurrently with detection. Second, Mediapipe is utilised to determine the joint positions to detect the visible joints and estimate the location of the non-visible joints using Leonardo's Virtuvian man idea. The discovered keypoints are fed into our model, where logistic regression detects patterns and examines their evolution over

time. Next, the model and training technique of framewise prediction and polling strategy for distinct images with probability range is predicted as output with the name Asanas are explained.

PREPROCESSING

The Python library is used for data preparation and includes features such as comprehensive file format support, fast internal representation, thumbnail creation, picture file format conversion, and image filtering.

FEATURE EXTRACTION

Mediapipe and the OpenCV library are used to extract features. We must follow the procedures during feature extraction. 1. We collect picture samples from the target workouts and use pose prediction to determine their poses. 2. We must convert the obtained posture positions to a structure appropriate for the learner and create a training set from these vectorized keypoints. 3.We then did categorization.

MODELING

The structure of each yoga posture is determined by the x, y, and z values of the joint locations. To categorise data and detect the yoga stance, we employed a logistic regression model. The x, y, and z values are provided to the model as X as an input and Y as an output respectively. 70% of the data was utilised for training and 30% for testing. Our model is nearly perfect.

CONCLUSION

A yoga posture classifier that works properly on photos, static video, and live video of any user was successfully built in this study. The research begins with the construction of an environment and then moves on to data collecting from open data sources. The Mediapipe posture estimating library is used for human position estimate, which produces body key points, which serve as the foundation for a new dataset. The target variables are then adjusted during data preparation. Following this, data is normalised for improved performance of machine learning algorithms, and feature engineering of features begins, with different joint angles of the body determined using the method.Because the data has been thoroughly preprocessed, it is eventually supplied to machine learning models. These models are evaluated on test data and compared based on their accuracy score. Among all classifiers, the logistic regression classifier has the highest score of 94%. For categorization, a threshold value of 97% is employed.

FUTURE WORKS

The models' performance is determined on the accuracy of OpenPose posture estimation, which may fail in circumstances of overlap between participants or overlap among body parts. This system may be equipped with a portable device for self-training and real-time forecasts. This paper exhibits the use of activity recognition in real-world situations. A similar method may be used for posture identification in applications such as sports, monitoring, and healthcare. Multi-person pose estimation is a completely new subject with a lot of room for investigation. There are several instances in which a single person posture estimate would not enough; for example, pose estimation in overcrowded scenarios would need tracking and detecting the pose of each participant.Many of the characteristics highlighted previously in this survey, such as backdrop, lighting, overlapping figures, and so on, would make multi-person posture estimate even more difficult.

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Damping of Power Flow and Frequency Oscillations in a Transmission Line by incorporating Unified Power Flow Controller

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Abstract. Current power systems are huge networks with number of interconnections. A power system may experience disturbances like switching of transmission lines and switching of loads. A design of dynamic model of Unified Power Flow Controller (UPFC) is presented here post brief review of operating principles. In this paper, the simulation three phase full controlled circuit is used to build the converters. SPWM technique is used for generating firing pulses for the IGBT switches. The active and reactive power characteristics are analyzed for switching of transmission line and a switching of load in the two-machine power system considered. The simulation results show the effectiveness of Unified Power Flow Controller device to damp the oscillations of active power, reactive power and frequency oscillations for the two disturbances considered.

Keywords— UPFC, Power flow control, Oscillations damping.

INTRODUCTION

Unified Power Flow Controller is an effective FACTS (Flexible AC Transmission System) device able to simultaneously perform the function of STATCOM (Static Synchronous Compensator) and SSSC (Static Synchronous Series Compensator). The SSSC block is responsible to inject the voltage as per requirement in series with the line. The power flow and voltage can be controlled in a transmission line by controlling the series injected voltage using a series injection transformer. The simulation result shows the ability of a Unified Power Flow Controller device damping the oscillations when the two kind of disturbances occur on a transmission line in the test system. The certain disturbances are switching of one of the parallel lines and switching a load at the receiving end.

MODELING OF UPFC

Operating principle of UPFC

The building block diagram of Unified power flow controller is presented fig. 1. STATCOM block is a voltage source converter (VSC1) acting as a rectifier. STATCOM block is connected in parallel to the transmission line with help of a transformer T_{sh}. The SSSC block is also a voltage source converter working as an inverter and connected in series with the transmission line by a transformer T_{se}. STATCOM (Block 1) and SSSC (block 2) can be termed as Series-Shunt connected device with the transmission line. The STATCOM and SSSC blocks are connected with help of a capacitor.

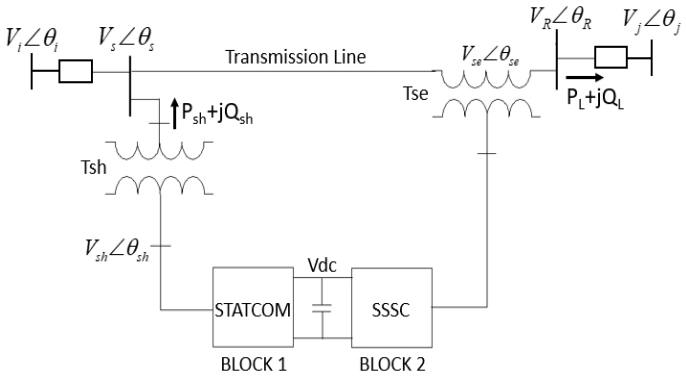

FIGURE 1. *Basic block diagram of UPFC*

The SSSC block inserts a certain amount of voltage V_{se} at a phase angle $\bar{}_{se}$ in the transmission line by a series injection transformer T_{se} connected at the output of SSSC. The STATCOM supplies active power (real power) to the SSSC through the DC capacitor. The STATCOM part converts the AC voltage available at the shunt terminals into DC voltage and helps to charge the DC capacitor. The SSSC is gets the input DC supply from the capacitor charged by STATCOM and inverts the DC voltage at the frequency matching with the line frequency. The SSSC injects a voltage for compensation with help of series injection transformer T_{se}.

UPFC model

Referring fig. 2, $V_{dc\ ref}$, V_{dc}, $V_{s\ ref}$, V_s, P_L, P_{Lref}, Q_L, Q_{Lref} are various parameters relating the shunt and series control blocks. V_{dc} is termed as the voltage across the capacitor. The STATCOM contains the three phase bridge full controlled circuits. To fire the IGBT switches, SPWM technique is used. The feedback variables for Shunt controller block are sending end voltage and V_{dc}. The active and reactive power values are the feedback parameters for SSSC (series control) block.

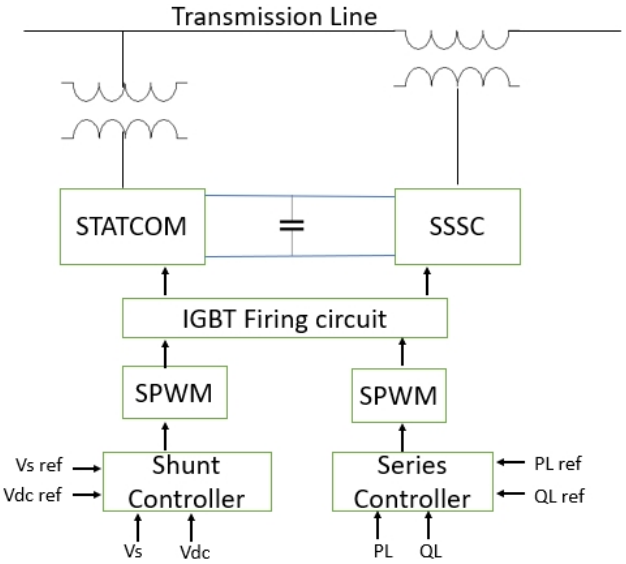

FIGURE 2. *Model of UPFC*

When UPFC is connected to the transmission system, referring to figure 1, the power in shunt side can be represented as follows:

$$P_{sh} + jQ_{sh} = Vs(\frac{V_s - V_{sh}}{jX_{T\,sh}})^*$$

$$= -\frac{V_{sh}V_s}{X_{Tsh}}\sin\bar{}_{sh} + j\frac{1}{X_{Tsh}}(V_s^2 - V_{sh}V_s\cos\bar{}_{sh}) \qquad (1)$$

Where $X_{T\,sh}$ = Equivalent reactance of transformer T_{sh}.

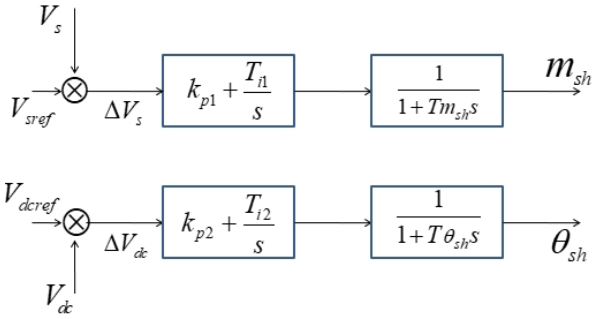

FIGURE 3. *Shunt converter block diagram*

Equation (1) shows that the V_{sh} affects the capacitance and flow of direction of real power $P_{sh.}$ Magnitude of V_{sh} affects Q_{sh} exchange between system and the shunt converter. Hence, the magnitude and phase of V_{sh} are chosen as the output parameters for the STATCOM (shunt) control block. The control block diagram is shown in fig. 3. In the block diagram it can be seen that m_{sh} affects magnitude of V1 and Θ_{sh} affetcs phase of V_1.

In the fig. 1, when the UPFC is connected to the system the transmission line power can be represented as follows:

$$P_L + jQ_L = V_R(\frac{V_R - V_j}{jX_{L2}})$$

$$= j\frac{1}{X_{L2}}V_R\angle\bar{}_R(V_R\angle(-\bar{}_R) - V_j\angle(-\bar{}_j))$$

$$= \frac{V_jV_R}{X_{L2}}\sin(\bar{}_R - \bar{}_j)$$

$$+ j\frac{1}{X_{L2}}(V_R^2 - V_RVjcos(\bar{}_R - \bar{}_j)) \qquad (2)$$

Equation (2) states that when $-90° < \bar{}_R - \bar{}_j < 90°$ condition is satisfied, the real power can be increased with the increment in V_R and $\bar{}_R - \bar{}_j$. The reactive power can be increased with the increment in $\bar{}_R - \bar{}_j$ and V_R when $0° < \bar{}_R - \bar{}_j < 180°$ condition is satisfied. The real power is determined by phase error of $\bar{}_R - \bar{}_j$ and reactive power is determined by V_R. Hence the magnitude and phase angle of V_R are the parameters as control variables. The series converter block diagram is shown in fig. 4.

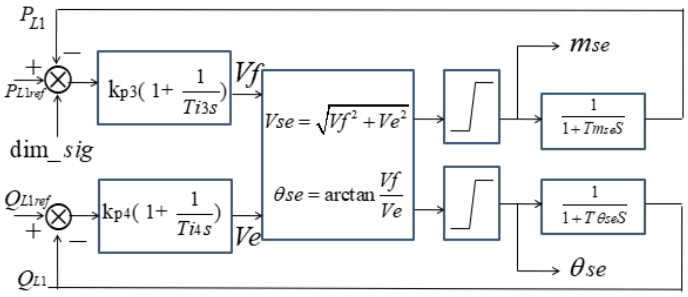

FIGURE 4. *Series converter block diagram*

I. SIMULATION OF TEST SYSTEM WITH UPFC

The simulation environment used is MATLAB/Simulink for demonstrating the use of UPFC for oscillations damping. The test system consists two generators, both of 11kV and a load connected through a circuit breaker to bus bar at generator 2. The transformer at generator 1 side is of 11/66 kV and at the receiving side is 66/11 kV. The transmission lines are having equivalent resistance of 1.69 Ω and inductance of 1.135 mH each.

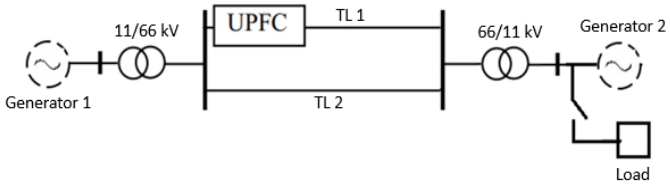

FIGURE 5. *Test system to be simulated*

Switching of one of the transmission lines

Figure 6 shows simulation of switching of a transmission line from one of the two parallel power carrying lines. During this switching, the load is considered switched OFF throughout the simulation of this case.

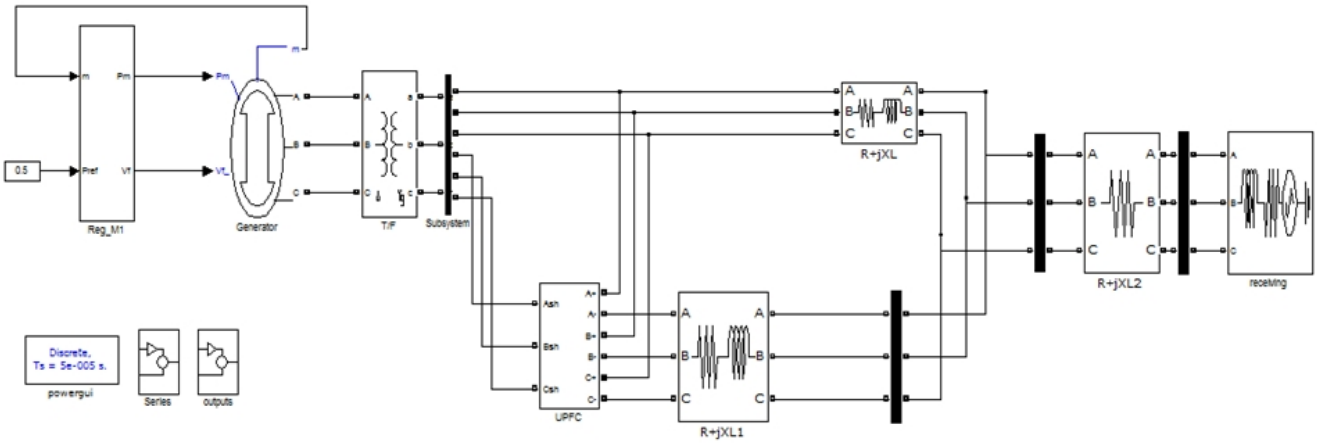

FIGURE 6. *MATLAB/Simulink Simulation of Switching one of the transmission lines*

The line -2 is switched on at the simulation time of 1 seccond. In this case the reference for active power flow is set to 18 MW for active power and 5 MVAr for reactive power transfer. The Kp1 = 0.05, Ti1 = 0.3, Kp2 = 0.2 and Ti2 = 1. Whereas the Kp3 = 1, Ti3 = 0.008, Kp4 = 8 and Ti4 = 0.008.

Sudden switching of load at the receiving end

Figure 7 shows simulation of switching of a transmission line from one of the two parallel power carrying lines. In this case the load is switched on at instant of 1 second. The parameters are K_{p1} = 0.05, T_{i1} = 0.3, K_{p2} = 0.2 and

T_{i2} = 1. Whereas the K_{p3} = 1, T_{i3} = 0.008, K_{p4} = 8 and T_{i4} = 0.008. The Active power reference is 15 MW and reactive power reference is 5 MVAr.

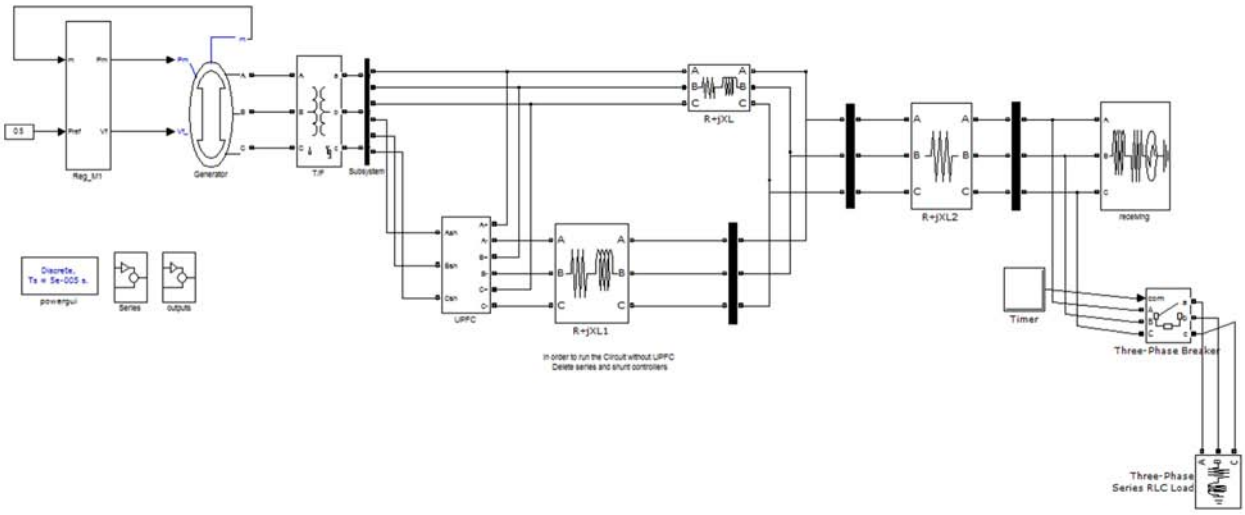

FIGURE 7. *MATLAB/Simulink Simulation of sudden switching of load at the receiving end*

UPFC parameters

Capacitance of DC charging capacitor is 9400 µF. The configuration of shunt transformer is of Y-D1. The LC filter shunt side is having capacitance of 1 µF and inductance of 12 mH. On the series side the RLC filter resistance is of 0.14 Ω, inductance of 22 mH and capacitance of 20 µF.

SIMULATION RESULTS

The simulation results have been obtained using MATLAB/Simulink and comparing the results for conditions without UPFC and with UPFC for the two cases of,

i. Switching of one of the transmission lines.
ii. Sudden switching of load at the receiving end.

Switching of one of the transmission lines

Simulation shows that after incorporation of UPFC the oscillations are well damped in active power, reactive power and system frequency. Figure 6 shows that Using UPFC, the oscillation of approximately 22 MW is damped to 18 MW in active power. Figure 8 shows that the oscillation in reactive power of approximately 7500 MVAr is damped to approximately 6250 MVAr with UPFC. Figure 10 indicates that the oscillations in frequency of 50.91 Hz has been damped to 50.82 Hz using UPFC.

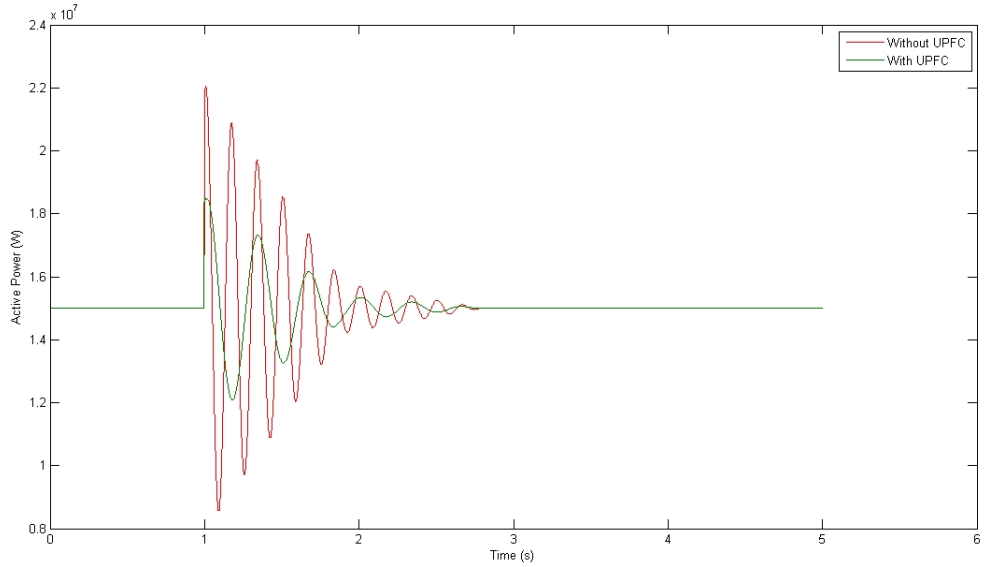

FIGURE 8. *Active power oscillations for switching of one of the transmission lines*

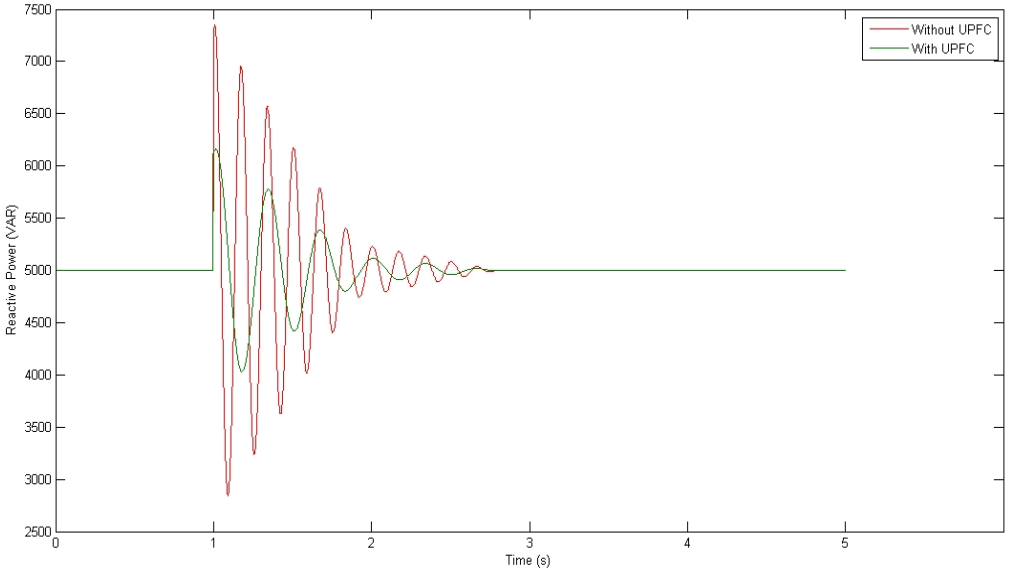

FIGURE 9. *Reactive power oscillations for switching of one of the transmission lines*

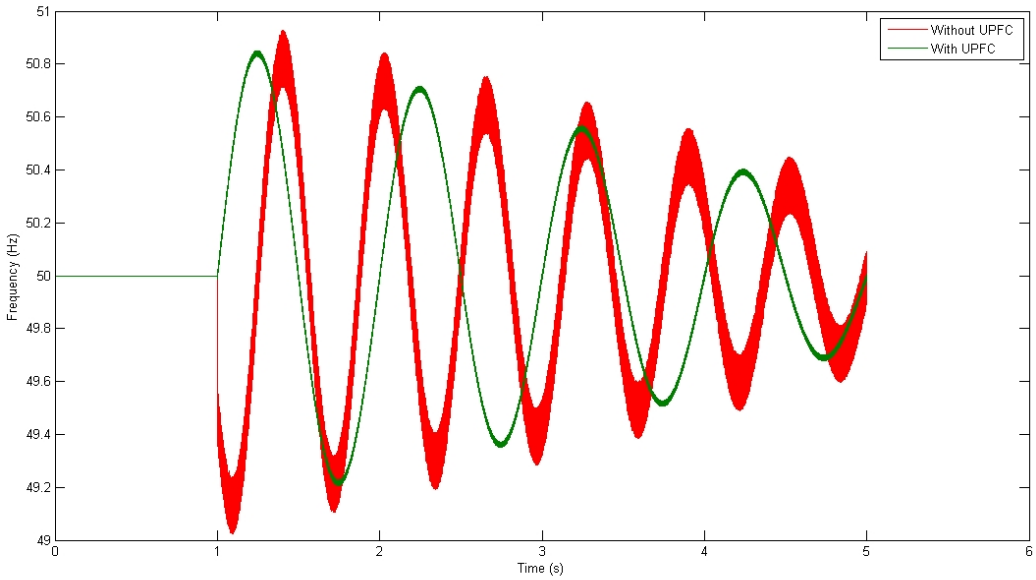

FIGURE 10. *System frequency oscillations for switching of one of the transmission lines*

Sudden switching of load at the receiving end.

Figure 10 shows that Using UPFC, the oscillation of approximately 22 MW is damped to 18 MW in active power. Figure 12 shows that the oscillation in reactive power of approximately 7500 MVAr is damped to approximately 6300 MVAr with UPFC. Figure 13 indicates that the oscillations in frequency of 50.90 Hz has been damped to 50.82 Hz using UPFC.

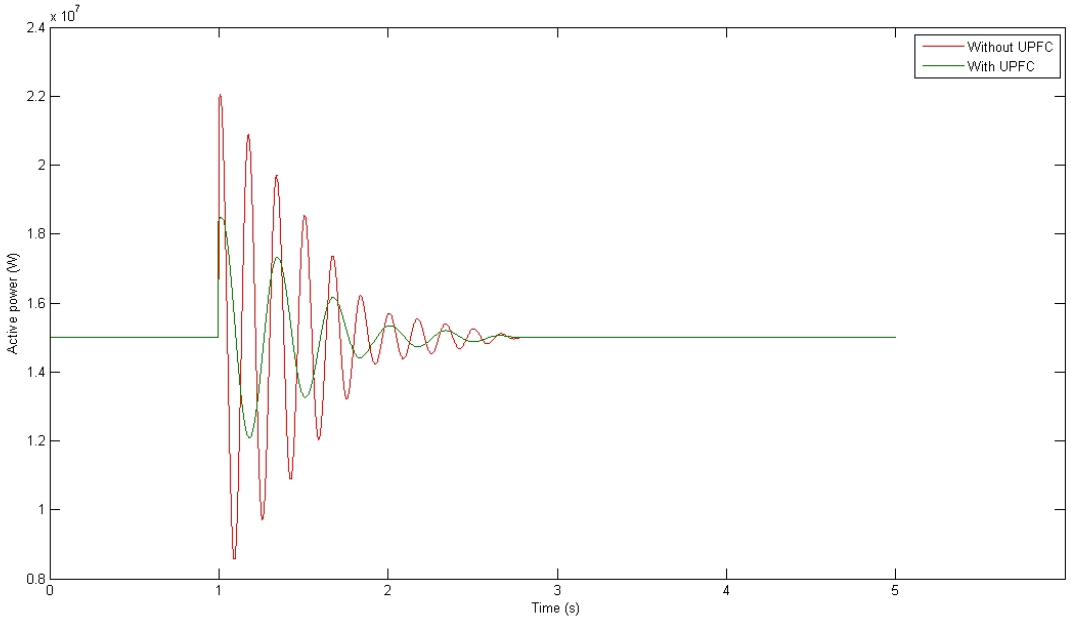

FIGURE 11. *Active power oscillations for sudden switching of load*

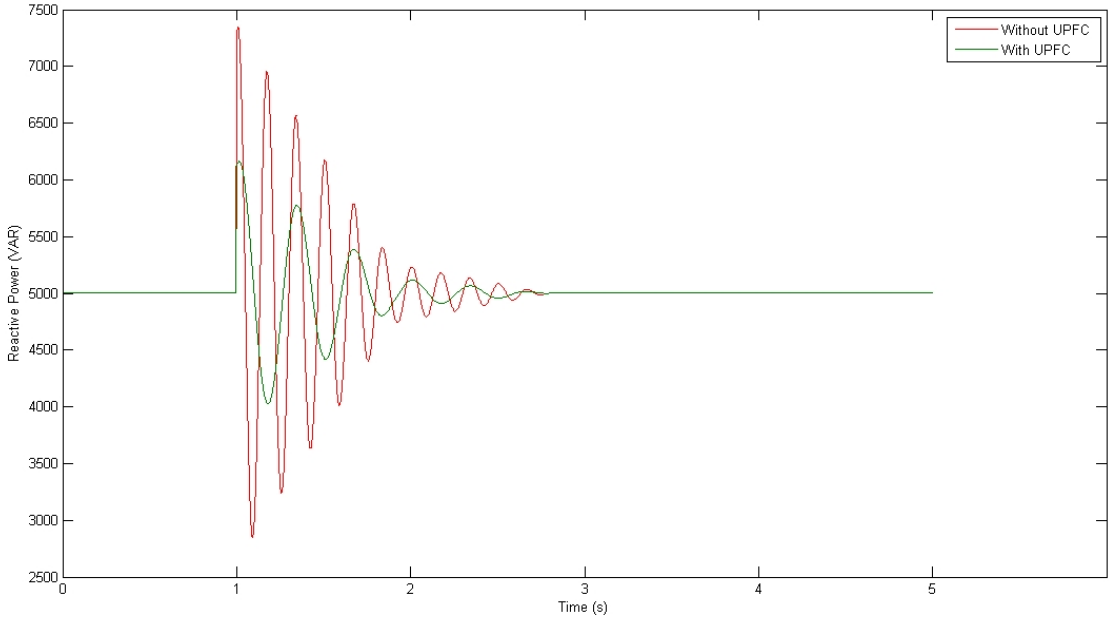

FIGURE 12. *Reactive power oscillations for switching of load at the receiving end*

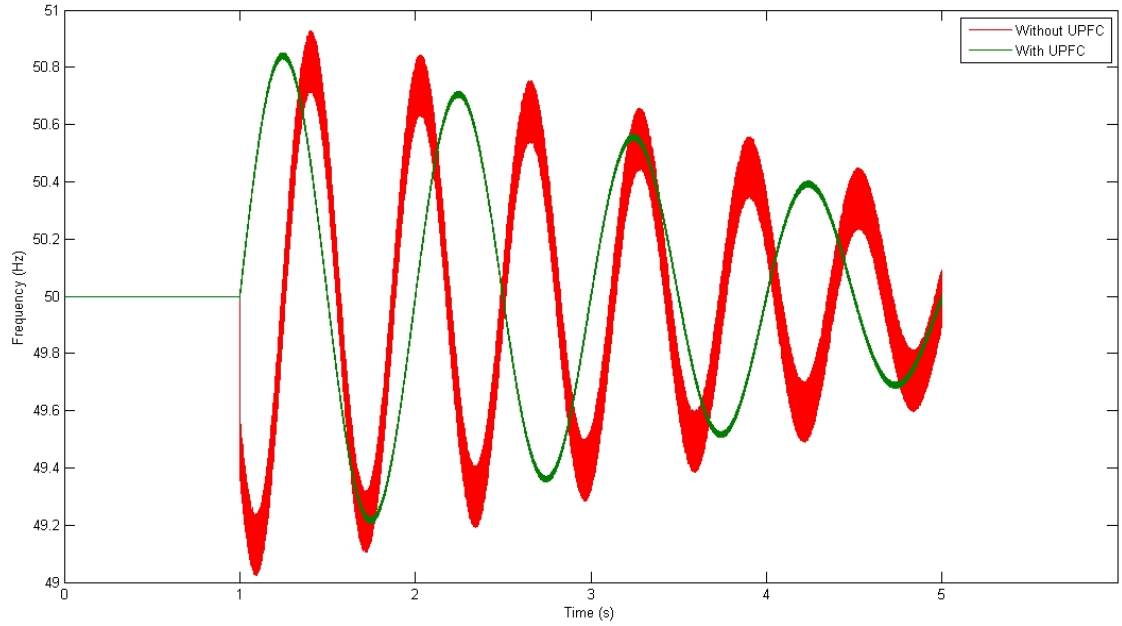

FIGURE 13. *System frequency oscillations for switching of load at the receiving end*

CONCLUSION

The MATLAB/Simulink simulation results of the test system without use of UPFC and with use of UPFC, shows that UPFC incorporated in this simulation is having the capability to damp the oscillations of active power, reactive power flow and system frequency oscillations in case of switching of one of the parallel lines and switching

of load at the receiving end. The effectiveness of UPFC in oscillations damping depend upon the designing of control strategy in an effective manner.

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Breast Cancer Classification using fine-tuned Convolutional Neural Network

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Abstract. Medical imaging uses fine x-ray systems to produce ultrasound images which aid in screening and diagnosing diseases. The result generated by the medical instrument consists of some speckle noise and shallow quality which really impacts the discovery of the infected regions. Therefore, to demonstrate the complex patterns of a latent region in the ultrasound images, a significant and reliable approach helps in the treatment to assist the classification and probable evaluation of the cause so that patients can recover at an early stage. Looking at the current situation, the majority of methods for breast cancer classification rely on manual approaches that are extremely cumbersome and lead to human errors. The dataset contains 1312 ultrasound images having a mean size of 560 x 750 pixels collected from patients having breast cancer types like benign and malignant. This paper proposes a fine-tuned convolutional neural network architecture to classify the type with the help of ground truth available in the labeled dataset. The final implementation of the proposed architecture along with data augmentation improved the metrics of the classification report significantly. This paper also compares the results with the approach of transfer learning and signifies the improvements in the terms of precision, recall, accuracy, and F1 score.

Keywords: Classification, Image Preprocessing, Data Augmentation, Deep Learning, Transfer Learning

INTRODUCTION

It is estimated that breast cancer causes the greatest number of women's deaths with over 8% of the mortality rate around the world [1]. About 80% of breast cancer diagnoses are IDCs (Invasive Ductal Carcinoma) [6]. Patients' chances of surviving breast cancer surge if it is diagnosed and classified properly. However, Mammography might occasionally reveal a worrisome spot that is not cancer, causing undue anxiety. The malignant form of breast cancer can grow rapidly and damage nearby tissues, making it the more dangerous form of breast cancer. Comparatively, benign breast cancer will grow slowly and doesn't cause much damage, unlike malignant cancer. This inherent characteristic will impact the accuracy metric in a breast cancer diagnosis due to intensity inhomogeneity. In addition, breast anatomic layers vary from person to person, causing anatomic layers to appear confusing [7]. However, the intricate structure of the breast and the limits of ultrasonography make it challenging to separate the tumor region from the surrounding tissue.

In the contemporary environment, deep learning algorithms have outperformed classic image analysis approaches in various research. However, due to the physics of ultrasonic imaging, speckle noise and a shadowing effect have appeared over the created images, decreasing image quality. In this paper, we conducted a detailed review of popular breast cancer classification methods. The proposed method produces significant results when tested on a well-known publicly accessible dataset. A dataset of 1312 images having types i.e. Benign and Malignant along with labeled ground truth has been utilized. In the transfer learning approach, models like ResNet50 [10], DenseNet201 [11], AlexNet [9], and VGG16 [8] are implemented. The data augmentation technique is also employed due to the lack of public datasets and to overcome overfitting. There is an extensive comparison between the baseline model and the transfer learning models in the paper.

RELATED WORK

An approach based on convolutional neural networks is used for classifying breast cancer types and extracting features. The transfer learning algorithms are employed as feature extractors from images in the previous models. In a number of studies, pre-trained models have been used to determine breast cancer subtypes using BUS histopathology images. To classify BUS datasets [13], authors in [2] used pre-trained deep learning models VGG16 [8] and AlexNet [9]. In [3], the authors introduced CNN as a method for extracting features from the BUS dataset [13]. Then, using data augmentation, they were able to balance out the class labels. Based on the data augmentation, the stated results for their method ranged from 88.3 percent to 94.1 percent.

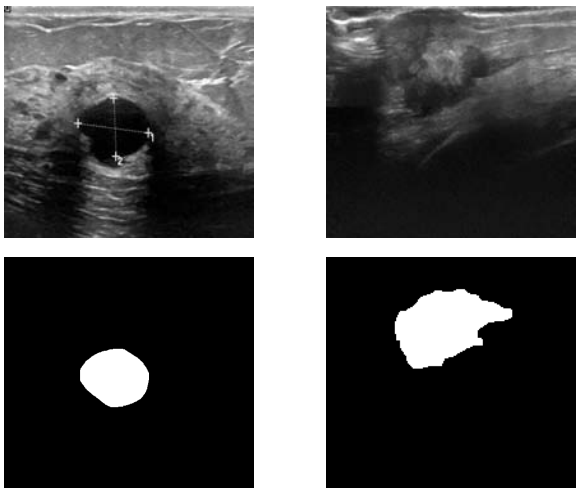
According to [4], the authors examined the inception-v3 [12] pre-trained model with previous works. In [4], the authors examine a BUS dataset [13] at different magnifications to differentiate between benign and malignant cases. The new two layers have been added to the last layer of AlexNet [9] by them. Then we used it to extract features and classify them. With 40 magnification, they acquired an improved f1-score of 94.6 percent for binary classification. However, they miss the multiclass task, which is one of the most challenging tasks in this domain.

[5] utilized VGG16 [8] with a magnification of 40X for BUS categorization. On multiclass classification, they scored 89.6 percent. Possibly, their poor performance could be explained by the fact that both models used convolutional neural networks as the classifier, which requires fine-tuning. As a result, supplying the features to the classifiers could yield positive results.

On the basis of previous research, we have made the following observations: As a first step, it is more effective to combine extraction and classification into a single model for better performance. Furthermore, scholars need to devote more attention to the BUS multiclass classification task. For addressing the dataset's imbalance, a data augmentation approach is necessary.

DATASET DESCRIPTION

The proposed breast cancer classification exploits the Breast Ultrasound Images Dataset (BUSI Dataset) [13] of 1312 images with a mean size of 560 x 750 pixels collected in 2020 from six hundred female patients between the ages of 25 and 75. Out of 1312, the benign class (Figure 1(a)) has 891 images and the remaining 421 are malignant(Figure 1(b)). Even ground truth mask images are included in both classes so that model can achieve higher performance by training ultrasound images and mask images too. The dataset has been imported with labels and furthermore, all the images are appended to the list for data wrangling and image pre-processing.



(a) (b)

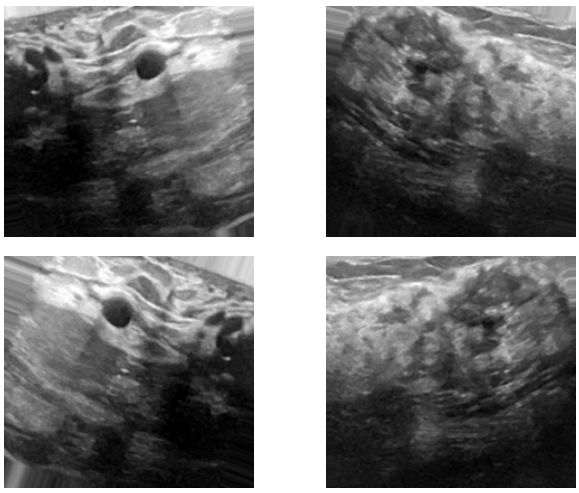
Fig. 1. Examples of images in the BUSI dataset [13]. (a) shows an ultrasound image of the benign class (first row) with its ground truth (second row) and (b) shows the malignant class (first row) with its ground truth (second row).

Data Pre-processing

A custom function has been made to process and transform the image data before any experiment. The transformation function reads images using the cv2 method and resizes the images by 128 x 128 pixels to enhance the chances of ground truth detection. All the images are rescaled and set to an RGB range of 0 - 255. In the same loop, labels are included simultaneously so they will be used for training. After converting the list of images into a NumPy array, the images are reshaped in the 1D array format. For the experiment, we also used ground truth mask images which helped to yield better results.

Data Augmentation

Data augmentation is applied to the dataset due to the lack of a public dataset in this domain and reduces overfitting. While generating more data, we implemented a few sets of transformations like horizontal flip, shear range of 0.2, and rotational range for 20 degrees which expands the scale up to 3057. From that 1791 images are malignant and the rest 1266 belong to the benign class. A similar pre-processing technique is then applied to new images to filter them and break them into training and testing sets. A total of 75% of the shuffled data is in our training dataset.



(a) (b)

Fig. 2. Set of filters applied in data augmentation. (a) shows benign class augmented images and (b) shows malignant class (second column) augmented images.

METHODOLOGY

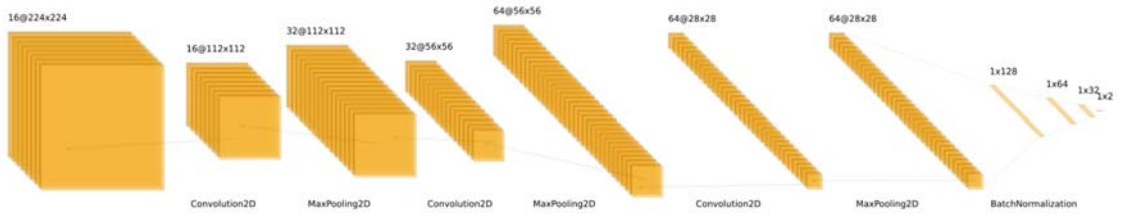


Fig. 3. Architecture of base model

In the proposed baseline model (Figure 3), we have utilized three convolution layers with 16, 32, and 64 filters respectively with the input feature shape of 128 x 128 x 1 to extract important features from the images. The MaxPooling2D layer validates the dimensionality reduction. A flatten layer converts the extracted features

into a 1D array. Later, the Dense layers with 128, 64, and 32 units are included. To reduce overfitting, we added a dropout layer with a rate of 0.3. As this dataset contains two classes, a sparse categorical cross-entropy loss function is utilized.

AlexNet

The AlexNet [9] comprises a total of eight layers with a range of parameters. It combines 5 layers followed by max pooling and 3 dense layers. These layers are loaded with ReLU activation aside from the output layer as it depends on the respective dataset. After precise observation, it is determined that utilizing the ReLU as an activation function sped up the speed of the process while training it multiple times. It also includes dropout layers to avoid overfitting.

ResNet50

We modified the ResNet50 [10] by removing the early layers. The flatten layer has been added before the output layer to reduce the dimensionality of extracted features by converting them into a 1D array. This is followed by an output layer comprising the number of classes per the dataset. Layers of the pre-trained model are set to false as trainable so it will only train the required layers.

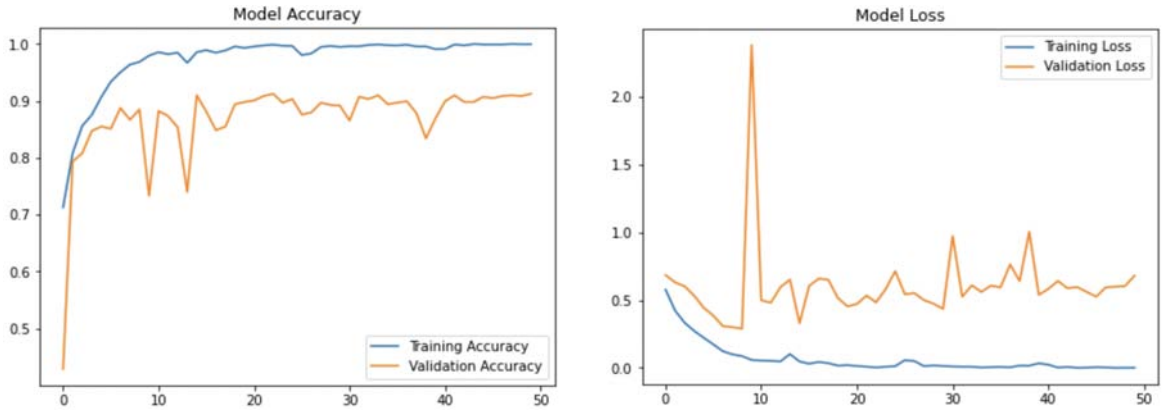
VGG16

[8] This pre-trained model contains 16 layers and the softmax activation function is used to compute the gradients in the last two layers including output. As per the requirement of input shape, all the images are resized by 299 x 299 minimum pixels. Such models provide excellent performance in fewer iterations.

Feature Engineering

Keras Tuner [14] is used for hyperparameter tuning. The main purpose of this approach is to achieve an optimal set of parameters for our model. There are two convolutional layers having a range of 16 to 128 with a step size of 16. The kernel size has the list of elements 4 and 5. Dense layers are implemented between the range of 32 and 128 along with the ReLU function. Lastly, the output layer has been added with softmax activation, and a random search yields the best model with hyperparameters in a maximum of 3 preliminaries.

RESULT AND DISCUSSION



(a) (b)

Fig. 4. Base model performance with data augmentation

Figure 4 demonstrates the results of a base model trained on augmented data. Figure 4(a) indicates that there is a slight difference between training and validation accuracy, while Figure 4(b) exhibits validation loss is quite high, indicating overfitting during training.

Confusion Matrix

The accuracy measures used to evaluate the breast cancer classification efforts are presented in this section. They're also used to show how accurate the measurement is. They are as follows:

I. *Accuracy*: In this way, we can determine whether the model correctly classified the cancer type, it is expressed as follows:
TM: True Malignant (Model classifies the malignant type of cancer correctly)
TB: True Benign (Model classifies the benign type of cancer correctly)
FM: False Malignant (Model fails to classify the malignant type of cancer correctly)
FB: False Benign (Model fails to classify the benign type of cancer correctly)

$$A = \frac{T + T}{T + T + F + F} \quad (1)$$

II. *Precision*: It is a metric that defines how much time our model classified a particular cancer type correctly. It is a ratio of classifying the type of cancer correctly to the sum of classifying cancer correctly and classifying cancer incorrectly. Higher the precision, the better our model.

$$P(M) = \frac{T}{T + F} \quad (2)$$

$$P(B) = \frac{T}{T + F} \quad (3)$$

III. *Recall (Sensitivity)*: For malignant, it is calculated as correctly classified malignant out of the total correct classification of malignant. Similarly, we can calculate for Benign.

$$R(M) = \frac{T}{T + F} \quad (4)$$

$$R(B) = \frac{T}{T + F} \quad (5)$$

IV. *F1-score (Dice Similarity coefficient)*: It evaluates the similarity rate between the correctly classified types of cancer and ground-truth regions by taking a harmonic average of precision and recall:

$$F1 - score = \frac{2 \times P \times R}{P + R} \quad (6)$$

TABLE 1

COMPARISON OF PERFORMANCE ACHIEVED BY TRANSFER LEARNING

Model	Cancer Type	Precision	Recall	F1-score	Accuracy
AlexNet	Benign	0.91	0.79	0.84	0.80
	Malignant	0.63	0.82	0.72	
ResNet50	Benign	0.79	0.90	0.85	0.77
	Malignant	0.69	0.48	0.56	
DenseNet201	Benign	0.75	0.95	0.84	0.75
	Malignant	0.71	0.30	0.42	
VGG16	Benign	0.72	0.98	0.83	0.73
	Malignant	0.80	0.16	0.86	

In the first row of Table 1, the overall performance of AlexNet is considered in the transfer learning approach. Further results are compared with the base model and Keras Tuner [14] using augmented data. A good performance is achieved by the base model on both original and augmented datasets.

TABLE 2

COMPARISON OF PERFORMANCE ACHIEVED BY BASE MODEL

Model	Data Augmentation	Accuracy
Base	0	0.85
	1	0.91
Base with Keras Tuner	0	0.82
	1	0.88

In the second column of Table 2, the sign 0 denotes that the model has been trained on the original dataset, and 1 indicates the use of augmented data while training. The results of Table 1 and Table 2 demonstrate that a fine-tuned base model achieves the highest accuracy and considerable validation loss.

CONCLUSION

Breast Cancer is a fatal disease that must be controlled, and numerous important procedures must be performed to avoid major infections. In the proposed system, a convolutional neural network is trained using a small set of images after the required pre-processing has been done. The results of the classification showed that the proposed design has potential as far as different known quality metrics. Various pre-trained convolutional neural network models are implemented in this paper to provide an accurate and reliable segmentation of breast cancer based on ultrasound images. There are 891 benign and 421 malignant cases in the dataset. In the wake of implementation and assessment, we observed that the best-performing models are the Base model, AlexNet [9], and ResNet50 [10]. We furthermore fostered a custom model since all pre-trained models comprise countless layers and consume more resources to train. The model can later be improved by tuning the models and increasing the size of the dataset by collecting images from different sites and machines. The results of test evaluation, architecture perception, accomplishment assessment, and outright insights can be used in every way to develop a computer-aided diagnostic tool that helps clinical professionals identify tissue types for future imaging procedures.

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Power Quality Improvement in Islanded Microgrid

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Abstract- The concept of Microgrid is develop in response to the need for reliable, flexible, high-quality power and environmental affordability. There are a number of control issues with regard to stability, power quality, and harmonics that arise when the microgrid is islanded, either intentionally or unintentionally. This study suggests a control strategy to enhance power quality by reducing harmonics and voltage swell in an islanded microgrid by injecting reactive power using a distribution static compensator (DSTATCOM). The simulations are made in MATLAB/Simulink environment. The objective of this study is to identify Voltage swell condition in islanded mode as per IEEE 1159-1995 standard and mitigate power qualities issues such as Voltage swell and Harmonics as per IEEE 519-2014 standard.

POWER SYSTEM SCENARIO, IMPORTANCE OF MICROGRID AND ISLANDING (POWER SYSTEM SCENARIO)

In these days, three phase system is widely used because we are able to convert power from one voltage level to another and supply it over long distances. In comparison to other modes of transmission, we can also transport power more effectively and relatively more cheaply. But now that unconventional sources are connected to the distribution systems, the electrical industry is undergoing significant upheaval. Power conversion devices are now incredibly widely available, and their performance efficiency has grown, making it possible. The entire electrical industry has become more environmentally friendly as a result of this. It has become necessary to connect the main grid with a microgrid that contains renewable energy sources in order to ensure that in the event of a failure of the main grid or some fault in the main grid, the microgrid is able to maintain the continuity of supply. This is due to the tremendous increase in demand for electricity and the need to maintain continuity of supply in important regions or for important applications such as railways, hospitals, airports, etc. to ensure the stability of the entire system.

Importance of Microgrid and Islanding

Microgrid aids the main grid in lessening its congestion as well as the line's losses, improving the efficiency of the line. Novel power generating technologies, such as renewable energy, clean and effective fossil fuels, and distributed generation, have been created to meet the steadily increasing demand for electricity and to increase energy consumption efficiency. The idea of a micro grid is coming into a shape to lessen the demand for the main grid, which is overloaded and has a high voltage distribution system. The world has already experienced a number of significant blackouts in the past. The main grid's collapse is mostly to blame for all of these outages. For instance, a fault in the main grid causes its voltage and frequency to collapse, which causes the majority of the

load to lose its supply. In these events various controlling actions to be taken to stabilize the voltage and frequency. When the microgrid is also connected to the main grid in this scenario, the issue worsens. In order to stabilize the voltage and frequency of the system if this condition persists in the main grid, adequate islanding of the microgrid is necessary. Islanding thus becomes one of the most crucial tools in this scenario. When a microgrid has many energy sources, such as solar, wind, diesel, turbo units etc. it is referred to as a hybrid micro grid and can run both islanded and grid connected mode.

Islanding occurs in two ways in which one is intentionally and another is unintentionally. When maintaining the quality of power is necessary, it is done on intentionally. But unintentional islanding occurs when a fault occurs in the main grid. When we have to deal with the overall system's stability problem, which is to maintain the system's stability and also protect the people who operate in that system, unintentional islanding becomes crucial. Additionally, it aids in the protection of the various systems associated equipment. Islanding helps to protect the microgrid from any disturbances that may have occurred in the main grid. Islanding is used to disconnect the microgrid from the main grid in addition to identifying the main grid's faulty condition. Actually, when an island is created, the circuit breaker between the main grid and the microgrid trips. When islanding occurs between the micro grid and utility grid, the micro grid is very helpful. Loads continue to get energy from the micro grid even after the main grid has been disconnected. However, taking into account non-linear loads, it may result in several power quality problems such as voltage imbalance, voltage swell, voltage sag, and harmonics after islanding. Due to the problems with the power quality, it is likely that other component parameters will be affected, resulting in data loss, an increase in maintenance costs, damage to other components, a decrease in system reliability, or a shorter lifespan for the system or its components. Therefore, when islanding occurs between the Micro grid and Utility grid, power quality issues must be addressed.

THEORY AND FORMULAS

Multiple PV modules connected electrically in series-parallel combination to form a large PV system known as PV array. In these studies, Microgrid is made of PV array and Nonlinear load. Microgrid is connected to the utility grid or Main grid. PV array produce energy and supplies energy to Main grid through Microgrid.

Maximum output voltage of PV array = V_{mp}*Series-connected modules per string (1)

Rated power of PV array (P) = P_{mp}* Series-connected modules per string* Parallel strings (2)

Where, Vmp = Voltage at maximum power point
Pmp = Maximum Power at maximum power point

Equation (1) gives Maximum output voltage of PV array. Equation (2) helps to calculate rated power of PV array. The Perturb and Observe (P&O) method is used in these studies for maximum power point tracking (MPPT) in solar systems.

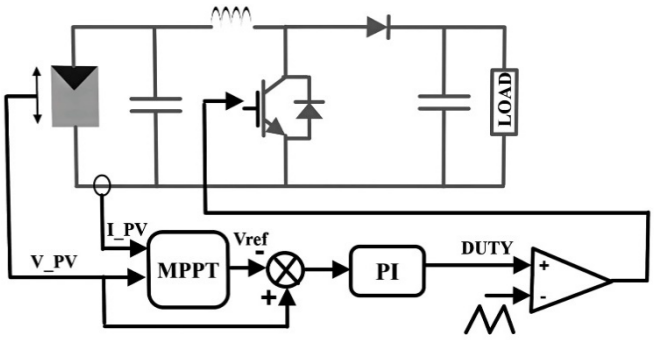


Fig. 1 Proposed circuit of PV array with Boost converter

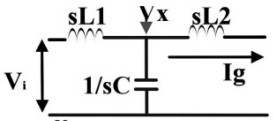
A boost converter is a DC-to-DC power converter that raises the input voltage to a higher level. A capacitor, inductor, or a combination of the two is required as at least one energy storage component in this class of switched-mode power supplies.

$$\text{Inductance (L)} = \frac{V_{in}\,(V_{out} - V_{in})}{\Delta I * f_s * V_{out}} \tag{3}$$

$$\text{Capacitor (C)} = \frac{I_0 (V_{out} - V_{in})}{f_s * V_{out} * \Delta V} \tag{4}$$

Above equations are helps to find out values of these capacitor and inductor to design boost converter. Harmonic mitigation is employed in grid-connected inverter systems by using passive filters such the L, LC, and LCL filters. LCL filters are among the most efficient and effective passive filters.

High attenuation, enhanced performance, economic effectiveness, and reduced weight and size are all benefits of LCL filters. With low values of inductors and capacitors, the LCL filter provides effective harmonic removal.



$$\frac{V_i - V_x}{sL1} = I_g + \frac{V_x}{\frac{1}{sC}} \longrightarrow (1) \qquad V_X = I_g sL2 \longrightarrow (2)$$

$$\frac{I_g}{V_i} = \frac{1}{S^3 L1L2C + s(L1 + L2)} \quad Let, L1 + L2 = L \;\&\; L_p = \frac{L1L2}{L1 + L2}$$

$$\boxed{\frac{I_g}{V_i} = \frac{1}{sL(1 + S^2 CL_p)}} \qquad w_{res} = \frac{1}{\sqrt{CL_p}}$$

$$\frac{I_g}{V_i} = \frac{1}{sL(1 + S^2 CL_p)} \qquad w_{res} = \frac{1}{\sqrt{CL_p}}$$

$$\frac{I_g}{V_i} = \frac{1}{sL\left(1 + \frac{S^2}{w_{res}^2}\right)} \quad s \rightarrow jw_{sw} \quad \frac{I_g(sw)}{V_i(sw)} = \frac{1}{jw_{sw}L\left(1 + \frac{(jW_{sw})^2}{w_{res}^2}\right)}$$

$$\left|\frac{I_g(sw)}{V_i(sw)}\right| = \left|\frac{1}{w_{sw}L\left(1 - \frac{W_{sw}^2}{w_{res}^2}\right)}\right| \qquad L = \left|\frac{1}{w_{sw}\frac{I_g(sw)}{V_i(sw)}\left(1 - \frac{W_{sw}^2}{w_{res}^2}\right)}\right|$$

$$Q = \frac{V^2}{X} \qquad \text{Where, } Xc = \frac{1}{W} = \frac{1}{2 * \pi * f * C}$$

Values of Inductor and Capacitor determined by above equations to design LCL filter. An inverter, often known as a power inverter, is a power electronics device that transforms DC voltage into AC voltage. No additional components are needed to control the output voltage, when we are using PWM technique. For the same fundamental voltage, PWM inverters have less harmonic content than square wave inverters. To produce an output waveform that is more resemblant of a sine wave, higher input DC voltage levels are used.

Switching frequency is common for overall system. The values of the design parameters for the PV array, Boost converter, and LCL filter are shown in the suggested model below using the aforementioned formulas.

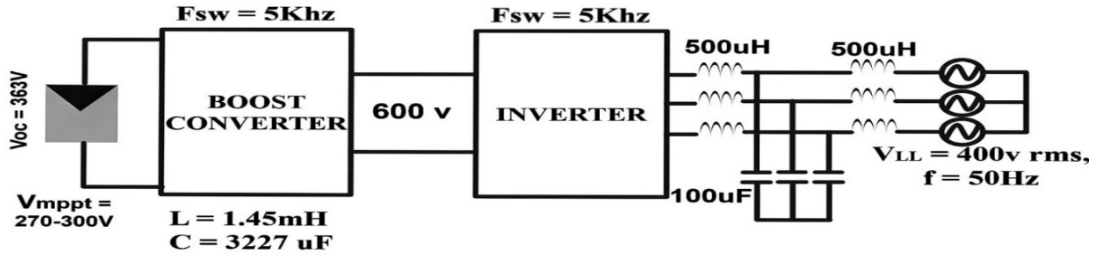


Fig.2 Grid connected PV system

In simulation, the Park and Clarke transformation methods have used to create controlling circuits. When approaching these methods, the number of compensators reduced and various controls such as PI and PID become simple to use in two reference frames.

The DSTATCOM is a shunt-connected compensator that quickly exchanges reactive power with an ac power system to increase dynamic voltage control, prevent voltage collapse, and dampen power oscillations.

A Three phase inverter using SCRs, MOSFETs, or IGBTs makes up a DSTATCOM. In a low-medium voltage power distribution system, DSTATCOM is among the greatest custom power device. For the distribution system's distribution static compensator (DSTATCOM), Without using a separate reactive power supply, DSTATCOM is mostly utilised for VAR compensation, can offer a cost-effective option to improve voltage regulations and reactive power and also unbalanced loading can be compensated. The DSTATCOM coupled with an energy storage system to increase efficiency. The control algorithm used for the extraction of reference current components affects how well DSTATCOM performs.

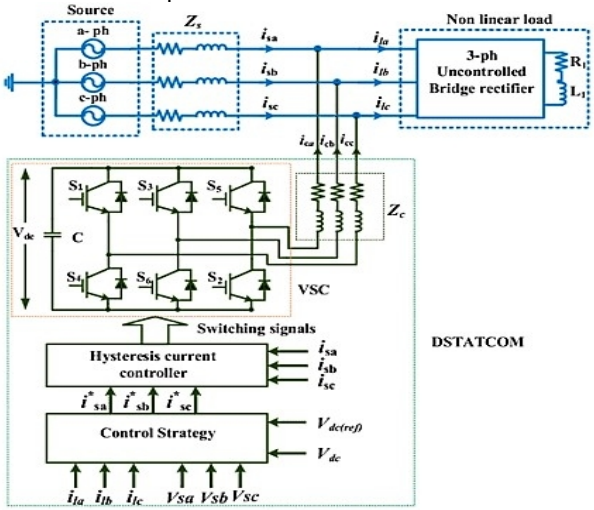


Fig.3 Proposed circuit of DSTATCOM connected with Grid

A ripple filter, interface inductor, and voltage source inverter are all included in the DSTATCOM's architecture. A DSTATCOM supplies reactive power as needed by the load for reactive power adjustment, so the source current maintains unity power factor (UPF).

SIMULATION & RESULTS

These studies proved in MATLAB/Simulink. Simulation of Microgrid with utility grid shown in figure. Rating of utility grid is 11Kv and 50Hz taken to make real scenario in power systems.

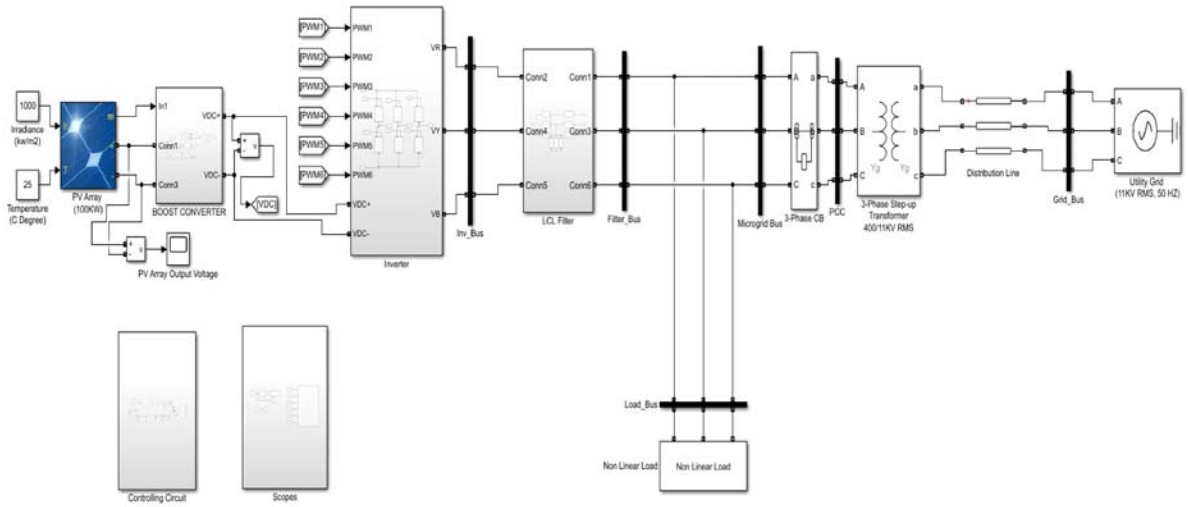


Fig. 4 Power quality issues in islanded Microgrid

PV array (rated 100KW) generates energy and supplies it to the Microgrid, while the Microgrid provides energy to the utility grid and nonlinear loads. The maximum output voltage of the PV array is 290V DC. The boost converter assists in increasing the voltage up to 600V DC. The voltage waveforms of the PV array and the Boost converter are shown in the results below.

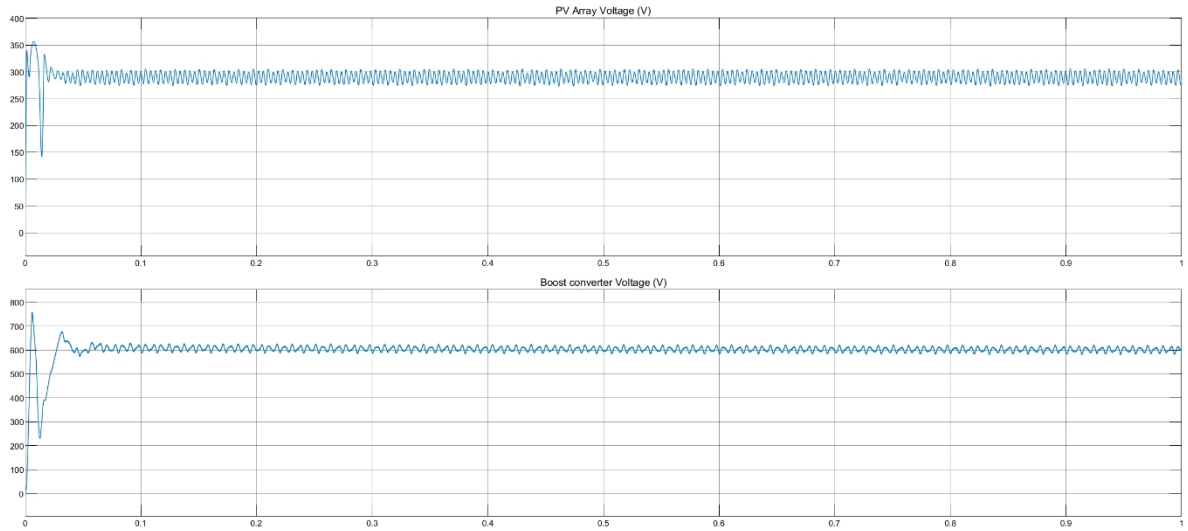


Fig. 5 Waveforms of PV array voltage and Boost converter Voltage

The inverter converts DC voltage (600V) to AC voltage (415V). These results have a high number of harmonics. THD of output inverter voltage measured is 77.17%. The LCL filter reduced total harmonics distortion to within the IEEE standards allowable range. THD is reduced to 4.61% with the help of an LCL filter. The voltage and current waveforms of the Inverter are shown in the results below.

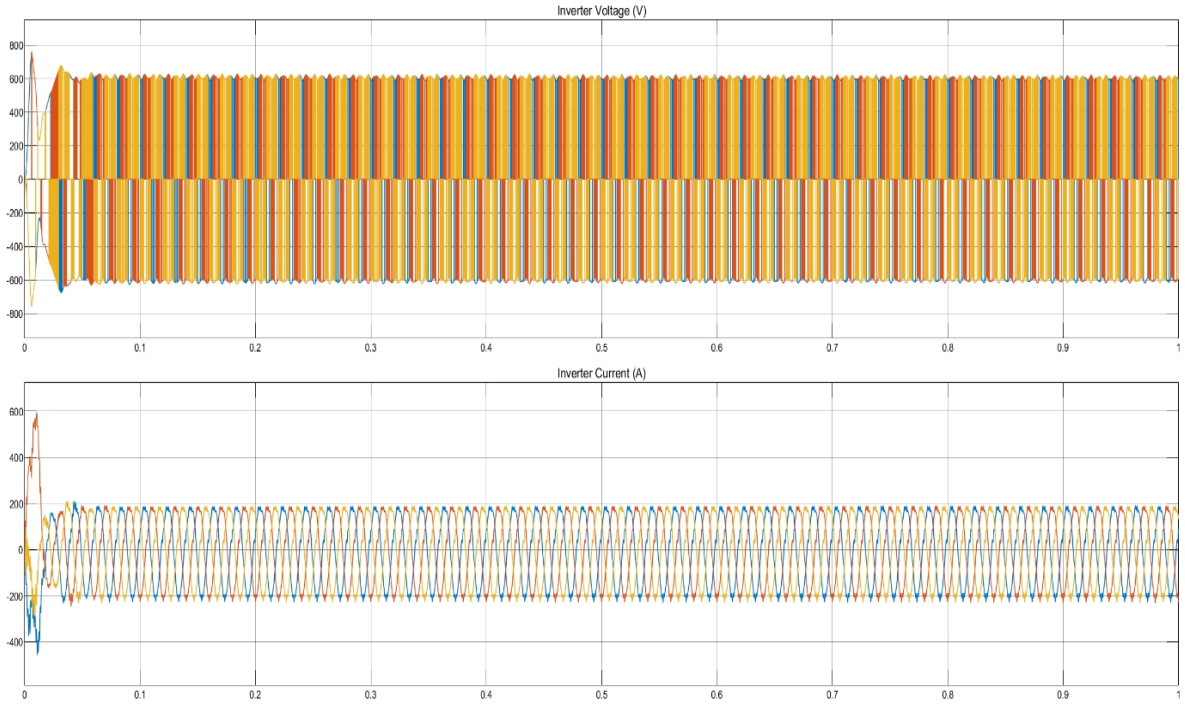


Fig. 6 Waveforms of Inverter voltage and current

The output voltage and current waveforms of the LCL filter are shown in the results below.

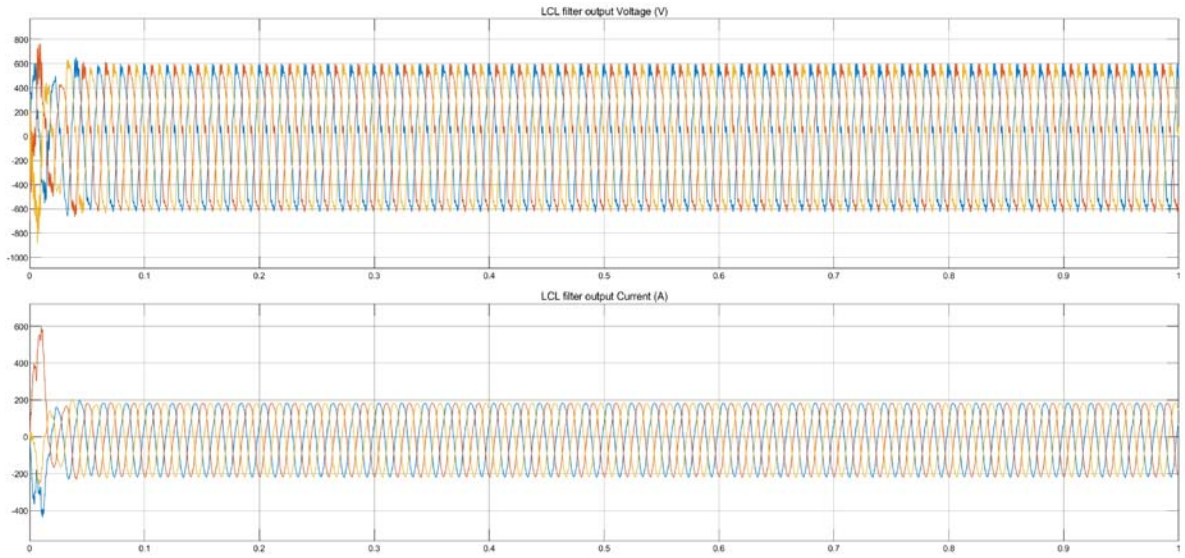


Fig. 7 Waveforms of LCL filter output voltage and current

Step-up transformer used in simulation to step up voltage 415V to 11Kv. Through a distribution line (100Km), this power was supplied to the utility grid. Three phase circuit breaker used in simulation for Islanding generation. Three phase circuit breaker adjusted at 0.3s. After 0.3s utility grid and Microgrid are disconnected to satisfy islanding condition between Microgrid and utility grid. Voltage swell is produced at nonlinear load after islanding. The voltage waveforms of the Utility grid and the Microgrid are shown in the results below. THD increased 4.61% to 15.67% at nonlinear load. As a result of the utility grid and microgrid being disconnected following an islanding, the utility grid or PCC current is zero. The current waveform of the PCC is shown in the results below.

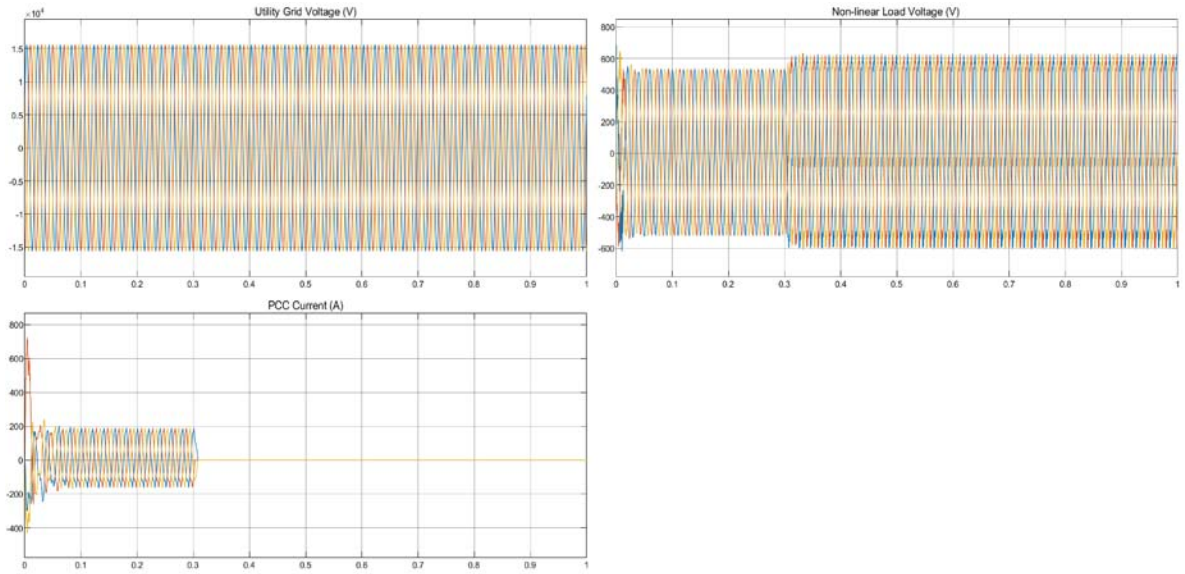


Fig. 8 Waveforms of Utility grid voltage, Nonlinear load voltage and PCC Current

This voltage swell effect also affect on PCC shown in results below. Voltage swell is produced at PCC after Islanding. Similarly, THD increased 4.61% to 15.67% at PCC. If other loads or sources are connected with PCC then this voltage swell affects also on these loads or sources. In this simulation proven that power quality issues such as voltage swell and THD produced in islanded Microgrid. This power quality issue also has an impact on PCC.

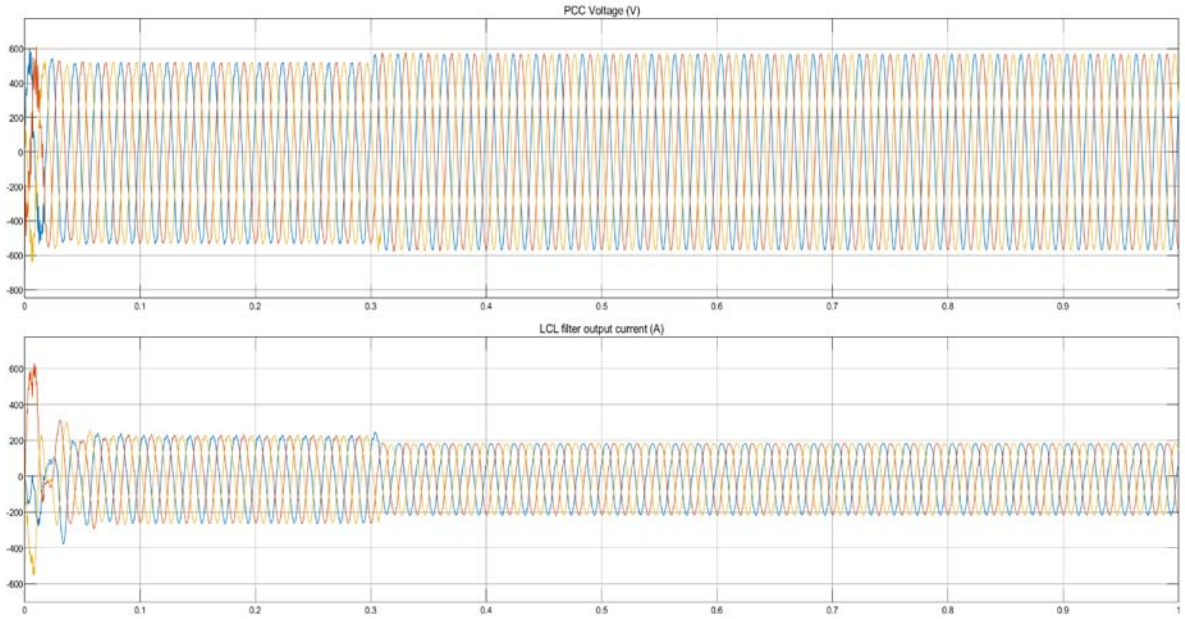


Fig 9. Waveforms of PCC voltage and LCL filter output current

Voltage swell and THD at various buses before and after islanding shown in below tables.

Table I
Total harmonic distortion (THD) before and after islanding

Bus Locations	THD (%)
Before LCL filter	77.17
After LCL filter	4.61
Before Islanding at load	4.61
After Islanding at load	15.67
Before Islanding at PCC	4.6
After Islanding at PCC	15.66

Table II
Voltage (peak to peak) at various bus locations before and after islanding

Bus Locations	Voltage (Vp-p)
Before Islanding at load	550
After Islanding at load	610
Before Islanding at PCC	530
After Islanding at PCC	590

Above simulation proven that Power quality are occurred in islanded Microgrid. In the below simulation, DSTATCOM is taken to minimize power quality issues such as Voltage swell and THD. Connection of DSTATCOM with Microgrid shown in simulation as below.

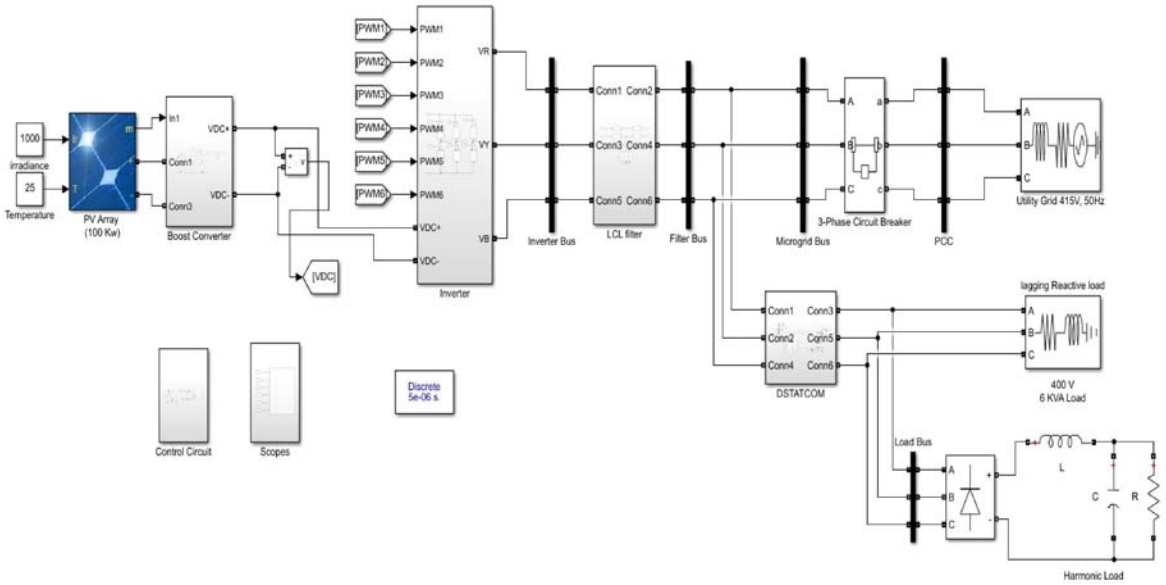


Fig. 10 Power quality improvement in islanded Microgrid

DSTATCOM able to inject or absorb reactive power at PCC. Nonlinear load is changed to prove this DSTATCOM work as universal. DSTATCOM able to mitigate power quality issues at PCC for all nonlinear loads. Similar way three phase circuit breaker adjusted at 0.2s for Islanding in Microgrid.

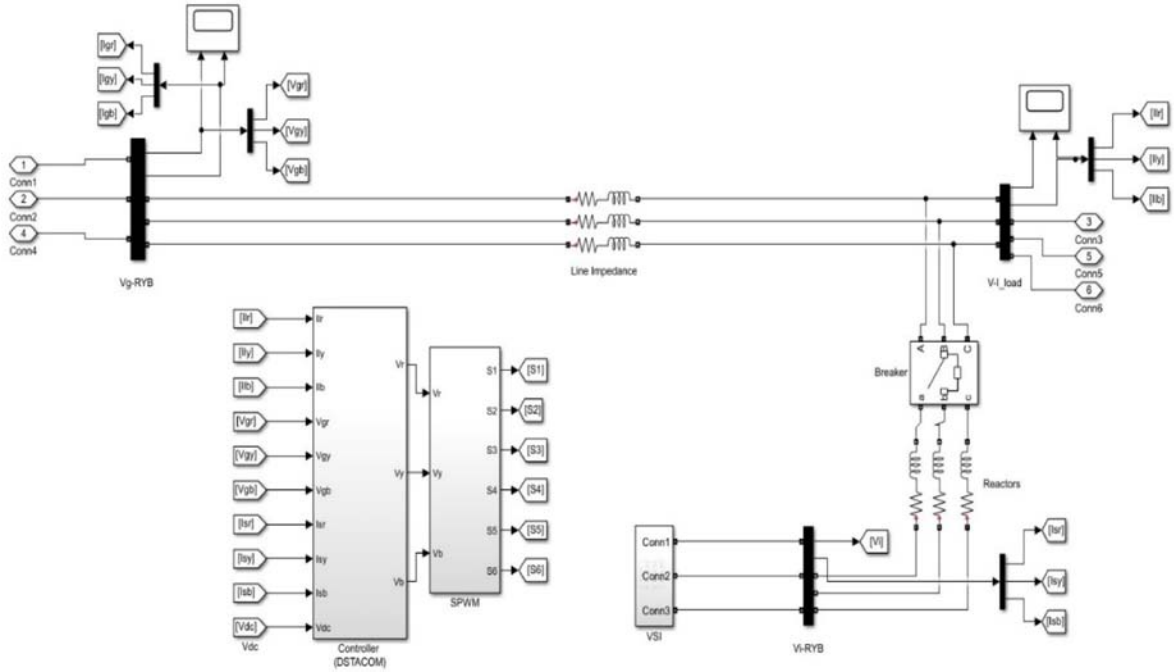


Fig. 11 DSTATCOM circuit

Voltage swell occurred at nonlinear load after 0.2s in islanded Microgrid. Waveforms of voltage and current for nonlinear load shown in below results.

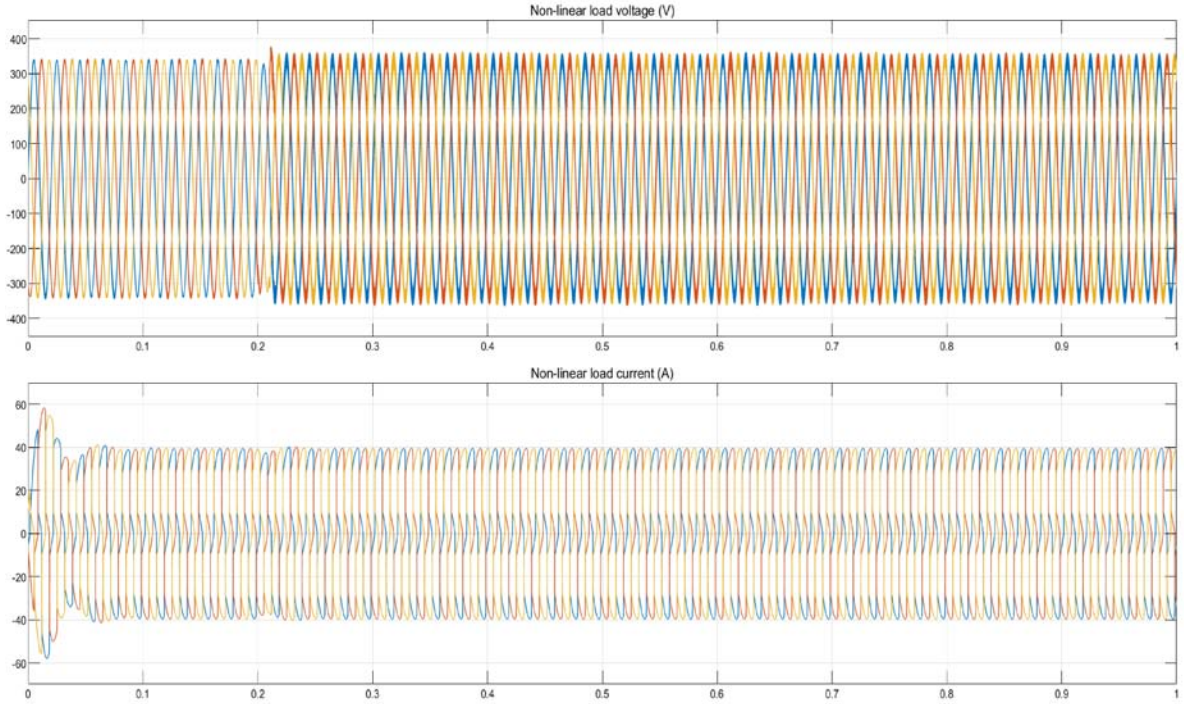


Fig. 12 Waveforms of Nonlinear load voltage and current

DSTATCOM absorbing reactive power at PCC and mitigate voltage swell and THD. Voltage waveform at PCC shown in below result. If other loads or sources are connected to PCC then they didn't affect by this power quality issues and increase reliability of overall simulation due to the DSTATCOM.

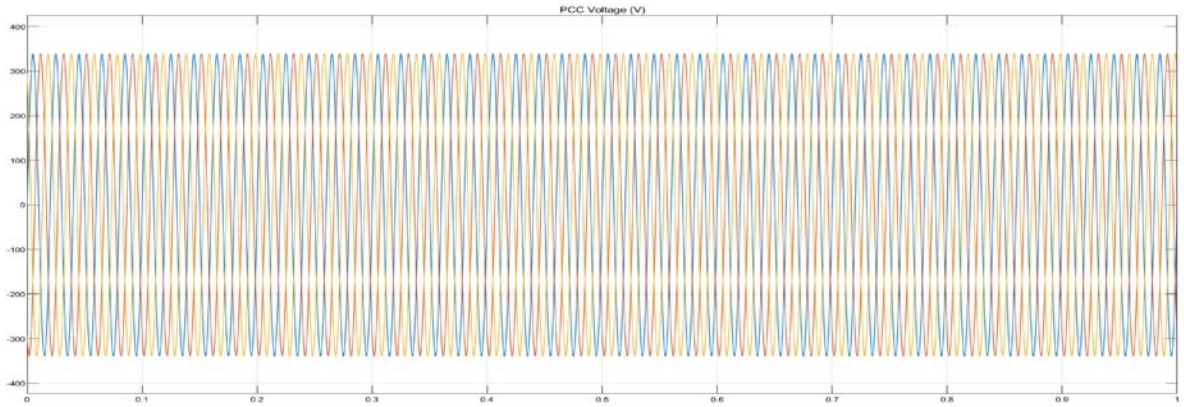


Fig. 13 Waveform of PCC voltage

The simulation clearly demonstrates that the proposed DSTATCOM can provide the necessary voltage stability at the PCC for an islanded Microgrid. In these studies, proven that DSTATCOM helpful FACT device to mitigate power quality issues such as voltage swell and THD at point of common coupling (PCC). Power quality issues are mitigated in permissible range of IEEE standards in islanded Microgrid. Voltage Swell and THD analysis at various buses before and after islanding shown in below table.

Table III

Total harmonic distortion (THD) and Voltage (peak to peak) at various bus locations before and after islanding

Bus Locations	THD (%)	Voltage (Vp-p)
Before Islanding at load	6.14	325
After Islanding at load	2.55	350
Before Islanding at PCC	0.05	325
After Islanding at PCC	0.13	325

CONCLUSION

The paper discusses power quality issues in islanded microgrid such as voltage swell and harmonics. The paper also models DSTATCOM and its applications in an illustrated sample power system. The DSTATCOM application results in an improvement of power quality parameters in an islanded Microgrid. This demonstrates that power quality issues are mitigated by a device known as DSTATCOM. DSTATCOM is installed in a power system network that is discussed in the paper. In the power system network, results were obtained with and without DSTATCOM. DSTATCOM mitigated power quality issues in Islanded Microgrid such as voltage swell and Total Harmonic Distortion by injecting or absorbing reactive power at the Point of Common Coupling (PCC). As a result, power quality improved within the acceptable range of IEEE standards in an islanded microgrid.

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Comparative Analysis Of Various Speed Control Methods For Brushless DC Drives

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Abstract. In recent times, the Brushless DC motor has gained much popularity in various applications like EV (Electric Vehicle), aerospace applications, industrial compressors, etc. Also, the Brushless DC motor overcomes many problems of brushed DC motors because of not using brushes. So, instead of brushes in BLDC motors commutation takes place through an electronic circuit. This trendy turn rises the difficulty and cost of controlling the speed of the BLDC motor. This paper offers a comparative analysis of various speed control methods for BLDC motor drives.

Keywords – PI, PID, Fuzzy, BLDC Motor, MATLAB.

INTRODUCTION

DC motors remain particularly the simplest choice of driving systems with simple speed control techniques. Commutation on standard DC motors is done by a turning portion mounted on the rotor and brushes. For the reason that of the mechanical components, DC motors contain a huge amount of losses [1]. Brushless DC (BLDC) motors and PMSM are the utmost commonly used motors instantly for the reason of their rewards over conventional DC motors. The BLDC motor has decent speed control topographies, particularly for low-power applications such as laser printers, hard disk drives, and more [2].

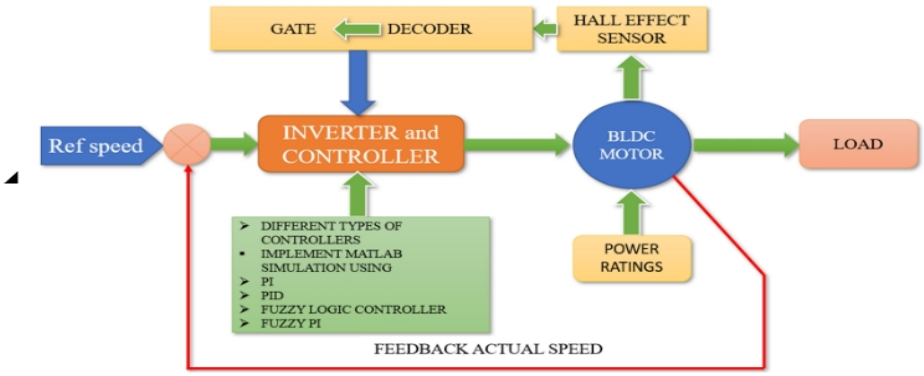

FIGURE 1 Basic diagram of BLDC motor drive

Nowadays, the Brushless DC motor has become superior in various applications like EV (Electric Vehicle), aerospace applications, industrial compressors, etc. due to its certain advantages. Also, the Brushless DC motor overcomes many problems of brushed DC motors owing to the presence of brushes [3]. So, instead of brushes in BLDC motors commutation takes place through an electronic circuit. This trendy turn rises the difficulty and cost of controlling the speed of the BLDC motor. This paper offers a comparative analysis of various speed control methods for BLDC motor drives**.** A Brushless DC drive motor, a 3-Ø voltage source inverter (VSI), and a feedback system are the three main parts of the PMBLDCM drives. A PM BLDCM has bifurcated into two parts: electrical

and mechanical. To sense the rotor side of the motor three Hall-Effect devices with kept electrically 120 apart. The controller will decode the Hall Effect signals and the suitable voltage space vectors will be situated selected toward supplying the motor. The converting signals are the input for the voltage source inverter (VSI) which further supplies to the BLDCM windings. The motor speed is adjusted by all of the controlling arrangements mentioned in the below figure. Figure 1 exhibitions the basic diagram of BLDCM used for controlling speed [4].

SPEED CONTROL TECHNIQUES FOR BLDC MOTOR DRIVES

Following are the different methods used for controlling the speed of BLDC motor drive:

- Proportional & Integral (PI) controller
- Proportional, Integral, & Derivative (PID) controller
- Fuzzy Logic Controller
- Fuzzy PI
- Fuzzy PID
- Sliding mode control
- PWM techniques
- ANN [5]

Above mentioned controllers and speed control techniques are widely used everywhere in industries. Here in this project, the controllers are used for speed control purposes. There are two types of controllers that are traditional controllers and Artificial intelligence-based controllers.

- **Controllers**
  Controllers are the main part of any system and they become even more important when they are used for performance enhancement. At this point in the paper, the controllers are used for speed control purposes. There are two types of controllers that are traditional controllers and Artificial intelligence-based controllers.
  .
- **Conventional Controller**: Simplest and inexpensive type of controller. These controllers have been used in industries for decades. These controllers provide feedback for any system especially working better for speed control of motors.

- **Artificially tuned Controller**: The conventional controllers are no doubt used in various places but the problem

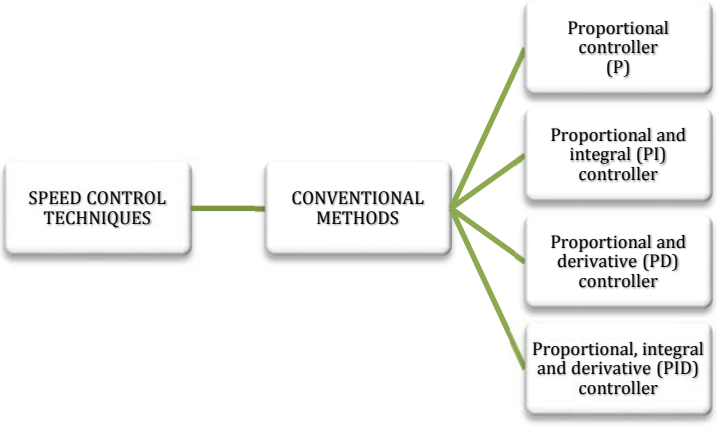

FIGURE 2 Classification of Speed Control Techniques for Brushless DC Motor

with these controllers is to develop a mathematical model for nonlinear loads. Hence it becomes necessary to tune such controller with different A.I. techniques for better performance with any kind of load.

PI controller

Firstly, PI control action is implemented. Fig. 3 expresses the basic diagram of the Proportional-Integral controller.
The basic diagram of the PI controller is shown below. The input of the controller is the error signal which has been generated by the difference between reference and actual speed.[6]

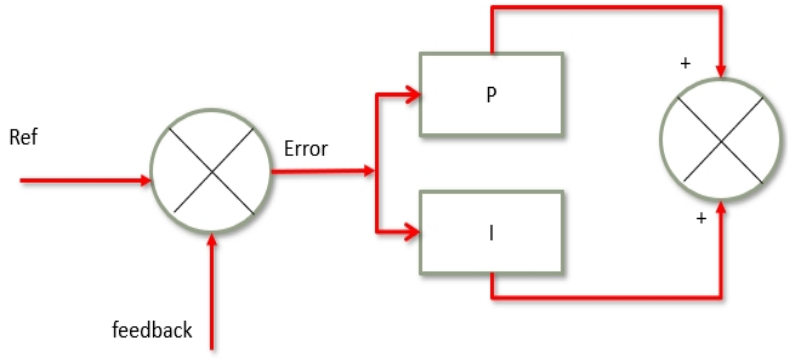

FIGURE 3 basic diagram of PI controller

Kp: Proportional Gain
Ki: Integral Gain

This controller is well known for its simple structure and for reducing steady-state error. Having said that if the value of the proportional factor exceeds a certain limit, the stability of the system will be hampered. Also if the value of the factor is too small, the system will fail to achieve the defined value for a given period

PID Controller

All three actions (proportional, integral, and derivative action) work together in this controller. Proportional action has the advantage that it even out the gain. The drawback of this action is it generates a steady-state error for which the integral component needs to be added

The derivative action of the controller has the advantage of a reduced rate at which the change of error occurs. The main disadvantage is it introduces noise into the system.

For better performance of any system, it is necessary that it has fewer oscillations, and overshoots, and gets settled in less time. PID exhibits all these qualities. Fig. 4 displays the PID's basic block diagram:

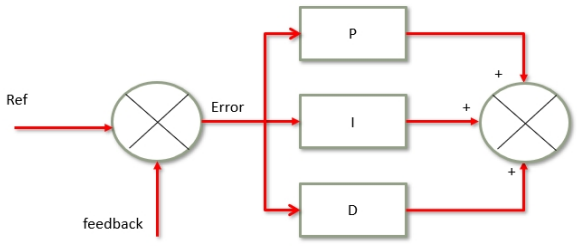

FIGURE 4 Block diagram of PID controller

This derivative gain is denoted by Kd. The productivity of the proportional controller is proportionate to the error. When the error reaches zero, the controller's output is zero, besides the system experiences damping and slows down. It can also result in an overshoot. The integral controller shortens the rise time, enhances the settling time,

in addition, utmost significantly, eliminates the steady-state error. Kd's furthermost imperative person is to decrease overshoot and settling time.

FL Controller

Considering the artificial intelligence technique, fuzzy is simple and easy to understand. There are certain steps utilizing a fuzzy logic controller for any application.

This works on three things

- Fuzzification process
- Control rule designing
- Defuzzification process [8]

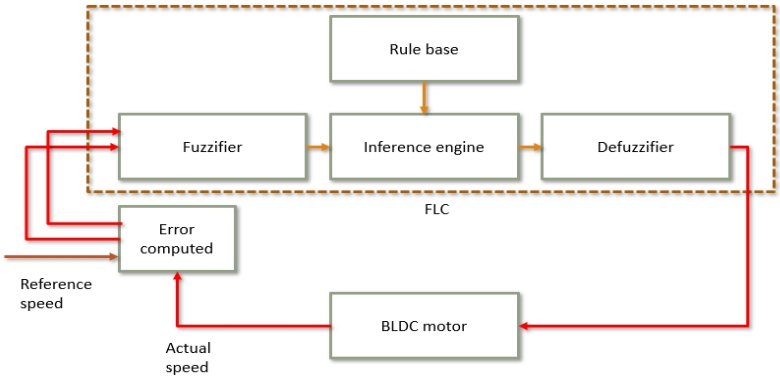

FIGURE 5 Basic block diagram of FL Controller

FUZZY-PI Controller

This FL controller is improved than the conventional PI controller in terms of control parameters. In practice, the FL controller is not feasible to use in industries everywhere as it consumes more time and memory. This is because designing a fuzzy logic requires a large number of rules. So, the problem exhibited in individual controllers can be overcome by integrating both controllers. The attributes of the fuzzy logic controller and the PI controller can be clubbed together to get better results. The assembly of the fuzzy tuned PI controller arrangement is exposed below in Fig. 6 [9].

In the overhead figure, the error is denoted through e, and the change in error is denoted by ec. The integration of fuzzy logic with PI controller is known utilizing the fuzzy PI controller. Unlike a traditional controller, it calculates the speed quickly. As a result, it consumes less memory as less calculation time is required. The values of KP and KI are so adjusted as per the algorithm designed for the given system.

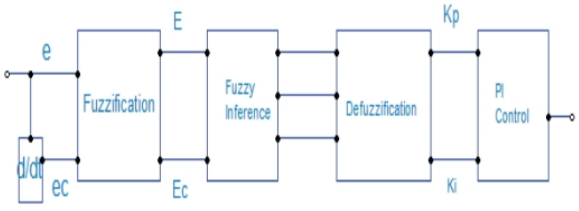

FIGURE 6 Construction of fuzzy tuned PI controller

FUZZY-PID Controller

Like fuzzy PI when combining fuzzy with traditional controller PID it is called fuzzy PID. The values of Kp, Ki, and Kd are taken from the trial-and-error method. The attributes of fuzzy and PID help the system to achieve the desired performance. The same block diagram can be taken for reference as shown in figure 6. The only change would be instead of PI there would be a PID controller.

SIMULATION

Figure 7 shows the MATLAB simulation of PI controller-based speed control of BLDC motor drive. In this case, a constant speed is given at about 1000 rpm and constant torque of 5 Nm is provided. PI controller gives the maximum overshoot and also the settling time is more.

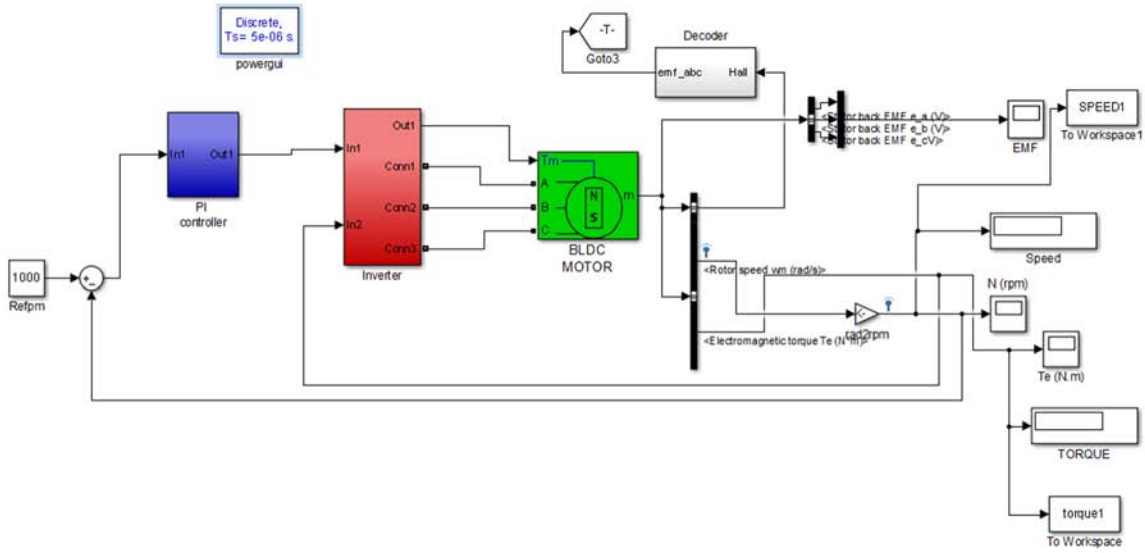

FIGURE 7 MATLAB simulation of PI controller

Figure 8 expresses the MATLAB simulation of PID controller-based speed control of brushless DC motor drive. In this case, a constant speed is given at about 1000 rpm and constant torque of 5 Nm is provided. When we are considering the conventional controller, the PID controller springs the best performance toward decreasing the overshoot in the speed response.

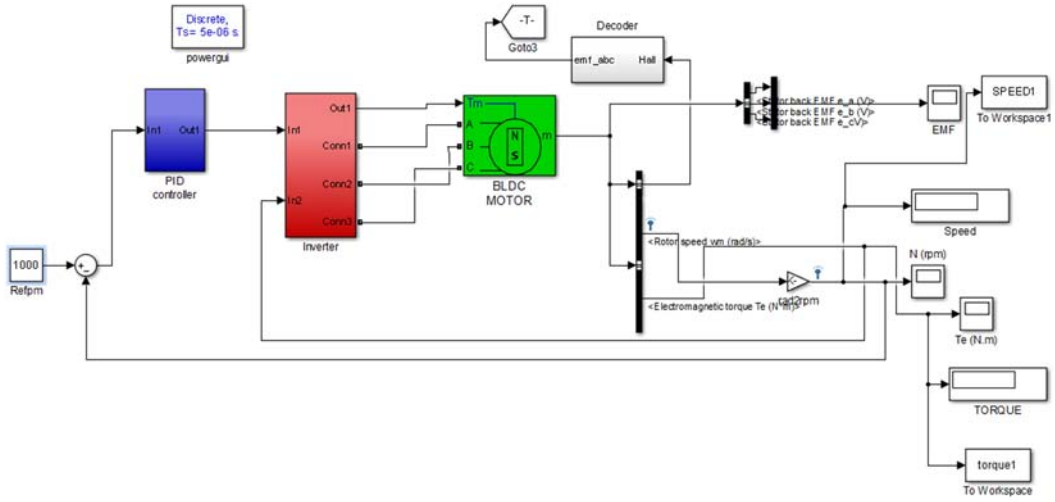

FIGURE 8 MATLAB simulation of PID Controller

Figure 9 expresses the MATLAB simulation of fuzzy controller-based speed control of brushless DC motor drive. In this case, a constant speed is given at about 1000 rpm and constant torque of 5 Nm is provided. This controller has the maximum overshoot in speed reply of a brushless DC motor.

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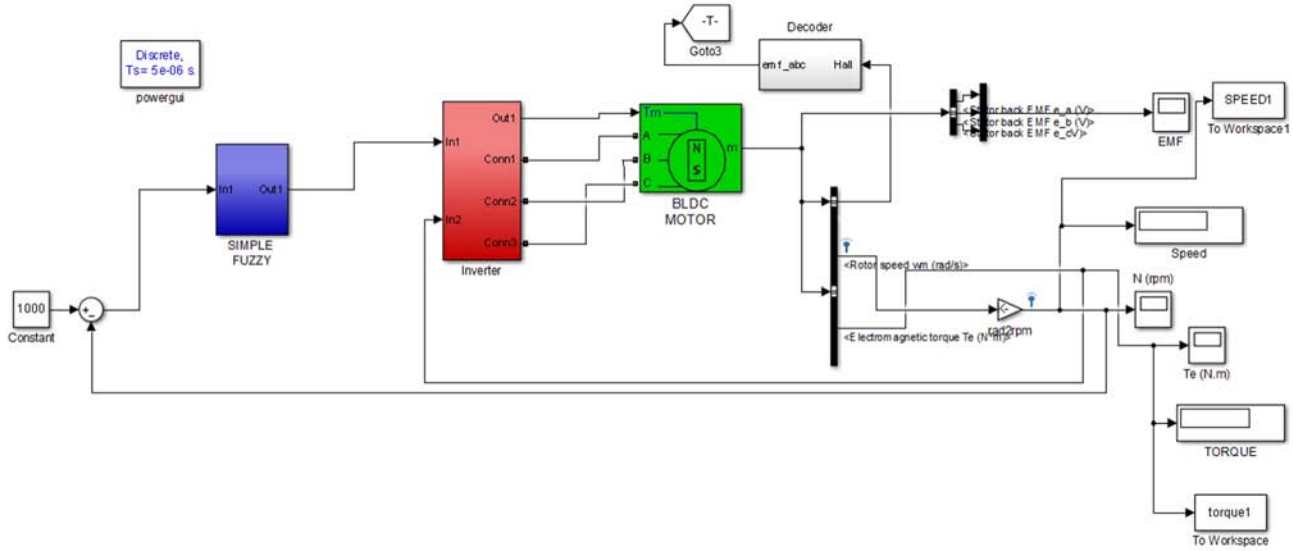


FIGURE 9 MATLAB simulation of FL controller

Figure 10 shows the MATLAB simulation of fuzzy-PI controller-based speed control of brushless DC motor drive. In this case, a constant speed is given at about 1000 rpm and constant torque of 5 Nm is provided. Instead of using fuzzy and PI controllers separately, when we are combining this two-controller, it gives less overshoot and also less settling time. Performance is better.

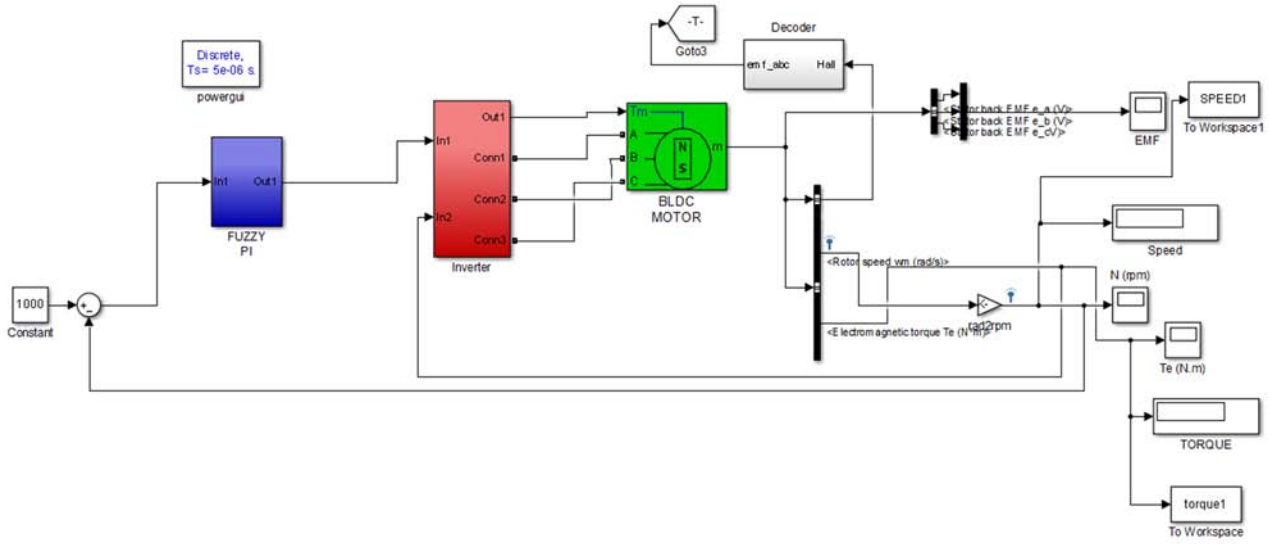


FIGURE 10 MATLAB simulation of Fuzzy PI controller

Figure 11 expressions the MATLAB simulation of fuzzy-PID controller-based speed control of brushless DC motor drive. In this case, a constant speed is given at about 1000 rpm and constant torque of 5 Nm is provided. Compare to all methods discussed above this method gives the best performance. Overshoot is minimum as compared to other methods discussed in this paper.

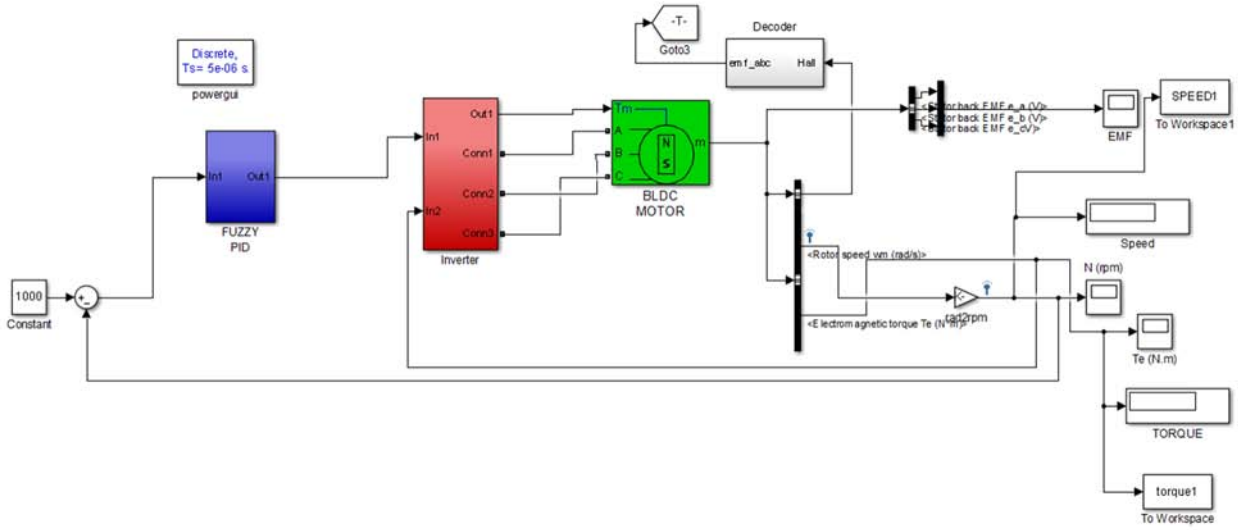


FIGURE 11 MATLAB simulation of Fuzzy PID controller

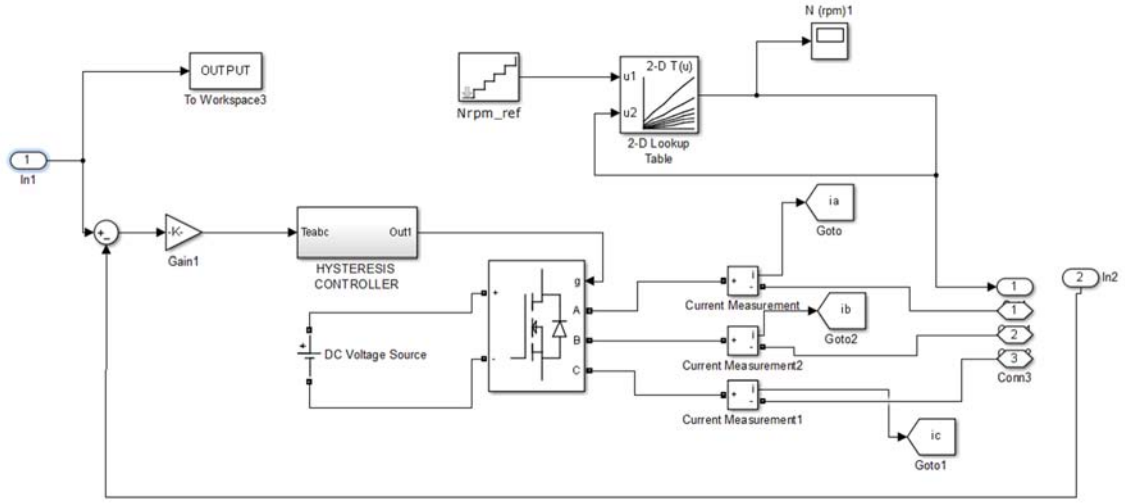
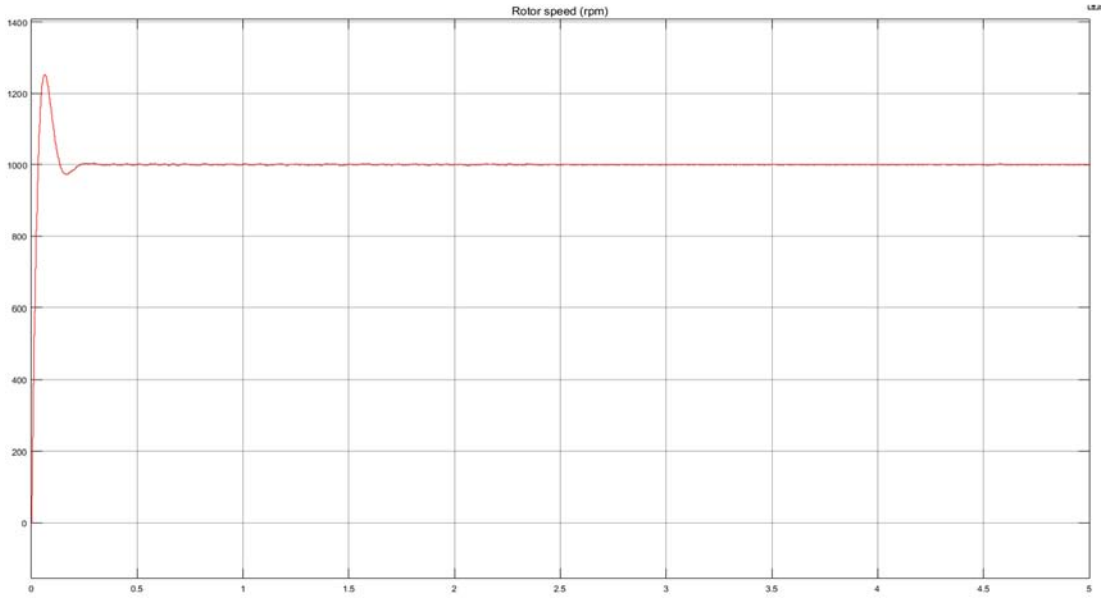


FIGURE 12 Subsystem of Motor drive and rotor position estimation

SIMULATION RESULTS

A PI control structure is implemented to control the motor speed. One of the main tasks in using PI is to decide to gain i.e. the values of Kp and Ki. From figure 13 considerable overshoot can be seen. Also, it takes some time to settle down to the speed given in the reference. After 0.3 seconds the speed gets stable. The settling time is 10. 10ms.The below figure 13 expressions the output of the PI controller when constant speed also constant torque is given. In the waveform, some overshoot is visible.



The below Figure 14 expressions the output of the PID controller i.e., speed versus time graph. From the output waveform, it is evident that the peak overshoot has been reduced in the PID controller compared to the PI controller. The value of peak overshoot and rise time is shown in the comparison chart.

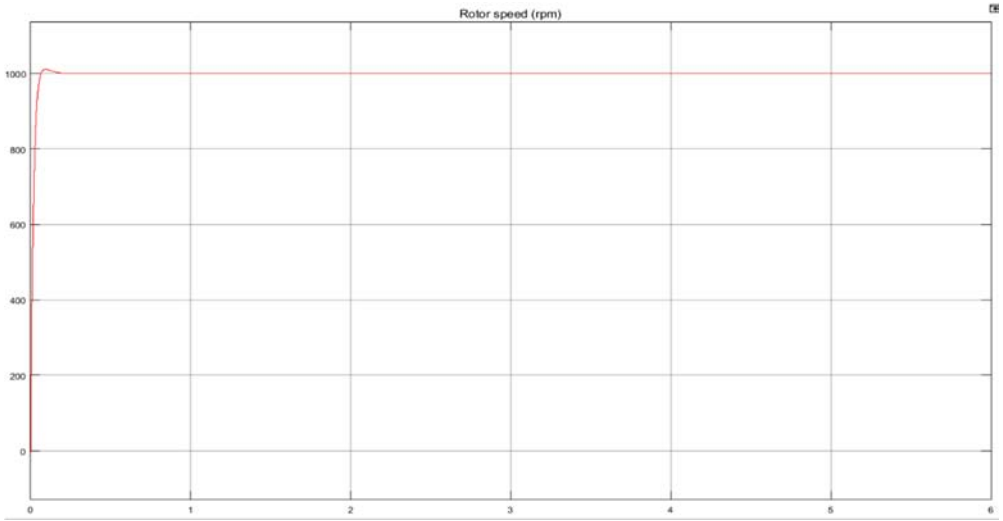
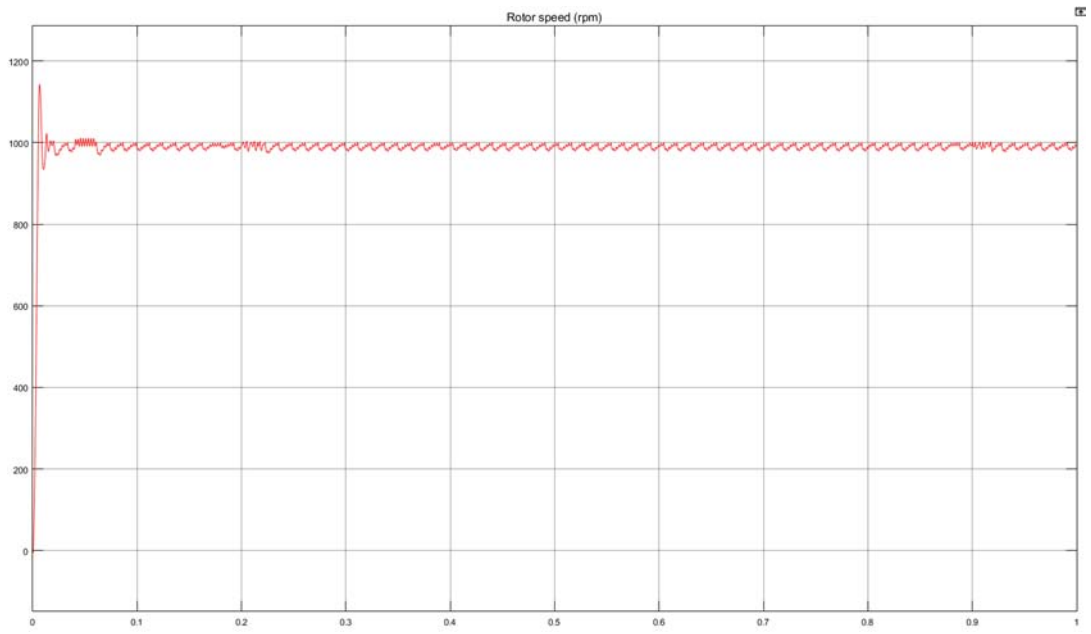


FIGURE 13 Speed response of PI controller

Below Fig. 15 exhibitions the output of the Fuzzy controller i.e., speed versus time graph. From the output waveform, it is visible that the peak overshoot has been increased in the Fuzzy controller equated to the PI and PID controller. The value of peak overshoot and rise time is shown in the comparison chart.

Figure 16 displays the output of the Fuzzy –PI controller i.e., speed versus time graph. From the output waveform, it is visible that the peak overshoot has been decreased in the Fuzzy-PI controller compared to the PI and increased as compared to the PID controller. The value of peak overshoot and rise time is shown in the comparison chart.



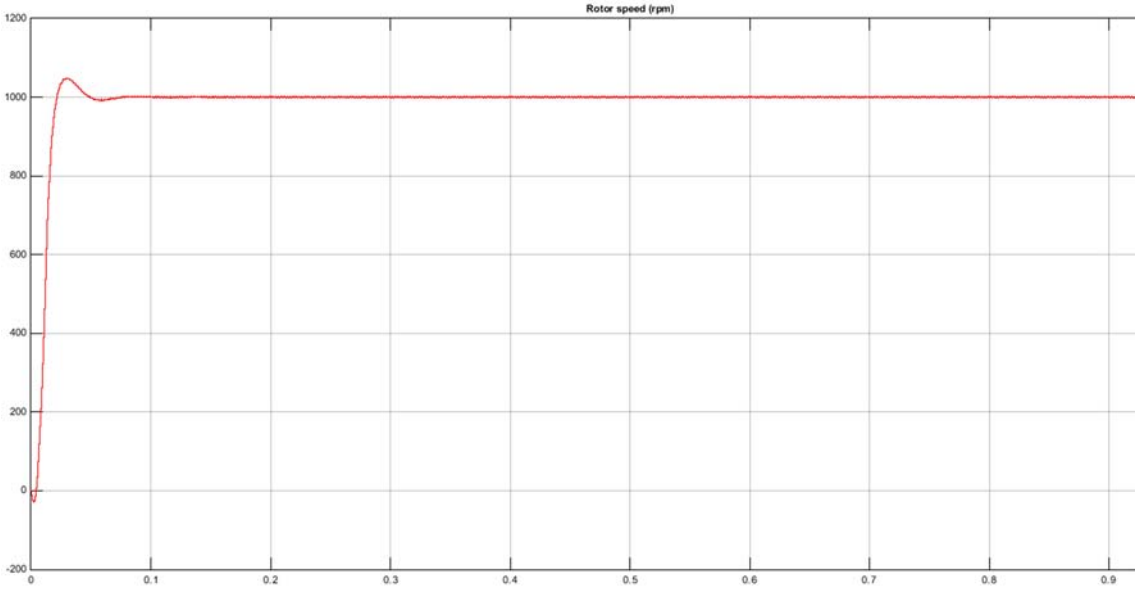


FIGURE 16 Speed response for Fuzzy PI controller

The combination of the Fuzzy-PID controller has been exposed in fig. 17. From the output waveform, it is visible that this controller gives the minimum overshoot as compared to all other methods discussed in this paper.

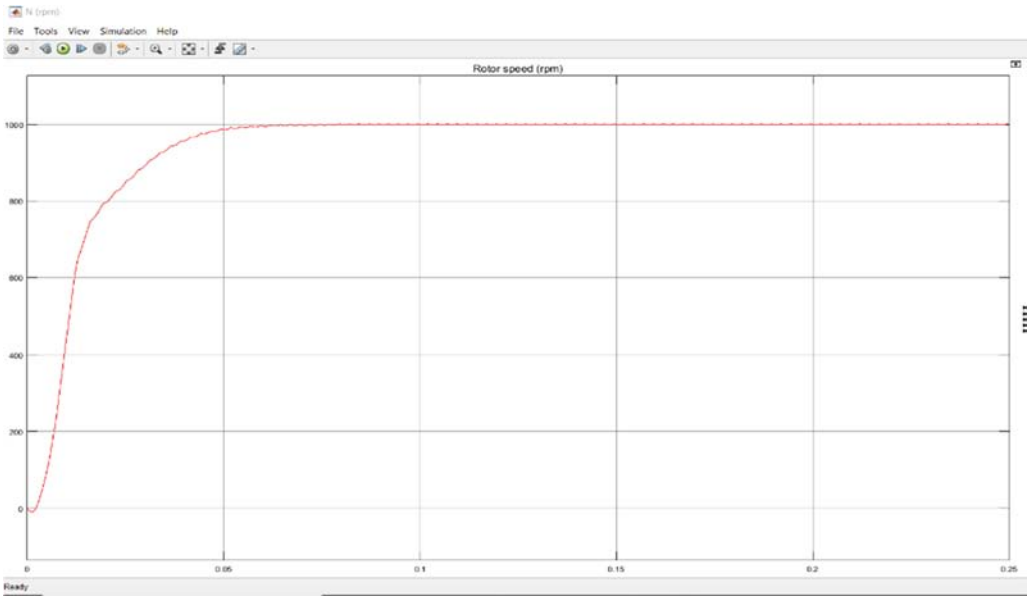


FIGURE 17 Speed response for Fuzzy PID controller

PERFORMANCE COMPARISON

This is the chart provided that compares the overshoot and rise of each of the five controllers for constant speed**.** From the chart, it is visible that fuzzy-PID is giving the minimum overshoot and having more settling time.

A fuzzy controller is giving maximum overshoot but when it is used in combination with conventional controllers then performance is improved. From the chart, it is easy to compare the performance of all different controllers for the different control parameters.

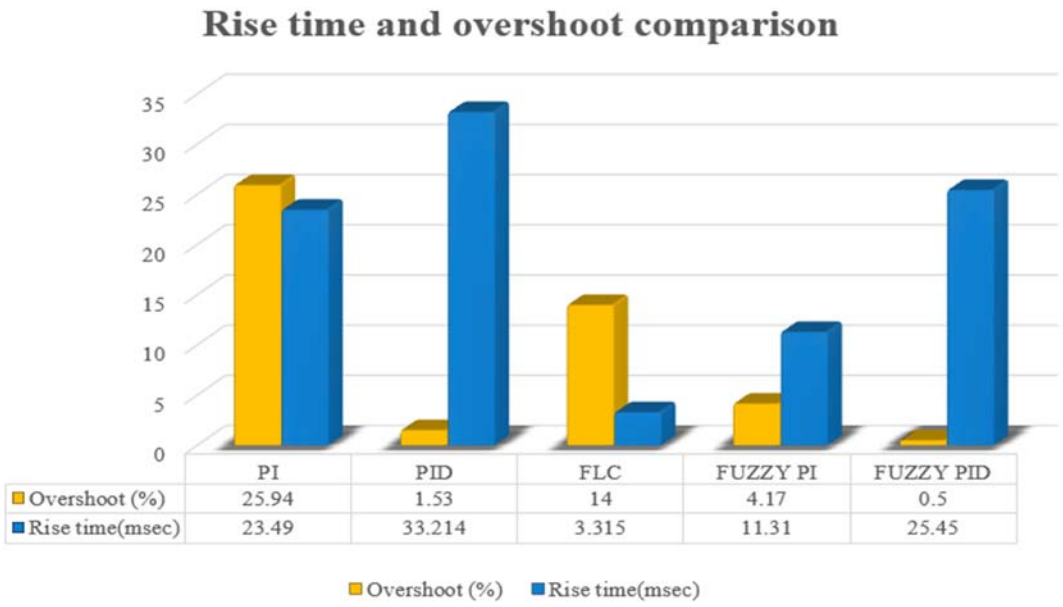


FIGURE 18 Performance comparison of various speed control methods of brushless DC motor drive

CONCLUSION

After simulating conventional controllers and artificially tuned controllers the conclusion can be drawn that A.I. techniques give better results in terms of control parameters like overshoot. Conventional controllers like PI and PID have to be suited for decades but with time, they require modification to deal with nonlinear loads. A simple fuzzy logic controller is also simulated but as it requires more memory it is not feasible to use in industries. The result of hybrid Fuzzy PID shows better performance when compares with the other controllers.

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An Algorithm for Performance Comparison of Non-Cooperative Spectrum Sensing Techniques in Cognitive Radio Networks

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Abstract. The 5G cell phone networks are designed to offer higher data transmission rate with less end-to-end latency, much higher system capacity, global connectivity, and improved energy efficiency. This necessitates high spectrum efficiency which is provided by Cognitive Radio Networks (CRN). The main function of CRN is based on the principle of spectrum sensing and dynamic spectrum sharing. It increases the usage of available frequency resources by allowing secondary users (SUs) to utilize the unoccupied spectrum by primary users (PUs). In non-cooperative indirect spectrum sensing (SS) techniques such as Energy Detection and Cyclostationary Detection, there is no collaboration among different SUs for accurate detection about the presence of PUs. In this paper, an algorithm to evolve a model for performance comparison of energy detection and cyclostationary detection spectrum sensing techniques in terms of probability of detection versus signal-to-noise ratio (SNR) is proposed It is observed that threshold value of SNR for energy detection SS technique is approximate equal to -10 dB and thereafter cyclostationary detection SS technique automatically detects the channel. This model can be extended to include other non-cooperative SS methods such as matched filter detection, feature detection and Euclidean distance based detection for performance comparison.

Keywords - *Cognitive radio networks, Cyclostationary detection, Energy detection, SNR, Spectrum sensing.*

INTRODUCTION

Cognitive radio (CR) is an advanced wireless communication technique employed in next generation wireless networks to sense the radio spectrum efficiently. It automatically indulges in the wireless environment and has the capability to utilize the available RF spectrum in that manner so that there is virtually no interference to the primary users (PUs), also known as licensed users [1]. The secondary users (SUs) who do not have the licensed spectrum but it can access spectrum allocated to PUs when they are not using it. For this, the secondary user has to monitor the spectrum being utilized by the primary user so that they can access the spectrum as and when the primary user is not using it. The process of monitoring the available spectrum by the secondary user is known as spectrum sensing. This process leads to proper utilization of the available RF spectrum by dynamic spectrum allocation (DSA) schemes [2], [3].

Due to increased communication and computational load in cooperative spectrum sensing, several types of non-cooperative sensing algorithms have emerged recently. Some of these algorithms are singular spectrum entropy based on information theory, multi-resolution and phase space reconstruction algorithm. It is always preferred to obtain enhanced performance in detection of RF spectrum at low values of signal-to-noise ratio (SNR), in addition to reduced computing requirements, increased stability as well as reliability of wireless links.

This paper is organized in different sections. In Section II, a brief review of related works is given. The essential aspects of spectrum sensing and spectrum allocation to PUs and SUs are presented in Section III. In Section IV, the basis of algorithm for performance evaluation in energy detection technique of non-cooperative spectrum sensing is

described. Section V gives the basis of algorithm for performance evaluation in cyclostationary detection technique of non-cooperative spectrum sensing. Section VI presents an algorithm for performance comparison of these two techniques with a plot of probability of detection for different values of SNR. Finally, the results are discussed and conclusion is drawn in the last section.

RELATED WORKS

The main task of cognitive radio is to enhance the usage of available frequency resources by allowing secondary users to utilize that part of spectrum which is not in use by primary users at the moment. Spectrum sensing enables a cognitive radio to obtain information about its spectrum availability and operating environment. According to J. Mitola [4], Cognitive Radio is a wireless communication system that offers a viable mechanism for flexible RF spectrum allocation in digital cell-phone networks. It is software-based radio which can sense and share the available spectrum in an efficient way. Manikandan [5] has presented real-time performance analysis of different cooperative and non-cooperative SS schemes used in cognitive radio. He has depicted a comparative chart of key features of various sensing methods such as energy detector, matched filter and waveform-based detection, Eigen value and wavelet based detection, cyclostationary based and multi-band cooperative sensing in different operating environments in wireless communications. Tevfik [6] has discussed external sensing algorithms along with statistical network traffic models for PU behavior prediction. An overview of cognitive features included in wireless network standards such as IEEE 802.11k, Bluetooth, and IEEE 802.22 is also given. T. Jothi [7] has introduced the concept of multi-band CR paradigm with seamless handoff capability between bands. This offers real-time reliable dynamic spectrum detection with reduced probability of false-alarm detection. T. Chakraborty [8] has proposed a design model that includes the effects of multiple path channels on voice-over-IP with introduction of adaptive strategy in evaluating the performance in CRN. Several modifications including decision-making algorithms in energy detection based spectrum sensing technique have been proposed for dynamic selection of the threshold value in real time operation [9].

SPECTRUM SENSING AND SHARING IN COGNITIVE RADIO

A typical cognitive radio device comprises of analog RF front end and customized programmable digital processors for the purpose of spectrum sensing and sharing. After identification of the vacant spectrum which can be possible used by SUs in cognitive radio network, the software algorithms embedded in CR processors determine various system parameters such as the transmit power of RF modulated signal, the frequency of transmission, the signal waveform and the channel bandwidth. Different spectrum allocation models such as interweave, underlay and overlay are commonly followed for sharing the spectrum among different users of the network. [10]. Figure 1 depicts the interweave model of dynamic spectrum allocation (DSA).

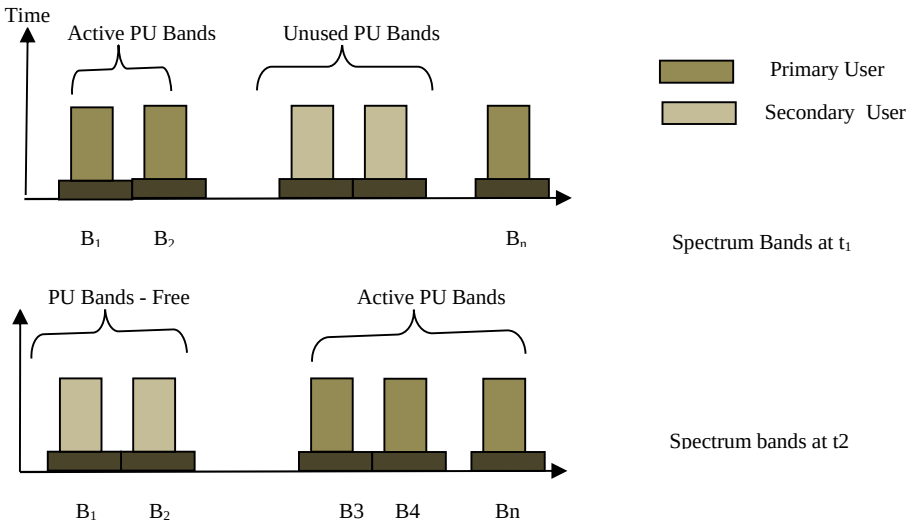

FIGURE 1. DSA - Interweave Model

However, there are certain issues related to DSA models which limit their deployment for various applications. In interweave model, the SU is unable to utilize the spectrum till PU is using it. This requires very accurate spectrum sensing so as to avoid denial-of-service (DOS) due to possible interference. Besides this, it is also required to estimate the spectrum sensing rate, that is, how recently the spectrum sensing has taken place. This activity leads to system complexity due to need of cooperation between PUs and SUs. Moreover, malicious PUs may tend to block the free spectrum, thereby resulting into DOS to SUs. Likewise, malicious SUs may block free spectrum that may cause denial of service or severe interference to PUs. It is mandatory that busy SUs must vacate the occupied spectrum instantaneously for an incoming signal from PU even though there is an ongoing transmission. This leads to several efficient, reliable and modified DSA techniques [11].

Mathematically, the spectrum sensing techniques can be expressed as

$$\mathrm{S(n)} = \begin{cases} G * P(n) + W(n) & H_1 : P \text{ is } D \\ W(n) & H_0 : P \text{ is } N \text{ d} \end{cases} \quad (1)$$

S(n) denotes the received signal level at SU, G_c represents the channel gain, *P(n)* being the received signal level from PU, *W(n)* being additive white Gaussian noise (AWGN).

The hypotheses, H_1 and H_0, corresponds to either PU signal is detected or not detected, respectively. The received signal level at SU, *S(n)* is then compared with pre-defined threshold level (λ). The condition may be represented as

$$\begin{cases} S(n) \geq \lambda & H_1 \\ S(n) < \lambda & H_0 \end{cases} \quad (2)$$

Based on the result of this hypothesis test, the SU is able to access the available spectrum when H_0 condition is applicable. The spectrum sensing process is illustrated in Fig. 2.

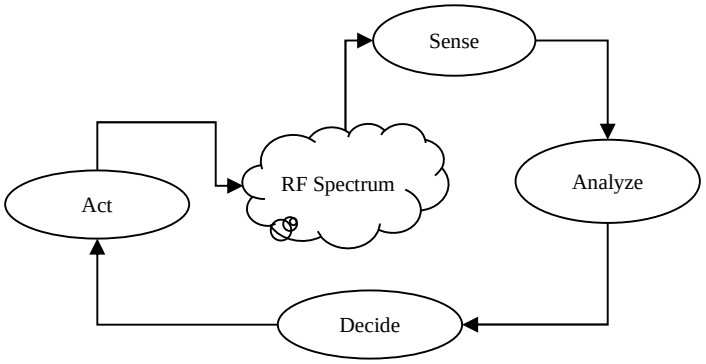

FIGURE 2. Spectrum Sensing Process Cycle

There are several spectrum sensing techniques which can be broadly classified as cooperative and non-cooperative techniques. The proper selection for a particular application depends upon numerous factors like the cooperation between PUs and SUs, the computational complexity, accurate estimation of noise variance, observation time and time period of the transmission. Energy Detection and Cyclostationary Detection methods are the most popular non-cooperative techniques.

ENERGY DETECTION SPECTRUM SENSING

This technique does not need any a priori information regarding the presence of PUs in the environment. The received signal energy level is sensed by the front-end, converted to digital signal by analog-to-digital converter and processed. After comparison with pre-defined threshold, the decision regarding presence or absence of PU is taken as per decision hypothesis conditions. [12]. [13]. Figure 3 depicts a simplified functional block schematic of energy detection spectrum sensing technique.

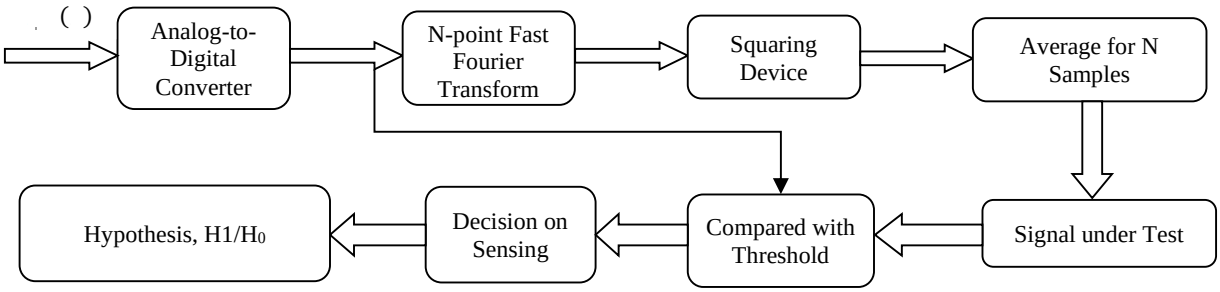

FIGURE 3. Functional Block Schematic - Energy Detection SS Technique

The test signal is expressed as

$$y_S\ (n) = \frac{1}{N}\sum_{n=1}^{N}(Y_S\ (n))^2 \tag{3}$$

The hypotheses can be specified as

$$H_1: y_S\ (n) = x_P\ (n) + \eta(n) > \lambda\ , P \quad s \qquad is\ p \tag{4}$$

$$H_0: y_S\ (n) = \eta(n) < \lambda, P \quad s \qquad is\ a \tag{5}$$

where, $y_S\ (n)$ represents the SU detector output signal, $x_P\ (n)$ represents the transmitted signal level of PU, $\eta(n)$ denotes the AWGN level, λ denotes pre-defined threshold level.
The Gaussian approximation of this test signal is given by

$$\begin{cases} H_0: y_S\ (n) \sim \mathbb{N}(N\delta_w^2\ , 2N\delta_w^4) \\ H_1: y_S\ (n) \sim \mathbb{N}(N(\delta_w^2 + \delta_s^2)\ , 2N(\delta_w^2 + \delta_s^2)^2) \end{cases} \tag{6}$$

$\mathbb{N}$ denotes the Normal distribution function, δ_w^2 and δ_s^2 represents the variance of the noise and PU signals, respectively. The probability of detection, P_d, and the probability of false alarm detection, P_{fd}, is given in terms of Q-function as

$$P_d = Q\left(\frac{\lambda - (N(\delta_w^2+\delta_s^2)}{\sqrt{2N(\delta_w^2+\delta_s^2)^2)}}\right) \tag{7}$$

$$P_f\ = Q\left(\frac{\lambda - N\delta_w^2}{\sqrt{2N\delta_w^4}}\right) \tag{8}$$

CYCLOSTATIONARY SPECTRUM SENSING

A cyclostationary signal is the one in which its autocorrelation function is periodic and depends on frequency only when it is represented in terms of Fourier series. Different spectral components of a cyclostationary process are not correlated to each other. The cyclostationary detection spectrum sensing is derived from analysis of cyclic auto-

correlation function of waveform features of the periodic received signal as well as wide-sense stationary aperiodic noise signals with no correlation. Figure 4 depicts a functional block schematic of cyclostationary sensing method.

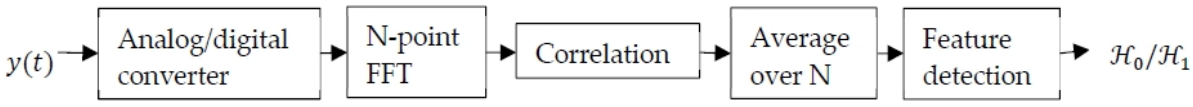

FIGURE 4. A Functional Block Schematic of Cyclostationary Detection Spectrum Sensing Technique

The received analog signal is converted to digital signal using an analog-to-digital converter, followed by computation of its fast Fourier transform by the *N*-point FFT. FFT values are auto correlated, averaged over N samples prior to feature detection for hypothesis determination. The periodicity properties of PU signals are embedded in system parameters such as center frequency, frequency hopping sequence, rate of modulation, pulse train sequence, spreading codes, or cyclic prefixes of the primary user signals which have cyclostationary properties. [14]. On the other hand, noise signal is normally stationary with no correlation property. This enables to discriminate among the primary user signals, the secondary user signals, and the interference signals. Thus, the cyclostationary properties can be extracted by using the cyclic spectrum or the input-output spectral correlation. Generalized Likelihood Ratio Test (GLRT) is used to detect the cyclostationary signals for number of cyclic frequencies.

The mean function, $m_y(t)$, and the autocorrelation function, $R_y(t, T_0)$ of a cyclostationary signal $y(t)$ are given as

$$m_y(t) = m_y(t + T_0) \tag{9}$$

$$R_y(t,u) = R_y(t + T_0, u + T_0) \tag{10}$$

T_0 is the time period of the signal. The autocorrelation function can be written in the form of the Fourier series expansion as

$$R_y(t + \tau/2, t - \tau/2) = \sum R_y^{\alpha}(\tau) e^{j2\pi\alpha t} \tag{11}$$

Where R_y^{α} is known as Cyclic Autocorrelation Function (CAF).

$$R_y^{\alpha}(\tau) = \frac{1}{T_0} \int_{-1/T_0}^{1/T_0} R_y(t + \tau/2, t - \tau/2)\, e^{-j2\pi\alpha t} dt \tag{12}$$

The Fourier Transform of Cyclic Autocorrelation Function, also known as Cyclic Spectral Density (CSD), $S_y^{\alpha}(f)$ is represented as

$$S_y^{\alpha}(f) = \int_{-\infty}^{\infty} R_y^{\alpha}(\tau)\, e^{-j2\pi f \tau} d\tau \tag{13}$$

The test statistic for cyclostationary detector in the frequency-domain is specified by

$$Y = \int_{-f_s/2}^{f_s/2} \hat{S}_y^{\alpha}(f) \left[S_y^{\alpha}(f) \right]^{*} df \tag{14}$$

$\hat{S}_y^{\alpha}(f)$ being an estimate of spectral correlation function of the received signal, and f_s is the sampling frequency.

Cyclostationary detection technique solely depends on the assumption about a priori knowledge of the periodicity of the received signal. [13]. Otherwise there is requirement of extracting the cyclic frequency which tends to increased computation complexity. The Fourier coefficient is then determined by

$$\hat{R}_y^{\sim}(\alpha) = R_y^{\sim}(\alpha) + \pounds_y^{\sim}(\alpha) \quad (15)$$

Where $\pounds_y^{\sim}(\alpha)$ represents the estimation error.

- When $\hat{R}_y^{\sim}(\alpha) = \pounds_y^{\sim}(\alpha)$; then Hypothesis H_0 (that is, the PU signal is not present).
- When $\hat{R}_y^{\sim}(\alpha) = R_y^{\sim}(\alpha) + \pounds_y^{\sim}(\alpha)$; then Hypothesis H_1 (i.e., the PU signal is present).

The performance of the cyclostationary detector can be analyzed asymptotically [17].

AN ALGORITHM FOR PERFORMANCNE EVALUATION

An algorithm is proposed for performance evaluation of energy detection and cyclostationary detection techniques of spectrum sensing is given as follow:

Step 1: Firstly, initialize number of sensing samples, that is, *u*. Determine the values of σ1 and σ2, where σ1 denotes SNR value for Energy Detection and σ2 denotes SNR value for Cyclostationary Detection.

Step 2: Determine the SNR of the received signal.

Step 3: Estimate the value of threshold λ, keeping probability of false alarm P_{fa} constant.

Step 4: If SNR > σ1, then go to Step 5; Else if σ2 < SNR ≤ σ1, then go to Step 6; Else go to END.

Step 5: If ζ1 > λ, then set detect = 1, go to END; Else go to Step 2.

Step 6: If ζ2 > λ, then set detect = 1, go to END; Else go to Step 2.

END

Where ζ1 and ζ2 are the test statistics for Energy Detection and Cyclostationary Detection.

Thus, the above algorithm gives the comparative results of performance evaluation for Energy Detection and Cyclostationary Detection spectrum sensing techniques. A plot between probability of detection, P_d and SNR for Energy Detection and Cyclostationary Detection is depicted in Fig. 5.

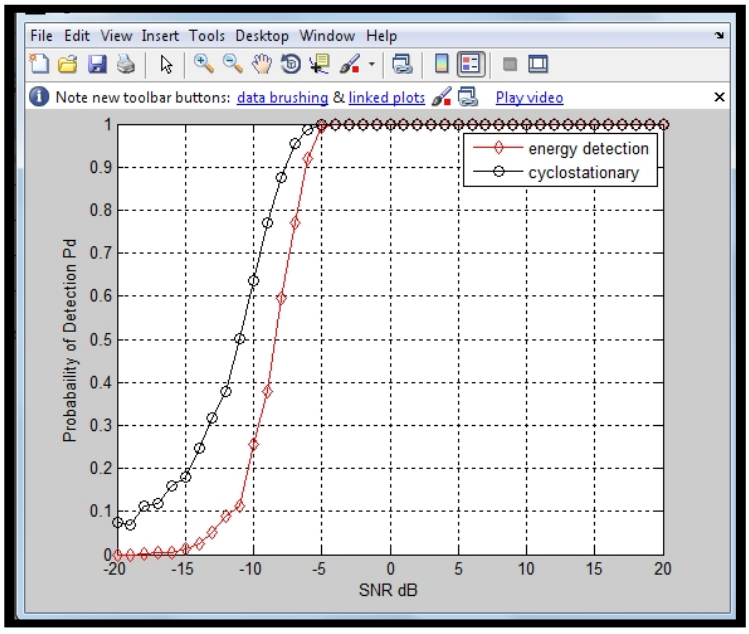

FIGURE 5. Plot between Probability of Detection, P_d and SNR (dB)

It is observed that the SNR hard decision threshold for energy detection technique is approximate equal to -10 dB and above it cyclostationary detection technique automatically detects the channel.

DISCUSSIONS AND CONCLUSION

Although energy detection spectrum sensing technique does not need a priori information regarding the presence of PU signals, yet it is difficult to differentiate the desired PU signal from noise signal under fading operating environment conditions. Therefore, the threshold level defined for making the decision on occupied or free spectrum for use by SUs becomes the most crucial parameter to evaluate the performance. Cyclostationary sensing technique seems to be reasonably robust under noisy conditions and performs satisfactorily under very low SNR regions. That is why cyclostationary technique has much better probability of accurate detection. In order to enhance the detection performance, number of samples can be increased. But due to increase in the length of the received signal, the time needed for sensing the spectrum as well as the system complexity is substantially increased. Moreover, it is also not very much robust under severe fading uncertainties. To summarize, one has to choose among the sensing performance, implementation complexity as well as practical aspects. Next generation wireless communication systems such as 4G/5G cellular system, upgraded versions of WiFi, Digital Video Broadcasting Terrestrial (DVB-T) and Worldwide Interoperability for Microwave Access (WiMAX) use spectrum sensing techniques that exploit cyclostationary features.

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AUTHORS' PROFILE

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Assessment of Air Pollution Tolerance Index of Plants in different zones of Kanpur City, Uttar Pradesh

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Abstract: In the present scenario, air pollution is the burning issue of the world. Vehicular emission is one of the most significant causes of air pollution. Kanpur is the 11th most populated city of the India and the registered vehicles are 3, 50,000. Road side plants are the primary receptor of pollutants emitted from vehicles. The tolerance capacities of these plants vary with their chemical compositions. Air Pollution Tolerance Index (APTI) is the parameter to assess the sensitivity and tolerance level of plants. The objective of this study is to estimate the tolerance and sensitivity of different plant species against air pollution. Vehicular emission is one of the aspects of air pollution in most of the developing nations. Road side plantation is the significant approach to reduce the emitted pollution from the vehicles. Four significant biochemical parameters : pH, relative water content (RWC), total chlorophyll (Tch) and ascorbic acid (Asc) content of leaves are used to measure the APTI value of the plants. The leaves of plants were collected from two different zones of the city: Residential zone (Rawatpur locality) and an Industrial zone (northern railway colony). Based on APTI values, it is found that Passiflora quadrangularis (35.42) and Tillia cordata mill (30.80) are the tolerant plants in the residential area while Polyalthia longifolia (17.84) and Nerium indicum (16.23) are the intermediate category plants in industrial zone.

KEYWORD

Vehicular pollution, Total chlorophyll, Ascorbic acid, Air pollution tolerance index (APTI).

INTRODUCTION

Air contamination is turning into a serious danger to climate because of expanding urbanization and industrialization. By combining more gases together and exposing suspended particle matter to the environment, air pollution has grown into a serious problem for ecological degradation. (Sarkar et al., 2021). When exposed to contaminants, plants have a variety of negative impacts, including disruption of the synthetic cycle, breath, impetus reactions, layer interruption, stomata behavior, and ultimately death. (Viradiya et al., 2020). The quality of the air has deteriorated due to ongoing vehicle pollution, which has also had a significant impact on roadside plants' morphological, biochemical, and physiological characteristics. These include enzymes, proteins, pigments, ascorbic acid and sugar contents, leaf area, leaf number, stomata number and flowering growth (Tak & Kakde, 2020). Plants operate as a giant sink for various polluting agents, making them the main recipients of these contaminants. Pollutants can be adsorbed, absorbed, and accumulated on the surface of leaves by plants. Because they are the most vulnerable to air pollution, leaves can exhibit a variety of apparent alterations.(Kaur & Nagpal, 2017). It is defined as a change in any air ingredient from the value that would have existed in the absence of human activity and deteriorates ecological conditions(Rai et al., 2013). Over the time, the concentration of gaseous and particle pollutants has increased due to the rise of the human population, road transportation,

automobile traffic, and industries (Maity et al., 2017). APTI is a key parameter to use for selection of tolerant plant species that can mitigate air pollution in the urban areas(Shrestha et al., 2021). It entails calculating the relative water content of fresh leaves, pH, concentrations of ascorbic acid and chlorophyll in leaf extract. APTI values range from 1 to 100 and classified as presented in Table 1.

TABLE 1. Classification of plants based on APTI values (Sharma et al., 2017)

APTI value	Category of plant
<1	Very sensitive
1–16	Sensitive
17–29	Intermediate
30–100	Tolerant

As bio-indicators of pollution, plants with higher APTI values are more tolerant of air pollution than those with lower APTI values. The plants can be divided into very sensitive, sensitive, Intermediate and tolerant plants based on their indices(Ahmad et al., 2019; Kaviani et al., 2021). The antioxidant ascorbic acid helps to protect plants from oxidative damage brought on by aerobic metabolism, photosynthesis, and a variety of contaminants(Bhadauria & Dixit, 2022). The present study was carried out in Kanpur, Uttar Pradesh, to evaluate Air pollution tolerance index (APTI) of several plant species.

MATERIAL AND METHOD

Study area

Kanpur, a city of Uttar Pradesh (U.P.) is the study location being considered for the current research. Due to the uncontrolled population growth, industrialization, urbanization, and increase in the number of vehicles on the roadways, environmental issues in the area have been becoming worse. With a population of more than 4 million (Dixit et al., 2022). The current study was carried out at two different locations of Kanpur. These locations were considered on the basis of residential and commercial areas. Fig.1 and Fig.2 shows the Rawatpur area (location-1) and northern railway colony (location-2) respectivley.

Fig 1 Map of rawatpur station (source: https://www.lmrcl.com/kanpur-metro/station-info)

Fig 2 location of northern railway colony,Kanpur (source: Google Maps)

SAMPLING OF LEAVES

Fresh leaves from each plant were collected for the study during the month of March 2022 within the residential and industrial area. The plant species chosen from both locations are shown in Table 2.

TABLE - 2

Location-1 (Rawatpur: residential area)		Site-2 (Northern railway colony : industrial area)	
Plant name	**Common name**	**Plant name**	**Common name**
Azadirachta indica	Neem	*Polyalthia longifolia*	Ashoka tree
Asclepias syriaca	Common milkweed	*Azadirachta indica*	Neem
Alstonia scholoaris	Blackboard tree	*Ficus religiosa*	Peepal tree
Polyalthia longifolia	Ashoka tree	*Ficus benghalensis*	Banyan tree
Tillia cordata mill	Linden	*Adina cordifolia*	Haldavan
Mangolia grandiflora	Sourthen magnolia	*Alstonia scholoaris*	Blackboard tree
Syzygium cuminil	Jambul	*Arcabela thevetia*	Kaneir
Passiflora quadrangularis	Giant granadilla	*Nerium indicum*	Indian oleander

Apti

For the assessment of APTI, leaves were tested for their chemical properties: relative water content (RWC), total chlorophyll (Tch), pH and ascorbic acid (Asc) (Sharma et al., 2017). APTI of the plants were measured by the eq. (1)

$$A = \frac{A(T+P)+R}{1} \quad (1)$$

Where: P : pH of the leaf extract, A :Ascorbic acid concentration (mg/gm), T: total chlorophyll (mg/gm), R : relative water content of leaf (%).

Rwc

With a few minor adjustments, the method of Henson et al. (1981) was used to estimate the relative water content. Polythene bags containing the leaves that had been collected at various locations were brought to the lab, where they underwent thorough washing and were drained of extra water using filter paper. For the analysis, a minimum of 10 leaves per plant. The weight of turgid leaves, turgid weight, and dry weights of leaf samples were all measured. Fresh weight (FW) was obtained by weighing fresh leaves, and turgid weight (TW) was obtained by overnighting the leaves in a Petri plate filled with water.turgid leaves were dried overnight at 70 °C in an oven for dry weight estimation, and dry weight (DW) was measured (Bandara & Dissanayake, 2021). A formula (Singh 1977) that used the fresh weight, turgid weight, and dried weight of leaf sample weights was used to determine the percentage of relative water content. RWC can be calculated by the Eq (2).

$$R \quad (\%) = \frac{(F \quad -D \quad)x1}{T \quad -D} \qquad (2)$$

Tch

For total chlorophyll content**,** 0.5 g of leaf samples was homogenized in 80% acetone and centrifuged. The absorption of supernatant was recorded at 663 and 645 nm using a spectrophotometer. The contents of chlorophyll a, chlorophyll b, and total chlorophyll were determined using eq 3 (a)-(c) proposed by Arnon1949 ; Kaur & Nagpal, 2017

Chlorophyll a (mg/L): 12.7 × A663 − 2.29 × A645 3(a)

Chlorophyll b (mg/L): 22.9 × A645 − 4.68 × A663 3(b)

Total chlorophyll (mg/L): 20.2 × A645 +8.02 × A663 3(c)

pH

The pH was measured with a few minor modifications to the Prasad and Rao (1982) procedure. A digital pH metre was used to measure the pH after homogenizing 0.5 g of leaf samples with 50 mL of distilled water(Tak & Kakde, 2020).

Asc

The 2,6, Dichlorophenol indophenol dye was used in the Titrimetric method of Sadasivam (1987) to evaluate the ascorbic acid level. 500 mg of leaf material were extracted with 4% oxalic acid and titrated with the dye until a pink color appeared.(Veni & Lavanya, 2014)

RESULT AND DISCUSSION

The estimated values of APTI with plants biochemical parameters for both the locations are presented in the Table 3 and 4 for the location -1 and 2.

TABLE 3. The biochemical parameters and APTI values of plants in Rawatpur residential area.

Plant Name	RWC	pH	Tch	Asc	APTI	Tolerance class
Azadirachta indica	43.95	7.31	10.43	9.81	21.79	Intermediate
Asclepias syriaca	68.94	7.41	9.938	4.29	14.33	Sensitive
Alstonia scholoaris	89.94	6.76	16.7	6.29	23.75	Intermediate
Polyalthia longifolia	78.84	7.95	28.75	5.43	27.81	Intermediate
Tillia cordata mill	46.7	7.39	32.09	6.62	30.80	Tolerant
Magnolia grandiflora	74.03	7.45	20.39	6.76	26.22	Intermediate
Syzygium cuminil	92.21	7.89	23.17	5.48	26.24	Intermediate
Passiflora quadrangularis	57.67	7.33	48.95	5.27	35.42	Tolerant

TABLE 4. The biochemical characteristics and the APTI for plants northern railway colony

Plant Name	RWC	Ph	Tch	Asc	APTI	Tolerance class
Polyalthia longifolia	66.21	6.84	5.74	8.92	17.84	Intermediate
Azadirachta indica	54.12	6.41	7.84	6.42	14.56	Sensitive
Ficus religiosa	60.52	5.83	6.52	6.94	14.62	Sensitive
Ficus benghalensis	55.61	5.41	4.42	6.61	12.05	Sensitive
Adina cordifolia	51.32	6.84	3.91	5.51	11.05	Sensitive
Alstonia scholoaris	50.44	6.06	3.89	5.21	10.22	Sensitive
Carcabela thevetia	59.18	6.82	3.82	5.93	12.22	Sensitive
Nerium indicum	78.44	6.99	5.48	6.73	16.23	Intermediate

The variation in APTI values are shown in the Fig. 3 and 4 for the location -1 and 2 respectively.

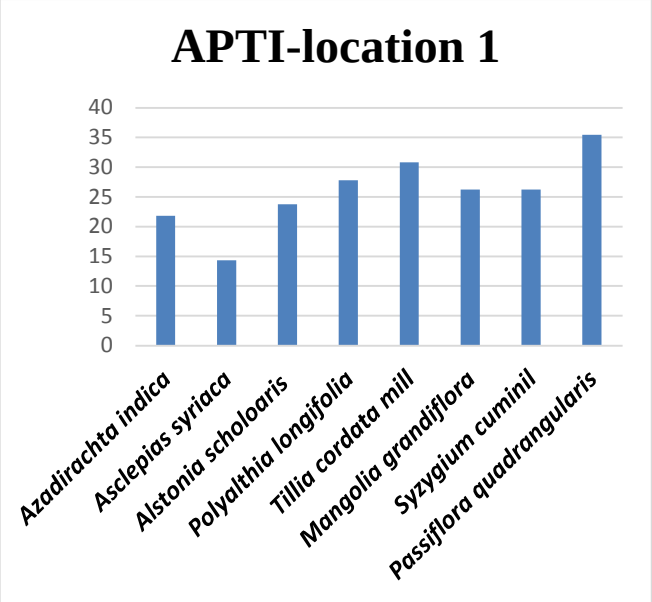

Fig.3 Variation of APTI of plants in Location -1

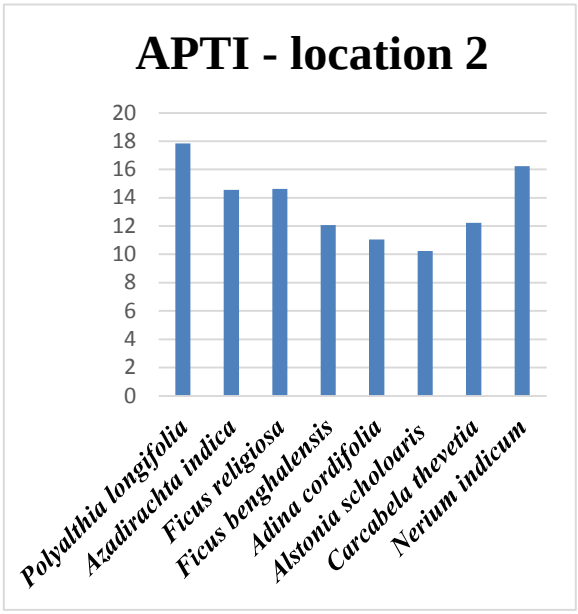

Fig.4 Variation of APTI of plants in Location -2

Fig.3 displays the APTI values of plants in ascending order as *Asclepias syriaca* < *Azadirachta indica* < *Alstonia scholaris* < *Mangolia grandiflora* < *Syzygium cuminil* < *Polyalthia longifolia* < *Tillia cordata mill* < *Passiflora quadrangularis.* In the same manner, ascending order for the APTI of plants studied at the location-2 (shown in Fig.4) as *Alstonia scholaris* < *Adina cordifolia* <*Ficus benghalensis* <*Carcabela thevetia* <*Azadirachta indica* < *Ficus religiosa* < *Polyalthia longifolia* < *Nerium indicum. Polyalthia longifoli and Azadirachta indica* are the two prevalent plant species. The *Polyalthia longifolia*, which is more resilient to air pollution in location location-1 and *Nerium indicum* in location-2.

CONCLUSION

The current study offers a framework for choosing appropriate plant species based on score, which can be utilised to better understand and regulate air quality. A useful tool for choosing plants for the development of green belts to reduce pollution is the APTI. Plant species tolerance can help to lessen the negative consequences of chronic exposure to air pollution. The present study offers the recommendations to competent authorities and environmental protection organization for the best suitable plants for the development of green belt in residential and industrial zones. As per the results, *Passiflora quadrangularis (35.42) and Tilliacordata mill*are (30.80) the best suited plant for residential area while and *Polyalthia longifolia (17.84) and Nerium indicum* (16.23) are the best suited plant for industrial area.

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Rexx Vs Python: A Comparative Study

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Abstract: Programming languages have been amedium through which instructions have been given to machines since the the inception of the field. The languages have developed over the ages. These languages have seen iterations such as the various older languages which started at the basic level of the memory access through instructions, and moved onto better tech where the languages were more powerful, included not only more complexity but also more functionality. This functionality has come in handy when it comes to various applications of languages as well. The languages can be broadly classified into various categories, including but not limited to low level, high level, object oriented, assembly, hardware language, machine language and many more. Here, we go through two popular scripting languages, Rexx, and python and compare their features.The age of the Rexx language should obviously meanthat the language has lesser features, but an attempt to measure the extent of its effects on scripting has been made here.

Index Terms—Rexx, Python, Language, Comparison

INTRODUCTION

Programmers and computer scientists alike fre- quently have strong opinions about the advantages and disadvantages of various programming languages. But at the same time, there is a dearth of reliable, accurate information regarding the relative advantages of vari- ous languages. The scientific and engineering literature offers numerous programming language comparisons, done in various ways and under various constraints.

Most of the comparisons thus done are highly opin- ionated and have less amount of data behind it. This work aims at comparing two languages, that is, Rexx and Python, with lesser opinions and relatively more experimentation. There, have been statistical studies before that have done overall averaged studies, such as [1] where a number of programmers writing multiple programs has been considered, and these studies have been taken relatively more seriously with respect tothe same.

Code has been written in both the languages andrun in both of them in this work, in order to reach the conclusions mentioned here. The code has had its own applications and works in similar (or in most cases, exactly the same) ways. Thus, the comparison is boundto be more or less uniform across the board.

The logos for the two language projects can be seenin the only two figures of this work.

Fig. 1. Logo of the Rexx language

RELATED WORKS

Previous works in the field have gone over differentconstraints of the works such as in [2] where the entire work has been theoretical. The work has no quanti- tative results and is quite speculative. Many a time, such a comparison has turned into a benchmark contestwhere the benchmarks were compared as they're the most efficient method of comparison. This, however is wrong due to the fact that ease of use and comparison is thus not compared in such a work, such as [3].

There have been other experiments where a degree of control has been attempted to be introduced, based on certain construct of a language or some style of notation such as in [4] and [5]. These experiments have gone up in the size of programs to have larger programs being executed. Some of these analyses compare data empirically across numerous, larger pro- grams. They talk about things like failure rates and production levels such as [6]. Lack of homogeneity in these comparisons is a problem. It is uncertain what percentage of the variations (or lack of differences) stem from the languages themselves and what per- centage is attributable to differing programmer back- grounds, software processes, application areas, design structures, etc. Each language is represented by a distinct program.

There are other works like [7] where a direct comparison of scripting languages with other languagesis done, this can also form a base for this work, as another method of comparison between Rexx and python is with respect to the fact that python canbe used for whole applications, including front-endin libraries such as Tkinter or PyQt and other back- end services such as Django, while also paving the path in web3 with web3py. These applications canbe seen summarised in [2] and [8]. Here, the obvious application of python where it is used in places such as Machine Learning, Data analytics and others should also be considered as in [9], since the boom has happened, bringing languages such as python and R into the limelight.

Fig. 2. Logo of the Python project

COMPARISON

In this section, the methodology of each type of comparison has been talked about first, and then we goon to see the actual comparison done. Each subsectionhere is a unique comparison in it's own.

Syntactic Differences

Since python is more than just a scripting language, the syntactic complexity is higher in python than in Rexx. Although things like variables are data typesare similar in the two languages, such as

```
variable = value
```

being the exact same in both of the languages. Both ofthese languages don't have a method for declaring the data type, unlike in languages like Java, C, C++ and others. Here, sticking to these languages, we see that the operations are also lesser in number in Rexx, such as, the fact that multiple assignment is not possible in Rexx.

```
x = y
y = y +1
```

whereas, in python, we can have

```
x,y = y, y+1
```

These differences do not make the big differences to the coder, so moving onto the differences that make a difference to the developer, we have the difference in importance for indentation among the two languages. The usage of indentation importantly is an unique feature of the python language. This can be seen as both, a boon and a bane. The fact that code is already indented makes it easier to read by default, whereas in other languages, readability of code becomes a huge issue unless written by a coder with good practices. That being said, python is helpful for beginners in coding as the complexity is lower, and it creates good coding practices. Thus, in python , we have indented blocks that form the code, while in Rexx, indentation is not necessary, but simply a tool to make code readable.

Data Structures

Python can be a classful language, so it can have essentially infinite data structures such as [10], while also having many data structures predefined, such as dictionaries, lists and has strong libraries for graphs and other data types. Rexx on the other hand, es- sentially has two data types, strings and integers. This however, has been extended to create lists with creation of functions like

```
word(x,#) pos(string, x)
```

```
parse var x ele1 ele2reverse(x)
```

where list like operations can be done. The word() function for example, can be used as an indexing method, on the string, as it finds the nth word in the string. Here, the string looks like :

```
string = "element1 element2element3"
```

and so on.

Thus, we can concatenate multiple strings to add elements to the list as well. The pos() function can then be used to reverse map the index to the numberof letters, so that other functions that are not mentioned here can be used.

In python on the other hand, we have lists as adatatype, where we can use indexing, appends, deletes, and other functions directly. The operations on this listis more natural and thus can be said to be better.

```
list = ["element1","element2","element3"]
```

The above are simply one dimensional lists, butsince python allows multiple dimensional lists andmore, we can use those for particular applications,especially in fields such as data science, where the number of dimensions in the can go in the hundreds. The libraries like sci-kit-learn [11], tensorflow [12], and keras [13] also have a lot of their own classes, objects and data types in general that are usually basedoff numpy arrays. These data structures are never used in python as a scripting language, but are worth mentioning here.

There are also other data structures such as dic- tionaries and arrays, and multidimensional lists in python [14]. Libraries like numpy [15] and pandas
[16] have their own data structures that are much more powerful, in their own regard. The operationson these multidimensional arrays as described by theirrespective libraries are also immensely powerful.

Control and flow of the program

One of the biggest paradigms of modern program- ming is control flow. Control flow is the concept in modern programming where the control flows from one stub to another. The flow thus forms the entire program. This is usually limited to functions and func-tional programming, but here we include conditional statements and also loops. Thus, programs can be described with flowcharts that essentially describe this,but pictorially.

Starting off with functions, although Rexx has the capability to write functions, most of the functions are essentially go-to statements, where a bunch of lines areredone based on the calls. Thus, these functions have no parameters and no return values. It is a control flowand only a control flow. Nothing beyond. Example, a typical function would look like :

```
functionname :
code goes herereturn
```

and the call to the function just uses a keyword call,that is

```
call functionname
```

This is useful only when it comes to scripts where the exact same lines need to be executed, with barely any scope for parameters. The functions are also file specific, that is, a function from one file cannot be run in another file, moreover the absence of classes also makes the entire application less powerful.

Moving onto python, the functions can be put in classes, the classes have default functions and can be parameterized. Overloading is not supported by defaultunlike in languages like Java, but instead overwriting takes place when newer functions are written with the same name. This is especially true since python is an interpreted language. The functions here can be writtenas :

```
def functionname(parameters):code goes here
    return var
```

The calls here do not require any keyword, and can be directly called as in

```
returnvalue = functionname(parameters)
```

The return statement in Rexx is to transfer control back to the calling line, without which, the flow would simply go on to the end of the file from the function in case it is written after the call in the file, and an infinite loop otherwise. Whereas in python, the return statement is optional and does not need to be written always, the control is returned to the calling line right after the block of the function ends.

The return statement also returns a value back to the call, which is why we have a returnvalue variable that stores the value returned by the function in the example above.

Moving onto if conditions and loops, there exist for and while loops in python, where as in Rexx, all the loops are do loops. Although for loops can be emulated by usage of :

```
do <number>
```

The other loops in Rexx are :

```
do while ... enddo until ... end
```

The usage of these loops would be similar in both the languages, that is, having to script the similar functions. Although it is true that the iterators in python are much more useful when compared to the loops in Rexx, since the iterators can be used for more versatile applications.

Finally, in this section if conditions can be dis-cussed. The working of if conditions is trivial and the only difference in the two languages here is syntactic.
In Rexx, one would write an if condition as

```
if condition then dostatements
else do statements
```

A noticeable feature is the absence of indents. They are not mandatory to be used, whereas in python we have

```
if condition :statements
elif condition:statements
else:
    statements
```

The difference is purely syntactic and the working is exactly the same, since an if condition is the most basic building block of any programming language.

Strings

Both python and Rexx have string handling capa- bilities. The major difference however, is the way in which string handling functions work. The functions are bound to be more in number in an open source language which was contributed to, by people all over the world, than in a proprietary language like Rexx created by IBM. For the sake of this comparison,

```
string[start:end]
```

The common functions in python that are used for string manipulations are

```
split lower upper endswithindex replace
```

Speed of Execution

The speed of execution in the case of python is expected to be slower than in the case of Rexx due to the fact that scripting is only a feature of the language,while Rexx was made only for scripting, thus making

```
translate('abc','xv','ab') == 'xvc'
```

the language as a whole very lightweight and quick Some of these functions maybe more useful in scripting, which is why they are provided by default in Rexx. Whereas, in the case of python, while these functions can be written with relative ease, due to the presence of data structures like dictionaries, they do not come packaged with the language.

It is however worth mentioning, that this is one of the few functions in Rexx that cannot be found elsewhere, and most other functions are more or else standard across the board for most modern languages.

Moving to the other functions, both of these lan- guages have pretty much the same functions in terms of string handling. An exception to this is due to the fact that lists or arrays are simulated in Rexx through these strings. Thus, we have string functions that countthe number of words, and a few basic functions to manipulate those words built into the language. This unorthodox way of dealing with lists has its own pitfalls, but it provides for a few string functions thatsome scripts would benefit from. This is because, a lot of scripting involves reading from log files, andlog files are strings, which would be needed to be converted into lists for them to be able to be used inpython scripts, but instead, here, we simply use the inbuilt functions to achieve the same.

Some of these functions are mentioned below

```
DELWORD SUBWORD WORD WORDINDEXWORDPOS WORDS
```

Most of these functions are self explanatory, where the DELWORD function deletes a word from a string after some n words, the WORDS function unpacksthe ”words” in the string into the variables, and so on. Thus, the functioning of strings in the two languages can be said to be stronger in Rexx, but python being more adaptable to newer changes.

For the sake of completeness, the common ways in which python strings are worked with are slicing and only similar functions that exist for both languagesare going to be compared.

The replace function for example in the case of python replaces a certain string with another string. The corresponding function in Rexx, which is the translate function, can be used to have a reference tablein and out, where the characters in the in table and those in the out table are mapped and those characters are replaced. A function that is mostly absent in other languages. The syntax of this function is

```
TRANSLATE(string [,[tableout][,[tablein] [,pad]]])
```

A better understanding can be obtained from the example below.
to run on servers and otherwise. On an average, the triggers by Rexx can be said to be faster than Rexx. However, when it comes to scripts where meaningful work is being done, the python script prevails, this also depends on other factors such as the programmer, the expertise of the programmer, the data structures that need to be used in the course of the program, but on anaverage, similar scripts that perform similar functions should take the same amount of time, as long as no complex logic or algorithmic coding is done in these scripts, as is common for scripts.

Program writing

A major part of comparison of languages is thelearning curve, the availability of information and the ease with which programs can be written. This has been made into a section, since there is statistical evidence on the same, to look at whether coding inone language is faster than the other. Learning of the language on the other hand is a very subjective term and is relatively harder to compare. But to put it fairly, the Rexx programming language has lesser resources when compared to python due to he difference in theirpopularity, and the usage of the two languages is also comparatively in favour of python.

However, from a dev-ops perspective, where script- ing is the main way in which programming is done, Rexx is more similar to batch files and command files, thus making it the easier choice. Python, although comparatively harder in this regard, does not have as steep a learning curve as some other languages.

Coming to the statistical analysis, as done in [17], the amount of time taken by the programmers who wrote the same program in Rexx and python, wascomparable, with python having the lower averagetime. It can be seen that statistically, there is more con- sistency among a decent number of python program- mers, which is more or less absent in the programmers of other languages, including Rexx. This, however is a statistical study, but since all the people involved were volunteers, we can say with a fair degree of certainty that the standard deviation in case of python is much lower, with the mean time also being lower when compared to the other languages in the same comparison.

Other comparisons have also been made in the above cited work, but those are trivial, and somewhat subjective in a lot of ways.

Usage and applications

As mentioned previously, python is used immenselyin programs where large scale development needs to be done and it needs to be done fast. Python is versatileand is not limited by functionality and with the help

of modern libraries, can practically perform any other task. Rexx on the other hand is limited by the number of publicly available libraries.

Python has been used traditionally for everything from beginner level programming to large scale cloud and Artificial Intelligence applications. Rexx, due to its limitations has been a scripting language and nothing else. This limitation of has been mentioned over and over again in this work, but that is the only reason why Rexx has the disadvantages it does. Python being as popular is due to its ease of use, versatility and the contributions of thousands of people all over the world.

CONCLUSION

While python is more versatile, has more applica- tions and can be used to create full stack applications, Rexx has its own advantages in terms of ease of coding and speed of execution when it comes to smaller scripts. Rexx also happens to be more lightweight, asit was designed for this very purpose. Python having object oriented concepts, the ability to write scripts andother small and large scale programs, has advantages with respect to exception handling, support for modernfull stack applications, REST and otherwise.

To pass a final verdict, everything that can be done by Rexx can now be done in python, and rightly so, asit has reached its end of life, but the minor advantages of Rexx may make it worthwhile to use in a nicheof applications, where a large amount of scripting is involved. Nonetheless, it provides an upgrade over thebatch file scripts written in windows to do certaintasks.

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GIS Based Evaluation of Surface Water Quality and Contaminants Determination in Baitarani River Basin, Odisha

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Abstract: All the river basins including Baitarani are polluted from unplanned anthropogenic activities. Water samples were collected from 13 locations during PRM and POM and assessed for suitability for drinking by using 22 parameters. Most of the parameters were found to fall in the allowable limits of the Bureau of Indian Standard (BIS) among others, except for turbidity, DO and TC. Water Quality Index (WQI) analysis was computed using five indexing methods such as Weighted Arithmetic (WA) WQI, Synthetic Pollution Index (SPI), Numerow's Pollution Index (NPI), Comprehensive Pollution Index (CPI) and Overall Index of Pollution (OIP). A geographical Information Systems (GIS) was employed to outline the spatial maps using Inverse Distance Weighted (IDW) technique. Multivariate statistical analysis such as Cluster Analysis (CA) were used for the evaluation of complicated water quality data sets. The findings of the WQIs indicate that excellent to poor (PRM) and good to poor (POM) in WA WQI, good to very poor (PRM/POM) in SPI, excellent to poor (PRM) and good to very poor (POM) in NPI, sub-clean to polluted water (PRM) and qualified to polluted (POM) in CPI and excellent to slightly polluted water in case of OIP. With the help of dendrogram plots, CA classifies 22 water parameters and 13 sampling points into three major clusters with similar surface water characteristics. As per integrated approach of different WQ indexes with GIS and CA, it is concluded that samples from the points S-8 represents poor quality water. It was concluded that the increasing and diverse nature of anthropogenic activities, industrial and agricultural waste disposal on the river course was responsible for the deteriorating quality of the water. However, water needs to be prior treatment before consumption at the alarming stations which are prone to be polluted.
Keywords: Anthropogenic, Water Quality Index, integrated, GIS, CA, pollution.

INTRODUCTION

Freshwater is an important resource for supporting life and the environment and its progress (Gupta et al. 2012). Safe and accessible water is essential for human beings to survive (Das 2022). Hence, good water quality leads to a healthier environment, thus improving human life (Sharma et al. 2013). The surface water bodies like rivers, lakes and wetlands are the main source of water for domestic, agricultural and industrial purposes (Mishra & Kumar 2020). Recently, most of the rivers have been subjected to heavy pollution loads caused by the discharge of untreated or partially treated wastewater and industrial effluents (Sharma et al. 2017a, b). Indiscriminate discharge of untreated mining and industrials wastes coupled with runoffs from agricultural activities contributes significantly to the pollution of water bodies (Obiri 2007). Wastewaters from these sources contain toxic organic and inorganic substances in addition to heavy metals (Ahmad et al. 2016), that cause severe damage to the ecosystem like eutrophication and pose serious health issues (Bhargava 2009). However, the rivers have also been influenced by surface runoff from farmlands that carries anthropogenic chemicals, pesticides and fertilizers (Bhardwaj et al. 2017). During the last several decades, the water quality of the Indian rivers including river Baitarani has been deteriorating due to continuous discharge of partly/untreated industrial effluent, urban runoffs and sewages from the point and non-point sources (Shukla et al. 2020). Both geogenic and anthropogenic factors become important when discussing the overall water resources quality of any given area (Naylor 2003). Several studies conducted on different rivers all over India have portrayed the same picture of poor water quality and deteriorating aquatic life (Shah and Geeta 2017). There cannot be accounted a single reason has arrived for such pity condition of the rivers but the scenario has arrived at these levels because of the combined effect of various intertwined factors. For evaluating the quality status of any river body, a plethora of water quality indices are

available. The first WQI was developed by Horton 1965 in which arithmetic weighting was used with multiplicative variables (Lkr et al. 2020). The Weighted Arithmetic Water Quality Index method (WAWQI) developed by Brown et al. (1972) was used to assess the suitability of surface water for drinking where water quality is classified based on the most common water quality parameters and according to its degree of purity (Smith 1998). This has been used by many scientists (Ahmed et al. 2017) because it has many advantages compared to other methods. One of which is that it has the ability to describe the suitability of both groundwater and surface water for drinking purposes (Tyagi et al. 2019), being free from overestimation or underestimation (Sharma et al. 2011) and it is based on a mathematical equation that includes several water quality parameters without depending on certain parameters (Chandra et al. 2010). Further many modifications were done according to the requirement and many new indices were developed such as Overall Index of Pollution (OIP), Comprehensive Pollution Index (CPI), Numerow's Pollution Index (NPI) etc. (Poonam et al. 2013). OIP helps in understanding the water quality condition of the surface water resources especially under Indian conditions (Sargaonkar & Deshpande 2003). NPI was created to measure the impact of each individual variable on the degree of pollution source and its origin (Numerow et al. 1970). CPI was investigated under Kamboj et al. (2017) and Matta and Kumar (2020) to classify water quality status. Another promising tool, the Synthetic Pollution Index (SPI) was also evaluated in this study to validate the pollution level assessed by WQI. It was developed by Ma et al. 2009 to assess the impact of pollutants on the water quality and was later adopted in various studies due to its simplicity (Sunar et al. 2020). Therefore, integration of the data set with a geographic information system (GIS) can help in illustrating the water quality status of river Baitarani to the general public. GIS programs contain spatial analysis tools that have the ability to deal with huge data (Madhloom and Alansari 2018). Surface interpolation techniques helps to predict the concentrations at locations where samples could not be collected (Venkatramanan et al. 2015). The method of IDW classification of spatial map interpolation was generating the parameters for the study area (Selvam et al. 2013). In IDW, points closer to the predicted position have a greater effect on the predicted value than points far from the predicted position (Chabuk et al. 2019). Many researchers interested in evaluating surface water for drinking purposes have adopted the WQI and IDW interpolation technique through GIS programs. Magesh et al. (2012) assessed surface water quality in Tamil Nadu region, India, using the WQI and GIS where the results showed that most of the surface water samples are suitable for drinking. This will make the research output more approachable and understandable. Pollution source identification through cluster analysis (CA) also helps the government to control water pollution (Saha and Paul 2019a). CA is one of the methods which is used to determine relative similarity in the homogeneity of measured parameters (Shrestha and Kazama 2007). Hence, comprehensive studies should be conducted to identify the pollution sources and evaluate the water quality. To the best of the authors knowledge, this is the first reconnaissance study representing a detailed assessment of the pollution status of the whole stretch of the Baitarani River, Odisha. However, minimal work has been performed on water quality assessment. Not even single research has been done with an integration of WQI, CPI, NPI, SPI, OIP and CA to assess the surface water quality. Thus, there is a research gap here, and more discussion is needed to have a better understanding of the extent and causes of its degradation. In light of these considerations, the effect of the various physicochemical and biological parameters on the quality of water of the Baitarani River has been assessed to discuss the suitability of the water for human consumption using the integrated approaches of different water quality indexes with GIS and multivariate statistical analysis such as CA. In the present study, the survey was conducted for ten years (2010-2020) and designed to understand the seasonal variation i.e., pre-monsoon (PRM) and post-monsoon (POM) seasons. Ultimately, the results of this study, will provide clear scientific evidence to regulate the situation of water quality of this river.

STUDY AREA

The present study is undertaken in the Baitarani River Basin, Odisha which is situated between 85°0'0" to 86°30'0" E longitude and 21°0'0" to 22° latitude. It constitutes an area of 8645 Km^2 with elevation ranging from 32 to 1181 m above the mean sea level (MSL). Temperature in the catchment vary between 30-36 °C during the summer and 16-17 °C during winter. The basin experiences various seasons such as mild winters, dry and hot summers and monsoon seasons. The average rainfall in the basin is 1628 mm with a predominant sub-humid climate. The basin experiences an undulated topography with an average slope varying between 0-2%. Being an agriculture dominant basin, rice, maize, green gram, wheat, groundnut and vegetables are cultivated throughout the year. The economy is dependent on the industrial sector, which includes automobiles, leather goods, handicrafts and stone craving. The surface water has a special importance in the study area, as it is used mainly for bathing, domestic purposes (drinking water, cooking, dishwashing, laundry), watering and irrigation of vegetable gardens. Therefore, water quality assessment and documentation of the management practices are required to safeguard human health. Hence, sampling points were selected on the basis of land use pattern,

population, potential anthropogenic activities and socio-economic important of locations. The Geo-coordinates, landmarks and demarcation of sampling stations mentioned in Figure 1.

MATERIALS AND METHODOLOGY

Sampling and Analysis

The Odisha State Pollution Control Board (OSPCB) is responsible for water quality monitoring of the stretch of River Baitarani in the State of Odisha. The physicochemical data of monitoring during 2010-2020 was obtained from the database of OSPCB. The surface water samples were collected in 1000 ml plastic bottles that were carefully rinsed, labelled, stored in a cool box at 4°C and transported to the laboratory for analysis during pre-monsoon (PRM) (March-May) and post-monsoon (POM) (October-February) period following the standard methods recommended by American Public Health Association (APHA 2017). The raw data analysed in this study is in the form of monthly average data in reference to surface water samples collected every month at 13 monitoring stations in Odisha. Precaution was also taken to avoid sample agitation during transfer to the laboratory. The location of sampling points was recorded by GPS at each location. Table 1 summarizes the methodology, which comprises the analytical techniques, software and instruments used to complete the work. 13 sites namely Chandabali (S-1), Jajpur (S-2), Akhuapada (S-3), Daitari (S-4), Bonth (S-5), Anandapur (S-6), Ghartagaon (S-7), Thakurmunda (S-8), Swampatna (S-9), Keonjhargarh (S-10), Karanjia (S-11), Jhumpura (S-12) were chosen for investigation of WQ (Figure 1). 22 Samples were examined using the procedure outlined by the American Public Health Association (APHA 2017). Approximately half of the volume (500 ml) of samples were specially separated and checked in the laboratory to ensure QA/QC mechanisms. The accuracy of the chemical analysis has been validated by charge balance errors and samples < 5% error were considered. Using the spatial analysis tool from the tool box, IDW technique was selected for preparing interpolated maps. Moreover, ArcGIS 10.5 was used to prepare the digitized base map of the study area.

Table 1. Analytical techniques adopted for analysis

Parameters	Methods
pH (mg/l)	Digital pH meter
Turbidity (NTU)	Digital Nephaloturbidometer
Total dissolved solids (TDS (mg/l))	TDS meter
Total suspended solids (TSS (mg/l))	TSS meter
Electrical conductivity (EC (micro-Siemen/cm))	Conductivity TDS meter
Dissolved oxygen (DO (mg/l))	Modified Winkler's method
Alkalinity (mg/l)	Sulphuric acid titrimetric method
Biochemical oxygen demand (BOD (mg/l))	Modified Winkler's method
Total hardness (TH (mg/l))	EDTA titrimetric method
Bicarbonate (mg/l)	Titrimetric
Sulphate (mg/l)	Barium chloride
Nitrate (mg/l)	Ion selective electrode
Phosphate (mg/l)	Stannous chloride
Chloride (Cl (mg/l))	Titration by sulphuric acid
Calcium (Ca (mg/l))	EDTA titrimetric
Magnesium (Mg (mg/l))	EDTA titrimetric
Sodium (Na (mg/l))	Flame photometric
Potassium (K (mg/l))	Flame photometric
Total coliform (TC (mg/l)) MPN/100 ml	Multiple tube fermentation
Faecal coliform (FC (mg/l)) MPN/100 ml	Multiple tube fermentation
Iron (Fe (mg/l))	HACH colorimeter
Chromium (Cr (mg/l))	Inductive coupled plasma mass spectroscopy
WQI method calculation	Drinking standards of BIS 10500:2012

Spatial distribution maps	Inverse Distance Weighted (IDW) interpolation technique

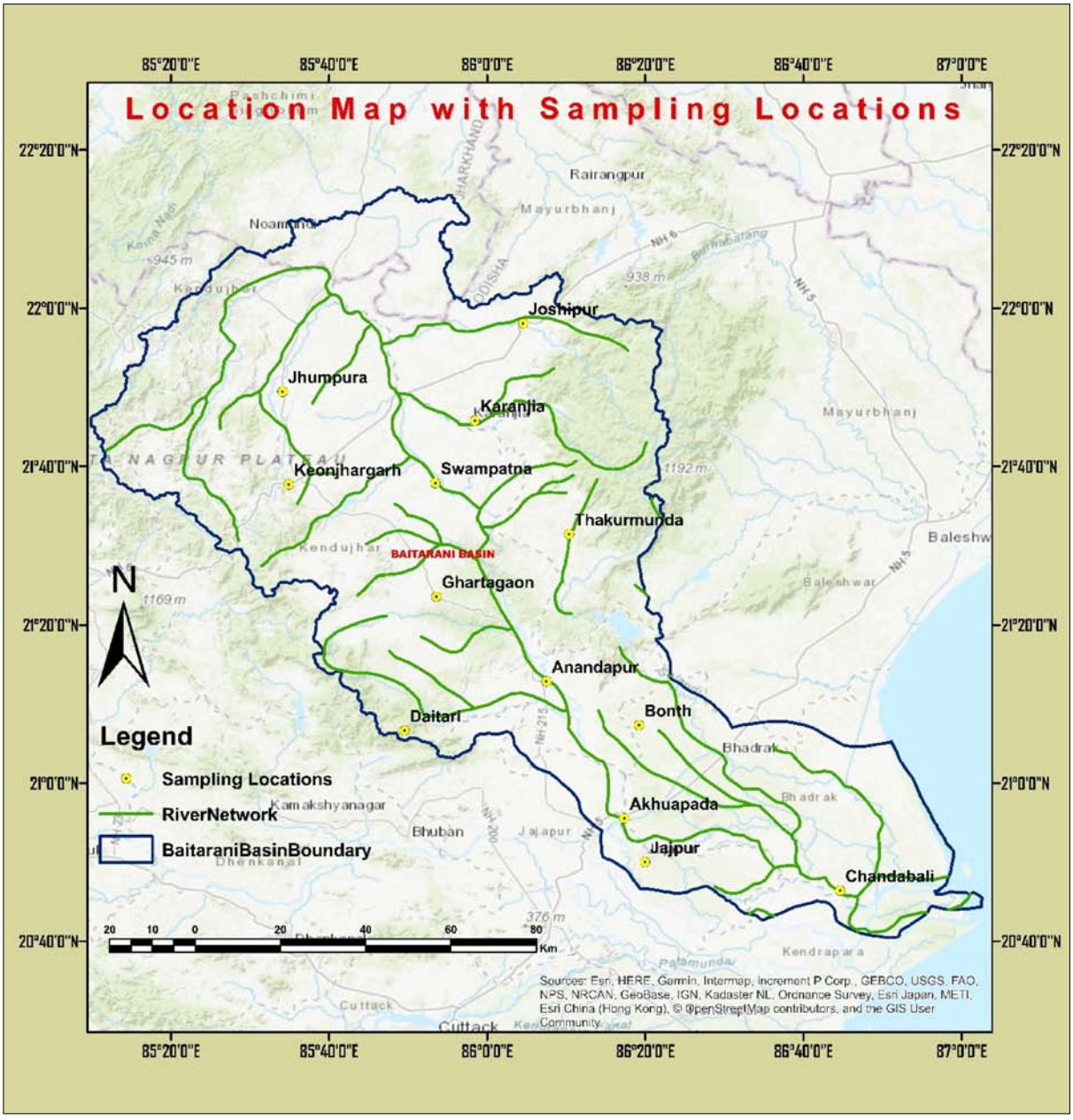


Figure 1. Index map of study area

METHODOLOGY

Surface Water Quality (SWQ) Modelling

In this study, the SWQ of all 22 samples were modelled using five indexing methods such as WAWQI, SPI, NPI, CPI and OIP. Those indexing models are deliberated in detail in the following sections.

WAWQI model

The computation was done using the weighted arithmetic index method (WA WQI) (Abbasi 2002; Lateef 2011) which is based on several physicochemical parameters which are then multiplied by a weighting factor and the final aggregate is obtained using the arithmetic mean. The weights assigned reflected a parameter's significance; this index is based on the comparison of the water quality parameters to regulatory standards. Three consecutive phases consist of the WQI calculations: The 1st step is to assign weight by assigning a weight (w_i) to each of the 22 parameters based on its relative importance to the quality of drinking water. Assigned weight of 2 stand for the least significant parameter and 5 as the most significant (Table 2). By adopting the following equation $W_i = w_i/\sum_{i=1}^{n} w$, the 2nd step is relative weight calculation. A quality rating scale (Qi) for each parameter is computed by dividing its concentration in each water sample by its respective standard according to the guidelines laid down by BIS 10500:2012 and then, the result was multiplied by 100 using $Q_i = (C_i / S_i) * 100$. Finally, for computing the WQI, the water quality sub-index (SI_i) for each chemical parameter is determined, which is then used to determine the WQI as per the $SI_i = W_i * Q_i$ and $WQI = \sum_{I=1}^{n}(SI)i$, where SI_i is represented as sub-index of each parameter. Finally, the WQI has been categorized into five classes according to Ramakrishnalah et al. (2009) as [Excellent (<50), Good (50-100), Poor (100-200), Very poor (200-300), Unsuitable (> 300)].

Table 2. Relative weight of each selected parameter

Parameters	Standard value BIS 10500:2012)	Weight (wi)	Relative Weight (Wi)
pH	8.5	4	0.05882
Turbidity	5	4	0.05882
TDS	500	3	0.04412
TSS	500	2	0.02941
EC	2250	5	0.07353
DO	5	4	0.05882
Alkalinity	120	3	0.04412
BOD	5	3	0.04412
TH	300	2	0.02941
HCO_3^-	100	2	0.02941
SO_4^{2-}	250	3	0.04412
NO_3^-	45	5	0.07353
PO_4^{3-}	1.2	2	0.02941
Cl^-	250	4	0.05882
Ca^{++}	75	2	0.02941
Mg^{++}	50	2	0.02941
Na^+	200	2	0.02941
K^+	12	2	0.02941
TC	1000	5	0.07353
FC	300	2	0.02941
Fe^{++}	1	2	0.02941
Cr^{++}	0.5	2	0.02941

SPI model

The SPI is determined by the following equation after the selection of parameters and unit weightage of each parameter (Ma et al. 2009). The following equation used is $SPI = \sum_{i=1}^{n}\left(\frac{V}{v}\right) * W$, where V_o represents the

analytical value of the water quality parameters and Vs stands for the standard value of the water quality parameters recommended by BIS 10500: (2012) as mentioned in Table 3. By combining all the water quality parameters with the unit weightage through SPI equation, the critical value estimated was 1. Further, it is classified into five classes as 0-0.25 (Excellent); 0.25-0.50 (Good); 0.50-0.70 (Poor); 0.75-1 (Very poor) and >1(Worst).

NPI model

This method is an overall pollutant indicator that takes into account the combined influence of several pollutants for a given application. Based on NPI (Numerow et al. 1970), water quality is classified as excellent when NPI<10; if it falls in between 10-20, 20-30, 30-40 and > 40, signifies good, poor, very poor and unsuitable category. As per Gauns et al. (2020), NPI is calculated with the help of the following equation $PI_n = C_n / S_n$, NPI = Σ PI_n, where PI_n is the nth parameters pollution index, C_n is the nth parameter's observed value, S_n is the nth parameter's permissible value and NPI is the Numerow's pollution index.

CPI model

CPI is used to access the overall pollution of water bodies (Liu et al. 2010). The formula (Sharma et al. 2018) to calculate CPI is presented as CPI = $1/n * \sum_{i=1}^{n}$ PIi, where CPI= Comprehensive Polluted Index; n= number of monitoring parameters; $(PI)_i$ = the pollution index number i. $(PI)_i$ is calculated according to the following equation as $(PI)_i = Ci / S_i$, where C_i = measured concentration of parameter number in water; S_i = permitted limitation of parameter number according to environmental standard. Furthermore, it is classified into five categories such as 0 to 0.20 (Clean); 0.21 to 0.40 (Sub clean); 0.41 to 1.00 (Slightly polluted); 1.01-2.00 (polluted) and >2.01 (Heavily polluted).

OIP model

The OIP index was showed the health status of water under Indian conditions (Sargaonkar and Deshpande 2003). The ultimate value was estimated by following equation as OIP = (1/n) * $\sum_{i=1}^{n}$ Pi where Pi = pollution index value for the ith parameter, n = number of parameters, Pi = [V_n (observed value of parameter)/ V_s (Standard value of parameter)]. According to classification, if the OIP score is < 1.9, it represents excellent and comes under the class C1. If the OIP score is < 3.9, then the water quality is acceptable and falls under the class C2. The OIP score < 7.9, < 15.9 and > 16 shows slightly polluted (Class-C3), polluted (Class-C4) and heavily polluted (Class-C5) respectively.

Cluster analysis (CA)

This is a group of multivariate techniques which primarily classify variables or cases (observation or samples) into the cluster with high homogeneity level within the class and high heterogeneity level between classes (Massart et al. 1988). It is commonly shown with the help of dendrogram which is a two-dimensional graph that displays a clear pictorial description of the process (Jankowska et al. 2017). CA was performed to group all sampling sites to classify them into a cluster to minimize the number. The distance between the parameters of samples is studied using hierarchical cluster analysis (HCA). Branches that have linkage closer to each other indicate a stronger relationship between samples/variables or cluster of sampling site/variable. The points that are the most similar are joined together to form a cluster and this is continued till all the points fit into the same cluster (George R et al. 2016). In this study, Ward's method using Squared Euclidean distances, is employed.

RESULTS AND DISCUSSION

The results of the statistical data of surface water samples collected during PRM and POM seasons and it is contrasted with that of the Bureau of Indian Standards (BIS 2012) as shown in Table 3. Several parameters taken into consideration in this work, is illustrated in Figure 2a-v. The most vital parameter pH denotes the amount of hydrogen ions in water and it represents acidic or basic nature of water. The recommended limit for drinking water is 6.5-8.5 (BIS 2012). In the study region, the value varies from 7.3 to 9.7 in PRM and from 7.4 to 9 during the POM (Figure 2a). Most samples fall within the recommended limit and only a few samples have a pH value above 8.5. It has been found to be alkaline in nature indicates presence of hard water minerals and the release of agricultural waste water can lead to factors influencing alkalinity (Dinka 2015). Higher pH witnessed in S-6, S-9, S-10 in PRM and S-10 in POM, indicating increase in productivity of river (Ravikumar et al. 2011). This may be because of pollution of water through seepage of wastewater from nearby industry. Turbidity describes the foggy

appearance of water caused by particles, often known as suspended matter (Kavanaugh et al. 1979). It may be estimated only utilizing measuring instruments, however above 5 NTU, a whitish, black or brown, muddy, suspension may be observable (WHO 2011). The values were observed between 8.2 and 25.20 NTU and 11.8 and 38.70 NTU in PRM and POM season respectively (Figure 2b). All values obtained during both seasons were above the permissible limits (5 NTU) as per BIS (2012). This may be attributed because of inorganic materials like manganese and iron. Excess of such inorganic substances are considered undesirable because it has adverse effect on water distribution and sanitation systems (Akhtar et al. 2020). TDS contains calcium, magnesium, potassium, sodium, bicarbonate, chloride and sulphate, primarily inorganic salts dissolved in surface water (Adimalla et al. 2017). These are common constituent of several effluents but are typically not well defined in terms of either chemical components or toxicity (Chapman et al. 1996). A general measure of the overall suitability of water for many purposes is the total concentration of dissolved minerals in water. Water with higher TDS used for drinking purpose, consumers often reported to have a poor taste (Young et al. 2019). In the present study, the value of TDS varies between 74 and 178 mg/l in PRM and 97 and 247 mg/l in POM (Figure 2c). All samples are within the optimal limit of 500 mg/l. TSS reflect the number of inorganic salts and small amount of organic matter dissolved in water (Harilal et al. 2004). Low value indicates bland taste and higher value can alter the taste and hardness of water (Khan R et al. 2018). Higher values attributed to faster rate of evaporation and decomposition activities and addition of surface runoffs by heavy precipitation (Manzoor et al. 2017). The values vary between 30 and 121mg/l in PRM and 43 and 127 mg/l in POM (Figure 2d). The acceptable TSS for drinking water is less than 500 mg/l. All samples are within the acceptable limits. Conductance is a calculation of the electric flow capability of water that is specifically related to ion concentration in the water (EPA 2012). However, for drinking purposes, EC should not exceed 2250 micro-Siemen/cm. Lower levels are attributed to precipitation dilution (Mandal et al. 2013). An abrupt rise or decline in conductivity in the water body may indicate pollution. Sewage discharge or agricultural runoff will rise conductivity because of addition of anions like chloride, phosphate and nitrate (Miller et al. 1990). When the EC of water is high, the TDS value is similarly high. In the present investigation, values observed during PRM period ranged from 96-318 and 121-393 during POM (Figure 2e). All sites are within the prescribed limits. DO of a water body depends on numerous factors like temperature, photosynthetic activity, wind action, respiratory process of the life in it, pollution load etc (Wavde and Arjun 2010). It fluctuates daily, seasonally and with the temperature variations as well (Victor 2017). The recommended level in drinking water is 6 mg/l. The concentration varies from 4.78-8.01 in PRM and 5.03-7.69 in POM (Figure 2f). The small hike in most of the samples is because of pumping of million gallons of water into the river during last month of the preceding water (Kodom et al. 2018). Alkalinity expresses the buffering capacity of water which will help in maintaining its pH (Lodh et al. 2014). It is the measure of the ability of water to neutralize acids (Kumar et al. 2014). The main source of alkalinity is dissolved carbon dioxide, which is found in large concentrations in most water sources. High value arises due to high rate of decomposition which releases CO_2 resulting in the addition of carbonate and bicarbonate ions (Verma et al. 2019). The value should not exceed 120 mg/l. For the study area, alkalinity ranges from 43-99 mg/l in PRM and 69-99 mg/l during POM (Figure 2g). BOD is the amount of oxygen required to degrade the organic matter present in a given water sample at a particular temperature for a given period with the help of micro-organisms. Low value of BOD gives an idea of greater toxicity in the river water and indicate the presence of industrial and domestic effluents in the water body; greater the waste, the less is the oxygen demand (Sharma et al. 2011). The values varied as 0.86-4.23 mg/l in PRM and 0.88-4.54 mg/l in POM (Figure 2h). The obtained values are well within the BIS standard of 5.0 mg/l (Kumar and Puri 2012). TH is defined as the water capacity in order to react with water, but for producing a lather, hard water required significantly extra soap (WHO 2011). High hardness can inevitably be due to industrial waste which is attributed to the handling of untreated and poorly treated waste (McGowan 2000). As per Indian standards, the limit for TH for human consumption (BIS 2012) is 300 mg/l. In the current research, the observed values ranged from 64-121 mg/l in PRM and 71-135 mg/l in POM (Figure 2i). Compared to the PRM, there is a greater shift in the hardness of the samples in POM due to the leaching of calcium and magnesium bicarbonate in the replenishment (Ritesh Vijay et al. 2011). Each research location in both seasons is well below the standard limits. HCO_3^- concentration ranges from 41.92 to 87.55 mg/l during PRM and 55.64 to 91.46 mg/l during POM (Figure 2j). Higher concentration of HCO_3^- may be due to the effect of dissolution of silicates and rock weathering. It is seen that concentrations were slightly higher in POM compared to PRM indicating the contribution of carbonate from weathering process. The limit of HCO_3 is 100 mg/l as per BIS (2012). All samples are within the limits. There is a slight variation observed in spatial and seasonal distribution which may be due to mixing of geogenically present salt patches in the soil profile and due to rise in the water table (Srinivasamoorthy et al. 2012). SO_4^{2-} occurs naturally in water namely gypsum and other common minerals, due to leaching from nearby rock bodies and can also applied to water by adding fertilisers (Hem 1970). The possible sources of sulphate in

rocks are sulphur minerals, sulphides of heavy metals which are of common occurrence in the igneous and metamorphic rocks, gypsum and anhydrite found in sedimentary rocks, input from volcanoes and bio-chemical processes; human economic activities (Nikanorov et al. 2009). However, it can be added by the application of fertilizers apart from the natural sources (Karanth 1987). In the current research, the values varied from 2.40 to 6.87 mg/l in PRM and 2.31 to 7.16 mg/l in POM respectively (Figure k). The observed levels were well below the permissible limit of 250 mg/l prescribed by BIS (2012). Higher values in POM than PRM may be due to the action of leaching and anthropogenic activities in the atmosphere through the release of sulphur gases from factories and urban utilities (Saxena et al. 2007). Due to potential effects on surface water use on human health, nitrate accumulation in drinking water is of particular concern. The upper nitrate concentration level in drinking water is stated as 45 mg/l (BIS 2012). Agricultural practices, septic tank leakage, unlined drainage and sewerage pipes, domestic sewage, leaching from indiscriminate disposal of animal waste can result in higher concentration (Sunitha et al. 2019). Higher concentration may also be attributable to the disposal of poultry waste and household/farm animal dung and mainly fertilizer bags that are washed by infiltration and return flow irrigation and drinking practices for entering surface water in addition to agricultural activities (Sunitha et al. 2019). In the present study, the values varied as 0.81-4.86 mg/l in PRM and 0.65-4.15 mg/l in POM (Figure 2l). All the samples in both seasons are within the limits. PO_4^{3-} is one of the limiting factors for productivity of any water body (Hutchinson 1957). Phosphate enters into the river ecosystem mainly through domestic wastewater, and agricultural runoff containing fertilizers (Gopalkrushna 2011). Higher concentration is indicative of pollution, and the major source of anthropogenic phosphorous is sewage, detergents, agricultural effluents and fertilizers (Sunitha et al. 2019). The concentration ranges from 0.25 to 1.04 in PRM and 0.31 to 1.17 in POM (Figure 2m). The limit as per BIS 2012 is 1.2 mg/l. All the sites are within the maximum allowable limit. The higher the Cl^- concentration in water, the more dangerous it is to human health (Chatterjee et al. 2020). The associated cation influences the taste threshold of the chloride ion in water. Geogenic or anthropogenic processes seems to be too responsible for the increasing Cl concentrations in surface water (Pius et al. 2012). The sources are mainly inorganic salts like NaCl and KCl in the water that mainly comes from soil, animal wastes and municipal and industrial wastes (Gopalkrushna 2011). It also considered as an important indicator of water pollution (Podhade et al. 2020). The levels should not exceed 250 mg/l. The amount of chloride in this study varies from 7.87-28.18 in PRM and 8.72-28.86 in POM (Figure 2n). Ca^{2+} is the fifth abundant natural element that is dissolved from soils, rocks and the essential component responsible for the hardness of water (Faruqi 2002). Geological sources, agricultural waste and industrial waste could be used to generate calcium in drinking water. Osteoporosis, defective teeth, nephrolithiasis (kidney stone), rickets, hypertension and stroke can result from inadequate calcium intake (Manzoor et al. 1988). High calcium is possibly due to the presence of carbonate rocks and sedimentary rocks. Ca plays an important role in human cell functioning, hormones, cancer, heart disease, fluid balance in the body, muscle contraction, neurodegenerative disease as well as the descent of the testes (Heaney et al. 1982). In drinking water, the recommended limit is 75 mg/l (BIS 2012). Calcium concentrations range from 14.83-28.72 mg/l in PRM and 14.03-29.74 mg/l in POM (Figure 2o). All locations are in the limits. The primary source of Mg^{2+} in the drinking water are several rock types, sewage and industrial wastes (Deshpande 2003). High Mg is due to higher solubility of magnesium sulphate and hydro-carbonate as compared the equivalent compounds of calcium, favouring increase in Mg concentration in water (Nikanorov et al. 2009). Also, high content in drinking water can trigger unwanted drinking water tastes that cause laxative effects. Mg vales range from 1.58-4.63 mg/l in PRM and 2.36-5.83 mg/l in POM (Figure 2p). For drinking purposes, the necessary permissible limit is 50 mg/l (BIS 2012). The bulk of all the samples is below the allowable limit. Na^+ concentration plays an important role in evaluating surface water quality for irrigation because sodium causes an increase in the hardness of soil as well as a reduction in its permeability (Tijani 1994). Soil structure and permeability may be adversely affected by high sodium concentration, leading to alkaline soils (Sunitha et al. 2019). Na can also seep into natural water (Muralidhara Reddy et al. 2019). The recommended level in potable water is 200 mg/l (BIS 2012). The value of Na ranged from 2 to 10.10 mg/l in PRM and 3.6 to 13.30 mg/l in POM (Figure 2q). All locations satisfying the BIS limits. K^+ salts are more soluble and therefore the last to crystallise during evaporation than sodium salts (Karanth 1987). It is an important element required in humans. It can observe in drinking water due to the application of potassium permanganate as an oxidant in water treatment process (Saxena 2004). While K^+ is an important essential nutrient when consumed in excess, laxative effects can occur (Alam et al. 2007). The occurrence of potassium in all water bodies is approximately one-tenth to one-hundredth that of sodium, which may be due to its poor migratory ability and resistance to decomposition by weathering (Nikanorov et al. 2009). In the present investigation, the concentration ranges from 0.7-3.2 mg/l in PRM and 0.8-2.9 mg/l in POM (Figure 2r). The maximum limit prescribed by BIS 2012 is 12 mg/l. All samples in both seasons, satisfying the limits. TC and FC present in large numbers in the normal intestinal flora of humans and animals, where it normally causes

no harm (WHO 2011). It can be responsible for serious illness such as urinary tract infections, bacteraemia and meningitis. These can also live and grow in water distribution systems mostly in the presence of biofilms (WHO 2011). The value of TC varies between 970-8000 MPN per 100 ml in PRM and 2500-11000 MPN per 100 ml in POM (Figure 2s). The limit set by BIS 2012 is 1000 MPN/100ml. All locations are above the limits, indicating surface runoff from urban areas and percolation process, signifying that the bacteriological water in these areas was not safe and required treatment before drinking (Cook and Bolster 2007). Range of FC varied between 70-360 in PRM and 90-510 MPN per 100 ml (Figure 2t). The limit prescribed by BIS 2012 is 300 MPN per 100 ml. Most of the samples satisfying well within the limits in both seasons except site 8. Higher values occur in site 8 is due to anthropogenic activities such as insufficient waste disposal and excess use of nitrogen fertilizers (Sarath Prasanth et al. 2012). Fe^{2+} is the burning issue of rural drinking water (Islam and Mostafa 2021f). Although a low level of iron is essential in the human diet and for plant metabolism and cannot do much harm, it encourages objectionable bacteria growth inside a waterworks and supply system, resulting in the deposition of a slushy coating on the piping (Can DNHW 1990). Besides high Fe content over 1 mg/l (BIS 2012) leads to an excess which can cause stomach problems, vomiting, diabetes, nausea and hemochromatosis (Toyokuni 2009). The concentration varies 0.19-1.08 mg/l in PRM and 0.13-1.43 mg/l in POM (Figure 2u). Most of the samples are within the criteria for both seasons except site 8. Cr^{2+} is an element vital to the proper working of humans, animals and plant metabolism as it is obligatory for the operation of several cellular enzymes and can aid in the activation of hydrolases, kinases, transferases and decarboxylases (IPCS 2002). Excess of it creates offensive taste, odour, colour, staining and corrosion (WHO 2011). The concentration varied between 0.05-0.17 mg/l in PRM and 0.06-0.15 mg/l in POM (Figure 2v). The desirable limit set by BIS (2012) is 0.5 mg/l. All the sampling locations are with the safe limits. The values of these parameters cannot discretely conclude the extent of deviation of the river water quality from drinking standard. Therefore, this study was conducted to assess the status of the river water quality applying WQI and NPI, SPI, CPI, OIP, and the pollution sources were identified through multivariate statistical tools, thereby suggesting appropriate treatment measures required to render the water suitable for drinking.

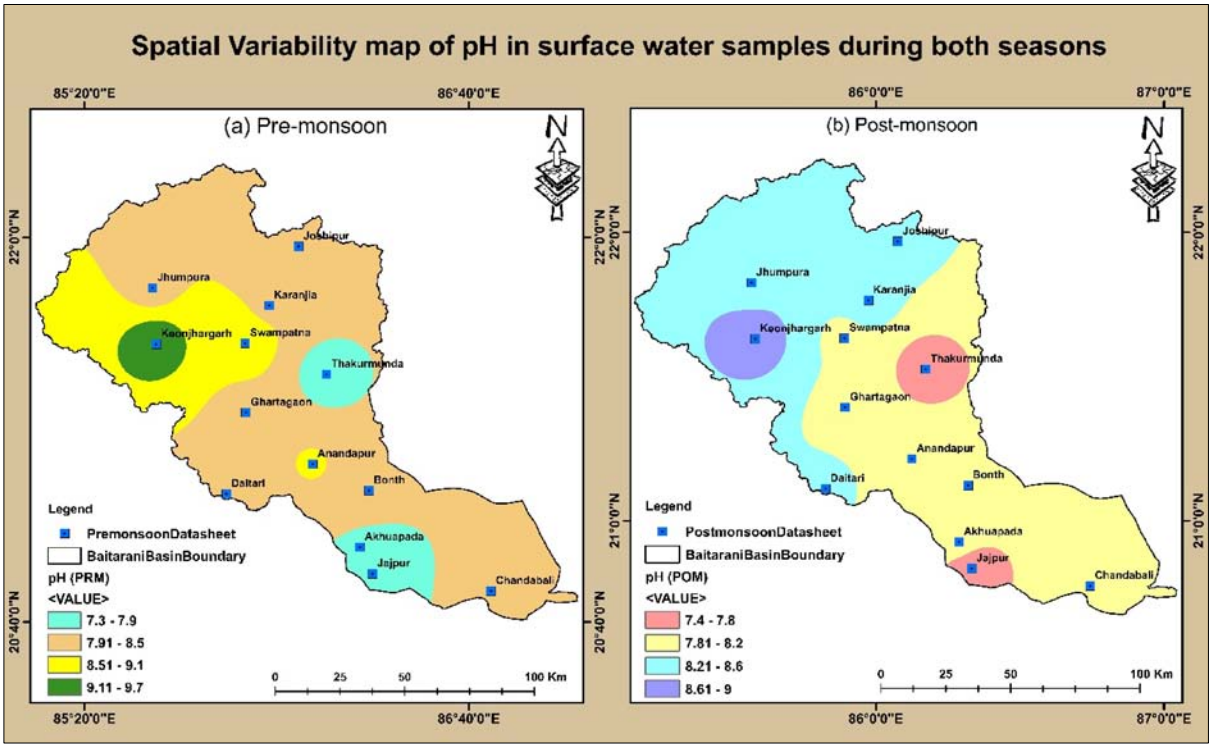


Figure 2a. Distribution of pH on sampling points during both seasons

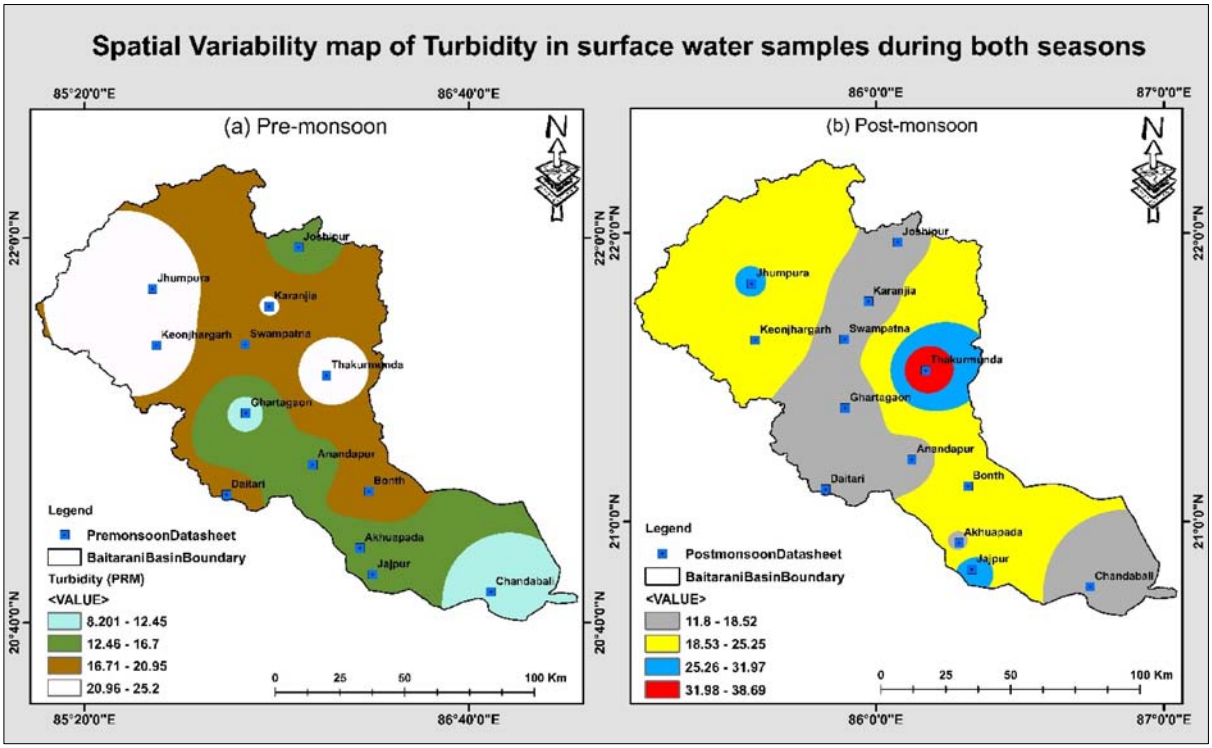


Figure 2b. Distribution of Turbidity on sampling points during both seasons

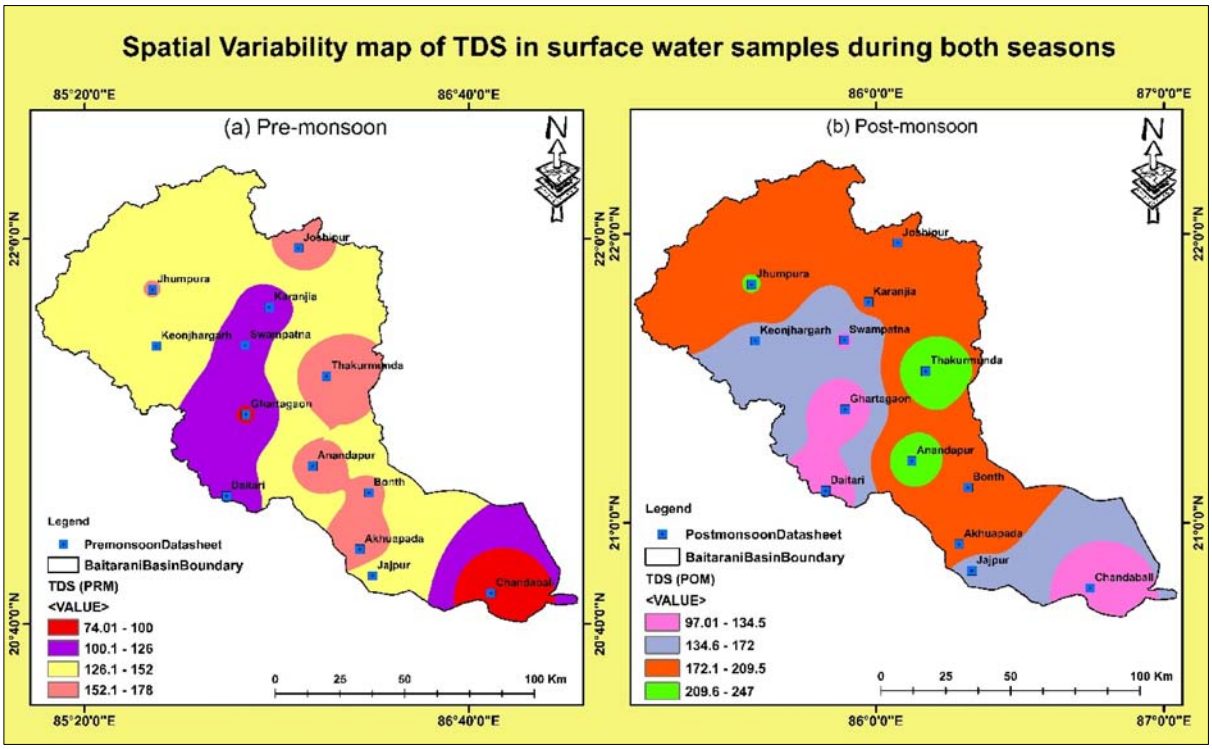


Figure 2c. Distribution of TDS on sampling points during both seasons

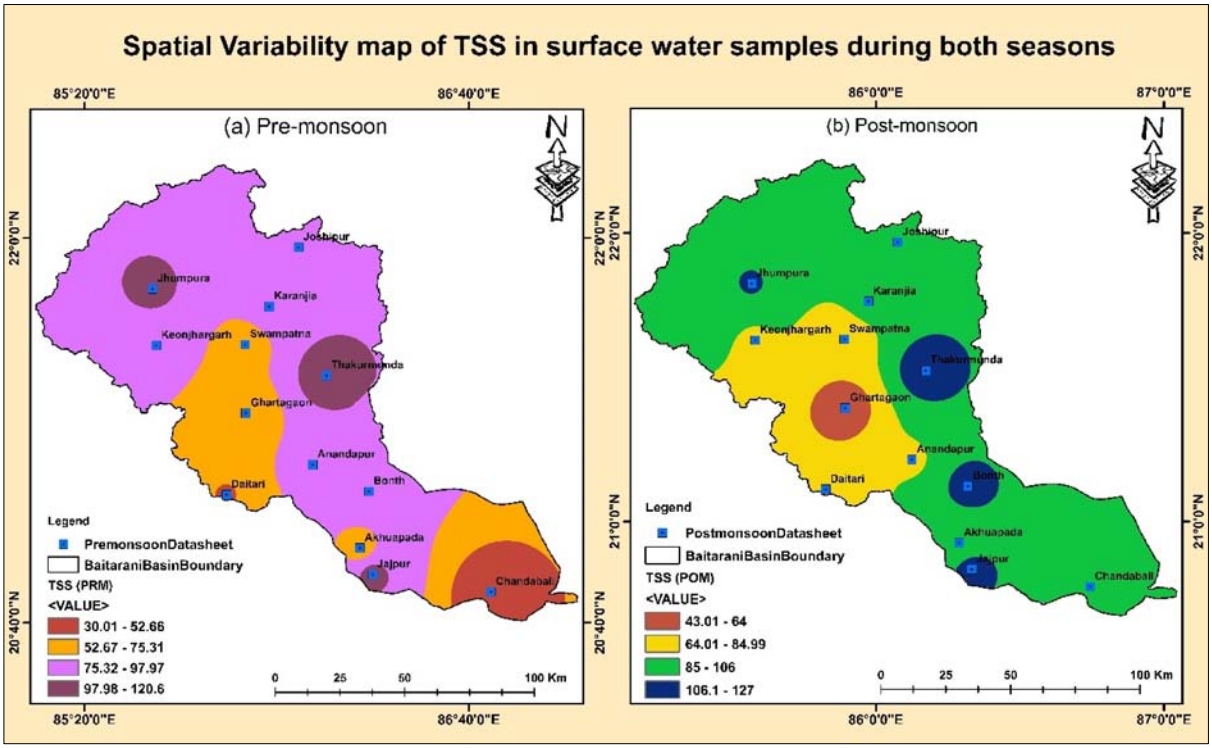


Figure 2d. Distribution of TSS on sampling points during both seasons

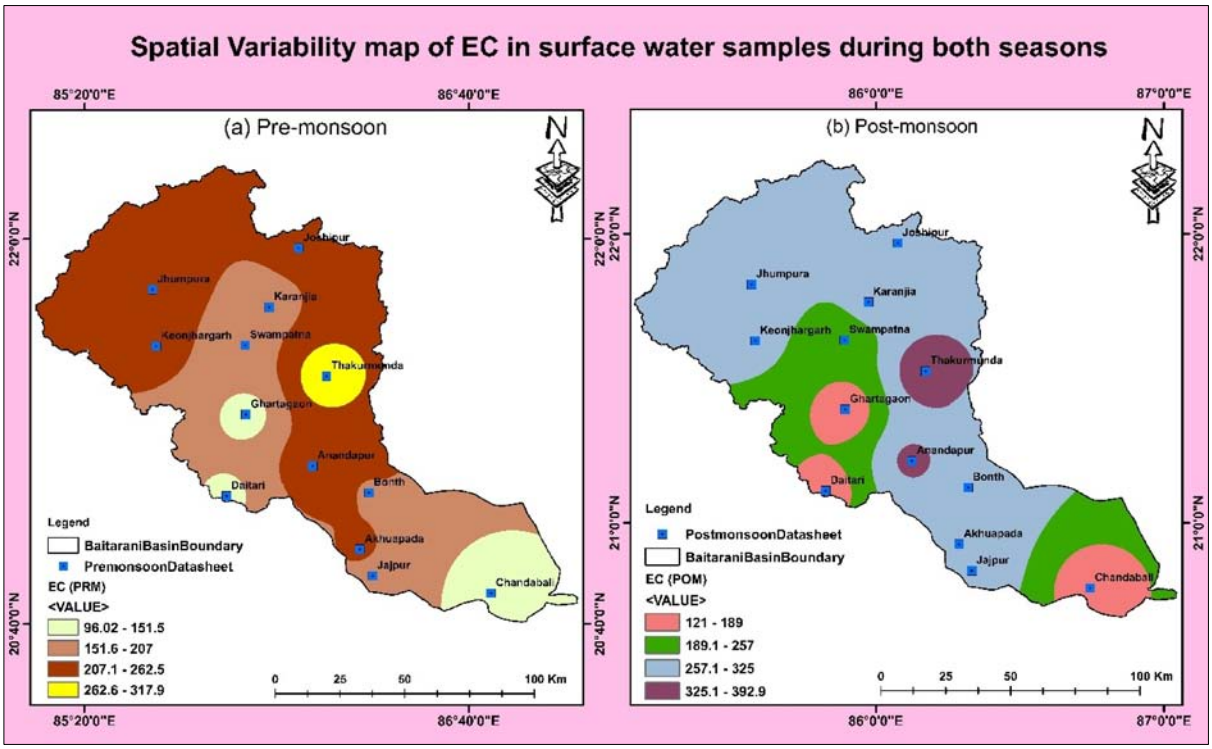


Figure 2e. Distribution of EC on sampling points during both seasons

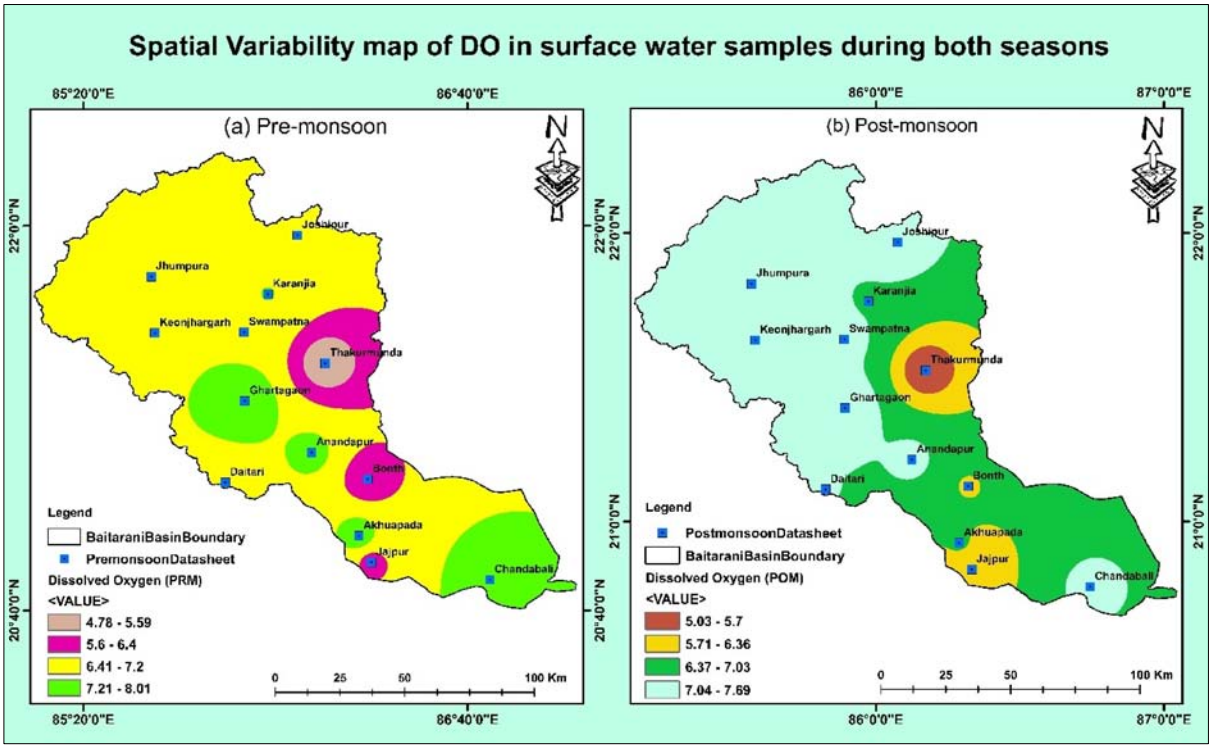


Figure 2f. Distribution of DO on sampling points during both seasons

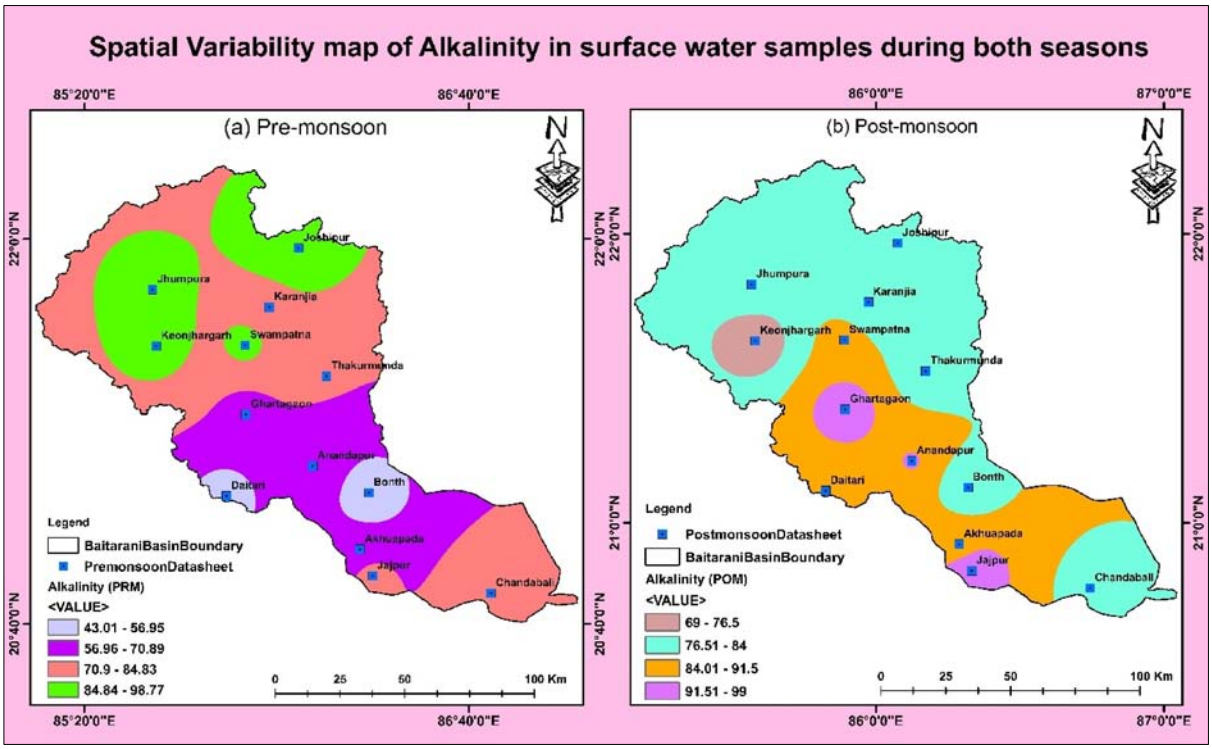


Figure 2g. Distribution of Alkalinity on sampling points during both seasons

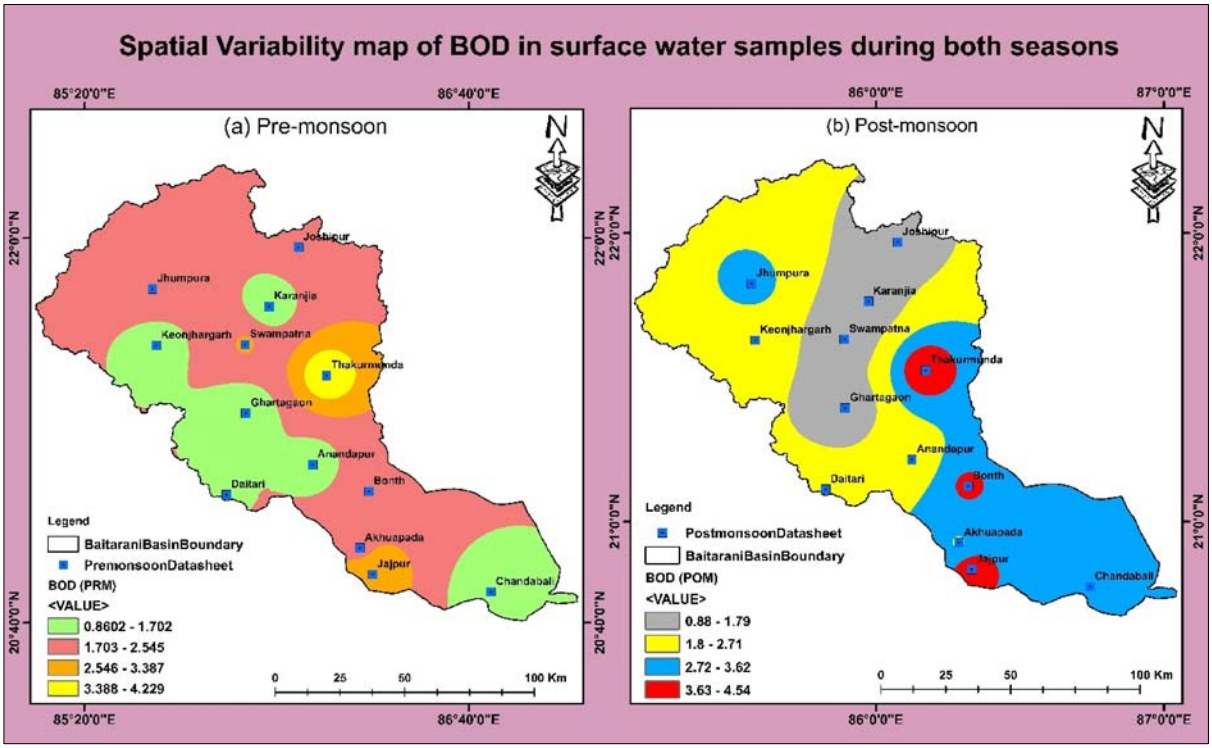


Figure 2h. Distribution of BOD on sampling points during both seasons

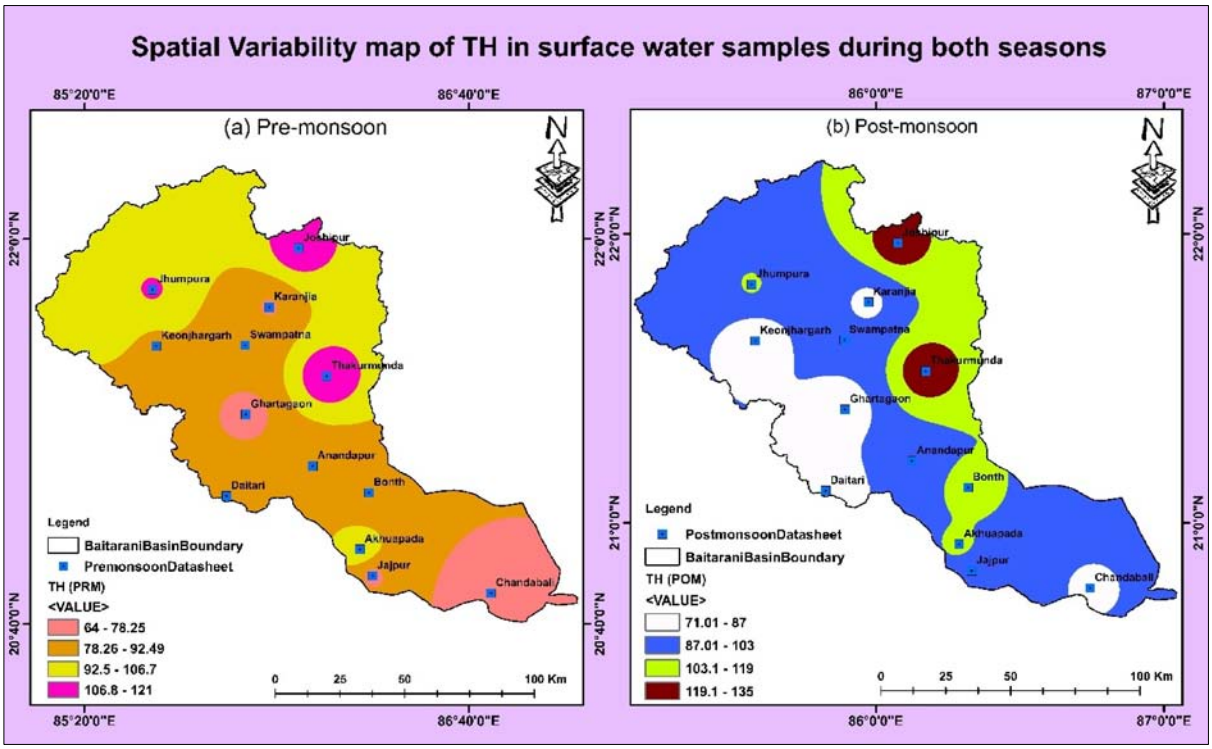


Figure 2i. Distribution of TH on sampling points during both seasons

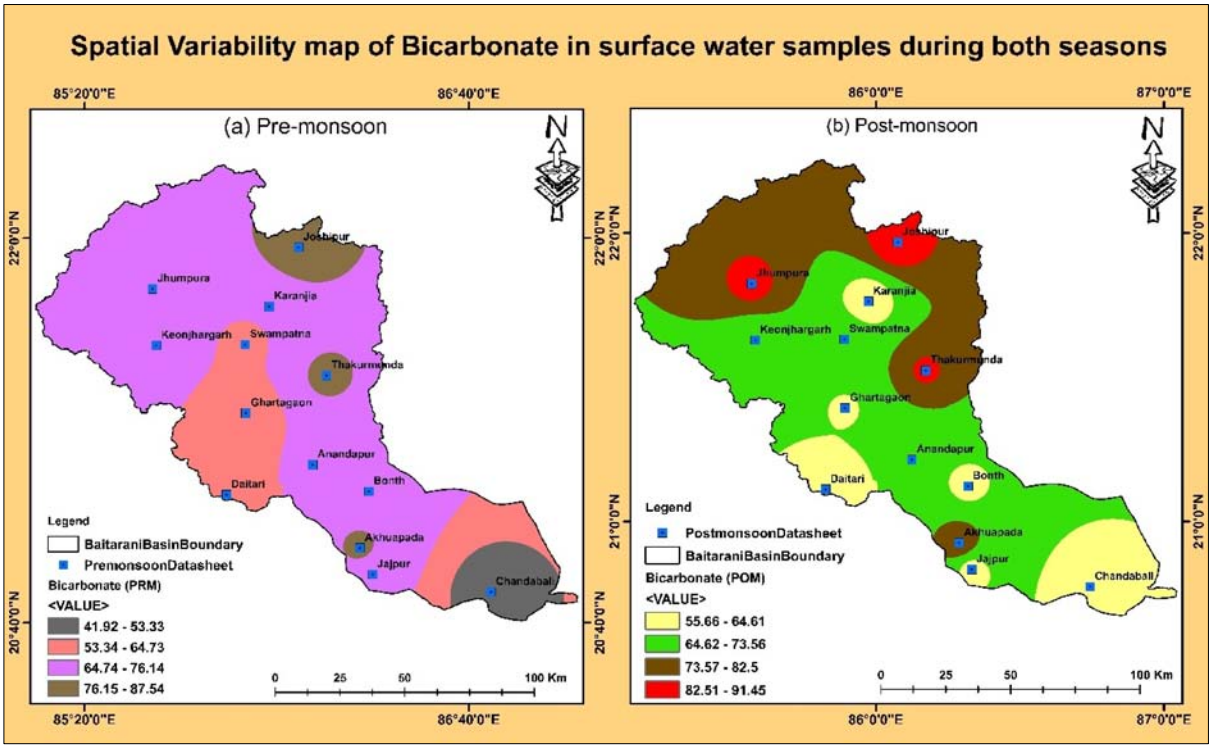


Figure 2j. Distribution of HCO_3^- on sampling points during both seasons

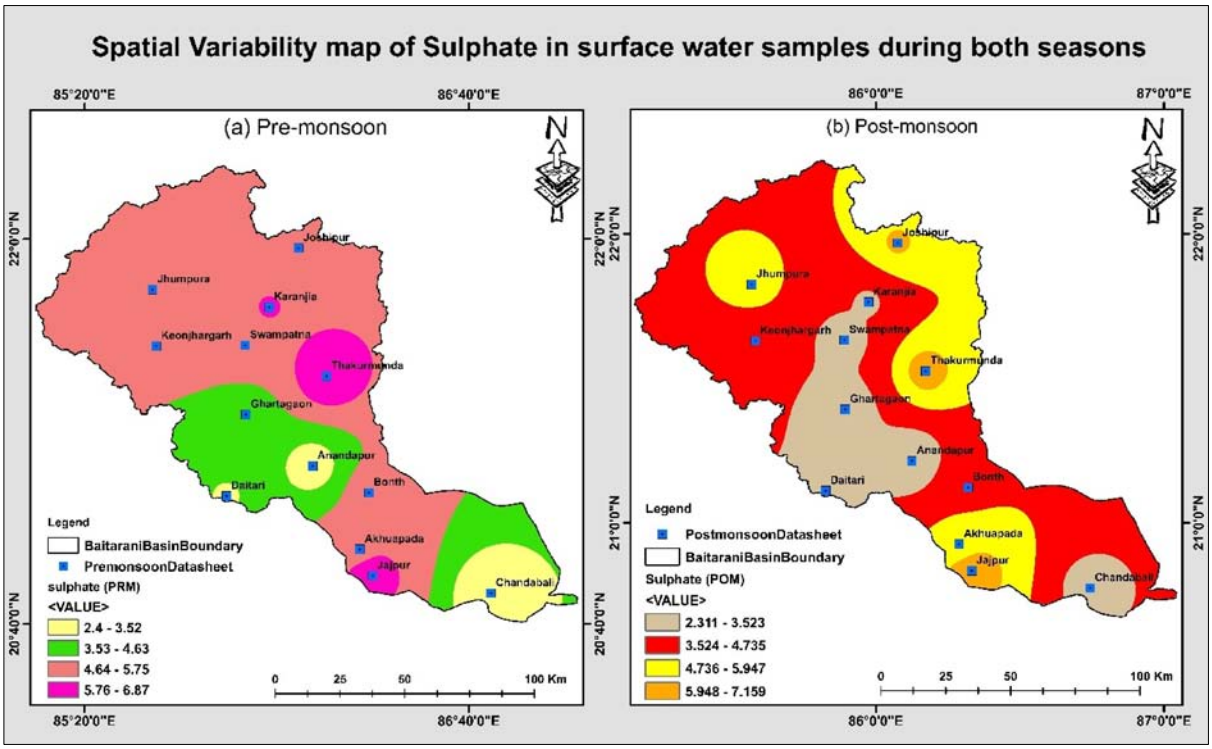


Figure 2k. Distribution of SO_4^{2-} on sampling points during both seasons

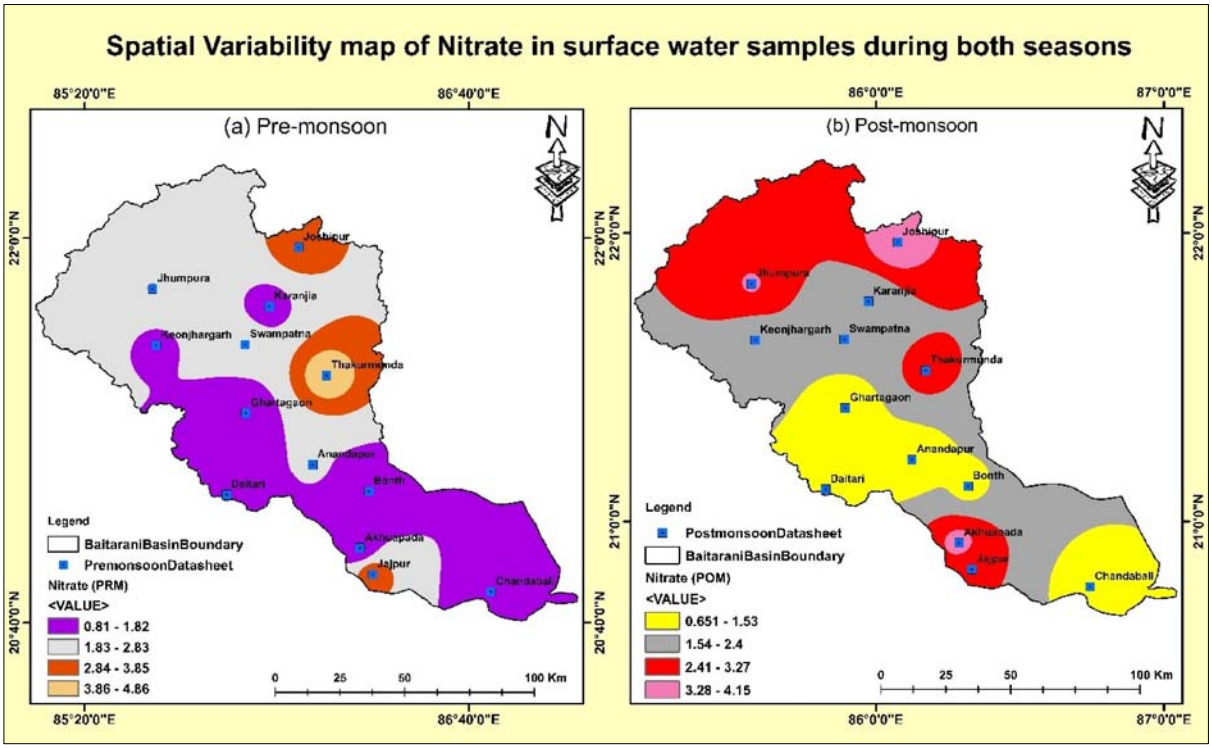


Figure 2l. Distribution of NO_3^- on sampling points during both seasons

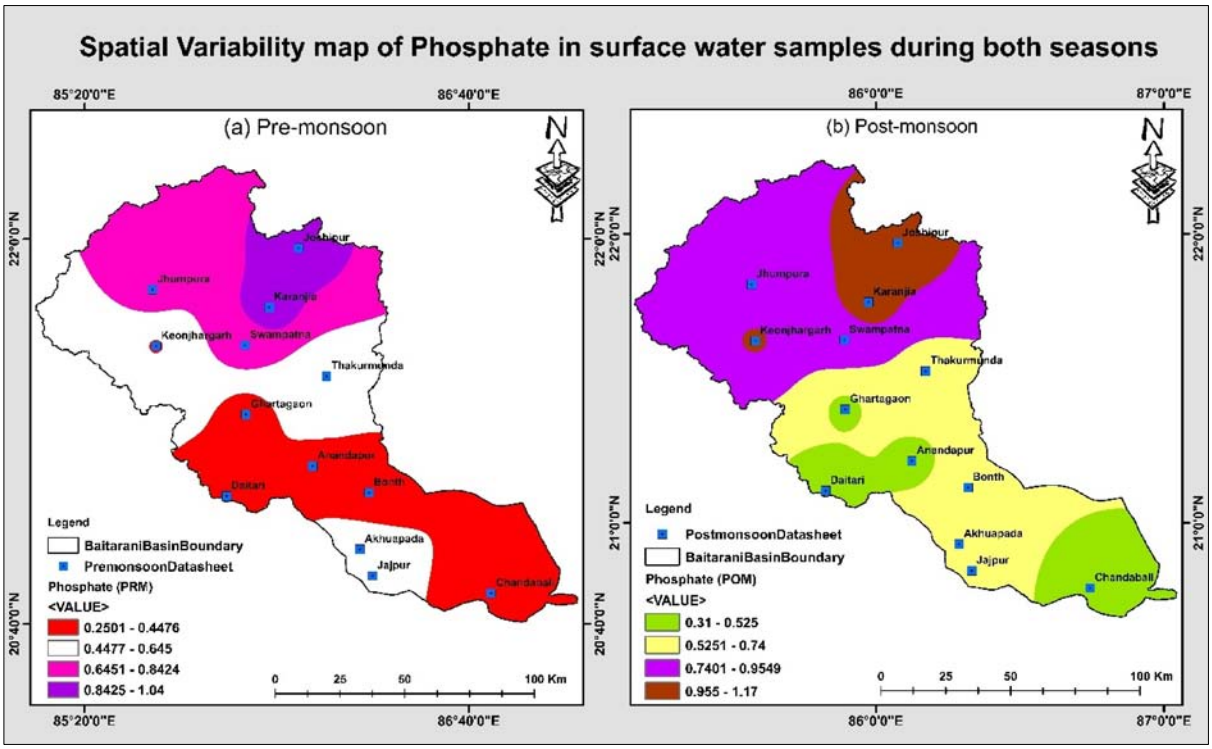


Figure 2m. Distribution of PO_4^{3-} on sampling points during both seasons

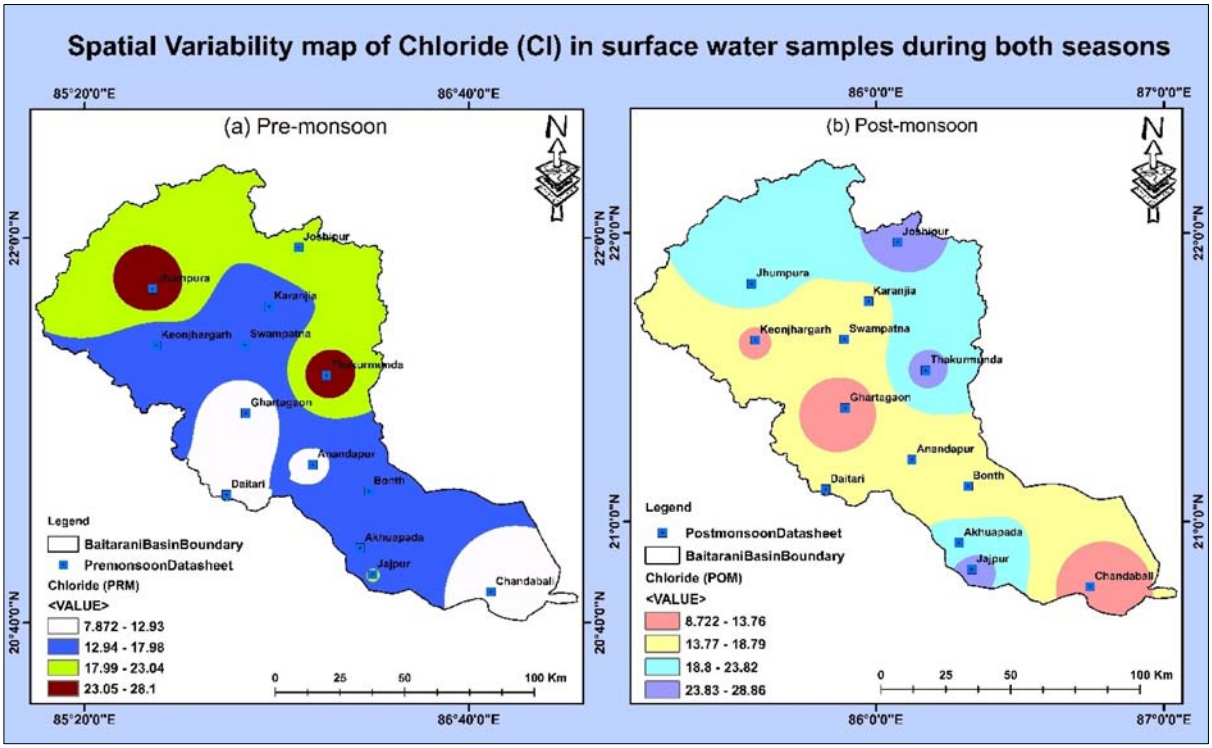


Figure 2n. Distribution of Cl^- on sampling points during both seasons

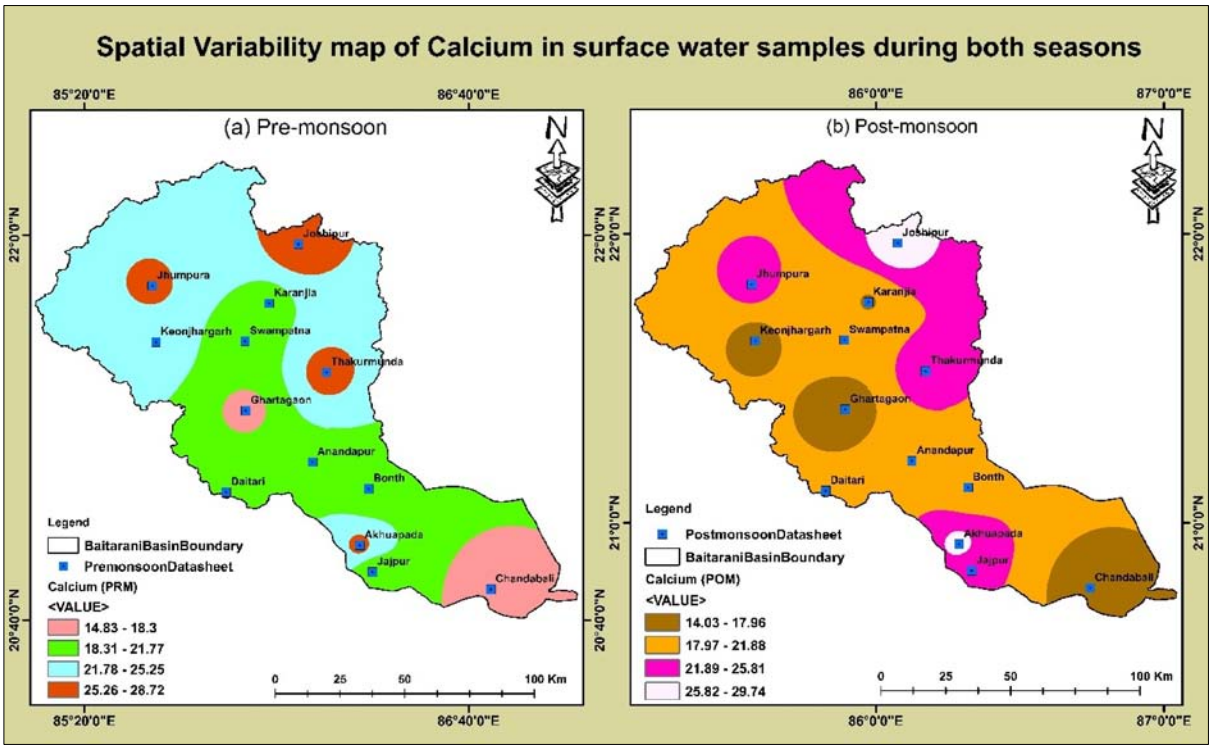


Figure 2o. Distribution of Ca^{2+} on sampling points during both seasons

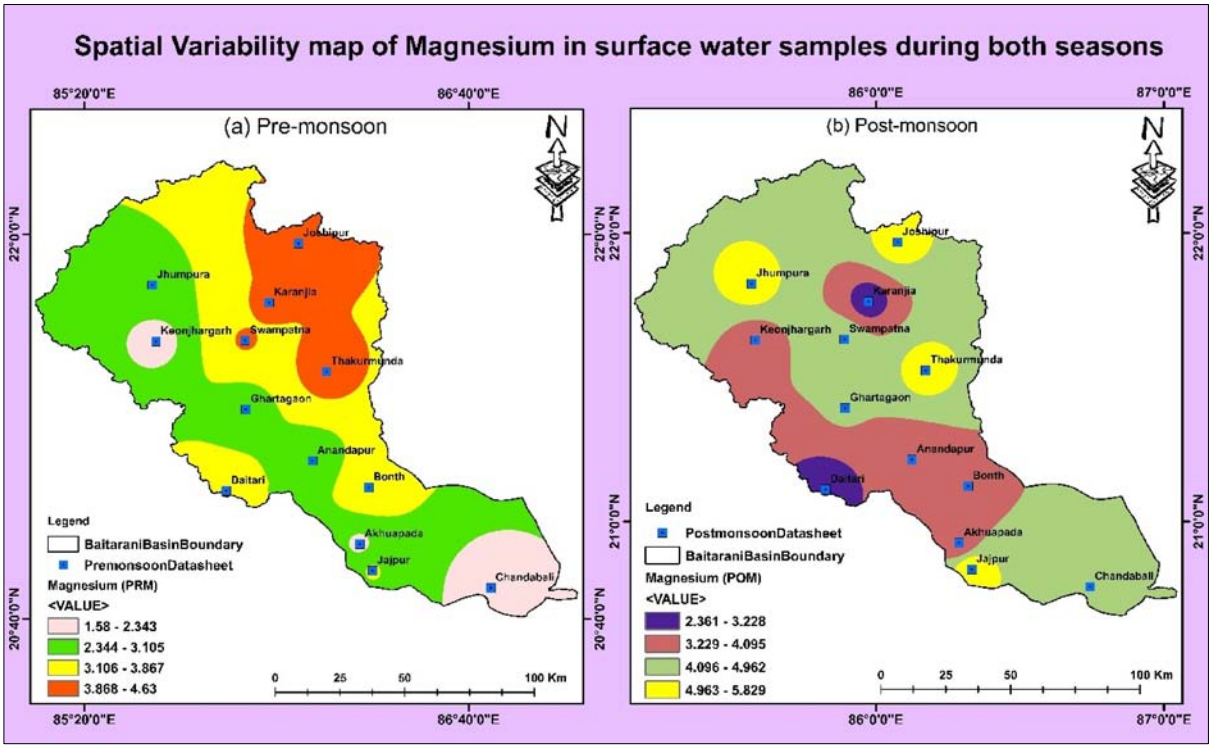


Figure 2p. Distribution of Mg^{2+} on sampling points during both seasons

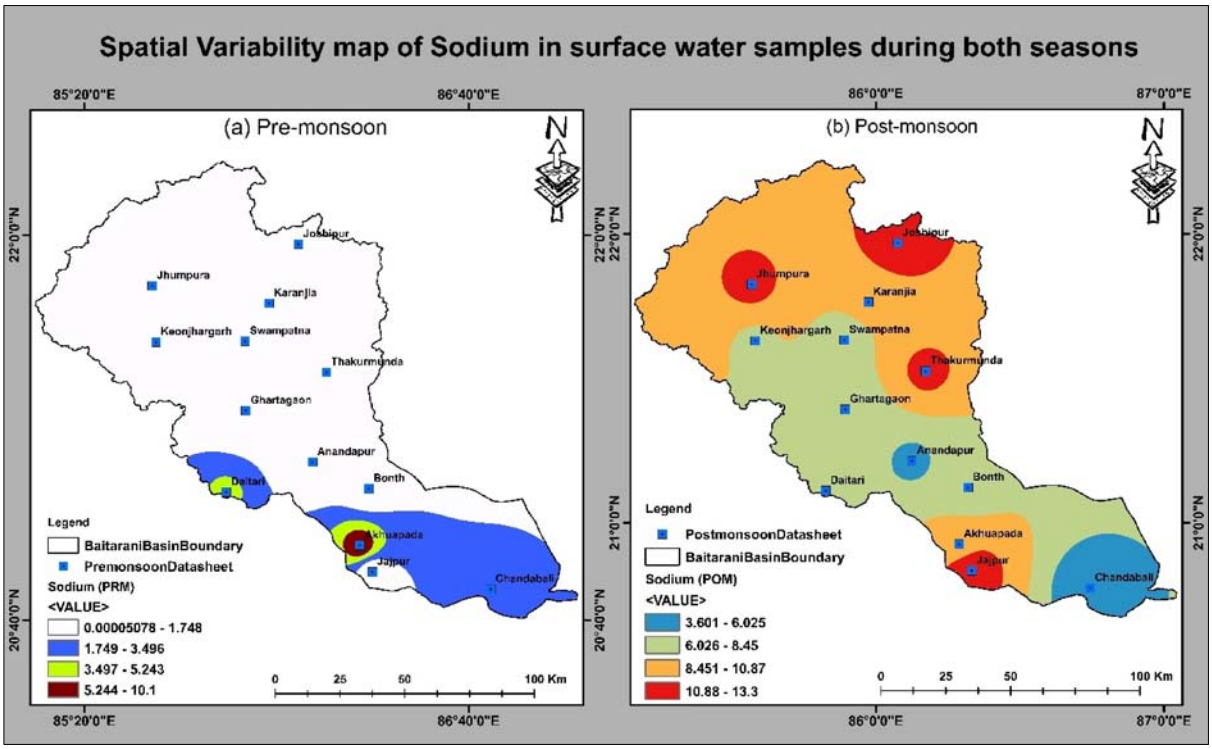


Figure 2q. Distribution of Na^+ on sampling points during both seasons

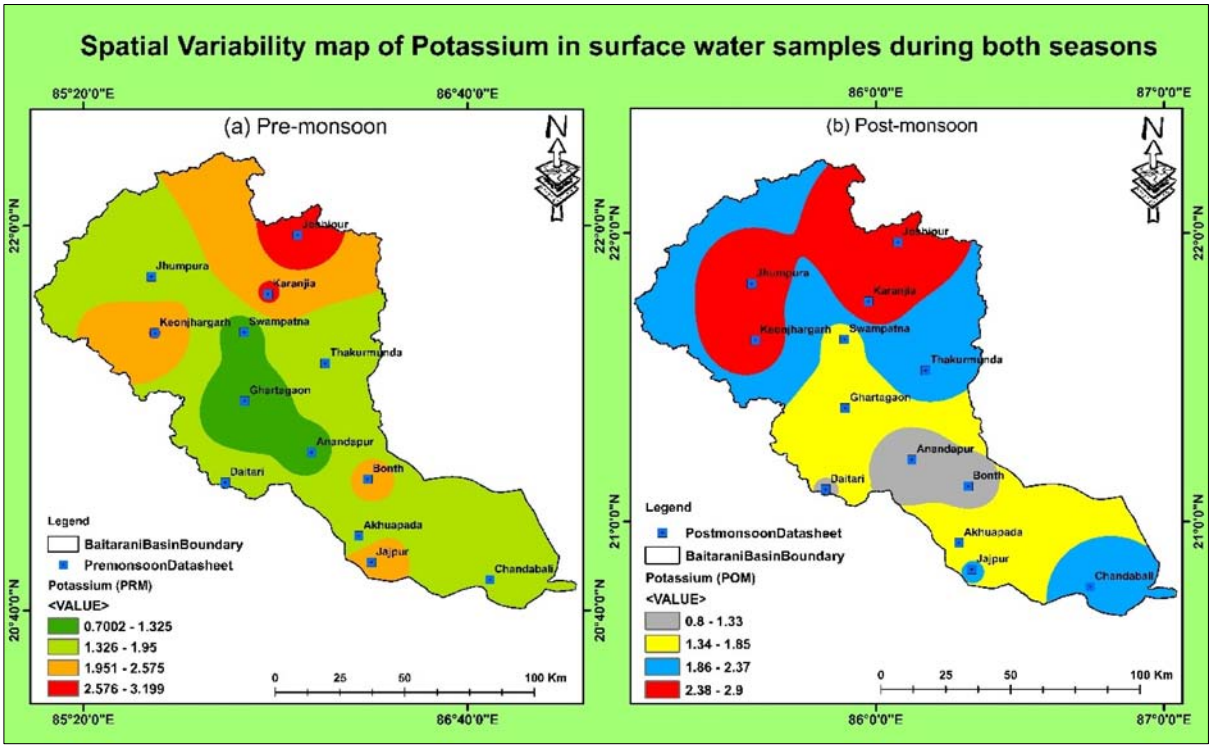


Figure 2r. Distribution of K^+ on sampling points during both seasons

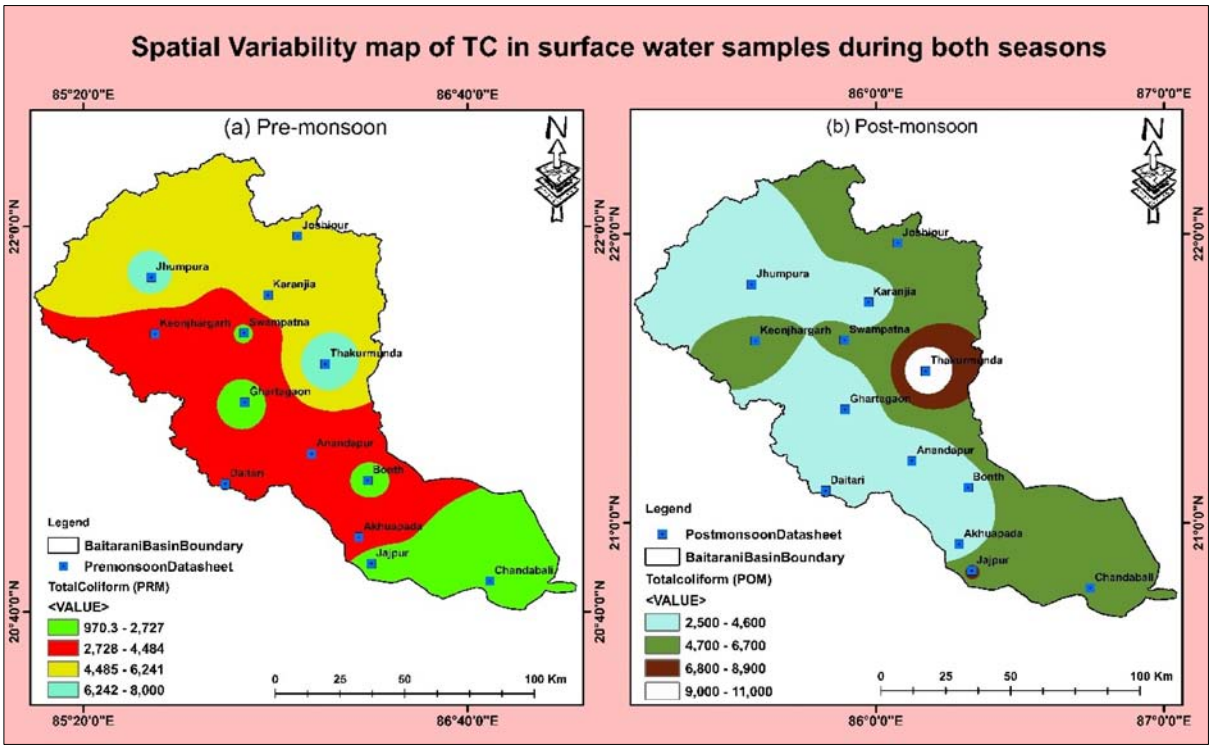


Figure 2s. Distribution of TC on sampling points during both seasons

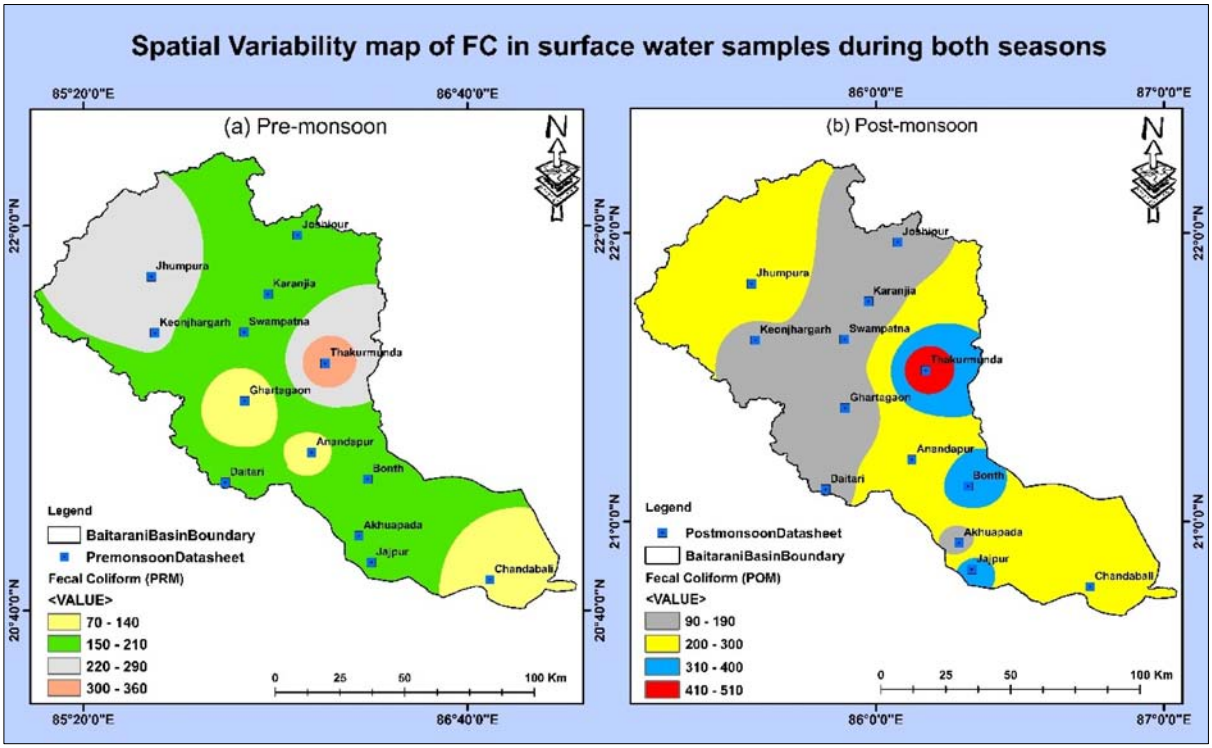


Figure 2t. Distribution of FC on sampling points during both seasons

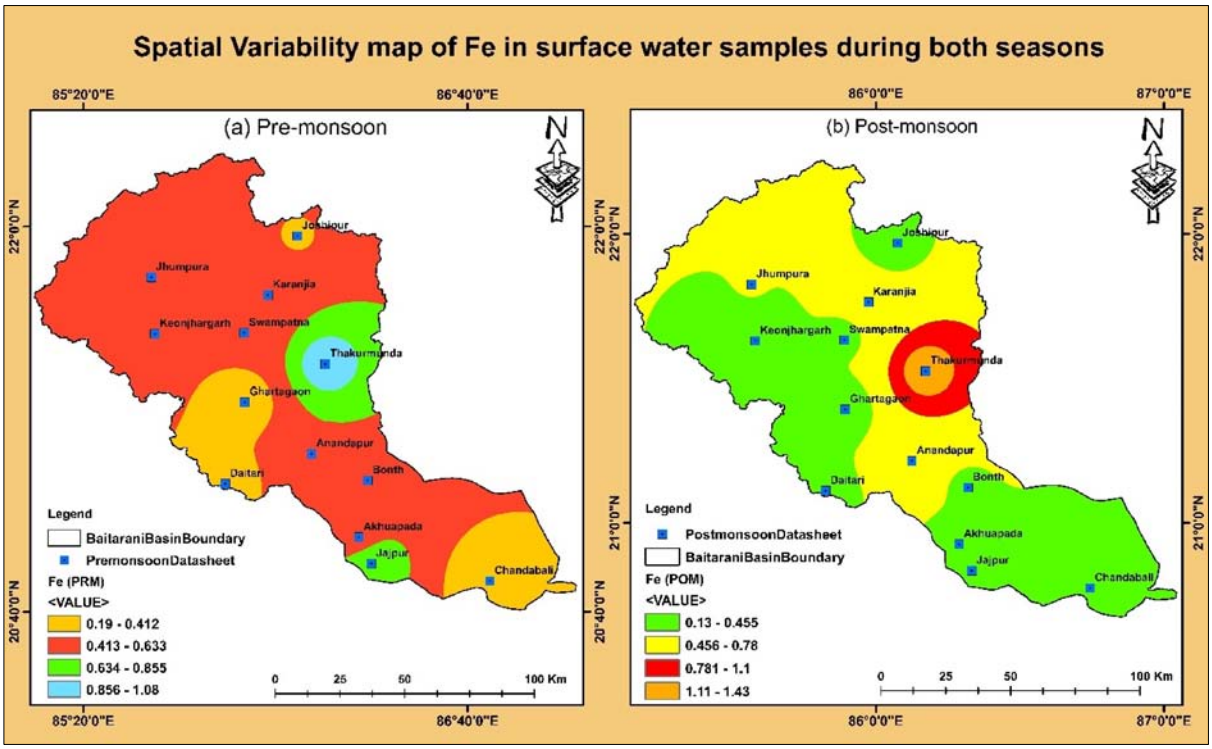


Figure 2u. Distribution of Fe^{2+} on sampling points during both seasons

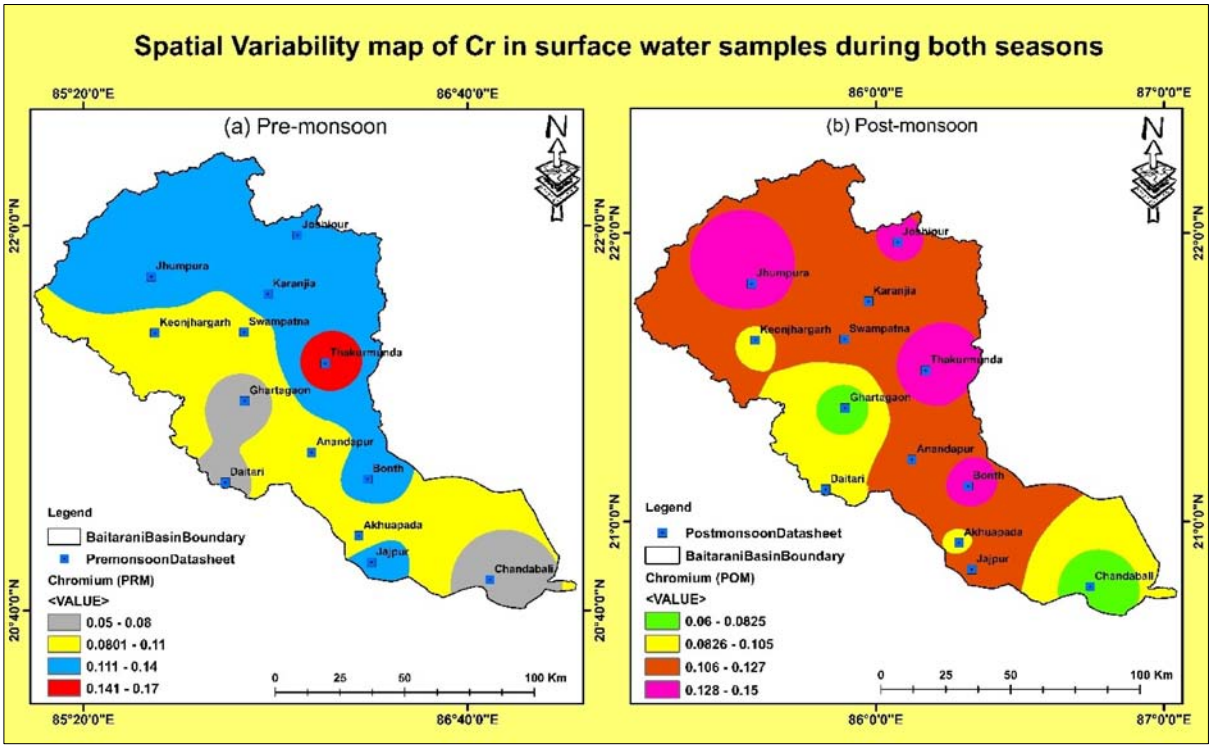


Figure 2v. Distribution of Cr^{2+} on sampling points during both seasons

Table 3. Statistical analysis of analysed physicochemical properties

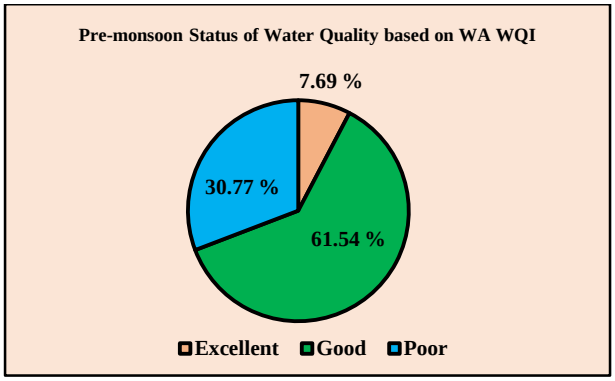
Parameters	PRM		POM	
	Minimum	Maximum	Minimum	Maximum
pH	7.3	9.7	7.4	9
Turbidity	8.2	25.2	11.8	38.7
TDS	74	178	97	247
TSS	30	121	43	127
EC	96	318	121	393
DO	4.78	8.01	5.03	7.69
Alkalinity	43	99	69	99
BOD	0.86	4.23	0.88	4.54
TH	64	121	71	135
HCO_3^-	41.92	87.55	55.64	91.46
SO_4^{2-}	2.4	6.87	2.31	7.16
NO_3^-	0.81	4.86	0.65	4.15
PO_4^{3-}	0.25	1.04	0.31	1.17
Cl^-	7.87	28.18	8.72	28.86
Ca^{++}	14.83	28.72	14.03	29.74
Mg^{++}	1.58	4.63	2.36	5.83
Na^+	2	10.1	3.6	13.3
K^+	0.7	3.2	0.8	2.9

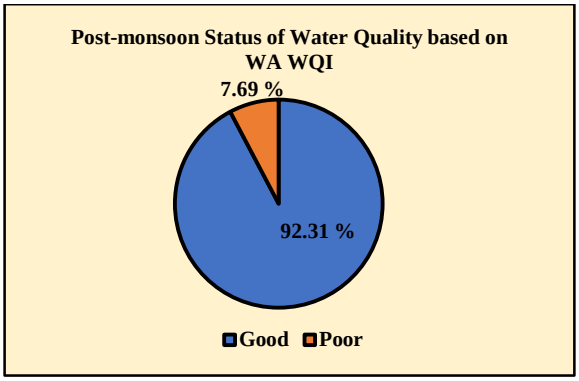
TC	970	8000	2500	11000
FC	70	360	90	510
Fe^{++}	0.192	1.084	0.132	1.432
Cr^{++}	0.051	0.172	0.062	0.153

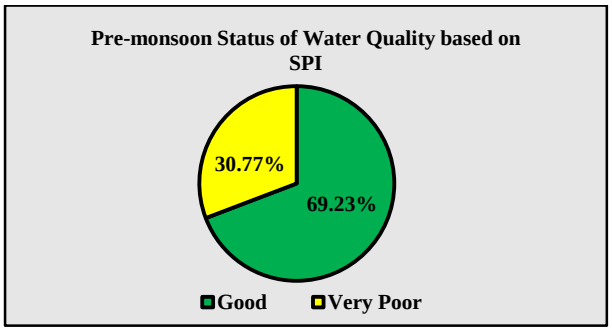
INTEGRATED APPROACH OF DIFFERENT WATER QUALITY INDICES WITH GIS

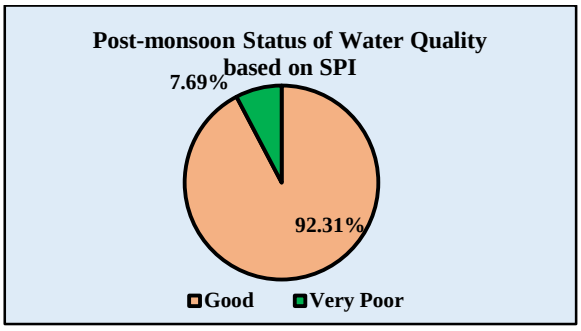
The WA WQI is another well-recognized model to justify the drinking water quality. The obtained WQI range is 42.75 to 123.86 in PRM and 60.26 to 167.24, suggesting excellent to poor and good to poor categories. Only 1 sample fall into the excellent category, 8 (PRM) and 12 (POM) samples fall in the good category and 4 (PRM) and 1 (POM) samples fall in the poor category. The percentage wise distribution 7.69% sources were of excellent quality, 61.54% had good water quality and 30.77% exhibited poor water quality in case of PRM, while in POM, 92.31% sources were of good quality and 7.69% belongs to poor quality, for both seasons is being represented in Figure 3. Variation of WA WQI throughout the sites could be seen in Figure 4. Variation of interpolation map across the study area is represented in Figure 5. The map clearly indicates that sites S-8, S-11, S-12, S-13 in PRM and site S-8 in POM lie in poor category. The high WQI values in surface water samples in sites S-8, S-11, S-12 and S-13 were principally due to the occurrence of higher values of turbidity and coliform. An overall SPI was calculated by combining all of the sub-indices for each parameter. The obtained SPI range is 0.39 to 1.3 in PRM and 0.35 to 1.4 in POM, suggesting good to very poor category for both seasons (Figure 6). As per SPI value, out of 13 samples, 9 (PRM) and 12 (POM) fall into good category and 4 (PRM) and 1 (POM) fall into very poor category. The percentage wise distribution of samples can be seen in Figure 3. Figure 7 depicts the SPI map interpolation across the study area. The map clearly indicates that site S-8, S-11, S-12, S-13 in PRM and site S-8 in POM lie in the very poor category. NPI was determined for the 22 samples for the provided water quality parameters. The summation of the pollution indexes of all parameters in each site gives the NPI value (Figure 8). The obtained NPI range is 8.24 to 21.99 in PRM and 11.15 to 31.50 in POM suggesting excellent to poor and good to very poor category. As per NPI ratings, out of the 13 samples, 2 in PRM fall into the excellent category, 9 in PRM and 12 in POM falls in the good category and 2 in PRM and 1 in POM falls in the poor category. The percentage wise distribution of samples showed that Excellent water is found in 15.38% in PRM, Good water is 69.23% (PRM) and 92.31% (POM), Poor water is 15.38% (PRM) and 7.69% (POM) which can be seen in Figure 3. The developed spatial map can be seen in Figure 9. The map clearly indicates that sites S-8 and S-12 in PRM and site S-8 in POM lie in poor category. CPI is calculated to understand the overall pollution load in the river. The value of CPI ranged between 0.37-1.2 in PRM and 0.51-1.32 in POM (Figure 10), reflects that the water quality fall under sub-clean to polluted and qualified to polluted category. Highest CPI value was recorded in both seasons in site S-8. The high values of CPI can be accounted to high values of turbidity, DO and TC. As per CPI ratings, out of 13 samples, 1(PRM) fall into sub-clean category, 8 (PRM) and 9 (POM) fall into qualified category, 3 (PRM) and 3 (POM) fall into basically qualified category and only 1 fall into polluted category for both seasons. The percentage wise distribution of samples can be seen in Figure 3. Figure 11 depicts the CPI map interpolation across the study area. The map clearly indicates that site S-8 in both periods lie in polluted category. The obtained OIP range is 0.37 to 4.40 in PRM and 0.5 to 4.2 in POM suggesting excellent to slighted polluted category for both seasons (Figure 12). According to the results, 12 samples in both seasons fall into excellent category and 1 sample in both periods falls into slightly polluted category. The percentage wise distribution of samples shows that in both seasons, 92.31% belongs to excellent water and 7.69% signifies slightly polluted water, which can be seen in Figure 3. The developed map can be seen in Figure 13. The map clearly indicates that only site 8 lie in slightly polluted zone. The water quality index approach along with pollution indices methodology has some limitations and uncertainty. A single figure cannot express the whole story of water quality and many other water quality parameters that were missing in the index. Furthermore, HCA was used to determine the relationship among various sampling sites using Ward's method (Euclidean distance as measure of similarity). Using 22 variables, HCA was applied to the 13 sampling locations. The dendrogram of the resulting HCA of the data was presented from which three main groups were visually selected. Figure 14a show a dendrogram depiction of parameter cluster analysis. Here Cluster I include pH, Turbidity, BOD, SO_4^{2-}, NO_3^-, PO_4^{3-}, Cl^-, Ca^{2+}, Mg^{2+}, Na^+, K^+, Fe^{2+} and Cr^{2+}. TDS, TSS, EC, Alkalinity, TH, HCO_3^- and FC are the seven parameters covered by Cluster II. Cluster III includes TC in PRM. In case of POM, Cluster II includes TDS, EC and FC. TC covered by Cluster III. Rest parameters belong to Cluster I. Figure 14b shows a dendrogram view of the cluster analysis of sampling locations. On the other hand, from 13 sampling locations, three clusters were generated by CA. The resulting Cluster I comprises of sites S-1, S-2, S-5, S-7 and S-9 in PRM and site S-1, S-2

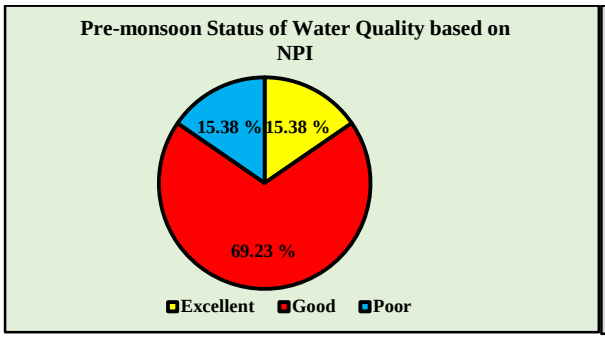
in POM. This group is characterized with low WQI values, hence, could be described as low polluted areas and their source of pollution is mainly the geological material. Cluster II comprises S-3, S-4, S-6 and S-10 in PRM and site S-3, S-4, S-5, S-6, S-7, S-9, S-10, S-11, S-12 and S-13 in POM. This group shows very little anthropogenic impact on the quality of the water. Cluster III comprises S-8, S-11, S-12 and S-13 in PRM and site S-8 in POM and is mainly dominated by surface water where anthropogenic activities are more pronounced. They are characterized by high WQI values. Even though, very few samples belong to excellent water quality, majority of the samples fall under good water quality rating. Furthermore, this shows that surface water in these areas is gradually being affected by anthropogenic activities. Cluster III in both seasons could majorly be attributed to the increased agricultural runoff entering the river at these sampling points, as well as intensive fishing activities especially in the month of October at these locations.

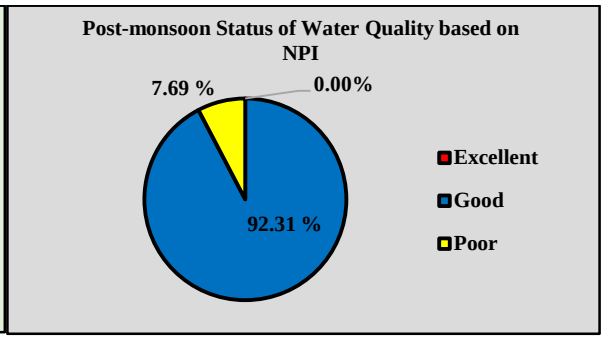












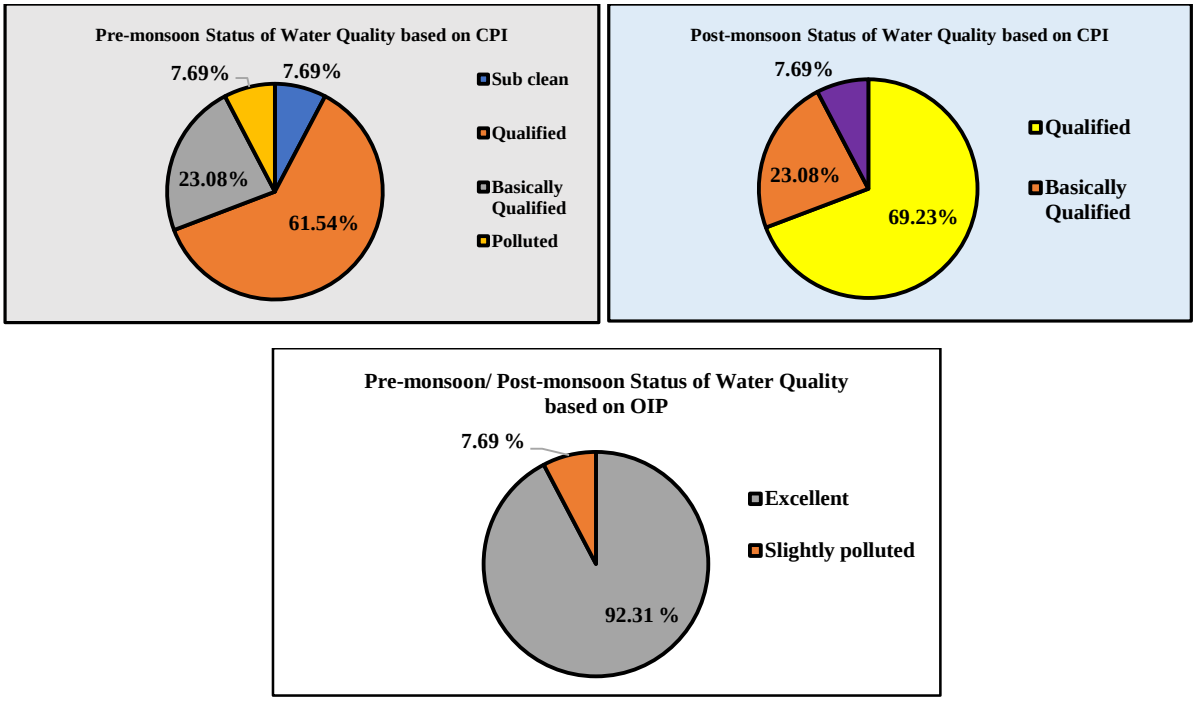


Figure 3. % wise status of water quality based on WA WQI, SPI, NPI, CPI and OIP

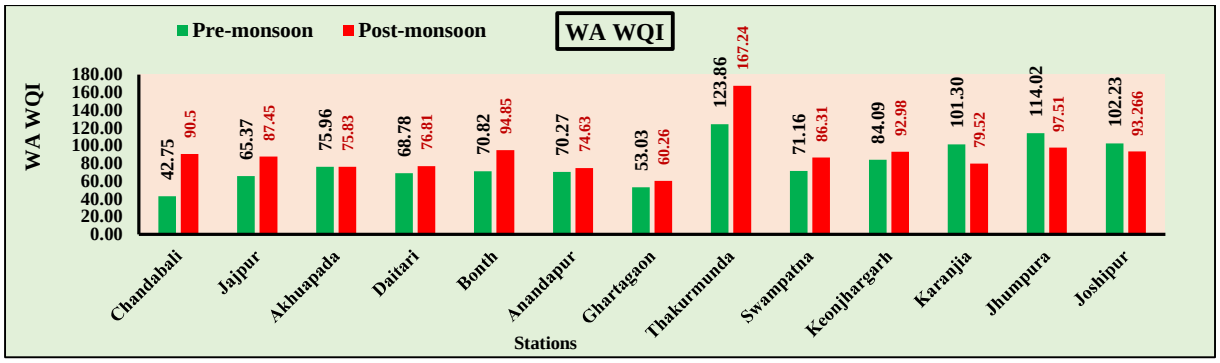


Figure 4. Plot showing WA WQI for each station

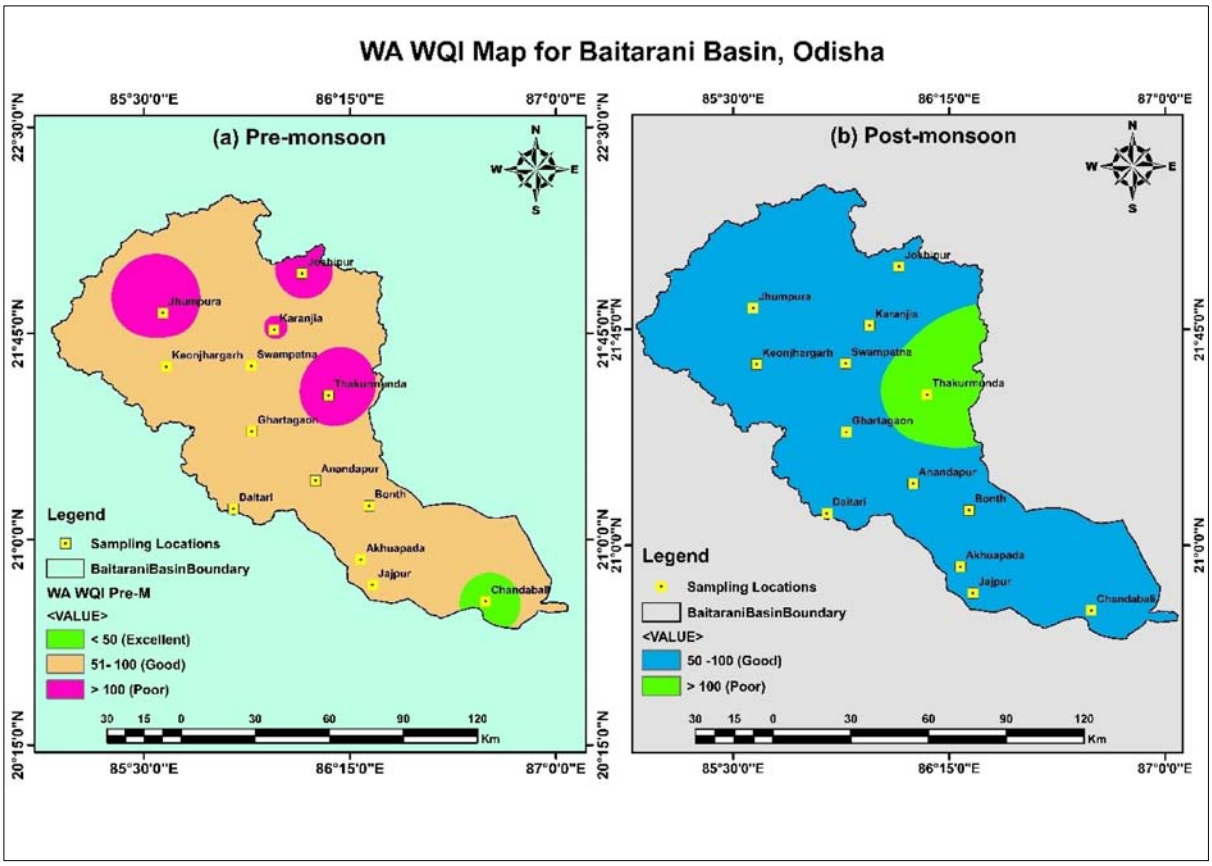


Figure 5. WA WQI map for Baitarani River

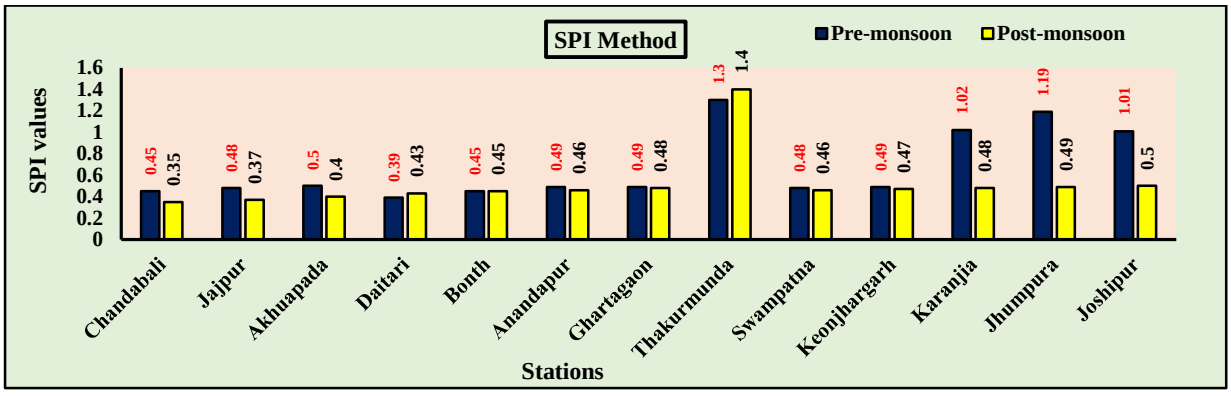


Figure 6. Plot showing SPI for each station

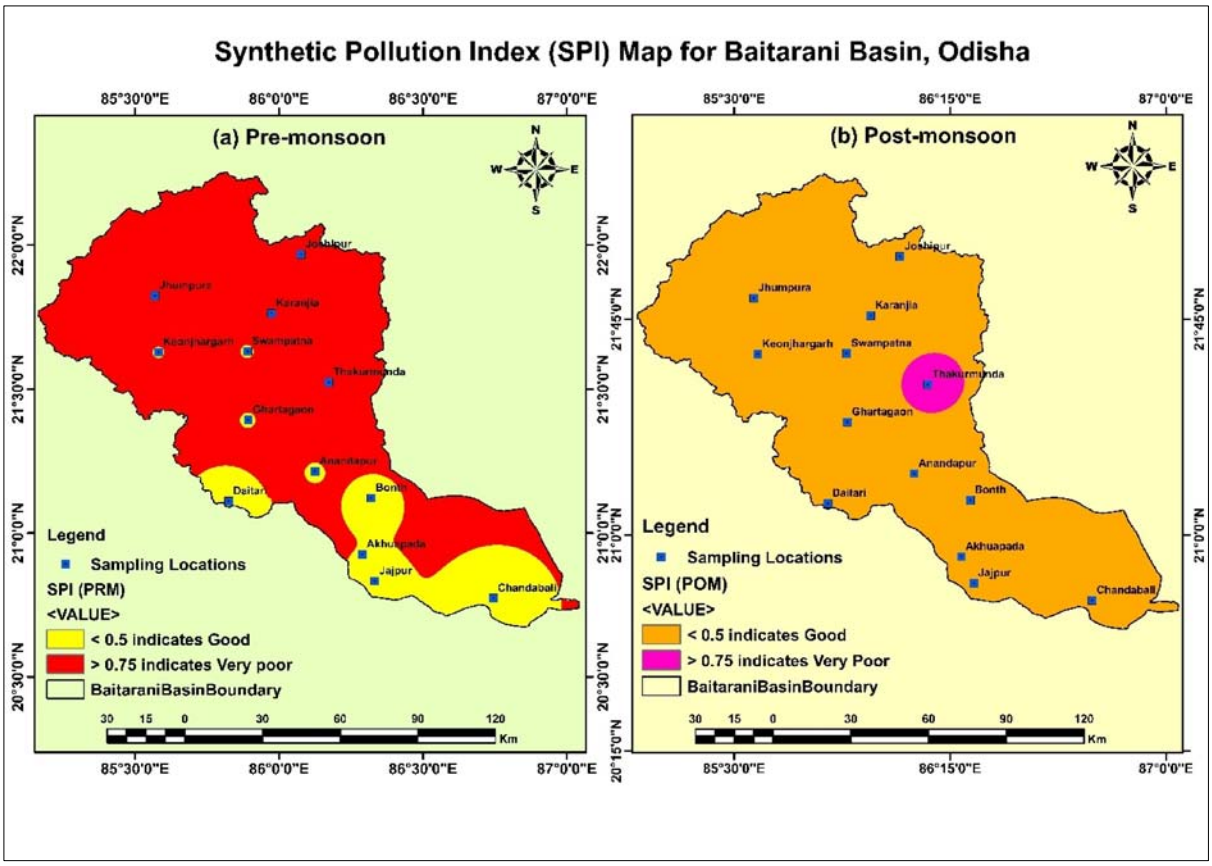


Figure 7. SPI map for Baitarani River

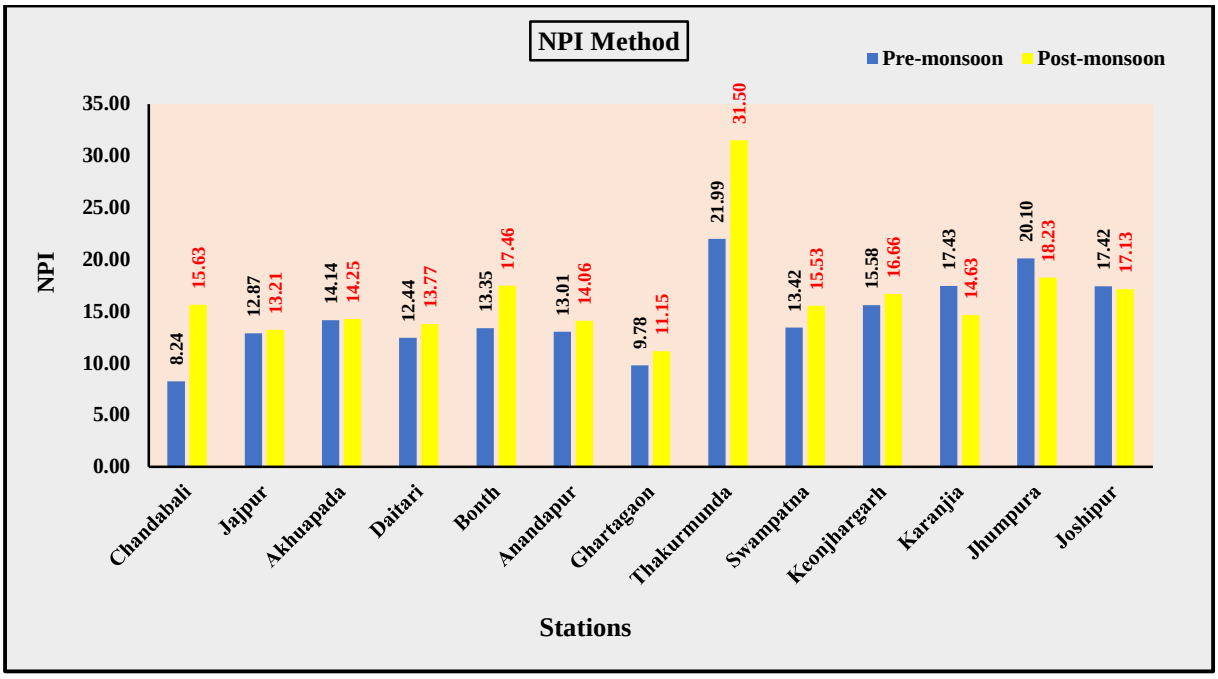


Figure 8. Plot showing WQI for each station

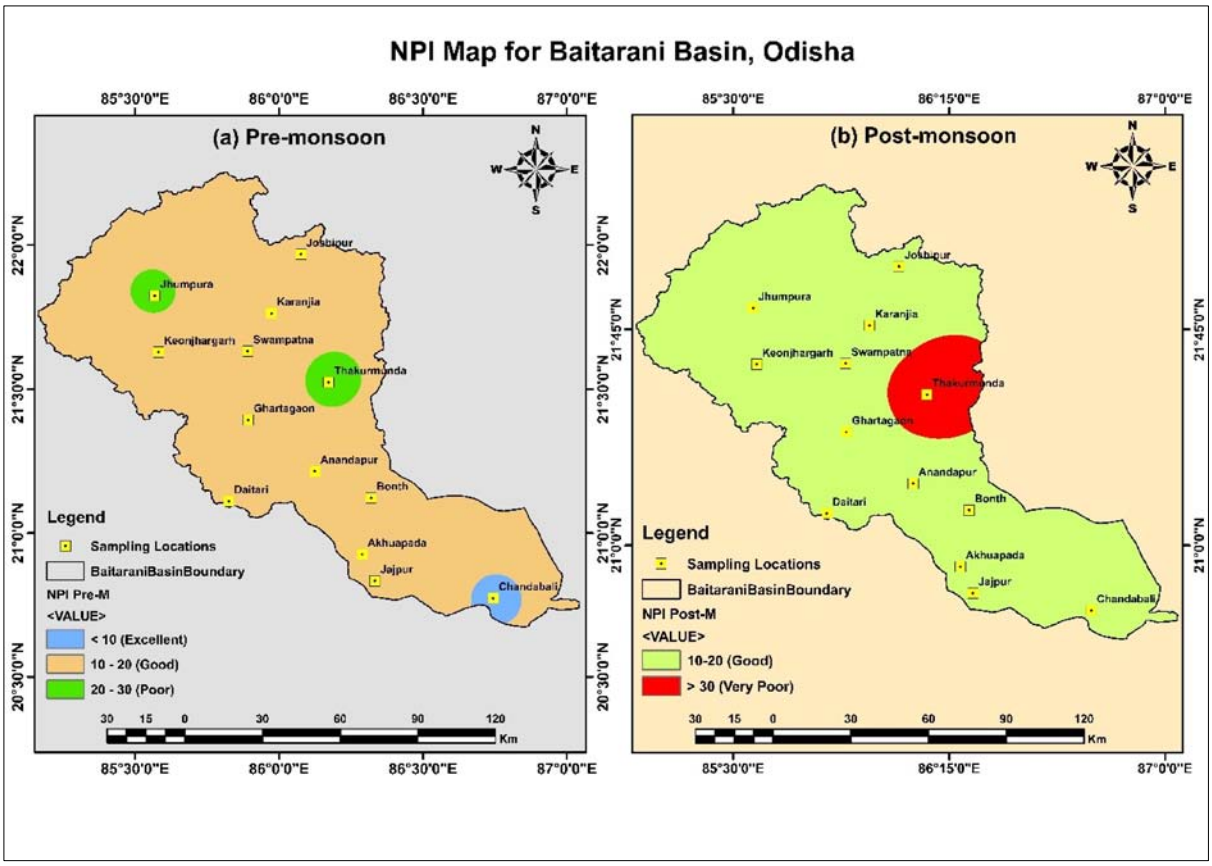


Figure 9. NPI map for Baitarani River

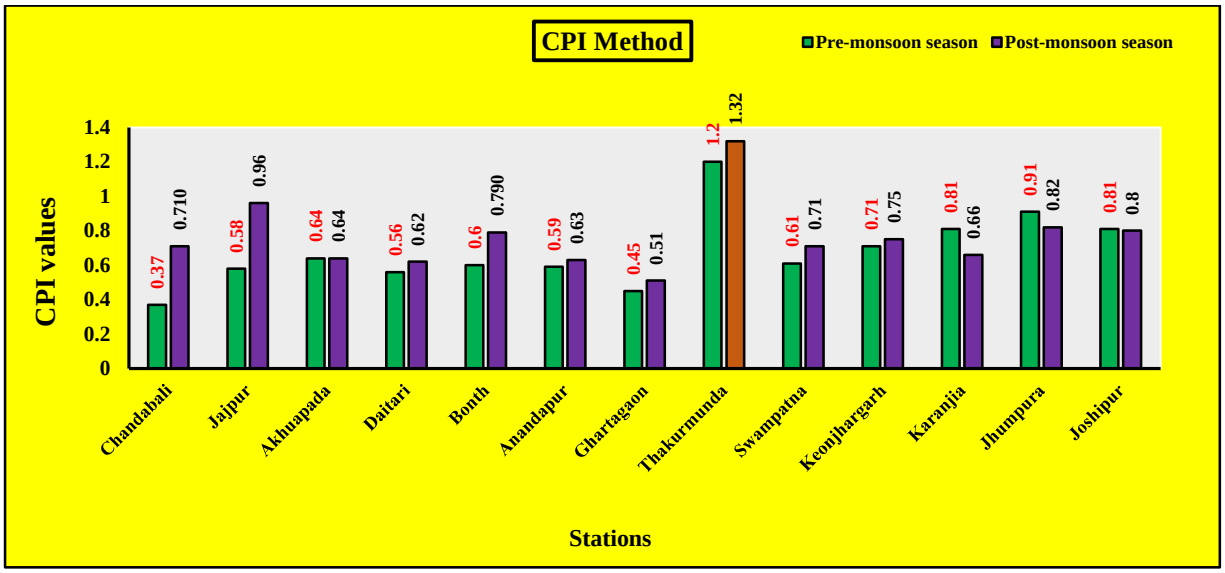


Figure 10. Plot showing CPI for each station

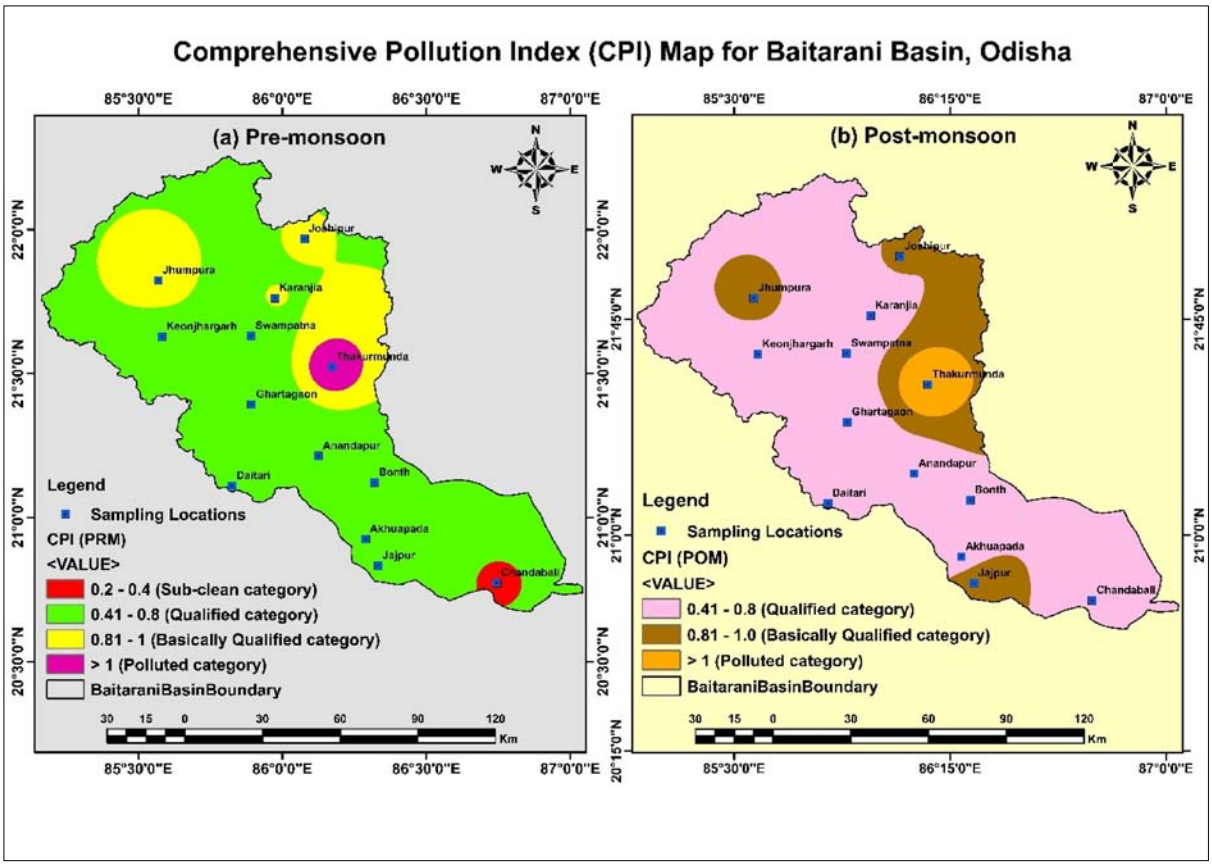


Figure 11. CPI map for Baitarani River

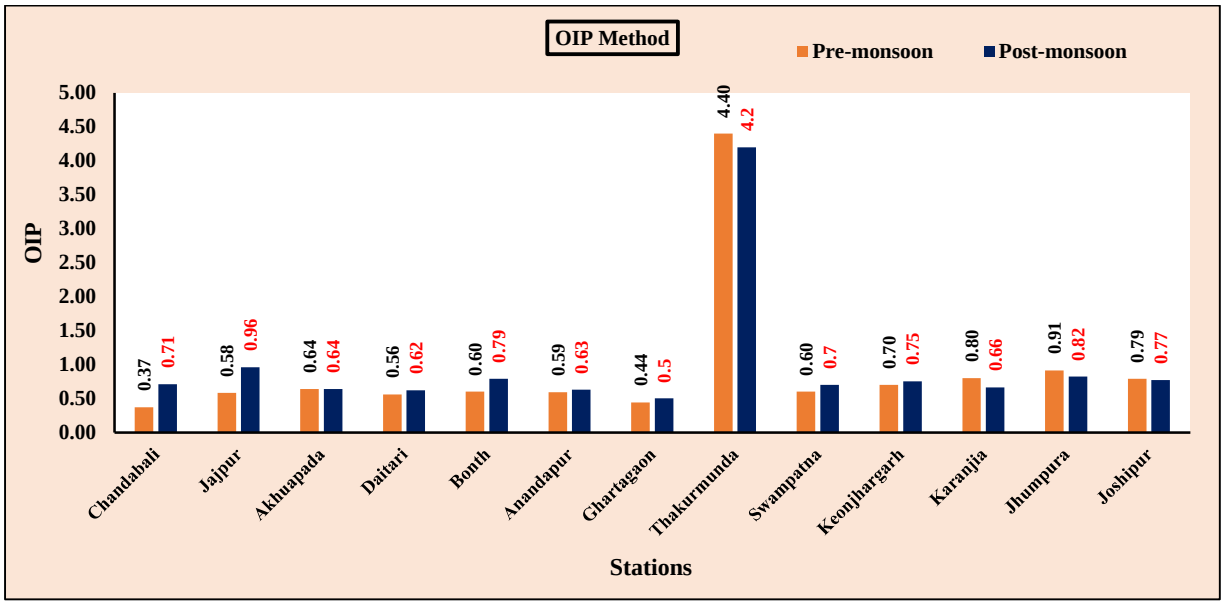


Figure 12. Plot showing OIP for each station

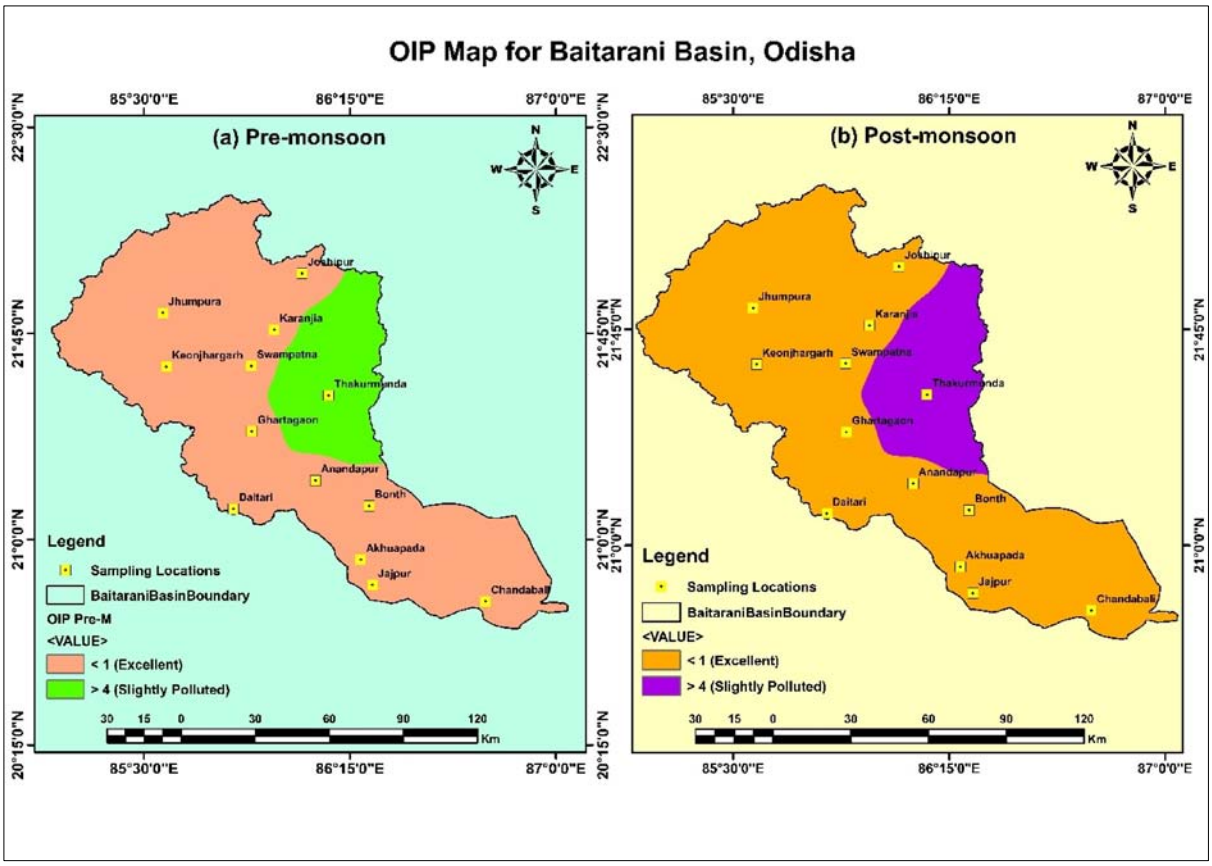


Figure 13. OIP map for Baitarani River

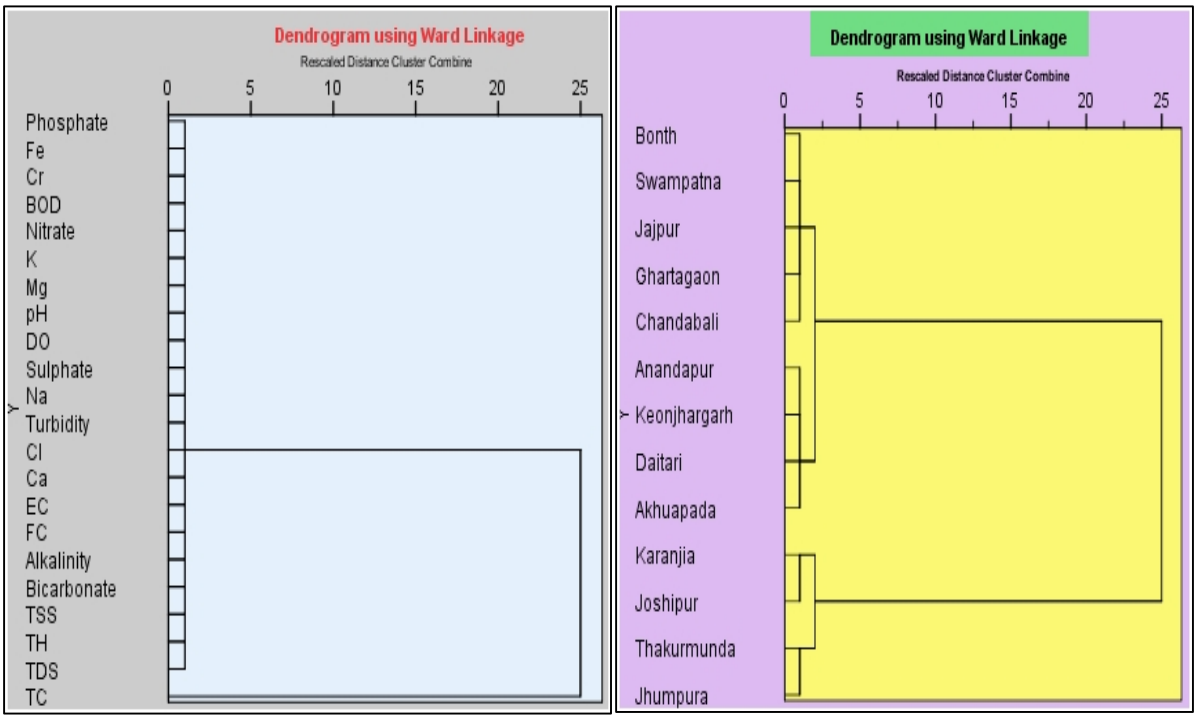


Figure 14a. Cluster analysis of 22 physicochemical parameters and 13 sampling locations (PRM)

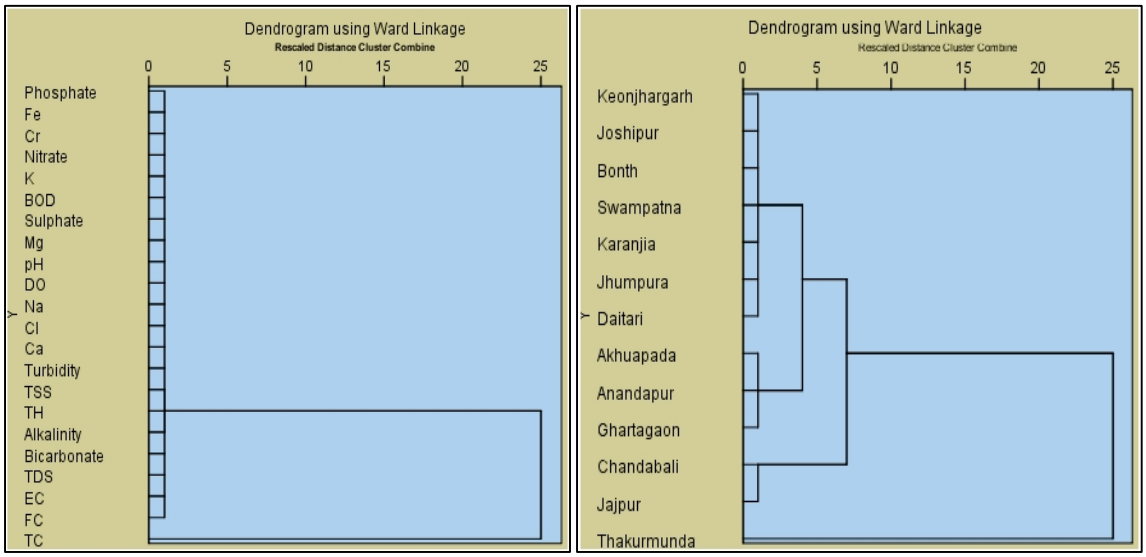


Figure 14b. Cluster analysis of 22 physicochemical parameters and 13 sampling locations (POM)

Keeping this in mind as stated above in the context of CA, it shows the order of water quality of which Cluster I represent lowest quality and Cluster III the highest. Representing the entire river, the polluted points (belonging to Cluster III) accounted for around (4 of 13 sampling points in total in PRM and 1 of 13 in total in POM). The results of cluster analysis (Figure 14c) stated that the water quality in POM was better compared to PRM season. It is being noticed that similar results were also obtained from WA WQI method.

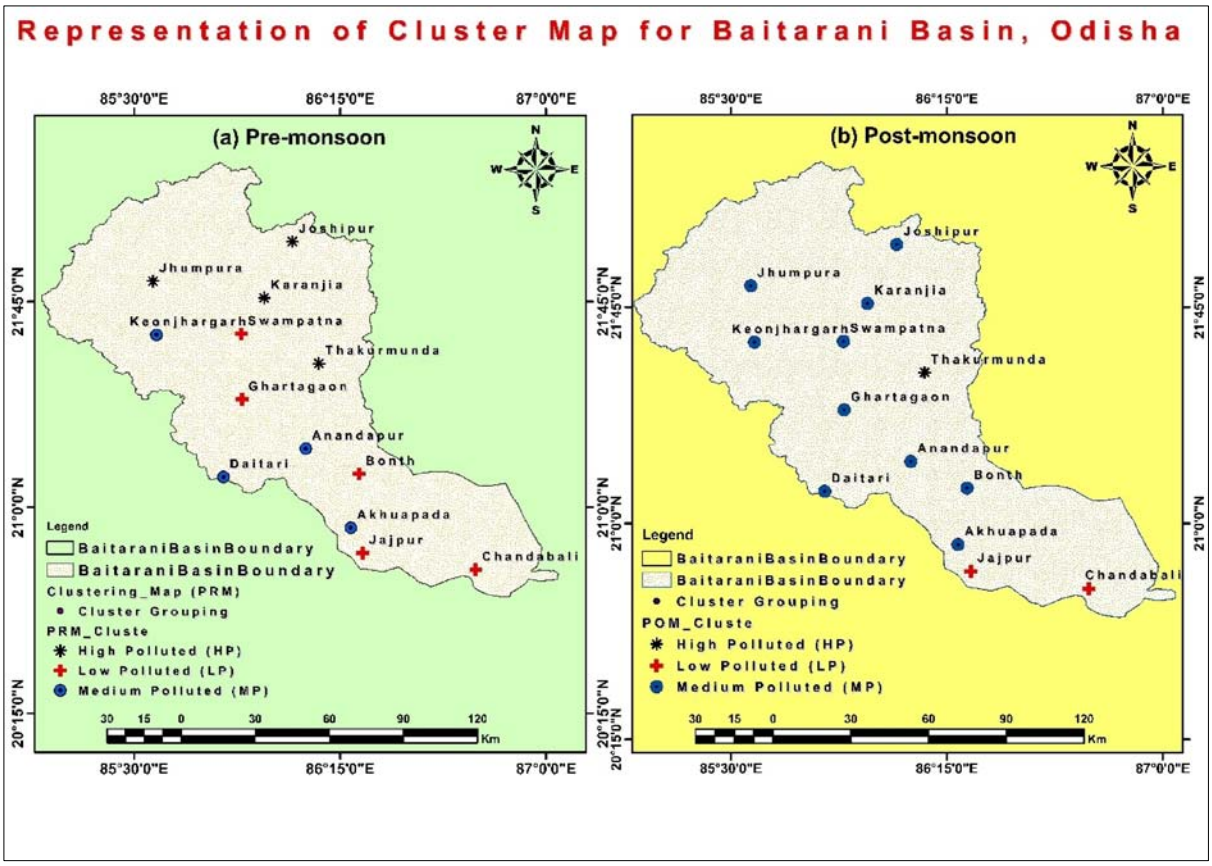


Figure 14c. Orientation of cluster map showing pollution criteria of sampling points

CONCLUSION

The main role of this study is to identify and assess the pollution loads in River Baitarani water in Odisha, was carried out using an integrated approach of different water quality indexes with GIS and multivariate statistical analysis. Different physicochemical and biological parameters are considered for the water quality deterioration at thirteen locations. Twenty-two water quality parameters were considered to assess the quality of river water. A few parameters such as turbidity and TC were identified as critical polluting parameters responsible for deterioration in the water quality. The summary of the physicochemical characteristics of river water shows that the water quality is not suitable for human consumption and polluted and eutrophic in nature due to huge anthropogenic waste discharge. WQI categorises water based on various parameters, culminating in a composite unit that may be used to determine the quality of water with a single numeric value. For further assessment, WQI, SPI, NPI, CPI and OIP is calculated in this study. CA indicated that the presence of TC is attributed to bacterial contamination, whereas turbidity originates from silicate weathering from the alluvial deposits as well as anthropogenic activities such as washing with detergents, discharge of industrial effluents and domestic sewage. CA groups 13 sampling locations into 3 clusters of similarity water quality characteristics as clusters of low, medium and high polluted zones. Based on the water quality status and origin of polluting factors, this study also suggested various treatment techniques. Moreover, an integrated approach of different water quality indexes using GIS reveals the most common words that are fit or unfit for human consumption according to all indexing methods. According to the findings, Site S-8 represents poor quality water in all methods. CA supports the results of WA WQI approach. The study also confirms that multivariate statistical analysis including CA is effective in evaluating spatial variability and identifying contamination sources in the studied area. The outcome of this study and the suggested techniques can be used by the regulatory authority for documentation and framing of effective water quality management plans to combat the pollution.

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DISCLOSURE OF POTENTIAL CONFLICTS OF INTEREST

No potential conflict of interest was reported by the author.

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Review on Precise of BlockchainTechnology

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Abstract: Blockchain technology is becoming widely popular nowadays along with their decentralized peer- to-peer network and its privacy. Bitcoin is also widely storming in the world. Blockchain technology changes the lifestyle of people and business views on many fields through its privacy and security. Many researches were done on this technology because of its security and requirements in various fields of life. In the current era major issues are security on online translation, cloud computing, large data and Blockchain more focus on designing secure service. The objective of writing this review paper is to summarize what Blockchain is and spread awareness about its usage, security and how it works.

Key Words: Blockchain, Ethereum, Cryptocurrency, Bitcoin, Consensus Methodor Algorithm, consensus rules, Hash, Genesis Block, Applications of Blockchain, Booming Domain of Blockchain

INTRODUCTION

Blockchain is a peer-to-peer Network where peers can communicate and do transactions with each other without support of any centralized system. Blockchain is a trending technology that has paved the way to solving various challenges in different sectors. It has received much interest from researchers over the years, as it is known to be a transparent, secured, no third party and tamper-proof public records repository system for documents, contracts, properties and assets. land title as being a major challenge in Nigeria due to the fact the existing traditional system, used to manage the sector is not effective, thus brought about issues such as, double spending, tamper, third party interference, it is not transparent. Hence the need for blockchain technology. The methodology considered for this research is Ethereum blockchain with smart contract which is written in solidity programming language. The research clearly shows the result of using Ethereum blockchain to manage land title and how the challenges of land title have been solved. (Obamehinti Adeolu Seun1, Touraj Khodadadi2,Sellappan Palaniappan3 - 2020).

Blockchain has been a prime invention in the past few years and nowadays everyone likes to invest in bitcoin and crypto so there is a question: is it safe? When you invest your money in a centralized system, it becomes easy to change and access by admin so somehow this method is not reliable. Now if we move onto the decentralized system which is not handled or accessed by only one person but is shareable with all the connected people and it's impossible to change or modify by anyone, so this type of system is more trustable than centralized.

This Review Paper Aims To Answer The Following Questions:

[1] who invented blockchain technology and how it works?
[2] Which Applications work for Blockchain Technology.
[3] In which areas Blockchain technology is Used and what type of Benefitprovides.
[4] How Proof of Work method and Consensus Method or Algorithm workfor Security of Blockchain Technology.
[5] In a Current Market Booming Domains of Blockchain technology whichhelpful to expand business and provide enhanced security for transactions.
[6] Demand for Blockchain Technology and Increasing Review Report.
[7] What Cryptocurrency and how and when it used
[8] Reward or Benefit of Blockchain technology and in which
[9] What is Block, Hash and how it works to create a new block.

When was Blockchain Technology Invented

The concept of a decentralized ledger or blockchain, was developed by **Stuart Haber** and **W. Scott Stornetta** in 1991. These two men teamed up with Bayern (Digital Asset for Fan) and created a system that employed a chain of cryptographically secured blocks. This first accomplishment of the blockchain is commonly referred to as a Hash tree. It is believed that this technology is the brain behind Bitcoin.

According to Wikipedia **Satoshi Nakamoto** made Bitcoin with the help of blockchain and he is the first person to conceptualize blockchain in 2009. He published a whitepaper on blockchain technology, describing how digital currencies enhance trust. The first proof-of-work algorithm was introduced by **W. Scott Stornetta**. The protocol was made more secure using cryptography.

What is Blockchain Technology, its types and how its working

Blockchain technology is normally associated with cryptocurrencies such as Bitcoin. It is a database of records of transactions which is distributed, and which is validated and maintained by a network of computers around the world. Instead of a single central authority such as a bank, the records are supervised by a large community and no individual person has control over it and no one can go back and change or erase a transaction history. As compared to a conventional centralized database, the information cannot be manipulated due to blockchain's built in distributed nature of structure and confirmed guarantees by the peers (Computer Science and Engineering 2018, 8(2): 23-29 DOI: 10.5923/j.computer.20180802.02).

The blockchain is a decentralized ledger that allows members to share and exchange digital data. Unlike a traditional bank account, theblockchain is not a currency. This technology is a virtual ledger that connects people and applications in the world.

Let's understand more clearly about blockchain. As we maintain and store data of our daily work record it's called ledger. So, blockchain is the ledger and its single record is a single block. Blockchain is a chain of groups of blocks. Now if we talk about blocks, every block has some **data and information**.

- Blockchain stores relevant **information or data** and transaction information like from where it comes.
- The second thing stored inside the block is **Hash.** Hash is a Unique Id or Fingerprint. When we store any new data on a block, a new **hash** or unique id is generated.
- The third thing stored inside a block is **Prev hash.** Every next block has saved the previous hash and created a chain of multiple blocks. And in the chain of every first block which does not store the address of any block it's called **Genesis Block.** So, it's very easy to track the history of a block and keep record of all the information.

Types of Blockchain

Blockchain is used in many industries for transaction and business, but some people are saying blockchain is not secure. There are several typesof Blockchains, some of the most important are:

Public Blockchain, Private Blockchain and Consortium Blockchain(hybrid Blockchain). Each type has its advantages and disadvantages, allowing them to meet the needs of various applications. Public blockchain which are open for all to transact and send money to others on this network. So, anyone can be a part of this network and join this public network. So, that's the issue when companies want to do secure transactions and therefore companies want their own private blockchain network. For concern of security many companies started private blockchain. So, companies keep all their records safe without sharing on public networks and no one other partycan be able to access that data without permission. So, a number of nodes and blocks are to be added in the blockchain it keeps secure by private network.

Federated Blockchain where a group of peoples or companies areknown about each node and so no one can easily change the data or address of block.In More there are two other types, permissioned blockchain and permissionless blockchain.

APPLICATION FOR BLOCKCHAIN

Cryptocurrency (Bitcoin, Ethereum, altcoin, Litecoin)

Cryptocurrency is a digital currency that is not real or any central currency to uphold or maintain it. Such as a government or Bank. It is a decentralized system for verifying that the parties to a transaction have the money they claim to have, eliminating the need for traditional intermediaries, such as a bank, when a required entity transfers funds. Individual coin ownership records are stored in a digital ledger. The computerized database uses strong cryptography to secure records of crypto transactions.

Smart Contract

Smart contract has been around since 1994, when Nick Szabo, a computer scientist, developed them as self - executing digital code in mind. A smart contract is executable code that runs on the blockchain to facilitate, execute and enforce the terms of an agreement between untrusted parties. It can be thought of as a system that releases digital assets to all or some of the involved parties once the predefined rules have been met. Compared to traditional contracts, smart contracts do not rely on a trusted third party to operate, resulting in low transaction costs. There are different blockchain platforms that can be utilized to develop smart contracts, but Ethereum is the most common one. [*Blockchain Based Smart Contracts:* [accessed Oct 08, 2022]].

Transportation and Supply chain Management

Digital supply and transportation provide control, security and efficiency from start to finish. SCM is a bit complex to connect and simplifies the global supply chain. It's in high demand in the market. There are five components of supply chain management planning, sourcing, Manufacturing, Delivery and Logistic. It's Effective because it minimizes cost and reduces time in the production cycle.

There are various platform uses Blockchain technology for security such as, Sensitive data storage, Digital Voting, Monitor supply chain management, Money transfer and payment processing

BENEFITS OF BLOCKCHAIN

Better Transparency

Transparency is the biggest issue in the current system. To improve transparency, organizations and companies have tried to apply more rules, regulations and validation, but there are some shortcomings which do not make a 100% system secure and transparent, i.e., Centralization. But, With Blockchain, an organization or company can go for a completely decentralized Network where there is no requirement of centralized authority.

A Blockchain consists of peers who are responsible for carrying out the transaction and validating them. Not every peer takes part in the consensus method.

Consensus Method or Algorithm

It is a decision-making process for a group, where individuals of the group construct and support the decision that works best for the rest of them. It's a resolution where individuals support the majority decision, whether they like it or not.

Let's clear this with an example. In a group of 50 people who want to make a project which is beneficial to each of them. Every one of them can suggest some idea, but the majority will be in favor of the one that helps them the most. Others deal with the decision whether they like it or not.

Now Imagine that same thing would happen within a group of thousands of people, so it becomes drastically more difficult to decide. Therefore, Consensus algorithms do not merely agree with majority votes, but agree with one that benefits all of them.

Enhanced Security

Utilized advanced security compared to other platforms or record keeping systems. Any transaction that is ever recorded needs to be agreed upon, according to the consensus method. Also, each transaction is encrypted and has a proper link to the old transaction using the hashing method. Security is also enhanced by the fact that each node holds a copy of the transaction ever performed on the network. So, if any malicious actor would make changes in the transaction, he/she would not be able to do as other nodes will reject the request to write the transaction on the network. Blockchain Network is immutable which means data, once written, cannot be reverted by any means.

Reduced Cost

Businesses spend lots of money to improve and manage their current network or system. That's why they want to reduce cost and divert the money to build up a new system or improve the current system. By using Blockchain organizations can reduce lots of cost to pay 3rd party vendors.

As blockchain technology is decentralized, so there is no need to pay cost to any vendor. And top of that there is less interaction needed when it comes to validating transactions. So, it reduces time and money for basic stuff.

True Blockchain Traceability

The use of Public, Private and Hybrid blockchain could introduce traceability, transparency and accountability in the movement of assets. With the help of Blockchain technology, companies focus on creating a supply chain that works on both vendors and suppliers. In the traditional supply chain, it's hard to trace items that can lead to multiple problems including theft and loss of goods. With blockchain, the supply chain becomes more transparent than ever. It enables every party to trace the goods and ensure that it is not being replaced or misused during the supply chain process. Organizations can also make the most out of blockchain traceability by implementing it in-house.

There are more several benefits of Blockchain in Government, Healthcare, Trade Finance, Logistic, Energy Sector.

SECURITY LAYER IMPLEMENTATION INBLOCKCHAIN

If anyone wants to create a new block first it will take 10 minutesto create a block and it will be shared with the whole network if majority of the votes for new changes are accepted, then the block is added to the blockchain. If we want to change data of any block, its hash automatically changes and if the hash of any block is changed then pass irrelevant information in the next second block and in the same way every block gets the wrong hash. So, whenever a block hash is changed, the block's data after that block becomes irrelevant or wrong.

Now if we change the hash of all the blocks, it will take too much time to change the hash of all the blocks and if the block hash is invalid it will break the block because the hash is no longer valid. It takes approx. 10 minutes to change 1 Block Hash. So, it's hard to change the hash of multipleblocks. The **Proof of Work** method calculates the time of changing a hash address.

The proof of work concept is considered more secure compared to other algorithms as it is almost impossible for the malicious to attack unless it acquires 51% of computing power which is impossible made by blockchain structure.

The third security layer added in this technology is that all the present hash in a network has one copy of the whole blockchain so if you want to change your block you need to share it with everyone and check whether every vote for this change is relevant or not. If change is not true, the majority of the vote for you temper on data of all blocks and your change has been blocked and this type of system is called **consensus rules**. So, if any person wants to harm blockchain, they need to spend more time tochange each block hash and need to open 80 % of the network for majority of the vote for changes.

BITCOIN AND BLOCKCHAIN: HOW ARE THEYRELATED

Many people still get confused about how bitcoin and blockchain are different. So, bitcoin is a cryptocurrency which is an application of Blockchain and Blockchain is a technology that works on various platforms. So, when you are working on Blockchain it's not compulsory to learn bitcoin or cryptocurrency. Whereas Bitcoin is currency and Blockchain is technology that built bitcoin and to work with bitcoin need to understand about blockchain and bitcoin is dependent on Blockchain technology. Without blockchain the bitcoin is not secure because the role of blocks is to provide enhanced security. Blockchain provides a substantiated database andensures that all claim transfers are securely transferred.

BOOMING DOMAIN OF BLOCKCHAIN

Cryptocurrency

Crypto is a new form of digital money powered by Cryptography. It started in 2008 with Bitcoin and you can use it to transfer as a fund or money to anyone or anywhere globally. If we take an example of Bitcoin, the bitcoin element is a mediator like a Bank and does transactions directly through the bitcoin of any of the currencies anywhere in the world and its charges are very low compared to other translation processes like there is no conversion from dollar to rupees. It transfers as bitcoin to bitcoin.

Blockchain uses killer feature-cryptography. Symmetric encryption is equivalent to using the same key to open and lock the door. Asymmetric encryption is equivalent to using a pair of different keys to open and lockthe door, namely, public key and private key. If you use the public-key encryption, you can use the private key to decrypt; if you use private-key encryption, you can use the public key to decrypt. These two keys are generally stored in the user's personal wallet. Once the private key is lost, the assets are gone. It is relatively safe in the blockchain in which the public key and private key are formed through multiple transformations, and the characters are relatively long and complex (Zhonghua Zhang,[1] **Xifei Song**,[2] Lei Liu,[2] Jie Yin,[2] Yu Wang,[3] and Dapeng Lan[4])

Real Estate Domain

In the Real Estate domain, most of the notary work is done with thehelp of blockchain so all the records of buying and selling are stored in it, and we can easily trace the history of any property.

The extensive run through will maintain, improve and will show up on realestate company strategies and structures across the world. This reliable reformist advancements in the field of real estate can be considered by experts and individuals as this would make the process easy and less burdening. However, within the primary area, there should be coordinationinside the squeezing thoughts, limits, and jargon you get on more valuesticker price houses. Through blockchain, monetary experts may need to replace the program to purchase and advance even divisions of tokens asthey see it fit. What is more prominent is, fractional possession may assistthem with the lease, sale and purchase. Upping all amounts can lead to apivotal accusation and adjusting of the populace is likely a bothersome effort. Dependent upon the expressions, landowners may likewise similarlykeep up acknowledging utilization in their assets (Yarlagadda Jyotsna - 2020)

Ethereum

Ethereum is a technology for building apps and organization, holding assets, transacting and communicating without being controlled by acentralized authority. There is no requirement to hand over all your data to Ethereum - You keep control of your own data and what is being shared. Ethereum has its own cryptocurrency, Ether, which is used to pay for certainactivity on the Ethernet network.

INCREASING REVIEW REPORT

In trends of technology, Blockchain is highly paid tech regarding researchon LinkedIn.

According to the Report overview of Grand View Research the global technology market size was valued at USD 5.92 billion in 2021 and is

expected to grow at a compound annual growth rate (CAGR) of 85.9% from 2022 to 2030.The legalization of cryptocurrency in countries, such as Ukraine and El Salvador (a country in Central America), is expected to create new opportunities for market growth. The legalization of cryptocurrency encourages businesses and investors to invest more in blockchain technology. Furthermore, it also encourages the market playersto make more efforts to improve their services to gain a competitive edge. These efforts made by the companies are expected to make blockchain technology more effective and efficient soon.

CONCLUSION

The recent development in new systems and technology is relatively good but it's very rare to develop a system that secures centralized and decentralized data.Blockchain technology is a very fast-growing technology in the last 5 years and innovation runs in every application of blockchain technology. It is popular because of its decentralized system and less human interactions. In various fields Blockchain technology is booming by itssecure application. Various secure layers are developed which are helpful for implementing security on this technology.

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Fuzzy Based Demand Side Management in Smart Grid

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Abstract. Demand Side Management (DSM) utilizes customer choices and helps to reduce overall cost and burden of energy demand. When implemented in smart grid, the use of information sharing and flow of electricity in bidirectional manner makes the system self-healing, optimized and energy efficient. In this paper, a DSM strategy based on Fuzzy Logic is proposed for cost reduction and load shifting. In proposed scheme, the load is scheduled to the best time of day to make the system most cost effective. Proposed strategy is demonstrated in two different load scenarios namely industrial and residential. For both scenarios, multiple prosumers are considered for demonstrating proposed DSM technique in large network. The results show the straightforwardness and easy application of the proposed methodology.

INTRODUCTION

The Demand Side Management (DSM) includes two-way communication between the grid utility as well as customer end for sharing real time information regarding demand and tariffs. The information sharing has to take place either real time or at least at a regular time interval. The first and basic task in making the system enhanced is to study the various methods by which this information is being utilized [1]. In every electric utility grid, there is always a need to have some stored energy as a backup to ensure the reliability of power supply during peak hours. In most of the power systems energy backup is provided by the battery energy storage system (BESS). In order to maximize the efficiency and to optimize battery-based storage system, Glow Swarm and Support vector machine are implemented [2]. The various case studies have been addressed for renewable energy using wind power with different techniques in [3]. A Fuzzy based algorithm has been proposed in order to ensure the reliability of grid tied photovoltaic system with different load conditions in [4]. In [5], a price-based cost optimization technique has been proposed for grid connected solar photovoltaic system under different consumer load conditions. In the literature, various Artificial Intelligence (AI) based cost optimization techniques have been proposed by the researchers as cited in [6]. In order to address the importance of environmental impact of various optimization techniques, an Artificial Intelligence based strategy has been proposed in [7] for residential load. An energy consumption scheduling based strategy has been proposed for DSM for an autonomous system in order to provide the access to the consumers so as to estimate their future load demands [8]. A highly efficient and robust system has been proposed using Game Theory for Cardinality Optimization for Sparse Load Shifting in DSM system in [9], the optimization to be minimization of peak to average ratio [10] and network evolutionary game based strategy has been reported in [11] and [12]. A highly efficient state feedback control of DSM has been designed and implemented successfully in [13]. In [14], the symbiotic organisms search algorithm has been addressed to reduce- user bill or cost to the consumers, as well as the peak demand. The uncertainty and unpredictability of information is taken care of in [15] for an efficient DSM system by using Distributed Stochastic Linear Proposed methodology Management (DSLPM) algorithm. In [16], the highly useful approach of particle hopping algorithm is used. The case specific to demand response in China is encountered using Deviation algorithm to establish a day ahead load peak shedding/ shifting scheme [17]. In general, the cost estimation is done and that itself serves the purpose of load scheduling or shifting. But in [18], the system maximized the profit

of the energy load, alleviates the supply-demand imbalance and reduces the bills of other market participants by using Finite horizon Markov decision process algorithm. The action of simply reversing the schedule according to the demand brings the problem of rebound peak [19] which was encountered using cost minimization algorithm for optimal management system.

In [20], an intelligent scheduling solution based on a stochastic optimization algorithm is designed and tested for the use in batteries of plug-in electric vehicles. In [21], Internet of Things (IoT) based hardware implementation of solar photovoltaic system is achieved for microgrid. In [22], progressive demand side response is proposed and implemented using the Multi Agent System (MAS) for solar microgrid. A detailed analysis of optimization of power consumption and DSM strategies is done in [23]. In order to address IEEE reliability indices in [24] and [25] statistical assessment of cost benefit analysis has been done on seven different power sectors to assess generating capacity adequacy assessment of DSM applications. The problems of water storage tank and a building thermal mass were addressed by the use of peak load shifting to minimize the real-time pricing tariffs [26]. An autonomous two-tier cloud-based system has been proposed and cost reduction using genetic algorithm have been discussed in [27] and [28] respectively. In [29], a multiperiod generation and transmission expansion is addressed using Fixed Series Compensations (FSC). Likewise in order to address the reduction of both- the peak hour demand and consumer cost, particle swarm algorithm and grasshopper algorithm have been tested in [30]. The active power and reactive power are addressed for voltage profile improvement, by load shifting for voltage regulation within tolerance limits [31]. In [32], a DSM strategy is proposed based on reinforcement learning and fuzzy reasoning to reduce user cost in residential load management. However, the above said swarm passed optimization techniques are giving very promising results in terms of efficiency and an effective load scheduling but still found very tedious to implement in practical as compared to Fuzzy based systems. So, in this paper fuzzy rule-based load shifting has been proposed for a smart grid consisting of rooftop solar array. The shifting of load demand on the system is performed using fuzzy rules and the whole strategy is implemented using MATLAB simulation. There are two scenarios will be taken to validate the proposed methodology through simulation results. Thus, a highly robust system is developed and tested successfully, giving the scope for new research.

Rest of the paper is organized as: Section 2 discusses problem statement. In section 3 the proposed cost reduction-fuzzy based strategy has been described. In section 4, proposed methodology is implemented for two different scenarios in the MATLAB environment. In section 5, results are discussed to validate the proposed cost-effective model. In the later stage (section 6), the results have been concluded in order to show that proposed model has outperformed as compared to the scenario such as the case without load scheduling.

PROBLEM STATEMENT

To shift the load of consumer with satisfying the constraints of schedulable load in DSM for the Time-of-Day (ToD) tariff between utility and prosumers to make the smart grid most cost effective and energy efficient. The objectives of this work include:

The reduction of peak demand by shifting the load demand to off-peak hours.

Flattening the load curve during the 24-hour ToD.

Consequently, these objectives will lead in reduction of electricity usage cost for prosumers.

The mathematical formulation of the proposed methodology is given as below:

$$F = M \quad (P^t) \tag{1}$$

$$P^t = \alpha_1(P_i^t - P_s^{t-1}) + \alpha_2 P_0^t \tag{2}$$

Where, P^t: average power consumed by prosumer between time (t-1) and t.

P_i^t: power consumed between (t-1) and t by prosumer.

P_s^{t-1}: average demand on the system.

P_0^t: average demand of prosumer.

α_1, α_2: constants which will be integers satisfying $\alpha_1 + \alpha_2 = 1$ (3)

The overall cost function for ToD tariff is as follows:

$$C_T = N_m * C_m + N_a * C_a + N_e * C_e \tag{4}$$

Where, C_T: Total cost of energy use in the day

C_m: Tariff for load used in morning hours

C_a: Tariff for load used in afternoon hours

C_e: Tariff for load used in evening hours

N_m: Total demand in morning phase
N_a: Total demand in afternoon phase
N_e: Total demand in evening phase

PROPOSED METHODOLOGY

The proposed methodology processes the demand of prosumer P^t by the use of Fuzzy Logic System (FLS). This follows ToD approach for its evaluation of demand and its cost. As the user provides the predicted demand for the day, for the upcoming day, week, month, or even a year, the system identifies the time when the demand is high and when it is low. System also takes into account of the fact that some of the loads are schedulable, also called as flexible load, while some of them are non-schedulable, also called as fixed load. Few examples of schedulable and non-schedulable loads are listed in Table 1.

TABLE 1. Examples of schedulable and non-schedulable loads

Schedulable load	Washing machine, Mobile chargers, Laptop charger, Dishwasher, Vacuum cleaner
Non-schedulable load	Refrigerator, air conditioner, toaster, mixer, water heater

Load Shifting Strategy

The steps for applying proposed methodology are given below:

Step 1: Set the number of prosumers to be assessed.

Step 2: Collect information about electrical appliances at consumer end and categorise them as schedulable and non-schedulable loads.

Step 3: Divide complete 24 hours into 3 ToD zones namely morning, afternoon and evening.

Step 4: Find the best suitable Time-of-Day (ToD) for each schedulable load.

Step 5: Map low as well as schedulable loads to peak load enabling the system to operate under wide range of operation.

Step 6: Set Fuzzy rules and apply Fuzzy Logic for proposed objective given in eqn. (1).

Step 7: Step 3 shifts schedulable load at best suitable time. Then, calculate ToD tariff as per eqn. (4).

The proposed DSM strategy is robust and could be used to shift the schedulable load and results into a cost-effective scheme for prosumers.

Cost Reduction Strategy

The cost calculation of the proposed methodology by the system is explained as follows:

Total hours in a day: 24 hours

For an industrial sector scenario/ day time scenario, the demand would, in general, be such that

$$C_a > C_m > C_e \quad (5)$$

For a residential sector scenario/ night time scenario, the demand would, in general, be such that

$$C_m > C_e > C_a \quad (6)$$

Step 1: Let the 24 hours be divided into three parts: morning, afternoon and evening. Each phase will have equal duration. Let morning range from 00:00 to 08:00 hours; afternoon from 08:00 to 16:00 hours; evening from 16:00 to 00:00 hours (in 24-hour format).

Step 2: In case of industrial sector scenario/ day time load, the total cost of energy use in a day would be minimum if total cost equals

$$N_m{*}C_m + N_e{*}C_a + N_a{*}C_e \quad (7)$$

Step 3: Similarly, in case of residential sector scenario/ night time load, the total cost of energy use in a day would be minimum if total cost equals

$$N_a{*}C_m + N_m{*}C_a + N_e{*}C_e \quad (8)$$

The aim would be to schedule a typical load in one of the three categories depending on the demand present the three categories. Thus, if there is a heavy load, it should ideally be scheduled at a phase where there is less

demand that is already present. On the other hand, if there is a light load, it may be scheduled to a phase in which heavy demand exit. This minimum cost case is found by the system. Thus, the result has minimum cost and reduced peak of electricity demand.

As an input, the user gives the electrical load in each ToD/ phase in the form of flexible and fixed load. The system analyses it, processes it to find the new schedule of each load such that there is reduction in peak and minimum cost, and provides the output about the best suitable ToD for each flexible load.

APPLICATION OF PROPOSED METHODOLOGY

The proposed methodology is elaborated for different load conditions which represents industrial scenario and residential scenario. In industrial scenario, the demand of electricity is high from 8 am to 4 pm, less during morning and evening hours as shown in Fig. 1. In residential scenario, the demand of electricity is higher in morning and evening hours, than during afternoon time, as shown in Fig. 2.

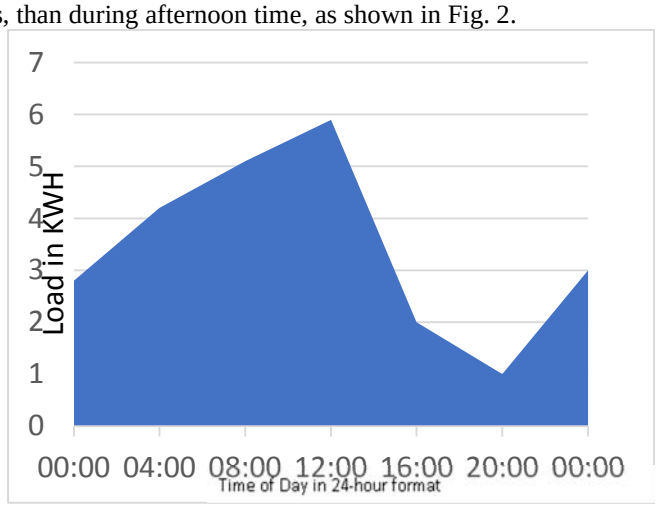

FIGURE 1. User demand for industrial load

In industrial scenario, because of switching on of a large number of machines including high energy demanding motors, cooling tower operation, lightening devices, air conditioning, computers and other industrial machinery, load demand is high during 8 am to 4 pm. In residential scenario, load curve variation depends on use of televisions in the evening, air conditioners and coolers, or heaters in the night, and geysers, toasters, mixture-grinders in the morning, charging of electronic gadgets, etc.

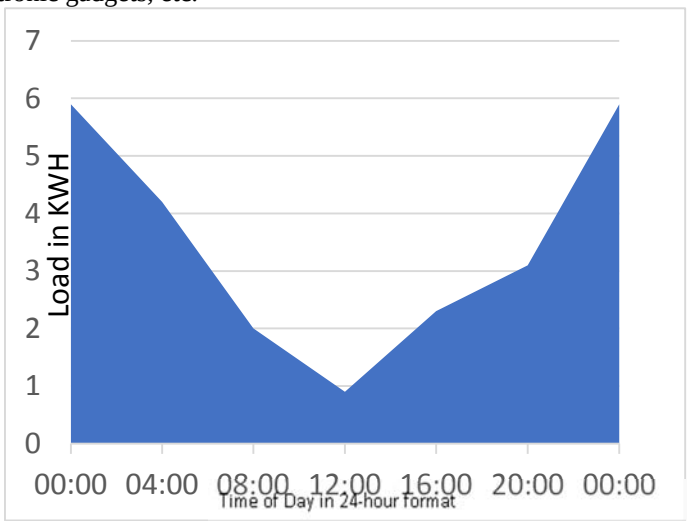

FIGURE 2. User demand for residential load

Two different scenarios have been discussed here based on when the peak demand is likely to occur. The proposed methodology has been applied in two different scenarios and results are discussed in subsequent section.

4.1 Case I: Peak in afternoon (Industrial scenario for single prosumer)

Step 1: The user enters fixed demand in following steps:

- From midnight to 8:00 am: 3 KW
- From 8:00 am to 4:00 pm: 5 KW
- From 4:00 pm to midnight: 2 KW

Step 2: The user enters flexible demand in following steps:

- From midnight to 8:00 am: 4 KW
- From 8:00 am to 4:00 pm: 6 KW
- From 4:00 pm to midnight: 1 KW

Step 3: An array of rules which confirms that a Fuzzy Logic System has been successfully developed based on the given data.

Step 4: The proposed methodology tells the user the best time to schedule each flexible load in following parts:

- The demand of 4 KW should be scheduled at 7:30 pm.
- The demand of 6 KW should be scheduled at 10:00 am.
- The demand of 1 KW should be scheduled at 9:50 pm.

Step 5: The initial and final cost to the user is displayed in Rupees as follows:

- Initial cost was Rs. 142.50.
- Final cost is Rs. 63.

Step 6: The plot of the Fuzzy Logic System, shown in Fig. 3 is generated by the software.

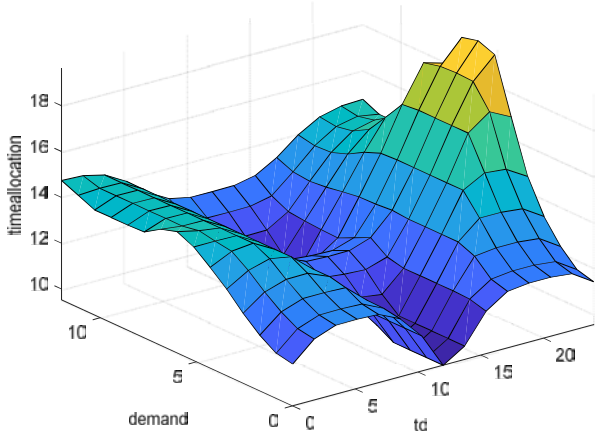

FIGURE 3. Plot of the FLS implemented in case I

4.2 Case II: Peak in morning and evening (Residential Scenario for single prosumer)

Step 1: The user enters fixed demand in following steps:

- From midnight to 8:00 am: 4 KW
- From 8:00 am to 4:00 pm: 1 KW
- From 4:00 pm to midnight: 3 KW

Step 2: The user enters flexible demand in following steps:

- From midnight to 8:00 am: 5 KW
- From 8:00 am to 4:00 pm: 2 KW
- From 4:00 pm to midnight: 4 KW

Step 3: The array of rules which confirms that a Fuzzy Logic System has been successfully developed based on the given data.

Step 4: The proposed methodology tells the user the best time to schedule each flexible load in following parts:

- The demand of 5 KW should be scheduled at 2:20 pm.
- The demand of 2 KW should be scheduled at 10:30 am.
- The demand of 4 KW should be scheduled at 2:05 pm.

Step 5: The initial and final cost to the user are displayed in Rupees as follows:

- Initial cost was Rs. 168.67.
- Final cost is Rs. 76.

Step 6: The plot of the Fuzzy Logic System, shown in Fig. 3 is generated by the software.

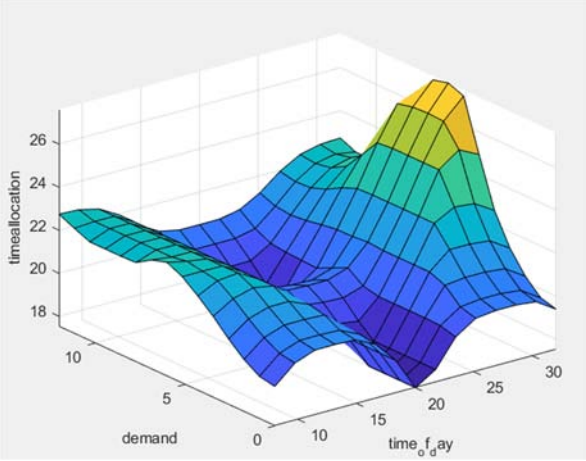

FIGURE 4. Plot of the FLS implemented in case II

From the results shown in Fig. 3 and Fig. 4, it can be observed that the proposed methodology shifts schedulable load to a particular ToD from peak hour. The allocation of each load as given by the user, modified and rescheduled to its best time possible, depending upon its load capacity, and the total demand during its use.

4.3 Case III: Peak in afternoon (Industrial scenario for multiple prosumers)

For applying proposed methodology, 10 residential prosumers are considered simultaneously. For different prosumers fixed and flexible loads connected in the system for different time slots of day are assumed and shown below in Table 2.

TABLE 2. Assumed fixed and flexible loads of each time slot for residential scenario

Prosumer No.	Morning fixed load	Afternoon fixed load	Evening fixed load	Morning flexible load	Afternoon flexible load	Evening flexible load
1	4	5	4	4	6	5
2	4	6	5	4	6	5
3	5	6	4	4	6	3
4	5	6	2	5	5	3
5	4	6	3	4	5	4
6	5	5	3	3	6	3
7	5	5	3	4	6	2
8	4	6	3	3	6	3
9	4	6	2	3	5	3

10	3	6	3	4	5	3

The results after applying proposed DSM methodology for 10 residential prosumers are listed in Table 3.

TABLE 3. Load shifting for residential scenario

Prosumer No.	Morning flexible load	Shifted ToD for Morning flexible load	Afternoon flexible load	Shifted ToD for Afternoon flexible load	Evening flexible load	Shifted ToD for Evening flexible load
1	4	7:50PM	6	8:11PM	5	6:50PM
2	4	7:50PM	6	8:19PM	5	6:53PM
3	4	6:52PM	6	8:19PM	3	5:52PM
4	5	6:41PM	5	8:11PM	3	5:15PM
5	4	7:50PM	5	8:11PM	4	5:52PM
6	3	7:50PM	6	8:11PM	3	5:31PM
7	4	6:52PM	6	8:11PM	2	5:15PM
8	3	8:35PM	6	8:19PM	3	5:31PM
9	3	8:35PM	5	8:11PM	3	5:15PM
10	4	8:35PM	5	8:11PM	3	5:31PM

It can be observed from the results of Table 3, that the proposed methodology suggests to shift the load of 3 KW from morning slot to 8:35pm, the load of 5 KW to 8:11pm, the load of 3 KW from evening slot to 5:15pm for Prosumer No. 9.

The proposed DSM methodology also performs cost analysis for each prosumer which is presented in Table 4. In all the cases, the percentage change has been calculated as

Percentage change in cost = ((Initial Cost – Final Cost)/Initial Cost) * 100 (9)

TABLE 4. Cost analysis for residential scenario

Prosumer No.	Initial cost	Final cost	Percentage change in cost
1	127.5	58.5	54.11
2	137	63	54.01
3	135.75	60	55.8
4	128	55.5	56.64
5	124.5	55.5	55.42
6	123	54	56.09
7	124.75	54	56.71
8	127.75	55.5	56.55
9	118.25	51	56.87
10	119.75	52.5	56.15

As elaborated in Table 4, after application of DSM, electricity cost for each prosumer has been decreased by a significant amount. As observed in Table 4, for prosumer No. 9, percentage cost of electricity reduced is 56.87%.

4. 4 Case IV: Peak in morning and evening (Residential scenario for multiple prosumers)

For applying proposed methodology, 20 residential prosumers are considered simultaneously. For different prosumers fixed and flexible loads connected in the system for different time slots of day are assumed and shown below in Table 5.

TABLE 5. Assumed Fixed and Flexible load of each time slot for industrial scenario

Prosumer No.	Morning fixed load	Afternoon fixed load	Evening fixed load	Morning flexible load	Afternoon flexible load	Evening flexible load
1	6	5	4	6	5	5
2	5	4	3	6	6	5
3	5	5	4	6	5	3
4	6	5	2	5	4	4
5	6	4	3	6	5	5
6	6	4	4	6	5	3
7	5	4	2	5	4	3
8	6	5	2	5	4	4
9	6	4	4	6	5	3
10	4	3	2	6	2	2
11	6	2	2	4	3	2
12	6	5	3	5	5	2
13	4	3	3	6	4	2
14	5	3	2	6	5	3
15	6	4	3	4	3	2
16	4	3	2	6	4	3
17	6	5	4	4	3	3
18	6	5	5	6	3	2
19	6	4	3	6	2	2
20	5	3	3	4	3	2

The results after applying proposed DSM methodology for 20 residential prosumers are listed in Table 6.

TABLE 6. Load shifting for industrial scenario

Prosumer No.	Morning flexible load	Shifted ToD for Morning flexible load	Afternoon flexible load	Shifted ToD for Afternoon flexible load	Evening flexible load	Shifted ToD for Evening flexible load
1	6	2PM	5	12 NOON	5	4PM
2	6	2PM	6	11AM	5	4PM
3	6	2PM	5	11:52AM	3	4PM
4	5	2PM	4	11:52AM	4	4PM
5	6	2:01PM	5	12:05PM	5	4:05PM
6	6	2:04PM	5	12:05PM	3	4:05PM

7	5	2PM	4	11:35PM	3	4PM
8	5	2PM	4	11:52AM	4	04:01PM
9	6	2PM	5	12:05PM	3	4:05PM
10	6	2PM	2	11:35PM	2	4PM
11	4	2PM	3	11:35PM	2	4PM
12	5	2PM	5	11:52AM	2	4PM
13	6	2PM	4	11:35PM	2	4PM
14	6	2PM	5	11:52AM	3	4PM
15	4	2PM	3	11:35PM	2	4PM
16	6	2PM	4	11:35PM	3	4PM
17	4	2PM	3	11:35PM	3	4PM
18	6	2PM	3	12:05PM	2	04:01PM
19	6	2:04PM	2	12:05PM	2	4PM
20	4	2:07PM	3	12:33PM	2	2:07PM

It can be observed from the results of Table 6, that the proposed methodology suggests to shift the load of 4 KW from morning slot to 2:07pm, the load of 3 KW to 12:33pm, the load of 2 KW from evening slot to 2:07pm for Prosumer No. 20.

The proposed DSM methodology also performs cost analysis for each prosumer which is presented in Table 7.

TABLE 7. Cost analysis for industrial scenario

Prosumer No.	**Initial cost**	**Final cost**	**Percentage change in cost**
1	107.25	77.25	27.97
2	100	72.5	27.5
3	96.75	69.25	28.42
4	90.5	63	30.38
5	101	71	29.7
6	97.75	67.75	30.69
7	80.25	55.25	31.15
8	90.5	63	30.38
9	97.75	67.75	30.69
10	68	43	36.76
11	68	43	36.76
12	90.25	62.75	30.47
13	77.25	52.25	32.36
14	84.25	56.75	32.64
15	77.25	52.25	32.36
16	77.25	52.25	32.36
17	86.75	61.75	28.81

18	94.75	64.75	31.66
19	82.25	52.25	36.47
20	135.66	64	52.82

As elaborated in Table 7, after application of DSM, electricity cost for each prosumer has been decreased by a significant amount. As observed in Table 7, for prosumer No. 20, percentage cost of electricity reduced is 52.82%.

RESULTS AND DISCUSSION

The proposed methodology generates a fuzzy logic system based on the data entered by the user. It provides the user with the best appropriate ToD for each of the schedulable load to be rescheduled as to create minimum cost burden.

The plot shown in Fig. 5 shows the allotted time to the user load, on y-axis as a function of the quantity of load demand in KW, on x-axis. The system successfully supresses the peaks during the afternoon hours. The plot shown in Fig. 6, for industrial load, shows graph between allotted time on y-axis and ToD on x- axis. Careful observation to the system plots in Fig. 5 and Fig. 6 reveals that allotted time goes beyond 24 hours. It means that the allotted time above 24 hour is an extension and have to be taken by subtracting it from 24. For example, if allotted time is 26 hours, it means that load is scheduled at 26 – 24 = 2 am. The same criteria has been applied in ToD calculation in this system. But the user does not need to compute this manually, as the proposed methodology computes the result out of the correct readings for the user automatically. The majority of load is intentionally allocated in 4 pm to 12 midnight so as to minimize the peak load in afternoon.

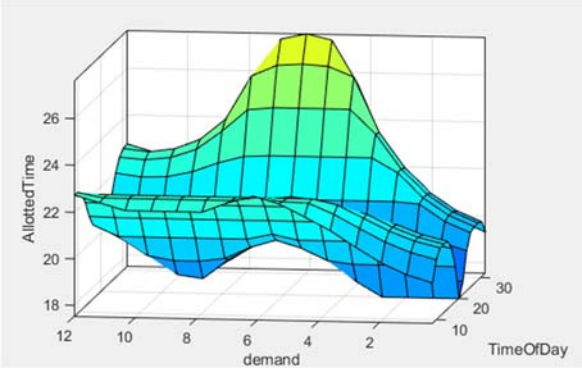

FIGURE 5. Allotted time vs demand graph of FLS Case I

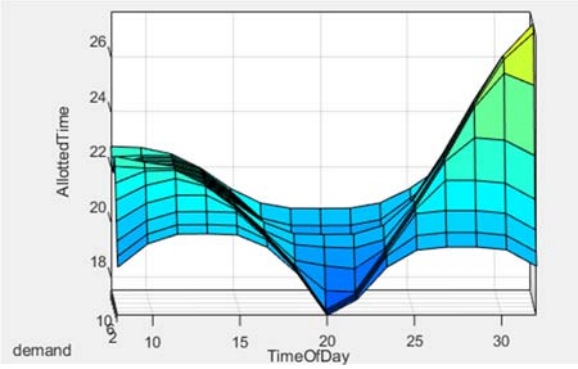

FIGURE 6. Allotted time vs time of day graph of FLS Case I

The plot shown in Fig. 7 is for residential load. It shows the allotted time to the user load, on y-axis as a function of the load demand in KW, on x-axis. The system aims to reduce the peak load to afternoon when the load is current very low. The plot shown in Fig. 8, for industrial load, shows graph between allotted time on y-axis and ToD on x-axis. Unlike in Fig. 6, the scale for allocated time is from 0 to 24 hours. Here, no time extension is not required. The majority of load is intentionally allocated in 8 am to 4 pm to minimize the peak load in the morning.

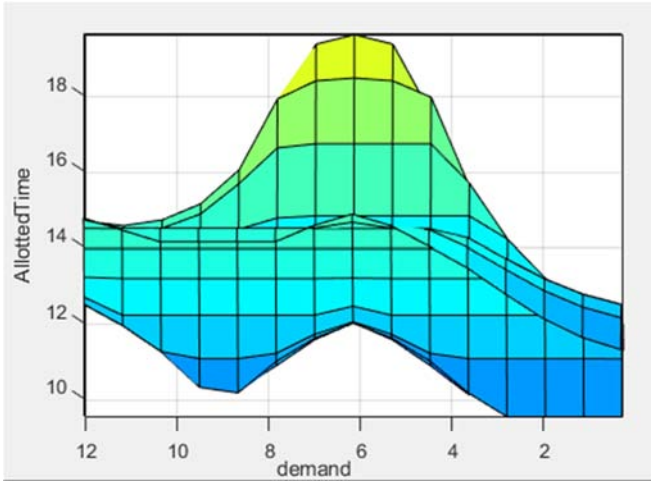

FIGURE 7. Allotted time vs demand graph of FLS Case II

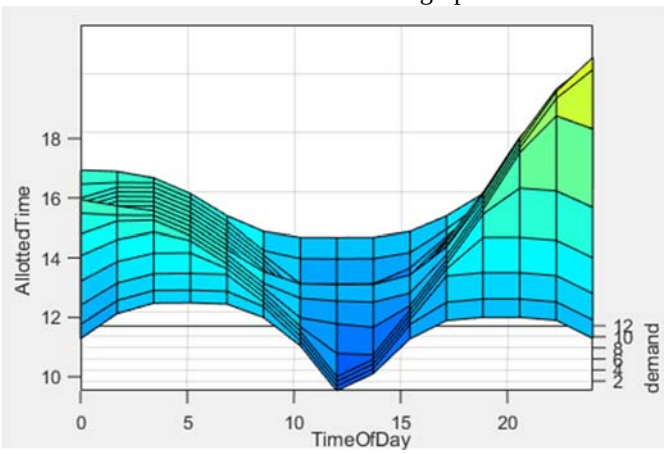

FIGURE 8. Allotted time vs time of day graph of FLS Case II

The proposed methodology also calculates the cost of electricity usage before and after the shifting based on DSM. The cost is reduced and the loads are scheduled to the best time of day possible. This process of verification makes according to use for ToD tariff calculation is presented in Indian scenario and in Indian Rupees (INR). The rules of tariff calculation can be further modified depending on the sector of demand, as proposed in the future scope of the paper. Here a system that can take a total of 6 h demand for flexible load and 6 h demand for fixed load is used. It also works with loads lighter that. Thus this system in its current state can solve the problems that have a total of 12 h demand or less. For higher demand, the system method can be used to easily modify the system. This may be needed for a smart grid of a much wider range of operation.

CONCLUSIONS

In this paper, DSM scheme is proposed that can easily be implemented to each household/ factory in a smart grid. The use of Fuzzy Logic makes the system to decide if a load is to be scheduled or not, and if it has to be, then the best appropriate time of day. In this paper, two general scenarios of demand have been tested which shows that the system makes the grid much more efficient and cost effective.

The proposed DSM technique is demonstrated for multiple residential and industrial prosumers and results shows its effectiveness for larger network also.

It can be implemented in various energy demand sectors making it robust and practical. A loop-based algorithm can be added in future to this system so that the power demand of higher order can also be mapped into the system, as the lower order power has been already mapped in it.

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An Overview of Electro Discharge Machining:-A Review

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Abstract: Electric discharge machining, the most well-known and widely used non-traditional production process, has been the subject of a comprehensive literature review in this essay (EDM). It is recognised for its ability to treat hard materials and alloys that are difficult to work with using traditional methods at high temperatures. The primary issues with EDM include a high tool wear rate, a low rate of material removal, and a high level of surface roughness since an electric spark is constantly being generated as between workpiece and the tool. Scientists have coupled the die-sinking EDM method with cryogenic treatment, cryogenic cooling, powder-mixed processing, ultrasonic assistance, and other approaches to overcome this issue. This study analyses the results of various association approaches on a range of performance measures, including material removal rate (MRR), tool wear rate (TWR), surface integrity, and recast layer produced during machining, in order to pinpoint potential problem areas and offer a solution. The text will benefit the EDM machining industry by introducing new resolutions and boosting efficiency.

Keywords: EDM, MMR,TWR.

INTRODUCTION

Each structural material has advantages and limitations, including metals, polymers, and ceramics. In addition to being appropriate for applications involving high temperatures and wear, metals and polymers are also susceptible to chemical reactions. Ceramic materials are distinctive because of their ability to maintain certain qualities at higher temperatures. In contrast, ceramic materials perform better than metals and polymers in a number of ways. because of their superior biocompatibility, stronger strength, higher temperature resistance, and high strength to weight ratio. EDM, sometimes referred as spark machining, is a manufacturing technique that produces an object's desired form as a mirror copy of the tool.By quickly repeating spark discharges between the two electrodes, which produce extremely high temperatures—typically in the range of 8,000 0 C to 12,000 0 C—and cause the material to vaporise at the place of discharge, the workpiece's material is removed. The substance that has been vaporised is scattered over the area around the electrodes. Electron beam, laser, or electric discharge machining are common high energy density methods used to produce complicated component forms in metallic carbides or high strength steels (EDM). When compared to traditional machining methods, these procedures have the major benefit of having reduced dimensional dispersion. Due to the unique qualities that qualify them to replace denser Ni- or Fe-based alloys now used in the aerospace sector, as well as for the use in turbines, automobile valves, or turbochargers, TiAl alloys have been the focus of continuous scientific research since the 1980s. It is said to be especially useful for intricate contour machining, high precision, and materials that are resistant to traditional removal techniques (Ho and Newman 2003). Each structural material has advantages and limitations, including metals, polymers, and ceramics.In addition to

being appropriate for applications involving high temperatures and wear, metals and polymers are also susceptible to chemical reactions. Ceramic materials are distinctive because of their ability to maintain certain qualities at higher temperatures. By quickly repeating spark discharges between the two electrodes, which produce extremely high temperatures—typically in the range of 8,000 0 C to 12,000 0 C—the material is vaporised at the site of discharge and is removed from the workpiece. Electro discharge machining (EDM) has its roots in the 1770 discovery of the corrosive action of electrical discharges by English scientist Joseph Priestly. First attempts at using electrical discharges to mill metals and diamonds were undertaken in the 1930s.

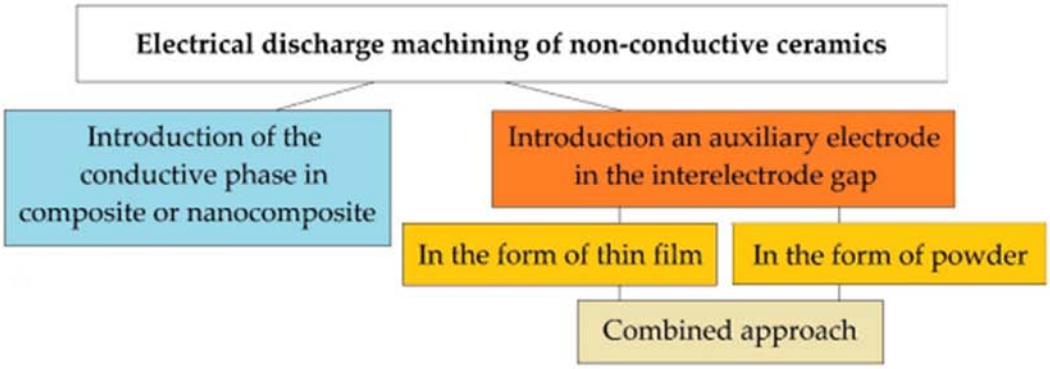

Fig.1 - Electro Erosion methods for processing non-conductive ceramics.

Additionally, because the diameter of the electrode-tool on EDM equipment may range from 0.6 to 0.05 mm, it is one of the most accurated machining techniques. When the attainable roughness Ra is around 0.4 m after roughing, the precision of electrode location on industrial equipment can, in certain situations, reach 1-2 m (80-100 nm). Additionally, it enables the removal of substantial amounts of material with just one wire tool pass. Comparing it to other machining techniques focused on the mechanical nature of removal might be very advantageous given the circumstances of the tool business.EDM is primarily employed in the production of steel rolls' surface textures as well as moulds, dies, punches, and cutting tools. 3 The method' uses, however, are expected to be expanded to include surface alloying and texturing as well as the production of components for the electronics, medical and surgical, optical, jewellery, automotive, and aviation sectors.

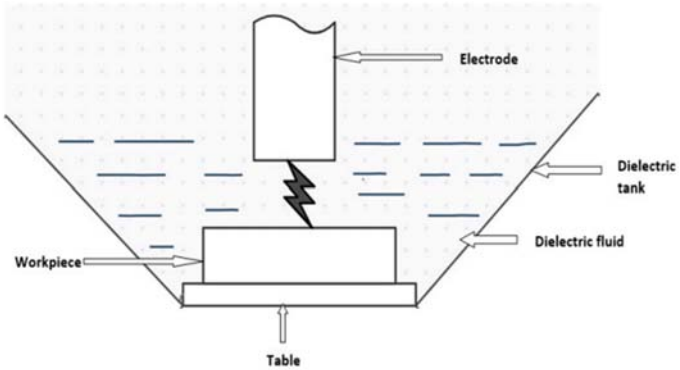

Fig.2 - Mechanism of die-sinking EDM.

The electrical resistivity of both electrodes must be between 100 and 300 cm as the electrical conductivity of the tool and workpiece is a prerequisite for this technique. A liquid dielectric gap that separates the electrode from the workpiece generates brief discharges. A computer numerical controlled (CNC) EDM was finally developed in the USA in the 1980s. Materials that can resist rising working temperatures, mechanical loads, mechanical distortions,

and chemical degradation are required for the continuous development of contemporary structures. This is demonstrated by the electric setup of the electro discharge machining process. A potential difference between tool and workpiece, which is then applied, causes a spark to be produced. The tool is formed of a cathode, while the workpiece is an anode.EDM's need that the tool and workpiece be electrically conductive and fully submerged in a dielectric media continually supplied by the pump is one of its key characteristics. Industry requires the production of complicated component forms with extremely tight tolerances and exquisite surface finishes.

Table 1 - Vikor-index optimization Technique

I	Current	L	Loss Function	A*	Ideal Solution
V	Voltage	η	S/N Ratio	A-	Negative Ideal Solution
Ton	Pulse-on Time	Y	Scaled S/N Ratio	S	Utility Measure
MRR	Material Removal Rate	TWR	Tool Wear Rate	R	Regret Measure

In the current article, Vikor-index optimization Technique has been used to jointly optimise MRR, TWR, Surface Roughness (SR), and Radial Overcut (ROC). Using the aforementioned optimization method, an appropriate combination of input process parameters such as current, pulse on time, and voltage has been found. In addition to the positional precision of the work table in the EDM process, Trezise (1982) proposed that the basic restrictions on machining accuracy depend solely on the dimensional consistency of the WEDM wire.Only conductive materials may be machined using EDM, and the tool electrodes must be changed often owing to tool wear, mostly under unfavourable machining circumstances (Nguyen et.al 2013, Diver et. al. 2004). By using nickel-plated copper electrodes with straight polarity, In13 has tested DS-EDM in inconel 825 alloy and reported that the applied current has a significant impact on getting the optimised SR. In addition to examine the impact of process factors like applied current, Ton, and Toff on output variable optimization, the major objective of this work is to achieve the highest MRR of AISI D2 die steel.In such instances, electrode wear become a challenging issue and techniques to account for it are needed in order to build correct three-dimensional cavities. Micro-EDM machining conditions are much different from those of traditional EDM. The figures show that they are forcefully ejected during electrical discharges and then solidify again after the discharge is over and cool dielectric liquid fills the discharge gap. The breakdown byproducts of the dielectric liquid may also be present in the resolidified layer of material as an alloying agent.

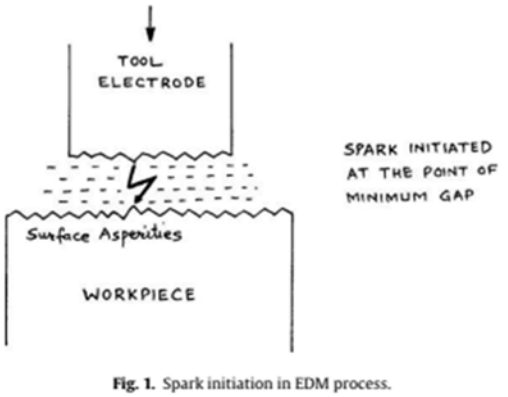

Fig. 1. Spark initiation in EDM process.

Fig.3 Spark Initiation in EDM Process.

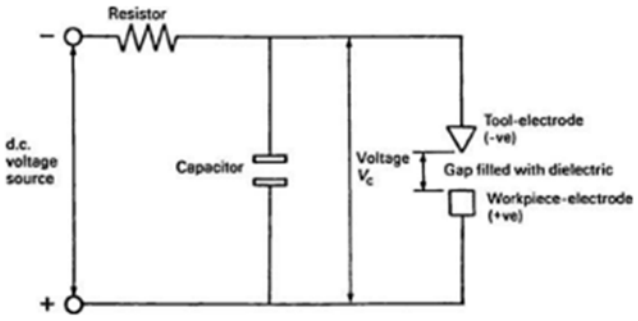

Fig.4 The Lazarenko RC circuit
(Ref: McGeough,1988)

LITERATURE REVIEW

[1]In the current production environment, industrial products must not only be created with great accuracy and quality, but also quickly enough to maintain their place in the global market rivalry. As a result, controlling the input process parameters is necessary to get the desired result or performance. Currently, out of all the machining techniques, EDM is the one that is most used. EDM is a popular non-traditional machining technique that can work with tough materials including metals, composites, and even ceramics. The automotive, aerospace, defence, and precision engineering sectors all use EDM in a variety of ways. Numerous research has been conducted in recent years to enhance the EDM procedure. This study examines recent advancements in EDM modelling and methodology, as well as current research trends.

[2]Since they have a wide variety of applications, the so-called unconventional machining processes may no longer be referred to as non-traditional. Electro Discharge Machining (EDM) is a method that has, up to now, only been used for manufacturing dies and moulds. The flow of high-tech products has caused astronomical changes in the technological coinment industries, which must now enter the crucial phase of competitiveness in the worldwide market for the items that need the improvement of non-conventional machining processes to meet the difficulties.This article offers a critical evaluation of the current state of the wide and complex tedd at unconventional machining, based on the formata shame thun abe deserung, destry, and discount seminar and giederences. It specifically addresses the present situation and future trends in non-conventional machining with a focus on Electric Discharge Machining. Das is shown by a number of concrete instances. New trends, some recent diselipsis, and highland The same technologies may be used to expand factoring techniques in winning the use they and thinner solutions revenue the specifications odumar pod.

[3]The quality of the final surface has a significant impact on the austenitic stainless steels' localised corrosion resistance. Due to the significant temperature gradients produced by electric sparks during EDM machining, significant changes are brought about. Micro-geometrical, microstructural, chemical, and mechanical changes are revealed by experimental methods such roughness assessment, Energy dispersive microanalysis (EDM), scan the electron microscopy (SEM) (EDX), and X-ray diffraction. These modifications result in strata that are white and heat-affected and are less than 100 m deep.Austenite, chromium carbide, and -carbide make up the dendritic, molten material that makes up the white layer. In comparison to the main material, the heat-affected layer is characterised by extremely high grain size. In comparison to a diamond-polished surface, an electrochemical test and metallo-graphic SEM investigations show a decrease of a resistance to pitting and intergranular corrosion. This weakening is due to variations in the white layer's chemical makeup and structure. Tensile residual stresses brought on by heat factors have

been linked to susceptibility to stress corrosion cracking. By wire brushing or polishing away the white coating substance, the AISI316L SS is once again resistant to corrosion.

[4]An effective production method for cutting intricate and irregular forms through challenging-to-machine electrically conductive materials is wire electro discharge machining (WEDM). Wire EDM is now a vital non-traditional machining technique that is extensively employed in the aerospace and automotive industries. Although this technique has been extensively studied, there is currently little information available on its applicability for intermetallic alloys and gamma titanium aluminides. These materials, which include aluminides, have been used in both traditional (such as turning, milling, and drilling) and unconventional machining processes, as ECM. Additionally, the outcomes of machinability are solely dependent on the chemical makeup of the particular alloy.This study uses analysis of variance (ANOVA) and regression models based on experimental findings to examine the connections between common WEDM process parameters and the quality of the created surface. The WEDM of a Ti-48Al-2Cr-2Nb (at.%) -TiAl alloy is the subject of this work, which focuses in particular on the effects of pulses on time, pulse off time, servo-reference voltage, and wire tension on the surface finish. Results are explored and contrasted in relation to the models that have been published in the literature.

[5]In this investigation, artificial neural network (ANN) models for electrical discharge machining surface roughness prediction are proposed (EDM). Two well-known programmes, Netlab and Matlab with related toolboxes, were employed for this purpose. The suggested models employ the pulse current, pulse length, and processed material as input parameters and were trained using data from a large number of EDM operations on steel grades. According to the published results, the suggested ANNs models can accurately predict the surface roughness in EDM. Additionally, they are useful resources for the process planning of EDMachining.

[6]Ceramics are often machined using traditional methods that involve milling, drilling, and turning, which involve high cutting forces and significant tool wear. Although ceramic materials are regarded as being exceedingly brittle and difficult to manufacture, non-contact methods like laser machining and electro-discharge machining (EDM) continue to be viable alternatives. This study makes an effort to give insight into the state of the art of the EDM process, kinds of ceramic materials and their applications, as well as the machining processes involved, keeping in mind the significance of ceramic machining. Additionally, a brief overview of previous experimental and theoretical research investigations on ceramics EDM is included in this article. The last part includes a summary of the main issues, remedies, and recommendations for future study areas.

[7]One of the various non-conventional machining techniques is called electro-discharge machining (EDM), in which the electrode materials melt and evaporate to remove the material. A kind of EDM known as Micro Electro-Discharge Machining (μ-EDM) is useful for creating small features on hard to process conducting materials. The writers of this paper undertook a thorough literature research in order to offer a detailed description of the -EDM process, its prerequisites, performance, and applications. It was decided to divide the information from more than fifty articles into five main categories: experimental setups and their subsystems, experimental investigations and optimization techniques, produced micro characteristics, modelling and simulation methods, and applications.

[8]In the past 10 years, there has been a growing interest in the innovative uses of the electro discharge machining (EDM) technique, with a focus on its potential for surface modification. Along with the erosion of a work material during machining, some tool material is also removed due to the inherent nature of the operation. The development of the plasma channel, which is made up of material vapours from an eroding work material and tool electrode, and pyrolysis of a dielectric fluid have an influence on the surface composition after machining and hence its features. Under appropriate machining circumstances, deliberate material transfer can be accomplished by utilising composite electrodes, distributing metallic powders in the dielectric, or a combination of the two.The phenomena of surface modification from electro discharge machining is reviewed, along with potential future applications, in this study.

[9]The primary electro physical and chemical properties of the components under heat when the inter electrode gap reaches 10,000 °C are covered in the data in the proposed review, along with a systematic organisation

of information on ceramic pressing techniques like spark plasma sintering and the chemical processes that occur in the inter electrode gap during the sublimation of primary (brass and copper) and auxiliary (Ti, Cr, Co, and Ni) electrodes.

[10]The three sustainability indicators for the electrical discharge machining process—the environmental impact, worker health, and operational safety—that have been the focus of the study evaluations in this article have all been covered by the researchers in this publication. Wet, dry, and near dry dielectric supply types have a considerable impact on the aforementioned sustainability criteria. When analysing the research on each indication, the three forms of dielectric supply have been taken into account. This study provides a basis for assessing the current level of research activities in the field of electrical discharge machining regard to sustainability measures. Metal removal using electrical discharge machining must be done in an environmentally friendly manner.

[11]The article mentions that the constant electric spark that is created between tool and the workpiece during EDM results in high tool wear rates, poor material removal rates, and high surface roughness. In order to overcome this problem, Cryogenic treatment, cryogenic cooling, powder-mixed processing, ultrasonic support, and other techniques have been used with the die-sinking EDM process in study..In this paper, potential gap areas are identified, and a solution is suggested after analysing the results of these association techniques on a variety of performance measures, including material removal rate (MRR), tool wear rate (TWR), surface roughness, surface integrity, and recast layer formed during machining. The text will help the field of EDM machining by providing new resolutions and enhancing performance.

[12]Electrical discharge machining is one of the earliest non-traditional machining processes (EDM). The EDM technique is built on the thermoelectric energy that exists between the workpiece and an electrode. By melting and vaporising the unwanted material between the workpiece and the electrode, in the confined space, a pulse discharge separates the parent metal from the unwanted material. To produce the spark, electrical conductivity is required on both the electrode and the object of work. EDM may be used to make a variety of goods, including dies and moulds. EDM may be used to finish components for the medical sector, automotive industry, and aerospace industry. The study on ultrasonic vibration, dry EDM machining, EDM with powder additives, and EDM in water is reviewed in this publication.

[13]Recently, EDM process researchers have examined a range of methods to improve the process parameters, including electrical parameters, non-electrical characteristics, tool electrode-based parameters, and powder-based variables. This present research has the same objectives of a more efficient rate of metal removal, a decrease in tool wear, and a greater surface quality. The research on die-sinking EDM, water-in EDM, dry EDM, and powder-mixed electric discharge machining that has been conducted over the past 10 years is analysed in this essay. A brief description of the future directions for EDM research is also given.

[14]The researchers came to the conclusion that the physical characteristics of the electrode had the biggest impact on the EDM's ability to machine. The optimal EDM electrode should have strong wear and erosion resistance, high specific heat, high electrical and thermal conductivity, and superior machinability. All of these conditions cannot be met by a single substance. In this work, alternate methods for creating electrodes for electric discharge machining utilising various procedures are reviewed.

[15]Electrical discharge machining is one of the earliest non-traditional machining processes (EDM). The EDM technique is built on the thermoelectric energy that exists between the workpiece and an electrode. The material is removed from the workpiece by melting and vaporising when a spark forms in a little region between the electrode and the workpiece.The spark can only be produced if both the electrode and the workpiece are electrically conducting. EDM may be used to make and/or finish a wide range of goods, including surgical components, aircraft parts, dies, and moulds. The different EDM research questions and the modelling approach used to forecast EDM performances are presented in this study.

[16]Using a L9 orthogonal array, tests have been planned in the current study to find the best possible combination of input process parameters, including current, pulse on time, and voltage. Material removal rate, tool wear rate, surface roughness, and radial overcut have all been optimised concurrently utilising a multi-objective optimization approach that uses the Vikor Index. The ANOVA Technique has been used to examine the influence of different input process characteristics on the overall performance of EDM. Additionally, a multiple linear regression analysis has been used to create a mathematical association between numerous input factors and the specific output parameters.

[17]Electric discharge machining (EDM) is utilised extensively in the manufacturing industry because of its distinct machining features and high level of precision, which are unmatched by other conventional machines. In order to reduce machining time while maintaining high material removal rate (MRR) and low tool wear rate (TWR), this study analyses the ideal machining parameter. It does this by altering factors such as current, pulse on time (Ton), and pulse off time (Toff). ANOVA was used to find the optimised parameters after numerous dry runs using the Taguchi approach of the L9 orthogonal array (OA) were completed. The error % could then be checked, and parameter contributions for the MRR and TWR were discovered.

[18]The development of novel manufacturing techniques to meet these new demands as well as the adaptation of traditional metal cutting techniques to these micro-scale applications have been sparked by the rising demand for micro-products. Prosthetics, surgical tools, and tissue engineering items all come in a great variety in the medical industry. In order to understand how the process parameters may affect the outcome, this work investigates the use of the traditional EDM method to create micro holes. The size and form of the micro-cavities are analysed as a consequence.

[19]The researcher's goal was to identify the critical variables that influence performance output in order to increase the workpiece's Material Removal Rate (MRR). They employed the thermal-based electro-discharge machining (EDM) technique to remove "hard to cut materials" with intricate forms. This research looks at how to use a conventional approach to optimise the EDM process variables. The current, pulse on time, and pulse off time have been chosen as the optimization parameters. L9 Orthogonal Array (OA) has been chosen to study the effect of the process variables on the performance, or on the rate of material removal.Positive polarity AISI D2 die steel has been used for the experimental experiments, while brass has been selected as the electrode material. Applications: Nickel base superalloys, titanium, and other hard-to-cut materials are typically machined with EDM.

[20]The study's goal is to determine if micro-EDM electrode wear compensating techniques are appropriate. In order to determine the precision possible with micro-EDM, two key aspects impacting the application of wear compensation techniques are investigated: random changes in the volumetric wear. EDM milling and drilling are seen as independent procedures since they need various methods for analysing and applying the study's findings.

[21]Recent years have seen a significant increase in the machining using electrical discharge (EDM), a non-traditional manufacturing technique, in the manufacture of dies all over the world. Surface roughness, together with material removal and tool wear rates, is the most crucial performance indicator in EDM. Experiments were conducted in this work to identify the factors affecting surface roughness. The design of experimental approaches have been used to analyse the data collected for performance metrics. Using power, pulse time, and spark time factors, a rather complex equation is developed to describe surface roughness. The findings are spoken about.

CONCLUSION

By reading this article, we learned about EDM, its components, applications, advantages, and a variety of other EDM-related abilities. EDM is an essential non-conventional machining process that has a wide range of applications. In this regard, the authors analysed several studies on -EDM and concluded that there is much research potential in this field. The outcome of this review causes the reader to consider numerous concerns covered in the paper, such as:

- Setups for experiments and their subsystems
- Experimentation and optimization methods
- Micro Features created
- Approaches to modelling and simulation
- Application areas

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The Effect Of Using Phase Change Material (PCM) With Rubber On Marshall Properties In Hot Mix Asphalt Of Flexible Pavement (An Experimental Study)

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Abstract. In this study will focus on the effect of phase change material(PCM) with the waste tire rubber together on the properties of Marshall (stability & flow) of the Asphalt mixture in hot mix asphalt .If these both material can improve the mechanical properties , how we can increase the stability by adding the (PCM) and waste tire rubber with different percentage to the mixture as a binder and compare the results with the results of previous researches.

In that way we will have environmental benefits such as reducing the amount of waste tire rubber and use it as a recycled material in pavement, and the cost of the material will be cheaper than using new raw material for pavement so that will be economic and ecofriendly mixture for pavement.

Phase change materials (PCM): is a Material that increase the storage of thermal energy in buildings, so the demand for energy will decrease, it absorbs the excess heat by melting.

The Aim Of The Study:

investigates the Marshall properties (stability & flow) of hot mix asphalt of flexible pavement the with the different percentage of these two materials and by apply high load on the samples.

Keywords:

Aggregates
Binder
Asphalt
Hot mix asphalt (HMA)
Phase change materials (PCM)
Waste tire rubber
Ceramic waste powder (CWP)

INTODUCTION

The bitumen is a material which is black or dark colored solid or sometimes viscus cementitious, content in emulsion is around 60% and remaining is water, bitumen has desired properties such as (adhesion, waterproof, strength, durability, hardness, economic). All these properties lead the engineers to use it as main material for road construction by preparing the mixture for flexible pavement of roads and highways. Sometimes we need to modify and improve the bitumen properties according to the environment of area surrounding so we add some modifier to the mixture to get best results and that's can happen with different stage by using different modifiers but when we will add new industrial materials it will be costly or when we should do maintenance work with new material it will not be economic ,that's why we resort to alternative materials like consumption the waste materials such as rubber of waste tire it will be low costly and will gain environmental benefits in addition to of desired properties pf bitumen mixture .

NEED FOR STUDY

To make sure if we can get a mixture that has the better characteristics with less using of new industrial materials by using waste material and economical savings.

OBJECTIVE OF THE STUDY

The main objective of this research is to evaluate the effects PCM materials with rubber together on (stability & flow) Marshall properties.

What Is The Kind Of Environment This Mixture Is Designed For?

- This mixture is designed for the areas of high temperature like Rajasthan city in India, where the temperature reached up to (50) ℃ about (122.3)℉.
- Also, it will be design for latakia city temperature in Syria because its record the hottest temperature during 20 last years, the temperature sometimes it reached up to (47.2) ℃, where has the hottest summer from July to September.

THE LABORATORY EXPERIMENTS:

THE LABORATORY EXPERIMENTS FOR BITUMEN WITH OUT ADDITIVES:

Marshall Mix Design Without Additives:

5.1.1 ***Marshall Mix Design***

The marshal stability and flow test are used for preparing marshal mix design method to predict the performance of the mixtures. The stability portion value is to measure the maximum load that can applied on the sample, by test the sample at a loading rate of 50.8 mm/minute, the load is applied on the sample till it fail. During the loading, an attached dial gauge measures the specimen's plastic flow (deformation)because of the loading. The flow value is recorded in 0.25 mm (0.01 inch) increments at the same time when the maximum load is recorded. The important steps involved in marshal mix design are summarized next.

TABLE 1. The value of flow and stability

Bitumen Content (%)	Stability Values (KN)	Flow Values (mm)	Marshall Stability/Flow
3.50	16.3	2.563	6.5
4.00	21.8	3.167	6.9
4.50	25	3.52	7.8
5.00	38.2	3.86	9.9
5.50	28.5	3.94	7.3
6.00	17.87	4.167	4.3

CHART 1. Bitumen content Vs Stability Value (HMA**)**

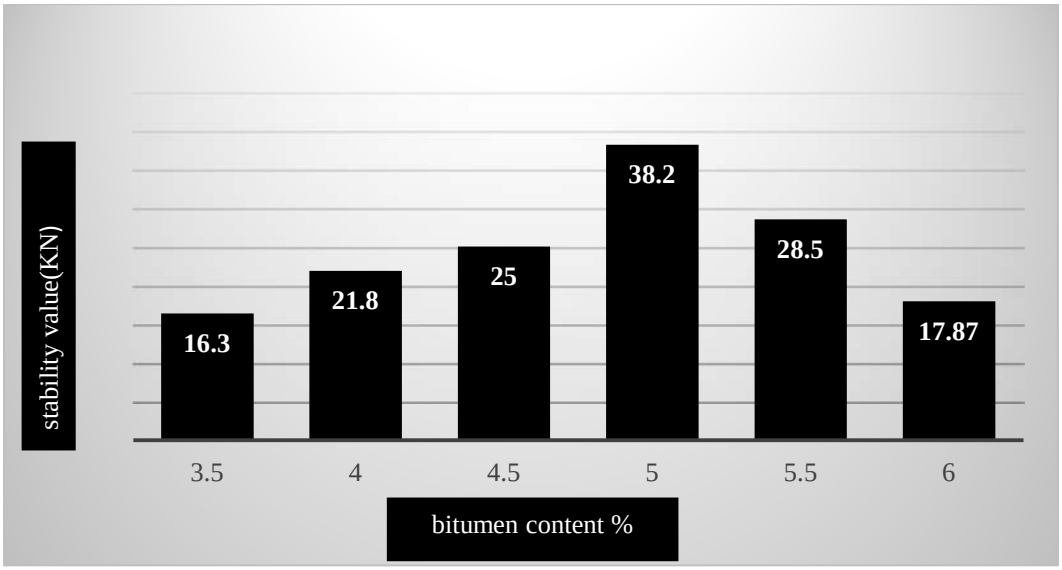
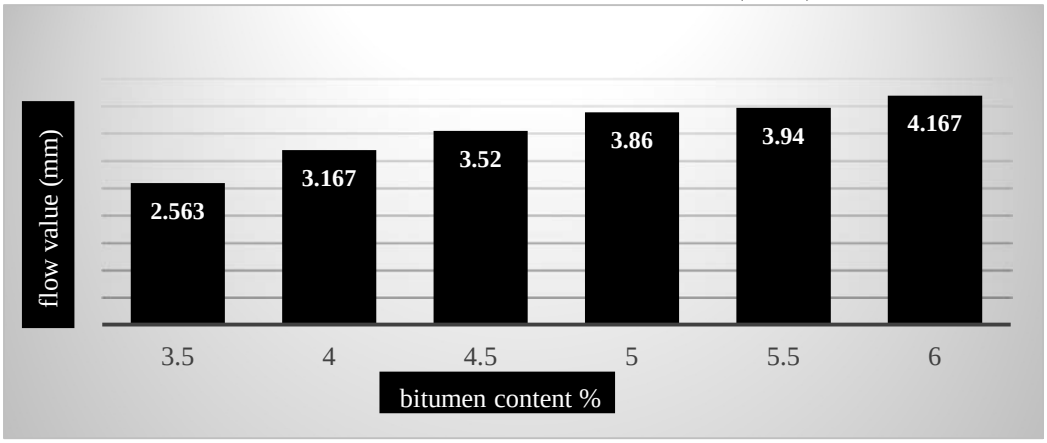


CHART 2. Bitumen content Vs flow Value (HMA)



THE DIRECT EFFECT OF ORGANIC PCM MATERIAL:

- Easy to leak of high temperature.
- Complex effect on the performance of asphalt binder and asphalt mixture.
- It provides the strength to the aggregates and reduce the heat of the surface.
- Can provide good mechanical and thermal stability and prevent the overheating.
- Improve the thermal properties of asphalt.
- Can solve the rutting problem which is caused by high temperature.

THE DIRECT EFFECT OF CRUMB RUBBER MATERIAL ON BITUMEN MIXTURE:

The reason of adding CRM to the bitumen mixture or binder because it can improve the anti-fatigue properties of asphalt mixture against the aging.

- It reduces the depth of the asphalt rutting at a particular temperature.
- It reduces the thermal sensitivity of asphalt mixture.
- It increases the stiffness which is cause positive effect in terms of bearing and stress distribution.
- It decreases the penetration and increase the softening point and improve the resistance of permanent deformation increase the viscosity.
- It recovers the horizontal deformation to the normal one

THE DESIGN OF THE ASPHALT MIXTURE WITH THE MATERIALS:

In this asphalt mix design will depend on the wet process of mixing the new materials (PCM &CRM) with the bitumen.

THE MATERIALS WHICH WILL BE ADDED TO THE BITUMEN:

- we prepared waste tire rubber with the size of (3 mm) as a scarp.
- we prepared phase change material (PCM) with properties of it.

THE RESULTS OF ADDING PCM & RUBBER:

We prepared the mixture with different additives; the first additives are (rubber and pcm) together to the mixture.

The results which I got it from these tests that when I add pcm to the mixture after I kept the moulds in the water bath of 60 degree the mould failed in the tube, it was not good effect.

These results led us to add one extra additive to the mixture to transfer the effect of pcm with rubber on the bitumen mixture from negative effect to positive effect. This material was Ceramic waste powder (CWP).

CERAMIC WASTE POWDER (CWP) AS A FILLER IN HOT MIX ASPHALT:

To improve the mechanical properties of the mixture in hot mix asphalt we are going to use the ceramic waste in this mixture and replace the stone dust with the ceramic powder to enhance the mechanical properties of the moulds and it will be economic and eco-friendly solution for the research**.**

CERAMIC WASTE DUST:

In the study one types of filler have been used, the conventional filler is ceramic waste. The ceramic waste was collected from Morbi Ceramic industrial area, Rajkot, Gujarat, India. Sieve analysis of powdered form ceramic waste result shows that 98.5% of ceramic powder passed through 75µ Sieve as per the Indian codal provision (MORT&H 2012, IS 2386). The chemical properties of the ceramic waste were considered as mentioned.

THE PERCENTAGES OF (CWP) FOR REPLACEMENT ARE:

- CPW25 (75% stone dust+ 25% CPW).
- CPW50 (50% stone dust + 50% CPW).
- CPW75 (25% stone dust+ 75% CPW).

The results of Marshall Mix with CWP:

6.3.1The stability and flow of Marshall test for 3.5% 0f bitumen content with different percentage of CPW:

TABLE 2. The value of flow and stability with CPW

Bitumen content (%)	CWP(%)	Stability values (KN)	Flow values (mm)	Marshall stability/flow
3.50	25	15.75	2.9	5.43
3.50	50	16.05	2.8	5.73
3.50	75	16.36	2.89	5.66

CHART 3. Stability And Flow Value with Different percentage of CWP & 3.5%Bitumen Content

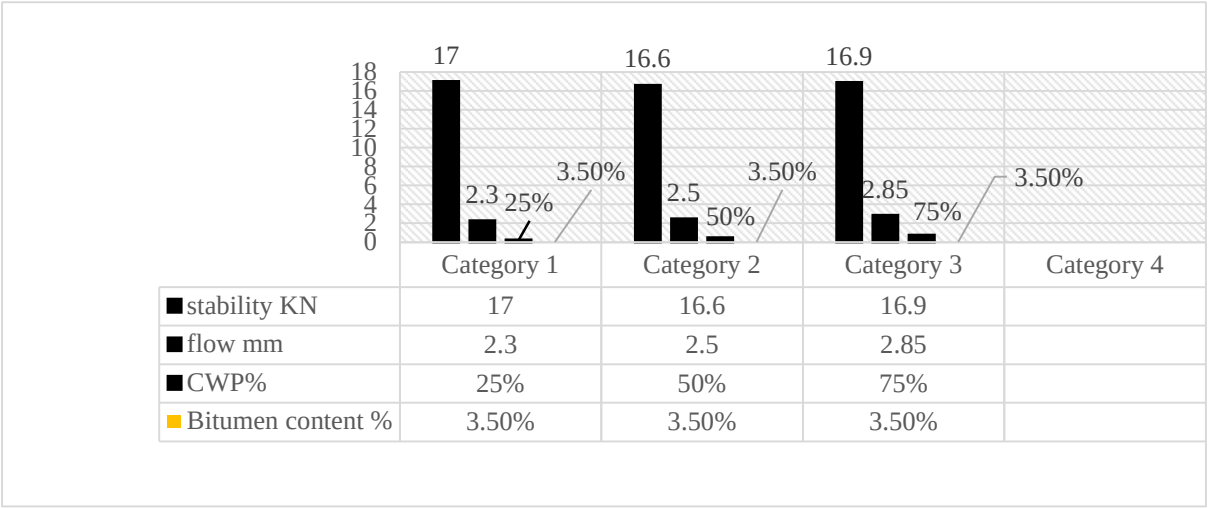
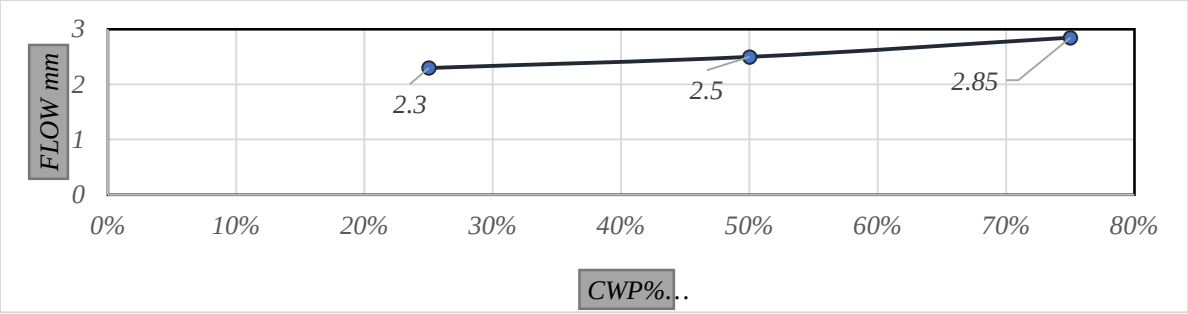


FIGURE 1. *The Value of Flow With Different percentage of CWP& 3.5%Bitumen Content*



6.3.2 The results of adding (CPW) as a filler instead of stone dust 3.50% of bitumen content:

- We noticed the increasing of the percentage of ceramic powder waste can improve stability of samples, we got better results than the pure samples we started with 25% replacement of stone dust we got (15.75) KN stability value and (2.9) mm of flow.
- By increasing the percentage of CWP to 50% the value of stability had increased (16.05) KN and 2.8 mm of flow value.
- We increased the percentage of CWP to 75% the value of stability reached to (16.36) KN and 2.89 mm of flow.

6.3.3The stability and flow of Marshall test for 4.00% 0f bitumen content with different percentage of CPW:

TABLE 3. The value of flow and stability with CPW

Bitumen content (%)	CWP(%)	Stability values (KN)	Flow values (MM)	Marshall stability/flow
4.00	25	21.5KN	3.09	7.06
4.00	50	21.75KN	2.65	8.2
4.00	75	22.57KN	3.36	6.62

CHART 4. Stability And Flow Value With Different percentage of CWP & 4.00%Bitumen Content

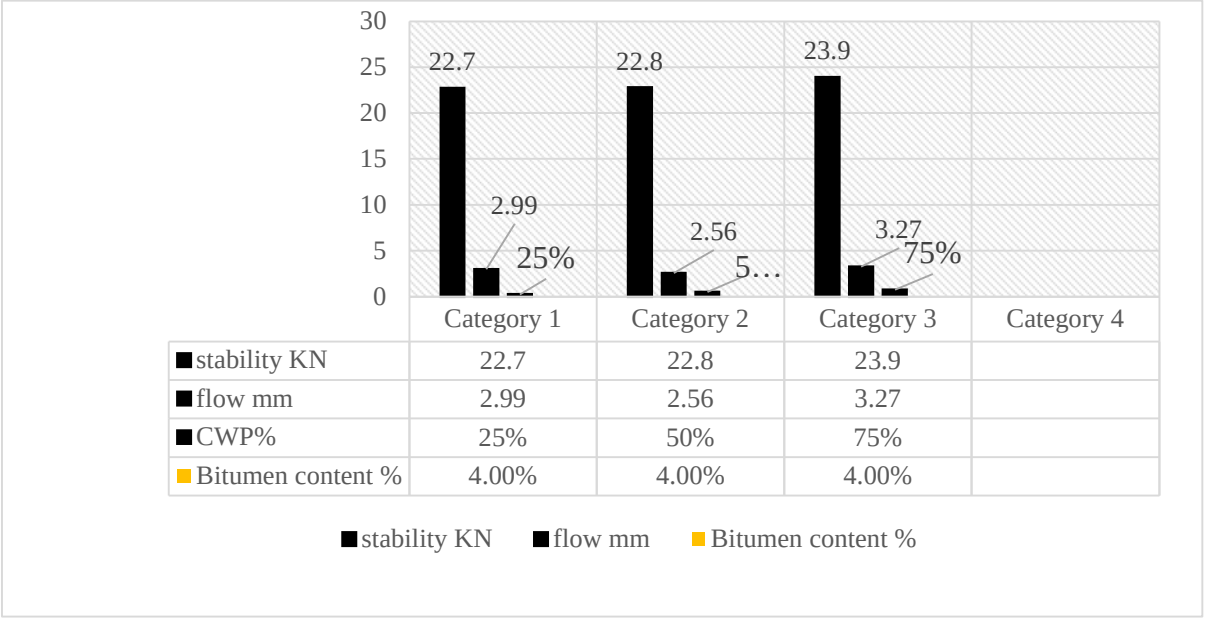
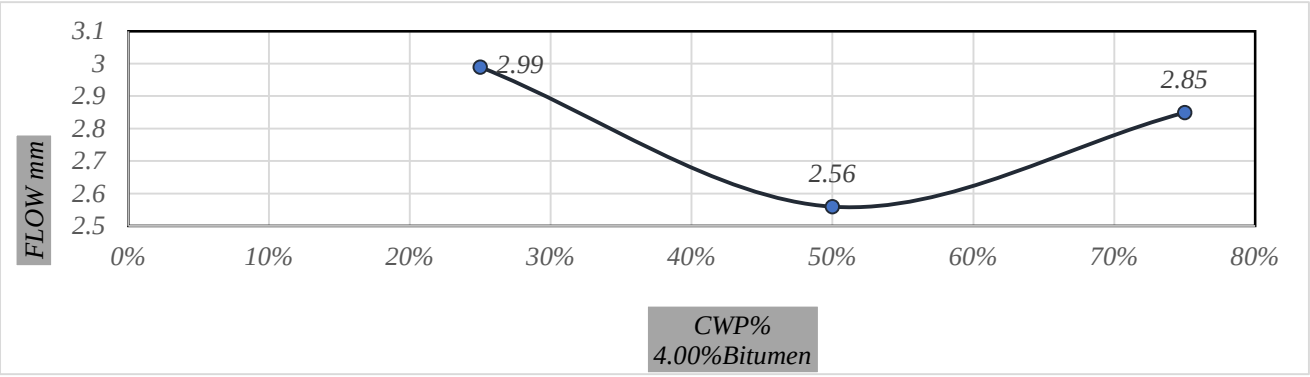


FIGURE 2. *The Value of Flow With Different percentage of CWP& 4.00%Bitumen Content*



6.3.4 The results of adding (CWP) as a filler instead of stone dust 4.00% of bitumen content:

a) We noticed that the stability value reached to (22.7KN) with 4.00% 0f bitumen and 25% replacement of CWP, the best value of flow which we got (2.99) mm for 25% of replacement.
b) The best stability which we got with 50% replacement of CWP with 4.00% 0f bitumen is (22.80) KN with better flow value of (2.56) mm.
c) The best result of stability with 75% replacement of CWP with 4.00% 0f bitumen is (23.97) KN and flow value of (3.27) mm.

THE STABILITY AND FLOW OF MARSHALL TEST FOR 4.50% OF BITUMEN CONTENT WITH DIFFERENT PERCENTAGE OF CWP:

TABLE 4. The Value Of Flow And Stability With CWP

Bitumen content (%)	CWP%	Stability values (KN)	Flow values (MM)	Marshall stability/flow
4.50	25	25.2	3.4	7.47
4.50	50	24.05	2.79	8.64
4.50	75	29.82	2.35	12.73

CHART 5. Stability And Flow Value With Different percentage of CWP & 4.50%Bitumen Content

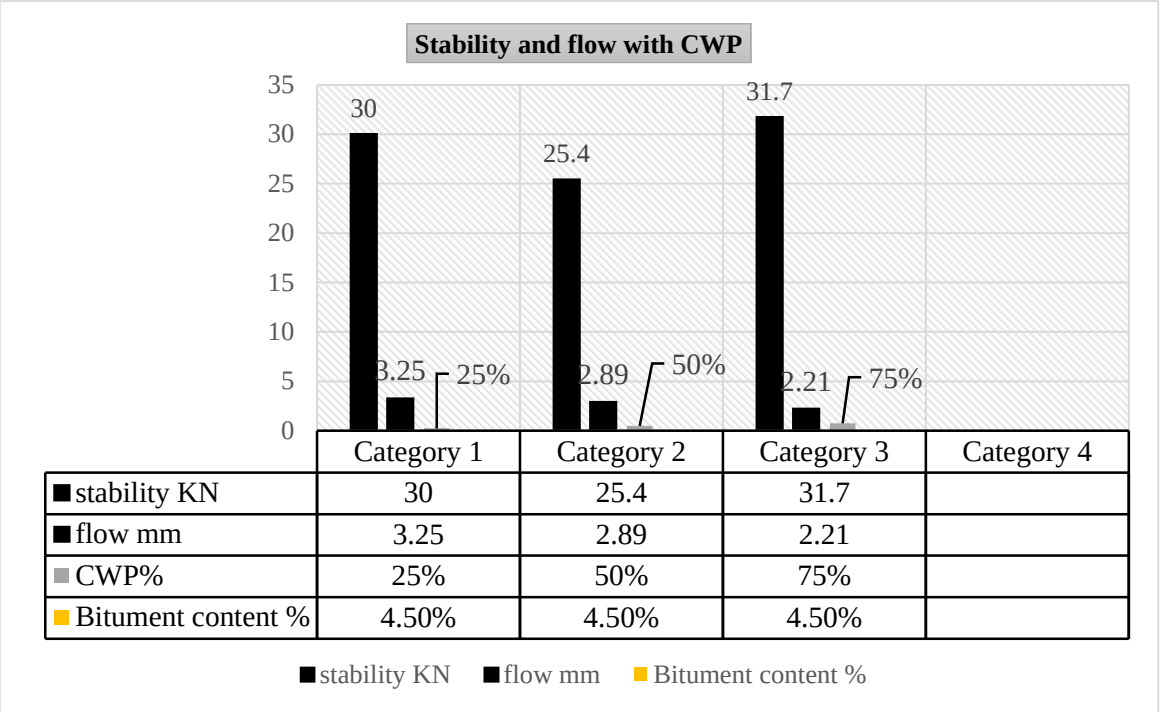
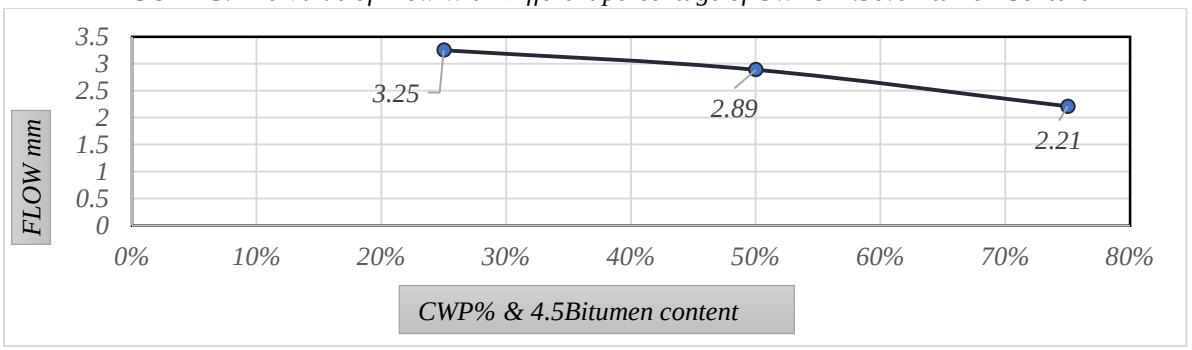


***FIGURE 3**. The Value of Flow With Different percentage of CWP& 4.50%Bitumen Content*



THE RESULTS OF ADDING (CWP) AS A FILLER INSTEAD OF STONE DUST 4.50% OF BITUMEN CONTENT:

a) We noticed that the stability value reached to (30KN) with 4.50% 0f bitumen and 25% replacement of CWP, the best value of flow which we got (3.2) mm for 25% of replacement.

b) The best stability which we got with 50% replacement of CWP with 4.50% 0f bitumen is (25.6KN) with better flow value of (2.89) mm.

c) The best result of stability with 75% replacement of CWP with 4.50% 0f bitumen is (31.7) KN and flow value of (2.21) mm.

THE STABILITY AND FLOW OF MARSHALL TEST FOR 5.00% 0F BITUMEN CONTENT WITH DIFFERENT PERCENTAGE OF CWP:

TABLE 5. The Value Of Flow And Stability With CWP

Bitumen content (%)	CWP%	Stability values (KN)	Flow values (MM)	Marshall stability/flow
5.00%	25	33.13	3.76	8.81
5.00%	50	33.14	3.01	11.01
5.00%	75	36.16	2.95	12.26

CHART6. Stability And Flow Value With Different percentage of CWP & 5.00%Bitumen Content

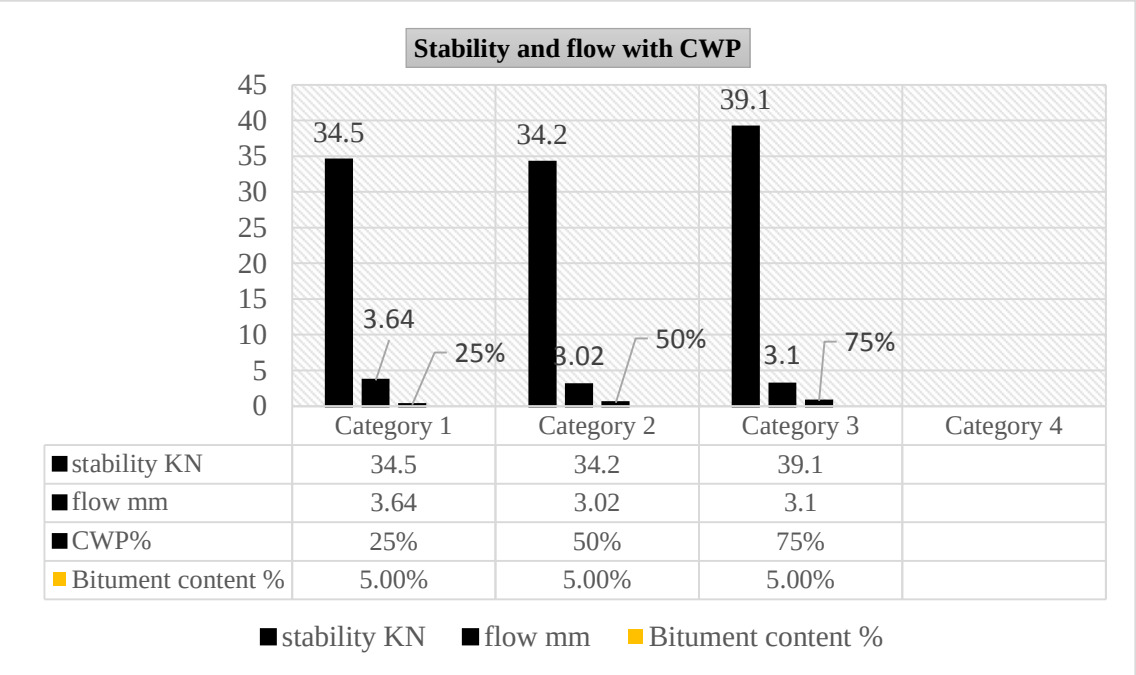
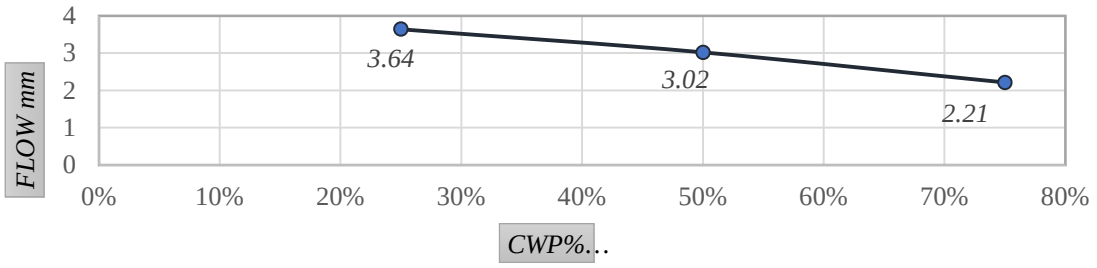


***FIGURE 4**. The Value of Flow With Different percentage of CWP& 5.00%Bitumen Content*



THE RESULTS OF ADDING (CWP) AS A FILLER INSTEAD OF STONE DUST 5.00% OF BITUMEN CONTENT:

a) We noticed that the stability value reached to (34.5KN) with 5.00% 0f bitumen and 25% replacement of CWP, the best value of flow which we got (3.64) mm for 25% of replacement.

b) The best stability which we got with 50% replacement of CWP with 5.00% 0f bitumen is (34.2KN) with better flow value of (3.02) mm.

c) The best result of stability with 75% replacement of CWP with 5.00% 0f bitumen is (39.1) KN and flow value of (3.1) mm.

The stability and flow of Marshall test for 5.5% 0f bitumen content:

TABLE 6. The Value Of Flow And Stability With CPW

Bitumen content (%)	CWP%	Stability values (KN)	Flow values (MM)	Marshall stability/flow
5.50	25	33.37	2.86	11.66
5.50	50	33.14	3.60	9.20
5.50	75	36.43	3.53	10.32

CHART 7. Stability And Flow Value With Different percentage of CWP & 5.50%Bitumen Content

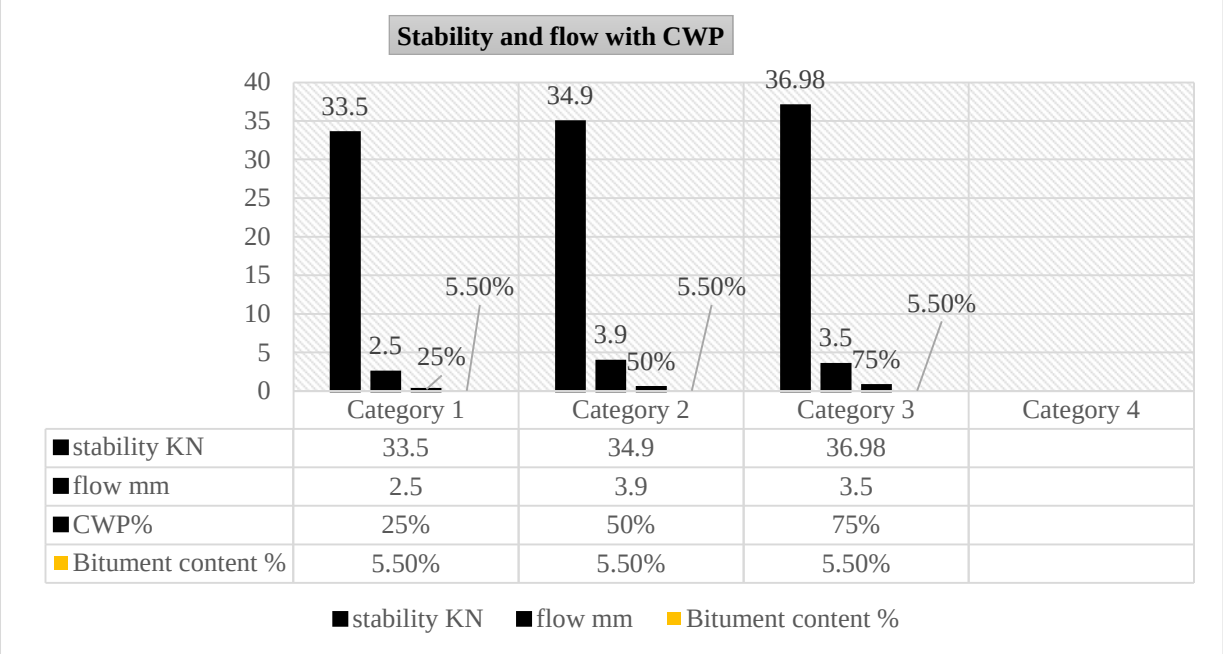
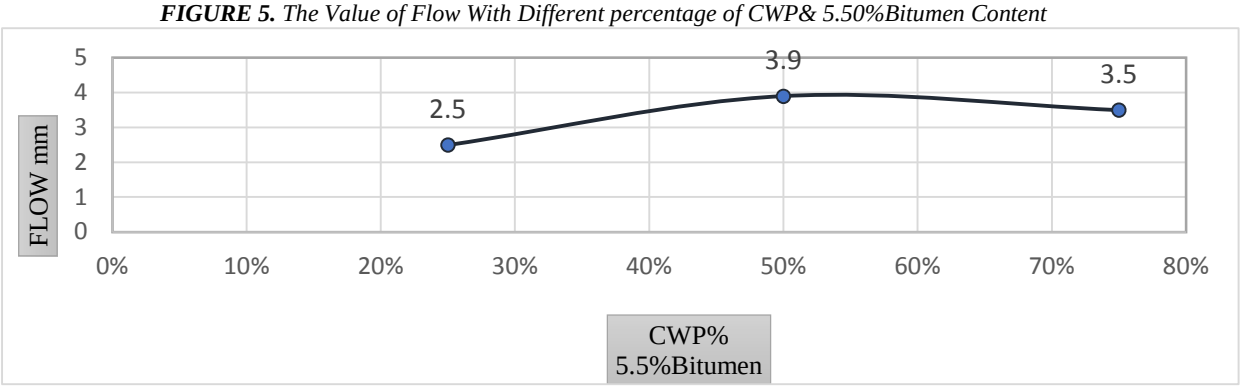


FIGURE 5. *The Value of Flow With Different percentage of CWP& 5.50%Bitumen Content*



THE RESULTS OF ADDING (CWP) AS A FILLER INSTEAD OF STONE DUST 5.50% OF BITUMEN CONTENT:

a) We noticed that the stability value reached to (34.3KN) with 5.50% 0f bitumen and 25% replacement of CWP, the best value of flow which we got (2.5) mm for 25% of replacement.
b) The best stability which we got with 50% replacement of CWP with 5.50% 0f bitumen is (34.9KN) with better flow value of (3.40) mm.
c) The best result of stability with 75% replacement of CWP with 5.50% 0f bitumen is (36.98) KN and the best flow value of (3.3) mm.

THE MARSHALL TEST FOR 6.00% 0F BITUMEN CONTENT WITH DIFFERENT PERCENTAGE OF CWP:

TABLE7. The Value Of Flow And Stability With CWP:

Bitumen content (%)	CWP%	Stability values (KN)	Flow values (MM)	Marshall stability/flow
6.00	25	34.27	3.06	11.19
6.00	50	35.59	4.06	8.77
6.00	75	36.70	4.20	8.73

CHART 8. Stability And Flow Value With Different percentage of CWP & 6.00%Bitumen Content

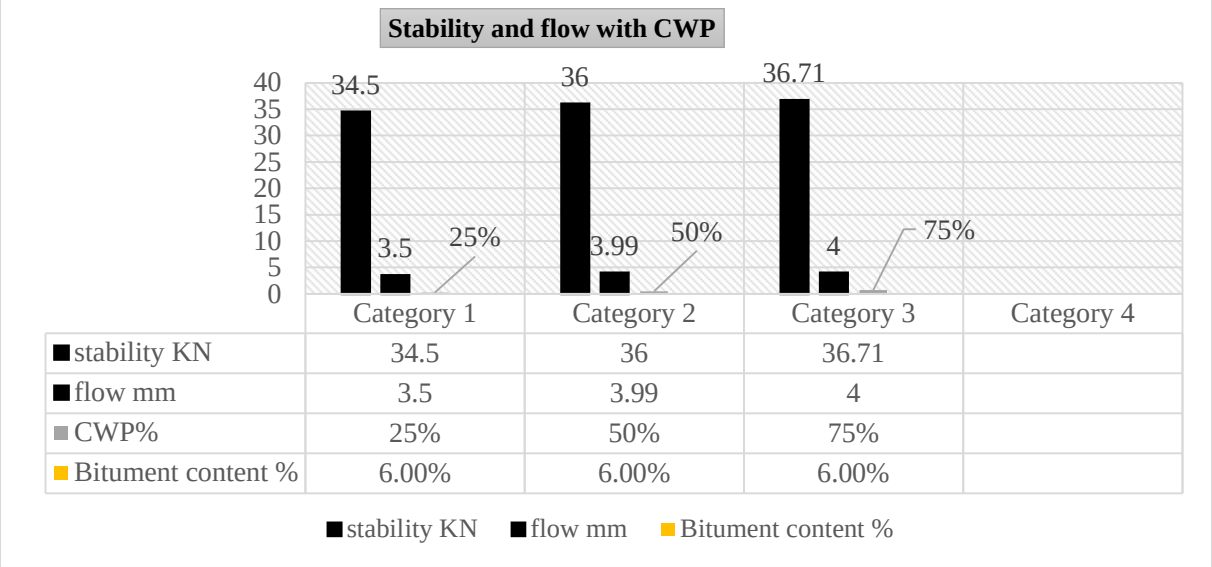
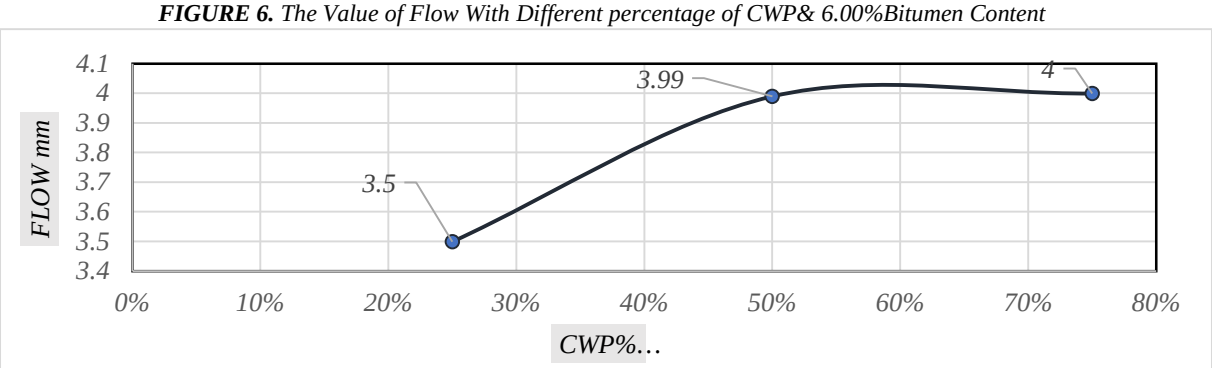


FIGURE 6. *The Value of Flow With Different percentage of CWP& 6.00%Bitumen Content*



THE RESULTS OF ADDING (CWP) AS A FILLER INSTEAD OF STONE DUST 6.00% OF BITUMEN CONTENT:

a) We noticed that the stability value reached to (34.5KN) with 6.00% 0f bitumen and 25% replacement of CWP, the best value of flow which we got (3.5) mm for 25% of replacement.
b) The best stability which we got with 50% replacement of CWP with 6.00% 0f bitumen is (36KN) with better flow value of (3.99) mm.
c) The best result of stability with 75% replacement of CWP with 6.00% 0f bitumen is (36.89) KN and the best flow value of (4.2) mm.

THE RESULTS OF ADDING (CWP) AS A FILLER INSTEAD OF STONE DUST:

d) We noticed from the tables of the stability and flow that the best percentage of CWP to add to the asphalt mixture was 75% of mineral aggregates, so we will try it with PCM and rubber together in the mixture to enhance the properties of the mixture.
e) We found the best percentage of rubber and pcm after testing are (2% of PCM) and (5% of rubber) from the bitumen content so we fixed these percentage for both materials and 75% of CWP and will start to increase the bitumen content according to Marshall stability bitumen content.

THE MARSHALL TEST FOR DIFFERENT PERCENTAGE OF BITUMEN WITH RUBBER &PCM &CPW CONTENT:

TABLE 8. The Value Of Flow And Stability With CWP And Rubber And PCM

Bitumen content%	CWP%	Rubber%	PCM%	Stability values (KN)	Flow values(mm)	Marshall stability/flow
3.50	75	5%	2%	16.36KN	2.89	5.66
4.00	75	5%	2%	23.30KN	3.21	4.40
4.50	75	5%	2%	27.45KN	3.87	3.73
5.00	75	5%	2%	30.69KN	3.25	4.42
5.50	75	5%	2%	30.69KN	2.6	5.3
6.00	75	5%	2%	36.7KN	4.2	8.73

CHART 9. Stability And Flow Value With 75%of CWP &5% Of Rubber &2%Of PCM Different Percentage Of Bitumen Content

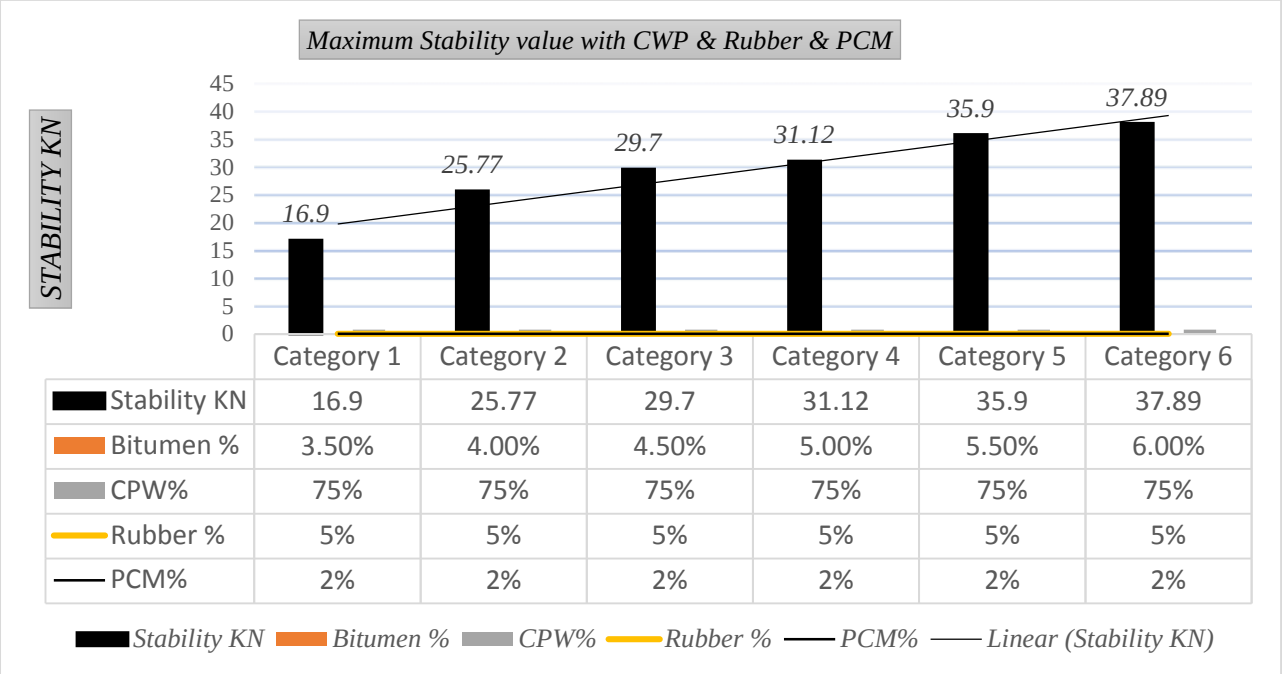


FIGURE 7. The Value of Flow With Different percentage of CWP& 5.50%Bitumen Content

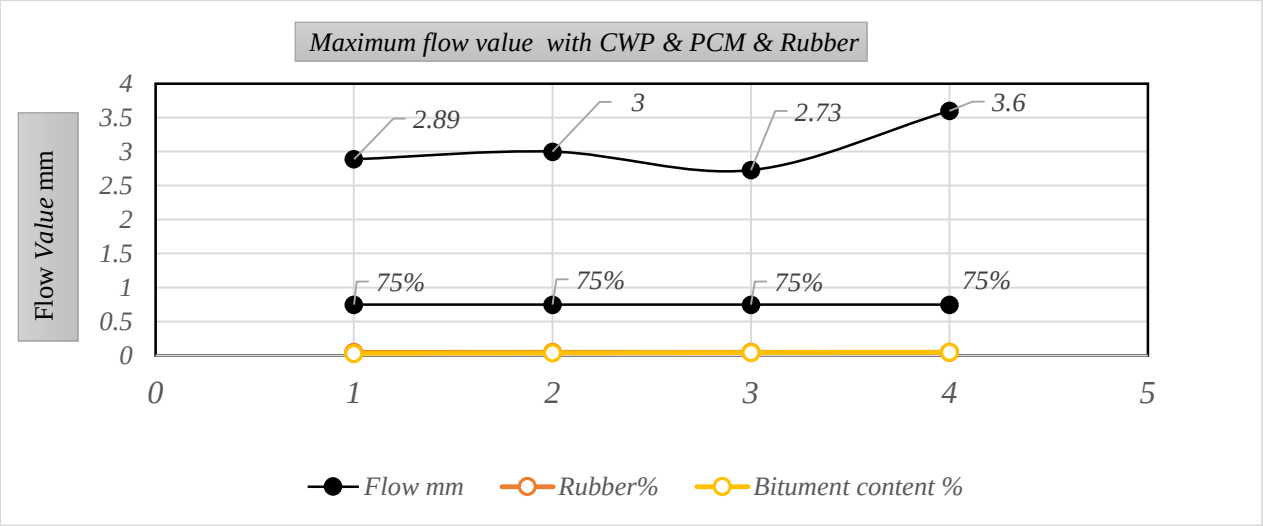
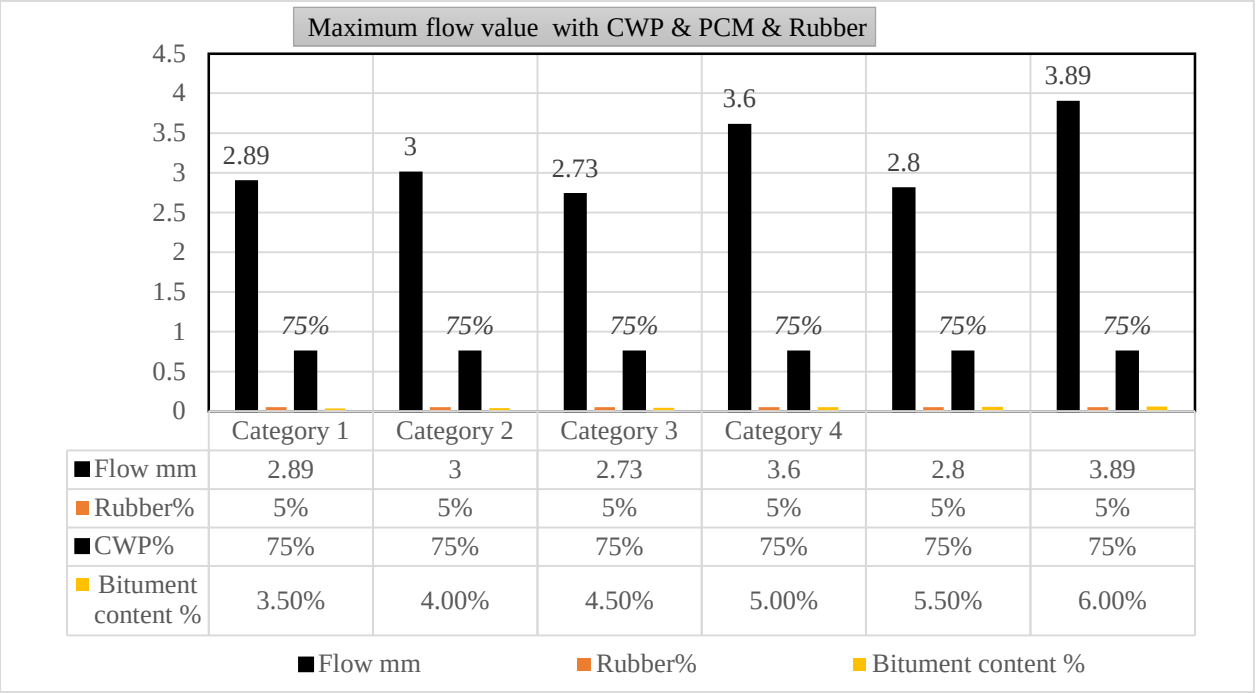


CHART 10. Maximum Flow Value With 75%of CWP &5% Of Rubber &2%Of PCM Different Percentage Of Bitumen Content



	Category 1	Category 2	Category 3	Category 4		
Flow mm	2.89	3	2.73	3.6	2.8	3.89
Rubber%	5%	5%	5%	5%	5%	5%
CWP%	75%	75%	75%	75%	75%	75%
Bitument content %	3.50%	4.00%	4.50%	5.00%	5.50%	6.00%

CONCLUSIONS

When we try to add the phase change material to enhance the properties of asphalt mixture, with rubber directly to the bitumen then we added the aggregates to the bitumen mixture it wasn't satisfy results, the moulds wasn't stable, That's why we replaced amount of dust stone with the waste ceramic powder (WCP) we started gradually from (25%) then (50%) then(75%) from the weight of dust stone , we noticed in the study from the tables and charts of pure moulds with (WCP)that when we replaced (75%) from dust stone we got the best results of stability with(36.7)KN and flow value (4.00)mm.

Our study is about the phase change material with rubber in asphalt mixture, so we added these both material to the asphalt with the (WCP) the stability (37.89) KN with flow value of (4.4) mm. so the stability enhanced with these additives to the asphalt binder, and we could recommend using in designing material for roads pavements

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Design of Smart Tap for Effective Use of Cold Water during winter.

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Abstract: This paper aims at reducing the wastage of water while using a solar water heater. A temperature sensor and solenoid valve system was used to reuse the cold water below a pre-set temperature. Such a device when installed in a 7-floor building with 4 flats in each floor can save about 150 liter of water every day.

Keywords: Digital temperature meter, Solenoid valve, Sensor, Analysis

INTRODUCTION

Many of the households use a solar water heater nowadays to heat up water. When one goes for a bath using a solar water heater, the initial stream of water is cold. The user dumps this cold water and starts using it only when the hot water starts streaming in through the tap. This results in the wastage of huge quantity of water, amounting to millions of liters every day. Water is a precious resource which is scarce. It is often perceived that if a third world war takes place in the future at all, it may beover water. Hence, conservation of water needs to be carried out very judiciously, and all necessary measures should be taken to this end.

Xiao zenghong et al. (2012) The field open washrooms utilize the sun-based vitality as the force it will be productive on both nature and the economy. This paper has utilized Polysun programming as the instrument for a reenactment of wide-open restrooms warming frameworks execution. Playing out a parametric report and to meet a given least sunlight-based portion with the most reduced expense. Finding ideal working conditions for the framework. Aldrin C.

A device should be installed to minimize the wastage of water from the conventional use of solar water heater, bolstering our efforts towards mitigating the environmental degradation. In this work, temperature-sensor and solenoid valve system have been used to control the flow of water and minimize wastage.

PROBLEM STATEMENT

This work aims at minimizing the wastage of water while using a solar water heater by controlling the water flow through a smart tap usingtemperature sensor and solenoid valve system.

MATERIALS AND METHOD

A digital temperature meter, sensor and solenoid valve system is installed at the outlet of the solar water heater. The temperature sensor measures the outlet water temperature. When it exceeds a pre-set temperature, the solenoid valve activates the hot water flow for use. At a lower temperature, however, solenoid valve ensures that the cold water comes out through a second valve, which can be reused. The schematic diagrams of digital temperature meter and the solenoid valve are shown in Figures 1 and 2, and the list of components with specifications are presented in Table 1.

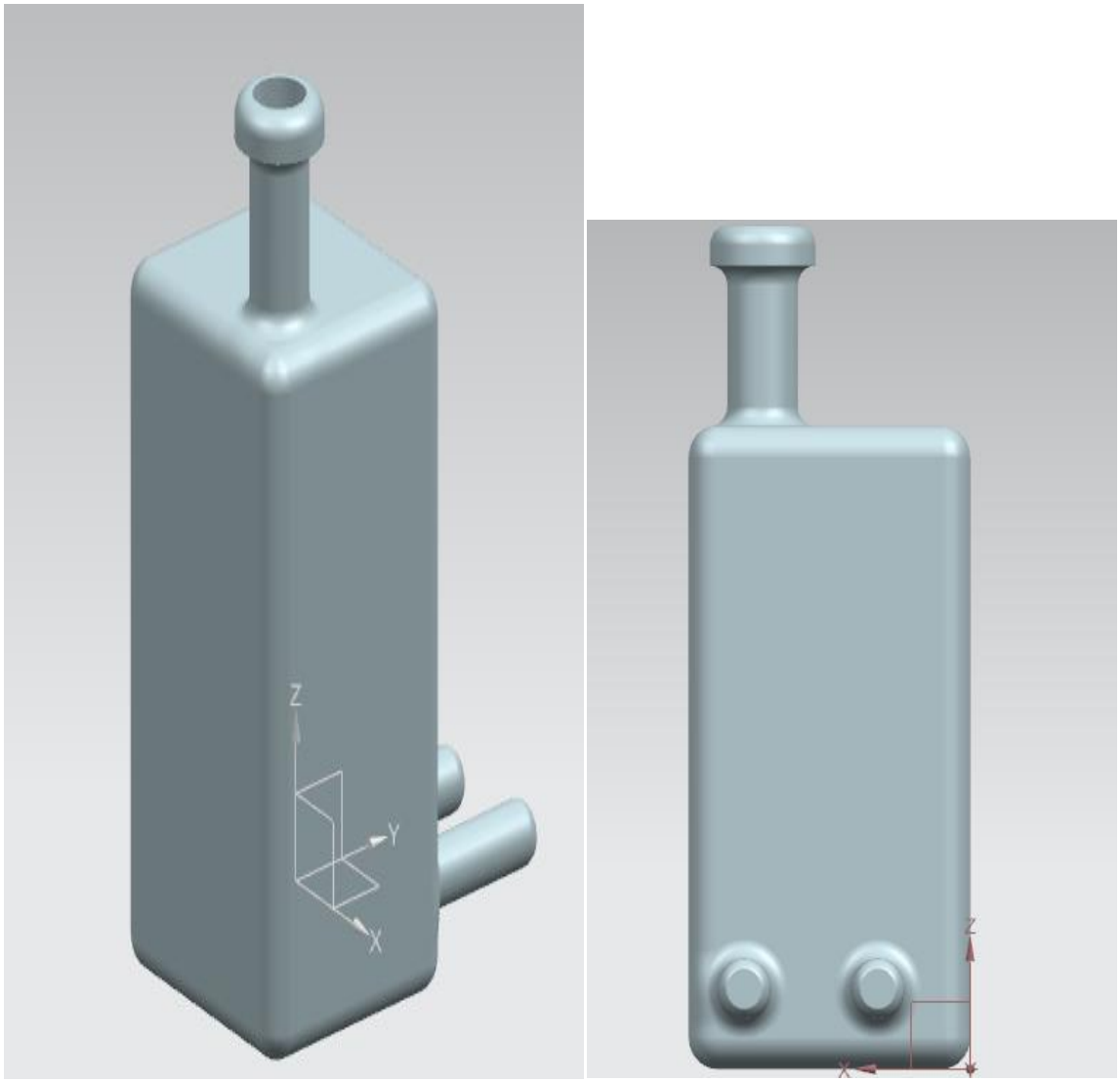

Table 1 List of Components with Specifications

Sl. No.	Description	Specifications
1	Digital Temperature Meter	Supply 230VAC. Includes.
2	Sensor	Temperature sensor
3	Solenoid Valve	Pressure range 2-10 bar
4	wire	Electric wire
5	Pipes	PVC

RESULTS AND DISCUSSION

In this project we prevent cold water from the solar and we prevent the cold water. There water is store and reuse. No pollution. Save water and electricity.

A four-member family home can save about 25-30 liter of water every day. The proposed device, if installed in a 7-floo building with 4 flats in each floor can save approximately 150 liter of water every day.

CONCLUSION

From this project concluded that there is a less wastage of cold water with the help of natural energy without using fossil fuels and any other gases.

ACKNOWLEDGEMENT

We would like to express our sincere gratitude RK University for giving us the opportunity of working on this problem. We are also thankful to the Head of the department, Prof. Chetan Patel, and the faculty members of Mechanical Engineering department for their valuable support and guidance during this work.

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3. https://en.wikipedia.org/wiki/Solenoid_valve

AUTOMATIC HTML CODE GENERATOR FROM MOCKUP IMAGES USING MACHINE LEARNING TECHNIQUES

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Abstract: Every website begins with the designing phase. Firstly, the design of the website should be drafted either with the help of designing tools or hand drawn. Once the design phase is completed code writing process begins which involves several breakdown steps of instructions. In our paper, code writing process is eliminated and only hand drawn image of the website prototype is uploaded as an input to the algorithm. This hand drawn image is processed through a series of repetitive steps which works on the principle of neural networks and identifies the components in the image. The components and text are detected using OCR technique. Once components are detected they are cropped and differentiated and find. the suitable match from the training data set using deep neural networks CNN technique. Once the components are detected and analyzed it will generate HTML code for the mockup image. This process is repeated several times until the desired result is obtained. During this process several images are produced as output during preprocessing stage. These images are obtained by processing single image through multiple phases using neural networks. Output of one phase is given as an input to the next phase during processing of an image. This multiple phase processing will produce accurate result.

Index terms - OCR, Deep Neural Networks, CNN, Mockup Image, Components.

INTRODUCTION

The importance of the websites has significantly increased due to the progress in present technology. Nowadays all the institutions, communities, people etc. are using websites to reflect their identity. Companies utilize these websites for marketing and advertising purposes. On the other hand, educational institutions, communities use websites to represent their services. At the front end of the web site web page is the main component which provides an interaction to the users. So, the design of the web page must be simple, interactive and efficient with wide range of flexible options. It is crucial to serve a page that is attractive to the end user and easy to use. However, developing webpage that responds efficiently to the users requires critical task in coding. In the process of developing code many different teams like specialists, software designers, graphic designers need to coordinate which is time consuming process. So, to avoid this complete process we proposed an idea in which user will make use of mockup images to generate HTML code. This way users can get the webpage instantly with minimal errors and desired design. By this process repetitive tasks by different teams and spending more time in debugging is reduced.

RELATED WORK

In the current advancing technological world, web pages role has become prominent. Many researchers provided different approaches to generate HTML code easily using different algorithms and principles. [1] In Factors Involved in Artificial Intelligence-based Automated HTML Code Generation Tool with the help of advanced technologies like artificial intelligence and machine learning developed continuous upgrade in the overall performance of converting mockup image to code by following 13 steps which includes from uploading mockup image to conversion of that to image format followed by OCR, object captioning, image processing, payloads etc. [2] In HTML code generation using CNN algorithm code is generated by a process which involves detection, dilation, erosion, classification and assembling of image. [3] In Automatic HTML Code Generation from Mock-up Images Using Machine Learning Techniques it involves object detection, cropping and object recognition to generate code from the mockup image. HTML builder in this model will develop html code as an output file. HTML builder will work based on the contour detection of the components. The proposed algorithm is shown in the below figure 2.1.

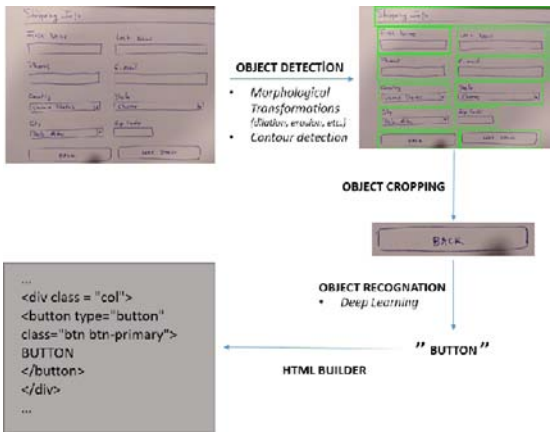

Figure 2.1 Proposed algorithm of one of the existing prototype

PROPOSED SYSTEM

In our proposed system, to provide better interactive interface user should create an account and login to the application with respective details. On successful login, user needs to go through series of steps to get html code for the mockup image. Firstly, user needs to ensure the Wamp server is online or not because it provides localhost user to host the application. Then user should upload mockup image and submit it. As a next step, which is image preprocessing user must upload the same mockup as in the previous step here. After submitting the image in second step it results in showing multiple images like gray scale, erosion, threshold image which are obtained by passing the mockup image to deep learning neural networks. After this phase user should upload the same image to again to obtain the html file. So, this complete process includes detection of components, cropping of components and recognition components. The model is trained by predefined dataset.

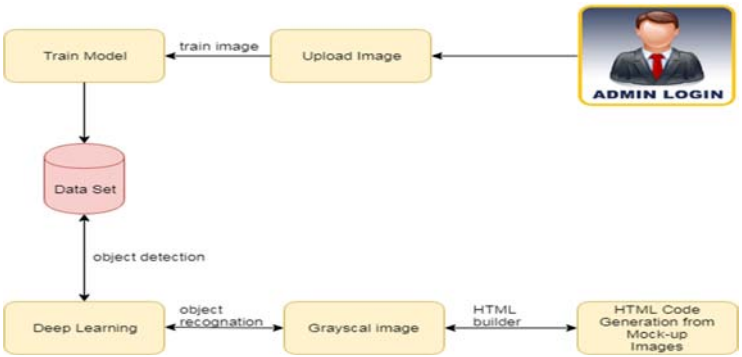

Figure 3.1: Architecture diagram of proposed system

ADVANTAGES OF PROPOSED SYSTEM

i. It requires less human support.
ii. Minimal coding.
iii. It produces efficient outcomes.
iv. Code for static webpages is obtained quickly.
v. Less time consuming.
vi. Easy to use.

WORKING OF PROPOSED SYSTEM

Algorithm

For the Algorithmic approach towards the proposed system, multiple principles and techniques are followed.

1. OCR (Optical Character Recognition) - It is used for recognizing the characters in the mockup image.
2. REMAUI (Reverse Engineering Mobile Application User Interface) - This process is considered as REMAUI because it produces code from image which is vice versa to the actual process.
3. Deep Neural Networks - Neural networks are used to process image through different layers so as to identify the components.

Steps to obtain html code from mockup image:

1. Login via new user registration
2. Upload Mockup image
3. Upload image for Mockup preprocessing phase
4. Upload image for processing phase
5. HTML file as an output

Login via new user registration

In this step, new user needs to register into the database to login to the application. Upon creation of new account user will be able to login. This includes details like username, emailed, password. Below shown figures are details of registration page and login page respectively.

Figure 5.1: Registration Page

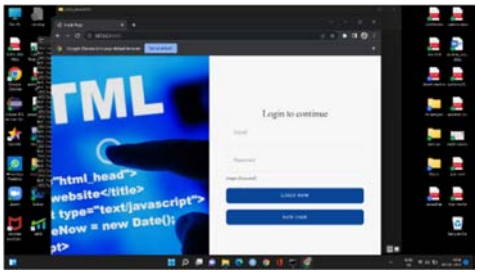

Figure 5.2: Login Page

Upload Mockup Image

In this step user should upload the mockup image which is of type .PNG. Once the image is uploaded submit it to the application. After submission it user OCR technique to recognize the text components and characters.

Figure 5.3: Upload Mockup Image

Upload image for Mockup Preprocessing Phase

In this phase user should upload the same mockup image as previous. After uploading the image, it produces multiple images like gray scale image, threshold image, erosion image etc. All these images are produced through several layers of processing. Each layer will produce one image as output. The output of first layer is sent as an input to the next phase until the last layer. Use of this phase it recognizes all the components and crop the patterns for each component.

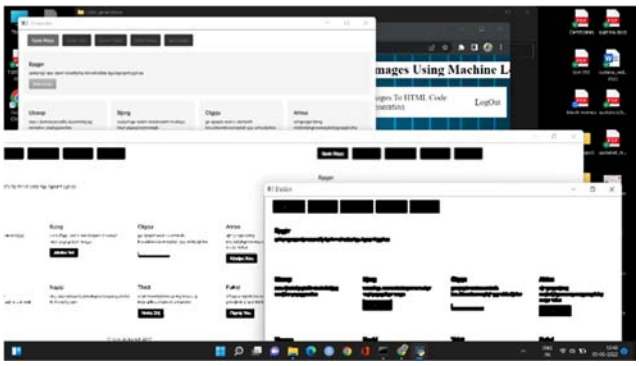

Figure 5.4 Output images of neural network layers

Upload Image of processing phase

In this step, user should upload the same mockup image again. This phase output will be the html file URL which need to be executed in any editor to crosscheck the code. We can use any of the web browser to run the file.

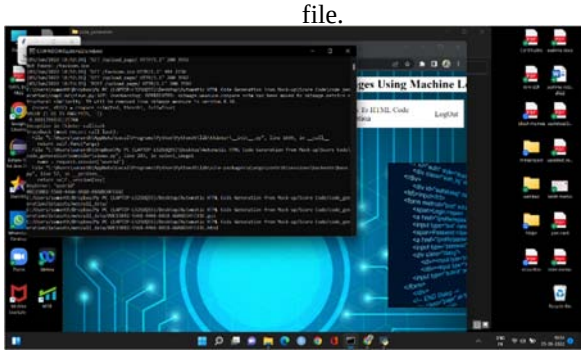

Figure 5.5 HTML file URL HTML file as an output

The code URL which is generated in the previous image is made to run in any of the web browser. It produces code for the uploaded mockup image. It can be verified by running the script file in any of the editor.

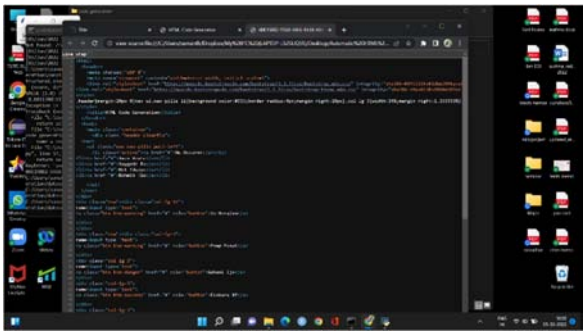

Figure 5.6 HTML Script file

RESULT

Below are few captured images of the model.

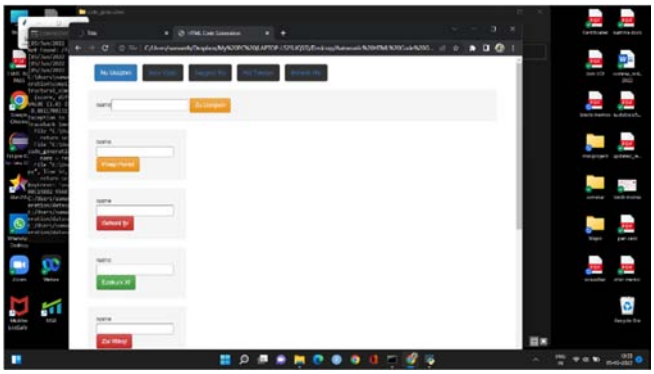

Figure 5.7: Output of the HTML file verified in a web browser

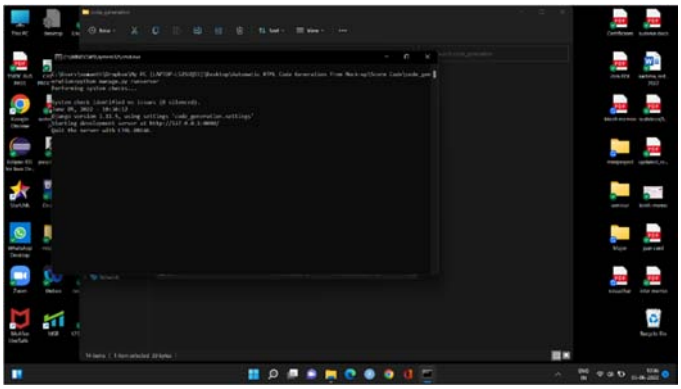

Figure 5.8 Virtual Environment

Performance evaluation

Table 6.1.1: Performance Criteria of various algorithms.

Performance Criteria	OCR	Neural Networks	OCR + Neural Networks
Detection	90%	94%	96%
Cropping	96%	92%	96%
Dilation	99%	97.4%	98%

CONCLUSION

This model will generate HTML code using different techniques like OCR, Neural Networks, Image processing which assists users to generate HTML code instantly without much effort. It produces less coding errors which ensures developers to concentrate on logical process of the website rather than templates. A basic static design can be obtained from which further modifications can be made to obtain user specified web page.

FUTURE SCOPE

This model does not support for animations, videos and series of images. Moreover, to obtain a HTML code for the mockup image there should be an associated GUI file for every image. So, system can be enhanced in such a way that it supports animations to produce dynamic web pages without GUI file in the system. The approach of enhancing system requires is more dataset with different models and examples. By providing huge amount of dataset system can be improved to make dynamic pages with different hover components, media queries and alternatives.

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The Effect of Nano Materials on Self-Compacting Concrete – A Review

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Abstract. One of the potential ideas that has lately attracted attention is the use of nanoparticles in concrete. Various programmes have evolved over time to enhance the durability of concrete. Although most uses of nanomaterials to improve concrete qualities are restricted to laboratory experiments, additional commercial applications are envisaged in the future years. Many types of nanoparticles that are already employed in concrete and their impact on durability were investigated in this study. Nano-silica was discovered to be the most widely employed nanomaterial in concrete. Furthermore, nanoparticles in all existing forms greatly increase concrete durability when compared to other approaches employed prior to the introduction of nanomaterials in concrete. Other nanomaterials, such as nano titanium oxide and nano aluminum oxide, are becoming more popular. However, the use of nanoparticles in concrete has various drawbacks, including high cost, production method, and toxicity. Further study and application of nanoparticles to improve concrete qualities is predicted to result in the creation of low-cost and simple-to-use nanomaterials. Furthermore, the usage of nanoparticles has the potential to increase present durability attributes.

Keywords: Carbon Nanotube, Nano silica, Nano titanium oxide, Nano Alumina, Durability, Self-Compacted Concrete

INTRODUCTION

Concrete is the basic material on which our physical infrastructure is built. Concrete is used as a construction material in a variety of applications, including the construction of roads, buildings, bridges and dams. The high resistance of concrete to many adverse environmental influences, as well as its enormous strength, make it the preferred and most widely used building material in the world. However, since concrete is a somewhat porous material, it is still subject to many harmful environmental issues. Therefore, it is of great importance to ensure that the concrete is durable and strong to ensure a longer service life of concrete structures. The quality of concrete that shows the ability to withstand these environmental degradation factors is called "durability" and is highly dependent on the components used to make the concrete. Despite the development of various types of high-strength concrete, durability remains a central issue for all types of concrete. Over time, various methods have emerged to improve the durability of concrete in different environments. Most methods to improve the durability of concrete involve the use of chemical and/or mineral admixtures. For example, an air drying agent is a chemical

additive used in concrete to improve its resistance to freezing and thawing. In addition, mineral admixtures such as slag and fly ash can improve the durability of concrete through the action of pozzolanics and filler, thereby intensifying the microstructure of concrete.

Additionally, the use of nanomaterials can be employed to minimize the amount of OPC required, as this in combination with a lower amount of OPC can result in comparable strength. Nanomaterials are materials with sizes in the nanometer to submicron range. Nanoparticles (0D), nanotubes (1D and 2D) and nanosilica [4] are some of the most common forms of nanomaterials used in concrete.

In latest years, maximum efforts to boom concrete sturdiness have targeted at the macrostructure and microstructure of concrete. Understanding and improving the characteristics of concrete are actually the order of the day, as substances technology and generation evolve. To the fine of the author's knowledge, the bulk of critiques at the software of nanomaterials in concrete are targeted on electricity enhancement. As a result, this evaluation focuses most effective at the influences of nanomaterials at the sturdiness of concrete. It is predicted that this newsletter could spur greater studies into using nanomaterials in concrete. And will act as a reference factor for different scientists running on specific approaches to enhance the sturdiness of concrete.

LITERATURE REVIEW

The Impact of Nanomaterials on Concrete Durability

The benefits of nanoparticles on concrete durability are further investigated depending on the most prevalent types of nanomaterials employed.

1.1.1 Nano silica.

This is the foremost common sort of nanomaterial utilized in concrete. this can be as a result of its without delay available, incorporates a characteristic pozzolanic reaction, and has a wide surface area, all of that accelerate the first age of concrete once mixed into a building material mix. They are available in sol or dry gain kinds [4]. Nonetheless, the colloidal suspension form is most popular for usage in concrete since it's going to be enclosed while not extra processing. Camillo et al.[5] shown that colloidal suspension types outperformed dry grain types in terms of characteristics. Owing to its pozzolanic reaction and acceleration of the association reaction, nano silicon dioxide is employed to extend the sturdiness of concrete [6]. The pozzolanic reaction promotes the synthesis of calcium silicate hydrate, and the acceleration of the hydration reaction promotes the formation of additional hydration products, resulting in densification of the microstructure [4]. Due to its size, nanosilica can also act as a pore filler in addition to these abilities. It has been shown that the addition of nanosilica to concrete significantly reduces water absorption compared to the control without nanosilica [7, 8]. The results of mercury-intrusion porosimetry (MIP) show reduced values for concrete with nanosilica up to a dose of 6% [4]. According to Du et al. [9] the addition of nanosilica makes the microstructure more homogeneous and less permeable. This finding was shared by Ji [10] who concluded that the addition of nanosilica to concrete caused interfacial transition zone (ITZ) compression. These benefits have been attributed to the reactive and filling effect of the nano pozzolanic silica. Ji [10] showed that using 3.8% nanosilica in concrete could reduce the water penetration depth by about 45%. Piper et al.[11] also showed that the use of 6% nanosilica significantly reduced the rate of calcium leaching from the cement paste. Concrete with 1% nanosilica was found to have higher chloride resistance compared to the control [12]. In addition, Quercia et al. [13] reported an overall improvement in self-compacting concrete with the incorporation of nanosilica into the mixture, despite the negative effects of nanosilica on fresh properties of concrete. Concrete containing timber significantly reduced chloride permeability and water absorption [14].

1.1.2 Nano-titania.

Zhang and Li [15] showed that the pore structure of concrete can be refined with nano titanium dioxide. Adding nano-titanium dioxide to concrete reduced the permeability and improved the durability of the concrete. Furthermore, nano-titanium dioxide has been shown to accelerate the reactivity of tricalcium silicate, one of the main phases of clinker [16]. As the reaction rate increases, more reaction products are formed, further compacting the concrete microstructure. This is consistent with the results of Zhang and Li [15], who found that incorporating

nano-titanium oxide into concrete resulted in a finer pore structure than incorporating nano-silica at the same dosage. Mohseni et al. [17] also showed that when nano-TiO2 was combined with rice husk ash to improve the durability of concrete, the water absorption rate was significantly reduced.

1.1.3 Nano alumina.

These nanoparticles are derived from alumina and have received less attention in concrete than other types of nanomaterials. Nano-alumina improves the durability of concrete by acting as a nano-filler and densifying the nanostructure of concrete [18]. This compaction makes the concrete less permeable and reduces the penetration of harmful ions into the concrete. Farzadonia et al. [19] found that incorporating nano-alumina into concrete improved durability and reduced gas permeability. Their study found that the addition of 1 wt.% nano-alumina to the binder can significantly reduce the permeability of concrete.

1.1.4 Carbon nanotubes.

Carbon nanotubes (CNTs) are characterized by tubular hollow channels made of graphene layers [20]. Their attractive properties have led to extensive research and use in various industries, including the concrete industry [21]. Their properties include size range (from 1nm to 10nm) and increased strength. “CNT is one of the toughest and most robust materials found in nature,” Dai wrote[21]. CNTs have been reported to fill the gaps at the nano-hi level and improve the durability of cementitious composites such as concrete [22, 23].

1.1.5 Graphene nano platelet.

The 2-D form of graphene nanoplatelet (GNP) lets in it to minimise the permeability of cement composites including concrete [9, 24]. When as compared to the control, GNP at a dose of 1.5% decreased permeability through as much as 37% in concrete [9]. This kind of nanomaterial's decreased permeability prevents the go with the drift of water, chloride, and different dangerous ions into the concrete. When GNP is hired at a dose of 2.5% through mass of the binder, the intensity of water penetration in concrete may be decreased through as much as 64% [25]. Peyvandi et al [26] determined that a smaller dosage of GNP would possibly lessen concrete permeability even as boosting acid resistance.

1.1.6 Polycarboxylates.

These nanomaterials have been used to alter the hydration of the main binder of concrete and improve its workability [28]. Additionally, the use of Polycarboxylates as water reducers at low water-to-cement ratios resulted in durable self-consolidating concrete (SCC) with fewer voids. It has also been found that Polycarboxylates change the microstructure of concrete, resulting in a less permeable concrete [29]. Concrete constructed with Polycarboxylates is more durable than concrete made with silica fume [30].

1.1.7 Nano kaolin and nano metakaolin.

These nanomaterials, as the name suggests, are made by processing kaolin. However, just as kaolin can be calcined to increase its reactivity, nano kaolin can be calcined to produce nano metakaolin, which has higher reactivity. Although the use of nano-metakaolin to enhance the durability of concrete is limited, its application in concrete is expected to result in greater improvement than known metakaolin.

1.1.8 Nano iron oxide.

Another form of metallic nanomaterial that can be used to increase the durability of concrete. As with other forms of nanomaterials, its ability to polish and densify the microstructure of the cementitious matrix enhances its durability. According to Figure 1, the concrete with iron nano oxide had lower chloride penetration and water absorption than the control. According to the available literature, this form of nanomaterial has been less studied and future research on this material could provide additional information on how it can be used to improve the durability of concrete.

1.1.9 Nano zirconia.

The incorporation of nano zirconia into concrete as shown in Figure 1 has been shown to increase the durability of self-consolidating concrete in terms of chloride penetration and water absorption. In fact, this form of nanomaterial has a higher resistance compared to nanomaterials such as nano titanium oxide and iron nano oxide.

1.1.10 Nano copper oxide.

Copper anoxide is made from copper oxide, which is a by-product of the metallurgical industry. Few researches have examined the use of this nanomaterial to improve the properties of concrete. When copper nano oxide is applied in concrete at a dosage of 3%, the water permeability is reduced [31]. This decrease in water permeability was attributed to early hydration and an increase in the amount of hydration products generated. Mehrinejad et al. [32] also found that the use of copper nano oxide alone or together with fly ash significantly reduced the chloride permeability of concrete. Madamdoust et al. [33] also observed a 44% increase in chloride permeability.

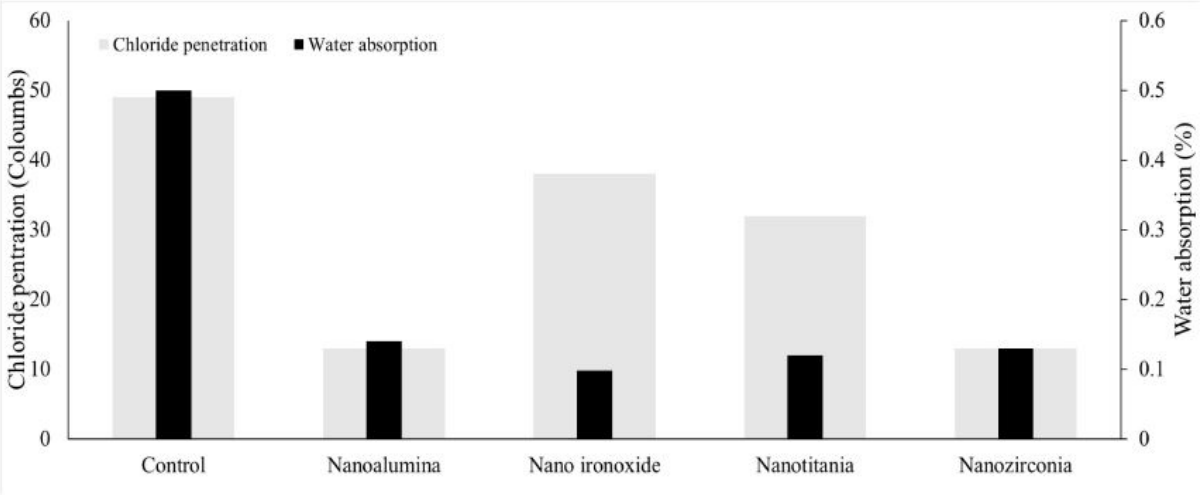

Figure 1: **CHLORIDE PENETRATION AND WATER ABSORPTION OF CONCRETE INCORPORATING DIFFERENT TYPES OF NANO PARTICLES (REDRAWN FROM [27])**

MAIN CHALLENGES

Although nanoparticles have some promising advantages, their use in concrete is currently hampered by significant limitations. Some of these limitations are briefly explained below.

1) Air Pollution:

Due to their small size, these compounds pose an environmental hazard as they are easily airborne and inhaled by living beings. Yu et al. [34] identified symptoms associated with exposure to nanomaterials such as nano titanium oxide. Therefore, extreme caution is required when handling these materials.

2) Expensive instrumentation:

The production of nanomaterials requires a variety of expensive and scarce equipment and methods, making nanomaterials expensive. Hammel and colleagues (2004) This is due to the limited use of current nanomaterials. Using nanoparticles to improve the quality of concrete comes at a cost, so scientists turned to alternative materials with fewer benefits. However, as nanoparticle applications develop in many fields, it is hoped that inexpensive methods will be found to produce these nanomaterials on a large scale.

3) Limited knowledge:

Some of these nanomaterials, such as CNTs and nano-alumina, have received little attention from the concrete industry in terms of improving concrete quality.

4) Impact on fresh properties:

Incorporation of nanoparticles into cement/concrete has been shown to reduce concrete curing time and workability [35, 36]. This problem has limited the use of nanoparticles in specialty concretes such as self-compacting concrete [37].

5) Cluster formation of nanoparticles:

The use of some types of nanoparticles in bulk binders can result in agglomeration or agglomeration, rendering them ineffective. For example, Du et al. [9] he suggested his 1.5% dose of CLT to increase concrete durability. His GNP after the suggested substitution level is shown to be ineffective due to clustering.

6) Standard:

There is no standard that can be met when using these nanoparticles compared to other elements put into concrete to improve durability. The majority of modern concrete construction is done in the laboratory and dosages are chosen based on literature and personal preference.

CONCLUSION

The use of nanoparticles in concrete is an upcoming trend that is set to expand rapidly due to their ability to enhance both strength and durability. As the production of OPC is one of the main contributors to greenhouse gases in the environment, the use of nanomaterials in concrete will provide a long-term benefit by reducing the amount of ordinary Portland cement (OPC) used in concrete. This review has shown that different types of nanomaterials can be used in concrete to increase durability while increasing strength. Further research and development into the use of nanoparticles in concrete will lead to wider applications and the introduction of standards to guide their users.

ACKNOWLEDGEMENT

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Design & Fabrication of Archimedes Screw Turbine

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Abstract: This project is about designing and fabricating the Archimedes screw turbine to helps people easy to generate the electricity. This project involves the process of designing the turbine using the blade of pvc for people to use. After the design has complete, it was transformed to its real product where the design is used for guideline. These projects also require ensuring the safety for indeed of publishing. Methods and process involve in this project for instance joining using bending, welding, drilling, and cutting process. This project is mainly about generating a new concept of screw turbine that would make easier to bring anywhere and easier to establish. This turbine is promising because the advantages of ultra-low head and fish friendly. A performance analysis based on experimental data from various performance tests on a screw turbine prototype's inclination angle position is presented in this paper.

Keywords: Archimedes Screw; Generator; Kinetic energy; Electrical energy; Renewable energy; Hydro; Fish friendly; Ecofriendly; Flow rate; RPM

INTRODUCTION

Archimedes screw turbine is a hydraulic machine that convert the kinetic energy of water into mecanical work. When water enters the top side of the shaft the flow of the water pushes the screw blades to rotate and allowing the water to fall to the lower side. The rotation of the screw can be converted into electricity by connecting a gearbox or pulleys\belt and generator to the main shaft of the screw turbine. The first Archimedes screw turbine was installed in Canada in 2013 near Waterford, Ontario.

Currently there are different types of turbines for electricity generation, including Kaplan, Francis, Pelton type turbines, etc. Comparing the relative costs of an Archimedes screw turbine and a Kaplan turbine, a common turbine for a low head hydropower site, it was found that for an energy production of about 15% more, for an Archimedes screw turbine the cost is about 10% lower, and the annual cost capital is 22% cheaper [1].

The first AST was tested at the Technical University in Prague from 1995 to 1997 directed by Karel Brada. In 1997, the AST was already installed at the river Eger in Aufhausen (Germany), where it has been running ever since with a generating capacity of around 4 kW. The AST first started commercial operation in 2000 at the river Fränkische Saale in Hammelburg (Germany). The number of Archimedes Screw Turbine has grown to more than 400 installations worldwide, based on our own research and consultation with the manufacturers. Consequently there are comparatively few operator reports available and a limited number of published scientific research papers. Although a recent publication by Dirk Nuernbergk [2].

Micro hydropower, one of the renewable energy sources, has attracted the most interest due to its environmentally favourable operation. Since water energy is a clean, affordable, and environmentally friendly method of power generation, it is crucial for a sustainable future [3].

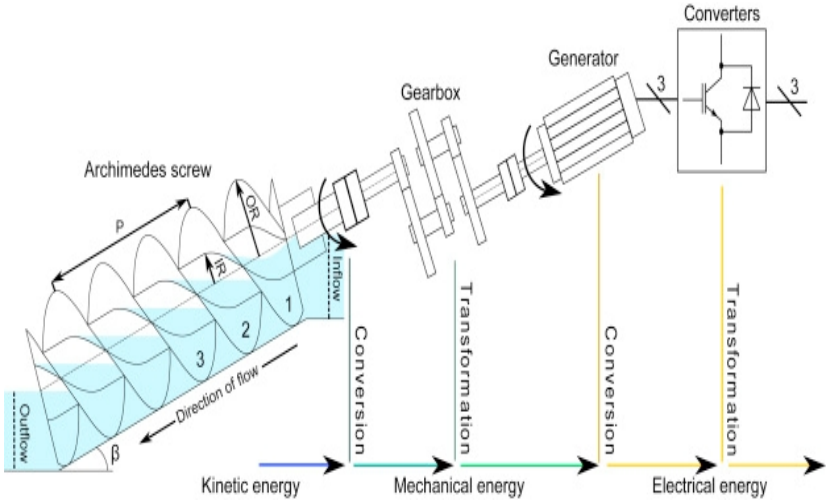


Fig:1 Basic Principle of Archimedes Screw Turbine [4]

LITERATURE REVIEW

One of the most environmentally friendly turbines, the Archimedes Screw Turbine allows fish and eels to flow through while still operating without harm. As opposed to other types of turbine, it is significantly less expensive because it does not require a guiding vane or penstock, trash racks, screens, or fish diversion devices. This turbine, which also goes by the name "extremely low maintenance turbine," needs to be recapped every 20 years, and its minimum useful life is 30 years. The main maintenance issue is the complicated gearbox required. The Archimedes screw turbine operates at low rotational speeds, which means a complex gearbox is required for connection to a generator [5].

There are numerous sources of micro or pico hydro power from low head rivers or irrigation that are available all over the world but have not yet been fully utilised. In underdeveloped nations like Indonesia, only 1.8% of the 400 MW of micro hydro power that may be produced is actually used to generate electricity.[6]

Archimedes Screw Turbine normally operate at heads between 1 m and 10 m and at discharges between 0.1 m3 /s and 15 m3 /s. The delivered power is usually below 1 MW. The operating speed is low for large runner diameters, but it increases as the diameter decreases [7].

Lashofer lists over 180 plants in Europe and 400 in the world that use Archimedes screw turbines. He conducted a further study of 14 plants located in Austria with an average overall efficiency of 69%. However, the efficiency of 6 out of these 14 plants is more than 75%. The biggest plant on which the study was conducted has an electric power of 140 kW [8]

Archimedes screw plants usually run at a ’constant’ rotational speed. They mainly use induction generators running in hypersynchronization: a gearbox increases the speed of the Archimedes screw by a factor of 20e30, which allows a high-speed commercial generator, thus reduced in size. The gearbox introduces maintenance problems, mechanical oscillations and has a variable mechanical efficiency as a function of the transmitted power. Typically, around 97%. It is possible to remove the gearbox in order to have a direct drive coupling, but

it requires the electric generator to rotate at the same speed as the turbine. Since the speed is very low, the generator must be much larger than it was designed to work, for example, at 1500 RPM.
Archimedes screws do have the ability to vary the flow rate through themselves which is most efficiently achieved by varying its rotational speed. Moreover, this variation of the rotational speed allows it to operate at maximum efficiency depending on the water flow variations and/or to undersize the geometrical parameters of the Archimedes screw, thus reducing manufacturing costs. The use of variable speed drives for wind systems is common [9].

ADVANTAGES OF ARCHIMEDES SCREW TURBINE

There are a several advantages of Archimedes Screw Turbine;

- Generating energy that produces no greenhouse gas emissions and reduces some types of air pollution.
- Diversify energy supply and reducing dependence on imported fuels.
- Suitable power consumption for small village or one or more than one family.
- Small canals, ponds and river can utilised as a resources.
- very small dimensions of the hydro power plant, resulting in low construction costs.
- Almost neglected maintenance cost & operational cost.
- fish friendly, can safely pass fish downstream.
- Efficient for low & variable water head.
- Changes in flow or water level in the river do not affect the efficiency of the hydraulic system.
- Creating economical development and job in manufacturing, installation and more.
- The installation costs of a hydraulic system with Archimedes screw turbines are much lower compared to those for Kaplan turbines. Following research by British researchers, it was found that a hydraulic turbine system with Archimedes' screw produces 15% more energy than a Kaplan system and the investment costs 10% less [10].

METHODOLOGY

A hydraulic device, Archimedes screw turbine converts the kinetic energy of water into useful mechanical work. The water flow causes the screw blades to rotate when it enters the top side of the shaft, allowing the water to fall to the lower side. By connecting a generator, belt\pulley or gearbox to the main shaft of the screw turbine, the rotation of the screw can be converted into electricityThe screw turbine used in this experiment is made out of a cylindrical shaft that has one helical blade (N = 1) wrapped around it six times in an orthogonal direction. It is enclosed with a cylindrical shell and secured with pvc special glue. PVC was used to make the shaft, housing, and blade of the screw turbine. Shaft, screw, and housing dimensions were chosen based on the tools and materials that were readily available. The pedestal bearings on either side of the turbine housing support the turbine shaft directly. The table below shows the dimensions of the screw turbine;

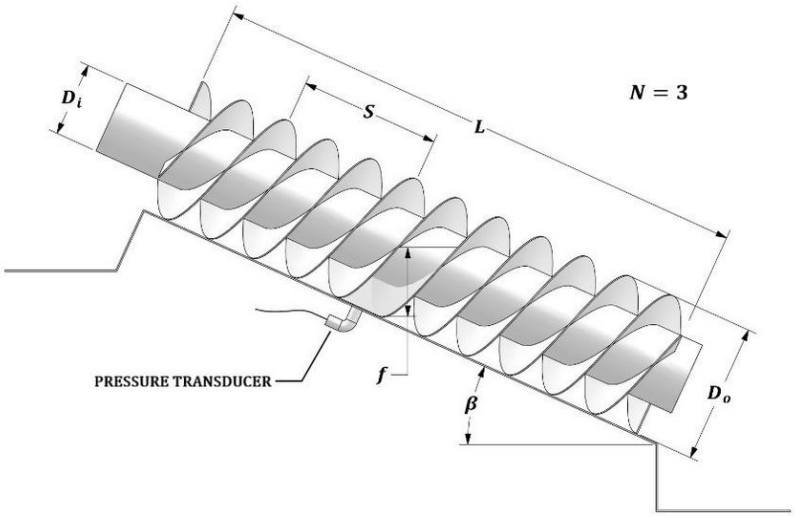


Fig:2 [11]

Table: 1 Turbine Specification

Parameter	Variable	Value
Slope	β	20^0 - 40^0
No. of screw	N	1
Inner diameter	D_i	76mm
Outer diameter	D_o	230 mm
Pitch	P	70 mm
Flow rate	Q	1 l/s
Casing diameter	D_t	254 mm
Screw length	L	900 mm
Gap width	G_w	10 mm

The parameters of the Archimedes' turbine screw for which the numerical simulation was performed were: screw length L = 900 mm, outer diameter (De) = 230 mm, inner diameter (Di) = 76 mm, number of blades (N) = 1, pitch (P) = 70 mm, Casing diameter (D_t) = 254 mm, slope (α) = 20^0, 22^0, 25^0,20^0,30^0,35^0,40^0, flow rate (Q) = 1 l/s

Calculation of hydraulic power:

To know about hydraulic power which resulted from water from some heights calculated from angle 10°, because from an angle 0° it's have no heights, The total extractable power can be from,

$\mathbf{P_w = \rho.Q.h.g}$

Where,

$\rho = 997\ k\ /m^3$
$g = 9.81\ m/s^2$

Efficiency of Turbine:

The efficiency of turbine demonstrate that how efficiently the kinetic energy of water can be converted into turbine motion, The efficiency of turbine can be fined as,

Efficiency (η)**=** $\frac{P(o\quad)}{P(i\quad)} \times$**100**%

The output power is calculated as,
$P(o\quad) = 2\times\pi\times N\times T/60\times 1000$ (Kw)

Where,
T = torque
N = RPM
π = 3.14

Torque of turbine:

The mechanical power P_s available at the turbine shaft can be determined by measuring by the torque (T) at a corresponding angular speed ω. The torque can be found by measuring the tangential force F on a pony break with moment arm ratio of pulley,

T = L$\times g \times$ **Re**

Where,
g = Gravitational Constant = 9.81 m/s^2
L = Load
Re = Equivalent Radius

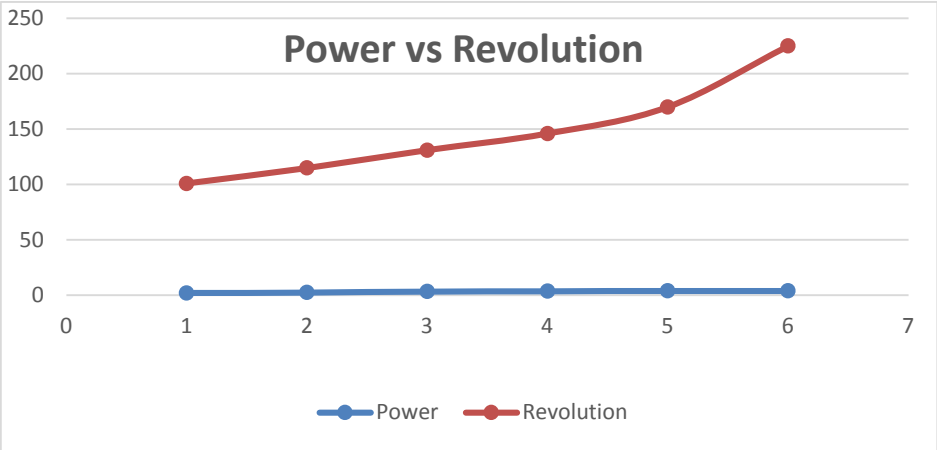
Equivalent ratio is calculated as,
$Re = (D_{brake} + 2\ D_{rope}) / 2$

Where,
D_{brake} = Brake Diameter
D_{rope} = Rope Diameter

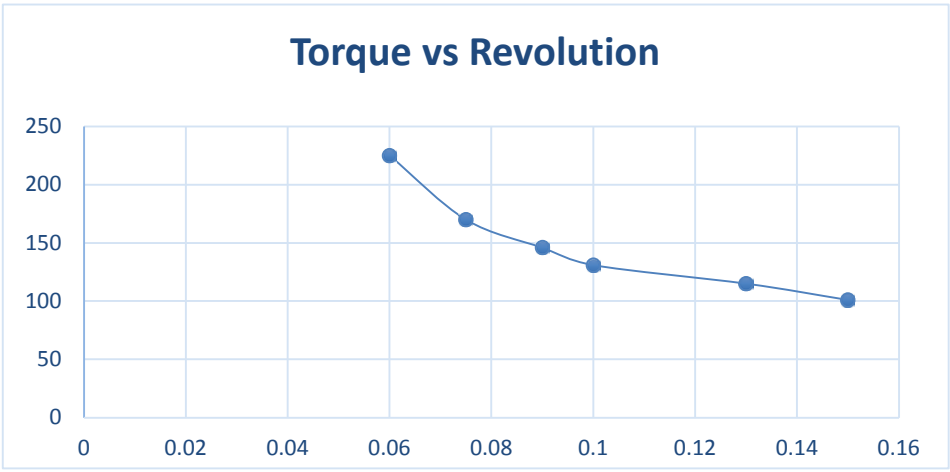
5. RESULT & DISCUSSION

Table: 2

S.No.	β (°)	Head (m)	Q l/s	N (rpm)	Torque(N.m)	Power(W)	η_m
1	20	0.22	1	101	0.15	2.1582	0.73473265
2	22	0.25	1	115	0.13	2.4525	0.63802922
3	25	0.35	1	131	0.10	3.4335	0.39933984
4	30	0.38	1	146	0.09	3.7278	0.36893610
5	35	0.40	1	170	0.075	3.9340	0.34008665
6	40	0.41	1	225	0.06	4.0221	0.35130902

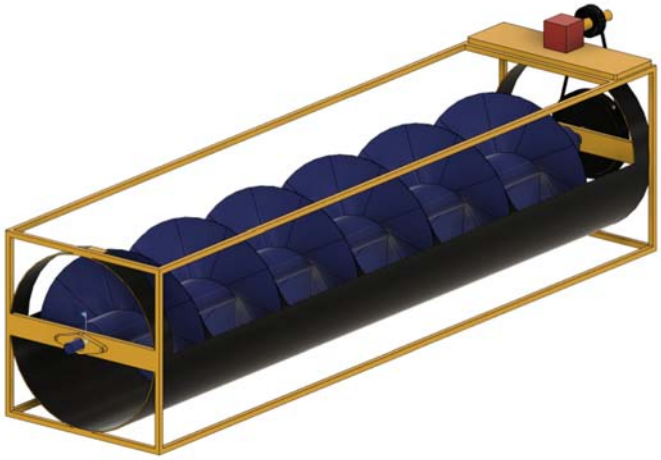


Through the analysis resulting from Graph 1 we notice that there is a linear relationship between mechanical power and rotational speed , an increasing of mechanical power of turbine can be observed with the increasing of rotational speed of turbine. The power of the turbine in relation to the rpm is direct proportion to the increase of the rotational speed, as can be seen from power vs revolution curve. We can see the maximum power 4.0221w at 225 rpm in table 2.

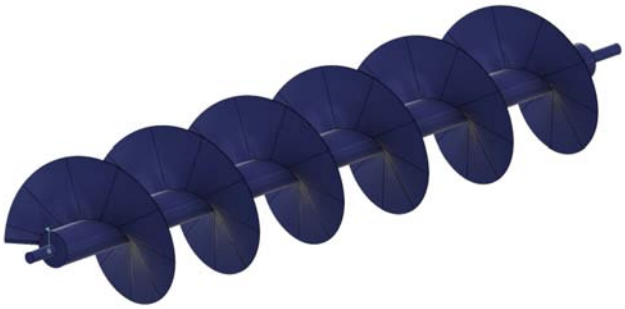


From Graph 2 we can observed that as the rotational speed of turbine is decreasing, the torque is increasing. That means the torque of the turbine is inversely proportion to the rotational speed of turbine. From the table 2 we can see that the minimum torque 0.06 N.m at maximum rotational speed of 225 rpm.

CAD MODEL OF PROJECT



1.1 Archimedes Screw Turbine



1.2 Screw

CONCLUSION

The Micro hydropower based on Archimedean turbine is an eco-friendly, fish friendly & there is no requirement of deforestation as well as people displacement and other harassments. In these types of plant there are no requirements of big dam, high Discharge, high Head & penstock etc. The efficiency of plant does not vary with load, but Power output & Speed of this plant vary with discharge at same Head condition. Hence this type Micro hydropower based on Archimedean turbine plant is most suitable hydro power plant in the present as well as future.

ACKNOWLEDGMENTS

I would like to express my sincere gratitude to this project “Design & fabrication of Archimedes Screw Turbine”. which has given me opportunity to explore my skills and vision which I had learnt in my four years of engineering. I am thankful to Dr. Chetan Kumar Patel, Professor and Head of mechanical engineering department and also, I would to thank all the faculty members of Department of Mechanical Engineering, Rk University who had helped me a lot during my project for being providing their valuable guidance, comments and suggestions throughout the project. I enjoyed a lot and learnt various thing beside my domain knowledge. I also learnt about the team management and role of engineer in the society.

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Face Mask Detection Using Deep Learning Algorithms

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Abstract: With the Corona virus Disease epidemic in 2019, life seems to have come to a halt. To prevent viral transmission, the World Health Organization (WHO) declared that wearing a face mask was an essential step in limiting virus spread. However, manually determining whether or not people are wearing face masks in a public place is a time-consuming operation. The need to monitor persons using face masks prompted the development of an automated system. Currently, various machine learning and deep learning approaches may be employed efficiently. All of the necessary conditions for such a model have been discussed in this work. For the same, we deployed a convolution neural network. The model is trained on a real-world dataset and successfully tested using live video streaming. The model's accuracy is further tested using several hyper parameters and many persons at various distances and locations inside the picture. In certain areas, infections have spread swiftly due to the inappropriate usage of face masks. We required a dependable mask monitoring system to overcome this problem. Several government agencies are aiming to make the use of a facemask mandatory; this process can be aided by the use of face mask recognition software based on AI and image processing techniques. Machine learning, Deep learning, and other techniques are used in the methodologies stated in the article for face identification, helmet detection, and mask detection. Using all of these methods, it will be easy to identify between people wearing masks and those who do not.

Keywords—Deep Learning, Face Mask, Convolutional Neural Network, Tensor Flow, Open CV, Keras, Image Processing, Computer Vision.

INTRODUCTION

COVID has a bad impact on human lives [1], where the inhalable droplets of one person are being spread to others which causes the virus to spread across, and to prevent that we use masks. Due to this covid pandemic killed thousands of people lives and led to major destruction, this impact also fall on major industries like clothing, food. The only advantage is for medical industry, who supplied major of medicines to people who are facing virus; this virus also caught education and job fields where many were not Properly educated and lost jobs in covid, during this impact WHO, which generates the reports accordingly stating the loss which were being affected and with brief analysis, and due to this also many people lost their immunity caused to deaths. When the virus gets affected in the body [5], it takes time several days to grow itself and destroy the immunology of living beings, then when a person contacts another person this virus gets attacked and spreads to the host by the means of the host, the only way to control this to detect whether a person has worn a mask or not, which can be done using this project, where it detects whether a person wearing a mask or not. We can also try an automation system that automates whether a person is wearing a mask or not. This also reduces manual way, so if the work is being included manually which leads to less human pruned errors if the government includes the fine, [8] so it can detect which person has not to wear masks and directly impose fines on them.

Fig.1.A Lady Wearing Mask

Fig.2.A Lady Not Wearing Mask

In the above images Fig.1. indicates a person wearing a mask and fig.2. A person not wearing masks where the data is being trained accordingly and being divided into two classes, class a has images with masks and class b has images with no mask. Then this model will classify accordingly based on our training. This problem statement will be similar to problem statements like object detection, helmet fine-based prediction, and in many areas. Like emotion detection. The common manual approach is detecting face masks manually face by face which is a difficult task, where there is a huge population, especially in temples [14]. The similarity between object detection and face mask detection is simple, in object detection we detect objects based on shape and size on a few dependencies whereas in face mask detection we detect faces mask based on human facial images, The major advantage of this project is this will reduce the cost of the [11] face mask detection systems, the model cost for huge multinational companies will be reduced. It is a two-phase system where we first train the images and then later we test the images also detect the faces using a validation set, To achieve this better we have used technologies like Keras, and Open CV. We have constituted a database that has 1300 images which are being divided into mask data and no mask data. To apply this to embedded devices we can also use Mobile Net V2, which is highly efficient for embedded devices and predict accurately [23].

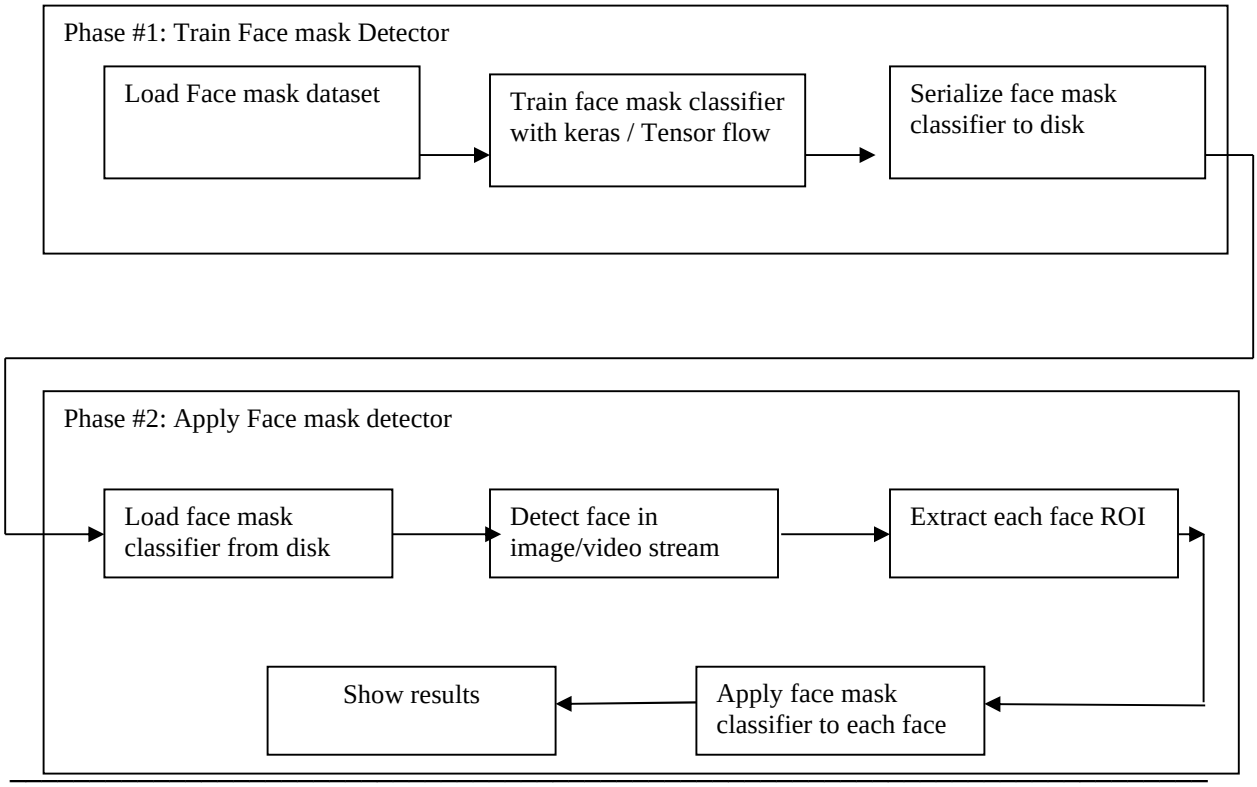

Fig.3.A.Process Sequence for detecting Face Mask

LITERATURE SURVEY

A literature survey involves the survey methods where the problem can solve; the actual problem statement is detecting face masks using AI technologies [18]. The face mask can be done using image semantic segmentation. Semantic segmentation is an AI-based CV task that involves grouping similar tasks of the image which belongs to the same class like grouping of masks, whether a person wore a mask or not like clustering. It includes three steps [15].

i) Classifying
ii) Localizing
iii) Segmentation

In semantic segmentation when we give input as images it will produce output as structures or regions like sketch of that image. We need to do is process the image. For image processing then we need to have filters, gradient information, and color information, it also involves identifying the image, pixels of the image, and inclusion of image [12]. Most traditional objects can tell what is there in the image. There are different datasets like Flickr, COCO, and PASCAL VAC, for identifying image objects, like identifying gestures in images. It is also used in medical imagining, and also major in detection-based searches [9].

a) Classifying: It is used for classifying certain objects in the image.

b) Localizing: Finding an object and drawing a bounding box around the object.

c) Segmentation: Grouping the pixels in a localized image by creating a segmentation task.

Semantic segmentation means classifying the image and separating it from the rest of the image layer and overlaying with the segmentation task.

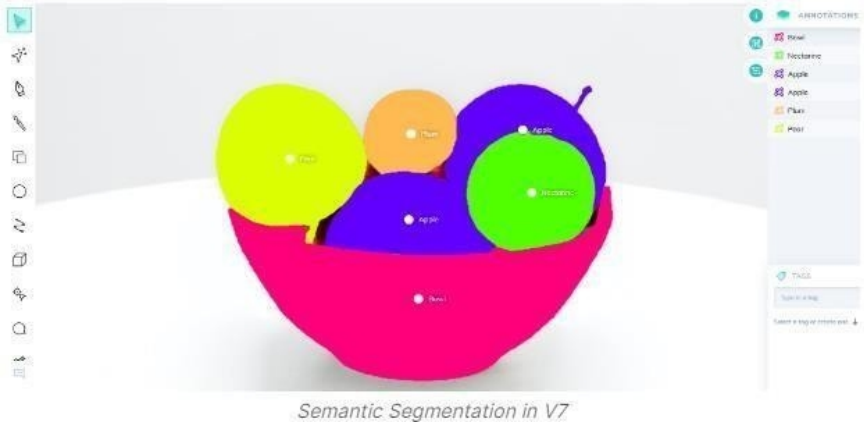

Fig.4.A.Segmented Images in V7 [20]

The above image tells about the image segmentation tool. First, it will take input as an image, Then it converts into segments like labels or objects available in the image then it will convert into segmented labels, then it will group based on it. There is another way where we can use Harcascade classifiers. It can be trained and also can be detecting the mask; they are used in finding the objects in Computer Vision Applications. The classifiers are very easy to use; Harcascade is a machine learning object detection program that identifies

objects in both images and videos. It is mainly used in face detection in mobiles [13].

The approach is where we can detect objects based on a machine learning task, which is somewhat less efficient than compared to deep learning, where in deep learning we use epoch for training the data, which is more efficient than compared to ML Algorithms, for detecting a face in digital images and videos and can be done for separate images. In [21]Author used PCA principal Component Analysis the model which is used to identify the face masks and also includes the face detection.

In [2] Author has mentioned the method of detecting face masks manually which has less accuracy comparatively, it will be able to classify classes, mainly with mask and no mask. In [3] Author, the group of researchers found a method using CNN, where here there will not be any bounding box and decreases noise, which also classifies the same. In [4] author has used GANS Approach with help of detecting with and without a face mask and reconstructing the face mask.

The Drawbacks faced by the model are:

i) The memory for training the images is not sufficient, in conditions when we require more accuracy, as we need to train the model [17].

ii) When there is a low illusion in images, the model cannot classify the images well.

iii) If the system is online, then Open CV cannot capture background well and predicts wrong information, like someone may use background images or boards to cover it [24].

iv) The model cannot predict well if the person has a beard or stickers on the face, it thinks as a mask and predicts as wrong, so it will be a bad prediction

PROPOSED METHODOLOGY

In this research we have included a convolution neural network for detecting the objects in images and videos; we train the data with a sufficient amount of images in the data set. The final objective is that when the webcam is on the model should detect whether the person is wearing a mask [20] or not and warn the person who doesn't wear the mask.

The steps involved are:

1. Preparation of the data set which has images.
2. Model creating for evaluating data.
3. Training the model for getting better accuracy.
4. Sorting and evaluating the model using a validation set.

Data Set: Two classes have been used in the data set, data set has 1376 images, whereas the first class has a mask: 690 images, without a mask: 686 images.

In face mask detection we used deep convolutional neural networks because of their better performance compared to other classification algorithms the problem is it is very expensive in terms of time-consuming and it requires high computational power. Here, in this situation to improve the neural networks, we use deep learning-based transfer learning [21].

Transfer learning is used for transferring the trained knowledge of the neural network in the terms of parametric weights to the new model [7]. Transfer learning boosts the performance of the new model even when it is

trained on a small dataset.

CLASSIFIERS USED IN THIS MODEL

Machine Learning classifiers are used to predict the class of images forgiven data points. Classification is a supervised Learning Algorithm. They use Mapping Function (f) from input variables to discrete variables.

Open CV: Open CV is an open source for computer Vision where the process is used to understand the images and videos, where the data can be manipulated from the images. For the real-time operation of images and we use computer Vision Algorithms. It is also used for motion tracking.

Tensor Flow: Tensor Flow is an open-source machine learning library it is used for numerical computations, it has nodes and edges.

Keras: Keras is open source Library for deep learning-related activities.

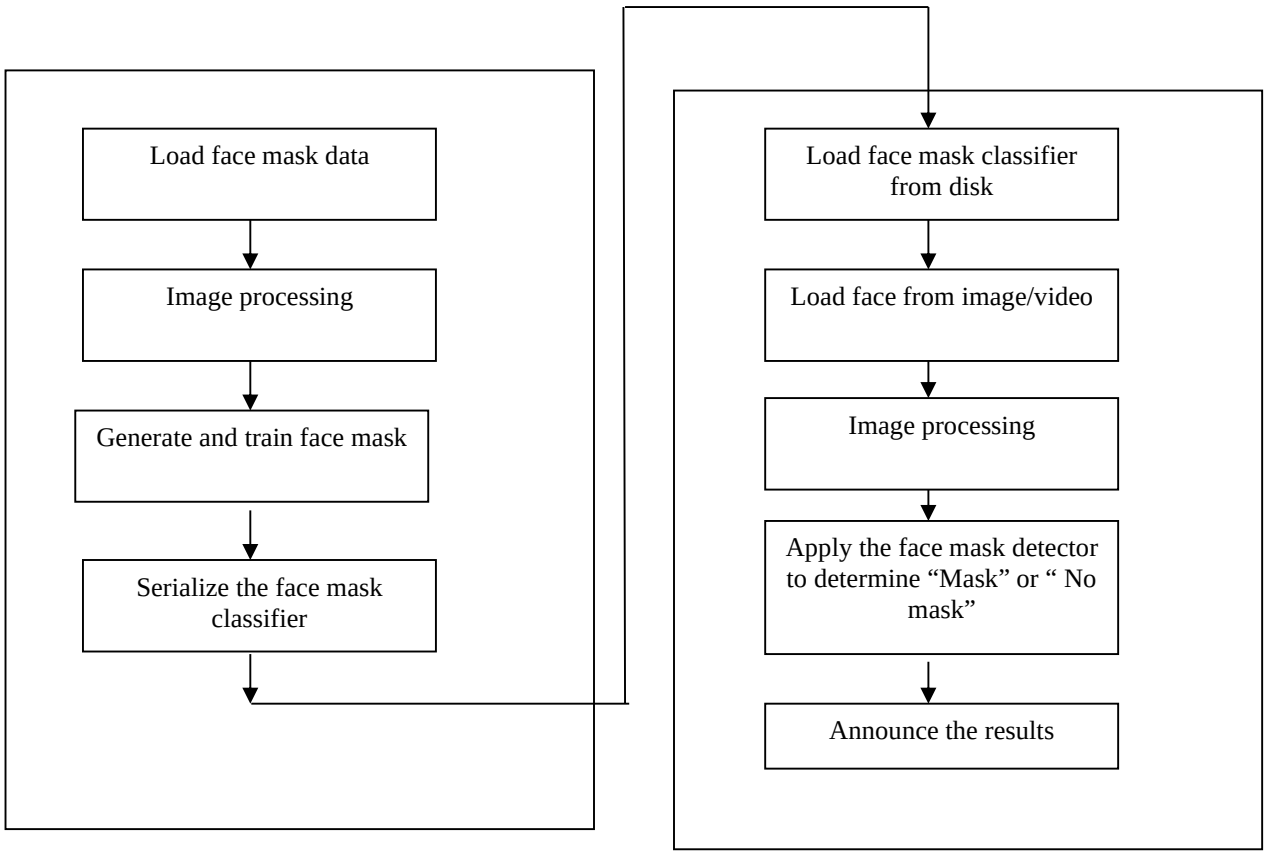

Fig.5.A Phases for Detecting Face Mask

METHODOLOGY

i) Data set Collection

The data is collected from online resources which have both training and testing data

ii) Training the Model (Validation)

Here data is being trained using Keras and Open CV is used to capture images [22].

Table 1. Different category of mask images

Label	Category	Number of Images
1	With Mask	1380
0	Without Mask	1371

a) Detecting the Model

Here the model is used to detect if a person wears a mask or not.

b) Alerting

If the mask is not wearing then it will alert the users to wear the mask.

MODEL WORKING

This project is built using Tensor Flow, Keras, Open CV, and other models for detecting the face mask and identifying whether a person wears a mask or not [6].

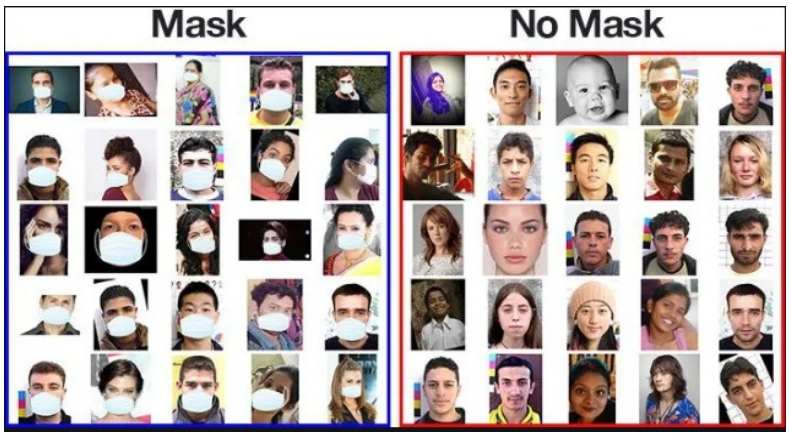

Fig.6.A.Dataset containing both mask and non-mask images

Here we have 1376 images and it is divided into two. A base model will be generated by using the packages namely: Keras and MobileNetV2 [7, 19]. Secondly, we create a head model which is placed on top of the base model; the model has 125 layers and an active function of “relu” and also the activation of the function of “softmax”. These 3 layers work together for training our model [10].

A labeled dataset will be used splitting the generated model into 2 parts where one part (75%) is used for training and the leftover portion (25%) will be used for testing the model of its accuracy when the training for the model is over we can use it for detecting the face masks[19].

An image/video taken from a source can be used or else we can use a live video o photo taken directly from a device attached to our personal computer will be given as the input to our trained model a frame of the video or the image is sent to the model for detecting the face from it. A resized image or the video frame is used for detecting a blob, then the detecting blob is sent to them which contains a cropped image of the face of a person without a background is utilized further from here and is sent to the model which has been trained by us [16]. The output that we'll receive is whether there is a mask or not.

DATA SPECIFICATION AND SOURCE OF DATASET

In this research, we are considering the benchmarked face mask detection dataset which consists of 1376 images of two classes including 690 images with mask and 686 images with no mask. As this images are very low for deep learning model training, we try to augment our data set to include more number of images for training this is also called as data augmentation which also means that we rotate the dataset and then flip the dataset, then including we get total of 2751 images which includes 1380 images with face mask and 1371 images with no class. There is also other data set where most commonly researchers has used it which consists of 7553 images with two classes and 3 color channel RGB , images with mask are 3725 and images without mask are 3828.These images are being filtered from google search engine.

OUTPUT

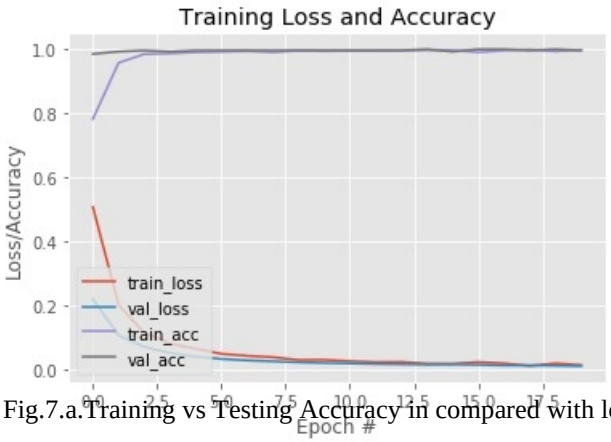

Fig.7.a.Training vs Testing Accuracy in compared with loss

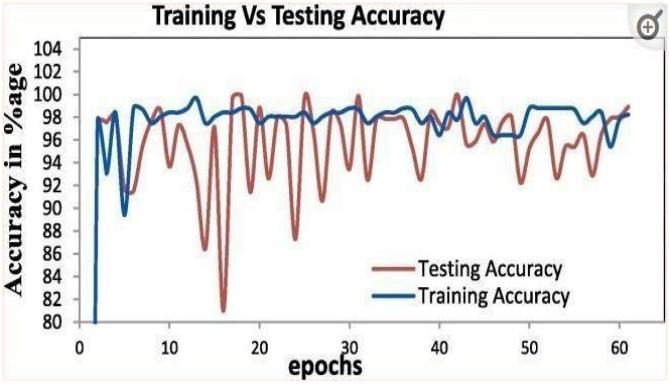

Fig.7.b.Training accuracy vs testing with accuracy

The following graph between the training accuracy and the testing accuracy was obtained. The output we received after taking in an image for the condition with mask and without mask are as follows:

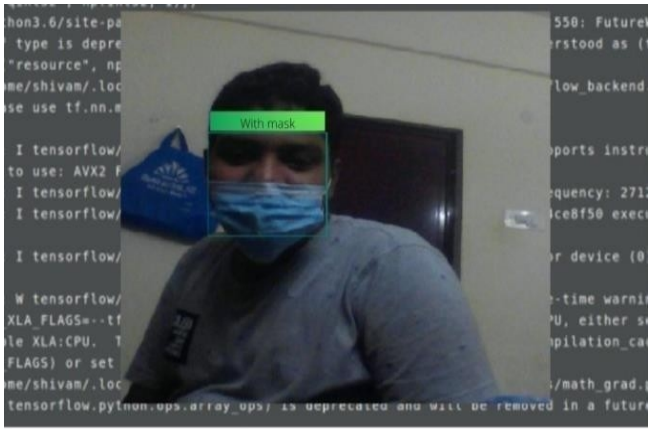

Fig.8.a with Mask Model Detection

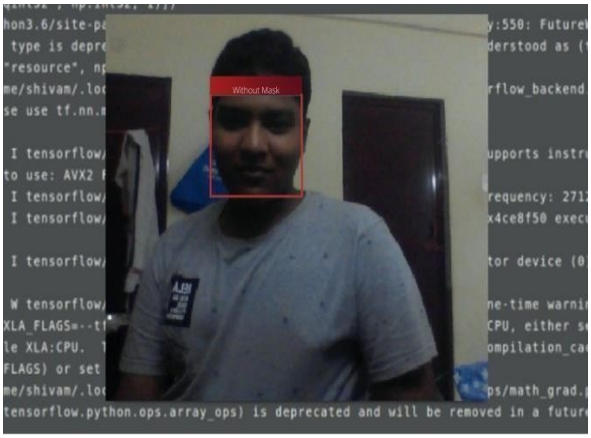

Fig.8.b.without Mask Model Detection

CONCLUSION

THE TESTING MODEL HAS ACHIEVED AN ACCURACY OF 98%BY USING SIMPLIFIED TOOLS AND MACHINE LEARNING TECHNIQUES. WEARING A MASK FOR THE WHOLE DAY IS A HECTIC TASK BUT IT IS NECESSARY TO WARD OFF THE COVID19 CRISIS AS IT CAN HELP TO CONTROL THE SPREAD OF THE VIRUS. MOST PUBLIC SERVICE PROVIDERS HAVE MADE IT COMPULSORY TO WEAR A MASK TO RECEIVE THEIR SERVICES. THE PROPOSED METHOD CAN BE EXPLICITLY USED FOR DETECTING FACE MASKS. THE APPLICATIONS OF THE SYSTEMS CAN BE USED IN MANY AREAS MCV TV DETECTION, PUBLIC AREAS, AND TEMPLES. THIS CAN ALSO BE USED WITH IOT BASED DEVICES TO DETECT THE FACE MASKS, WHICH CAN CLASSIFY IMAGES AND PROCESS THEM PROPERLY. FACE MASK DETECTION WORKS IN REAL LIFE AND ALSO BE USED IN REAL-LIFE SITUATIONS.

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Earned Value Analysis Using Software For a Project

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Abstract. The term Project wider means to accomplished performing a set of activities. Each Project is unique in sense of activities to Perform these activities we want to do Project management. The Project management is a technique to achieve these set of activities on time without any delay and without any cost over burn. The Need Project management is broadly known and achieving more and more Value as an organizational Structuring Concept. When size of Project increase then it is difficult to Plan, Schedule and Control the project activities so Primavera p6 Management software offers the facilities to manage multiple operation of Project and compare the Analysis to stop delay in project. Primavera software uses baselines for storing the Project Plan. A Base line in a project contain Project plan for original tasks like Resources, costs time of completion of project as Per Plan before execution and it is used for future Reference for comparing with actual plan. Primavera also offers a tool of Earn value Analysis which is the measurement of the key performance indicator and compare them to base line indicator. By comparing the Actual cost to Planed cost variance is calculated and then proper measures to be taken where the Project delays. Earn value concept helps in construction Project by early delay of working or in excess cost or risk in Project by giving negative values of cost variance and schedule variance. So it can give proper indication that where project is lagging behind hence project manager can take proper measure.Our main objective to study and under stand The Role of Primavera in Project management by earn value analysis.

Keywords: Project Management, baselines, Earned Value Analysis, Schedule and Control ,Primavera, Cost Variance.

INTRODUCTION

The need of Project Management is being mainly known and gaining more and more importance as a concept of structure. The project structure flows both vertical as well as Horizontal work flow. It is easy to monitor the work flow as vertical but it may start conflict when Work flow made horizontally & vertically both then work may become complex. In a Project environment for smooth flow of activities it is necessary to effective communication.Project information system for being effective Project implementation gives the Project Managers to a proper path to understand of Review the things. For large construction project with huge budget it is become very hard for project groups to handle the task so it is necessary to provide a tool to handle the activities of a project that help them to track.

Earn value Management working

The Earn Value Management concept used to indicate actual progress of work against the actual work to be performed it is basic concept which show the actual physical condition of project. EVM is generally used where estimation of time and cost is required it help the project manager to make decisions that the project is going as per planned or not. It gives common idea where the cost is overrunning so the project manager cast proper adjustment of resources to mitigate it.

SURVEY DATA ANALYSIS

Research completely aims to find out the Cost and Schedule Variances indices of Earn value management system to completing this a case study is selected for alive road project of total Work of construction of Widening and strengthening of a Road Bakasar Road to swarupe ka Tala 0/0 to 18/0 and 24/0 to 36/0 Division Chohtan District Barmer has been sanctioned for amounting to 1650 Lacs Rupees of Estimated cost which include all Road

Marking. Total Length of stretch is 30 km. To analysis better of a project primavera software is selected for proper managing the activities and Earned value indices calculation per day tracking is done as per schedule measurement is noted.

EVA by using Primavera software

The Earn Value analysis can be made out in primavera software Fig1(a) Show Eps For the Project. The Enterprise Project Structure is Centralised Management of Multiple Project by Which a Project can be Categorized in work of organization. Our live Project comes under PWD division Choutan which centrally managed by Jaipur head . All the work order is issued by centrally jaipur head. Then further organization breakdown of structure at particular level of branch.

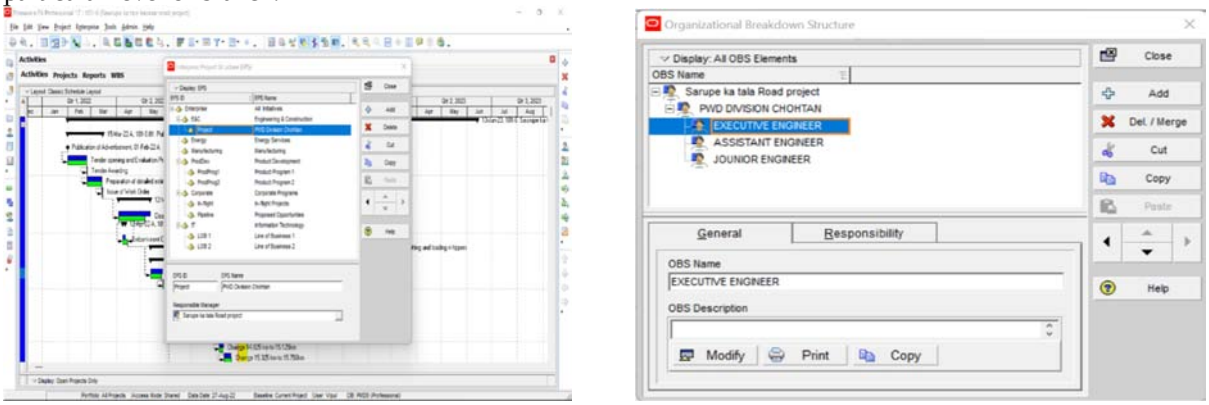


Figure 1 Creating EPS and OBS (a)Creating EPS (b) Creating OBS

Fig. 1(b) shows Organization breakdown of structure is a totally breakdown of a organization involved people according to their Professional Experience into a hierarchy level. In our Project PWD Division choutan runs under Executive Engineer and that is subdivided to Assistant engineer which help executive engineer to make decisions. And junior engineer which is direct responsible for execution made on site all daily reports are prepared by him. In next step project is created new Project:- In EPS a project is created be name as per our Project widening and strengthen the road swarupe ka Tala to bakasar road is created. Project start date is assigned

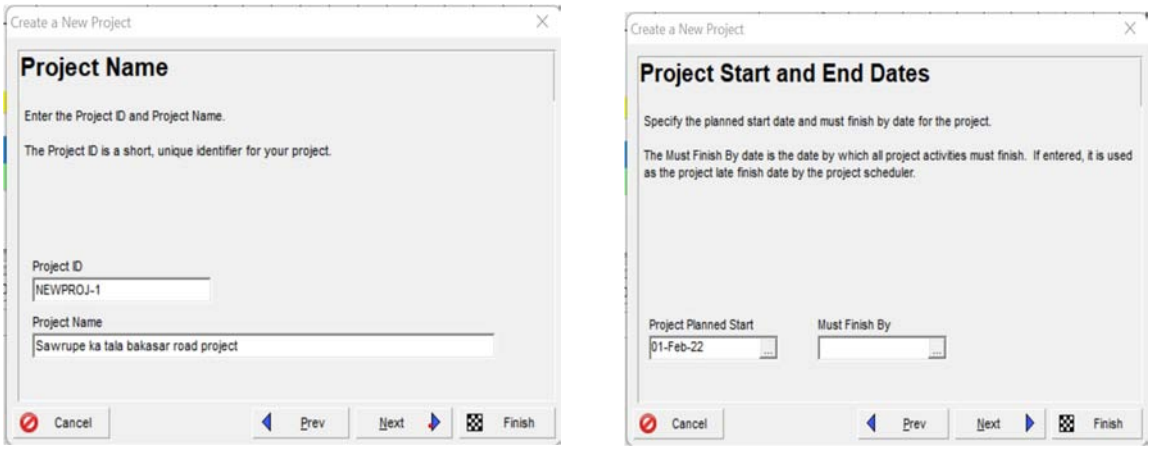


Figure 2 Creating Project(a)Assigning Project name (b) Assigning project start and end date

Fig. 2 (a) Project name is assigned that is strengthen and widening sawupe ka tala bakasar road Fig 2. (b) shows to assigning the project start date and finish date which can be constraint to the project.

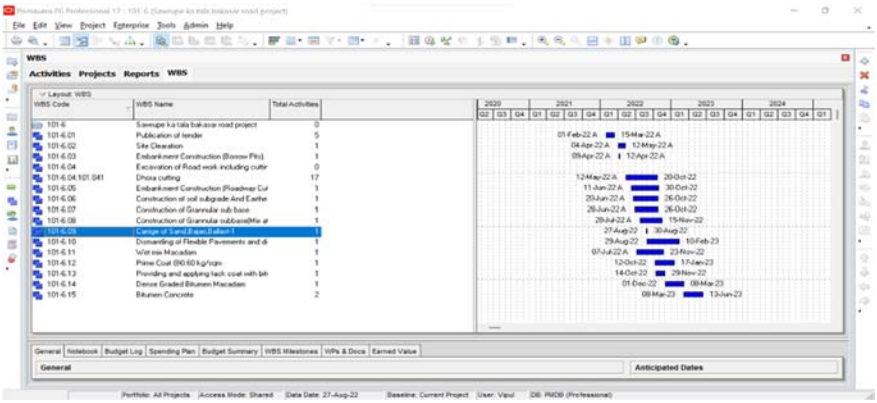


Figure 3 Creating WBS

Steps involved in Project analysis:-

1. Creating a WBS:-Work Break Down of a Structure is a complete segregation of a work According to their Schedule and Favourable conditions Work is breakdown in to no. of components to analysis better of a project. see fig. 3 shows Wbs in project. It help in a project to break the works in parts so each work is properly managed by certain teams. further in wbs activities are assigned for each day work.
2. Creating a calendars : Creating a new calendar of modify existing calendar. By Modify of a calendar we can set the work hours and work/non work days according to project requirement.

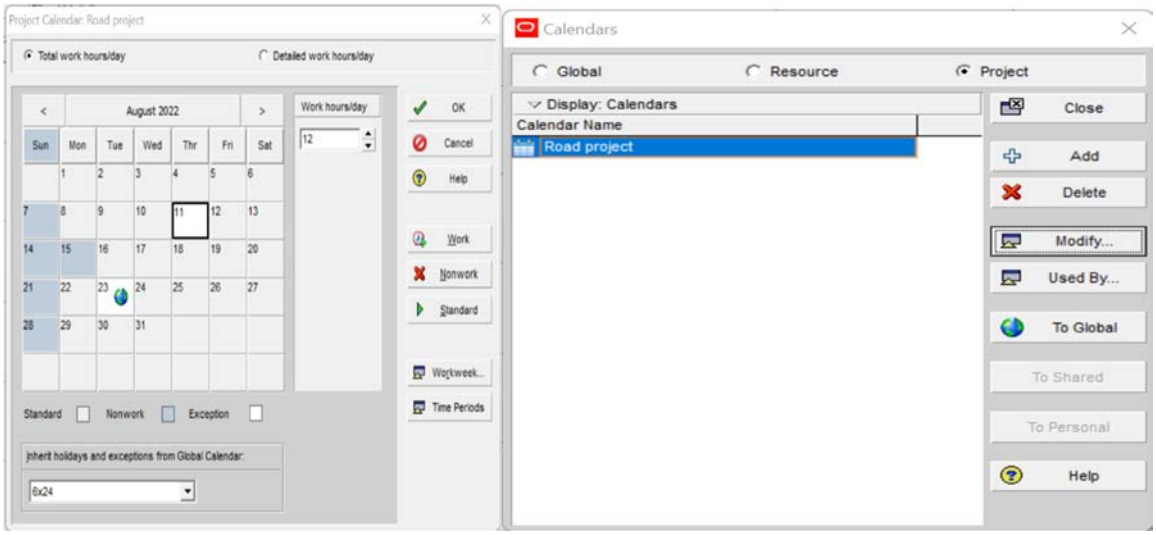


Figure 4 Creating Project Calendar

Calendar is of three types in Primavera which is Global ,resource, and project calendar. Global calendar is assigned by default in any project if we want to make new calendar for a particular project then we assign project calendar and modify it According to our project requirement. In resource calendar we can define a particular calendar for a particular resource according to their work hours decided.

3. Adding of activities:- After Creating calendars in a Project work break down in structure the activities are assigned in lowest level. The duration of a particular is assigned as per planned schedule is added. activity is

a part of work which is executed on the site which consume time.

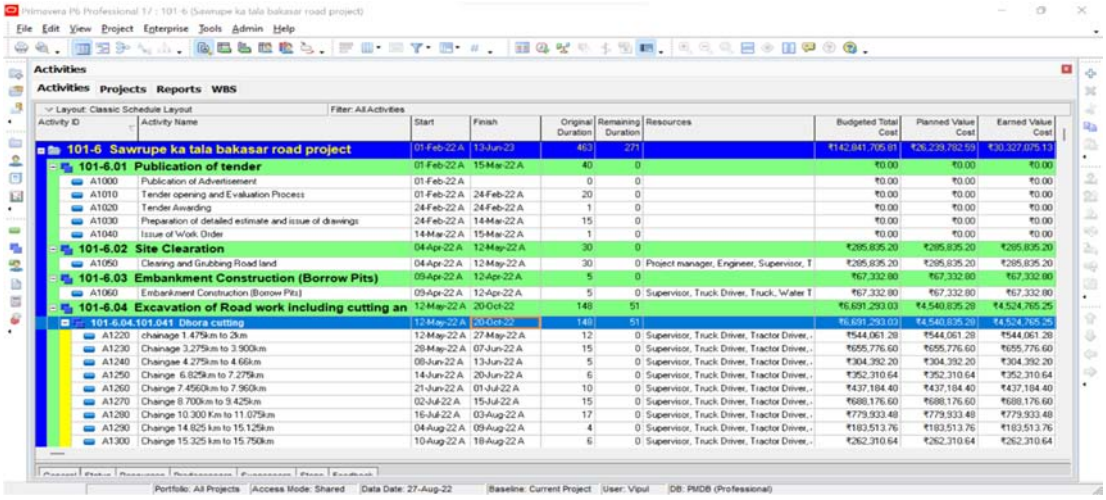


Figure 5 Activities

4. After adding activities relationship is assigned as per logic and planned schedule. Predecessor and successor is assigned. All the activities are assigned in particular WBS as per scheduled then by right clicking on the activity shows activity details.

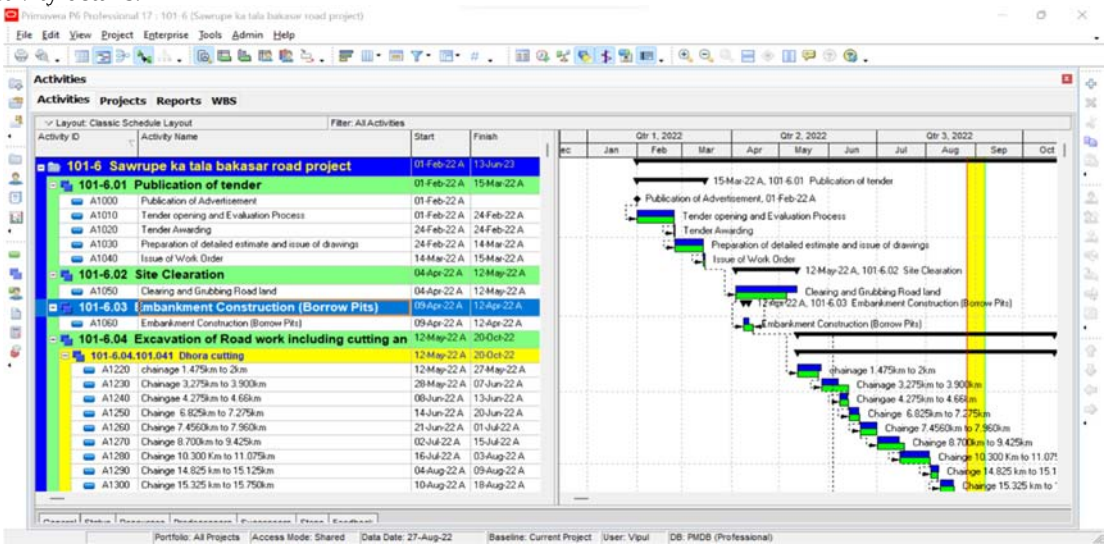


Figure 6 Assign relationship in bars by arrows

In activity details relationship tab all the relationship is assigned as per planned like some activity are followed by some other activity that show predecessor and successor activity wise assigned.

5. Assigning a Baselines:- A base line is a mirror of a activities after assigning the base line it is by default show Primary baseline which show the duration as per scheduled data. See Fig. 7 (a) shows the base lines with their types we can modify the baselines as per requirement. After updating the project secondary base line show the original duration of a project.

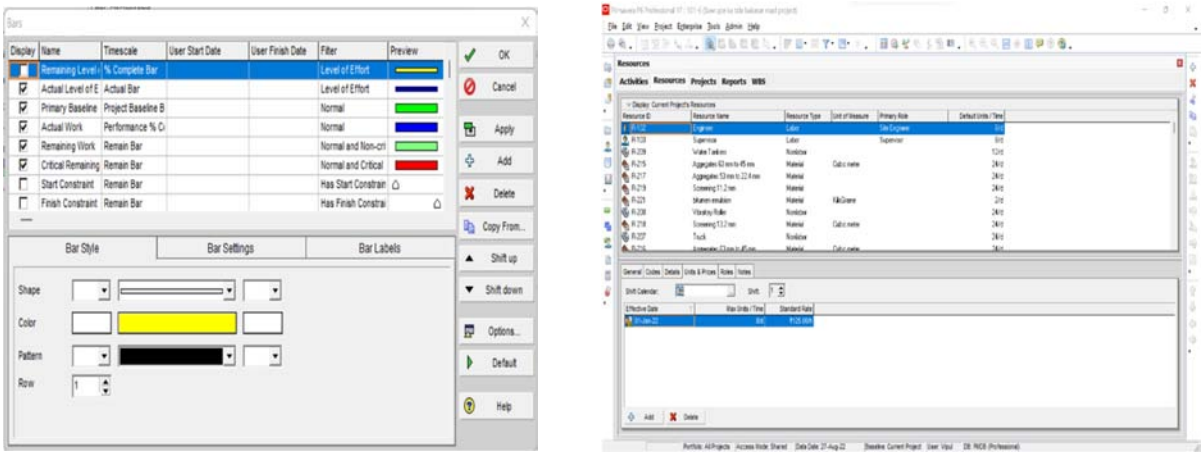


Figure 7 Assigning Base lines& Adding Resources (a) Assigning Base Lines (b)Resources

6. Adding Resources:- Resources of activities are the medium by which an activity can be performed. It is of 3 types Labour, material and non labour. Fig 7(b) shows addition of resources .Per hour rates are multiplied bye per day work and the cost is calculated accordingly.
7. Updating :- Now the real part of a project finding is starts. In this Part all the scheduled activities are updated as per work is performed in the status tab the activities assigned to started and then scheduled the date as real work day is started. After performing the activities per day schedule is updated as per work is executed %of work done is calculated and data is field in this tab .

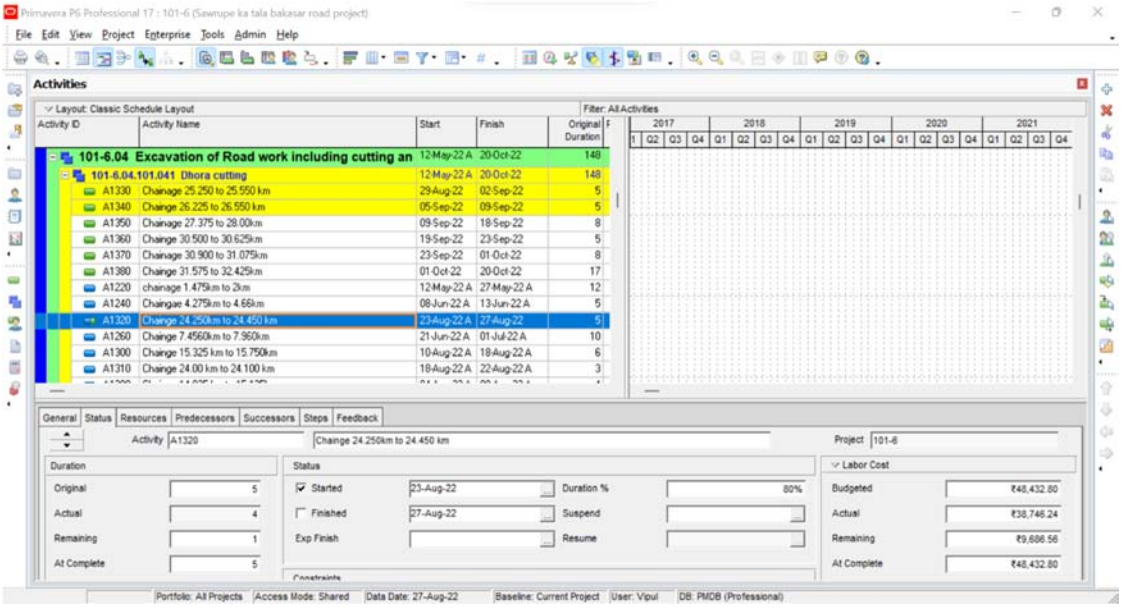


Figure 8 Updating

In this figure 8 After updating the status of a activities dhora cutting at the chainage 24.250 km is currently running and 80% of that activity work is performed in 4 days . The activity is scheduled 5 days in original work 1 day work is reaming. The cost is calculated as per work hours performed in the resources.

After updating the schedule of the project in primavera EV parameter are find out by adding a customized column tab. Click on column tab after right clicking on it Earn value parameter AC,PV,BTC,SV,CV,SPI,CPI is added to table. Primavera automatically calculate all the parameters form that .

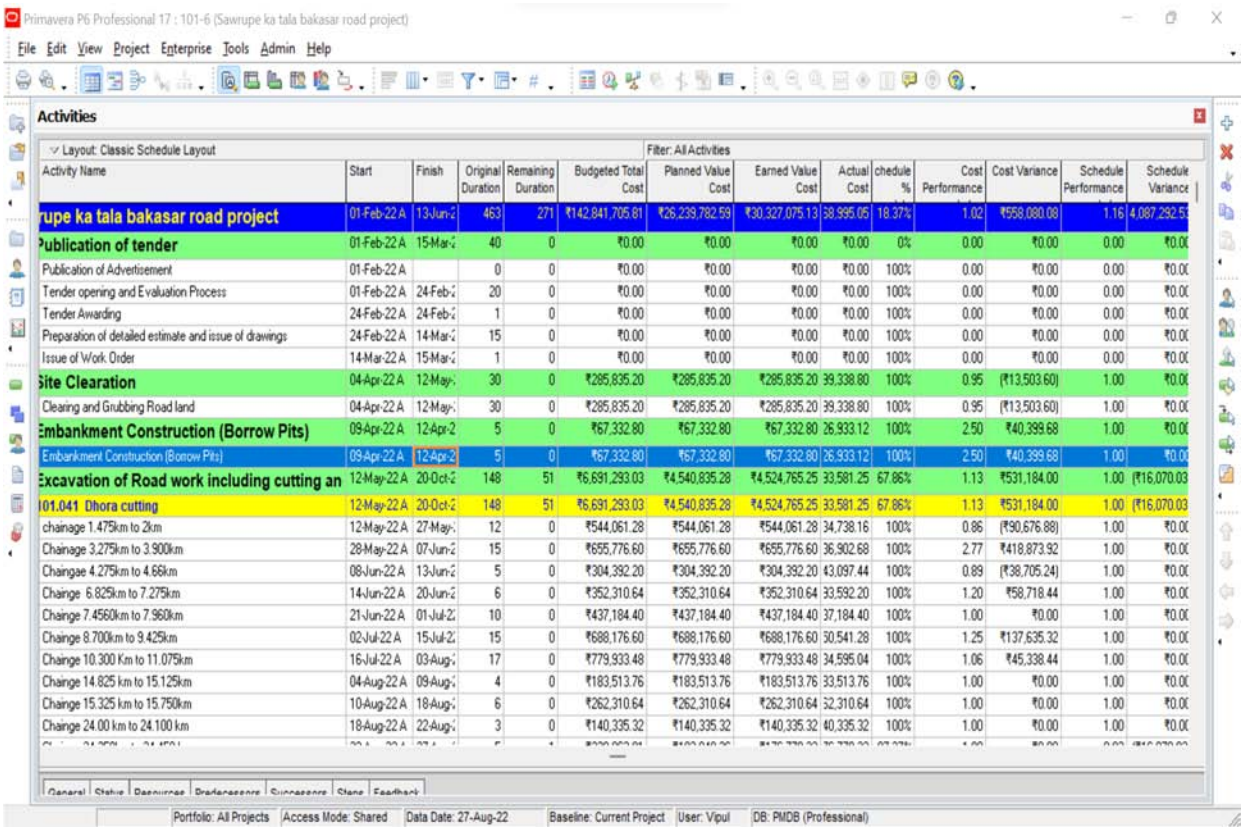


Figure 9 EV Parameters

INTERPRETATION OF RESULT

Earned Value

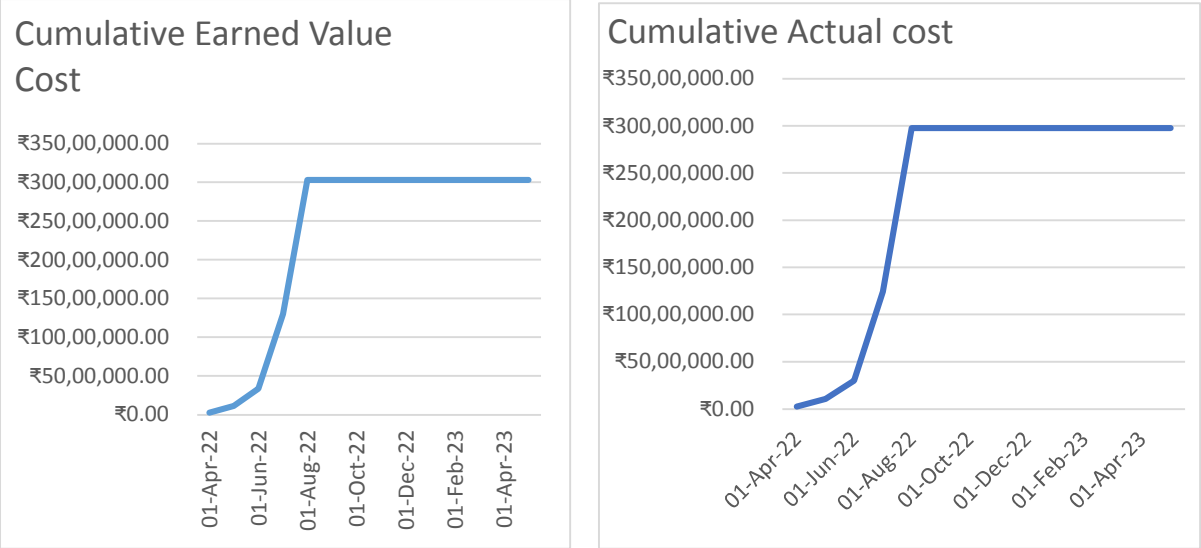
It is the Value of work that actually has been performed in the field so far. If a plan of Activities is decided to be performed then earned value shows the cost of work according to plan %.It may not be confused with actual cost of a work which is the actual cost that we spent on a particular activity. In Earned value as per schedule the % of work that is planned to spend on that activity show will give earn value.

Fig. 10 (a) Graph is plotted between Cumulative Earned value and time period show the variation gradually increasing as the work progress. The work is performed shows the variation of cost as per scheduled data or not .It represent current state of the Project that we have achieved so far. In our Project Till 27 Aug Earned value of 30327075.13 has been achieved the Variation in actual data will discus in next chapter

Actual Cost

Actual Cost (AC) is real and actual investment during execution phase and should be recorded on daily basis since it is actual expenditure as project progresses which shows some variation from our scheduled expenditure as real field situation is different from planned value.

Fig. 10 (b) Graph is plotted between Actual cost and time of Precedence. As the time passes as the work is performed the cost increases as graph show gradual increment of the cost. In our Project till 27 Aug ₹ 2,97,68,995.05 of Actual cost is spent yet of different activities.



(a) (b)

Figure 10 Cumulative cost vs time (a)Cumulative Earned Value cost vs time (b) Cumulative Actual cost vs Time

Planned Value cost:-

The Planned value cost is also called BCWS represents the approved cost of the project based on schedule. The PV information is included in initial accepted contract. The work is planned before the construction of a project. Estimated duration of activities is calculated and planned resources is multiplied with actual cost will show us total budgeted cost of the project.

A Graph is plotted between Cumulative Planned Value vs time of precedence it shows the variation of cost as the activity time passes the cost get increasing gradually up to estimated cost of the project shows its peak value

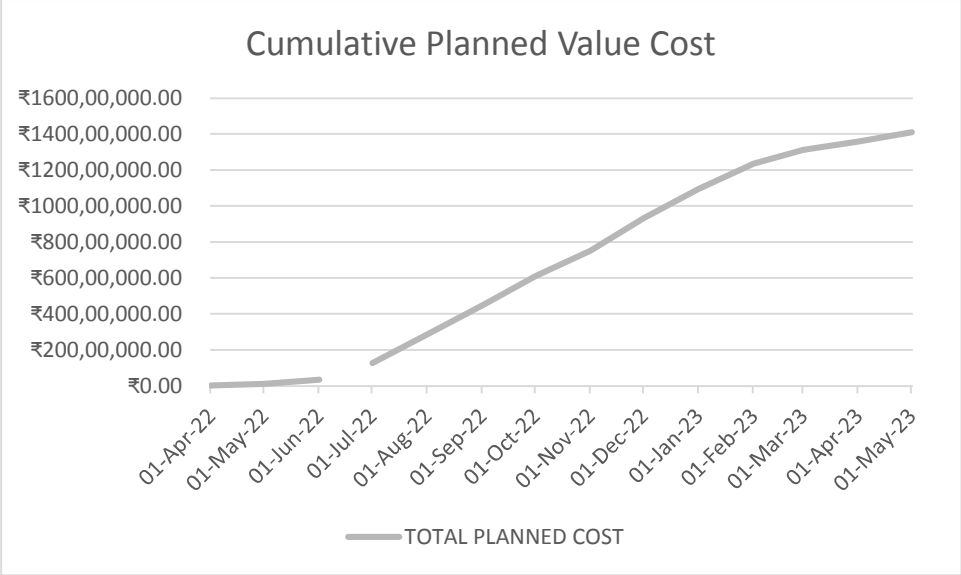


Figure 11 Cumulative planned value cost vs time

Variances and Indices

Cost variance and cost performance index: -

Cost Variance is determined by subtracting the value of EV and AC. The positive value of Cost Variance shows that our Earned Progress is more then the actual expenditure of the project which is a positive sign to a particular project.

Cost Variance = EV-AC

In the activity site clearance and chainage 1.475 km to 2km show negative value of Cost Variance that means that particular activity spent more days form required or scheduled and other activity which is done before the schedule shows positive value of cost variance because the actual amount of money will be lesser.

In overall the project is under budget yet we are ₹ 632005.10 saved from scheduled budget .

Cost performance index can be calculated as follow:

CPI = EV/ AC

If CPI is >1 then project is under budget and if CPI<1 Then Project is over budget.

In this Project two activities show the values of CPI less then 1 means they required more effort and man power to done as that activities are delayed by some days so it show value less then one. Over all the project shows the CPI value as 1.02 which is more then one means the project is running under budget.

Schedule variance and Schedule performance index:-

As the result shows chainage 24km to 24.10 km, embankment construction from road way cutting and Soil sub grade construction activities are behind the scheduled shows negative value of SV so it show clear indication to project manger to make these activities on time the conditions are judge properly. The gsb and WMM is running ahead of the Schedule because the work is started on the stretch where all cleaning cutting is done.

So these activities show negative value of schedule variance. Overall the project is running behind of the schedule show SV as ₹ -282963.10.Schedule performance index is the ration of EV to PV it is the measurement of the project scheduled data with actual earned value.

IF the value is equals to 1 shows that project is completed as per planned scheduled and if it shows less then 1 value then Project shows the portion of the project completed less then the planned scheduled for example if SPI is 0.5 for any activity shows double the expenditure on that activity as per planned. IF the Value of SPI is Greater then 1 show more achievement then planned schedule.

Table 1 Current Project Data

Total Budgeted cost of Project	₹142841705.81
Original duration of project	463 Days
Project Start & End Date	1 Feb to 13 Jun 2022
Planned Value Cost	₹26239782.59
Earned Value Cost	₹30327075.13
Actual Cost	₹58995.05
Cost Variance	₹558080.08
Schedule Variance	₹ -282963.10
Cost performance index	1.02
Schedule Performance index	0.99
Estimate to completion cost	₹142283626.73

S Curve

Number of measurement need to be evaluated in the process of finding out the current status of the project and future forecasts about the project. They are:

1. Performance Measurement Baseline (PMB), which is also known as Planned Value cost
2. Earned Value
3. Actual Cost

All of these factors need to be compared with the planned S-curve to generate results. This comparison is done to know if the project is overrunning the budget or some other task is behind schedule, the graph show variation in planned cost and Actual cost so we get to know that how much we are behind the schedule so proper measurement can be taken at that time to over come the effect on other activity

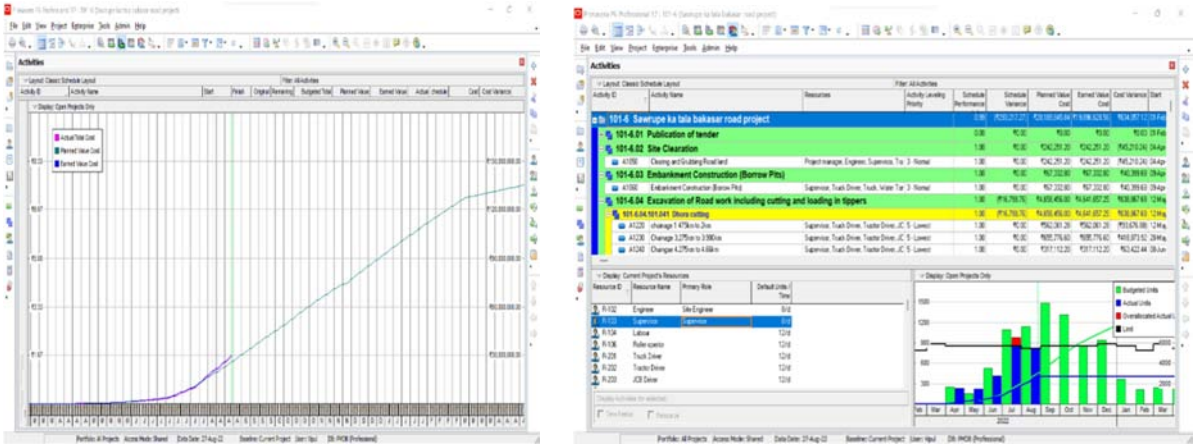


Figure 12 S curve& Resources over allocation (a.)S curve (b.) Resource Allocation

In Above graph clear Fig. 12 (a) show the variation between Earn value cost and actual cost with planned value cost as the work is proceed the cost may vary from budgeted cost shown in this graph. In this graph overall project actual cost is running lower then Earned Value so then project is running under budget yet.

Cost over burn areas and solutions

There are many areas where the project cost is gone higher then scheduled cost. The actual field conditions are different then assumed so it will caused delay in the project. Where the Scheduled performance index is less then one the project is lagging behind the Schedule. When a activity got delay or behind the schedule so it will affect further coming activities and the resources involved in it.

In Primavera software we assign the resources for any particular activity as per availability but in actual field conditions if activity get delay then the resources over allocation will happen.

These over allocation of the resources will cause the extra amount so project cost may slightly over burn. Some of the resource over allocation is shown in see fig.12 (b).

It is clearly shown that resource name supervisor is over allocated in month of july as shown in red bar because of some delay in the activities of july month primavera over allocated the resource so that project time may not affected. In real field situation same thing will happen because of some delay we have to pay extra amount of money for extra amount of spending days.

Like this resource some of resource involved in activity which schedule performance index is less then one get over allocated so primavera SPI directly indicate the activity which causing delay so now we have the task to over come this delay in the activity to make proper recommendation so further delay may not happen. We choose the resource optimization technique to overcome the cost over burn problem.

Resource optimization can be done by two methods :-

1.Resource smoothing

2.Resource Leveling

Resource smoothing :-

It is a technique by which the project resources are moved to make the project cost lower. In resource smoothing technique resources are assumed to be infinite no. and the project time is limited .Where high fluctuation of resources is required the project cost may increase due to hire them to cover the peak demand of resource profile. In this resource smoothing technique critical path is not affected so the duration of the project remains unaffected it means we have to adjust the float available so that optimization can be done.

Table 2 Labor Maximum Units

Resource name	**Availability/day**
Project Manger	22
Site engineer	22
supervisor	30
Labor-2	42
Labor-3	42
Truck Driver	63
Excavator Dirver	32

Resource Leveling:-

Resource leveling is the method by which the resources are assumed to be limited and project time is not a constrain so we have to make proper adjustment to level the resources means proper analyzing the situations to shift resources from one activity to another by leveling. In primavera software there are automatic leveling option so the software automatically analysis the requirement area of the resources and shift them accordingly doing this the project time may increase.

In our project we adopt the resource smoothing technique so the we can reduce over allocation of the resources to make the cost over burn solution.

Now as per month of july over allocated units and budgeted units as per primavera data are given below:-

Table 3 Wastage reduction Table

Name/month			**July**		
	Budgeted units	Actual Units	Over allocated units	wastages of man days	Limits
Project manger	631	647	23	3	624
Site engineer	631	647	23	3	624
supervisor	1093	976	125	16	851

Labour-2	1445	1261	70	6	851
Labour-3	1445	1261	70	6	1191
Truck Driver	2184	1854	67	6	1191
Excavator Driver	959	988	81	7	681

So as shown in table 3 all the over allocated units are performed leveled by resource smoothing to lead minimize the man waste days ie minimization of project cost which is over burning Primavera serve better to performing this.

Table 4 resource optimization

		July	
	Budgeted cost	Waste days cost	%reduction in cost
Project Manger	₹118312.5	₹4500	3.803486529
Site engineer	₹78875	₹3000	3.803486529
supervisor	₹90992.625	₹10560	11.60533615
Labor-2	₹121380	₹6048	4.982698962
Labor-3	₹130050	₹6480	4.982698962
Truck Driver	₹120120	₹3960	3.296703297
Excavator Driver	₹119875	₹10500	8.759124088

In this table 4 overall wastage in days as per cost is determined as per demand of resources are properly optimized and the project duration remains unchanged the project cost as per resources reduced shown in table 4.

CONCLUSIONS

Overall studying the data of site proper measuring the performance of each days of work in primavera scheduled performed and activities shown which get delay or performed on time are measured and the areas are marked where the delay is happened the reasons of delay has been founded and by proper resource optimizations the delay is minimized and the cost over burn problem is solved. Currently the project data's are:-

1. Over all the project BAC is ₹142841705.81 rupees
2. Planned Value Cost ₹26239782.59
3. Earned Value Cost ₹30327075.13
4. Actual Cost ₹2,97,68,995.05
5. Cost Variance 558080.08 Project is Spending less then budget
6. Schedule Variance₹-282963.10Project is spending more then budget
7. Cost performance index 1.02 > 1 i.e. the project is under budget
8. Schedule Performance index 0.99> 1 i.e. the project is slightly behind of schedule
9. Estimate to completion cost 142283626.73 3 i.e. future cost performances are going as per budget only.

10. In July month the over allocated resources are optimized and managed wastes days cost of₹45048 is adjusted for saving in over burning cost which is 5.54% in July month cost.
Identification of problem can be with ahead solution in time to resolve the issues can provide better by utilization of Earned value concept.In this thesis EVM framework as a strong execution estimation and anticipating instrument was effectively executed and tried for assembling industry and exceptionally fascinating outcomes have been delivered for far.

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A-Review of Literature Related to the Concept of Kaizen Philosophy

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Abstract. The document summarizes a variety of Kaizen approach literature that will benefit manufacturers as well as other people in their respective fields. The paper explains how individuals may use this Japanese technique (Kaizen) to increase their output, adaptability, and product quality. Additionally, it explains how to use Kaizen in conjunction with other techniques to boost a certain industry's productivity. Those who are serious about learning about the Kaizen process can benefit from this paper.

Keywords: Kaizen, Quality improvement, Changes for improvement, Workflow.

INTRODUCTION

Kaizen (Ky "Zen") is a Japanese phrase that translates to "continuous improvement" and is derived from the terms "Kai" (continuous) and "Zen" (improvement). Kai and Zen are both translated as meaning change and good or for the better, respectively. The late Dr. W. Edwards Deming, an American statistician, developed the idea of kaizen, or continuous improvement. "Do it better, make it better, and improve it even if it is not broken," according to the Kaizen concept, since if we don't, we can't compete with those who can [24]. Many of the features of Japanese companies that have been credited with their success are included in kaizen. As seen in the graphic, the Kaizen method of operating a firm includes quality circles, automation, recommendation systems, just-in-time delivery, Kanban, and 5S. Kaizen entails establishing standards and then continuously raising them. In order to support the higher standards, Kaizen also entails giving staff the instruction, resources, and oversight they require to fulfill the higher standards and keep their capacity to do so over time.[25]

Inventor of Kaizen Japanese organizational theorist and management consultant Masaaki Imai (Imai Masaaki, born 1930) is well-known for his work on quality management, particularly on Kaizen. Kaizen prioritizes increases in efficiency, effectiveness, and safety. However, individuals that adopt Kaizen will ultimately experience a variety of other advantages, such as: Less waste - inventory is utilized more effectively. A type of employee skill is kaizen. Kaizen and Lean ideas are effectively applied by many businesses to encourage continual improvement throughout the facilities. Kaizen supports businesses globally in reducing waste and streamlining operations. Toyota, which pioneered the practice, is the most well-known Kaizen corporation.[26]

Fig.1 Kaizen – An Umbrella Concept

Fig.2 Principles of Kaizen

Every kaizen tool and every KAIZEN action are based on the 5 Fundamental Kaizen Principles that are depicted in Fig. 2. The 5 guidelines are: know your customer, let it flow, go to the gemba, give people authority, and be transparent are the first three rules.

Fig.3 Kaizen Steps

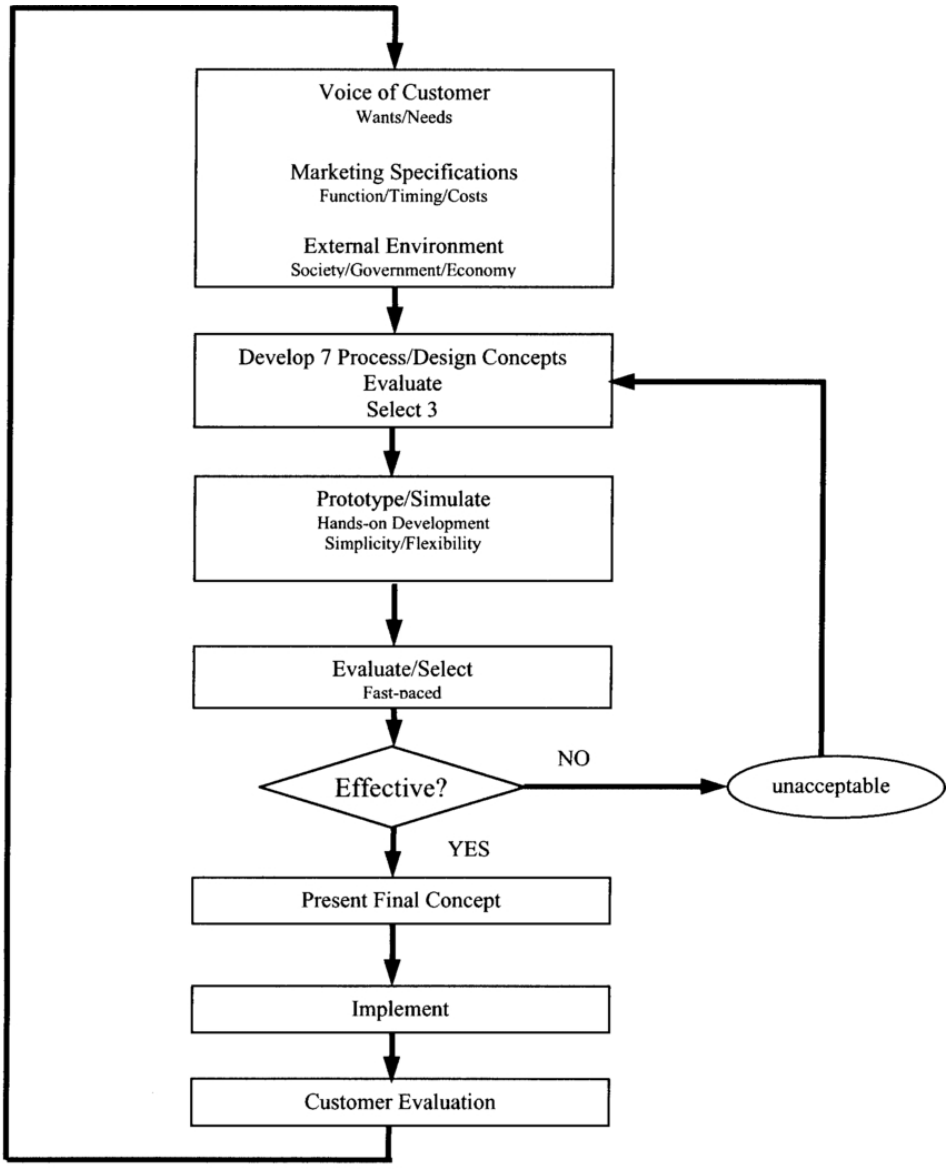

Fig.4 Kaizen Process Overview

Application process of kaizen event basically consists of,
1 definition of the area to be improved
2 key problem analysis and selection
3 identifications of cause of improvement
4 improving project implementation
5 measuring, analyzing and comparison of the results
6 standardized systems.
Kaizen encompasses a wide range of strategies, including Kanban, total productive maintenance, six-sigma, automation, just in time, recommendation systems, and productivity enhancement (Imai, 1986).

LITERATURE REVIEW

Haftu Hailua et al. (2017) [1] "**Critical Success Factors Model Developing for Sustainable Kaizen Implementation in Manufacturing Industry in Ethiopia**", The researcher's objective is to identify critical success factors and develop a model for maintaining the look of Kaizen. Peacock shoes are one of the Ethiopian manufacturing companies fighting to maintain Kaizen. The technique is based on empirical testing factor analysis of ideas. A factor analysis using principal components and varimax rotation was applied to recognize the significant success variables. According to studies using multiple regression models, several of the basic success traits have links to success indicators. Because of time restrictions, the inquiry focused primarily on the peacock shoe manufacturing industry. Another limitation is the absence of recent local research revealing critical success factors.

Jose Arturo Garza-Reyes et al. (2020) [2] "**Deploying Kaizen Events in the Manufacturing Industry: An Investigation into Managerial Factors**", Although the authors conducted substantial study on Continuous Improvement (Kaizen), little reflection has been documented on the management aspects required to successfully implement Kaizen Events (KEs). This study looks into numerous managerial elements that influence KE implementation. Following a review of the literature and consultation with specialists, the study's goals and six research questions were developed. A survey questionnaire was created and verified with the help of 175 industrial companies. The acquired data was analyzed using a combination of descriptive statistics and one-way ANOVA testing. In addition to other soft' elements, the findings determine: (1) the motivations and hurdles to KE implementation in the pre-implementation stage; (2) the important success elements and problems associated with KE implementation in the implementation stage; (3) the reasons for failure KEs; and (4) the reasons that prevent organizations from running KEs. By examining different stages of KEs implementation, the study gives insights into an under-researched area. The study adds to the contingency and RBV theories by demonstrating the significance of various scenarios and resource planning for KEs implementation. The findings are useful for industrialists who want to drive CIs in their organizations by using KEs.

Asayehgn Desta et al. (2014) [3] "**Analysis of Kaizen Implementation in Northern Ethiopia's Manufacturing Industries**"**,** Kaizen manufacturing practices in Japan have transformed the way businesses deliver goods to their consumers. Many manufacturing companies, similar to Japanese manufacturing enterprises, have aspirations to advance, retain market share, and satisfy their domestic market while expanding into the international market. Building many manufacturers now wish to cultivate a culture of continuous improvement. companies. In other words, a lot of international organizations are attempting to cultivate the habit of continuous improvement through kaizen, as well as to focus on a customer-driven approach to enhance efficiency and product and service quality by accruing incremental gains over time. The impacts of newly adopted kaizen approaches at three case factories in Northern Ethiopia were analyzed using a questionnaire survey, and interviews, and direct observation of workers who had a direct hand in the implementation process. The three pilot case firms were evaluated based on key performance indicators that particularly relate to inputs, outputs, and process variables of the kaizen management system. If 1) senior management and workers really care about the company's immediate and long-term health, 2) work teams have an action attitude, 3) employees are dedicated to the company's value systems, and 5) employees' proposals are utilized as leverage for improvement in the production process. According to the study, the three pilot companies have reduced production costs, improved quality, reduced lead time, increased customer satisfaction, and partially achieved three of the five (5S) kaizen steps: sorting, setting, and shining, but they have yet to learn how to standardize and sustain self-discipline. The study also found that the CEOs in the three pilot cases did not appear to be devoted to kaizen collaboration. Despite the importance of front-line workers in continuous improvement, they are rarely encouraged to engage as a team.

Edna Maryani et al. (2020) [4] "**Do Gemba Kaizen and 5s Reinforce Medical Equipment Manufacturing Performance?**", The goal of this study is to examine how the Gemba Kaizen culture and the application of 5S (Seiri, Seiton, Seiso, Seiketsu, and Shitsuke) affect the productivity of the medical equipment manufacturing sectors in Indonesia. Structural Equation Modeling (SEM) is used in this study as a quantitative method with smart PLS software. Data collection methods using online questionnaires and simple random sampling techniques, the number of samples to be used by respondents as many as 300

Medical Equipment manufacturing managers. The findings of this study show that the Gemba kaizen has a favorable and significant impact on the efficiency of the production of medical equipment. The performance of the manufacturing of medical equipment is significantly and favorably impacted by 5S. The research's implication is that kaizen and 5S can be used as a reference for other industries and can be applied to various manufacturers to improve their performance. The originality of this study is in the development of a new model for the impact of applying new kaizen and 5S to Indonesian industries that produce medical equipment.

Dipak P. Gauri et al. (2015) [5] "**Application of Lean Kaizen in Productivity Improvement and Safety Measures in A Manufacturing Industry**", Productivity is an extremely important component in every industrial company. The efficiency of a machine is equivalent to the productivity of a manufacturing system. Productivity is an average measure of production efficiency. Highest production efficiency is achieved by producing the needed quantity of goods, of required quality, at the required time, using the best and cheapest way. The fundamental necessity of any industry is to continuously increase product quality and production. To enhance this, employ suitable manufacturing strategy and tools to fulfill corporate goals in order to stay competitive and boost profit. Kaizen, which means "continuous improvement," is the ideal strategy for continuously improving production. Kaizen results in increased labor productivity improvement. The Kaizen idea has been adopted by enterprises worldwide as a means of boosting production values while also enhancing staff morale and safety. Kaizen is a team practice that fosters engagement between workers and management. It concludes that the implementation of Kaizen and transformation at the workplace can lead to increased productivity.

Shaman Gupta et al. (2014) [6] "The **5s and Kaizen Concept for Overall Improvement of the Organization: A Case Study**", The goal of this research is to use some of the 5S and kaizen principles to help small scale manufacturing organizations become more efficient and productive. The work categorizes, analyses, and examines the published material meticulously. The 5S and kaizen guidelines in the organization were examined and applied within the framework of a case study. According to the case study, implementing the 5S and kaizen rules causes significant improvements in the organization, such as increased process effectiveness and efficiency, enhanced process visibility, improved staff morale and safety, decreased delays, searching time, and risky circumstances.5S and kaizen are strong tools that may be used in any sector, whether micro, small, medium, or big. The implementation of 5S and kaizen has a significant horizontal development and may be implemented in all of the organization's workstations. Each company's improvement program begins with the 5S and kaizen methods. Its outcome is a successful workplace organization. The papers and case studies offered in this paper will help scholars, professionals, and anyone interested in this topic comprehend the importance of 5S and kaizen.

Pratesh Jayaswal et al. (2012) [7] "**Implementation of Kaizen and Jishu Hozen to Enhance Overall Equipment Performance in A Manufacturing Industry**", In recent years, there has been a tremendous increase in the maintenance management of physical assets and productive systems to decrease energy and resource waste. Total productive maintenance (TPM) is a tried-and-true strategy for increasing equipment's overall equipment effectiveness (OEE). It comprises eight operations, two of which are targeted improvement and autonomous maintenance to increase equipment performance. These exercises are designed to educate participants on the ideas and philosophy of equipment maintenance while also providing a chance for them to expand their knowledge and abilities. In the case study of a leaf spring manufacturing firm, an attempt is made to discover equipment areas for development; kaizen and Jishu hozen are done to improve overall performance and productivity. To remove the reasons, the why-why approach of root cause analysis is applied. The equipment's OEE is enhanced from 43% to 68%, while labor costs are reduced by up to 43%. Improved OEE in the manufacturing industry resulted in increased availability, better resource use, higher quality goods, and increased employee morale and confidence.

Mayank Dev Singh et al. (2015) [8] "**Process Flow Improvement Through 5s, Kaizen and Visualization**", The lean manufacturing philosophy is currently attracting the attention of manufacturers all over the world. The lean manufacturing techniques used in this project include 5S, Kaizen, and Visualization. A tool for ensuring a systematic workplace environment is 5S, Kaizen is continuous improvement through small steps to achieve economic results for the organization, and Visualization is a technique for creating images, diagrams, or animations of the firm's activity that are a helpful and effective way of communicating

for all people associated with the firm. This project aims to make use of these technologies and provide an integrated strategy. Also, to eliminate abnormality in organizations by implementing ergonomics for various employee working positions, which boost productivity, by implementing it at the pipe manufacturing business "Sandvik Asia Pvt. Ltd, Mehsana, Gujarat. "The firm's owner is likewise interested in implementing this idea; so, from an industrial standpoint, this project will teach us how real implementations of lean principles take place.

Amit Kumar Arya et al. (2015) [9] "**Assessing the Application of Kaizen Principles in Indian Small-Scale Industry**", The purpose of this research is to depict Kaizen implementation in a machine vice manufacturing firm. Kaizen has had a significant influence on manufacturing practices and lead times. In India, a great number of small-scale industries have emerged. Due to fierce rivalry among small businesses, it has been difficult for them to survive. All are dealing with issues such as low output and bad-quality items. Design/technique/approach - The methodology used to execute Kaizen in small-scale industries in India. To show cause and consequence, fishbone diagrams have been utilized. The end result has been savings in both money and time. **Findings:** Inventory access time is decreased by up to 87%, while total distance traversed and total time consumed by product are lowered by 43.75 and 46.08 percent, respectively. Workers have established the practice of keeping the workplace tidy. **Limitations/implications of research** - ISO might be linked with Kaizen for additional improvements. **Practical implications** - The study should help practitioners and consultants who want to learn more about Kaizen implementation in India's small-scale industry. **Originality/value** - This study provides several benefits for practitioners in understanding the necessity, implications, and relevance of Kaizen implementation in India's small-scale enterprises. It also bridges the gap between Kaizen theory and practice in real-world working situations in Indian industry.

Ravinder Kumar et al. (2019) [10] "**Manufacturing Organization**", Kaizen is a continuous improvement practice in manufacturing, assembly, quality, and engineering. The authors of this paper discussed the issues that a leading automobile manufacturing organization was having with the quality of interior car parts such as plastics and rubber. During the study, the author employed a novel technique known as "Global Customer Audit," which is essentially a vehicle audit from the perspective of the final customer for automobile interior parts. During this audit, the author observed various defects and arranged them according to their intensity or magnitude of occurrence, i.e. finding a useful one from a large number of trivial ones, using various quality control tools such as pareto charts, histograms, and check sheets. This paper discusses Using various quality control tools, the author discovered the root cause of defects. Kaizen is used to eliminate defects and continuously improve products and manufacturing processes. Kaizen contributes to making the manufacturing process leaner, simpler, and more efficient. The primary goal of this paper is to discuss the concept of Kaizen and its application in case organizations solve problems that raise significant quality concerns on a daily basis.

Manjunath Shettar et al. (2015) [11] "**KAIZEN – A Case Study**", The ultimate goal of manufacturing industries is to increase productivity while maintaining high quality. Many manufacturing companies are currently dealing with issues such as high-quality rejection, high inventories, long lead times, high production costs, and an inability to meet customer orders. Many problems can be solved by implementing and practicing the lean production system, rather than using high-tech and high-touch approaches, but by involving people on the shop floor in Kaizen activities. Kaizen is a powerful tool in lean manufacturing. Kaizen is the Japanese term for continuous improvement in performance, cost, and quality. Kaizen makes sure that production procedures are leaner and more effective while also getting rid of waste (problem) in areas where value is added. The primary goal of this paper is to provide an overview of kaizen concepts that are used to transform a company into a high performing lean enterprise. A case study of Kaizen implementation has been discussed.

Sandeepsoni et al. (2015) [12] "**Quality Circle: A Methodology to Identify Scope of Quality Improvement Through Kaizen Approach**", Kaizen has become one of the most important tools for achieving improvement in any field, such as production, process, quality, and maintenance, in the manufacturing industry. Kaizen can be achieved through improved performance by team players working together to achieve any industry's goal. As a result, quality circles are introduced to keep the improvement process on track through teamwork. This research paper is an empirical study of the Kaizen approach based on the Quality Circle in which extensive literature was studied chronologically. The study's conclusion

implies that the Quality Circle methodology, in conjunction with the Kaizen approach, is a useful tool for improving process, product, and quality in the manufacturing industry. This research paper discusses a case study that provided evidence of product quality improvement in a small-scale industry by using the Quality Circle Methodology.

Leandro Vieira et al. (2012) [13] "Ergonomics **and Kaizen as Strategies for Competitiveness: A Theoretical and Practical in An Automotive Industry**", With increased international competitiveness in the automotive industry, companies were concerned about saving money and lowering production costs. Many methods are being developed to reduce raw material costs and waste, as well as activities that add no value to manufacturing processes. The manufacturing system, which processes were hard with little concern for the health and safety of employees and workplace conditions, appears in the early XVII. Following the introduction of the lean manufacturing production system, a new paradigm in terms of production system capable of providing high levels of productivity and quality emerged. The research will be carried out by collecting data "on the spot" and conducting interviews with workers. According to some studies, in companies with a lean system and It is based on the elimination of waste during the manufacturing process. After that, a new way of thinking began, with the creation of a culture of continuous improvement and lean processes with no waste and cost reductions, without ignoring the welfare of workers and improving their working conditions. This essay offers a reflection on the use of ergonomics in a lean production system for the automotive industry. It discusses the benefits and drawbacks of using this methodology for ergonomics along with a methodology based on continuous improvement known as Kaizen.

Puneet Sharma et al. (2015) [14] "**Process Improvement by Implementation of Kaizen as A Quality Tool Within Defined Constraints: Case Study in Manufacturing Industry**", The idea of kaizen is to gradually improve a workplace or an organization. Imai, author of KAIZEN - The Key to Japan's Competitive Success, was the first prominent and most frequently cited proponent of kaizen (1986). The kaizen case study in this essay focuses on The ABC Company, a Small Medium Industries (SMI) business that makes nonwoven fabrics. This case study aims to minimize material waste. To conduct the case study, Kaizen steps are used as guidelines, and the PDCA Cycle is used as a problem-solving approach. Why, Work Instruction Sheets, Pareto diagrams, Process Mapping, PDCA Cycle, and brainstorming were used as appropriate tools and techniques. Kaizen implementation has reduced time losses. Furthermore, the sales order processing and production lead times were reduced. These findings demonstrate the effectiveness of the kaizen methodology.

Fasika Bete georgise et al. (2020) [15] "**Kaizen Implementation in Industries of Southern Ethiopia: Challenges and Feasibility**", Continuous improvement strategies are a method of making small incremental improvements to the processes of an organization. To remain competitive, these organizations must constantly maintain a low cost of quality, reduce waste, trim production lines, and speed up manufacturing. Companies in both developed and developing countries are attempting to develop the habit of continuous improvement through Kaizen, as well as to focus on a customer-driven strategy to increase productivity. Over time, the quality of products and services continues to improve marginally. Kaizen, a Japanese concept that calls for continuous improvement, has been introduced in Ethiopia to improve organizational performance through increased productivity and quality. Even though there has been a formal interest in implementing Kaizen for twenty years, the results are rarely seen. In this essay, the feasibility and acceptability of Kaizen are examined within Southern Nation and People Regional State organizations. In the Region, 71 stakeholders and 24 pilot businesses participated in a survey that included a questionnaire, interviews, and observational research. The study found that participants were willing to implement Kaizen. The study did identify certain challenges to the sustainability of kaizen initiatives, though. The study's conclusions show that, despite the fact that Kaizen's viability is quite challenging, it is acceptable and suitable among the organizations analyzed. The study also discovered that the enterprise executives did not appear to be committed to Kaizen teamwork. Despite the fact that teamwork is critical for continuous improvement, front-line workers are rarely invited to participate. This paper covers many domains like, Industrial Engineering & Manufacturing; Manufacturing Engineering; Engineering Management; Electromagnetics & Communication; Engineering Economics.

Taposh Kumar Kapuria et al. (2017) [16] "**Root Cause Analysis and Productivity Improvement of an Apparel Industry in Bangladesh Through Kaizen Implementation**", The garment industry is leading

the way in improving Bangladesh's economic situation. It began in the late 1970s and is now Bangladesh's leading foreign currency earner. It is without a doubt that the Bangladesh garment industry is improving garment service quality and innovative design features in order to compete in the global market. The global competition in the garment market is changing on a daily basis. Leading garment manufacturers around the world are incorporating new innovative features and techniques to compete in the global market. However, the point is that Bangladeshi garment manufacturers have not remained silent. They are also emphasizing better service quality by incorporating new design elements and employing cutting-edge technology in their garments. Using the Kaizen (Continuous Improvement) approach, this paper's only goal is to pinpoint the underlying factors that contribute to sewing errors in the Bangladeshi garment sector. In a nutshell, the apparel industry's productivity is increasing. "ABONTI Color Tex. Ltd." is the garment manufacturing company we investigated. To identify the top defect items, Pareto Analysis is used. Cause-Effect Analysis assisted in determining the root causes of sewing defects. Kaizen is then used to continuously improve the minimization of sewing defects.

Silvia Pellegrini et al. (2012) [17] "**Study and Implementation of Single Minute Exchange of Die (SMED) Methodology in A Setup Reduction Kaizen**", Cutting setup time becomes essential given the urgent need for businesses to improve the efficiency of their product delivery. Setup, also known as changeover, is frequently one of the most time-consuming and non-value-added activities in a manufacturing operation. The goal of this paper is to show how setup time reduction techniques can be used in a medium-sized manufacturing plant to reduce overall process lead time. The project was carried out during a kaizen event and focused on the application of Shigeo Shingo's Single Minute Exchange of Die (SMED) methodology for setup reduction. Deming's Plan-Do-Check-Act (PDCA) cycle, which is based on a scientific approach to problem solving, was used to generate and implement ideas for improvement, with an "idea assessment prioritization matrix" developed to evaluate the soundness of each idea. As a result, the process setup time was reduced from 90 to 47 minutes, and additional opportunities for improvement were identified. The paper also discusses how such techniques can be used not only in a medium-sized plant, but also in a large major manufacturing industry that engages in mass production at multiple global locations.

Manuel F. suarez-Barraza et al. (2008) [18] "**Kaizen within Kaizen Teams: Continuous and Process Improvements in A Spanish Municipality**", Researchers want to develop a team learning approach and try to establish inventory development for delivering more quality work. In this paper the author has presented a method of studying kaizen terms in a local Spanish government that has been using kaizen for more than ten years. Twenty teams took part in the study by completing Lingham's Team Learning and Development Inventory (TLI). In addition, researchers interviewed team members to clarify and confirm their quantitative results. This is one of the first studies in Spain's public sector to examine team performance using the Team Learning (TI) and Development(DI) Inventory.

Table of Review Papers

Authors: Maharshi Bhatt et al.
Year: 2014
Paper Title: " A brief literature review on Total Productive Maintenance"
About the Paper: This paper presents a review of the literature on Total productive maintenance (TPM), which is a positive approach to solving manufacturing problems with the goal of achieving zero defects and thus increasing productivity and quality in manufacturing industries. This paper also discusses the TPM pillars and how they play an active role in the manufacturing system. OEE (Overall Equipment Effectiveness) is used to determine TPM success or failure.

Table. 1 [19]

Authors: Jagdeep Singh et al.
Year: 2009
Paper Title: "Kaizen Philosophy: A Review of Literature"
About the Paper: The authors of this paper have highlighted the ultimate goal for manufacturing industries, and the current scenario is to increase productivity through system simplification, organizational potential, and incremental improvements through the use of modern techniques such as Kaizen. They also provided a brief overview of how the kaizen philosophy has been implemented in various industries and workshops.

Table. 2 [20]

Authors: Mohd Ghazali Maarof et al.
Year: 2016
Paper Title: "A Review of Contributing Factors and Challenges in Implementing Kaizen in Small and Medium Enterprises"
About the Paper: The introduction of ASEAN Economic Community (AEC) in 2015 poses another challenge to the Small and Medium Enterprises (SMEs) in Malaysia to remain competitive in a larger market of ASEAN, apart from the existing effect of globalization from low-cost countries such as China and India. It is important for these SMEs to remain competitive in the market since SMEs contribute significantly to the Malaysian economy. One method to improve business competitiveness is by applying the concept of continuous improvement also known as Kaizen. This paper reviews some selected factors contributing to the successful implementation of Kaizen and its challenges among small and medium enterprises. The factors such as good communication between the top management and their employees, clear corporate strategy, the presence of a Kaizen champion personnel in the organization, good knowledge management and employee's empowerment were found to contribute to the successful implementation of Kaizen. The review also found that resistance to change, failure to motivate employees, lack of understanding on companies' strategic path and difficulties in managing continuous improvement itself formed some of the challenges in implementing Kaizen. It appears some similarities exist between small and medium enterprises, and large companies in terms of the contributing factors in implementing Kaizen. Thus, this paper can provide some insights into the factors contributing to successful implementation of Kaizen and its challenges. Hopefully, this paper can be beneficial to the Small and Medium Enterprises as well as other industry players in formulating their continuous improvement or Kaizen strategies.

Table. 3 [21]

Authors: Haryadi Sarjono et al.
Year: 2022
Paper Title: "Systematic Literature Review: Analysis of Determinants of the Quality of BRT Transportation Using the Kaizen Method"
About the Paper: Transportation comes from the Latin word transporter, and has 2 utilities, namely place utility and time utility to facilitate relationships between other communities. Article searches are carried out using the "Google Scholar" and "ResearchGate" databases. The preparation of the research follows the basic steps of research which include determining the research objectives, conducting a literature review on the development of the Kaizen method. This paper finds that the kaizen method has been used in various social fields, transportation and so on. Road transport is a major contributor to C02 emissions due to dependence on fossil fuels. The main causes of emissions are motor vehicles, buses, taxis, and intercity foam. The main reference for the design and development of Transjakarta is the BRT system. Transjakarta is considered as

one of the cities in the world that has failed to achieve high quality BT services. Building a sustainable transportation system for big cities and complexes is not an easy thing. The Transjakarta BRT system is projected to be a sustainable solution for the ever-increasing needs of urban transportation. Various problems and shortcomings are interconnected such as: Inefficiency (low carrying capacity), physical problems (design) and construction), operational issues of mismanagement and political issues of lack of transparency and corruption. Refers to the best practice of the BRT system in the world, development of regulations and plans have been studied and implemented extensively.

Table. 4 [22]

Authors: Lidia Sanchez-Ruiz et al.
Year: 2020
Paper Title: "Scoping Review of Kaizen and Green Practices: State of the Art and Future Directions"
About the Paper: Given the importance that environmental management is acquiring, the main aim of this work is to know what the state of the field kaizen and green practices is at present. A systematic narrative review is conducted in accordance with the PRISMA Statement. Two databases (Web of Science and Scopus) were searched. Finally, after applying the defined inclusion and exclusion criteria, 19 documents were analyzed. Based on the results, it might be concluded that, despite the growing interest in the relationship between kaizen and green practices, this is a topic in the early stages of development, with a clear predominance of case studies. It is, therefore, necessary to develop more research on this kaizen and green issue as improving environmental management is undeniably becoming a must in today's competitive environment. For instance, more research is needed on the application of kaizen tools as results obtained so far seem not to be conclusive. Additionally, more academic and rigorous studies should be developed on this topic as many of the analyzed papers seem to be clearly created for dissemination among practitioners, some of them lacking the traditional academic structure and scientific method during their development.

Table. 5 [23]

CONCLUSION

According to existing literature, there is a largish literature available on Kaizen philosophy, which provides a broad view of past practices and research carried out around the globe. However, because Kaizen is a widely accepted philosophy in manufacturing industries, more research is needed in this area. The authors believe that the Kaizen philosophy can be applied to a variety of fields such as business, service, and commerce. As a result, fresh researchers in this field have a diverse set of study options. Success stories show that fully implementing the system necessitates team efforts involving every employee in the organization. However, there is a lack of awareness among employees about the various strategies involved in the Kaizen philosophy, as well as the various principles underlying these strategies and their application. Even today, kaizen philosophy can be applied on a personal level as a life management strategy, but the literature on it is scarce. As a result, it could be a new area for kaizen implementation.

ACKNOWLEDGMENTS

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A PROPOSAL TO IDENTIFY TRUSTWORTHY DATA IN SMART CITY APPLICATION

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Abstract: Era of Internet of things from past to give bargain numerous problems like security, authentication, privacy, confidentiality, additionally extraordinary assaults like tampering, jamming, sinkhole etc. Numerous issue is some way resolved using different IDS system (DEMO, SEVLTE) and other protocols like FIWARE, SMARTIE, and different scheme like RealAlert, Time based key generation etc. In this period a number of smart devices will increase rapidly and the use of smart devices also be increased to access the services from different things to made a city Smart, so it can be easy to manage by Internet of things (IoT).The Internet of things is transparently provide access to the different system, so that all the data is collected from different things. The main goal of these research is to provide trustworthy and correct data to sensor node. To identify trustworthy data for that we use the RSSI value, 6LoWPAN based on IEEE 802.15.4 and also check on – off attack so, utilizing our approach we use the Contiki OS and Cooja simulator to implement the trust evolution framework for smart city application.

Keyword: Trustworthy, IoT, Smart City, WSN, Security, RSSI

INTRODUCTION

Internet of Things (IoT) is a computing concept which provides interconnection between the uniquely identifiable devices. By integrating several technologies like actuators and sensor networks, identification and tracking technology, enhanced communication protocol and distributed intelligence of smart objects, IoT enables communication between the real time objects present around us. The effectiveness of IoT can be seen in both domestic (e.g. Assisted living, e-health, enhanced learning) and business (automation, intelligent transportation) fields.

While various issues are related to the implementation of IoT, Security of IoT have significant impact on the performance of IoT applications. Trust is an important aspect while talking about secure systems. A system can behave in untrustworthy manner even after having security and privacy implementation. Behavior based analysis of devices is required that can predict the device performance over the time. Trust management provides behavior based analysis of entities, using their past behavior, reputation in the network or recommendation. A trustworthy system is needed to prevent from unwanted activities conducted by malicious devices. My research work is to design a dynamic trust management system for IoT devices.

The IoT is an emerging area of interest for current developing networks. It has varied field of applications like industry, healthcare, transportation, smart city, etc. The IoT Connect both inanimate (nonliving) and living things by using sensors for data collection. A primary aim of the Internet of Things (IoT) is to deliver personalized or even autonomic services to individuals, building on a pervasive digital ecosystem that collects information from and offers control over devices that are embedded in our everyday lives. In future the number of smart objects are increase rapidly so all data must be passed in secure way via base station to smart things. As numerous problem arise like tempering, sinkhole, privacy issue, bad mouth attack, on-off behavior etc. when transfer the data in Internet of Things (IoT). So all these issues effects to the data and appropriate information cannot get through numerous objects and also generate the delay. To avoid these issues to must check the trustworthiness of data. Trust issue generate from malicious node, fault tolerant when sensing task done in wireless sensor networks.

State of Art

Internet of Things (IoT) is known as one of the key enabling technology for smart city application. In these paper author proposed policy based secure and trustworthy sensing for smart city application and these system is known as RealAlert. In these system to check the trustworthiness of data and IoT devices based on the report generated from collect the context of data based on policy rules. In RealAlert system evaluate the trustworthiness of IoT nodes and detect the malicious nodes [1].

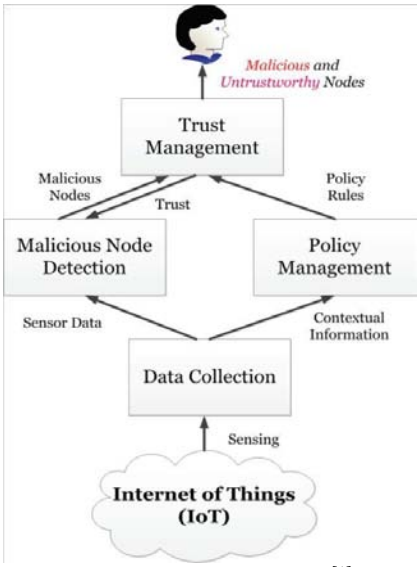


Fig 1 RealAlert Scheme [1]

Related Work

Policy-based Secure and Trustworthy Sensing for Internet of Things in Smart Cities [1]

This paper illustrate the trustworthiness of data as well as the sensor node and that system name as the RealAlert. In this paper, a policy-based secure and trustworthy sensing scheme is proposed for IoT called RealAlert. In the scheme, we identify the untrustworthy IoT nodes by evaluating its data reporting history. Moreover, policies are used to identify malicious nodes that have been compromised by attackers using contextual information. RealAlert is a holistic scheme, which is comprised of four components, i.e., data collection, policy management, malicious node detection, and trust management, aiming at properly evaluating the trustworthiness of the IoT nodes and detecting malicious ones in different contexts using policies.

State space model-based trust evaluation over wireless sensor networks: an iterative particle filter approach [2]

This paper authors proposed the state space modeling approach for evaluate a trust in wireless sensor networks. In these model each sensor node associate with a trust matric, which measure what kind of data transmitted from one node to another node and trusted by a server node. The performance of WSN depends on collaboration among distributed sensor nodes, while those nodes are often unattended with severe energy constraints and limited reliability. In such conditions, it is important to evaluate the trustworthiness of participating nodes since trust is the major driving force for collaboration and the trust value can be used as a decision making criteria for the end-user to take appropriate measures such as replacing detected faulty nodes.

Trustworthy service composition with secure data transmission in sensor networks [3]

This paper authors describe the service composition in sensor networks with secure way to transfer the data and over wireless sensor networks. Service composition provides us a promising way to cooperate various sensors to build more powerful IoT applications over sensor networks. However, the limited capability of sensor node poses great challenges not only to trustworthy service composition but also to secure data aggregation. In service-oriented sensor networks, the functionality provided by each sensor node is treated as a service and Services can be composed together dynamically and rapidly to develop novel and powerful

applications. For a variety of candidate services, consumers can select qualified ones with respect to their specific functional and security requirements. In many cases the services might be malicious. They may not deliver its task with promised quality, or cause confidential data leakage to the public. Therefore, trust and security are the main concerns of service composition in sensor networks.

The Smart Citizen Factor in Trustworthy Smart City Crowdsensing [4]

The authors proposed the reputed based crowd sensing for smart city application. Smart city areas expect to enhance nature of life by merging ICT framework into physical and social foundation in urban conditions. The smart city foundation comprises of an application layer in which services are conveyed to citizen; a network layer in which users, information sources, and service provider's communication and in perception layer in which data acquisition and recruitment of sensing devices take place.

A survey of trust computation models for service management in internet of things systems [5]

In these paper authors survey on trust computation model for Internet of things for the purpose of service management. The open issue to solve is to devise an effective and efficient trust computation method for an IoT device acting as a service requester to dynamically assess the service trustworthiness of an- other IoT device acting as a service provider, taking into consideration of the service history. Trust computation done using quality of services (QoS) and social trust. In QoS trust refers to the belief that IoT devices is able to provide the quality service in response to a service request. To measure the QoS by packet delivery ratio. Social trust define from social relationship between owners of IoT devices and is measured by privacy, connectivity, intimacy. Propagation of trust done through to provide the evidence and trust propagation scheme that is 1. Distributed 2.
Centralized. In distributed manner the observation of IoT devices without any centralized entity and it is difficult to access the centralized entity. For making the distributed trust propagation each node in network maintain a data forwarding information table for hearing the activity of neighboring node but the disadvantage is if RSS field provide the wrong information to that data forwarding information table then wrong services provided by malicious nodes. In centralized trust propagation that require the centralized entity either a physical or virtual. Centralized trust propagation require more cost if the centralized entity is physical and may be require large amount of processing time. It is necessary to collect the evidence through the self-observation or feedback for the trust aggregation is required.

Trust Management Mechanism for Internet of Things [6]

Trust management has been used for providing the security service for the smart device. In these paper the authors illustrates the trust management architecture. In trust management architecture contain three layers: sensor layer, core layer and application layer. However, due to complex and heterogeneous architecture of IoT so the trust management issue cannot solved by cryptography. When provide the trust to data that time it is necessary consider how data passed through from sensor layer to core layer to application layer. In which one problem arise when to
assign the fuzzy logic by sensor node from sensor layer. In these trust procedure the trust management include when the service provide to service requester.

A Survey on Security and Privacy Issues in Internet-of-Things [7]

In these paper authors illustrates the architecture of authentication and access control mechanism for IoT, another segment describes the limitation of IoT devices and security issues in different layers. Limitation of IoT devices is the effect of environmental that time sensor networks or any sensing task is done so due thunderstorm or tsunami effect to provide the services to different things and also may contain the battery life problem due environmental effects.The final phase is the authentication request which is sent from the IoT device to the gateway. For the authentication scheme an approach is Datagram Transport Layer Security (DTLS) based on certificates with mutual authentication. The communication is done by introducing a new device called IoT Security Provider (IoTSSP), which is responsible for managing and analyzing the devices' certificates along with authentication and session establishment between the devices.

Security Access Protocols in IoT Capillary Networks [8]

Smart city services must be easily access by the IoT devices and that will used the huge amount of sensors, topologies of networks secure way to manage them. The capillary networks provide the short range extension network for show the IoT traffic. The author proposed the two types of IoT devices like IP-

bidirectional and IP-unidirectional devices. Capillary networks are seen as the fundamental enabling infrastructure(s) required for IoT, and more in general, for Internet of Everything, and then for the realistic development of the smart environment (SE) concept. It allows to collect traffic from any sensor device. In IoT scenarios, a number of technologies have been developed in order to achieve information privacy and security goals, such as the transport layer security, which could also improve confidentiality and integrity of the IoT, and the onion routing, which encrypts and mixes Internet traffic from different sources, and encrypts data into multiple layers, by using public keys on the transmission path. 6LoWPAN enables embedded nodes to use a restricted subset of IPv6 addresses, 6LoWPAN is a combination of IPv6 and IEEE 802.15.4.

Security in Internet of Things: issues, challenges, taxonomy, and architecture [9]

In these paper the authors illustrates DDOS, security challenges for different layers, RPL and various security issues in RPL and 6LoWPAN. The Routing Protocol for Low power and Lossy Networks (RPL) proposed for low power devices which will be an integral part of the IoT scenario lacks a proper security model. There are no special security measures proposed with RPL.

Modelling trust dynamics in the Internet of Things [10]

In these paper authors illustrate the trust management framework for IoT environments. In these framework there are mainly three main layer is: Services, Scenario, and Requirements. The scenario is the lower level of trust management framework and it's include the context and Use cases. Context include the dynamicity of a trust model could be captured if we are able to determine the factors that influence trust in a given moment in time for a specific purpose. We advocate that trust models that are going to be defined for a given "thing" do not depend only on its behavior but also on what we call the Context or things around it.

PROPOSED FRAMEWORK FOR IDENTIFY TRUSTWORTHY DATA FOR SMART CITY APPLICATION

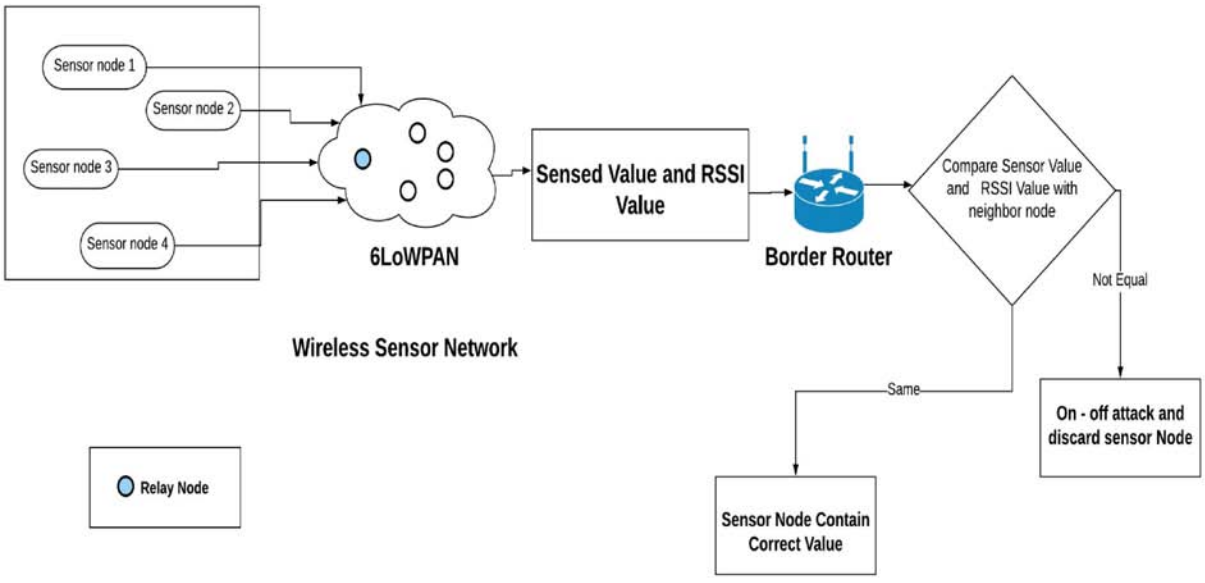


Fig 2. Proposed architecture for Identify trustworthy data for Smart city application

All the component of proposed architecture described below:

- Sensor node: Sensor node contain sensed value. In these sensor used the sensor data of temperature sensor, humidity sensor and light sensor.
- 6LoWPAN: It is an IPV6 based local personal area network with limited processing power and IEEE 802.15.4 based networks.

• Relay Node: When number of sensor node connect and that all node must in synchronous way to pass the sensed data that task done using Relay node.

In Proposed architecture to identify trustworthiness of sensor data for that 6LoWPAN, relay node and RSSI value used in above given smart city scenario framework. Relay node main task is to all the number of sensor node is connected them, so all the sensor node in synchronous way done the sensing task. Perhaps any of sensor node or malicious nodes come to wireless sensor network that time during sensing task must compare its sensor data and also checked it is connected with relay node or not. If it's new added sensor node is connected to relay node then its RSSI value and sensor data compare with its neighbor sensor node. If its value of newly added sensor node and its neighbor node sensed value, RSSI value same then in wireless sensor network no any malicious nodes available. When sensor node does not connect to relay node because its sensor data same with any sensor network sensor node but its location and its RSSI value is different, so wireless sensor network contain on – off attack. It is necessary to discard that particular node from sensor network. In these proposed scenario we used temperature sensor, Humidity sensor and light sensor. In on – off attack sometimes malicious node act good or bad. Using border router to route the information and sent to base station. Using 6LoWPAN the sensor node ipv6 address capture and store it to the route table. Because sensor has a low memory capacity and low processing power for that we used the 6LoWPAn based on IEEE 802.15.4 networks. We simulate our approach using Contiki OS and Cooja simulator.

IMPLEMENTATION AND ANALYSIS

Contiki is a wireless sensor network operating system and consists of the kernel, libraries, the program loader, and a set of processes. It is used in networked embedded systems and smart objects.

Starting Cooja
We can start the Cooja simulator using the following commands:
1. cd Contiki-3.0/tools/cooja
2. ant run

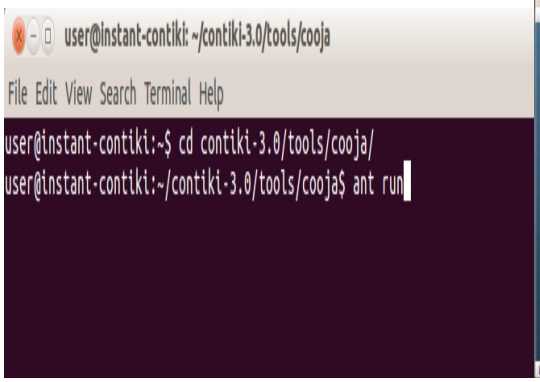


Fig 3 Starting Cooja

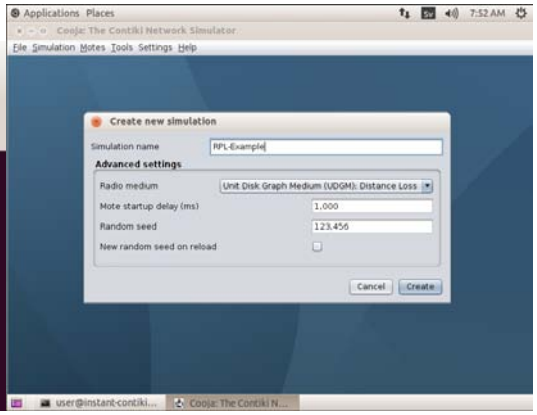


Fig. 4 Creating new simulatio

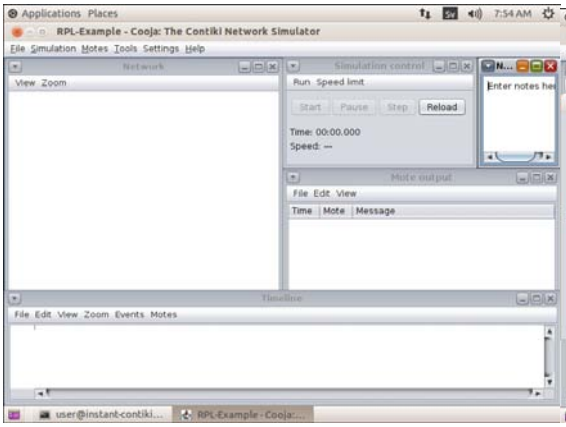


Fig. 5 Simulation interface

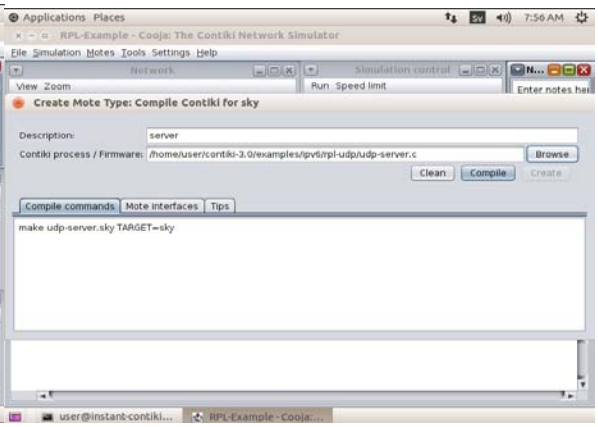


Fig 6 Create mote type interface

Setting Mote Types

Similarly, we may create the UDP Client mote by using the *udp-client.c* file. Once we do this, we will notice that a total of six randomly placed nodes will appear in the Network window. One possible random arrangement can be seen in Figure 7 . Amongst these, node 1 is the UDP Server and the rest are nodes which will execute the UDP Client code.

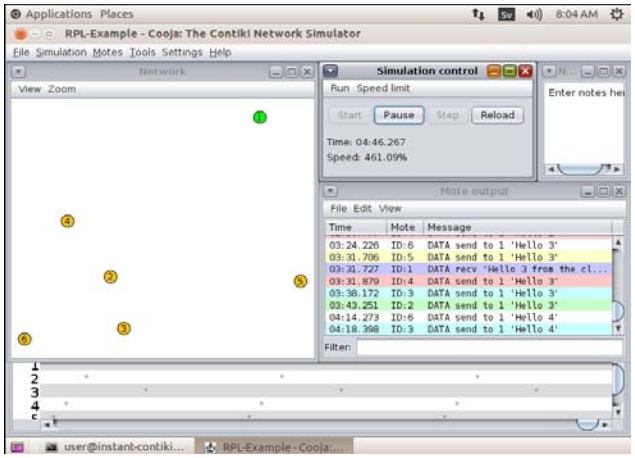


Fig. 7 Example Output

Proposed Work

The proposed algorithm shows the method of trustworthy data identify by RSSI value. To identify trustworthy data we check the RSSI value and also sensing value of sensor neighbor node as well as own node. If both have a same RSSI value and sensing value then sensor node is trustworthy. But some sensor node does not have same RSSI value but same sensing value i.e. temperature value, humidity etc. then that particular sensor node will be discarded.

1. Repeat
2. Sensor node: Sensor Value
3. for i in Read (Sensor node)
4. Print “Sensor data”
5. End For
6. If RSSI value (Sensor node)! = RSSI value (neighbor node) and
Sensor value (Sensor node) == Sensor value (neighbor node) then
7. Print “On – off attack generate in Sensor network and node will discard”
8. Else
9. Print “Right Node available in sensor network”

Wireless Sensor Network

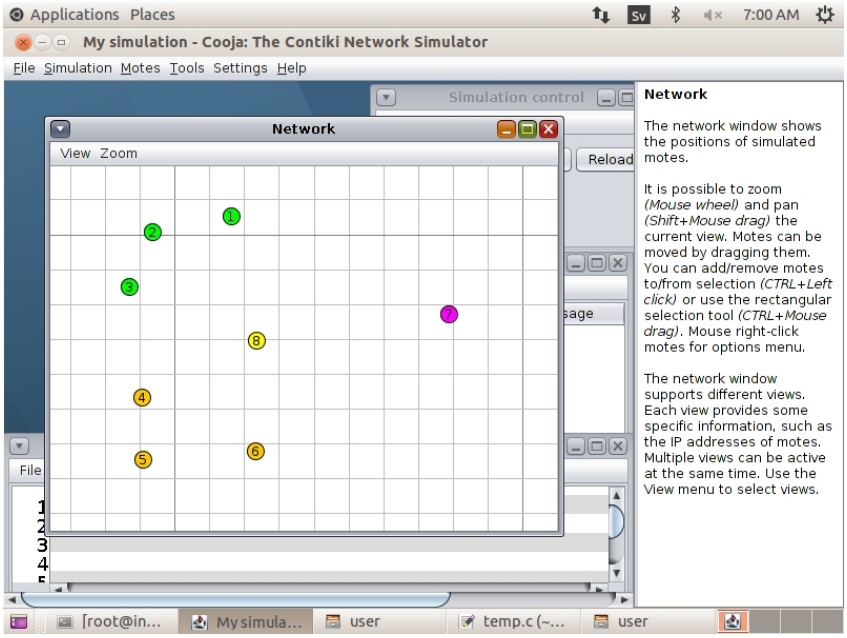


Fig 8 Wireless Sensor Network

To identify Trustworthy Data Using RSSI Value

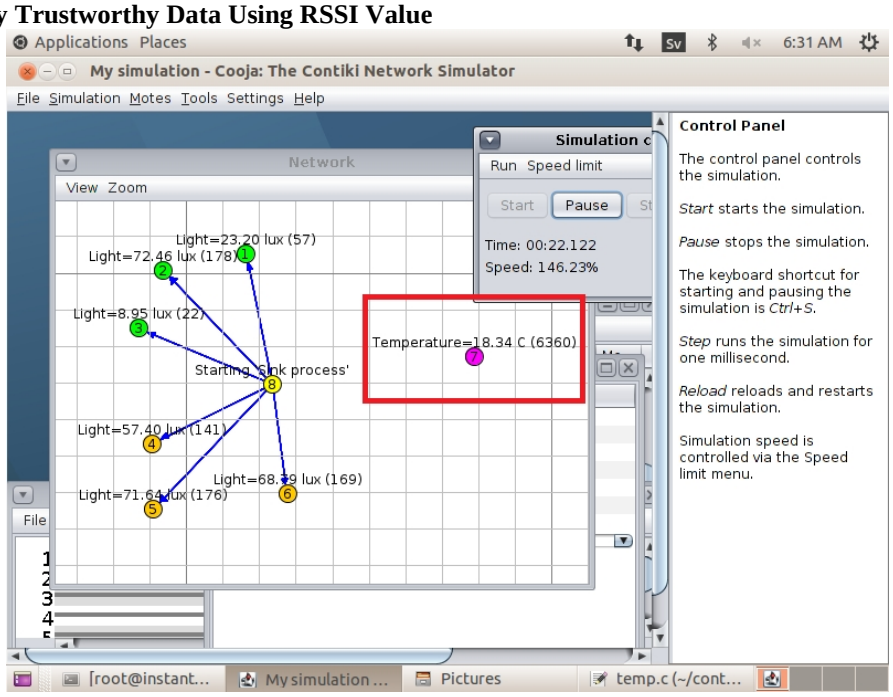


Fig 9 Identify Trustworthy Node and Data

In Figure 9 red rectangle indicate the untrustworthy data and node because it is not connect to sensor node and behave like on-off attack. Because its temperature data is same but RSSI value is different.

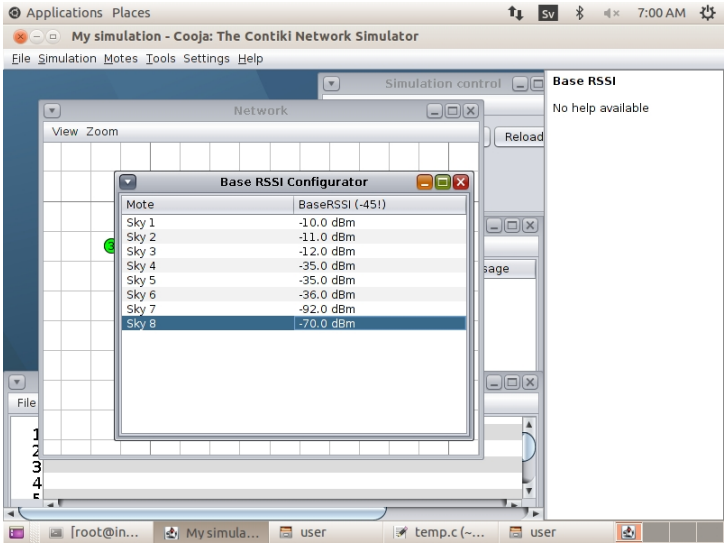
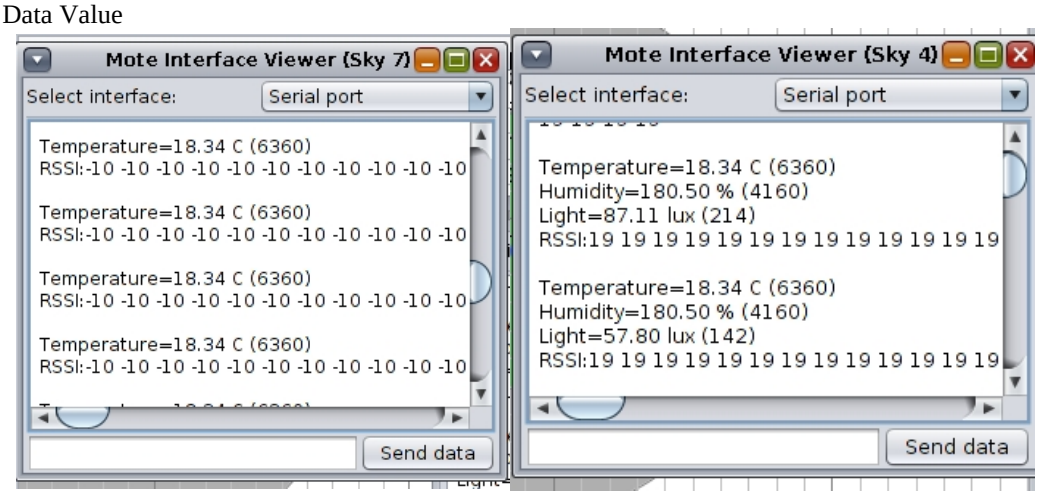
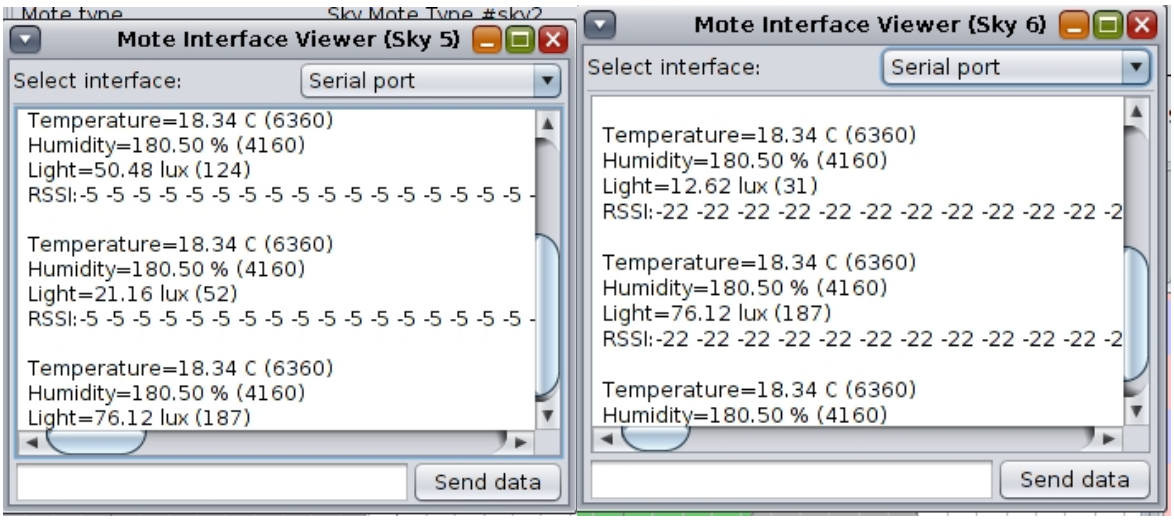


Fig 10 Base RSSI Value of Sensor Node

Sensor Data Value





CONCLUSION AND FUTURE WORK

Every sensor has a limited memory and computing power so it is required store data in sensor node must be trustworthy, which make routing in devices more challenging. Using 6LoWPAN (IEEE 802.15.4), RSSI value we easily find trustworthy sensor data by comparing its RSSI value to its neighbor node available in network. As in our proposed algorithm, we have considered RSSI value of the particular signal as a parameter which indicates the strength of the received signal. This will help in the selection of the sensor node from which the incoming signal is having high RSSI value i.e. nearby node which leads to the best path to follow for the

Transmission of the packet. There are several other aspects that need to be explored as a future work. Our next work is to measure value of the performance metrics for the existing algorithm and for the proposed work we measure on – off attack. Using RSSI value and 6LoWPAN IP based protocol we compare the sensor node RSSI value with near available sensor node and also compare sensor node sensed data. If sensor node have different RSSI value but same sensed data then in wireless sensor network contains on – off attack and that malicious behavior must be detect.

In these proposed system we create virtual sensor network but in future we work with real time data of sensor network so we find malicious activity and avoid the bad mouth attack, ballot stuffing attack from wireless sensor network. Then compare their scenario with result of simulation study.

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Modelling and Speed Control of BLDC Motor for Electric Vehicle

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Abstract. Due to the rise in energy demand, new technologies such as regenerative braking have emerged to improve energy efficiency. The major goal of this thesis is to manage power flow under braking and acceleration with speed control of motor. The power travels from the battery to the motor during accelerating and normal modes, and the kinetic energy of the motor is transformed into electrical energy and sent back to the battery during braking or regenerative mode. A three - phase BLDC motor (star connected) drive having optimal trapezoid back-EMF waveforms is also addressed. To rotate the motor six – step commutation with trapezoidal back emf technique is used. The fuzzy tuned PID control scheme for BLDC motor speed regulation employing a bidirectional converter's which are suggested in this paper. For modeling MATLAB/Simulink software will be used to simulate a BLDC motor with a PID controller.

Keywords: *BLDC motor, regenerative braking, Fuzzy-PID controller, Electric vehicle.*

INTRODUCTION

Electric vehicles have gotten a lot of interest in recent time as a viable replacement for conventional Internal Combustion Engines(ICE). EVs have emerged as one of the greatest conceivable replacement to ICE cars as batteries and powertrain techniques improve. EVs have become a solution to the climate disaster that will occur in the not-too-distant future. However, the issue that is usually raised is how does the endurance of EVs be extended. The achievement of the search for an effective and robust form of energy, such as an enchanted batteries or competence using fuel cell technology, effective energy recovery systems, and so forth, will determine the solution towards this problem[1-2].

Regenerative braking converts mechanical energy directly into electric energy, which may then recharge the battery that can be used to propel the car throughout the drive scheme. Regenerative braking does have the ability to regulate energies in this way, improving fuel efficiency and lowering pollutants that pollute the atmosphere. Across a proper power line, this mechanical energy is transmitted to the car's wheel, causing motion[3].

In a three – phase BLDC motor, the PID control is utilised to oversee the functioning of the four quadrants without losing any electricity. After simulation of the speed control of BLDC motor model we will see that generated back emf voltages of all three - phase are in form of trapezoidal and 120˚ apart from each other. Hall effect signal of all three - phase will be in square wave. Hall effect decoded signal, stator current waveform and six gate pulse signals will also be generated. We will also examine that the actual speed of the vehicle follows the reference signal with less deviation. We will see that as the speed increase the battery will be discharged and as the speed decrease the battery will start to charge[4].

PID has a straightforward structure with benefits in each variable. A good controller must respond quickly and settle quickly without producing overshoot. Furthermore, in various loading conditions and with a changed setpoint value, the PID has been unable to deliver a rapid response. The FLC, in additional to PID controller, is used to control the speed of the motor. However, due of the complicated fuzzification as well as defuzzification , FLC has a larger commutation time over PID controller. The PID and FLC methods are combined in this study. Towards this systems, PID has become primary controller, and FLC is utilised to tweak PID's parameters. As a result, this technology have been used to a dynamical system to create steady state reaction for motor speed for BLDC motors in EVs[5].

Apart from that, the motor may be regulated over all 4 aspects without wasting of any energy; in reality, energy can be stored well during regeneration time. In the regeneration phase, those power is produced inside an energy storage device may be

sent returned towards the inverters main supply in the situation of a source supply insufficiency. MATLAB software is used to create and evaluate a BLDC motor drive prototype to be used in an EVs. Regarding BLDC motor control, an analysis of PID controller and fuzzy tuned PID controller are made for vehicle speed control system. The outcomes demonstrate that the fuzzy tuned PID controller significantly improves speed characteristic i.e., rise time, overshoot, settling time, accuracy and steady state error as compred to the other.

BRUSHLESS DC MOTOR

Mathematical Modeling of BLDC Motor

A BLDC motor can be modelled using one of two methods: the abc phase variable model or the d-q axis model. The back EMF of a BLDC motor is trapezoidal, whereas the back EMF of a synchronous motor is sinusoidal. The mutual inductance sandwiched between the stator and the rotor is non-sinusoidal because the stator and rotor are trapezoidal. As a result, shifting to the d-q axis adds no value, and it is decided to use the abc phase of the system model. In this concept, the motor is considered to be star linked with isolated ground[7-8].

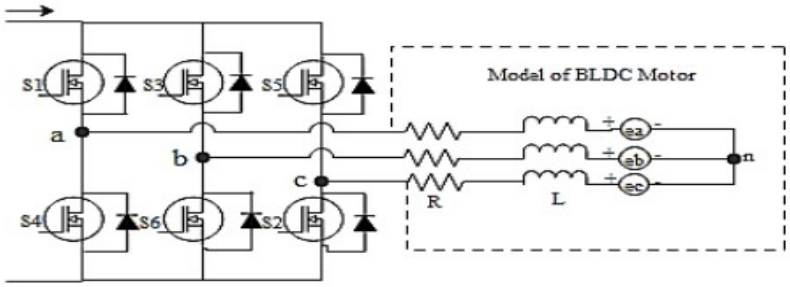


FIGURE 1. BLDC motor drive system

The matrix from the phase voltage equation of brushless DC motor can be shown as

$$\frac{d}{dt}\begin{bmatrix} i_a \\ i_b \\ i_c \end{bmatrix} = \begin{bmatrix} -\frac{R_s}{L-M} & 0 & 0 \\ 0 & -\frac{R_s}{L-M} & 0 \\ 0 & 0 & -\frac{R_s}{L-M} \end{bmatrix}\begin{bmatrix} i_a \\ i_b \\ i_c \end{bmatrix} + \frac{1}{L-M}\begin{bmatrix} V_{as} \\ V_{bs} \\ V_{cs} \end{bmatrix} - \frac{1}{L-M}\begin{bmatrix} e_a \\ e_b \\ e_c \end{bmatrix}$$

Speed Control of BLDC Motor

Figure 2 shows a block diagram of the speed control of a PID based BLDC motor utilising a bidirectional converter. There are two modes of operation for the DC-DC converter: buck and boost. The converter enhances the voltage from the battery and feeds it to the motor via the voltage source inverter in boost mode. A bidirectional DC-DC power converter is required to charge and discharge the batteries. The BLDC motor drive must be able to receive power from the battery. All four quadrants can be driven by the brushless motor. The battery is used to store the extra electricity is produced by regenerative braking system[6].

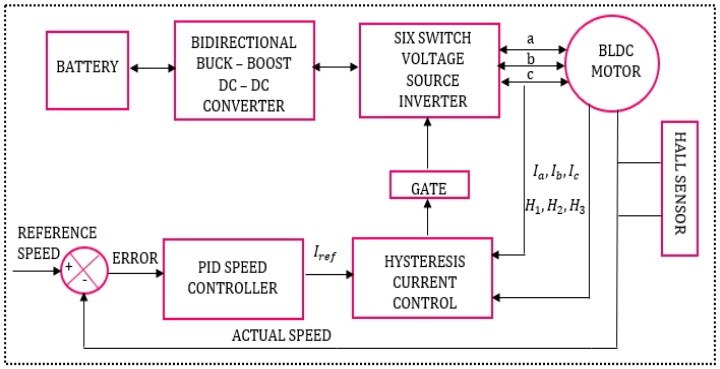


FIGURE 2. Block diagram of the proposed control system

A fuzzy tuned PID controller is used to regulate the speed of brushless motor. The inaccuracy is determined by the discrepancy between the given speed and observed speed. A disparity between the standard and required speed of the motor, which is investigated by a hall signal, produces the error signal that is used to formulate fuzzy rules and generate gate signals to operate the switching circuit. For this project, it was decided to use a three-phase BLDC motor with designed Hall sensors. The operating point must be detected using hall sensors and supplied into the controller. The given speed signal is provided as an input to the controller[9-10].

DESIGN OF CONTROLLER

Fuzzy Tuned PID Controller

Fuzzification, fuzzy rules, fuzzy inference engine, and defuzzification are the four factors to take into account while implementing a fuzzy control scheme. In aspects of motion control, the BLDC motor system has two input data: error and change in error. Error would be defined as the variation between the position setpoint value and the original stance. Whereas, change in error, also known as delta error, is the error in process excluding the preceding error[11]. The resulting value is the voltage enforced to the BLDC motor drive scheme as shown in figure 3.

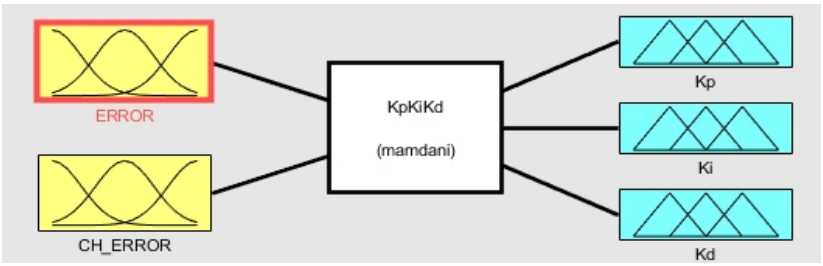
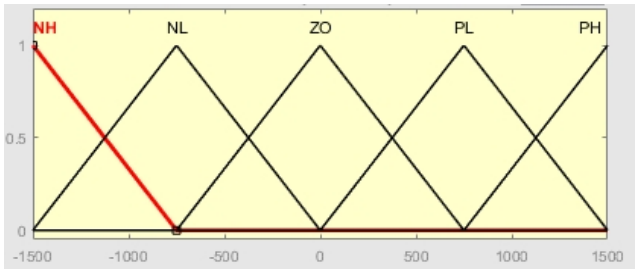


FIGURE 3. (a) Membership function for fuzzy logic control scheme input and output

To do a fuzzy computation, the input data can be converted from numerical / crisp values to fuzzy elements, and the output data must be converted from fuzzy sets to crisp values. The following linguistic phrases are used to quantify the fuzzy elements error, delta of error, and output such as Negative High (NH), Negative Low (NL), Zero (ZO), Positive Low (PL), Positive High (PH), Positive Very Low (PVL), Positive Low (PL), Positive Moderate Low (PML), Positive Moderate High (PMH), Positive High (PH), Positive Very High (PVH). Figures 3(b) and 3(c) demonstrate the membership function with speed deviation (e) and change in speed deviation ($\triangle$e).



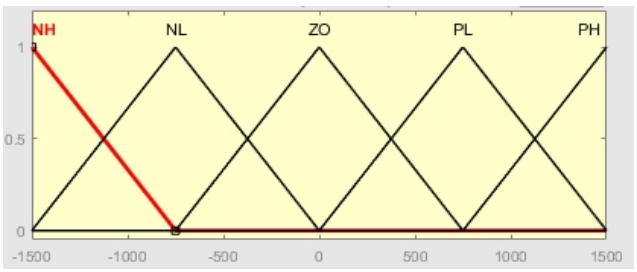
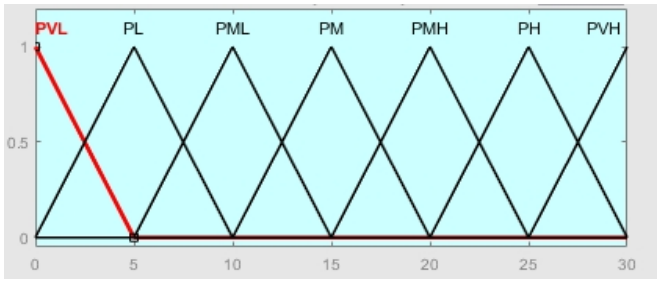


FIGURE 3. (b) Membership functions for error, (c) Membership functions for change in error

While the fuzzy output consists of three output. There are output for Kp, output for Ki, and output for Kd. The membership function output of Kp, Ki, and Kd parameters is shown in figure 3(d),(e),(f) respectively.



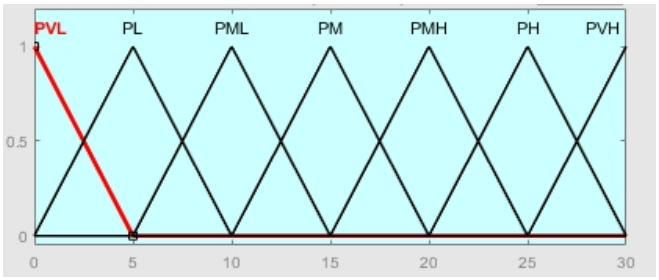


FIGURE 3. (d) Membership functions for k_p, (e) Membership functions for k_i

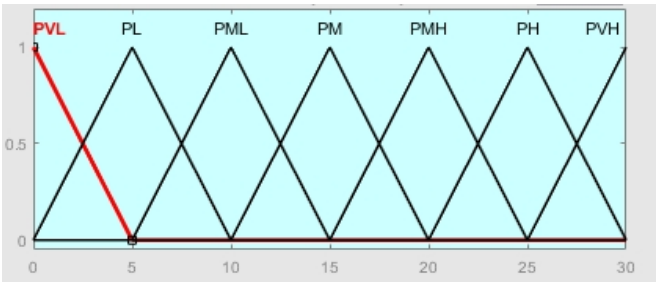


FIGURE 3. (f) Membership functions for k_d

The parameter values of Kp, Ki, and Kd at fuzzy output are obtained from the system tuning result using Ziegler Nichols method. So we get the value of Kp, Ki, and Kd at each set point and each load. The parameter value is used as a reference for fuzzy output.

TABLE 1. FLC rule base of k_p, k_i , k_d

e/∆e	NH	NL	ZO	PL	PH
NH	PVH	PVH	PVH	PVH	PVH
NL	PMH	PMH	PL	PH	PVH
ZO	PVL	PVL	PL	PML	PML
PL	PMH	PMH	PMH	PH	PVH
PH	PVH	PVH	PVH	PVH	PVH

MATLAB/Simulink model for BLDC motor drive

Figure 4(a) shows the model for BLDC motor speed controller drive with regenerative braking system which contains 3-Phase inverter, buck-boost converter, battery and controller block with fuzzy tuned PID closed loop control system.

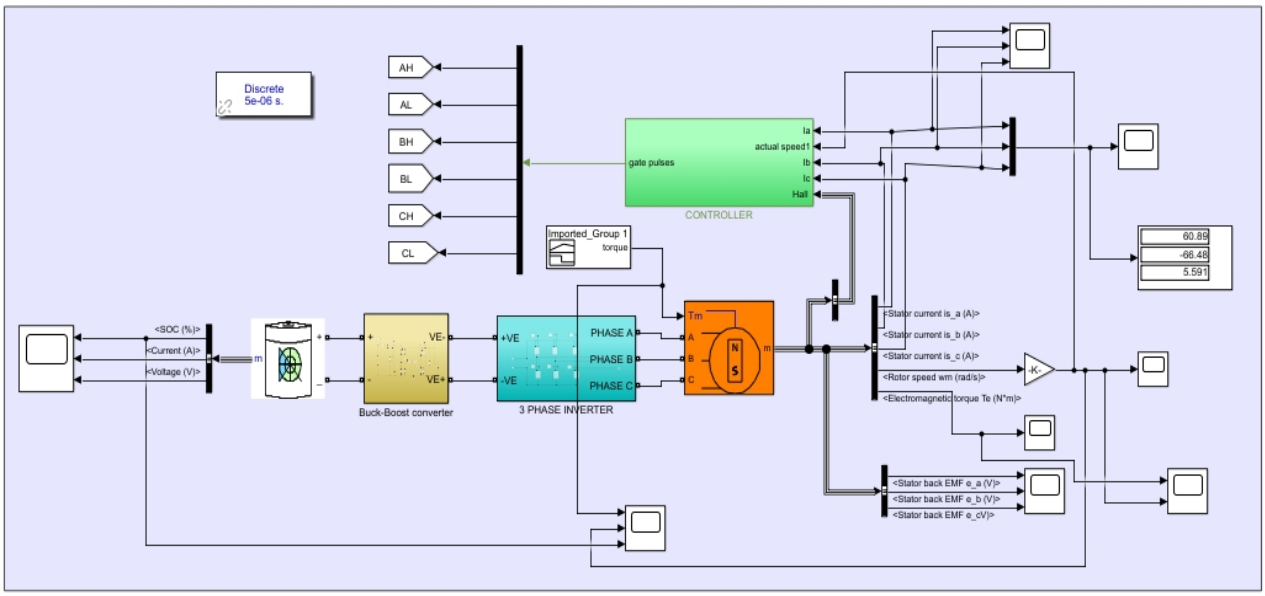
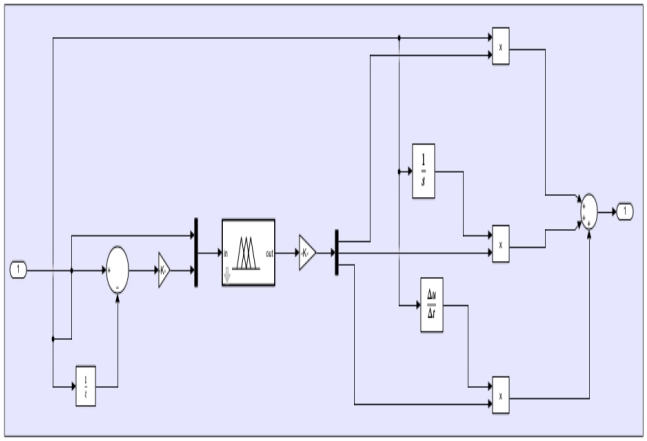


FIGURE 4. (a) Linear BLDC motor MATLAB/SIMULINK model



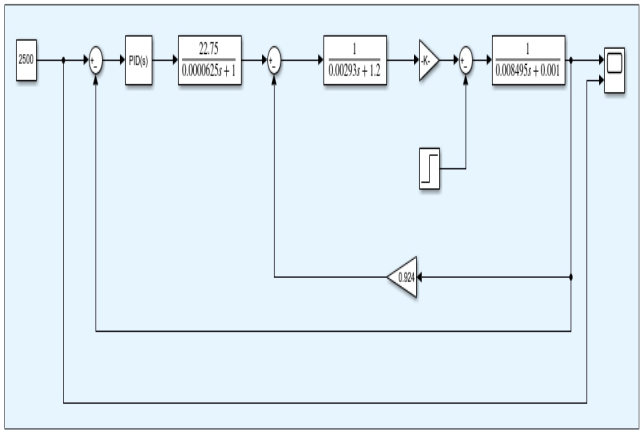
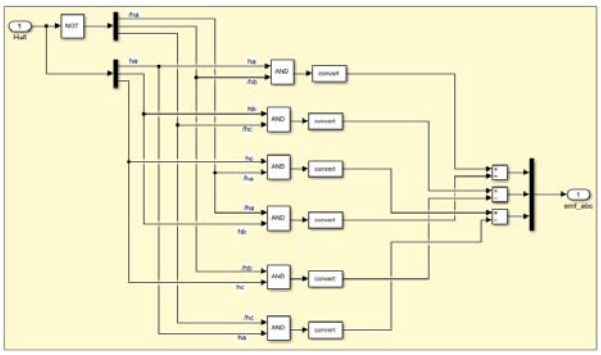
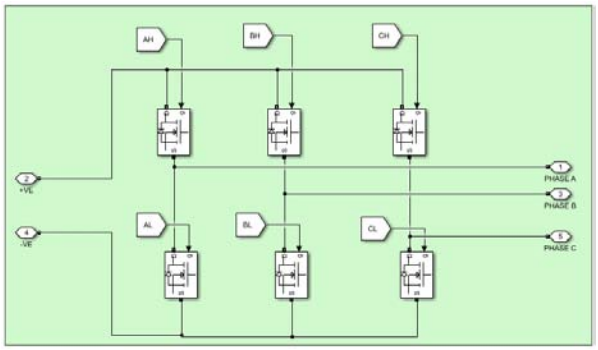


FIGURE 4. (b) Fuzzy-PID Simulink block for BLDC motor model, (c) PID Simulink block for BLDC motor model

Figure 4(b) and figure 4(c) illustrate the Fuzzy tuned PID controller and PID controller subsystem block respectively.





(d) (e)

FIGURE 4. (d) Hall effect decoder Simulink block for BLDC motor model, (e) Inverter Design for Simulink block for BLDC motor model

Hall sensor decoder and Inverter switching design circuit Simulink block for BLDC motor demonstrate by figure 4(d) and figure 4(e) respectively.

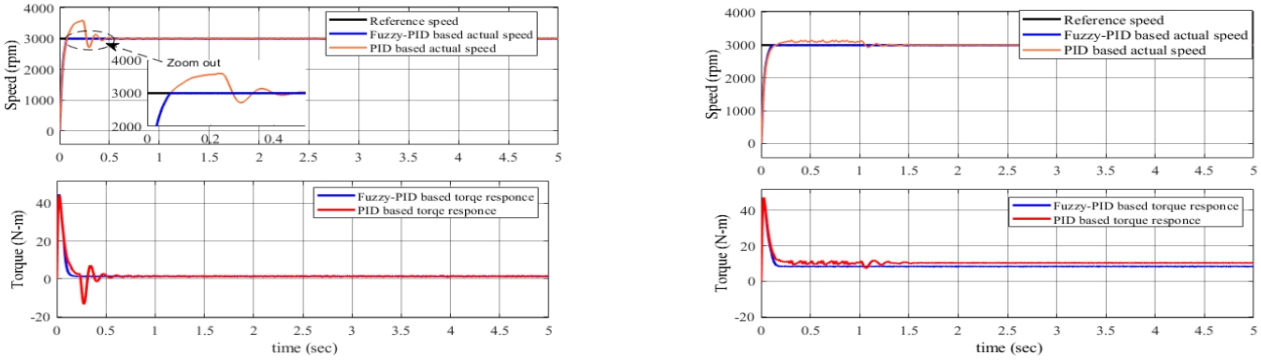
TABLE 2. Rotor angle with sector number

	ANGLE		SECTOR
IF	$0° < \theta < 60°$	THEN	Sector = 1
	$60° < \theta < 120°$		Sector = 2
	$120° < \theta < 180°$		Sector = 3
	$180° < \theta < 240°$		Sector = 4
	$240° < \theta < 300°$		Sector = 5
	$300° < \theta < 360°$		Sector = 6

SIMULATION RESULT

The simulation is performed using 48V; 1KW brushless DC motor, with nominal speed of 3000 rpm. Figure 5(a) and figure 5(b) show output response from PID-Fuzzy and conventional PID at set point 3000 rpm with no load and with load.

At a steady speed of 3000 rpm, the reference signal is obtained. Figure 5(a) depicts the speed response characteristics of a BLDC motor under no load for PID and fuzzy tuned PID controllers. Settling time for a PID controller is 0.087 seconds, however it is 0.013 seconds for a fuzzy tuned PID controller. PID control has a 9.4 % overshoot; In contract, fuzzy tuned PID control has 0% overshoot.



(a) (b)

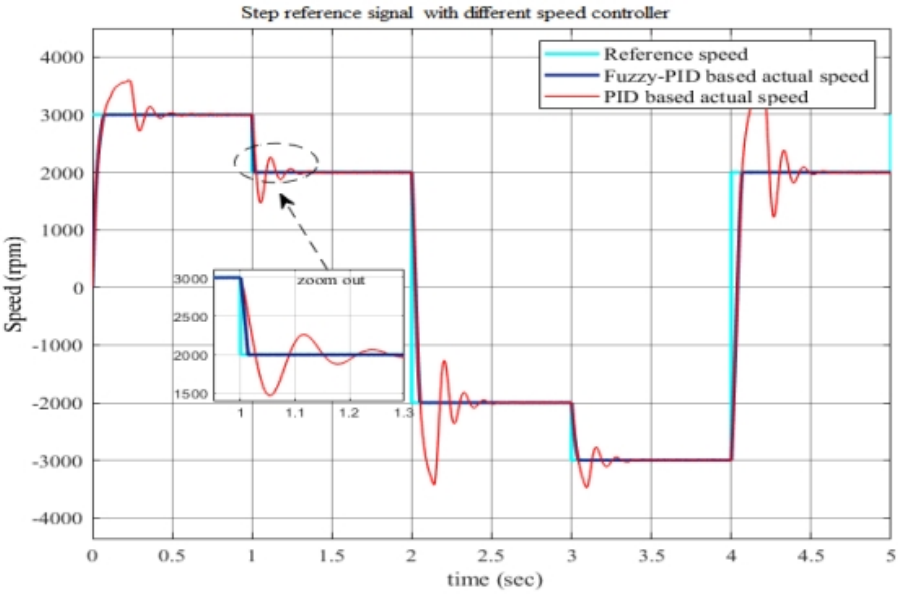
FIGURE 5. (a) Speed and torque response under no load condition, (b) Speed and torque response under high load condition

Figure 5 (b) depicts the speed response of a BLDC motor under heavy load for PID and fuzzy tuned PID controllers. After a heavy load is given to the system, the PID controller settles in 0.01 seconds. After applying a heavy load to the system, the settling time for the fuzzy tuned PID controller is 0.004 seconds.

Figure 6(a) shows the speed response of a BLDC motor for PID and fuzzy tuned PID controllers under no load conditions. On figure 6(b), the fuzzy self-calculated Gain parameters were k_p = 1.503, k_i = 0.1763, k_d = 7.503, and the performance parameters were found to be rise time of 0.04974sec, 1.96 percent overshoot, and vary good stability. In contrast,

these settings were k_p = 0.082119, k_i = 10.374485, k_d = 0.0001368, with rising time of 0.05192sec, 9.420 % overshoot, and good stability for PID Controller performance.

(a)



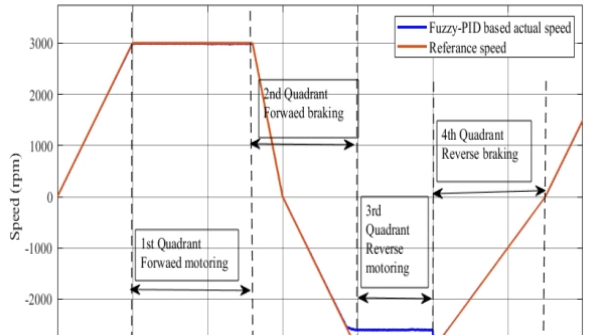
(b)

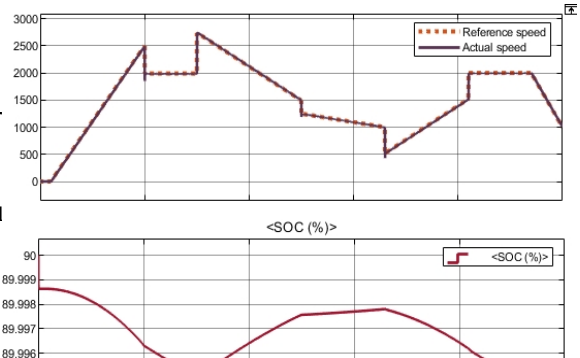
FIGURE 6. (a) Step reference signal and rotor speed responses of PID and Fuzzy-PID controller, (b) Performance comparison results for PID and Fuzzy-PID controller

To compare system performance on conventional PID and PID-Fuzzy, measurement of speed response performance on brushless DC motor is shown in Table 3. Where tr is Rise Time (ms), ts is Settling Time (s), and Mp is Overshoot (%).

TABLE 3. Performance comparison results for PID and fuzzy tuned PID controller

TIME RESPONSE SPECIFICATIONS	CONTROLLER	
	PID	FUZZY - PID
Settling time (t_s)	0.087sec	0.013sec
Rise time (t_r)	0.05192sec	0.04974sec
Overshoot (%)	9.4 %	1.96 %
Steady – state error (e_{ss})	0.005	0.003





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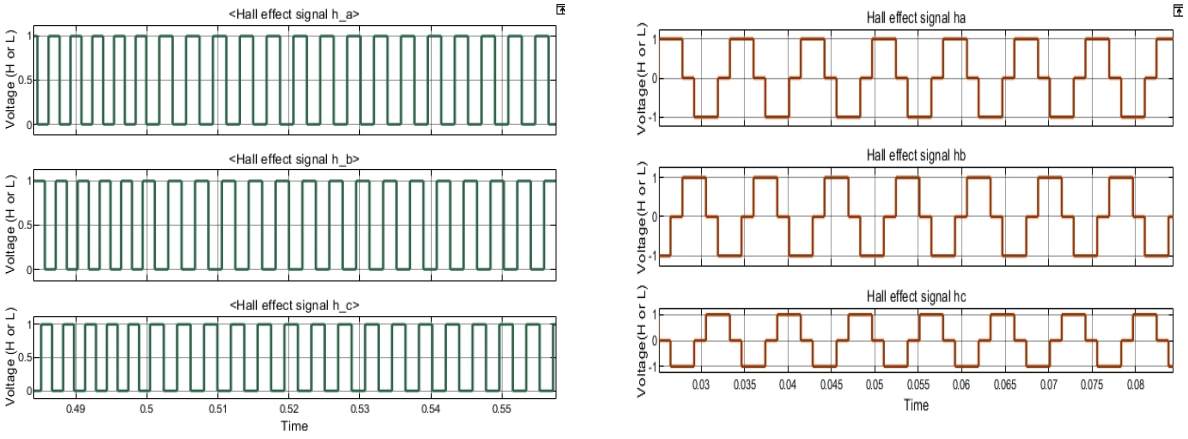
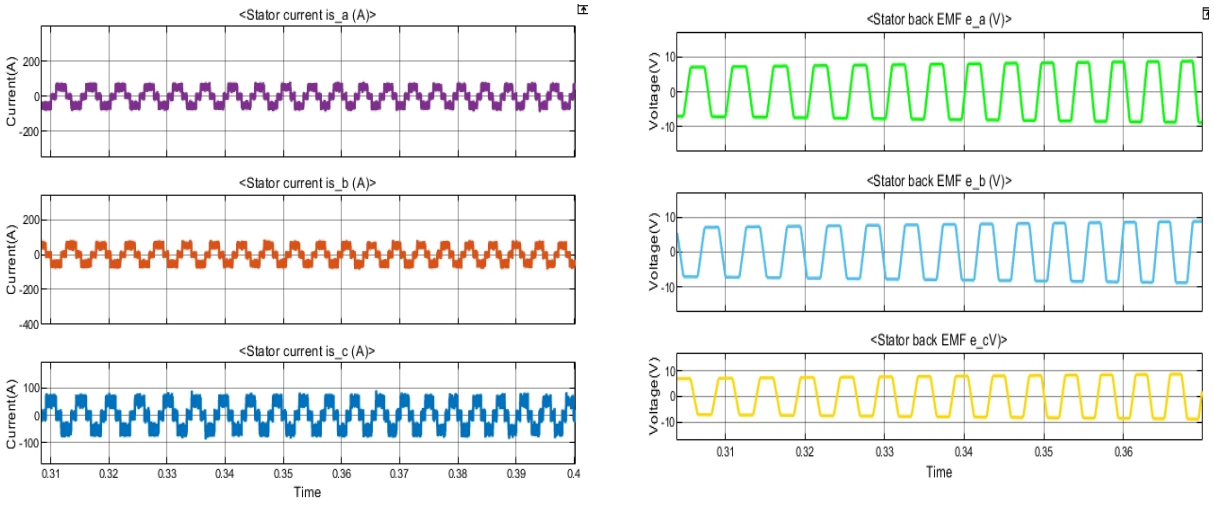
(a) (b)

FIGURE 7. (a) Rotor speed (four quadrant operation) , (b) Fuzzy-PID based speed control of BLDC motor vs battery state of charge



(a) (b)

FIGURE 8. (a) shows the 3-phase signals generated from hall sensor, (b) BLDC motor hall effect decoded signal



(a) (b)

FIGURE 9. (a) Phase stator current of the BLDC motor , (b) BLDC motor 3-phase back electromotive force.

Figure 7(b) shows the vehicle speed and power usage i.e., state of charge characteristics graph. From the graph we can see that as the speed of the vehicle is increases the converter operates in boost mode. In that mode battery will be discharged and energy transfer from the battery to the BLDC motor in normal motoring condition. Also speed is constant battery will be discharged slowly. As soon as we can see that as the vehicle speed decreases the converter operates in buck mode. In that mode battery will be charged slowly and energy transfer from motor to the battery in generator mode. Figure 8 (a) and figure 8(b) illustrate the BLDC 3 – phase signals generated from sensor and BLDC motor 3- phase BLDC Motor.

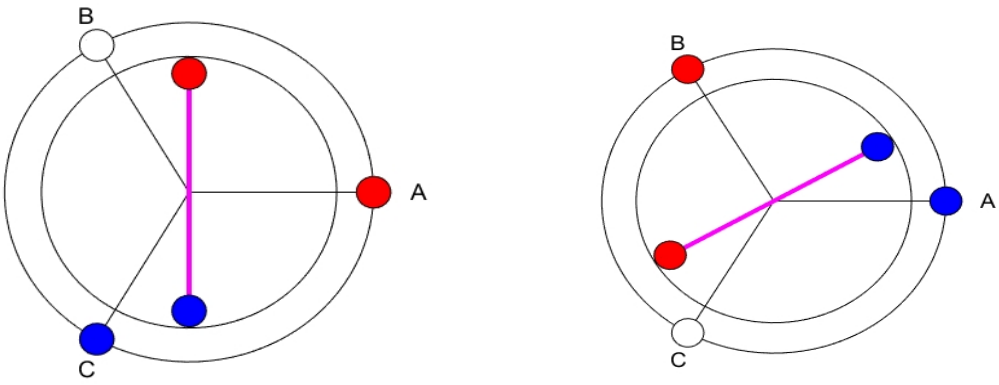


FIGURE 10. Hall sensor detection with rotor position

The simulated outcomes from figure 10 demonstrate that the speed regulation performs well in terms of speed tracking, precision, and disturbances load rejection. The generator mode allows kinetic energy to be converted into electrical energy and stored in batteries, which helps to overcome difficulties with the rechargeable batteries power storage device and boost the vehicle's mobility.

CONCLUSION

This study suggests using a fuzzy-PID control method to regulate the speed of brushless dc motors using a bidirectional converter. Kinetic energy could be kept in a battery as an alternative to being lost during braking modes. According to the operating condition of the bidirectional converter, the extra energy is efficiently retained in the battery. Simulation studies were used to evaluate the results of both the fuzzy tuned PID speed control technique and the PID controller. The benefits of this suggested technology include superior speed control, a smooth transition among quadrants, and efficient energy saving. As a consequence, there is no overshoot in the Brushless dc motor's speed reaction, and torque action fluctuations are reduced, according to the fuzzy-PID controller's behaviour at low and high loads.

ACKNOWLEDGEMENTS

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STRUCTURAL HEALTH MONITORING ON R.C.C. BRIDGE

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Abstract: This paper gives an overview of almost three years of monitoring data obtained from instrumentation installed in a 90m long reinforced concrete integral bridge in South Africa. The main objective of this structural health monitoring project was to assess the effect of environmental factors on integral bridge abutment movement, with specific focus on thermal effects. The data obtained from the instrumentation enables designers to compare real and assumed effective bridge deck temperature, earth pressure and abutment movement. Analysis of the data seems to indicate that the deck cross section shape (defined as the ratio of surface area to cross sectional area) has a significant effect on the effective bridge temperature, abutment movement and earth pressure. This hypothesis was tested using the preliminary SHM data, and conclusions were drawn as to whether an increase in deck thermal inertia might be used to mitigate the effects of increased deck length.

INTRODUCTION

Integral bridges are favoured by bridge authorities and road agencies because they eliminate the use of bearings, providing a simpler form of construction, with reduced maintenance costs. Most existing integral abutment bridge (IAB) research focused on the behaviour of IAB substructures, and as a result, the design limit states considered by many road authorities are largely based on substructure considerations, usually as a function of soil properties at the abutment and pile foundation. This focus has been motivated by the significant increase in substructure demands for integral construction. Integral bridge behaviour during construction and service life however remains poorly understood. As integral bridge decks become ever longer, and working environmental conditions become harsher, there is a need for monitoring and the development of design tools to support the use of this type of bridge.

Recent research indicates that a better understanding of the bridge deck behaviour can benefit integral bridge designers. LaFave et al., (2016) has shown that integral abutment construction also affects superstructure behaviour and demands, and that superstructure properties can directly influence on substructure behaviour. Parametric studies by Kim et al., (2010) indicate that the bridge deck factors with the most significant influence the structure are the deck length and Coefficient of thermal expansion of the deck material. Englandet al., (2000) shows that smaller bridge deck thermal movements results in lower lateral earth pressures and reduced settlement of the fill behind the abutment.

Understanding the effect of changes in deck temperature is thus crucial to the efficient design of durable integral bridges. While temperature effects in conventional jointed bridge structures are often negligible (as the thermal movement is accommodated at the expansion joints), integral bridges cannot be designed without taking thermal movement into account. Work done by Elbadry et al. (1983), Emerson (1976) and Blacket al. (1976) on reinforced concrete decks shows that the changes in effective bridge deck temperature are dependent on the ratio of the deck cross sectional area to deck width. Thus the response of any structure to environmental climatic variation is dependent on the structure geometry and material.

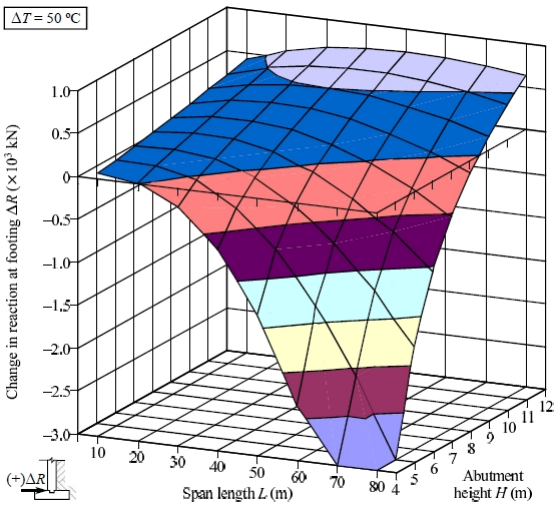
BRIDGE DECK TEMPERATURES

Changes in the ambient shade temperature and solar radiation result in changes to the bridge deck temperature. In reinforcedconcrete decks, the low thermal conductivity of concrete and avariation in the depth of the deck across its width has a significant effect on the temperature variation in the deck. Thetemperature variation in the deck affects the effective deck temperature, which governs the change in length of the deck due to temperature variation. The effective bridge temperatureis defined by Emerson (1973) and Roeder (2003) as the weighted average bridge temperature.
The change in length of the deck of an integral bridge results in both a reaction force applied to the top of the abutment and in the movement of the abutment. The movement of the abutment causes changes in the earth pressure behind theabutment.

Robberts (2003) used work and energy principals to solve forthe horizontal reaction forces (ΔR) on single span portal framed structures with hinged supports. The portal frames weresubjectedto cyclic thermal changes where material properties and loads (i.e. earth pressure) varied with time and change in seasonal temperature (ΔT). This study identified span length and abutment height as having the biggest influence on the abutment reaction, while the stiffness properties of the members had a lesser influence. Temperature variations were identified as the parameter with the most uncertainty as designvalues in codes are usually limiting values based on the maximum possible temperatures that can occur. It is noted that the influence of the beam (i.e. deck) cross section on the thermal inertia of the deck was not discussed, and the ΔT values used in the analyses were assumed. Solar radiation wasalso discussed, but does not seem tobe included in the models.

Using an assumed seasonal temperature change of ΔT = 50°C the largest values for ΔR occurred when the span length L becomes large and abutment height H becomes shallow (see Figure 1). The 50°C temperature change was not based on measured values. It would thus be valuable to know what real deck temperature changes are.

Figure 1 Influence of span length and abutment height on the change in reaction R at the footing (Robberts, 2003)



EXPERIMENTAL SETUP

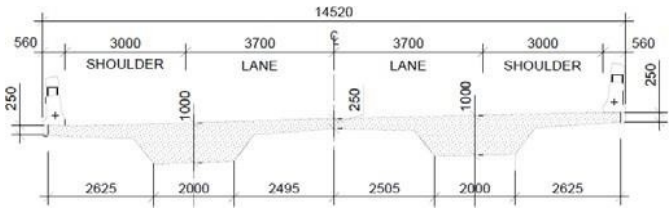
The Kalwa chowk bridge is located on the South AfricanNational Roads Agency SOC Limited (SANRAL) National Route N1 in central South Africa, about 600 km South of Pretoria, near the town of Trompsburg (see Figure 2). This is an area known for its dry harsh climate with both high and lowtemperatures.

The bridge is a 90m long, reinforced concrete, fully integral bridge has been extensively instrumented to measure the environmental effects on the structure. Instrumentation wasinstalled during construction, and the data from this instrumentation has been logged continually from the construction phase onwards. This instrumentation includes
41 thermistors, 110 vibrating wire strain gauges (whicheach have a built in thermistor), 20 earth pressure cells, a shape-accel-arrays (string of approximately 21 tilt meters) at each abutment and 8 tilt meters, one on each pier.

The deck section varies significantly in depth with the flange thickness being a quarter of the beam thickness (1000mm). The deck comprises two 2000mm wide outside flanges which vary in depth from 250mm to 350mm, two 2000mm wide and 1000mm deep beams, and a 250mm thick, 4000mm wide central flange that connects the beams(see Figure 3).

Figure 2 Kalwa Chowk

Figure 3: Typical section through deck showing variation in deck thickness.



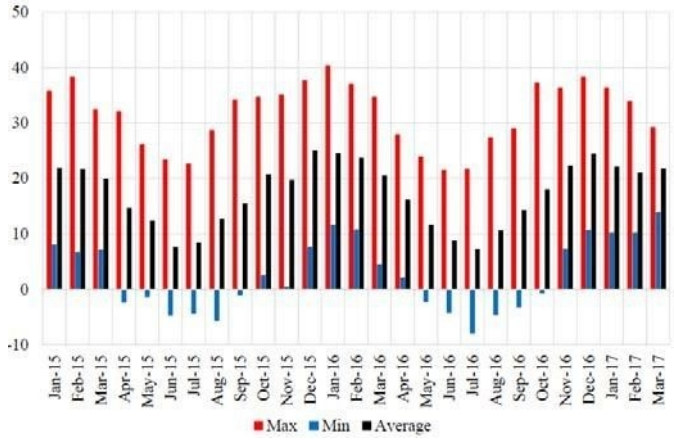
MEASURED TEMPERATURES

AMBIENT TEMPERATURE AND SOLAR RADIATION

In summer, the shade temperature at the bridge varies between about 20°C and 40°C, and the solar radiation reaches a maximum of 1000W/m2 at midday. The length of solar day in peak summer is approximately 13 hours. In winter, the shade temperature varies from about -6°C to 18°C, and the solarradiation peaks at 600W/m2 at midday, which is almost one third less than the maximum radiation measured in summer. The length of solar day in mid-winter is 11 hours. The solar radiation on a hot summer's day is significantly higher than the solar radiation on a cold day; however the range in ambient shade temperature is higher in winter.

Measured maximum, minimum and average shade air temperatures at the bridge site from January 2015 to March 2017 are shown in Figure 3. The shade temperature range is approximately 48.2°C, varying from a maximum of 40.3°C in summer and -7.9°C in winter. The average shade temperature in summer is 23.9°C and 10.9°C in winter.

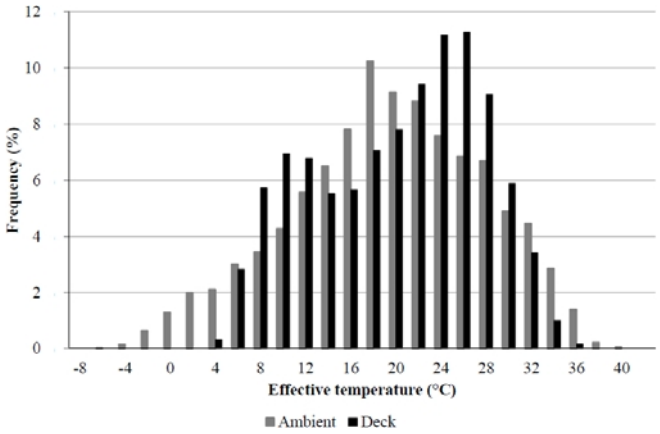
Figure 4 Maximum, minimum and average shade temperatures on site from January 2015 to March 2017



EFFECTIVE BRIDGE TEMPERATURE

The thermistor data was used to calculate the weighted averagetemperature of the bridge deck (i.e. the effective bridge temperature). This temperature governs the thermal deck movement. Figure 5 shows a normal distribution of this calculated effective bridge temperature compared to the ambient temperature. The deck temperatures were on average higher than the ambient temperature. The effective deck temperature over a two-year period ranged between 35°C in summer and 3°C in winter, a range of 32°C which is a lot lowerthan the ambient temperature range, and also lower than the assumed seasonal temperature range of 50°C used by Robberts(2003).

Figure 5 Normal distribution of effective bridge temperatures and the ambient temperature



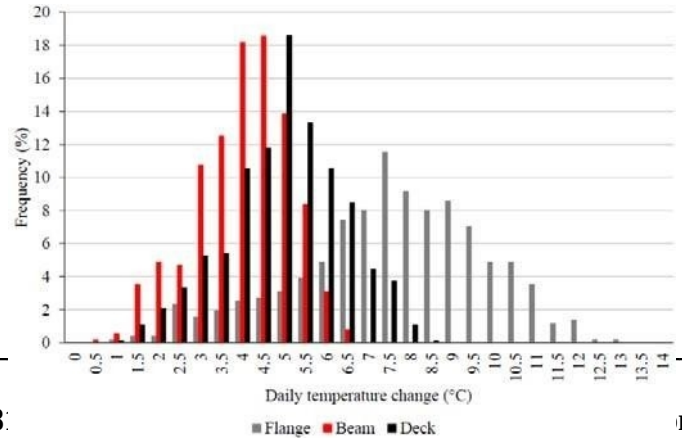
CHANGE IN EFFECTIVE BRIDGE TEMPERATURE

The most important aspect of bridge temperature with regards to integral bridges is the change in effective bridge temperature(daily and seasonally) which causes the deck tomove, and withthat the abutment and fill behind it.

Figure 6 shows a normal distribution of the measured daily change in effective deck temperature, with a maximumdaily temperature change of 8.5°C.

Included with this is the daily change in the effective flange temperature (250mm thick) as well as the effective beam temperature (1m thick). This graph shows a much larger daily temperature range for the thin flanges (up to 13.0°C)compared to the thick beams (a maximum of 6.5°C). It also shows that the mean daily change in effective temperature is definitely dependant on the thickness of the section. The difference in the mean effective temperature of the beam is at least 3°C lower than the thin flanges.

Figure 6 Normal distribution of the daily change in effectivebridge, flange and beam temperatures



The trend observed in the measured daily change in effective bridge temperature is consistent with work done by Black et al., (1976) and Emerson (1796) who compared the daily change in effective bridge temperature for bridge decks of various thicknesses. Black et al., (1976) suggested that the daily range of effective bridge temperature can be related to the area of cross section of deck per unit width of the deck. This work was continued by Emerson (1976) who selected various concrete bridge cross sections, and for each cross section calculated the temperature distribution and maximum effective temperature using the same theoretical input data of solarradiation and shade temperature, and the same starting temperature.

Figure 7 shows the effect of area of cross section per unit widthofdeck on daily range of effective bridge temperature, and compares them to the original calculations done by Black et al.,(1976). A summer ambient temperature change from 18°C to 38°C was used as well as a maximum midday solar radiation of900W/m^2 and a 14 hour solar day, which is similar to weather conditions on a typical summer's day at the Kalwachowkbridge. The deck marked as number 3 was a 2.15m thicksection and deck marked as number 16 was a 0.15m thicksection. The correlation between the daily change in effective bridgetemperature and area of cross section of deck per unit width ofthe deck can be clearly seen. It is clear that increasing the deckcross section per unit width ratio increases the thermal inertia ofthe section and this reduces thermal movement. On a 90m longbridge with a co efficient of thermal expansion of 9.5x10^{-6}/°C(concrete with dolerite aggregate) the difference in daily deckmovement in summer for Deck 3 (2.15m thick) and Deck 16(0.15m thick) could be as much as 5mm.

Figure 7 Effect of deck cross sectional area per unit width on daily range of effective bridge temperature (Emerson, 1976)

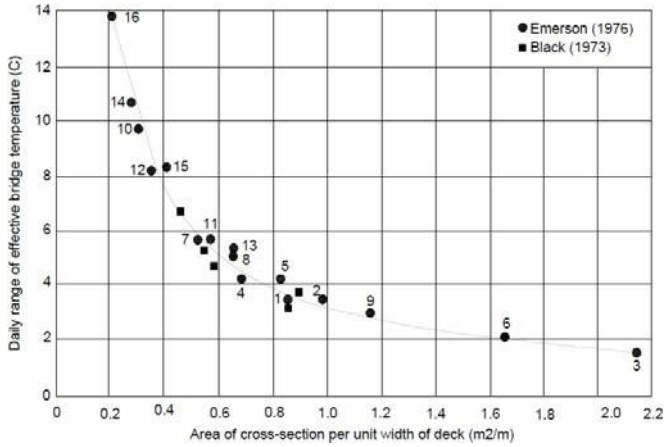
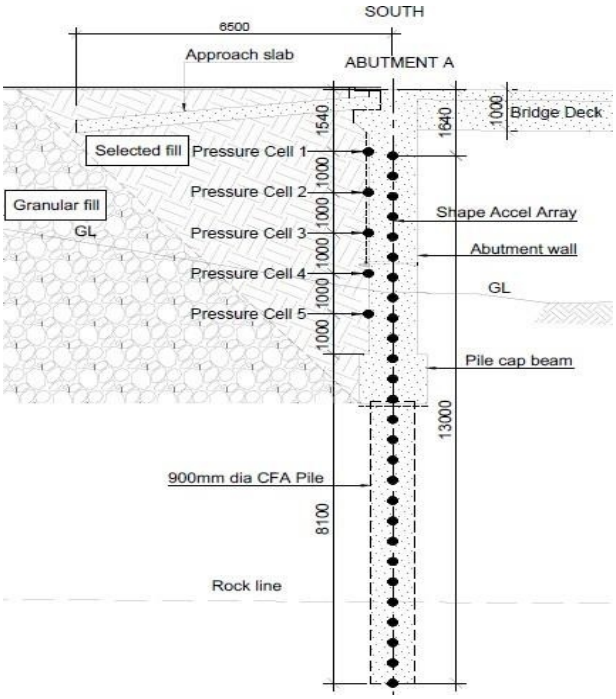


Table 1 Predicted abutment movement

	ΔT °C	α /°C	ΔL mm
Deck	33	9.5x10^{-6}	14.0
Beam	30	9.5x10^{-6}	12.8

Figure 8 Section through the southern abutment wall showingpressure cell and SAA positions

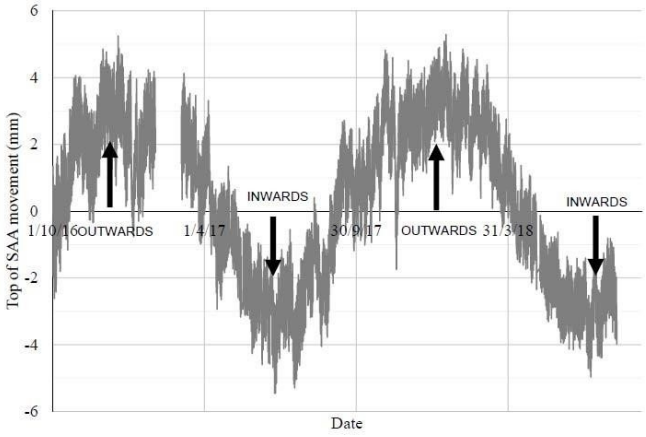


ABUTMENT MOVEMENT

In an integral bridge, once the deck has been cast monolithically with the abutment, the abutment movement is governed by the deck. The thermal action of the deck on the abutment causes the abutment to move outwards, as the deck expands, and inwards, as the deck contracts. To verify the deckaction onto the abutment the relative movement of the top of the shape-accel array (located 1m down from the centroid of the deck) was plotted with respect to the base ofthe instrument, which is at the bottom of the central abutment pile. A sketch ofthe abutment showing the relativepositions of the shape-accel-array as well as the lateral earthpressure cells is shown in Figure 8.

Figure 9 shows the thermal movement of the top of the shape- acccel-array (SAA) from October 2016, up until August 2018. As October 2016 is almost 10 months after the completion of the deck, the shrinkage movement can

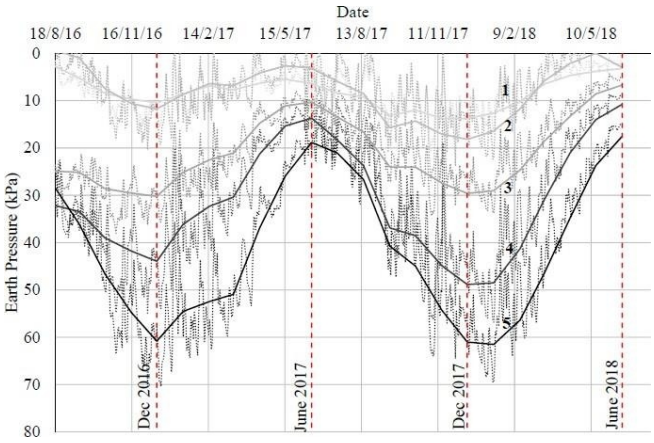
Figure 9 Relative top of SAA movement from October2016 to August 2018



LATERAL EARTH PRESSURE

The seasonal change in temperature causing the deck and abutment to extend outwards in the hotter summer monthsand inwards in the colder winter months is reflectedin the earth pressures measured from August 2016 (just after the backfill was completed) to June 2018 (see Figure 10). The readings from the earth pressure cells were zeroed in April 2016 before the backfilling began and temperature compensated, so that the readings from the backfill surcharge are taken into account. Earth pressure in summer increases linearly towards the base of the abutment wall, however in winter the earth pressure is significantly reduced. This seasonal change in earth pressure has been observed in other integral bridges where earth pressures have been monitored (Darley et al., 1998).

Figure 10 Earth Pressure measured Aug 2016 to June 2018



A linear relationship between the effective bridge temperature and the lateral earth pressure can be observed in Figure 11 where the earth pressure and corresponding deck effective temperature are plotted against each other. An increase in effective deck temperature results in anincrease in earth pressure as the deck pushes out into the earth fill.

Figure 11 Effective deck temperature plotted against the average North and South abutment earth pressure

The earth pressure variation from season to season seems to haveincreased between December 2016 and December 2017, which could be caused by the ratcheting effect and this will continue to be monitored.

When the earth pressure variation along the height of the wall is plotted, pressures higher than soil at rest were observed in summer months, and lower than active pressure in wintermonths.

Heat flow modelling

Beside solar radiation and ambient temperature, the other important parameters to consider when studying the heat flow and temperature change of a concrete bridge decks is the concrete conductivity and specific heat. To assess theimportanceof the heat flow parameters of the deck material on change in effective temperature of a cross section, a number of heat flow finite element models were performed in Abaqus (2018) for a range of concrete conductivity and specific heat values and typical summers and winters day conditions. Different deck cross sections, ranging from 0.25m to 2m thick were modelled and the change in effective temperature calculated.

A range of conductivity and specific heat values typically usedin research were assess (Emerson (1973); Priestly (1978); Branco and Mendes (1993); Larson et al., (2013)). Conductivity was varied from 1.5 to 2.5 W/m/°C and specific heat values varied from 700 to 1500 J/(kg°C). Higher specific heat is linked to concrete with a higher moisture content.

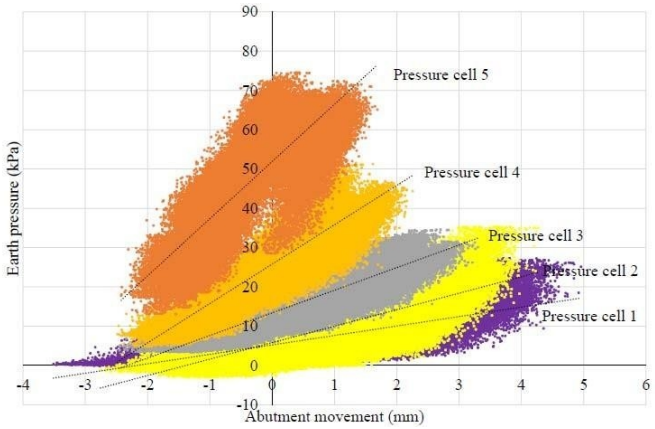
The heat flow models show that conductivity has a smaller influence on the change in effective temperature than specific heat. Figure 12 shows the influence of specific heat on thechange in effective temperature in summer when the ambient temperature

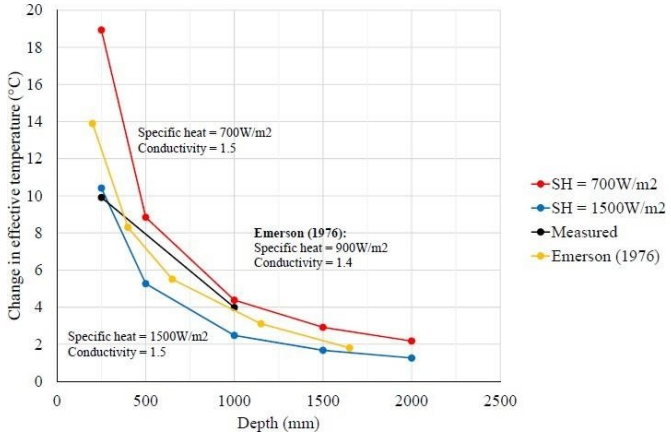
changes by 20°C (thermal loading as per Emerson (1973) example) when the conductivity is assumed to be 1.5 W/m/°C. It is clear that the lower the specific heat, the higherthe change in temperature on any given day (i.e. less energy required to heat the deck). The measured results from Kalwa chowkon a day similar to this fall within the range of calculated values.

The trend of small effective temperature changes observed in decks with a higher thermal inertia (i.e. higher area of cross section per unit width of deck) is still evident. The biggest daily temperature changes were calculated for a thin section with low moisture content, and the smallest temperature changes ina thicksection with a higher moisture content. The difference in the change in effective temperature was as much as 16°C, indicatingthat the thermal inertia of a deck cross section shouldbe carefullyconsidered when selecting a deck cross section for an integral bridge.

Figure 12 Daily change in effective deck temperature compared to the area of cross section per unit width of deck fordifferent

Specific heat values





CONCLUSION

Measured temperature, movement and lateral earth pressure data from the Kalwa chowkBridge have been presented and discussed in this paper. The measured data has proved valuable as it shows the real temperatures, movement and loads on an integral bridge structure.

The effect of deck cross section thermal inertia on theexpansion of integral bridges has been shown. An increase inthe cross sectional area per unit width of deck results in alower change in effective deck temperature, and therefore smaller movement of the integral abutments. This trend is clearly seenwith the measured data and confirms research done by Emerson (1976) and Black et al., (1976).

Measured top of abutment movement was comparable withthe measured change in effective deck temperatures. In reinforced concrete decks it appears that the abutment movement is governed by the change in temperature of the un-cracked decksection.

Seasonal earth pressure variation was observed as the abutmentmoved into the fill in summer and away from the fill in winter. Earth pressures higher than soil at rest were observed in summer months, and lower than active pressure in wintermonths.

Heat flow modelling confirmed the importance of the thermal inertia of the deck cross section on the daily (and hence seasonal) movement of the bridge. The trend of smaller effective temperature changes observed in decks with a higherthermal inertia (area of cross section per unit width of deck) was evident.

Both measured and modelled temperature data confirm that atfor a given set of bridge environmental conditions, longer integral bridges could be constructed if careful consideration is given to the selection of a deck cross section with a high thermal inertia.

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A Review and Comparison of Different Machine Learning Methods of Email Classification for an Educational Institute

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Abstract. In the modern world, email information transmission is happening more quickly. Given that educational institutions, have numerous departments and segments, it could be difficult to filter through and categorize emails from students with inquiries. As a result, the importance of creating a thorough system for various predetermined topic-based categorization systems based on words mentioned in emails has been investigated, and the objective is to construct a model with high performance and efficiency.

INTRODUCTION

Most educational institutions have many departments for various disciplines, and today practically all instructions and inquiries from institutions are sent to various service providers via email. and many of them share a mail ID to answer questions from pupils. The problem is that students could have inquiries concerning a range of subjects, including tuition, payments, lodging, coursework, health concerns, and so forth. The workflow in most modern systems is very conventional. The email will be read by one person or an admin before being forwarded to the appropriate department. The department will determine the mail's precise purpose before returning it to the inquiry department, which will then return it to the students. Time and a lot of human connection are required for this process. With the use of sophisticated categorization techniques and machine learning, this might be solved.

OBJECTIVE OF STUDY

This study illustrates the precision and application of various machine learning techniques to categorize email subjects.

RESEARCH METHODOLOGY

Machine Learning

Machine learning (ML) is a branch of study focused on comprehending and developing "learning" methods, i.e., methods that use data to enhance performance on a certain set of tasks. It is a component of artificial intelligence. Without being expressly taught to do so, machine learning algorithms create a model using sample data, also referred to as training data, to make predictions or judgments. In a wide range of fields, including medicine, email filtering,

speech recognition, and computer vision, where it is challenging or impossible to create traditional algorithms that can complete the required tasks, machine learning algorithms are used.
[https://en.wikipedia.org/wiki/Machine_learning]

Naïve Bayes

A group of supervised learning algorithms known as naive Bayes methods are based on Bayes' theorem and assume conditional independence and equal contributions from each pair of features regardless of the value of the class variable. A straightforward mathematical formula called Bayes' Theorem is used to compute conditional probabilities.

Gaussian A variation of Naive Bayes is one in which the likelihood of the features is taken to be Gaussian. Each feature's continuous values are assumed to be distributed according to a Gaussian distribution. It produces a bellshaped, symmetrical curve around the mean of the feature values when plotted.

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

- A, B = Events
- P (A/B) = Probability of A given B is true
- P (B/A) = Probability of B given A is true
- P(A), P(B) = The independent Probabilities of A and B

Support Vector Machines

Support Another supervised learning method that is utilized for classification, regression, and outlier identification is vector machines. The SVM method may be used to divide data points into two groups by using a plane to do so. Straight decision boundaries are seen in SVMs. The SVM algorithm offers a lot of flexibility. For the decision function, many kernel functions can be defined.

The hyperplane that divides the two groups forms the basis of the SVM algorithm; the larger the margin, the better the classification (also called margin maximization).

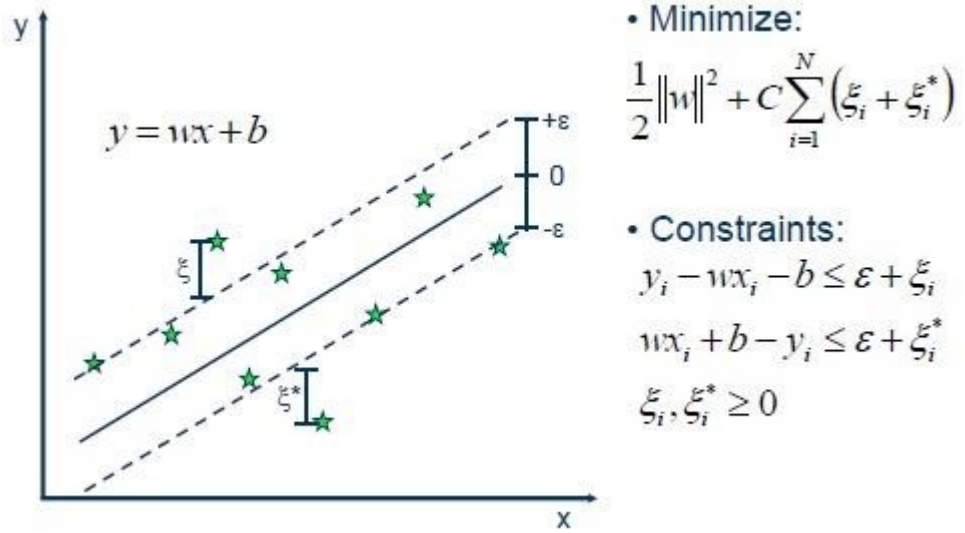

Fig-1: Support Vector Machines Algorithm (https://www.saedsayad.com/support_vector_machine_reg.htm)

Decision Trees

A non-parametric supervised learning technique for classification and regression is called a decision tree. On a dataset, decision trees are capable of multi-class categorization. On each node, data is categorized sequentially using certain decision criteria deduced from the properties of the data. Decision trees are simple to see. By seeing a dataset being processed through a decision-making tree, we may better grasp the algorithm.

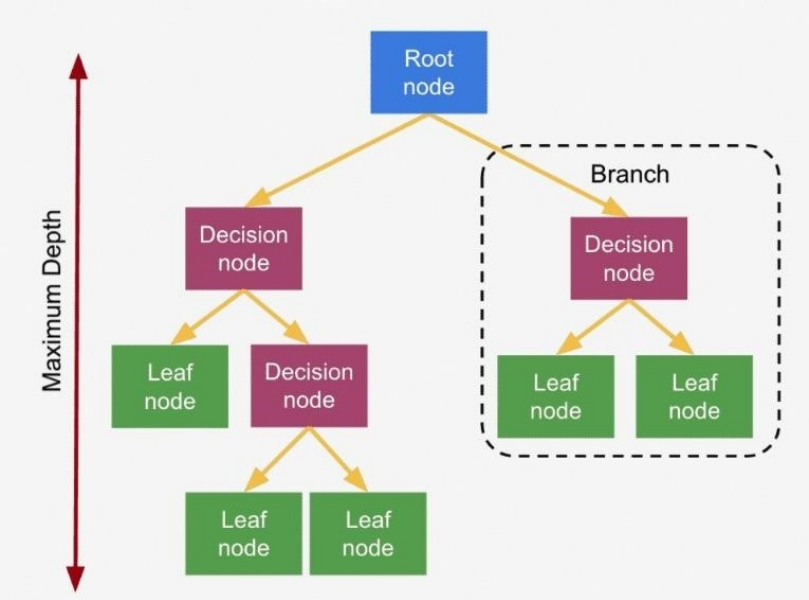

Fig-2: Decision Trees Algorithm (https://www.jcchouinard.com/decision-trees-in-machine-learning)

Random Forests

An algorithm for collective supervised learning based on decision trees is called a random forest. For classification and regression problems, Random Forests are used. The random picking of characteristics is where the algorithm gets its name.

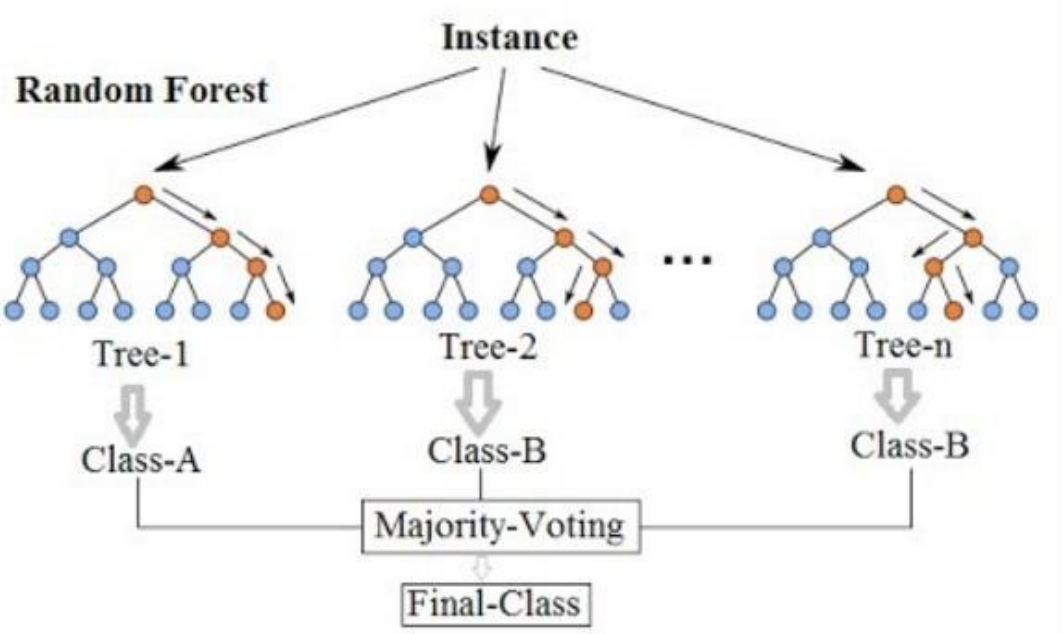

Fig-3: Random Forests Algorithm (https://en.wikipedia.org/wiki/Random_forest)

K Nearest Neighbor

A supervised machine learning approach called K Nearest Neighbor can be applied to classification and regression predicting issues. KNN learns slowly. Since it uses distance to classify objects, normalizing the training data can greatly increase its accuracy.

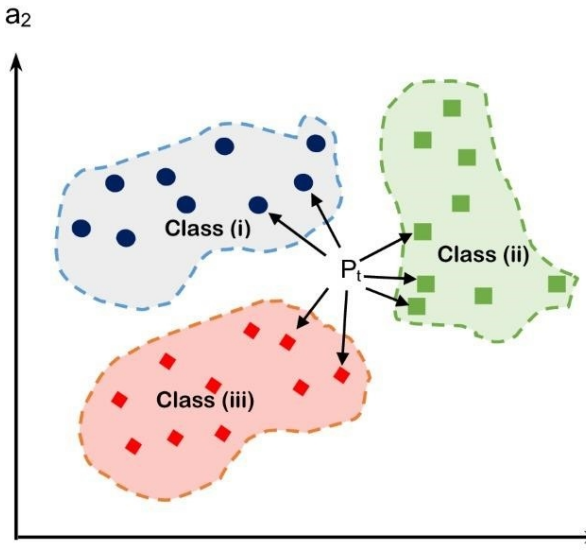

Fig-4: K Nearest Neighbor Algorithm (https://link.springer.com/article/10.1007/s42452-019-1329-z)

Adaptive Boosting

Ensemble boosting classifiers include a-boost, also known as adaptive boosting. It is a meta-estimator that starts by fitting a classifier on the initial dataset and then fits additional copies of the classifier on the same dataset with the

weights of instances that were mistakenly categorized as being changed such that future classifiers concentrate more on challenging situations.

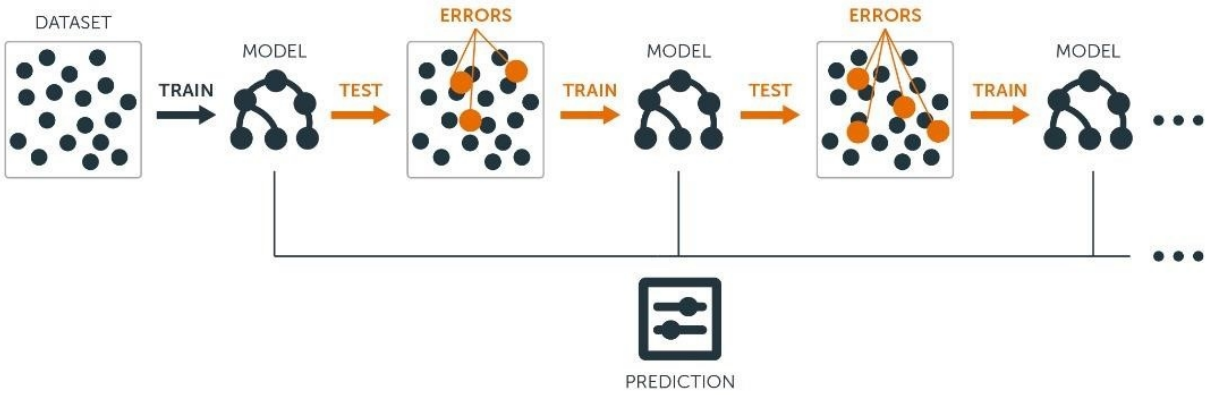

Fig-5: Adaptive Boosting Algorithm (https://medium.com/diogo-menezes-borges/boosting-with-adaboost-and-gradient-boosting-9cbab2a1af81)

LITRECHAR REVIEW

A. Sumithra, A. Ashifa, S. Harini and N. Kumaresan have presented research in January 2022 that showcase that E-mail spam, a sort of e-spam, is one of the most widespread online concerns. Email is the most used method of communicating important and official information. Most institutions and corporations prefer email to all other kinds of communication because it is the most cost-effective, simple to use, immediately available, official, and dependable. It is widely used since it assures that the information entered is kept secret. Most emails are sent for commercial objectives, and some informative concern. However, there are negatives and positive means of communication, as many individuals misuse it by sending unwelcome and unnecessary messages for their personal profit. A robust email classifier is necessary, one that can accurately filter a high amount of emails while guaranteeing only important emails. The purpose of this work is to categorize emails using an improved and efficient classification method. The purpose of this research is to improve the accuracy of categorizing emails into two groups with minimum training. The Nave Bayes (NB) classifier is used in this study to guarantee that the conditions are satisfied with minimum training and that the results are more accurate than earlier techniques.[1]

Tiziano Lattisi, Davide Farina, and Marco Ronchetti presented a study that shows how they can automatically divide it into chunks that make sense semantically. If the number of semantic boundaries is known, can we identify them? Can we count the number of portions of the text that are semantically distinct? In this essay, they respond to these queries. In order to reply, they examine the text using the Bidirectional Encoder Representation from Transformer (BERT) and assess a function that they name local incoherence; they anticipate that this function will reach its maximum at the locations where a semantic boundary is identified. Even though they are preliminary, our results are encouraging and indicate that their strategy can be successfully used. [2]

The current tendency in Natural Language Processing models is to use more and more extra-data to achieve the best models. They want to create NLP models that require no additional data and take the least amount of time to train. To do this, they investigate Hidden Markov Chain (HMC) and Pairwise Markov Chain (PMC) Markov chain models for NLP segmentation tasks. These models are used in three well-known applications, including Chunking, NamedEntity-Recognition, and POS Tagging. They created a novel technique to modify these models for the unique difficulties of text segmentation to achieve meaningful performances with very quick training and execution times. When no additional information is utilized, Conditional Random Fields (CRF), one of the most often used models for these jobs, and PMC produce outcomes that are identical. Additionally, given our goals, PMC's training times are 30 times faster than those of CRF. This model is therefore validated. [3]

Amit Maraj, Miguel Vargas Martin, and Masoud Makrehchi presented a research paper that states that Text segmentation is an NLP-based activity with the goal of separating paragraphs and text bodies into thematic and semantic pieces. This is crucial when, for instance, digitizing paper-based materials to provide organized, searchable text-based representations. Text segmentation has traditionally been approached via heuristic modeling and suboptimal feature engineering efforts. For better predictions, we suggest a unique supervised training method using a pre-labeled text corpus and an enhanced neural deep learning model. Using the Pk and WindowDiff metrics to assess our results, we can see that they outperform all currently available, publicly available text segmentation systems in terms of performance. Bidirectional Encoder Representations from Transformers (BERT) is used in the proposed system as an encoding technique. BERT feeds to numerous downstream layers with a final classification output layer, and it even shows promise for improved outcomes with subsequent BERT rounds. [4]

M. Deepika and Nagaratna P. Hegde presented a study in May 2022, Efficient Email Classification Algorithm for Better Customer Support by stating that the task of managing and categorizing this enormous volume of emails is difficult. Traditional technologies are fairly effective in separating messages. Filtering has to be improved in a number of ways. We worked on this project to recognize and filter communications as they were sent. The majority of the solutions offered for dealing with this problem take into account the high dimensionality of email through the selection of syntactic features. This article discusses an effective method for email filtering that relies on semantic methods and similarity tests to eliminate the vast majority of derived textual data. As a result, the complexity of space and time is diminished. The goal of this study is to improve the manually set regulations. Machine learning techniques are now applied to a telecommunications company's operations. The proposed model with long short-term memory (LSTM) keeps information in memory for a longer period of time and performs more accurately and with a higher F1 score. It combines or transfers management and upkeep duties from a manually created rule-based model to a machine-learning model. It ought to make the model more adaptable as well. [5]

As part of the proposed technique, Pinkesh Badjatiya, Litton J. Kurisinkel, Manish Gupta, and Vasudeva Varma discussed the procedures for gathering and processing data as well as the presentation of their neural model architecture. A sentence si with a left-context of size K (i.e., K sentences before 8) and a right-context of size K (i.e., Si+1,..., 8i+K) (i.e., K sentences after si). Context size in this case is K. Whether or whether the sentence si marks the start of a new text section.

They fixed the length of sentences to L words and trimmed them as necessary in order to obtain the correct fixed length embedding of the phrases during data preparation. They used 100B-strong 300D word2vec [P number] embeddings trained on the Google News dataset.

To display the words, they used 300D word2vec [P number] embeds trained on the Google News dataset, which has 100B words and a vocabulary size of 3M words. Let d be the word embedding size and let V stand for the vocabulary. Let EVxd represent the embedding matrix, and each row correspond to the neural attention-based text segmentation embedding. [6]

$$S_i = [e(lc_i)^{K\times L\times d}, e(s_i)^{L\times d}, e(rc_i)^{K\times L\times d}]$$

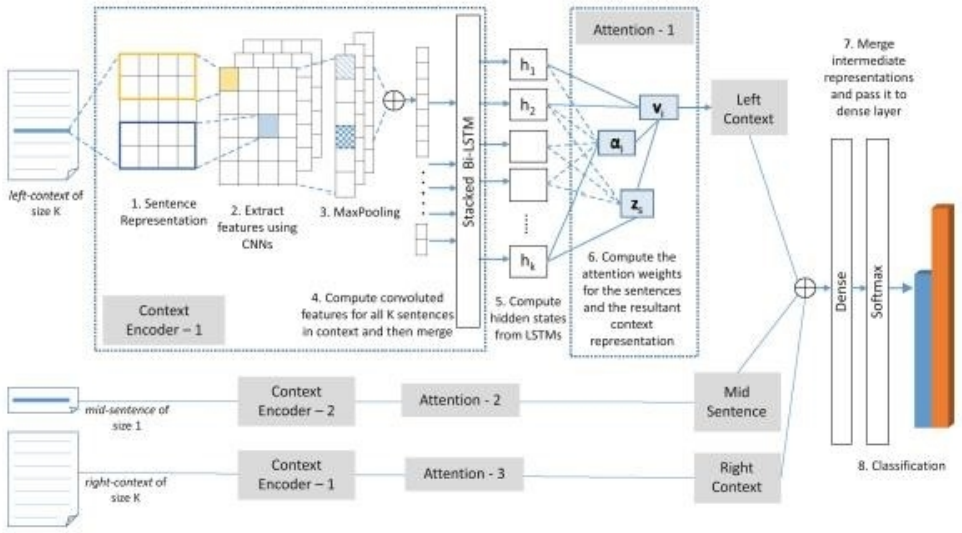

Fig-6: Architecture diagram for the proposed model for Attention based neural text[6]

CONCLUSION

It is clear from the various studies and research papers reviewed that machine learning and neural networks were employed in the majority of studies on text classification for email. Decision Trees, Ada Boost Classifier, SVM, K Nearest Neighbor, Naive Bayes, and Random Forest are just a few of the algorithms available for this task. As a result, SVM has the longest training time and the algorithm with the highest accuracy score has optimized C=10000 and RBF kernel settings. The Random Forests method had the lowest accuracy rating, the statistics in the table had the shortest prediction time, and the Naive Bayes algorithm had the fastest prediction time.

Analytical Comparison of Different Machine Learning Algorithm for Email Classification

Algorithm	Training	Testing	Accuracy
Decision Trees	6.116	0.04	0.988
Ada Boost Classifier	17.946	0.314	0.9653
SVM	22.735	1.925	0.9596
K Nearest Neighbor	2.883	16.968	0.9379
Naïve Bayes	0.133	0.021	0.9203
Random Forest	1.2	0.037	0.7707

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4. Amit Maraj, Miguel Vargas Martin, Masoud Makrehchi (Sep 2021) A More Effective Sentence-Wise Text Segmentation Approach Using BERT
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Various Clustering ideas and its attainment for Wireless Multimedia Sensor Network

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Abstract. Hundreds of resource-constrained sensors are frequently used in Wireless Sensor Network (WMSN) to monitor their surroundings, gather data, and send it to distant servers for additional processing. Despite the fact that WMSNs are thought of as highly versatile AdHoc Networks, network monitoring within those kinds of networks has been a central problem due to the magnitude of the implementation and the reliability issues like managing resources, scalability, and dependability connected with them. Topology management is seen as an effective method to address these issues. The most popular topology management technique in WMSNs is clustering, which groups nodes for administration and/or distributes various duties including resource management. Although energy utilization optimization is the prime goal of clustering approaches can be achieved. In sensor networks, the clustering protocols are developed to address the energy problem. The network longevity and performance have been improved by the clustering protocols that have been proposed in the past using a variety of methods and concepts.

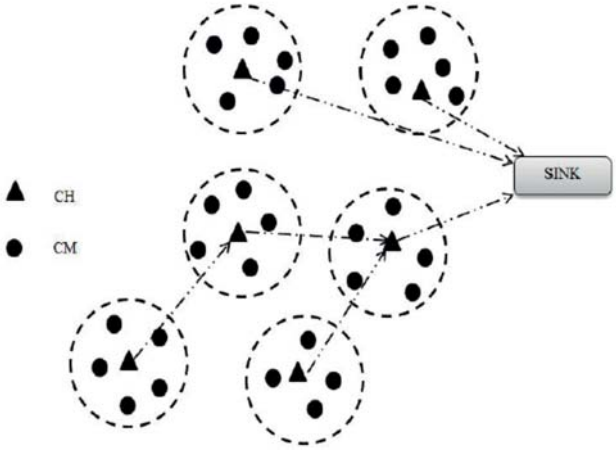
INTRODUCTION

The use of wireless multimedia sensor networks (WMSNs) is expanding quickly across several fields, and now, it has drawn a lot of attention. The design and type of sensors have undergone technological improvement, which has refocused researchers' interest on WMSN. The WMSN is made up of a sizable number of battery-operated sensors that collect environmental data for a variety of applications. The sensor nodes are linked by a wireless channel, and they communicate with one another to complete the duties that have been assigned to them. Numerous applications for WMSNs have been suggested during the past years, including monitoring the environment, healthcare, intelligent homes, smart manufacturing, and disaster management. Despite the fact that WMSNs are thought of as highly dynamic ad-hoc networks, managing the network's topology has shown to be difficult in these networks especially in terms of resource management, scalability, dependability, and efficiency [1]. The WMSN encounters a number of difficulties and problems because of its constrained battery, processing power, computing power, bandwidth, communication dependability, etc. The management of energy is regarded as the most important issue in WMSNs because improper management of energy might cause nodes to fail more quickly [2]. The methods used in network applications concentrate on dealing with node energy issues by applying various energy management approaches, which improve network performance and lifetime [3]. The clustering is one of the many techniques used to address WMSN difficulties. The most efficient method for addressing the network's energy-related issues is clustering, which also increases the network's lifetime [4]. Prior until this, a number of methods for controlling the network's energy consumption that use the clustering was already offered [5].

CLUSTERING

Clustering is a form of topology management approach that can combine nodes to increase performance of the network by managing resources and distributing tasks in a fair manner among nodes. Data is gathered by

sensor nodes from surroundings, and they either send it directly to a sink or work together with other nodes to do so. To achieve scalability, reliability, and lower network traffic, many sensor applications cluster the sensor nodes**. Figure 1** displays a hypothetical example of clustering [6].



CH- Cluster Head, CM- Cluster Member

Figure 1. Wireless Sensor Network Cluster
[I.S.Akila, S.V.Manisekaran and R.Venkatesan, Modern Clustering Techniques in Wireless Sensor Networks, http://dx.doi.org/10.5772/intechopen.70382]

In this situation, clusters are given cluster heads, which broadcast the aggregated data to the base station or the sink. Clustering has the potential to scale performance across growing sensor networks as one of its main benefits. The clustering strategy also offers a wide range of other benefits. As a result of its localized solutions, it guarantees reliability and prevents one-point failure. To efficiently reduce power consumption, a clustering solution can recommend a sleep/wakeup schedule for a WMSN. It is not necessary for the sensor nodes to be awake and to use energy. Some sensor nodes can be placed in an energy-free sleep state based on the temporal and spatial dependencies. Through the sink or controller, a useful schedule may be created and distributed to these sensor nodes. Due to its semi-distributed structure, clustering also guarantees the performance of the application can scale. Clustering has advantages as well as drawbacks [7]. Certain sensor nodes have been designated as "cluster head," and these nodes keep an eye on and control the data flow between clusters, which uses a lot of energy. As a result, the procedure of reclustering and reelection of cluster heads is necessary, which reduces the lifetime of the sensor based network.

TYPES OF CLUSTERING

On the basis of analysis, WMSN has a variety of grouping modes. The recommended comparative study's focus on clustering categorization based on intra- or inter-cluster communication of nodes in WMSN is illustrated in Figure 2.

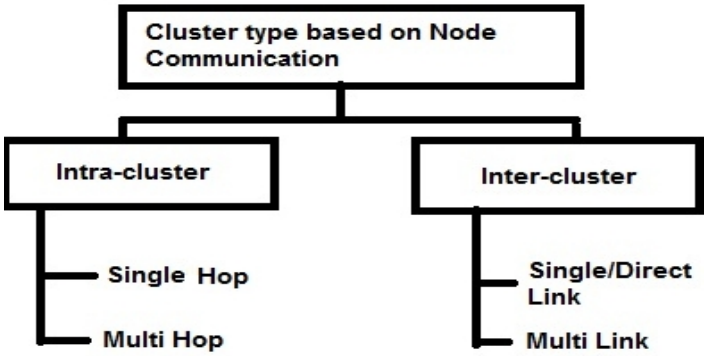


Figure 2. Cluster Classification in WMSN

Communication among cluster members is referred to as intra-cluster communication. Usually, this communication takes place by a single hop or multiple hops from members to the cluster leader. In order to broadcast cluster data to the outside world through the cluster head, a network's clusters must communicate with one another [8] and [9]. A single hop to the sink can be used for this transmission, or numerous hops between CHs can be used. Figure 3, illustrates a WMSN communication scenario with a single hop versus multiple hops. Data can be added to the cluster head with ease and transmitted to the base station using only other cluster heads over single-hop networks [10] and [11]. If data had to be sent to the cluster head via more than one hop, it has been said that it's a multi-hop network.

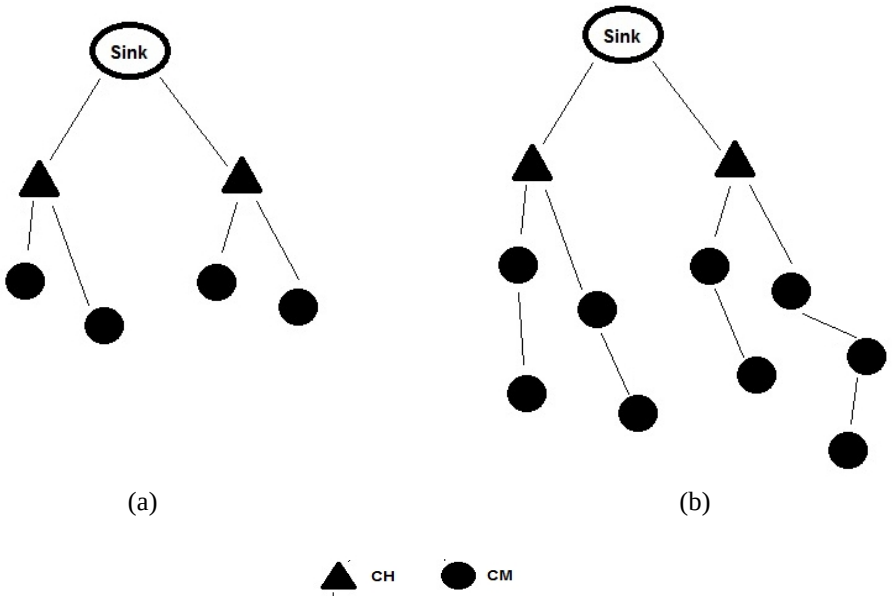


Figure 3. (a) Single-hop Clustering, (b) Multi-hop Clustering

[ref: A case study of Internet of Things based on wireless sensor networks and smartphone. Alkiviadis Tsitsigkos, Fariborz Entezami, Tipu A. Ramrekha, Christos Politis and Emmanouil A. Panaousis Manuscript received Apr, 2012 Wireless Multimedia and Network research group, Kingston University, London]

INTENTS OF CLUSTERING

With a variety of goals centered on extending the network's life and improving performance, cluster-based approaches in WMSN are used [12]. In order to accomplish their goals, the clustering protocols take into account several techniques. The WMSN clustering protocol goals are depicted in Figure 4. The following are some of the goals of clustering protocols:

1. Exploiting the Network-Lifetime
2. Minimize the Energy-Consumption
3. Network Stability-Enhancement
4. Lessen delay
5. Minimum Data-Redundancy
6. QoS
7. Packet-Delivery-Ratio

Exploiting the Network-Lifetime

For the performance assessment of clustering methods in WMSN, the network-lifetime has always served as a significant aspect [13]. The protocols emphasize prolonging network life by utilizing a variety of strategies and tactics. The energy-aware methods seek to identify the best data connection paths, which lengthens the network lifespan [14]. The network may run for a longer time and supply services to the user, which results in higher performance [15]. Data communication, networking energy use, data collection, data aggregation, CH selection, node placement strategy, etc. are some of the activities that affect the network-lifetime in WMSN.

Minimize the Energy-Consumption

In any clustering technique, the energy consumption is one of the elements that determine the network's overall performance and lifespan [16] [17]. In order to keep the network running for a longer period of time, the protocols put a focus on minimizing the energy consumption of the nodes. To lessen the energy consumption of nodes, the clustering protocol employs various clustering algorithms, CH selection policies, and methodologies. However, CH duty can be rotate at a particular interval or it can be changed by measuring energy level of every node at a particular interval and then select the CH for further communication. It is taken into consideration as a major issue for practically all WMSN clustering techniques. The network consumes energy to send and receive data packets, and the protocols focus on reducing packet transmission to conserve-energy [18] [19] [20]. By using hierarchical-clustering or balanced-clustering, we can also minimize the energy-consumption in the network.

Network Stability-Enhancement

In order for nodes to live for longer periods of time, their battery power needs to be used in the right way. The amount of time (in-rounds) until the first node dies is known as the node stability period. According to [21] and [22], the stability period exhibits the network's effectiveness and is therefore regarded as a crucial metric in the performance evaluation of clustering approaches. The protocol seeks to lengthen the network's time of stability in order to enhancement. Also we can increase the Network stability by reducing Node failure. Ultimately, the stable number of clusters will be also boost.

Lessen delay

When a packet has a delay, it takes longer for it to reach its destination. The network reliability can occasionally suffer as a result of increased delay brought on by the network's high traffic volume. Through a slowing of the packet receiving rate, the delay has an immediate impact on network performance. Some clustering techniques employ a variety of ways to reduce network delay and enhance network performance [23] [24]. We can lessen the delay by controlling the number of Hops, as well as by configuring more clusters with more number of cluster-head. Inter-cluster and intra-cluster routing can have a significant impact on latency; as a result, establishing the shortest-fastest routes that can increase efficiency and decrease delay is a significant problem. Different clustering strategies are presented to provide concurrent routing because the primary goal of clustering techniques is not to build routes [25].

Minimum Data-Redundancy

Sometime few sensors pick up on the same information, data redundancy may happen. The network's performance may suffer as a result of the redundant data wasting energy. Data aggregation techniques are used in clustering algorithms to address the issue of data redundancy [26], [27]. The information acquired from several nodes is combined into a single packet before being sent to the BS. The CH manages the data aggregation tasks in the majority of clustering protocols by using data fusion and data aggregation routines to remove redundant data. The data aggregation method increases network performance by reducing energy used to handle redundant data [28], [29], [30].

Packet-Delivery-Ratio

It’s a variable with a strong correlation to throughput. Due to the fact that more data is transferred in a shorter amount of time, a higher packet delivery ratio can increase throughput concurrently. By enhancing the network infrastructure's resilience (means reducing data-loss), packet delivery rates can be optimized. In this sense, enhancing reliability refers to lowering packet loss, node failure, and improving connectivity. In addition, in time-sensitive applications, network congestion can cause packet drops which reduces packet delivery ratio. In [256] , a method has been proposed to improve the packet delivery ratio by selecting CHs based on their remain- ing energy, QoS parameters and node’s location. They use the immune-inspired optimization algorithm to select routes for delivering packets.

Quality-of-Service

Different factors should be taken into account in order to enable QoS in WMSNs, such as jitter and throughput optimization, delay minimization, etc. Ad-hoc network support for QoS in WMSNs has always been a difficult problem. Individual QoS parameters are as follow:

• Dependability: The percentage of successful data transfer in computer networks is one indicator of reliability. Clustering strategies in WMSNs can increase network dependability by preventing node failure and preserving connectivity. For instance, the developers of [32] increase the packet delivery ratio to increase network dependability.

• Output: The amount of data that is successfully transferred through the entire network for a specific period of time is known as throughput (T). This can demonstrate the effectiveness of the entire network in terms of latency reduction. Throughput is a crucial characteristic that can raise the network's effectiveness in time-sensitive applications. To increase WMSN throughput, various clustering approaches are employed. Network-stability, deterministic no. of Cluster-head and data-aggregation cum data-compression helps to stable the output of the network.

• Variable latency: Using jitter-prevention measures is another strategy that can enhance QoS. Jitter prevention is crucial, especially for real-time and multimedia WMSN applications that demand steady, resilient and uncongested connections. Tree-clustering can reduce the variable latency, Jitter [33].

Figure 4 shows the different clustering objectives are already discussed and its probable solution.

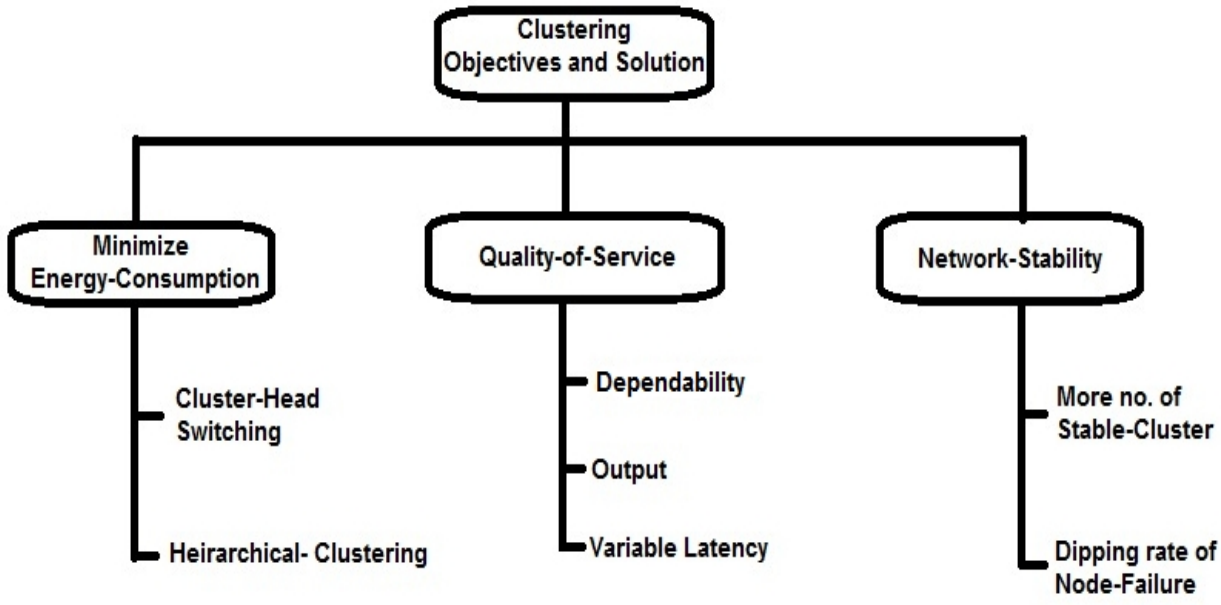


Figure 4. Clustering objectives-solutions

PROPOSED WORK

Basically, there are three classifications of clustering protocols like Traditional clustering protocol, Fuzzy based clustering protocols and Empirical based clustering protocol. Out of them from the group of Traditional Clustering protocols, LEACH protocol proven very efficient protocols in different ways like, LEACH, LEACH-E, LEACH-C, LEACH-M. In conventional LEACH protocol, based on timer, for the particular time interval, nodes will be automatically stay active and transmit its data/information to the cluster-head. Author's results shown in Table 1 [34]. In this paper, only the Nodes, already having information about the minimal routine path will be considered for the data/information transmission.

By applying this logic in the work the energy consumption is reduced up to the certain level as well as the throughput is also at very good level. Table 2 shows the simulation parameters and its results shown in the Figure 5 and Figure 6, respectively.

TABLE 1 Author's simulation results [34]

Protocol	Energy Consumption
LEACH	Low
LEACH-M	Moderate
E-LEACH	Moderate
LEACH-MAC	Low

TABLE 2 Proposed work simulation parameters

Parameters	Value
Network-Size	100
Packet Length	100 bytes

Propagation Model	Log-normal
Time slot	10ms
Slot length	500 slots
Message	DIO

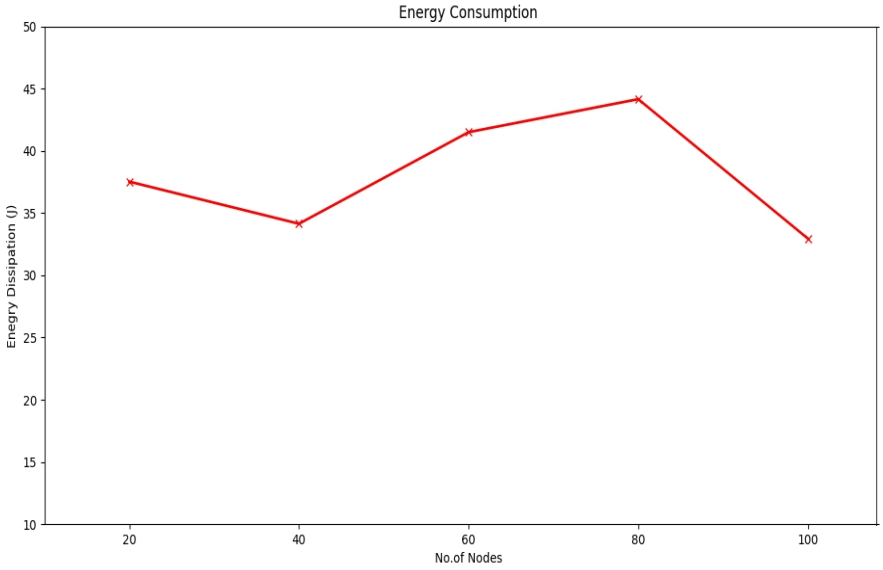


Figure 5. Existing LEACH protocol result of Energy Consumption

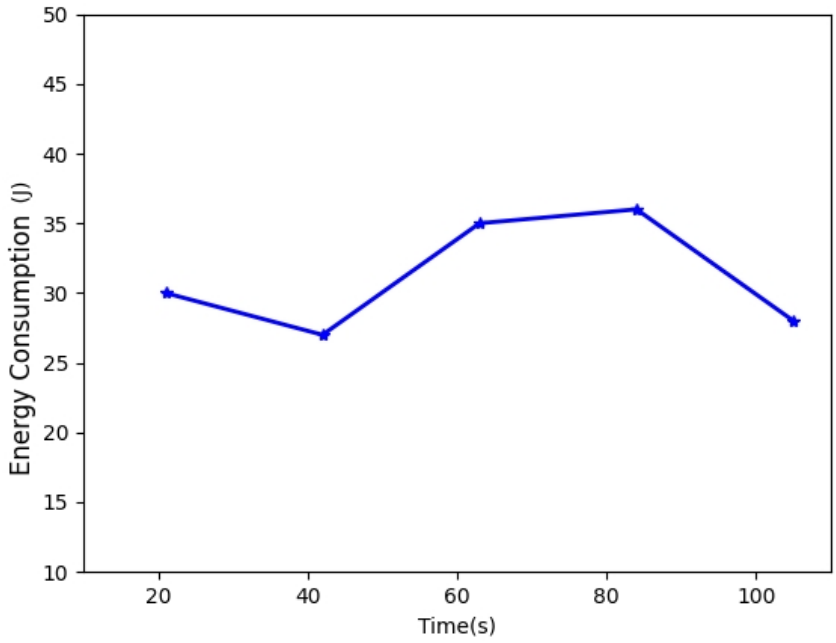


Figure 6. Energy Consumption result of proposed work

CONCLUSION

In WMSNs, clustering has been used as a standard topology maintenance strategy. Clustering can address a number of networking issues, such as load balancing, QoS, security, and mobility management, even though it is mostly known as a way to reduce energy usage. The results in **Figure 6** of the proposed work shown that the energy consumption is reduce up to the mark, approximately 37j as compare to the already developed idea in Figure 5. Proposed work shows the lowering the energy-consumption.

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A Review: IoT based emergency patient care system

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Abstract. When an accident occurs, the patient is required to be moved to the hospital, it takes too much time due to many factors. In the in-between phase, it is considered as a very crucial time. In most of the cases it becomes too late to due basic tests, and while reaching at the hospital in many cases patient is declared dead on arrival, if not then he may be already in serious condition. At that time even a single minute plays an important role. So with the help of IOT technology we can build a wearable device so that it can send vital health data points by quickly and automatically sending test results to the destination hospital staff. Measuring heartbeats, breathing pattern, body temperature, etc. vital tests, are conducted and send over Internet. In this kind of major injury situation humans lose their decision making capability and perhaps became psychologically imbalanced. So for that kind of hectic situation we can also fit pre-saved play white noise music, dopamine, and serotonin release waves to make it more calm of an environment and help the patient relax.

Keywords. Raspberry Pi, IoT, Remote health monitoring.

INTRODUCTION

Road Accidents by type of traffic violation			
Violation	Number of Accidents	Persons Killed	Persons injured
Over-speeding	327,448	98,613	343,083
Driving on wrong-side	29,148	9,527	30,124
Drunk driving/consumption of alcohol and drugs	14,071	4,776	11,776
Use of mobile phone	8,526	3,172	7,830
Jumping red light	6,324	1,826	5,977
No violation and not known	79,394	29,999	72,185
Total	464,910	147,913	470,975

Figure 1. Sensors attached for remote health monitoring.

The Internet of things describes physical objects with sensors, processing ability, software, and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks. In the health care area there are many research and developments occur, now in the present era most of the equipment are based on automation and high accuracy based, so for the combination of technology and medical devices can effectively play major role in enhancement of research and development in health care area. With the help of IOT, it is possible to do this. But with the great innovation area there are also many challenges occurring, like technical and generating those things and also adoption of new devices and technology among medical workers. In this project we build a system that can measure heart rate, body temperature of the patient and ECG. This all the data is sent to the hospital before the ambulance reaches that hospital. So the base of this data medical team can prepare in advance before patients come to hospital. It can send current measurements of patient condition on the particular time period. We also fit some pre-saved waves in the system for patient psychological imbalance.

LITERATURE REVIEW

Raspberry pi is small, very capable, low cost, single board computer generally credit card size, it is capable of doing the things which we expect to do a desktop computer or a laptop can do, for the internet usage, running HD video, it can also have capability to interact without side world. All over the world, people use the Raspberry Pi to build hardware projects, do home automation, and even use them in industrial applications. It has all the basic hardware components of a computer (processor, memory, etc.) and various extensions (USB, HDMI, video, sound, etc.). Raspberry Pi (RPi) is now increasingly being used to connect IoT devices. It is not feasible to brig or attach laptop or desktop on ambulance to collect the data. So, with the help of raspberry pi, we can make this kind of system which can take measurements of patient data and then send it to the hospital in real time. Approximately 1.3 million people die each year as a result of road traffic crashes.

EXISTING APPROACH

In the current time if any accident happens on a highway or far away from the hospital, it takes time to reach the hospital, and when we reach the hospital they have certain mandatory procedures/tests to be carried out. So while doing all the important tests, we can say that basic and important data like heart rate, body temperature, breathing patterns, which are utterly important and take some time to be conducted utilising important critical time. And since all the tests are must, they can be done with the help of the IOT, we can conduct all the basic and important tests on the ambulance while going to in between the accident location to the particular hospital, in the existing approach there is not any mandatory tests which are carried out, but only the basic first aid is provided to the patient at the time of initial contact on site at ambulance arrival.

PROPOSED METHODOLOGY

ECG graphs, temperature of the body and the rate of heart-beat are measured in this project via multiple sensors and also Arduino for processing the real-time data. The main sensors used are these 3 - galvanic skin response sensor, the heart pulse sensor and the body temperature sensor. They are put together in one whole circuit beside Arduino Raspberry Pi and UNO. The captured real-time data is sent to the cloud bucket from the Raspberry Pi. The wifi module ESP8266 is used to feed the live data to the server and that will get displayed on the Android application as well. Device automatically connected to Wi-Fi and sends the data to a server which will appear in the android application. A crocodile clip, which shall be attached to the finger of the patient, will continuously monitor the patient and measurements will be reflected by the Android app live. The final data is stored in the cloud with the help of Raspberry Pi. The data in the cloud will be updated in real-time. The system also generates an ECG Diagram and can show the health measurement graphically. The ambulance number is also a part of the information transmitted to the application. The application shows the ambulance numbers of the ambulances that are currently on their way to hospital. With the help of the ambulance number, the doctors can access the record of a particular patient. For data confidentiality, only authorized entities should be able to access and modify the data.

Table 1: Sensors and Their Usage

TABLE 1. Some sensors which can be used to monitor the patient while travelling.

Sensor Name	Use of Sensor
Dallas18820	To measure body temperature level
Heart rate sensor	To measure Heart-beat of patient
ECG	To measure Electrocardiogram of patient

The body heat is calculated by subtracting the total heat produced by the human body from the heat lost by the body. The importance of consequently monitoring the body temperature is that it justifies the patient's condition because the temperature of the body is a function of the heart's performance. The heart starts pumping blood faster as the temperature of the body gets high. The normal body temperature stays between the range of 36.5°C and 37.5°C. The patient might suffer from hypothermia if the temperature level goes below 36°C. Here,

the Dallas 18820 sensor is used for measuring the body temperature of the patient. The installation is not fixed which is why a change in the number of sensors will immediately reconfigure your network. Physicians can readjust the network's mission as medical needs change. Sensors self routing paths, work together in data processing and establish hierarchies.

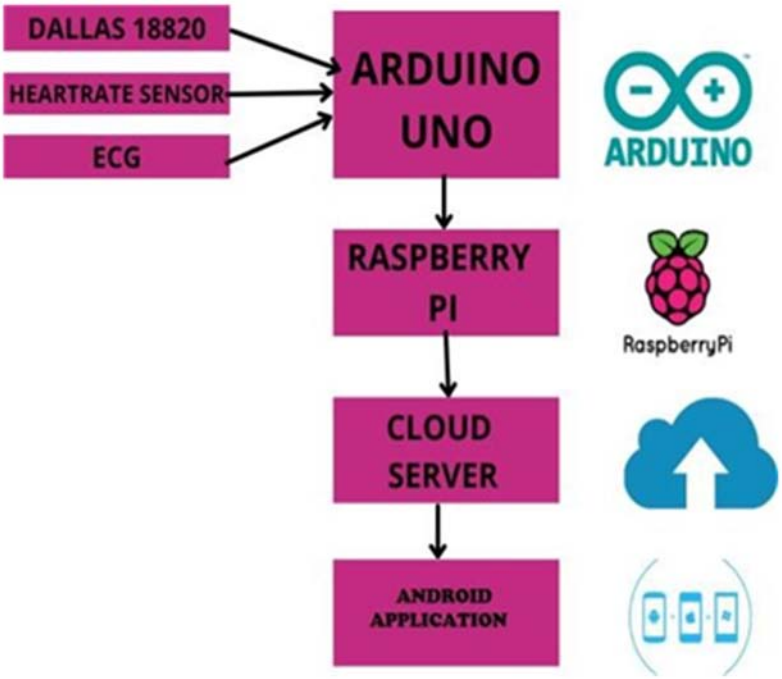

Figure 2. Sensors attached for remote health monitoring.

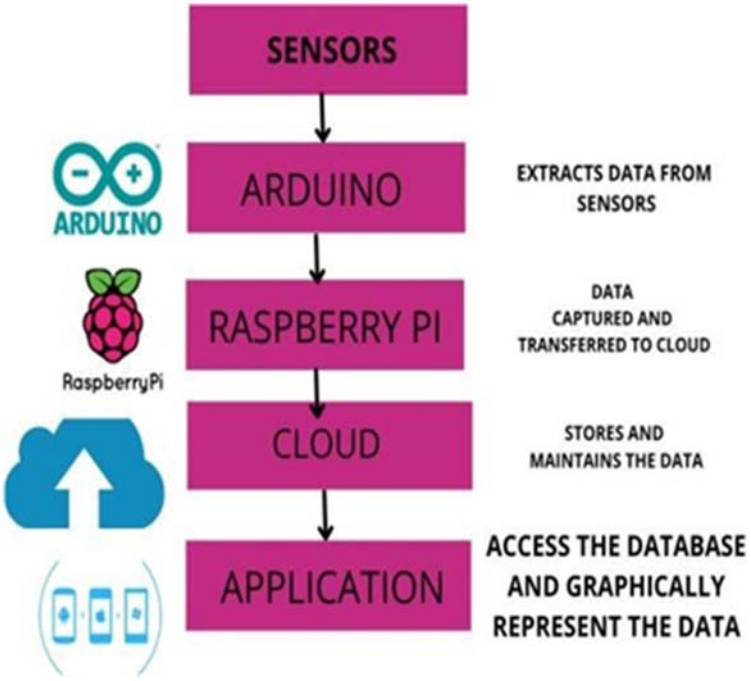

Figure 3. Architecture of the remote health monitoring system.

The android app, continuously connected to the server, is the primary user interface and is connected with the server. The alarm notification will be sent directly to the hospital staff in cases of emergency by the application. The emergency alarm notification will prompt the staff to send urgent ambulance help to the place

where the patient is currently situated. This location is tracked and sent through the android application. A gyroscope is used to identify the position of the patient. A gyroscope comprises a rapidly spinning disc or wheel fixed on an axis which can freely change its direction at any time. Even if the wheel/disc is titled the orientation of the axis remains unaffected.

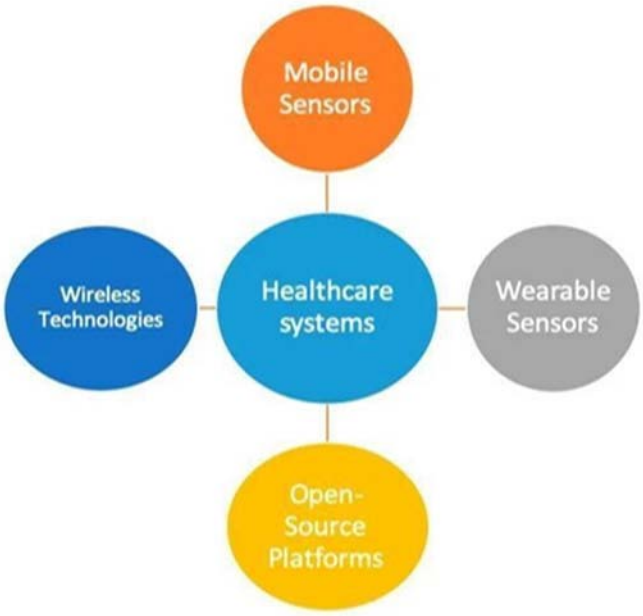

Figure 4. System architecture.

An algorithm of working of a system.

1. Detectors measure the condition of the patient with the gadgets.
2. Convert raw data to digital form.
3. And sent to the particular hospital.

CONCLUSION

With the help of the this product we can send the information about necessary information the hospital staff, so before the ambulance reach at the hospital all hospital staff will ready in advance, to do their tasks, it can save significant amount of time in the emergencies, and the hospital staff can directly take decision and do appropriate their treatment accordingly, there can be life saving things to be done, with the certain period of time system can also send current situation of the patient.

FUTURE SCOPE

In the future it can be more enhanced feature like virtual doctor assistant in an ambulance. It can also be an advancement in the ambulance manufacturing company that provides this kind of hardware and software built in the ambulances. In medical equipment like stretchers, it can also be a temperature measuring thing and other more enhanced research filled areas in critical care or healthcare.

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A Thorough Analysis of Battery Charging Standards and Infrastructure for Electric-Based Automobile Deployment

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Abstract. The projected study communicates the critical dimensions obligatory for considering the battery charging strategies planted to achieve various applications of electric vehicles. Electric Vehicles, regardless of embracing numerous advantages over conventional IC engine-based cars, higher efficiency of electric motors, relatively economical and more environmentally justifiable, to name a few, however, face certain objections. Significant challenges governing EVs (Electric vehicles) are appropriate attainability of charging of battery infrastructure taking into account the greater energy density of battery packs and competent topologies of charging. The dominance of EVs however outshines its disadvantages, crucial of which is notably plunging the oil dependencies, making it the befitting substitute for Internal Combustion (IC) engines. The heavy deployment of EVs and the rising call for them have made it extremely difficult for power networks to maintain power quality and peak load demand. The following section of this paper discusses the various battery charging techniques, or battery chargers, as well as the effects of their use in electric vehicles (EV) and hybrid EV applications. The battery charger's components, for instance, ac-dc\dc-dc converter configuration, control techniques, and modulations have also been dated. Topologies of charging have been categorized relying on the level of power and charging in this all-inclusive review paper. Quite a few battery charging converter topologies that are able to meet the demands of commercial applications and are also capable of handling domestic and industrial applications have been put forward. Additionally, charging infrastructures accompanying the design standards of converters are as well talked about briefly.

Keywords: electric vehicle (EV), IC engine cars, Internal Combustion (IC) engines, AC-DC/DC-DC topologies, Hybrid EV.

INTRODUCTION

Amongst several other things, the constant deterioration of the environment is caused due to the large-scale release of harmful gases hailing from internal combustion engines, which bargain profitable consumption in vehicles as one of their uses. EVs have made a strong case for themselves as a replacement for other forms of transportation by the virtue of various technologies of batteries and the creation of effective chargers for the same. The HEVs with the ability to recharge the battery pack by charging cable is called Plug-in Hybrid Vehicles. The demand for EVs is expanding along with the requirement for charging infrastructure and applications of renewable energy. Subsequently, the evolution of advanced and sophisticated high-speed charging infrastructure has hiked the likelihood of strategies of charging, opening the door in favor of numerous upgraded utilizations of EVs. The functional and management component of EVs is a power electronic converter. The battery charging method and the available setup pose the biggest problems for widespread deployment [3]. The most significant obstacles to

EV application are the storage cell architecture, technique, and energy concentration of the package of battery [1,2,6]. EVs can indeed dominate the market immediately after the architecture for charging the battery is enforced in all respects. The quality of the grid power is currently facing a significant problem due to the rising demand and equivalent arrangement of EVs. The extensive use of EVs will bring about a huge harmonic distortion in the grid. The proposed study aims to compile the infrastructure, standards, and battery charging topologies currently in use for EVs. According to the power and charging steps, the anticipated endeavor categorizes battery charging topologies. The modulation and strategies of control are portrayed in the 4th section of the report whereas the selection of the battery charging topology is highlighted in the 5th section alongside the aid of a step-by-step flow diagram. The existing infrastructures of charging and norms of battery charging are covered in Section 6.

ELECTRIC VEHICLE COMPONENTS

Following is a list of the current battery charging topologies in Table 1. A 1-phase or 3-phase external power source that is utilized to activate or recharge the battery is represented by the block "Grid". The traction motors are linked to the load side of the battery pack and are driven by the DC-AC converter.

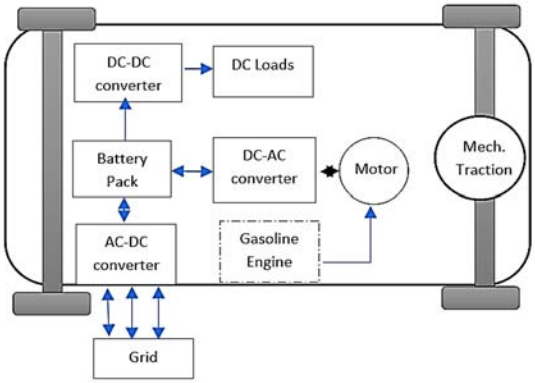

***FIGURE 1**: Architectural modal of a battery-operated vehicle*

Despite, the fact that converters (DC-DC) usually play a key role in Electric vehicles, current EVs employ AC-DC converters for battery charging implementation [23]. The research claims that, in addition to effective converter charging strategies, the battery chemistry which determines to charge and discharging rates is a crucial factor [27,35,36]. Without the UC, a sharp decline in battery health is seen, thereby shortening the battery's lifespan. As a result, batteries are unable to give rapid energy to the load during acceleration. UCs are utilized in the power storage device to supplement the traction motor's primary torque. The number of times the acceleration and deceleration event occur reduces the battery life cycle. To obtain the anticipated energy and power concentrations, and improve the performance along with the elevated life of a battery pack, parallel and series mash-up of batteries with UCs are utilized [29,34]. In EVs, peak power density/energy motors are picked; however, the traction mechanism is what makes EVs and IC engine vehicles different from one another. Different electric motors now have the chance to find use in EVs and HEVs leading to advancements in power electronics control. Multiple varieties of motors such as DC and AC motors etc. are available for use in automobiles. In-home and commercial EV applications, PMSM motors as well as BLDC motors are frequently used instead of IM(Induction Motors) [38,39]. In the early stages of EV application, DC motors were widely used. They have drawbacks that include the need for a lot of maintenance and making noise from the brushes and commutators [40]. For optimal performance, the flexible voltage and frequency control strategy is applied. High power applications can employ the PMSMs, which are incredibly powerful motors. In the proposed study, several converter topologies that are employed in effective battery charging applications are compared. In Table 1, a few of the converters have been compared and compiled.

TABLE 1 DIFFERENT TYPES OF AC-DC AND DC-DC CONVERTER STRATEGIES

Strategies /No. of switches	Twelve switches [16] DAB [7,17-20]	Eight switches [13-15]	six switches [8-11]
Remarks	improved switching circumstances while using carrier-based modulation. Minimal power conversion, high switching frequency operation, low switching losses, small size, and broadband gap switches are employed. [17-20]	Reduced size, weight, and high-power density due to a high-frequency transformer; reduced harmonic distortion; PFC with fewer switches; and low noise losses [13-15]	Because of the new modulation approach and linear power relationship, no snubber circuit is required, and the lightweight, soft-switching range is extended. Provide reactive power to the utility, five operation modes, omit the output ripple capacitor, onboard charging, and a DQ-frame controller that provides 0% steady-state error for high power applications. [8-11]
drawbacks	Snubber circuit, an additional drive circuit for four-quadrant switch operation. Efficiency at higher frequency	At a lower frequency, a big transformer is required. [15]	On contrary, the lower working frequency necessitates the use of a massive transformer., [8-11]
isolation	non-isolation [11,21-24]	Galvanic isolation [13-15]	Galvanic isolation [8-11]
modulation	Carrier-based, PSM, SVM, PWM, SHBM [7,17-20]	SVM, PWM, soft switching for all devices [13-15]	Advance modulations technique. Phase shift control for Zero voltage switching, bipolar [8-11]
Switching frequency	>50 kHz (High), 500 kHz (very high) [19]	Medium, low high (>50 kHz) [13-15]	Low(<25kHz), High(>50kHz) [8-11]
Phase	Single, three-phase [7,17-20]	Three, single [13]	Single-phase [8-11]
Stages	Single-stage, Two-stage [7,17-20]	Single-stage Dual active bridge, Two-stages, half-bridge [13-15]	Single-stage Dual active bridge, Two-Hybrid Buck resonant, two-stages FB BB, single-stage Bidirectional HB with active shunt filter [8-11]

Strategies /No. of Switches	3FB interleaved DAB, two full bridge interleaved DC-DC converters [30]	Two Full Bridge inverter, DC-DC converter, SW(8,14,16) [26-29]	Three-level PFC, buck-boost, 10SW [13]	Nine switches with the propulsion motor [25]	Sixteen switches [7,24]
Remarks	Less output inductor size, higher power application, lower conduction losses, easier to enhance power handling capability, and current frequency of 60 kHz. [30]	Small size, cheap cost, 7 kW power rating, completer ZVS switching, reduced conduction losses, low secondary voltage stress, ZVZCS, SOC control, interleaved operation, ZVZCS, SOC control, interleaved operation. [26-29]	Topology can be advantageous for high power applications, wide voltage ranges, and bidirectional operation with a larger number of gate drivers. [13]	Motor(windings)is used as the induction for DC converter [25]	Beneficial switching conditions can achieve using carrier-based modulation, unity PF, fast charger [7,24]
drawbacks	As output power rises, primary switching loss rises as well, heavy, and costly [30]	The number of components used is more, complex operations [26-29]	More switching loss [13]	Limited for domestic applications [25]	Snubber circuit, low load operation, limited [7,24] ZVS range
isolation	There is no need for isolation [30]	Two transformer isolation, single transformer isolation [26-29]	Isolation of the transformer is not required [13]	Isolation of the transformer is not required [25]	Transformer isolation [7,24]
modulation	PSM, FBM [30]	PSM, PSM & APWM, PWM [26-29]	PWM [13]	PSM [25]	Carrier-based, PWM [7,24]
Switching frequency	High (>100 kHz), low(10khz) [30]	High (100 kHz), medium [26-29]	Low(<25Khz) [13]	Low (<25 kHz) [25]	Medium, high [7,24]
Phase	Two-phase, three-phase [30]	Single phase, two-phase [26-29]	Single-phase [13]	Three-phase [25]	Three single phases [7,24]
Stages	Two stages [30]	Two-stage [26-29]	Quasi-two-stage [13]	Two-stage [25]	Single-stage, two-stage [7,24]

BATTERY CHARGING SCHEMES

Energy producing stations, electrical converters, and electrical load are the primary components of the powertrain of battery-powered vehicles. Power converters are necessary for BPVs for effective charging and discharging since they play the part of intermediary controlling units amidst the sources of power and sources of consumption. Power converters, thence deal with the growing expectations to do much more than just transfer power from a battery to loads [42]. As was mentioned, EVs can incorporate a variety of power converters; hence, by the application, multiple design topologies are accessible. The two main classifications of power converters are high-power application converters and low-power application converters. For loads like lights, electrical equipment, and cooling fans, low-power application converters are used. In contrast, large power application converters have been deployed for the operation of electric motors and the charging of batteries [43]. And the same with battery chargers, high power converters(ac/dc) get utilized. In the process of extraction of a large current through the grid, a high-intensity current is detected at the rectifier side. There have been a few documented drawbacks, including output voltage disturbance, harmonic distortion, and deficient input power factor (as a result of the harmonic distortion gathered via the grid) [4]. The major constituents of the current filter are LC, LCL, capacitor, and inductor. Another converter obtains the rectified power, this then governs the level of voltage. Two-stage conversion of power is the term used to describe power conversion that uses two converters and the converters themselves go by the name. That is, the typical rectifier could potentially be considered as a power converter comprising only a single stage in this regard. The final phase involves employing converters (DC-AC or DC-DC), according to the type of electric motor, to provide energy to the motor. One of the major obstacles to the application is the harmonic distortion that the battery charger imposes on the grid. For the sake of decreasing power consumption and, consequently, the converter size, ZVS, an active rectification method, is deployed [3,26]. The dimensions of the converter are significantly lowered at larger operating frequencies, whereas electromagnetic emission occurs at higher operating frequencies. The supply is subjected to more harmonics as a result of the distorted switching scheme. The converter's size is further enhanced by a suitable EMI filter. Table 2 provides a list of the EMI suppression standards.

DC-DC Converter

These converters have largely been used to power the electric motors in traditional BPVs. A bidirectional variety of these converters eventually became commonplace to supply the battery with power. According to the literature, traction motors and battery charging in current EVs use both converters, AC-DC and also DC-AC. Batteries may sometimes be charged directly from DC grids using DC-DC converters. [14,37,46,47] Along with the standard non-insulated DC to DC converter, Figure 2 shows the two most widely used insulated converters for battery charging. Because numerous legs play a crucial part in the generation of current, the output current injection capability grows with the elevation in the count of stages and levels. Multilayer converter, consisting of a specified shift of phase cycle in one single feedback, helps to reduce the resulting oscillations. As an outcome, in the integrated system, a modest ripple rejection filter is required. The complications and expenditure increase as the level increases. In [29], the author suggests an extremely concentrated boost converter for ultrafast charging in the paper. They benefit from a reduction in the count of inductive elements. Because only a single inductor is needed in this topology, the dimensions of the converter are reduced. The mock-up model of hardware is also discussed to ensure that the statements are consistent. Table 1 compares some of the various direct currents to direct current converters.

AC-DC Converter

Fig-1 shows the pack of batteries which is coupled with an electric network via the AC-DC converter. In [5,35,37] the importance of the aforementioned factors, as well as power concentration, dependability, efficiency, economics, mass, and volume of converters for EV applications, is lengthened. To achieve its implementation in PHEVs, it is important to employ an appropriate architecture of converter with just a potent outline. The necessary line potential difference is achieved by the inductor linked in series with that of the transformer. Fig3.1 depicts a matrix-based converter of the insulated one-phase (ac-dc), while Fig.3. 2 depicts a not-isolated 3-phase AC to

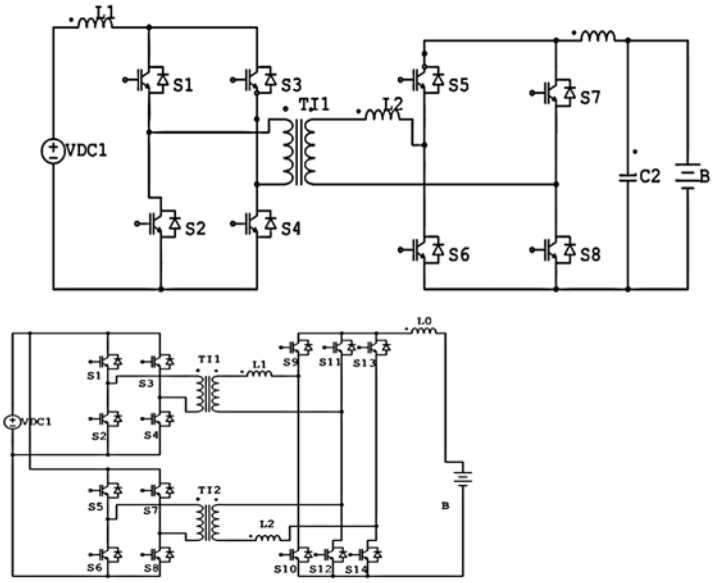

Figure 2 DC-DC Converter Topologies, Applicable for Charging in PHEVs

(1) Bidirectional FB DC-DC Boost converter (2) High power Full bridge (Interleaved) Boost converter

DC converter to achieve rapid charging; the final converter has this benefit when compared to the latter one.3.2, the transformer is absent in the converter, leading to a more compact size than the converter in the given Fig.3.1. Due to the one-phase, one-stage design, Figure 3.2 has a 3-phase infrastructure, which leads to the necessity of a lower capacitive storage bank to achieve harmonic reduction. Other advantages of this proposed topology include the absence of a transformer and the use of fewer capacitors. Unlike the single-stage version, the power conversion involves two stages. The stage 2 converter makes an effort to increase power beginning from the first stage itself while keeping the resultant potential difference steady. A bidirectional converter is utilized in favor of regenerative strategies in several scenarios in the place of a DC traction motor. Figure 4a depicts a 3-phase scheme of two-stage. A basic 2-stage converter is depicted in Fig 5.1. The range anxiety problem is one of the obstacles to its success. Therefore, the WPT strategy of storage cell charging is becoming more and more popular for real-time or opportunity charging. Fig 4 represents the AC to DC scheme for IPT. Fig 4.2 depicts a 2-stage battery charging depending upon the scheme provided in Fig 5.1, whereas Fig 4.1 depicts the Inductive power transfer with only one stage converter scheme presented in Fig 3.1. The efficiency is affected by the separation of the two coils.

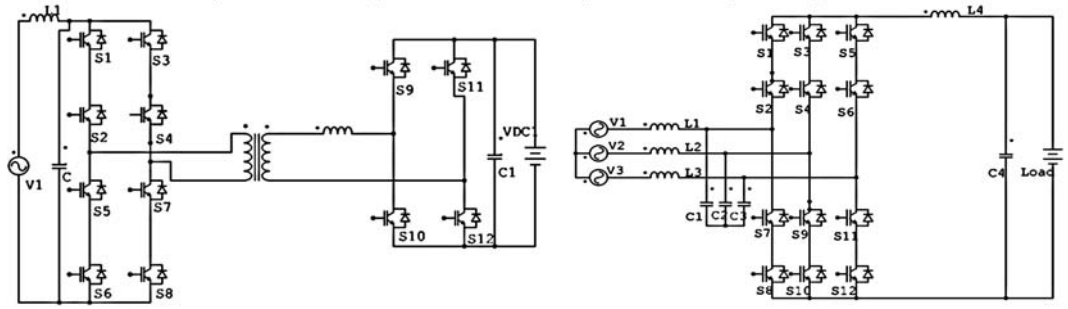

Figure 3 Single-stage AC-DC Converter topologies, Applicable for Battery Charging in PHEVs

(1) Isolated bidirectional AC-DC matric converter (2) Three-Phase non-isolated bidirectional Ac-Dc matrix converter)

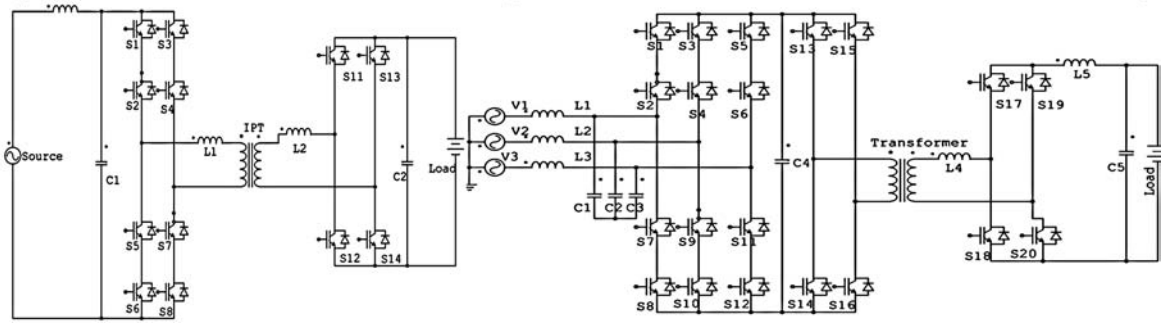

Figure 4Topologies for Wireless Battery Charging

(1) Bidirectional Single-stage matrix-based converter for IPT (b) Three-phase two-stage AC-DC converter with Inductive Power Transfer (IPT)

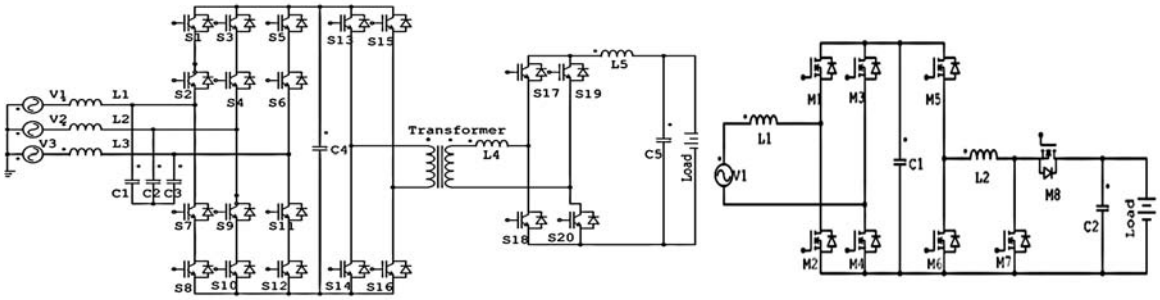

Figure 5 Two Stage AC-DC converter topologies, Applicable for Battery Charging in PHEVs

(1) Three-Phase two-stage isolated AC-DC bidirectional converter (2) Two-stage Non-isolated AC-DC converter

MODULATION AND CONTROL TECHNIQUE

With the use of the PWM technique, it becomes convenient for the converter to achieve particular standard voltage estimates. At the time of switching, the pulse width passed to switches is controlled by the modulator. The topology of the converter is determined by the application. Standard PWM methods make a comparison between the sawtooth wave and the DC level to produce impulses of a particular width. Carrier-based modulation has been discussed in articles [16, 24], phase-shift modulation is covered in [7, 13, 17, 33], and the duty factor of the recommended converter is calculated using a space vector modulation scheme presented by Castelino et al [15]. Both, the half-bridge and full-bridge modulations are referred to as single half-bridge modulation methodologies and full-bridge modulation methodologies, respectively. By using ZVS/ZCS, the dimensions of the power stage may very well be lowered while retaining the same efficiency [11]. According to the literature, establishing a closed-loop control system can be complex, and complete ZVS/ZCS is unlikely to be accomplished with operational parameter volatility. According to the papers [16, 24], a discrete scheme of gate drive alongside efficient transmission must be employed to attain enhanced regulation of the system of power electronics altogether. When bidirectional power flow is utilized, communication amongst switches is extremely critical because negative power might flow, for example, via the automobile to further elements or via the engine to the storage cell if the RBS will be used [7,8, 48]. While [49] outlines the authors' projections for future standards and rapid charging methods applicable to EVs using a combination of control and modulation schemes, [3] elaborates on the numerous optimization strategies for charging applications in Plug-In Hybrid Electric Vehicles. DSP, as referenced [16, 24], also serves the purpose of transmission and control. As aforementioned, the outline of a one-stage converter is simpler, however, ripples occur at lower working frequencies. Two-stage converters are commonly used in high-power applications to lower the output filter capacitor and reduce ripples. The current voltage is employed as a state parameter in two of the stages to control the necessary functionality [32, 35, 45]. When such a resultant DC is used as a state parameter, the dynamic responsiveness starts to deteriorate. The structure of the battery, on the other hand, is restricted to a single topology. For example, the authors' primary

issue addressed in [50] is the one-phase, two-way ac/dc converter for PHEVs, however, the usage of the converter configuration is minimal. Similar to the article [31], Paper [31] only examines front-end AC-DC topologies for a universal battery charger technique as an use for electric automobiles, which limits the evaluation of alternate topologies and DC-DC converter methods. Furthermore, research [21, 44] details the enhanced system of charging deployed for an onboard charging system but limits the investigation to a certain strategy.

CONVERTER TOPOLOGY SELECTION

The selection of the best converter topologies for battery charging applications is covered in this section. The first decision to make is the kind of input power source and voltage level (Table 3 lists the three voltage levels of battery charging that are attainable). The required rate of charging (as well as the type of package of batteries), efficiency, regulation over varying factors, quality of power (total harmonic distortion at the side of supply), measurement, and expense are narrowed down according to the applications. For all applications, it is typically preferred to have a low-cost converter that is effective, seems to have a large density of power, low THD at the side of supply, elevated reliability, and compact dimensions. The preferred level of voltage has not been represented in Figure 6 because, by the way of explanation, the preferred configuration could be created considering the given level of voltage and rating of power. It is important to remember that chargers with more switches make chargers larger and more expensive; as a result, the majority of applications are acceptable for standard charging topologies with full electrical isolation. Preserving the quality of power is indeed a crucial component when charging in Mode 3 at high power. To sustain the grid's reliability and quality of power, it is advised to charge more gadgets.

TABLE 2 DESIGN SPECIFICATIONS FOR CONVERTERS

Operations	DEC	SAE
Charger effectiveness and power quality	IEC61851	SAE J2894
Connectors, sockets, and plugs for charging; conductive charging, levels, and modes	IEC 62196	SAE J1772
Transmission for PHEVs	IEC61851	J2931/1
secure communication	IEC 15118	J2931/7
DC charging communication	IEC61851-24	SAE J2847/2
suppression of electromagnetic interference	IEC 60940	SAE J2954
Injection of harmonics	IEC1000-3	SAE-J2894
Utility grid interconnection with dispersed power sources (EVs)	IEEE 1547, UL 62109 (IEC does not have)	SAE J2954 (unidirectional power flow G2V), J2931/5 (communication)
Communication of wireless power transfer	IEC 61980	SAE J2954

INFRASTRUCTURE AND STANDARDS OF CHARGING

Among the key components of an effective EV, efficient charging infrastructure is vital. The absence of effective battery charging infrastructure lengthens the charging process and, as a result, restricts the practical use of EVs. Lack of infrastructure results in onboard charging, a large battery pack, extended charging periods, and the need for separate chargers for various localities [3, 6]. The quality of grid power being utilized for charging is often impacted by the charging infrastructure. Nonetheless, effective battery charging, which is widely accepted, and utility synchronization are essential for the boom of EV deployment [51]. Due to various regulations and national policies, the architecture of the evolving infrastructure differs. The International Electrotechnical

Council's EV specifications are extensively utilized in Europe, whereas in the US, the Society of Automotive Engineers sets standards for the infrastructure used for charging electric vehicles. The charging standards in different countries differ from those in IEC and SAE, though they exhibit some resemblance to the latter. Relying on the modes of charging, the battery charger's charging capacity, rating of the converter, battery pack, etc. is estimated. The charging methods that are accessible are covered in Table 2. The type 2 or moderate mode charging equipment is intended for both public and private places. As even the name implies, charging is quicker than Mode 1 charging. The financial prosperity of moderate charging can be credited to its characteristics of being simple to install and of modest size. High-performance EVs have type 2 charging available on board, therefore all they need to link to the main supply is a power socket [51, 52]. The architecture of several nations' power grids is still not configured to deliver enough power enabling widespread battery charging at some point with the necessary quality of power. As a result of the significant current surge that damages the dielectrics of the transformer, causes power outages, and sometimes even alters the provided voltage. Type 2 and type 3 charging schemes could harm the power quality as well as impact the lifespan of the distribution transformer. Consequently, a potential difficulty that the electrical system may encounter is bulk battery charging. The stability of the power grid can indeed be severely impacted by distortion caused in the transformer and, consequently, also on the grid. A deeper understanding of the grid system is essential for controlling grid behavior. Without the ability to regulate charging time, the electrical system may become unstable, necessitating the use of a smart grid.

TABLE 3 STANDARD RATINGS AND VOLTAGE LEVELS

Levels of charging	Mode	Location	Voltage (Input)	Ratings of power	Probable time is taken for charging	Storage Battery rating
level 1	Slow Mode Charging	Residential Area	120 /240V_{ac} 48 V_{dc}	3.3–10 Kilo Watt	6 to 11 hours	5–15 kWh (PHEVs); 16–50 kWh (EVs)
level 2	Moderate Mode charging	Residential Area	230 V_{ac} 400 V_{ac} 200–450 V_{dc}	7–24 Kilo Watt	3 to 4 hours	
level 3	Fast mode charging	Public facility	208–600 V_{ac} 600 V_{dc}	43 kilo Watt	0.4 to 6 hours	15–42 kWh (PHEV); 100 kWh (EVs)

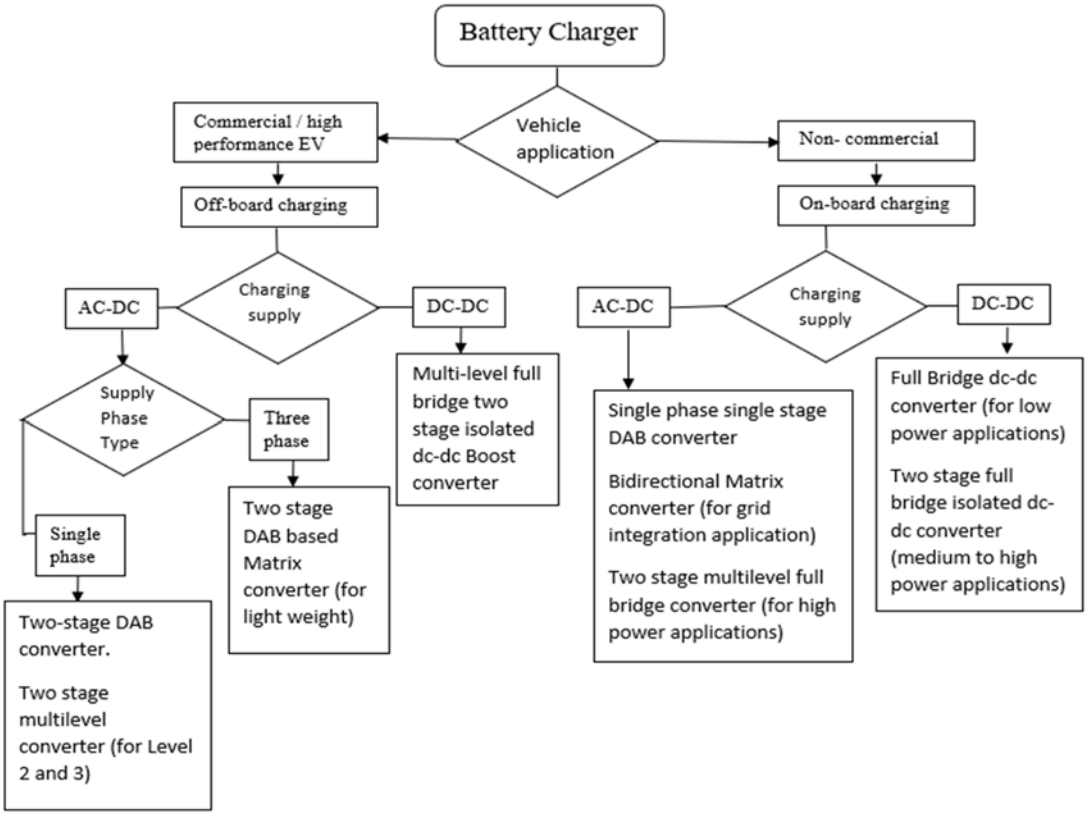

Figure 6 The Selection of Converter Topologies for the Implementation of PHEV Battery Charging

CONCLUSIONS

The thorough literature study that was conducted highlights the major topologies of power converters, architecture, and norms necessary for the implementation of charging batteries in EVs. Various factors, including input voltages, rated power, speed of charging, frequency of stages, and element count, are used to categorize the charging topologies. A judgment flow diagram is suggested to help choose the optimum topology to implement for numerous industrial and commercial uses such as EVs. The report also suggests efficient modulation schemes, converter adjustments, and charging architecture strategies, among other significant contributions. Following are a few of the study's major findings:

In contrast to charging velocity (off-board), which is favored by industrial and highly reliable EV applications, less expensive and compact chargers are recommended for the sake of non-monetary uses. Three possible levels are available in the charging network (Levels 1, 2, and 3), which are shown in Table 2. The two commonly utilized standards for charging converters and topologies are IEC and SAE (listed in Table 3). As soon as charging stations become easily accessible, solutions of charging (off-board) have the potential to reduce the price and the complexity of Electrical Vehicles. Wireless charging (battery charging) technology necessitates a significant infrastructure.

EV adoption as a substitute mode of travel and motion is growing rapidly. Their widespread use has resulted from the effective performance and compact size of the various elements alongside environmental concerns. Broad bandgap (WBG) semiconductor devices, nevertheless, will be deployed much more frequently in the future, which could cause a further reduction in size and an improvement in the electronic converter's power management ability. Now because wide band gap (WBG) devices work at about extremely large frequencies, they thence tend to produce a noise spectrum of quite large frequencies, necessitating an efficient noise filter for their application.

In addition to the current methods, certain fresh approaches should be used to improve the grid's quality and stability to support widespread EV charging.

As a result, this study provides a variety of battery charging methods and topologies that are appropriate for EV applications. Here, the operated simulation of the mechanism of EV charging is depicted. The study is beneficial for researchers and scientists to create innovative converter architectures for effective battery charging systems.

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Impact of News Sentiments on Stock Price Prediction

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Abstract. A significant amount of research is carried out on integrating historical data and sentiment analysis to predict stock prices. This study proposes DTR-SA approach to predict the next day's high price for the randomly selected stocks from the NIFTY 50 Indian stock market index. The approach first calculates sentiment scores based on the news data collected from various news portals. The Decision Tree Regression (DTR) algorithm next combines historical stock prices with a sentiment score to predict the high price for the next day. Results indicate that sentiment analysis of news data along with historical stock prices significantly improves the prediction accuracy and hence the Mean Absolute Percentage Error (MAPE) value. The MAPE value of all stocks considered by this study is better compared to the previous historical results.

Keywords: Sentiment Analysis, Decision Tree Regression, Machine Learning, Prediction Accuracy.

INTRODUCTION

Stock price prediction started by making use of machine learning algorithms like Autoregressive Integrated Moving Average (ARIMA), DTR, Support Vector Regression (SVR), Long Short-Term Memory (LSTM), Neural Network Multi-layer Perceptron (NNMLP) and many more techniques. Since the stock data is non-linear, new algorithms and new approaches improved the prediction accuracy of stock prices. However, even at present none of the approaches is 100% accurate. A large amount of text data became available and the use of digital devices increased, its impact on the human mind also increased. Stock and finance-related text data are mostly available through Twitter, blogs, news portals and other social media platforms.

Certain news headlines on stocks, finance or politics; blogs written by influential financial analysts caused the stock index or certain stocks to move upwards or downwards drastically. This led to the correlation between social media data and the stock market. Moreover, this led to a new area of study known as Sentiment Analysis. It is a Natural Language Processing technique that is used to first analyze whether the text data is positive, neutral or negative. This was initially a classification technique used to mine text data. This technique was further improved to convert the positive, neutral or negative tag to a sentiment score between -1 and 1. Thus this quantitative numeric data can be used with many regression-based algorithms to predict some future values.

Many studies have been carried out on Twitter and other news data to predict the stock price. These studies make use of only social media text data and not historical stock data. As time went on to improve the accuracy of predicted values, historical stock data was combined with social media data.

This research work first calculates the sentiment score based on news data related to stocks, finance and politics as these subjects influence the stock market the most on the next day. The 'nltk' python library is used to calculate

sentiment scores from the collected news data. This study uses the DTR machine learning algorithm to predict the next day's high price based on sentiment score and historical stock data.

RELATED WORK

Investors earning from the stock market are always keen to know future stock prices in advance. Hence, significant research is already carried out for predicting stock prices. Past research has proved that social media sentiments are correlated to future stock price movement. The study [1] uses LSTM that considers Empirical Mode Decomposition (EMD), sentiment index and attention layer to predict stock prices. The study considers only one stock AAPL. Along with historical data of 5 years, the sentiment index is calculated based on stocktwits.com – only one portal is considered. The proposed model results in an impressive MAPE value of 0.0165.

HiSA-SMFM model again uses LSTM to combine historical and sentiment data as proposed in [2]. Only one stock of Tata Motors is considered and historical data of 1 year is collected. Sentiment data is collected from Twitter. Accuracy of 97.18% resulting in a MAPE value of 0.0282 is achieved by the study. The research work presented in [3] first uses Convolutional Neural Network (CNN) for sentiment analysis and then LSTM to combine historical data and sentiment analysis. One day ahead closing price is predicted for 5 stocks selected from different industries. The proposed hybrid model of CNN-LSTM results in the best MAPE value of 0.0405.

The study [4] compares three models GRU, CNN and LSTM to predict the next-day close price of the Nepal stock exchange index. Here sentiment score is based on news data, fundamental as well as technical indicators are included. LSTM returns the best MAPE value of 0.5826 which is significantly high. Sentiment score based on news articles and Twitter is directly collected from Bloomberg in [5]. The research indicates that the stock price prediction can be significantly improved by making use of sentiment score. The research [6] uses Artificial Neural Network (ANN) to combine sentiment scores and historical prices. The study suggests that explicit sentiments improve the performance of ANN while predicting the closing price direction.

The prediction model proposed in [7] uses Naïve Bayes for sentiment analysis and K-NN to predict the future trend of rise and fall of stock prices. K-NN integrates sentiment scores based on financial news and historical stock prices. The best accuracy of 89.8% is obtained when the sentiment score is used by K-NN. The future trend of stock buy or sell was predicted by [8]. News and Twitter data were considered to calculate sentiment scores. The various deep learning algorithms use both basic stock indicators and sentiment scores. The study reveals that sentiment score is related to the next day's share value. The work in [9] uses LSTM to prove that collective emotional states are correlated to the stock transaction data over time. Basic stock indicators of six stocks from the Shanghai stock exchange were used in the experiment. The study indicates that financial data predictions can be improved by using public opinion along with stock data.

Six different models are implemented in [10] to predict stock prices. Five years of stock data from the Hong Kong stock exchange and news articles from FINET were considered in the study. It gives an important conclusion that sentiment analysis improves prediction accuracy. The research [11] uses StockTwits for sentiment analysis. The study uses 9 months of data for five stocks. It concludes that sentiment analysis improves the stock price direction prediction accuracy. Sentiment analysis and neural network techniques are combined in [12] to predict the stock faith recommendation. Stock faith enables the investor to buy or sell stocks. The study [13] uses Nave Bayes and Random Forest to classify tweets and calculate sentiment scores. Next linear regression is used to build a prediction model. Experiments indicate that sentiment score helps in improving prediction accuracy.

Deep learning models Recurrent Neural Network (RNN) and LSTM are used to improve stock price prediction accuracy by making use of financial news articles in [14]. Five years of stock data for Apple was considered in this study. RNN-LSTM that included sentiment score performed best with a MAPE value of 0.0203. A rare result of a study [15] states that there is a negligible effect of sentiment analysis on the stock price prediction. An ensemble model was proposed that combines tweets about Infosys along with basic and technical stock indicators.

RESEARCH METHODOLOGY

Research Data

The historical stock data was extracted from www.nseindia.com making use of the nsepy python library. Historical data of certain randomly selected stocks are collected from 1-Jan-2000 for the DTR model. Here, the basic stock price indicators – open, low, close, previous close and Volume-Weighted Average Price (VWAP) are considered.

Web scraping is carried out to extract news data from RSS links. Reputed news portals like moneycontrol, economic times, mint, investing, business-standard etc. were used to scrap news data. News data is scraped from 1-Jun-2022 onwards. Around 200 news items are scraped on each stock trading day. The news data along with historical data is used for DTR-SA model. News data is collected using 'BeautifulSoup' library of Python. Next, the sentiment score is calculated using the 'nltk' python library. The range of sentiment scores is between -1 and +1, a negative value indicates negative sentiment about the news and a positive value indicates positive sentiment about the news.

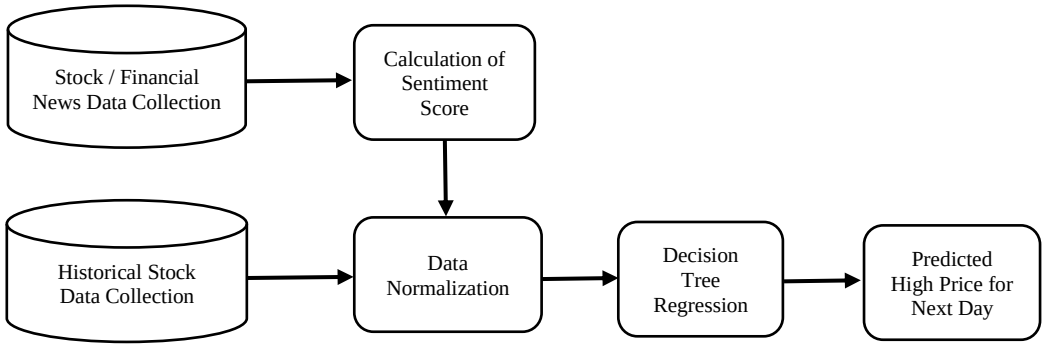

Figure 1. DTR-SA Model.

As part of data pre-processing, normalization of stock prices and sentiment score is carried out using MinMaxScaler from Sklearn python library. Next Decision Tree Algorithm is applied to the normalized data to predict the High stock price for the next day.

Decision Tree Regression

Regression trees are generally used when the dependent or target variable is continuously valued, i.e., when the problem is prediction type. In a regression tree, a regression model is fit to the dependent variable using each of the independent variables. After this, the data is split at several points for each independent variable considered for study. At each such point, the error between the actual value and predicted values is squared to get 'A sum of squared errors' (SSE). The SSE is compared across the variables and the variable or point which has the lowest SSE is chosen as the split point. This process is continued recursively. The biggest advantage of using a regression tree is that it creates a very simple model which predicts the values very quickly. No assumptions are required as the regression trees are non-parametric and non-linear. However, overfitting is one of the biggest problems as far as DTR are concerned.

To validate the performance of DTR-SA and DTR models MAPE (Mean Absolute Percentage Error) is used.

$$\text{MAPE} = \frac{1}{n}\sum_{i=1}^{n}\left|\frac{Y_i - \hat{Y}_i}{Y_i}\right| \qquad (1)$$

In the above equation Y_i is the actual high price and $\hat{Y}_i$ is the predicted high price of the stock under study.

RESULTS AND ANALYSIS

Some stocks from the NIFTY50 dataset are selected at random. To study the effect of news sentiment on stock price prediction, first the DTR algorithm is applied to only the historical data and results are obtained. Next, the DTR-SA i.e. the same DTR algorithm is applied, but this time to historical and sentiment scores and results are obtained. MAPE is used to compare both results.

Table -1: Comparison of MAPE results.

STOCK NAME	TOTAL TEST RECORDS	DTR MAPE	DTR-SA MAPE	No. of Records with improvement in predicted price.
SBIN	30	0.022	0.012	17
HINDALCO	30	0.021	0.016	16
CIPLA	30	0.0116	0.0089	18
EICHERMOT	30	0.0205	0.0144	19
HEROMOTOCO	30	0.0117	0.0086	19
HDFC	30	0.0163	0.0093	18
BPCL	30	0.0208	0.0148	18
BHARTIARTL	30	0.0166	0.0152	16
HCLTECH	30	0.0142	0.01	18
INFY	30	0.0181	0.0142	16
KOTAKBANK	30	0.0194	0.0119	22
RELIANCE	30	0.0135	0.008	16
BAJFINANCE	30	0.0159	0.0114	18

The MAPE value for all the above stocks improves when DTR includes the sentiment score. Thus, clearly indicating that news has a significant impact on the decision-making ability of investors. Moreover, the obtained MAPE value of all the stocks considered in the study is far better than those achieved by [1], [2], [3], [4] and [15].

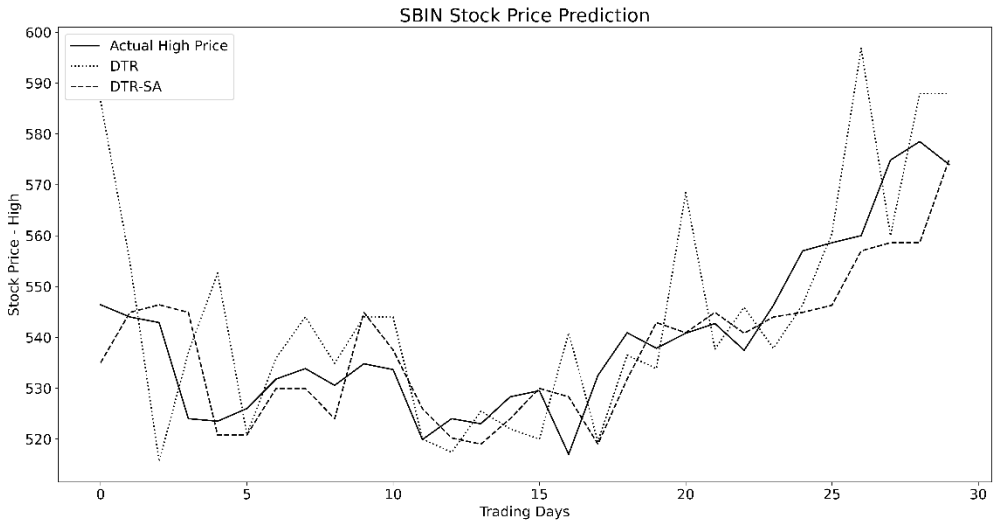

Figure-2: SBIN Stock Price Prediction

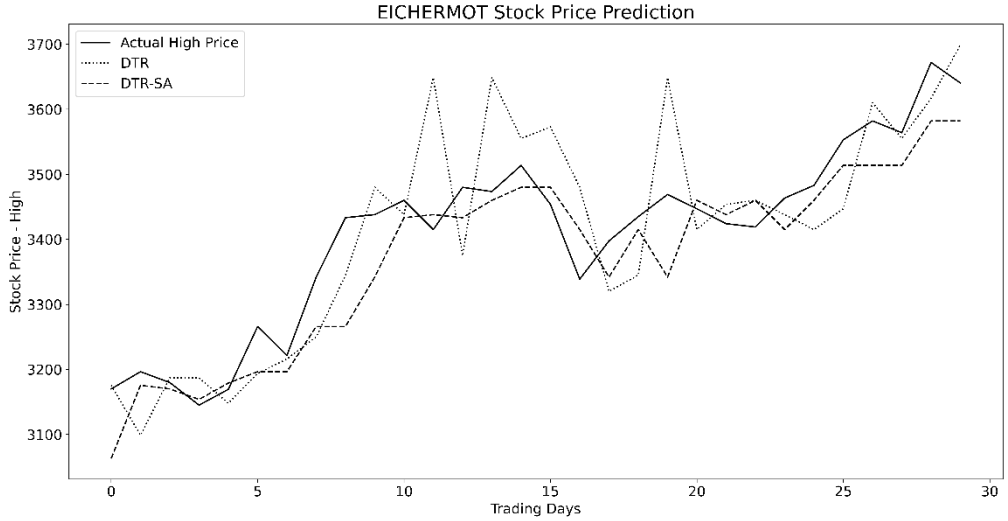

Figure-3: EICHERMOT Stock Price Prediction

Two specimen stock price prediction performances are presented in figure-2 and figure-3 respectively. In both the above stocks – SBIN & EICHERMOT the graph also validates the fact that the price predicted using DTR-SA approach that includes news sentiment is far better than the one that uses only historical data.

CONCLUSION

This study proposes a new DTR-SA approach to predict the stock's HIGH PRICE for the next day. It is a simple approach that utilizes sentiment scores and historical stock prices. The sentiment score is calculated based on news data related to stock, finance and politics collected from news portals. Results clearly indicate that news sentiments have an impact on investors. Hence, including a sentiment score while predicting the next day's high price improves the prediction accuracy. This improvement is validated by both MAPE value and graphs. Moreover, the obtained results when compared with previous studies indicate that DTR-SA simple approach gives better results than other approaches and results obtained so far.

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Emission Control of a Gas Turbine Combustor: A Review

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Abstract. The combustor plays a vital role in the performance of the gas turbine engine, which is expected to provide low emissions. Complete combustion happens when all of the fuel's energy is released. It is crucial to work toward complete combustion for cost-effectiveness. The key to lowering NO_x emissions is to lower reaction zone temperature and minimize local hot spot regions in the reaction zone. Lower temperatures and longer residence times result in a slower reaction rate, which produces CO. In addition, at high equivalence ratios, an improper air-fuel mixture that results in a fuel-rich zone emits CO. For complete combustion to take place, there must be enough air in the combustor. The addition of excess air reduces the formation of CO by allowing CO to react with O_2. The less CO remains in the combusted gas, the closer to complete combustion the reaction becomes. This is due to the fact that the poisonous gas CO still has a sizable quantity of energy that needs to be entirely burned. Further, at elevated temperatures, CO_2 can dissociate, which is not expected in any gas turbine application. Numerous combustion approaches have been investigated so far in order to achieve lower pollutant emissions. An exhaustive literature review based on Colorless Distributed Combustion, flow field pattern and NOx Emission, lean premixed combustion, ultra-low NO_x emission, natural gas and biogas, LPG combustion, micro gas turbines, fuel spray characteristics, effect of swirl, fractal grids, stability and combustion efficiency, and residence time has been performed.

COMBUSTION TECHNIQUES

Numerous combustion approaches have been investigated so far in order to achieve lower pollutant emissions (NO_x, CO, and UHC) for gas turbine combustors [1]. Reducing reaction zone temperature and minimizing the local hot spot regions in the reaction zone are the keys to reducing NO_x emissions. Lower temperature and residence time result in a lower reaction rate, which causes CO emission in the gas turbine combustor. In addition, at high equivalence ratios, an improper air-fuel mixture that results in a fuel-rich zone emits CO. Further, at elevated temperatures, CO_2 can dissociate, and it is not expected in any gas turbine applications [2]. There are several techniques which have been followed to reduce NO_x by lowering the temperature in the primary zone of the combustor. Water injection technique and hot gas recirculation with the help of heat sinks are widely used. However, the introduction of additional hardware with those techniques would reduce the efficiency of the combustion system [1]. Several concepts have been developed to reduce emissions, the most well-known of which is the RQL (Rich burn, quick quench, and lean burn) concept. This approach starts the combustion process in a fuel-rich zone, which reduces NO_x formation because of the reduced air supply. This is followed by fast cooling of those products with high-speed air jets and then the remaining unburnt hydrocarbons and CO are oxidized in a lean burning zone. This technique also needs additional hardware and extra control systems for maintaining the rate of quenching and equivalence ratio required for achieving different burning zones. The hotspot region can be minimized with premixed combustion to provide ultra-lean hot gas. However, flame flashback and combustion instability are the severe issues that occur due to premixed combustion [2].

COLOURLESS DISTRIBUTED COMBUSTION

High temperature air combustion (HiTAC) [3]–[5], often known as flameless oxidation (FLOX) [6], is the basis for the concept of colorless distributed combustion (CDC) [1], [7], [8]. In this method, NO_x and CO emissions are lowered with stable combustion and a uniform pattern at the exit of the combustor. The combustion has been performed without a stabilizer and low noise generations are advantageous for this combustor [1].

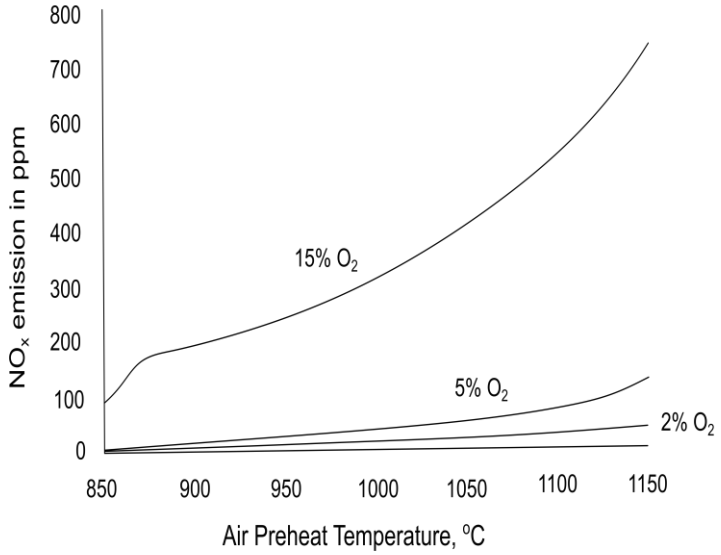

Fig.1. Emission of NOx as a function of air-preheat temperature and O2 concentration in air using propane as the fuel with nitrogen as the dilution gas. Reproduced from [5].

Non-premixed CDC is attained by the separation of high momentum air jet and low momentum fuel jet and their controlled mixing inside the combustor [9], [10]. The distributed combustion reaction is produced due to large recirculation of mixture and continuous combustion due high rate of turbulent mixing, avoids local hot spot zone and minimizing NO_x formation [3]. Because of a fuel-rich zone and non-variable stoichiometry, CO emissions were decreased. Studies were done on burners with low heat release intensities for use in furnaces [3]–[6]. But in order to produce thrust, gas turbine combustors have to work at a high heat release intensity. This means that they have to work with high-speed gases, with a small combustion volume, and for a lower residence time [2], [11].

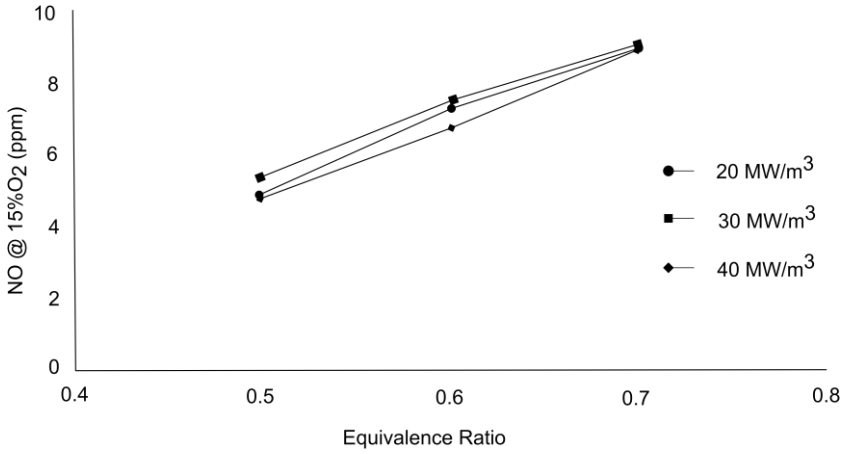

Fig.2. NO emission as a function of equivalence ratio from CDC flames at various combustion intensity. Reproduced from [7].

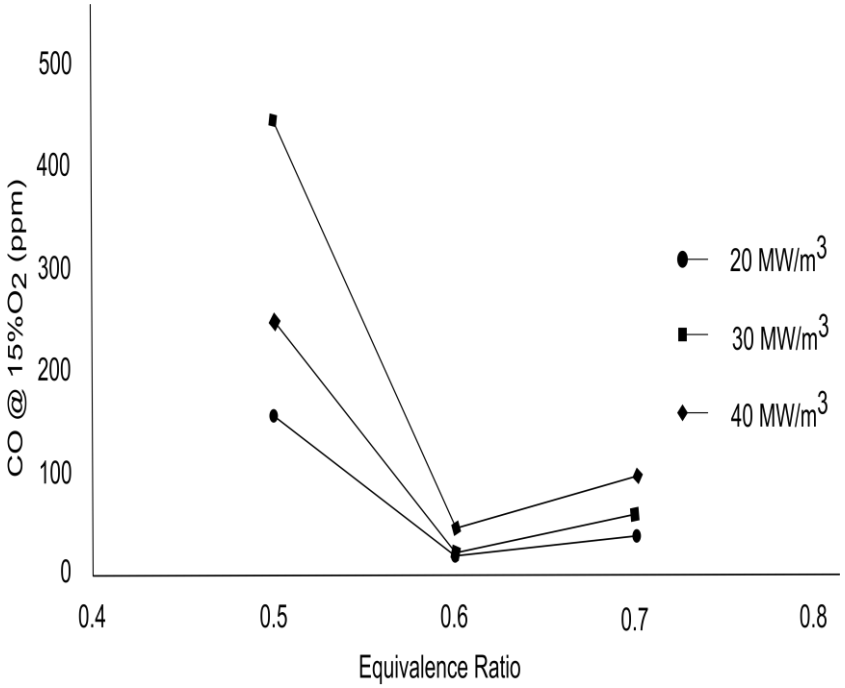

Fig.3. CO emission as a function of equivalence ratio from CDC flames at various combustion intensity. Reproduced from [7].

FLOW FIELD PATTERN AND NO_X EMISSION

The flow field patterns of forward, reverse, and an opposed flow configuration were investigated. Design and development of methods to reduce NO_x formation in combustion systems have become more focused due to environmental concern [1], [12]. Air breathing engines use atmospheric air for their combustion, in which nitrogen reacts with hydrocarbon fuel and forms the nitrogen compounds through two different mechanisms. The Zeldovich mechanism is of the first kind in which the oxidation of free nitrogen produces nitrogen oxide during combustion, which is called "thermal NO_X." It mostly depends on the fuel's stoichiometric adiabatic flame temperature, or the temperature gained by burning the correct fuel-air mixture. The local temperature of reactants during combustion plays a key role in thermal NO_x. Prompt NO_x is another type in which the radicals of hydrocarbons react with nitrogen and oxygen in a fuel-rich reaction and form the compounds of nitrogen [13]–[15].

LEAN PREMIXED COMBUSTION

Lean premixed combustion [15] is more adaptable than steam injection, catalytic reduction reaction [16], RQL [17], [18], and combustion with stages in controlling the NO_x emission [19], [20]. In this technique, a limited amount of fuel is added, which forms the mixture and is allowed to combust at a limited temperature. Due to less temperature in the reaction zone, NO_x emission can be minimized to a greater extent [21].

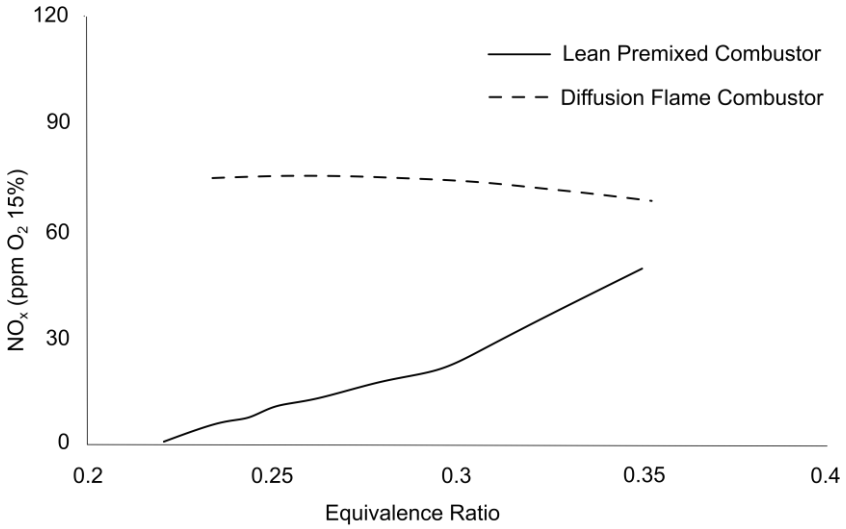

Fig.4. NOx emission under lean premixed and diffusion combustion conditions. Reproduced from [15].

A pre-mixer fixed at the upstream portion of the combustion zone is used to mix the fuel and air. Local hot spots are typically the result of inappropriate fuel and air mixing in the combustor's primary zone, which produces NO_x [22]. Because the physics of mixing, recirculation of fuel-air mixture, and flame stability using this method are not fully understood, the use of lean premixed combustion in a gas turbine's combustor is limited. The most difficult parts of making a fuel-lean flame inside the combustor are mixing the air and fuel, making it go back through the reaction zone, and keeping the flame stable [23].

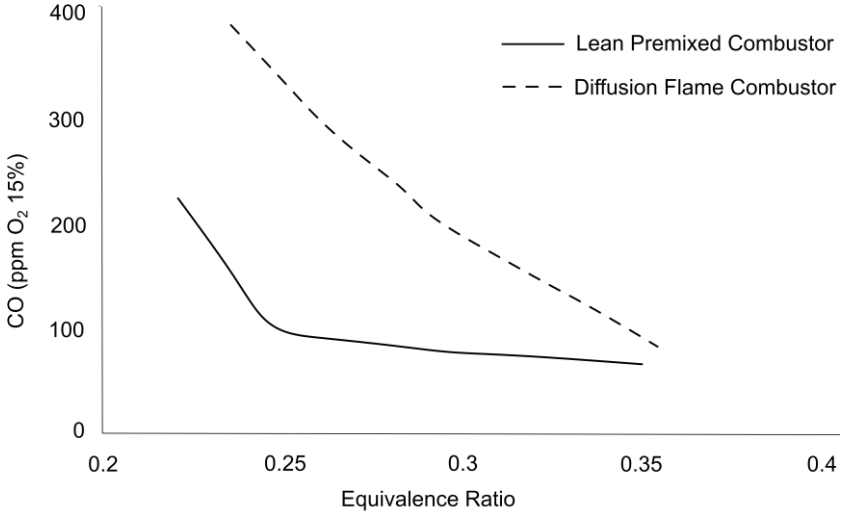

Fig.5. CO emission under lean premixed and diffusion combustion conditions. Reproduced from [15].

ULTRA-LOW NO_X EMISSION

More research in the future will be needed to fully understand the effect of fuel-air premixing on the formation of nitrogen compounds and lean premixed flame stability in order to develop an ultra-low NO_x emission in the gas turbine combustor. Attempts have been made to design various pre-mixers [21]. It is known that hydrocarbon fuels are the main source that can power most gas turbine engines, and their usage is questionable in the future due to concerns about global warming. Many fuels are in the research phase to provide lean combustion due to their clean nature, thereby reducing pollutant emissions with improved performance. When pure hydrogen and hydrocarbon fuel are mixed together, stable lean combustion at low temperatures is made possible.

NATURAL GAS AND BIOGAS

The use of fuel affects engine design, so one must design the engine based on the choice of operating fuel. Natural gas is the cleaner, hydrogen-rich, and most energy-efficient fuel for power production. It is expected that the natural gas domain will dominate other fuels by 2030 [24]–[26]. Biogas has wider application in the field of combustion engines, burners and industrial-based gas turbine powerplants. Based on environmental concerns, biogas is more advantageous than natural gas [27].

LPG COMBUSTION

LPG has been used as the fuel in research to better understand the features of lean premixed combustion. The major aim is to realize how fuel/air premixing, which is frequently employed in lean premixed gas turbine combustion environments, affects NO_x emission levels. Using various fuel/air premixers, the emission of NO_x and CO has been investigated under a variety of conditions. The findings indicate that if the fuel/air mixture is carefully prepared to have homogeneous properties at the combustor's inlet, the NO_x emission will be reduced.

By using a wider fuel injection hole and extending the axial mixing distance between the fuel injection and the premixer's outlet, the homogeneity can be enhanced (for the same velocity). The use of a larger dome angle in the premixer minimizes NO_x emission because the larger dome enhances recirculation in the flame zone and decreases hot spot regions. Premixed combustor has a greater impact on NO_x emission than diffusion flame combustor due to the equivalency ratio. The results also demonstrate that the lean premixed combustor reduces NO_x emission levels better than the diffusion flame combustor [15].

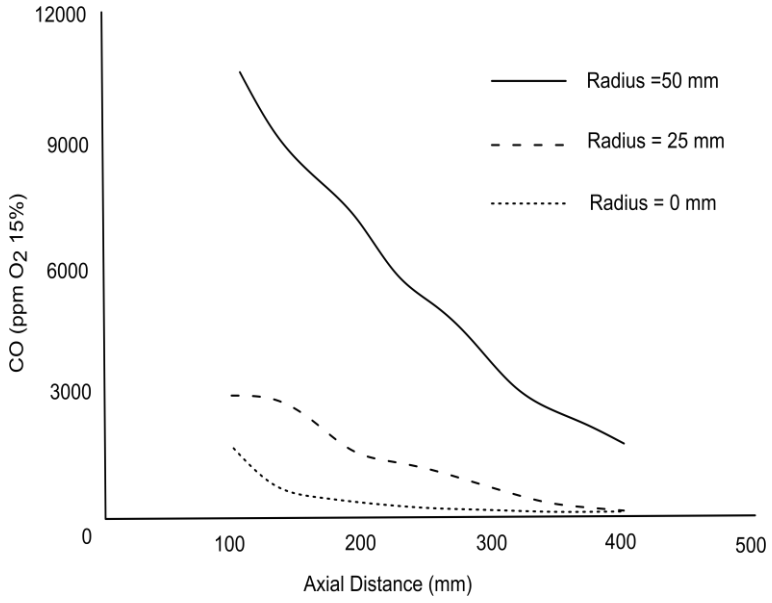

Fig.6. CO concentration along the axial distance downstream of the combustor. Reproduced from [15].

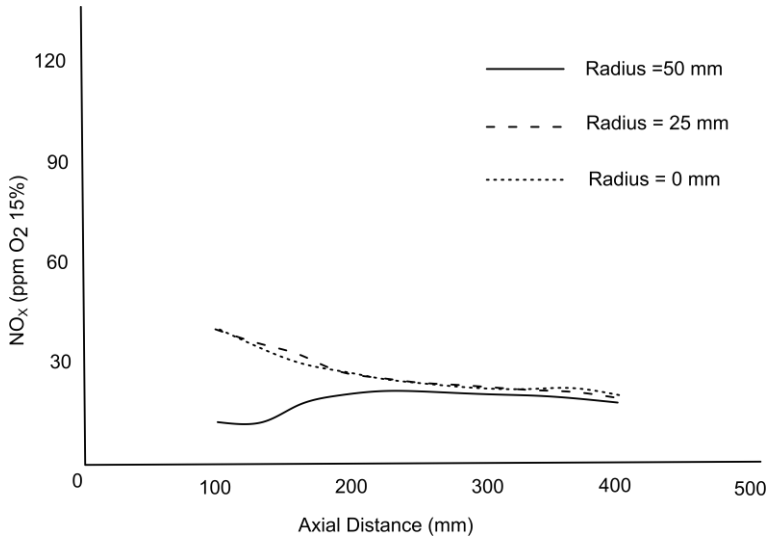

Fig.7. NOX concentration along the axial distance downstream of the combustor. Reproduced from [15].

MICRO GAS TURBINES

The thermodynamic principle of a micro gas turbine (MGT) does not change with size, and it is also a mass flow machine, the same as a conventional gas turbine engine [22], [28]. The MGT can deliver maximum output when its rotor operates at near sound speed. So, the radius of the turbine needs to be as small as possible to prevent vibration and tip losses so that it can be run at a faster speed to get the most power out of it [29], [30]. A lot of research has been performed in the area of micro gas turbine systems. Based on the design of a small turbocharger, a two-staged micro-gas turbine was employed to burn biomass fuel [28], [31]. To ensure correct air-fuel mixing and its formation, which directly influences the emissions, the design is more intricate. The lifetime of combustor components and thrust production of gas turbine engines can be improved when the fuel is uniformly distributed from all the fuel injectors of the combustor. High fuel consumption, high exhaust emission and low reliability of hot section components will result due to incomplete combustion in the event of uneven distribution of fuel and its improper mixing with air. Therefore, a suitable fuel injector has to be employed for good fuel distribution, and it is a major concern in the design and development of the combustor [2].

Emission of MGT

The purpose of MGT is to deliver lower NO_x and CO emissions, which in turn means cleaner combustion while also being more eco-friendly. The Environmental Protection Agency (EPA) of the United States restricted NO_x emissions to 15 ppm (at 15% O_2) and CO emissions to 130 ppm (at 3% O_2) by the EPA [32], [33]. Engine manufacturers are expected to produce lower emissions due to these regulations. It is projected to produce 90% less NO_x by the year 2050 [34]. The development of flameless combustion has demonstrated decreased emission levels. It was also said that it would be useful in a number of applications [6], [35].

Nitrogen Oxides

The NO_x correction factors are affected by the combustion products produced when using different fuels, and the gas turbine engine is controlled to estimate a constant combustion temperature. The gas turbine's highest-headed emission is NO_x. The gradual decrease of emissions is the goal of the development of various combustor designs and technologies. That worry might surpass attention to their results and indicators [36]–[39].

Unburned Hydrocarbons

Unburned hydrocarbons (UHC) are related to ineffective combustion. At low loads, UHC emission levels are below 7 ppmvw (parts per million by volume wet). The non-stoichiometric air-to-fuel ratio results in the production of hydrocarbon emissions. In other words, the amount of hydrocarbon emissions highly depends on the equivalence ratio. UHC is released into the exhaust as a result of the lack of oxygen in the fuel-rich mixture. If the air-to-fuel ratio is too lean, the combustion will be weaker, producing UHC emissions once more [37], [40]–[42].

Carbon Monoxide

For steady state operation, the carbon monoxide (CO) emissions from a standard gas turbine combustion system are less than 10 ppmvd (parts per million by volume dry) during the lowest loads. There may be transitory emission levels higher than those shown during ignition and increase in speed. These levels contribute relatively little to the combined emissions due to the gas turbine's small loading phase. The heat input from burning fuel in the combustor and releasing air from the compressor limits the micro-gas turbine's ability to produce electricity. The gas turbine industry is increasingly using gaseous fuels like natural gas and biogas as well as liquid fuels like kerosene [43], [44].

FUEL SPRAY CHARACTERISTICS

Several research studies have not focused majorly on the choice of fuel nozzle and its flow distribution while designing the MGT. Different types of fuel and its flow distribution affect fuel temperature to a greater extent in the annular combustor of MGT [45]. The fuel spray characteristics of the injection system are of primary importance for a fuel nozzle. The fuel droplets have to be injected in atomized form so that they can evaporate easily and mix thoroughly with pressurized air. The size of the droplet will vary according to the type and mode of fuel injection. Sauter Mean Diameter (SMD) is one of the methods in which characterization of fuel droplets can be performed effectively. Sauter mean diameter is an average of particle size [46]. A conventional technique is to supply swirling co-flow around the fuel spray to produce a recirculation zone that restricts the droplets in order to stabilize the flame and govern the flame length. By controlling the flame length, one can avoid the flame travelling till the end of the combustor since it is expected to complete the combustion within the secondary zone of the combustor and only the hot gas has to leave the combustor. In some circumstances, this can prevent the heat exchanger tubes from being damaged and the turbine blade from experiencing significant thermal stress [47]. Swirl injectors, multi-hole injectors, and outwardly opening injectors are the three main fuel injector types utilized in combustors. Every fuel injector is operated on its own unique principle to produce a different pattern of fuel spray [48]. Maintaining an optimum temperature in the reaction zone is more important in order to avoid flame extinction. In some cases, flames can extinguish when in contact with the cold flame tubes during the preliminary portion of engine starting. When the temperature is critically lower, flame extinction can happen [49].

EFFECT OF SWIRL

Many researchers have made attempts to comprehend how the swirl affects the dynamics of the flow and flame. Studies on the flame structure and its properties due to the effect of swirl in a non-premixed swirl combustor show the improvement of flame stability and fuel-air mixing by increasing the number of swirls to approximately unity in the combustor. An increase in the number of swirls reduces flame stability and the level of turbulence [51]. Swirl stabilized combustors have been investigated for flame dynamics and equivalence ratio by varying the swirl [52]. To comprehend various instabilities, such as Kelvin-Helmholtz, helical, and centrifugal instabilities, as well as their interactions with one another, vortex flow and its dynamics in a radial entry swirl injector were studied [53].

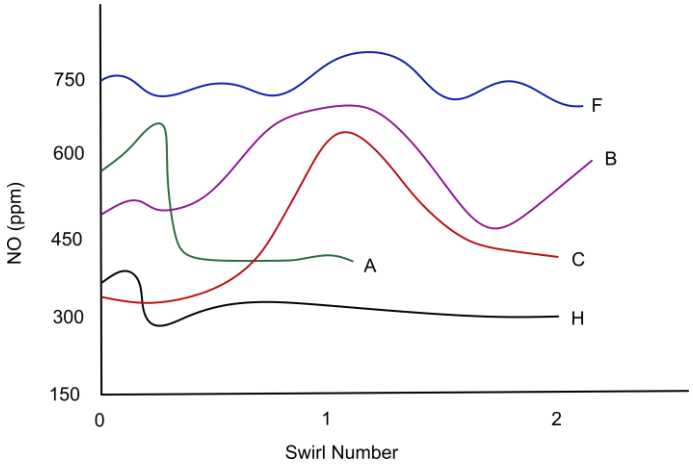

Fig. 8. Effect of varying fuel injectors. Reproduced from [50].

Table 1. Fuel injector type. Reproduced from [50].

	Injector Type	Velocity m/s
A	Single hole	19
B	Single hole	19
C	Single hole	26
H	Single hole	52
F	Radial hole	27

The effect of the fuel injector is shown in Fig. 8. It represents the NO emission for various fuel injectors across a range of swirl numbers. The specifications of those fuel injectors are presented in Table 1. The effect of the primary air percentage on NO formation for the radial fuel injection is shown in Fig.9. The effect of the primary air percentage on NO formation for the annular fuel injection is shown in Fig.10 [50].

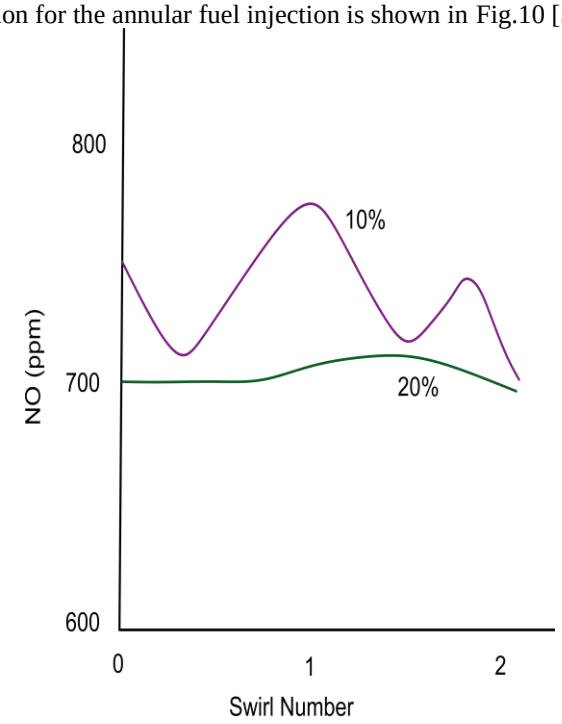

Fig.9. Radial fuel injection-effect of primary air percentage on NO formation. Reproduced from [50].

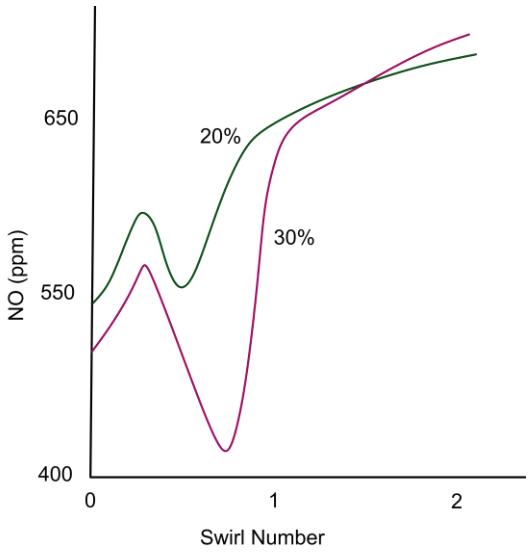

Fig.10. Annular fuel injection-effect primary air percentage on NO formation. Reproduced from [50].

FRACTAL GRIDS

To analyze the turbulence characteristics, grids of perforated plates or meshes of various sizes are put in the upstream region of the flame. Higher intensity turbulence was produced, and it rapidly diminished as it moved downstream [54]. In a diesel burner, the spray properties of swirl injectors and fractal grids were examined and compared [55]. Orifice plate flowmeters' circular grid fractal flow numerical study revealed reduced flow distortions and fully developed flow [56]. In a numerical study, the combustion chamber's circular fractal grid perforated plate demonstrated improved perceptivity in generating turbulence and fractal flow behavior. Additionally, it was found that the intensity of the turbulent flow increased on the grid with a higher blockage ratio [57].

STABILITY AND COMBUSTION EFFICIENCY

The researchers conducted studies on the stability and emission properties of premixed ammonia/air flames in a swirl combustor. The premixed flame of ammonia and air was found to be stable under a variety of equivalence ratios and inlet velocity conditions. The lean and rich blow-off limits are relatively near to the ammonia flame's flammability limit. The mixture inlet velocity of flame stabilization has a minimum limit. The swirl number and burner geometry had an impact on the blow-off limits, while the flame tube length had no impact on the flame stability properties [58], [59].

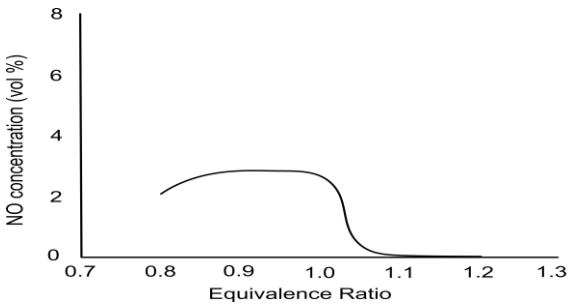

Fig.11. Concentrations of NO in the case of the swirl number of S = 0.736. Reproduced from [58].

The ratio of the actual heat released to the maximal heat released during the combustion process is known as combustion efficiency. Accordingly, the real fuel-air ratio for the same combustion temperature increment corresponds to the theoretical fuel-air ratio for that temperature rise. A concept experiment was conducted to examine the ultra-micro-combustor with premixed flame's combustion properties. The flat-flame combustion on the porous plate itself was found to be hardly affected by the heat loss to the nozzle, resulting in a temperature drop in the expelled gas after full combustion. Further, it was observed that as combustion reactions and the equivalence ratio drop, the flame zone thickens [60].

RESIDENCE TIME

Because of the association with different emission indices, measurement of residence time and temperature is of great importance in combustor [61]. Only very lean mixtures (equivalence ratios below 0.4) lose significance for residence time because temperature controls the dissociation reaction's equilibrium point [62], [63]. In hydrogen and helium flames with basic chemistry, the Damkholer number—which may be interpreted as the ratio of residence time to chemical kinetic time—correlates well with NO_x emission data [64]. Flame blowoff has also been predicted using the Damkholer number [65], [66]. Several scholars have reported the use of alternative techniques to determine combustion chamber residence times. Tracing particles through measured [67] or CFD predicted [68] velocity fields can be used to determine residence time. Researchers used TiO_2 as a particulate passive tracer in a combustion zone. After the tracer injection was done, the concentration was measured at a certain spot using Mie-scattering. Concentration was measured at a point via Mie-scattering. This procedure is referred to as a ‘‘step-down’’ procedure [69]. Researchers injected helium with and without reaction into a swirl-stabilized combustion chamber. The abrupt termination of the helium injection allowed for the study of the attenuation curves (helium concentration decay) at various places. The investigators found that heat release induced slightly shorter residence times than they might have anticipated given the flow acceleration driven on by density reduction. Although the accuracy of the absolute concentration measurement was relatively low (20%), it was found that the technique's key consideration was the rate of concentration change. Despite these results, the two methods discussed above were single-point measurements that could not pinpoint the emissions' source without a thorough measurement traversal [70], [71].

A quick and effective method for estimating residence time with spatial resolution is that which uses temporally resolved planar-induced fluorescence (PLIF). This measuring method evaluates the dynamic reaction of the non-reacting and isothermal fuel concentration following the abrupt cessation of fuel injection in a representative high-swirl combustor flow. Planar LIF is reportedly being used in this step-down methodology for the first time ever, especially for a combustion-related flow. In previous research, point measurements weren't taken instantaneously and had poor spatial resolution [61].

CONCLUSION

Air-fuel mixing is very important for good combustion. For a complete combustion to occur in any gas turbine, fuel has to be properly injected and get mixed with air and burned. UHC and emission is the result due to improper mixing of fuel and air and due to incomplete combustion. Worldwide interest in gas turbine emissions and the enactment of regulations in every nation have resulted in numerous requests for information on gas turbine exhaust emission estimates and the effect of exhaust emission control methods on gas turbine performance. Modern aircraft need to be addressed for two main reasons: fuel efficiency and emission characteristics. Here, an exhaustive literature review based on Colorless Distributed Combustion, flow field pattern and NO_x emission, lean premixed combustion, ultra-low NOx emission, natural gas and biogas, LPG combustion, micro gas turbines, fuel spray characteristics, effect of swirl, fractal grids, stability and combustion efficiency, and residence time has been performed for emission control. Lean premixed combustion shows promising results in emission control. However, other methods also hold good based on fuel selection, equivalence ratio, spray characteristics, and the geometry of the combustor.

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Computational Studies on Unstart in Supersonic Inlet at Mach 1.8

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Abstract. The supersonic inlet demands an appropriate method of compression with a series of shockwaves and provides the required pressure rise to aid the combustion process. Different types of inlets based on the compression process are currently under research. One of the designs that permits the flow to be supersonic within its bounds is the mixed-compression inlet. In this inlet, the flow speed must be reduced from supersonic to sonic using a series of oblique shocks and finally becomes subsonic due to the terminal shock, as subsonic combustion is required for supersonic inlets. The shape of the inlet can be changed by either adjusting the center-body or cowl-lip to adjust the terminal shock for the varied flight conditions. Inlet unstart refers to a severe breakdown of the supersonic airflow, produced when mass flow rate changes significantly within the flow passage, making the shock unstable and oscillating upstream and downstream. An attempt has been made to design and simulate a mixed compression inlet operating at Mach 1.8, as this kind of inlet is believed to be most efficient at a freestream Mach number greater than 2.5. A numerical simulation has been performed to understand the shock physics and unstart phenomenon in mixed compression supersonic inlets at Mach 1.8 with different turbulence models, and the results are compared. Numerical simulation showed that the unstart occurred at a time when the mass flow rate was well below that required for engine operation. The scope of this research is to study the shock movement from downstream towards the upstream portion. Simulation is carried out to investigate the unstart phenomenon via measuring its mass flow rate, velocity, and time of shock wave travel at sea level altitude. Therefore, a series of computational fluid dynamics simulations were conducted, and the corresponding visualization pictures of shockwave travel were obtained for each simulation.

NOMENCLATURE

TPR	Total Pressure Ratio	p	Static Pressure
MCR	Mass Capture Ratio	p_{t_m}	Maximum total pressure
θ	Wedge angle	p_{t_m}	Minimum total pressure
M	Mach Number	p_{t_a}	Average total pressure
β	Shockwave angle	$\dot{m}_i$	Mass flow rate at capture area
FD	Flow Distortion	$\dot{m}_\infty$	Freestream mass flow rate
T	Static temperature	A_i	Capture Area
ρ	Static density	A_∞	Freestream area

INTRODUCTION

The supersonic inlet is a critical research topic for the aerospace industry. Supersonic inlets compress the incoming air to increase the pressure ratio through shockwaves for combustion [1-3]. The efficiency of the supersonic inlets depends on the Total Pressure Ratio (TPR) and Mass Capture Ratio (MCR) of the inlet. Note that, based on the compression, supersonic inlets are classified into three types: external compression, internal compression, and mixed compression supersonic inlets [4]. In the case of mixed compression inlets, compression takes place outside as well as inside of the inlet, as shown in Fig 1. For the external compression inlets, compression takes place outside of the inlet, and for the internal compression inlets, compression takes place inside the inlet. Under the design conditions, external oblique shocks are generated due to ramps and get reflected at the cowl lip, and further compression processes occur inside the inlet [5, 6]. At the design condition, the normal shock wave is located at the throat of the inlet, but due to the heat losses and improper combustion process, the location of the normal shock will alter, which leads to unstart [7]. In the same manner, the boundary layer interaction with shock waves causes the performance losses of the inlet like spillage at the cowl, disorientation of the shock structure, unstart of the inlet (thermal chocking), buzzing, flow distortion, reduction in mass capture ratio, low total pressure ratio, etc [5, 8, 9]. The phenomenon of unstart is causing the drop-in Mass Flow Rate (MFR) of the overall engine, which leads to a decrease in thrust. One of the reasons for the unstart phenomenon is the effect of back pressure. This is due to improper combustion, which creates a pressure rise in the duct and forces the internal flow into the subsonic regime [10].

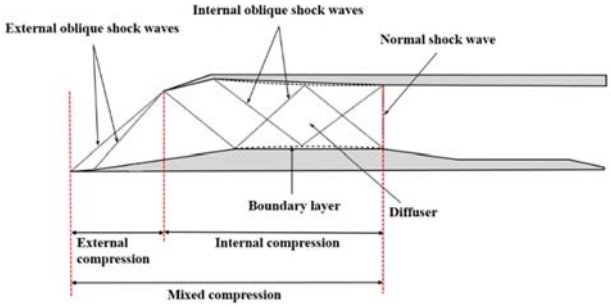


FIGURE 1. Schematics of mixed compression type of inlet

The pressure imbalance inside the duct alters the location of the normal shockwave, which pushes the normal shockwave towards the outside of the inlet [11]. During the unstart of the inlet, a shockwave comes out of the duct and the bow shock takes place ahead of the inlet, which decreases the MCR. To overcome these problems, variable-geometry inlets are one of the options [12,13]. The geometry can be adjusted as per operating conditions. This study deals with the general flow field characteristics of the inlet, operated at sea level and at a 0° angle of attack for Mach 1.8. The numerical studies were carried out to understand the flow physics of shockwaves during the unstart phenomenon at sea level altitude with respect to flow time and with three different turbulence models.

NUMERICAL SIMULATION

A supersonic mixed-compression inlet was designed and simulated at sea level altitude. The simulation was conducted at Mach 1.8 at an angle of attack, $\alpha = 0^{\circ}$. The $\theta - \beta - M$ relation was used to create geometry. The design is provided in Table 1, and the geometry is shown in Fig 2. The total length of the geometry is L = 1080.11 mm. Two ramps have been chosen for this mixed compression type of inlet, which provides the external compression. The cowl has been designed in such a way that the multiple external oblique shockwaves will meet at the cowl lip. The mass flow rates and velocity were examined to understand the onset of the unstart phenomenon. A numerical simulation was carried out using ANSYS® with different turbulence models at sea level altitude. Meshing was carried out and is shown in Fig 3. A grid independence check was performed, and the results are shown in Fig 4 for five different meshes, which are given in Table 2. Mesh E has been chosen for further numerical simulations as there is no significant flow field variation observed when compared with Mesh D. The boundary conditions of the fluid domain are shown in Fig 5.

TABLE 1. Flow field parameters with respect to θ a β

M_1	M_2	θ	β	p_2/p_1	T_2/T_1	ρ_2/ρ_1
1.8	1.662	4	37.443	1.230	1.061	1.159
1.662	1.526	4	41.017	1.221	1.059	1.153
1.526	1.458	2	43.116	1.103	1.028	1.072
1.458	1.389	2.82	46.707	1.147	1.040	1.103
1.389	0.748	0	90	2.055	1.241	1.654

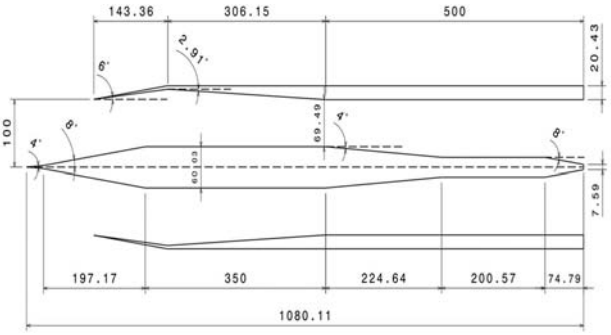


FIGURE 2. Geometrical dimensions of inlet in 'mm'

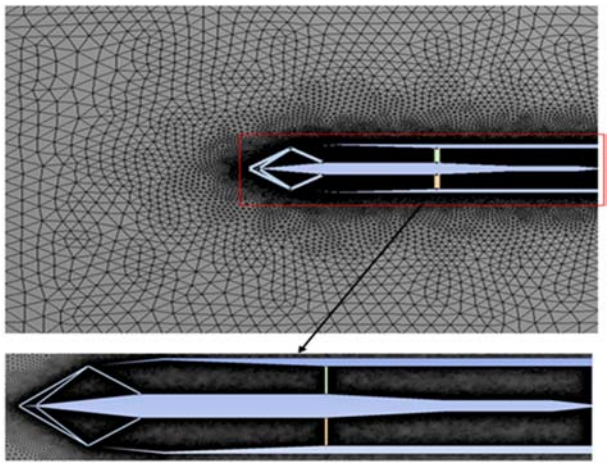


FIGURE 3. Meshing of geometry

TABLE 2. Comparison of mesh

Mesh Definition	Mesh A	Mesh B	Mesh C	Mesh D	Mesh E
Number of Elements	30145	120580	470244	1880926	7711797
Number of Nodes	16363	68724	261140	1070614	4496579

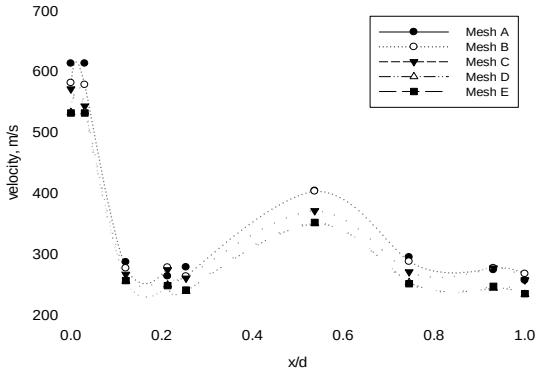


FIGURE 4. Grid independence check

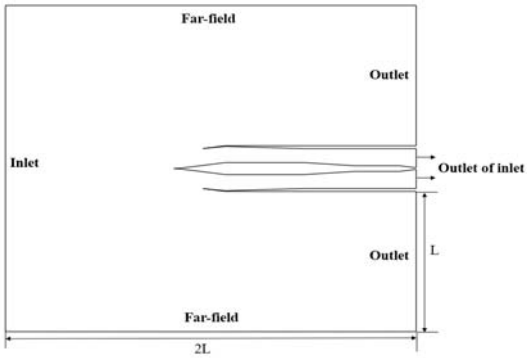


FIGURE 5. Boundary conditions of fluid domain

The design of the inlet is an important component of a supersonic engine. Atmospheric air entering the engine must be decelerated to subsonic flow from the supersonic condition without unstarting. A series of numerical simulations were carried out to visualize a supersonic inlet unstart, which is a phenomenon due to pressure variations. Whenever the mass flow rate of an air inlet is decreased in an off-design condition, buzzing is common. Most of the research for the inlet unstart has been done solely on an experimental basis.

The scope of this research is to study the shock movement from downstream towards the upstream portion at sea level, rather than the prevention of unstart. Simulation is carried out to investigate the unstart phenomenon via measuring its mass flow rate, velocity, and time of shock wave travel. Therefore, a series of extensive numerical simulations were conducted, and the corresponding visualisations of shockwave travel were obtained for each simulation. The MCR is defined as the ratio of the inlet's actual mass flow rate to the maximum mass flow rate that the inlet can capture. The illustration of the flow area is shown in Fig 6. The validation of the analytical and computational MCR shows good agreement and is shown in Fig 7. The error is calculated to be 0.58 percent.

$$M = \frac{\dot{m}_i}{\dot{m}_{oc}} = \frac{A_i}{A_{oc}} \quad (1)$$

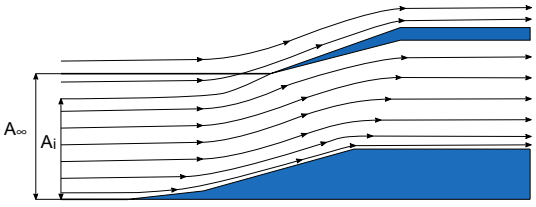


FIGURE 6. Illustration of the flow area

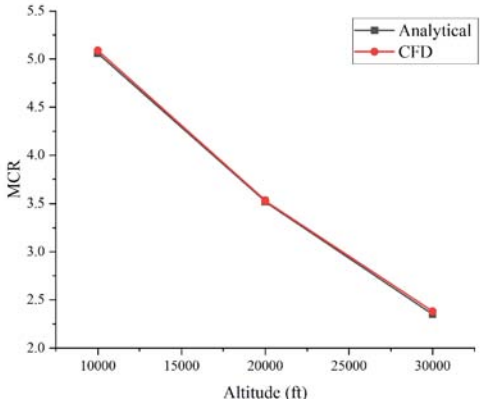


FIGURE 7. Comparison of analytical and computational MCR

For a complete combustion process, the inlet flow distortion (FD), which indicates the flow uniformity at the inlet exit face, must be as low as possible. This is represented as,

$$F = \frac{p_{t_{m\ x}} - p_{t_m}}{p_{t_a}} \quad (2)$$

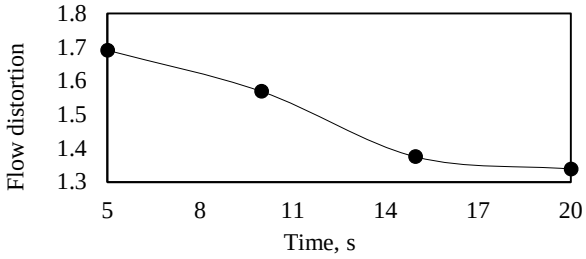
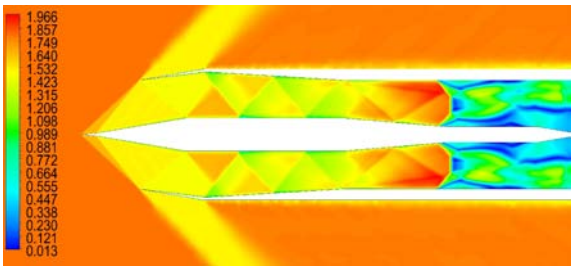


FIGURE 8. Flow distortion with respect to time

It depicts the flow uniformity at the inlet exit and is expected to be as low as possible to aid the combustion at the combustor. As shown in the Fig 8, flow distortion is reducing over time. The movement of the shockwave from leeward to windward is captured for 2 s, 5 s, 10 s, 15 s, and 20 s which is shown from Fig 9 to 23. It is clearly visible that shock moves from downstream towards upstream. Further spillage is visualized at 15 s and the inlet becomes completely unstart at 20 s. The results of the mass flow rate at zero angle of attack were examined clearly, which is ultimately required to understand the onset of the unstart phenomenon. The results of the velocity and mass flow rate at zero angle of attack are plotted against x/d and are presented from Fig 24 to Fig 29 for 2 s, 10 s, and 20 s of flow time. The mass flow rate is reducing at downstream continuously from 2 s to 20 s and got spilled outside. At each time level, all plot compares the turbulence models $k-\varepsilon$ R , $k-\omega$ S , and tr S for velocity profile and mass flow rate. In order to examine the boundary layer effects on the flow features of the inlet, the solver is verified using universal benchmark data generated from a closed-form analytical model [14,15].



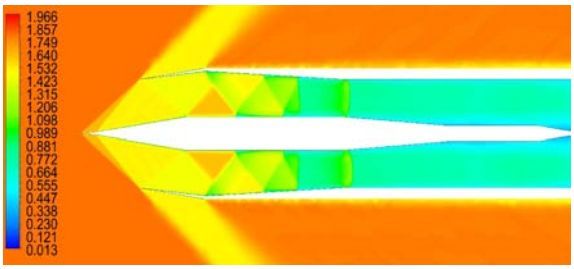


FIGURE 9. Mach contour of $k-\varepsilon R$ at $t = 2\ s$

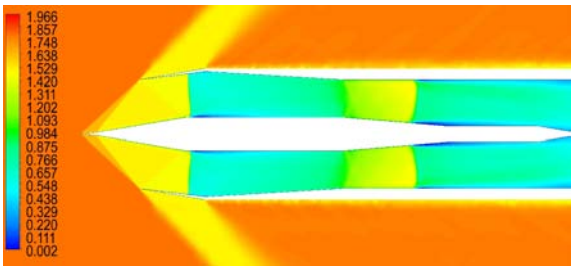


FIGURE 10. Mach contour of $k-\varepsilon R$ at $t = 5\ s$

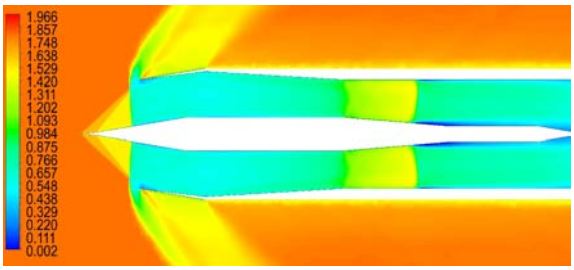


FIGURE 11. Mach contour of $k-\varepsilon R$ at $t = 10$

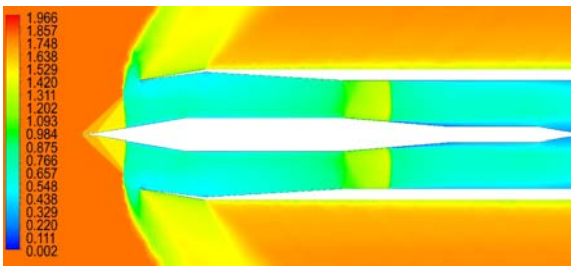


FIGURE 12. Mach contour of $k-\varepsilon R$ at $t = 15\ s$

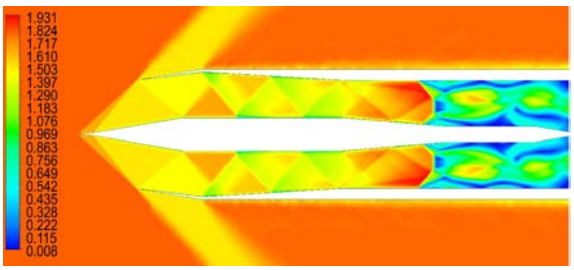


FIGURE 13. Mach contour of $k-\varepsilon R$ at $t = 20\ s$

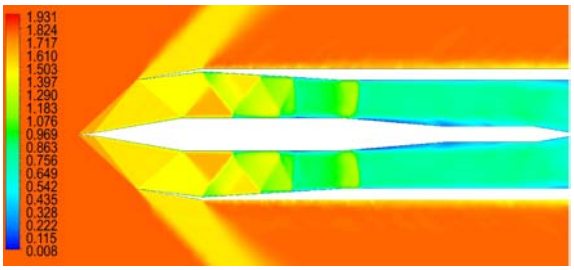


FIGURE 14. Mach contour of $k-\omega S$ model at $t = 2\ s$

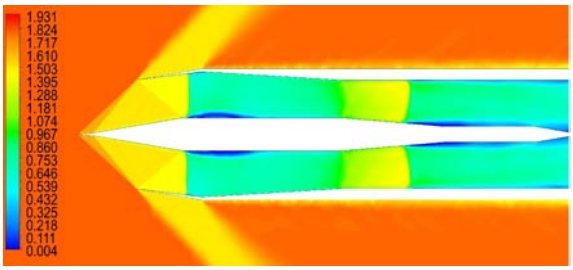


FIGURE 15. Mach contour of $k-\omega S$ model at $t = 5\ s$

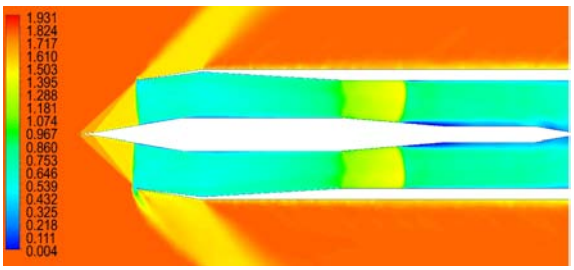


FIGURE 16. Mach contour of $k-\omega S$ model at $t = 10\ s$

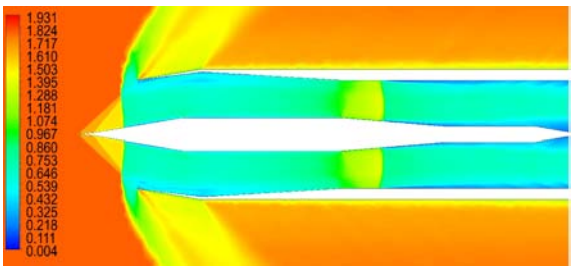


FIGURE 17. Mach contour of $k-\omega\,S$ model at $t=15\ s$

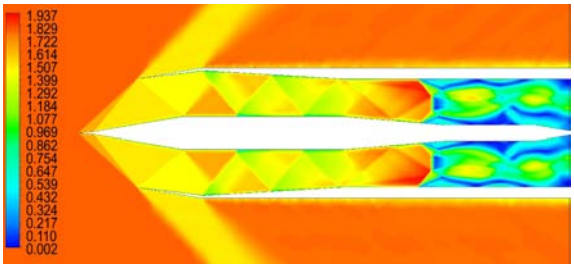


FIGURE 18. Mach contour of $k-\omega\,S$ model at $t=20\ s$

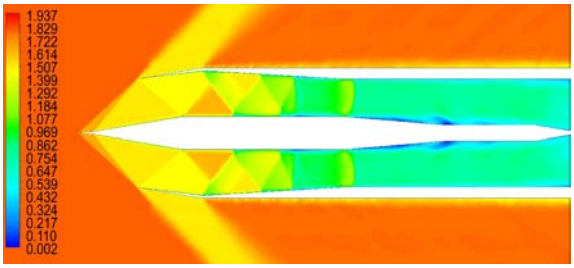
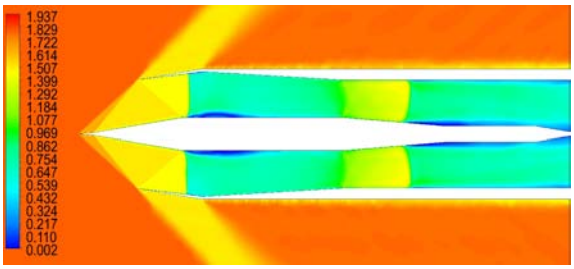


FIGURE 19. Mach contour of t: S at $t=2\ s$

FIGURE 20. Mach contour of t: S at $t=5\ s$



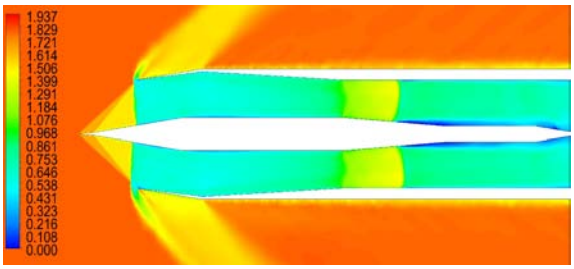


FIGURE 21. Mach contour of t: S at $t=10\ s$

FIGURE 22. Mach contour of t: S at $t=15\ s$

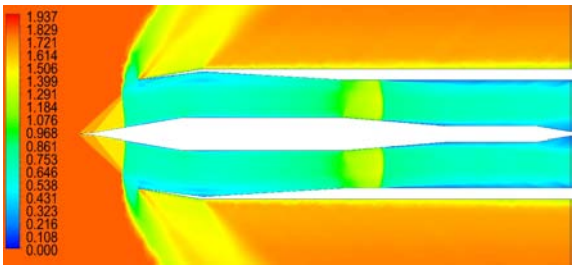


FIGURE 23. Mach contour of t: S model at $t=20\ s$

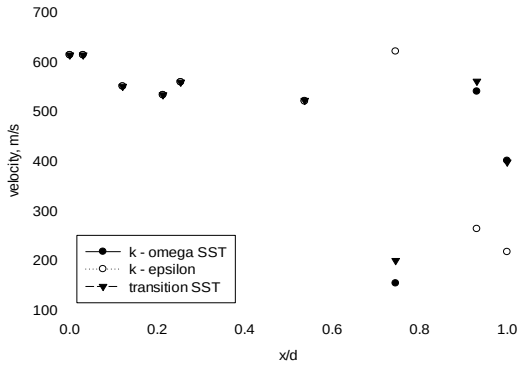


FIGURE 24. Velocity profile at t = 2 s

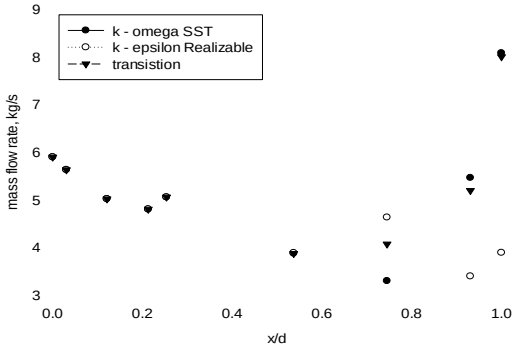


FIGURE 25. Mass flow rate at t = 2 s

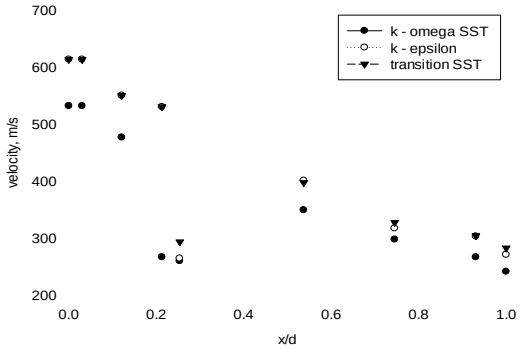


FIGURE 26. Velocity profile at $t = 10\ s$

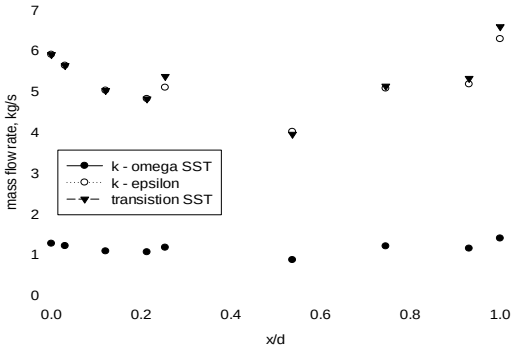


FIGURE 27. Mass flow rate at $t = 10\ s$

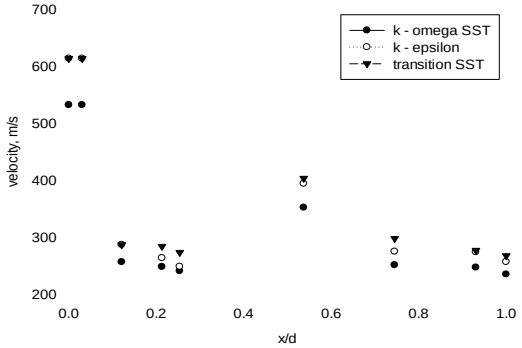


FIGURE 28. Velocity profile at $t = 20\ s$

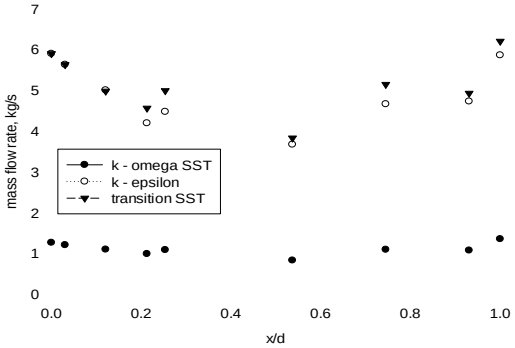


FIGURE 29. Mass flow rate at $t = 20\ s$

CONCLUSION

The results of a numerical simulation were compared and validated using the $k-\varepsilon R$, $k-\omega S$ and transition SST turbulence models to understand the shock physics and unstart phenomenon in a mixed compression supersonic inlet at Mach 1.8. From the graphs and contours, shock locations for different turbulence models were predicted. It is observed that $k-\varepsilon R$ and transition SST turbulence models showed good agreement when compared to $k-\omega S$ model. Flow distortion was reduced over time. The movement of the shockwave from leeward to windward was captured for 2 s, 5 s, 10 s, 15 s, and 20 s. The mass flow rate was reducing downstream continuously from 2 s to 20 s and getting spilled outside. Numerical simulation showed that the inlet had stable operation over the range of large mass flow inside the inlet. However, the unstart occurred at a time when the mass flow rate was well below that required for engine operation. Results show that there was a relationship between the variations in the mass flow rate of air and the sea level altitude of the inlet for predicting the unstart. The data collected from the simulation improves the existing knowledge about the onset of unstart and its variation with different turbulence models.

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Urban Road Traffic Safety Management by Gaussian Mixture Model: A Review

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Abstract: Traffic safety is extremely important, especially on city streets where traffic volumes are high and traffic conflicts are common. As a result, it is critical to design a methodology for assessing traffic safety. The following are the study's problems: Many seasoned road users as well as vehicle traffic use the common roadway. Along that stretch of the road, driving standards are subpar and traffic safety is not very good. However, field survey results show that in busy traffic situations, a lateral split between the leader and the follower happens regularly. We therefore added lateral separation to the time-to-collision equation in order to redefine it (TTC).

Keywords: Time to collision, traffic safety, traffic volume study, Gaussian mixture model

INTRODUCTION

A traffic collision is any automobile accident that takes place on a public route. Except for incidents involving exclusively off-road motor vehicles, which are classified as non-traffic accidents unless otherwise specified, a vehicle accident is presumed to have occurred on a public highway. The majority of automakers are currently concentrating on vehicle technology to increase driver comfort, which could affect the features of traffic flow and traffic safety. The safety impact analyses are justified by recent technological advancements in the area of automated driving activities, such as the creation of Autonomous Intelligent Cruise Control (AICC) or Collision Avoidance Systems, as well as their proper implementation.

The phrase "car-following," which describes the precise movement of automobiles travelling in a single lane, was established by Sheng JIN[1]. This idea is predicated on the idea that every driver responds to a stimulus from the vehicle in front of him in a unique way. The car-following idea is based on the incorrect assumption that cars will follow the center line of the lane, which is particularly true in developing nations. Poor lane-based car-following driving practices are prevalent in many nations due to a variety of issues, including poor road conditions, inconsistent driving behavior, confusing road markings, and varying lane lengths (Gunay, 2007). Traffic engineering and scientific investigations are two categories of car-following models that have been explored in the literature over the past 60 years, according to Sheng JIN [2].

Traffic engineering car-following models can be categorized as artificial intelligence, psychophysical, safety distance, stimulus-response, or stimulus-response. In statistical physics car-following models, which are also known as intelligent drivers or cellular automata, vehicles are seen as self-driven particles. A lateral uncomfortable automobile model was initially developed by Gunay. Gipps' idea of employing stopping distance was enhanced by Gunay, who also provided a new car-following model that takes into account lateral friction between vehicles. A non-lane-based car following model with a modified full velocity difference model was put forth by Sheng JIN [3]. However, the FV's driver had little capacity to immediately access speeds and distances and had trouble detecting even slight lateral separation.

Sheng JIN3] defined "safety indicators" as traffic flow indicators that are statically related to the frequency of traffic accidents at a specific area. These estimates are based on the temporal and spatial closeness of road users during hazardous conditions. Spot speed and vehicle headway are determined using a survey of videography data in the Sheng JIN[1], Sheng JIN[2], and Sheng JIN[3] traffic volume studies. In Sheng JIN[1], the means of TTC samples taken from various lanes are determined. The equation is used in Sheng JIN [2] and Sheng JIN[3] to calculate TTC. A weighted sum of Gaussian component densities is presented in Sheng JIN [1]. Additionally, Sheng JIN [2] presents a new car-following theory that takes lateral separation into account.

DATA ANALYSIS

A video survey on the Beijing North Ring III expressway between Si-tong Bridge and Lian-xiang Bridge was used to collect the field data for the Sheng JIN [1] study. An essential component of Beijing's road network is the 48-kilometer-long overhead Ring III roadway. Data was collected on June 20th (Tuesday), 2006, between 7:00 a.m. and 10:00 a.m. (including morning peak hour), and 16:00 p.m. and 19:00 p.m. (including evening peak hour). Five possible locations are used to select the study sites.

Locations 1 through 5 are situated on the weaving segment downstream of the on-ramp (direction WE), the mainline downstream of the off-ramp (direction WE), the mainline downstream of the on-ramp (direction EW), and the weaving segment downstream of the off-ramp (direction WE) (direction EW). Three lanes—the median lane, the centre lane, and the shoulder lane—were picked for this study at each location. Table 1 provides TTC's descriptive data. TTC is calculated by dividing the separation between the vehicle in front and the one in back by the relative velocities of the two vehicles over time. Therefore, the formulation is as follows:

$$TTC_i(t) = \begin{cases} \dfrac{x_{i-1}(t) - x_i(t) - VL_{i-1}}{v_i(t) - v_{i-1}(t)} & \text{if } v_i(t) > v_{i-1}(t) \\ \infty & \text{otherwise} \end{cases}$$

Where xi-1(t) and xi(t) represent the positions of the leading vehicle i-1 and the following vehicle I at time t, respectively. Vi-1(t) and vi(t) represent the speeds of the leading vehicle I - 1 and the following vehicle I at time t, respectively. VLi-1 denotes the leader's vehicle length.

$$\frac{1}{\mathrm{TTC}} = \frac{\varphi'(t)}{\varphi(t)} - \frac{\theta'(t)}{\theta(t)}$$

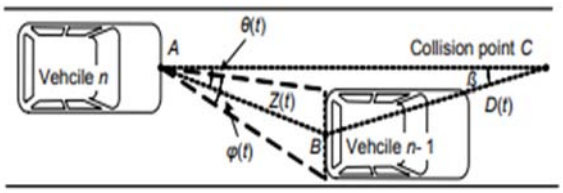

Figure 1. Staggered car-following behavior

According to Sheng Jin's[2] research, visual angle information is present in TTC perception, as demonstrated by the aforementioned geometrical investigation. According to the equation above, TTC is calculated as the sum of the respective rates of dilation and constriction of the optical contour of the LV and the optical gap angle separating the LV from the collision location.

This equation shows that the next driver is sensitive to visual information included in the relative rate of dilation or constriction of the optical gap angle even if there is no contour dilation component for the LV. when the angle is zero, or when the lateral distance between the follower and the leader is zero. ϕn(t) = visual gap angle separating the LV from the collision point shown in fig. 4, θ = visual angle perceived by the driver of the nth automobile at time t.

Visual angle information is present in TTC perception, as demonstrated in the geometrical analysis below, according to Sheng Jin's [3] research. According to the equation above, TTC is calculated as the sum of the respective rates of dilation and constriction of the optical contour of the LV and the optical gap angle separating the LV from the collision location. The next driver is sensitive to visual information included in the relative rate of dilation or constriction of the optical gap angle; therefore, if there is no contour dilation component for the LV, this should be taken into consideration.

$$\frac{1}{TTC} = \frac{\varphi'(t)}{\varphi(t)} - \frac{\theta'(t)}{\theta(t)}$$

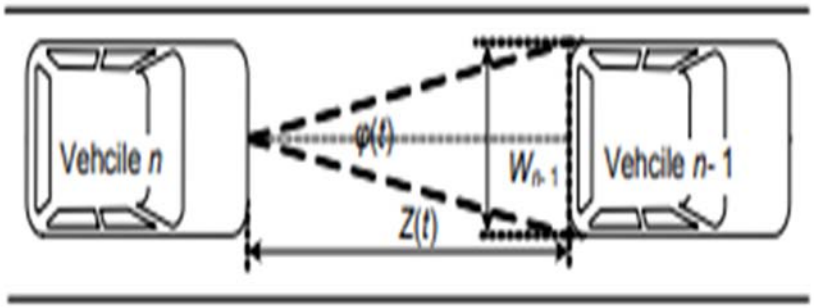

Figure 2. Basic car-following behavior

Where, Zn (t) is the distance between the front and back of the nth car (following vehicle) at time t, and φn(t) is the visual angle that the driver of the nth car observes at that time of the (n−1)th car (leading vehicle), and Wn−1 is the width of the (n−1)th car (fig.2).

Table 1. Descriptive statistics of TTC.

Study sites		Number of samples	Traffic Volume (veh./h/lane)	Mean (s)	SD (s)	Min (s)	Max (s)
Location 1 (upstream of on-ramp)	Median Lane	713	995	16.79	14.38	0.02	76.36
	Middle Lane	780	1245	17.20	12.73	0.24	65.46
	Shoulder Lane	835	1410	15.81	10.52	0.01	53.74
Location 2 (weaving segment)	Median Lane	951	1179	13.19	11.52	0.01	79.60
	Middle Lane	937	1294	15.75	11.93	0.03	64.44
	Shoulder Lane	885	1181	14.51	8.62	0.04	44.24
Location 3 (downstream of off-ramp)	Median Lane	660	1393	21.66	16.70	0.04	81.36
	Middle Lane	749	1467	14.96	9.74	0.04	47.64
	Shoulder Lane	799	1736	14.82	8.76	0.08	46.76
Location 4 (weaving segment)	Median Lane	753	821	15.78	11.90	0.10	63.64
	Middle Lane	736	1105	15.55	11.67	0.08	60.92
	Shoulder Lane	762	1205	16.24	10.55	0.01	54.96
Location 5 (downstream of off-ramp)	Median Lane	496	1546	23.14	17.68	0.09	89.56
	Middle Lane	692	1321	16.88	11.58	0.19	66.40
	Shoulder Lane	641	1722	17.34	12.21	0.05	66.60
All		11389	1308	16.34	11.79	0.01	89.56

METHODOLOGY

The Gaussian mixture model, which is a parametric probability density function in the Sheng JIN [1] study, is stated as the weighted sum of the densities of the individual Gaussian components. The probability distribution of continuous measurements can be described using GMMs, which are frequently employed in parametric models. GMMs have been successfully applied in a variety of applications, including pattern classification, speaker recognition systems, and video image processing. According to the equation, a Gaussian mixture model for the TTC distribution is the weighted sum of the Gaussian densities of the M component variables.

$$P\left\{TTC_k \left| \left(\omega_i, \mu_i, \sigma_i^2\right)\right.\right\} = \sum_{i=1}^{M} \omega_i g(TTC_k \left| \mu_i, \sigma_i^2\right.)$$

The levels of the mixing weights depend on the security of the flow of traffic. The mean, variance, and mixture weights from all component densities are used to parameterize the complete Gaussian mixture model. Because GMM can represent a broad class of sample distributions, we utilized it to evaluate TTC distribution data and gather component Gaussian distribution patterns for various traffic safety scenarios. The use of a GMM to explain TTC feature distributions may be motivated by the intuitive notion that individual component densities may represent some underlying set of hidden classes. Acceptable hypotheses include, for instance, TTC values that correspond to different safety components, such as dangerous scenarios, relative safe conditions, and absolutely safe situations. These categories of safety situations highlight some common accident risks that are useful in identifying a safety situation. These kinds of safety situation reflect various general accident risks, which is useful in identifying a safety situation. The ith TTC class can be represented by the mean I of the ith component density and the variance σi 2. The GM model (Gazis et al., 1961) is arguably the most well-known car-following model in the Sheng JIN [3] study. These models describe the motion of the nth vehicle following the (n1)th vehicle by using the relative speed between the leader and follower as the stimulus, in accordance with the stimulus-response framework.

$$a_n(t+T)=\frac{\lambda v_n^m(t+T)}{\left[x_{n-1}(t)-x_n(t)\right]^{l-1}}\cdot\frac{v_{n-1}(t)-v_n(t)}{x_{n-1}(t)-x_n(t)},$$

Where, "an(t+T) is the acceleration of vehicle n at time t+T, vn(t+T) is the velocity of vehicle n at time t+T, vn−1(t) and vn(t) are the velocities of the (n−1)th and the nth vehicles, respectively, xn−1(t) and xn(t) are the positions of the (n−1)th and the nth vehicles, respectively, T is the driver reaction time, and λ, m, and l are parameters that should be determined". The Sheng JIN[2] investigation found that the proposed GM model had both advantages and disadvantages. The major drawback is that, regardless of the distance travelled, acceleration will be zero as the visual angle rate approaches zero. To fix this problem, it is suggested that a term based on the visual angle be added to the equation below and that driver's respond not only to TTC information but also to the difference between actual and intended visual angles. As a result, the updated dynamics equation for following a car is

$$a_n(t+T)=\lambda_1\frac{v_n^m(t+T)}{\left[\Delta x_n(t)\right]^{l-1}}\left(\frac{\theta_n'(t)}{\theta_n(t)}-\frac{\varphi_n'(t)}{\varphi_n(t)}\right)+\lambda_2\left[\frac{1}{\varphi_n(t)}-\frac{1}{\varphi_{des}(t)}\right]$$

Where, "ϕdes(t) is the desired visual angle at time t", which can be calculated by

$$\varphi_{des}(t)=2\arctan\frac{\frac{W_{n-1}}{2}}{t_p\cdot v_n(t)}$$

Where tp is the intended time headway, λ1 and λ2 are constant parameters, and tp is expected to be constant and irrespective of vehicle speed. The visual angle at which drivers react to both TTC information and the difference between real and desired visual angles is now used to create a car-following model. The weight of two stimuli is determined by parameters λ1 and λ2.

RESULT COMPARISON

Sheng JIN [1] asserts that as TTC threshold values increase, so do the percentages of serious disagreements. The TTC threshold value should be carefully examined and validated using a substantial amount of field data because it has such a significant impact on safety evaluations. The percentages of significant traffic conflicts that are recorded on the weaving segment are higher than on mainlines. These outcomes occur as a result of the more erratic lane shifts and traffic flow on the weaving segment, which led to lower TTC values and more major conflicts. We then look at the variations in lane-to-lane expressway traffic safety. Sheng JIN [2] looked into the matter. Visual angle information that is directly perceptible by drivers is used to determine the TTC. It is challenging to anticipate that vehicles would follow the centre line of a lane. In order to account for two-dimensional space, the TTC equation for non-lane-based car-following was modified.

TTC is determined as a measure of the relative rate of optical contour dilation/constriction of the leading vehicle and, in its most basic form, the optical gap angle dilation/constriction between the leading vehicle and the crash location. This equation demonstrates that the following driver is likewise sensitive to the visual information included in the relative rate of dilation/constriction of the optical gap angle even in the absence of a leading vehicle contour dilation component. Based on basic optical information (visual angle and change in visual angle), Sheng JIN [3] analyzed the TTC formulation and expanded it into two-dimensional space Jin, Wang, and Yang 13. Second, the TTC and the difference between the actual and ideal viewing angles are added as two stimuli to the GM model. Thirdly, the suggested optical-based non-

lane-based car-following model is capable of describing several complicated driving behaviors, including lateral movement and partial lane changes.

Finally, the results of the simulations demonstrated that the proposed model could qualitatively reflect complex real-world driving behavior in a variety of settings. The results demonstrate that the innovative car-following theory can simulate driving behavior that is not lane-based. The latest approach incorporates visual angle information and builds two-dimensional interactions, which leads to a more accurate model of human driver behavior than earlier car-following theories.

CONCULSION

This paper proposes an assessment method for assessing the incidence of vehicle crashes under diverse circumstances in metropolitan roads. Viedography data survey is used to calculate spot speed study and vehicle headway. The TTC definition follows the equation. The mean readings for TTC samples on various lanes vary widely, from 13.19 to 23.14. TTC is calculated by dividing the separation between an FV and an LV by their relative speeds. A parametric probability density function is represented by a Gaussian mixture model, which is the weighted sum of the component Gaussian densities.

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Design and Development of sea water distillation systemby solar

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Abstract: The desalination of water has long been done using direct sunlight. Small villages in isolated coastal areas receive desalinated water fromsolar distillation units. Solar stills are simple to build, may be completed by locals using materials that are readily available in the area, are easy to operate by inexperienced staff, require little to no hard maintenance, and have essentially no operating costs. They do, however,have drawbacks, including a high initial cost, a substantial amount of installation land requirement, and output that depends on the amount of solar light available. For the traditional basin type model, productivity is nearly negligible in the absence of sunlight. To boost its efficiency, researchers have made significant strides from the earliest, most basic basin-type solar models. Using only little amounts of land and even on gloomy days, a well modified solar still can produce great output.

INTRODUCTION

Water is a basic necessity of man along with food and air. Fresh water resources usually available are rivers, lakes, and underground water reservoirs. About 71% of the planet is covered in water, yet of all of that 96.5% of the planet's water is found in oceans, 1.7% in groundwater, 1.7% in glaciers and the ice caps and 0.001% in the air as vapor and clouds, only 2.5% of the Earth's water is freshwater and 98.8% of that water is in ice and groundwater. Less than 1% of all freshwaters is in rivers, lakes and the atmosphere. Distillation is one of many processes available for water purification,and sunlight is one of several forms of heat energy that can be used to power that process. To dispel a common belief, it is not necessary to boil water to distill it. Simply elevating its temperature, short of boiling, will adequately increase the evaporation rate. In fact, although vigorous boiling hastens the distillation process it also can force unwanted residue into the distillate, defeating purification.

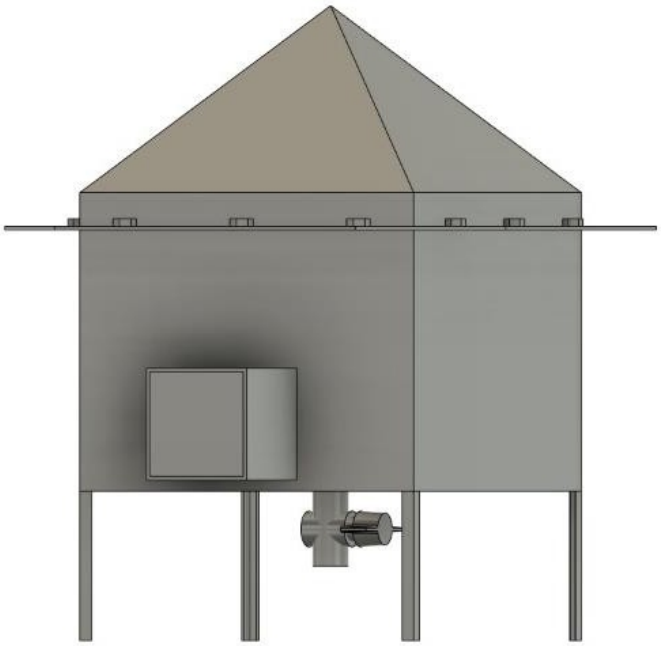
Solar Distillation is by far the most reliable, least costly method of 99.9% true purification of most types of contaminated water especially in developing nations where fuel is scarce or too expensive. Solar distillation is used to produce drinking water or to produce pure water for lead acid batteries, laboratories, hospitals and in producing commercial products such asrose water. Conventional boiling distillation consumes three kilowatts of energy for every gallon of water, while solar distillation uses only the free pure power of the sun. Expensive filtration and deionizing systems are even more expensive to purchase and use and will not totally purify the water by removing all contaminants. No additional heat or electrical energy is required in our still and even after the sun sets, distillation continues at a slower pace into the night. Recently, we've been experimenting with a unique optional solar energy booster using our top quality "Sola Reflex reflector" to increase the water vaporization by increasing the temperature on the internal fluid heat absorber. This will add efficiency and increases the amount of daily pure water production.

Keywords: Distillation, solar energy, solar still, Sea water, Glass, metal stand, radiation, valve.

BASIC PRINCIPLE

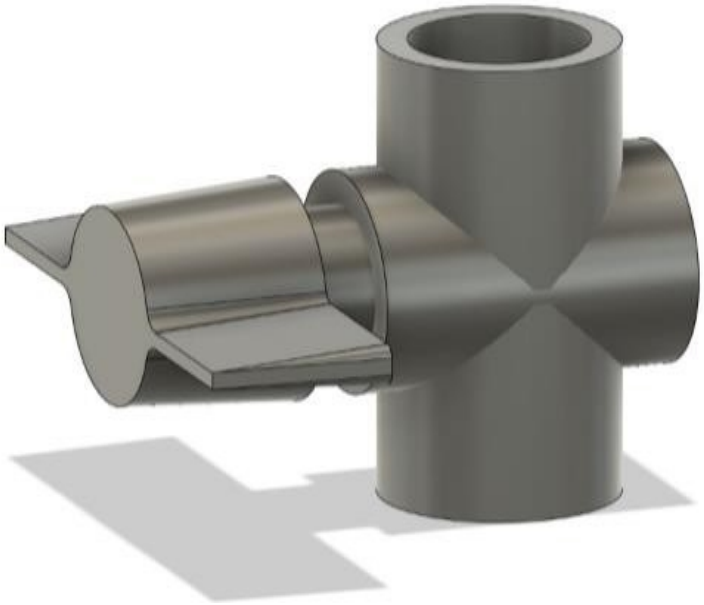
The fundamentals of solar water distillation are straightforward but effective since distillation mimics how rain is created in nature. The heat from the sun causes water to vaporise. Water vapour rises when the water evaporates and condenses on the glass surface to be collected. This procedure gets rid of microorganisms and removes pollutants like salts and heavy metals.The final product is water that is more pure than the cleanest rainwater.

CAD MODEL

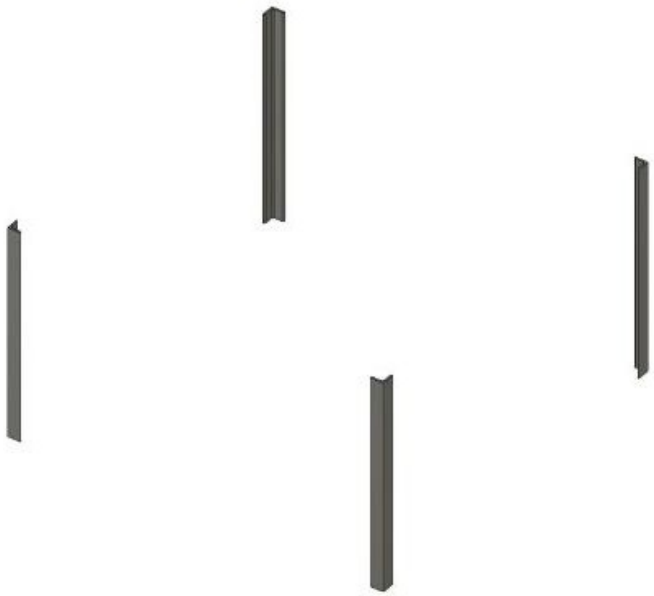


DEFINITION OF PARTS

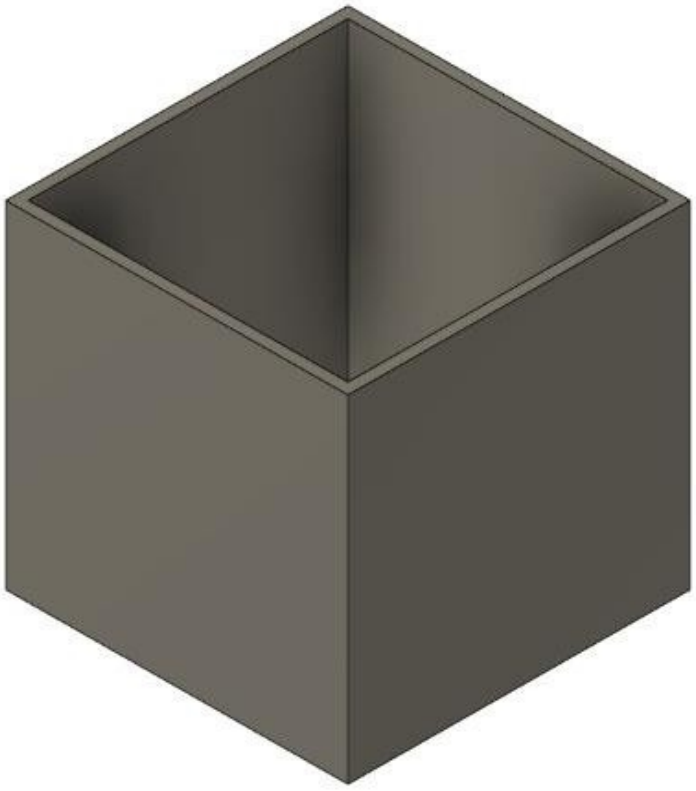
1. **Valve**: It will remove the waste material from valve.



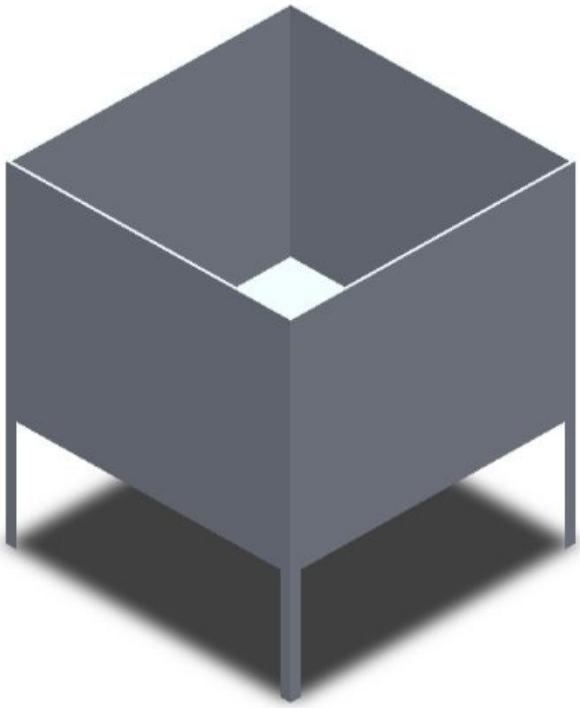
2. **Frame**: to support the sea water distillation's components and to deal with static and dynamic loads.



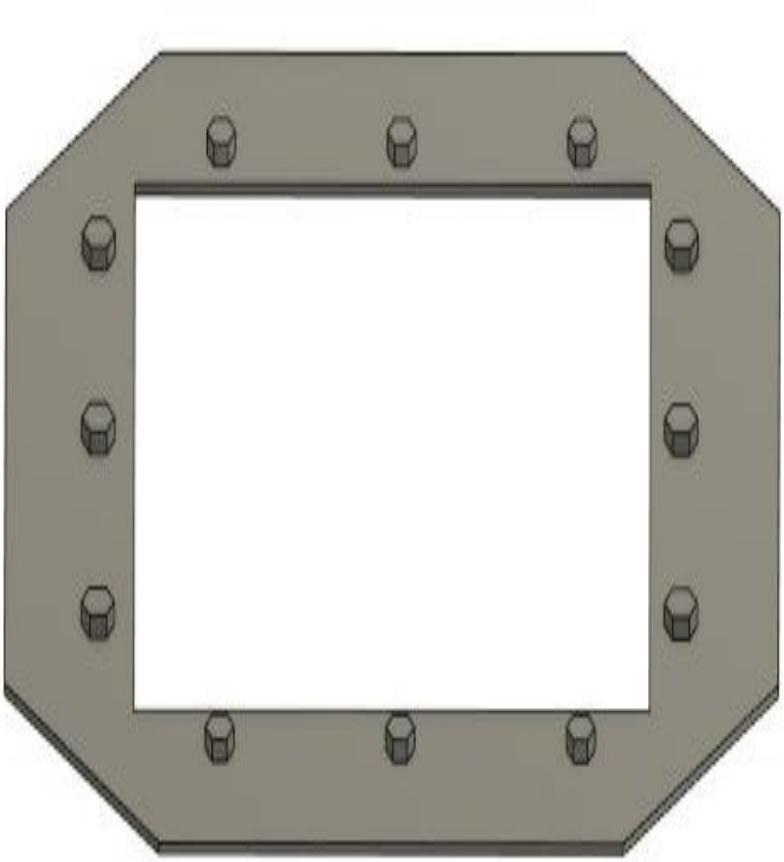
3. **Tank**: It will used to store the sea water.



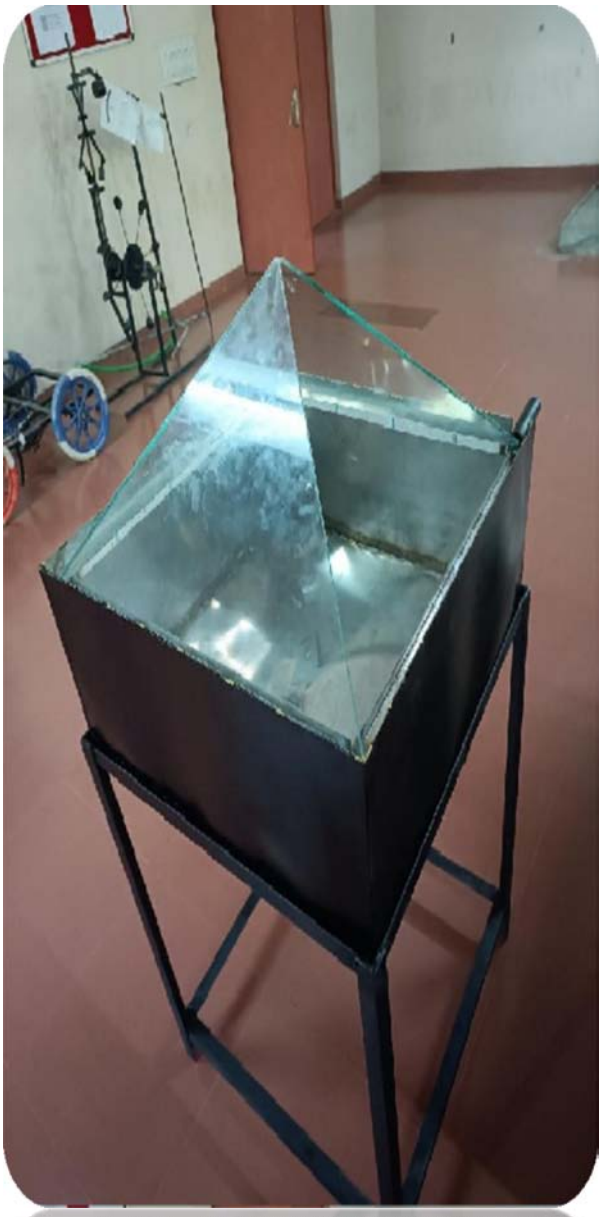
4. **Collector system**: It will collect Fresh water from tank.



5. **Glass supporter**: To support a glass and the thickness of glass is 6 mm.



REAL MODEL



CONCLUSION

The aim of this study was to determine the feasibility of using solar-energy to obtain fresh waterfrom natural seawater during a typical day and to test the performance of the system in terms ofboth the quality and quantity of fresh water produced. According to our experimental results, system was able to generate 6 litters fresh water between 10:00 am to 4:30 pm.By increasing areaof inlet of sunlight we can increase the amount of output as well.

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Comprehensive Analysis of Deep Learning in the Indian Retail Sector

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Abstract: The Indian retail industry has emerged as one of the most dynamic and fast-paced industries due to the entry of several new players.Technology is about innovation and innovation in business is all about doing things differently in order to provide better products and solutions, and an improved service to customers. Technology is not just essential for day-to-day business processes, but it can also help companies to achieve growth and success when utilised effectively. Successful businesses don't view technology simply as a way to automate processes, but instead use it to open up new ways of doing business. With the help of man-made consciousness(Ai) we get solutions which is become hard for even human to think and work on that task again and again.Demand forecasting is a best way to organize your business such a way that you can compute with other competitors.

INTRODUCTION

The Retail sector in India

Whenever we are talking about the Retail industry, especially in India, we are having a very global and large retail industry in both organized and unorganized retail industries. Our entire infrastructure and framework which run our lives on a daily basis is also a form of unorganized business. [23] With a youth of 43 million employees in the retail industry, making it the second largest employer in India. The Industry market size in 2020 was approximately INR 65.50 trillion and it is growing faster than we have ever thought with the collaboration of technology like man-made consciousness(AI), logistics automation, data analytics and self-learning and improving technology.

Challenges:

India has a retail market worth $1.17 trillion, which contributes over 10% of India's GDP[23]. It is also having one of the world's fastest-growing e-commerce markets. [2]With this large market, the online retail sector is having so many challenges like Cybersecurity, Order fulfillment, Customer experience, perfect visibility of the product, return and refund policies, and finding the right market. and if we talk about it, the Indian online retail market is facing mainly some challenges.[4] In the fast-growing environment of the retail industry, it's necessary to understand and fill in exactly what our customers need and what are the points of satisfaction.

Key Words: Machine Learning, Deep Learning, Artificial Neural networks, Retail industry, Sentiment analysis, Sales forecasting

LITERATURE REVIEW

In the 5th industrial revolution, The speed and scope of information-based innovations are more than expected, technology innovations including smart factories, the Internet of Things(IoT), self-improving technology(AI), etc [1]. Nowadays people are aware of how to use this technology in such a way that we can make collaboration with machines. That outcome becomes more graceful and satisfied with the desired efficiency. In the year 2022, we all are surrounded by this type of self-learning technology in the field of E-Commerce business, social media analytics and industrial automation.

Everyone admits the fact that Change is inevitable. Those days are gone when a retailer could sell what they wanted to sell. Now, Retailers have competed in every sector of excellence beyond price. Convenience and old experience consumers are becoming the two most important factors (Offline and online) of a battleground for brands[4]. Nowadays we have an infrastructure where most people are connected to the internet knowledge of How to use these technical devices like mobile, laptops and tablets. And because of this large infrastructure of the internet[5], many companies are providing solutions which can help you to grow your business as well as it can improve your productivity and words to your business and personal life also. We all know that giant companies of e-commerce like Amazon and Flipkart are the very first competitors in every retail sector. And they are working very fast to achieve their goals[6]. So it's necessary to use some technology with that, they can make their space in the retail business with a better stock, supply chain, customer service and segment understanding and management.

Using man-made consciousness (AI) we can handle these challenges in a better way. The entire retail industry is trying to cope with fast-changing consumer shopping insights and giving importance to shifting conventional trading to the web. Using technologies like Big data, machine learning and deep learning we can design autonomous retail experiences[7], self-improving technology can help many businesses provide better service to their customers, a better response to what customers want and their demands and an efficient supply chain can give perfect support to grow and improve any business and this all can be done with the help of Artificial intelligence and the topics like Big data, Data analytics, Demand forecasting, improved version of the stock management system and customer segmentation.

METHODOLOGY

Sentiment analysis

Like in the current scenario, there are many e-commerce platforms e.g. Meesho, Flipkart, Amazon, Myntra, Snapdeal etc[3]. Many of these companies use the system of sentiment analysis on the basis of consumers' search for products and ordering. They suggest to consumers the products that are relevant to their previous search or older buying history. For example, if we search for mobile on Amazon the app will recommend many mobiles with approx. some similar specifications. Consumers as well as retailers also yet have to perform analysis of the reviews of products for their personal satisfaction. As we've taken an example of the mobile above, consumers still have to analyze the reviews of that Mobile phone for their satisfaction of purchasing the good product.

The rapid climb of the internet and its users has altered the manner in which people communicate worldwide, in particular, once doing business. Sentiment Analysis may be an increasing technology that taps into client demands based mostly on Natural Language Processing. This motivation is used to properly recognize what customers need, when, why and the way they need it.

Sentiment libraries are made with multiple dictionaries that have an exhaustive list of phrases and adjectives that have been manually scored beforehand. This is the same way we understand phrases - based on the context it is used in, and at last, we have positive, negative or neutral connotations.

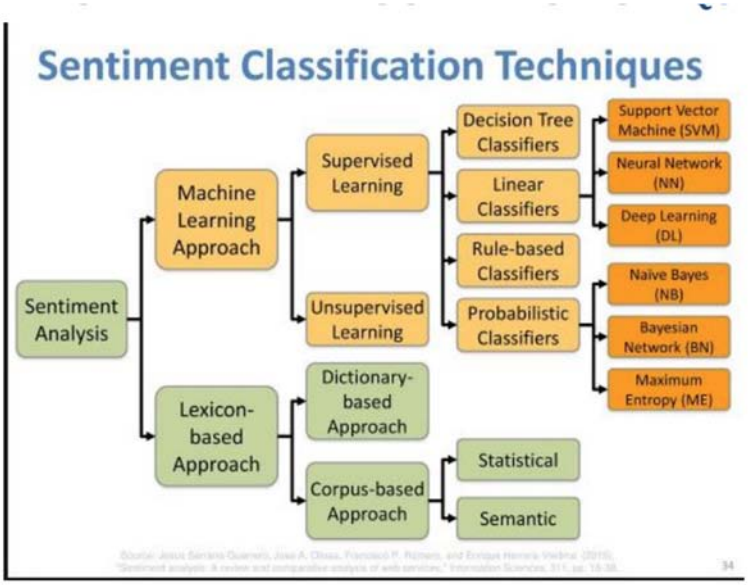

Figure 1: Different technique of sentiment analysis [14]

Rule or Lexicon-based approach

This approach uses dictionaries of words with positive or negative values to denote their polarity and sentiment strength. It counts the number of positive and negative words in the present text.

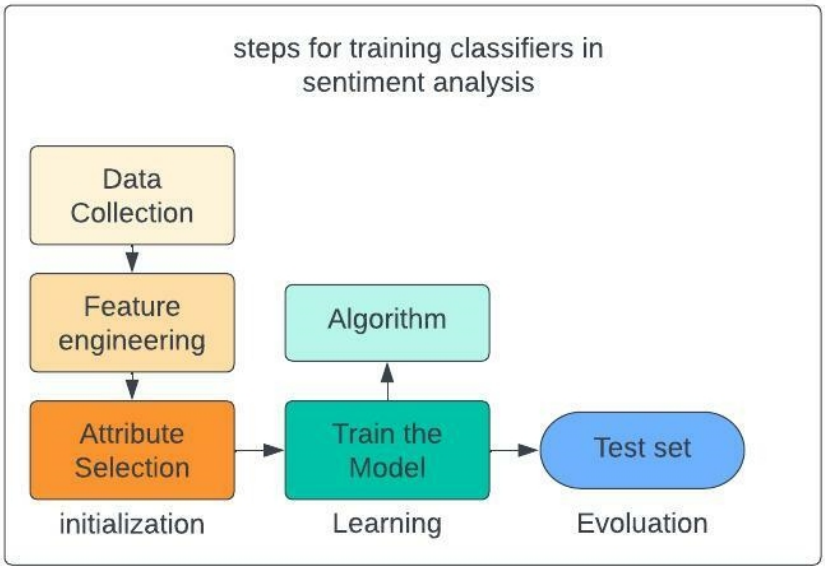

Figure 2: steps for training classifiers in sentiment analysis[24]

Automated or Machine Learning approach

Instead of clearly defined rules, this sentiment analysis model uses machine learning to give the analysis that can be done with proper criteria. The main models used for sentiment analysis classification algorithms are Naïve Bayes and Deep Learning. Sentiment analysis examines the subjective content of a statement, such as opinions, assessments, feelings, or attitudes about a subject, person, or object. Expressions can be categorized as either neutral, positive, or negative. For illustration, say, "I absolutely appreciate the new style of your website!"-positive. The 'Bayes' is because it is based on the principle of the Bayes principle of the Principality of Relativity.

DEMAND FORECASTING

of vanishing and exploding gradients. The modern model works on the Many-In-Many-Out mechanism, that is it predicts a couple of forecast outputs with the usage of more than one input (lag variables).
Descaling: The output of the LSTM network is inversely modified to attain the unique range of values.
Adding back the seasonality and trend: We add again the seasonal and trend factors to the forecast output from the model. Sales forecasting is an approach retailers use to increase future sales by analyzing past sales, identifying trends, and projecting data into the future.First, our model will recognize the demand pattern with attributes like weather, season, wind speed, and geo-location, selling pattern, repeat customer ratio. After collecting this data, an Artificial intelligence-based model helps to improve customer satisfaction and reduce inventory stockouts. To complete this task we use **LSTM** networks a type of recurrent neural network (RNN)

Partitioning data: Our information consists of yearly, quarterly and month-to-month frequencies. Since quarterly and every-year records have a much smaller range of information points, LSTM trains ineffectively on this set and poses the problem of overfitting. Hence, we forecast month-to-month time collection only
Check seasonality and Trend: LSTM or any neural network struggles when working with non-stationary data. We use STL decomposition to separate seasonal, vogue and residual aspects and the LSTM model is then utilized on the residual phase to learn lengthy time period dependencies
Normalization: As the data values might also range throughout a huge scale, we function min-max normalization to make sure they lie inside a constant vary (0 to 1) for the higher forecast.
Feature Engineering: Since we do not now have parameters for the enterprise unit of the data, we solely use the previous 20 found lags as features to our LSTM model for forecasting.
LSTM Model: Long short-term memory network is a kind of recurrent neural network, mainly designed to study long-time period dependencies, overcoming the troubles
Statistical performance measurement: The performance of the LSTM model is judged over MAPE (Mean Absolute Percentage Error) across all the monthly time series

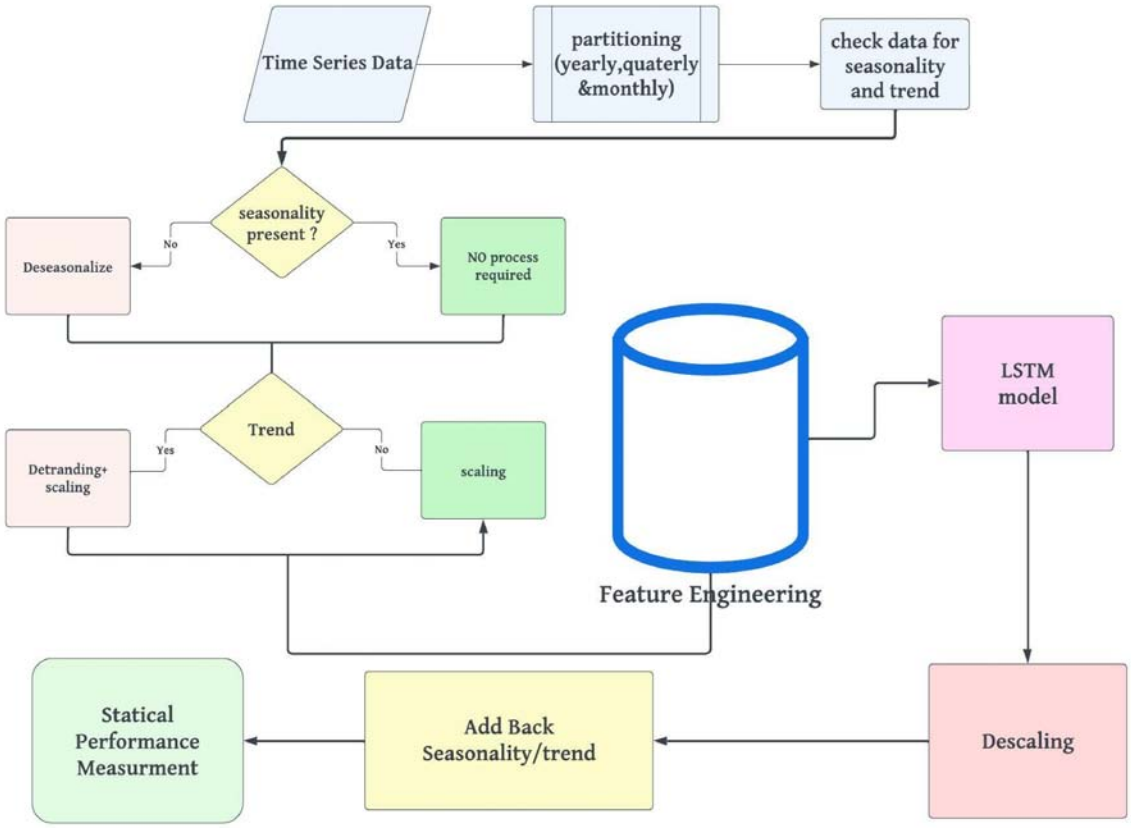

Figure 3: Demand Forecasting

CONCLUSION

Emergence of technology with business this combination can surely help to achieve your goals. Technology like artificial intelligence and deep learning are providing features like sentiment analysis, which is providing to analysis of what your exact customer thinking and what they really want and features like demand forcasting can be realy help full to manage from factory stock in/out. To manage supply chain,Additionally, you can centrally control some areas of your organisation with the aid of automation tools. As a result, your personnel may focus on boosting production in other areas of the company rather than having to spend time altering posters.You market your business through different channels to improve brand awareness, build relationships and boost sales. In a fast-changing business world, customers and audiences now expect more from technology to improve the customer experience,Overhead costs are necessary to keep your business running, but they can add up quickly. By helping you analyze your business data, AI can tell you where you can cut costs and improve your efficiency, such as bottlenecks in your processes.With good

reason, artificial intelligence is becoming more and more prevalent in many commercial operations. AI can be particularly helpful for enhancing risk management by lessening the effects of human mistake in cybersecurity and supply chain forecasting. It may immediately personalise your customers' experiences, make suggestions for cutting expenses elsewhere, and even quicken or automate your regular procedures.

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Traffic Stream Characteristics at Heterogeneous Traffic: A Case Study of Indian State Highways

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Abstract. Due to the expeditious urbanization, state highways have witnessed increase in number of vehicles significantly all over the country as they cater maximum traffic in cities. Traffic conditions are heterogeneous in all cities of the world, but the degree of heterogeneity is different in developed and developing countries. Passenger Car Unit (PCU) is a relative weightage factor given to the traffic flow of different vehicle type to deal with the heterogeneity in a mixed traffic situation. This paper focuses on traffic flow in heterogeneous traffic. The data is collected in field with the help of manual method i.e. classified volume count and licence number plate survey at Narmada Maiya Bridge at Bharuch-Ankleshwar Old NH-8 for three days in a week during 8am to 11am in morning and 4pm to 7pm in evening. With the help of this data, traffic flow and mean speed is known and density is calculated by using Wardrop relation(q=uk). Flow is converted in to PCU/hr by using IRC values and relationship is compared with Greenshield's fundamental relationship. Considering the no-lane discipline and the presence of various sizes of vehicles, macroscopic traffic variables are analysed for their suitability in describing the heterogeneous traffic. The results show diverse variation in fundamental relationship and field values.

***Keywords*:** *speed, flow, density, PCU*

INTRODUCTION

In India traffic is of mixed type. We have found about nine different classes of vehicles, Indian Highway Capacity Manual (CSIR- Central Road Research Institute, 2017) of vehicles on the road with poor lane discipline. Among all Vehicle characteristics, speed is very important. Due to these unfavorable characteristics of the traffic, the conventional used speed–flow–density models might not be applicable to heterogeneous traffic conditions. Speed–density models was found to be a linear relationship between them (B.D.Greenshield, 1934) which may not be accurately replicating the real-field conditions. In order overcome this problem there is need to convert the traffic flow in PCU/hr.

The objective of this paper is to find speed, flow and density relationship, compare with fundamental model and calculate PCU by using Chandra method and compare with other researchers.

LITERATURE REVIEW:

Traffic Stream Models:

Many researchers have given different model with respect to time starting with Greenshield model which ruled around five decades and he was considered as a father of traffic flow theory. Later Greenberg model came with logarithmic model followed by Underwood model and Drake model with exponential models and some complex model were also given by some researchers. All the models are macroscopic models which takes traffic flow at aggregate level. The modelling method of traffic flow at macroscopic level assumes that traffic streams as a whole is similar to fluid stream. At first macroscopic modelling of the traffic was done by Lighthill and

Whitham in 1955, where they called traffic flow as a long crowded roads like flood movement in long rivers. Based on literature review, it is understood that research on the development of suitable speed–density functional relationship for Indian traffic condition is less and some this type of work is required.

STUDY AREA AND DATA COLLECTION:

This study is concerned with finding the traffic flow and speed from site data, calculating density with the help of Wardrop equation, (q=kv) and PCU values for different categories of vehicles on mid-block of road under heterogeneous traffic condition on state highway and to see the variation of PCU value with respect to the volume for road.

The study sections were selected for the study on the four-lane divided state highway based on criteria which are, there must be no on street parking, free from road side friction, bus stop pedestrian movement, curvature etc. A straight mid-block section is selected on both the roads for the data collection purpose. The length of section is 4.244kms with one merging and diverging points at the mid section.

Fig1: Bharuch City and Narmada Maiya Bridge

FIELD DATA COLLECTION:

Traffic Volume

The date have been collected with the help of manual survey sheet of classified volume count and number plate registration survey during 8am to 11am in the morning and 4pm to 7pm in evening for three days of the week and the vehicle count is done at 5 min interval Speed of the vehicle is measured on the site with the help speed = distance/time for each vehicle with help of reference line method. For the measurement of flow, volume and vehicle composition trap length of 4.244kms is used.

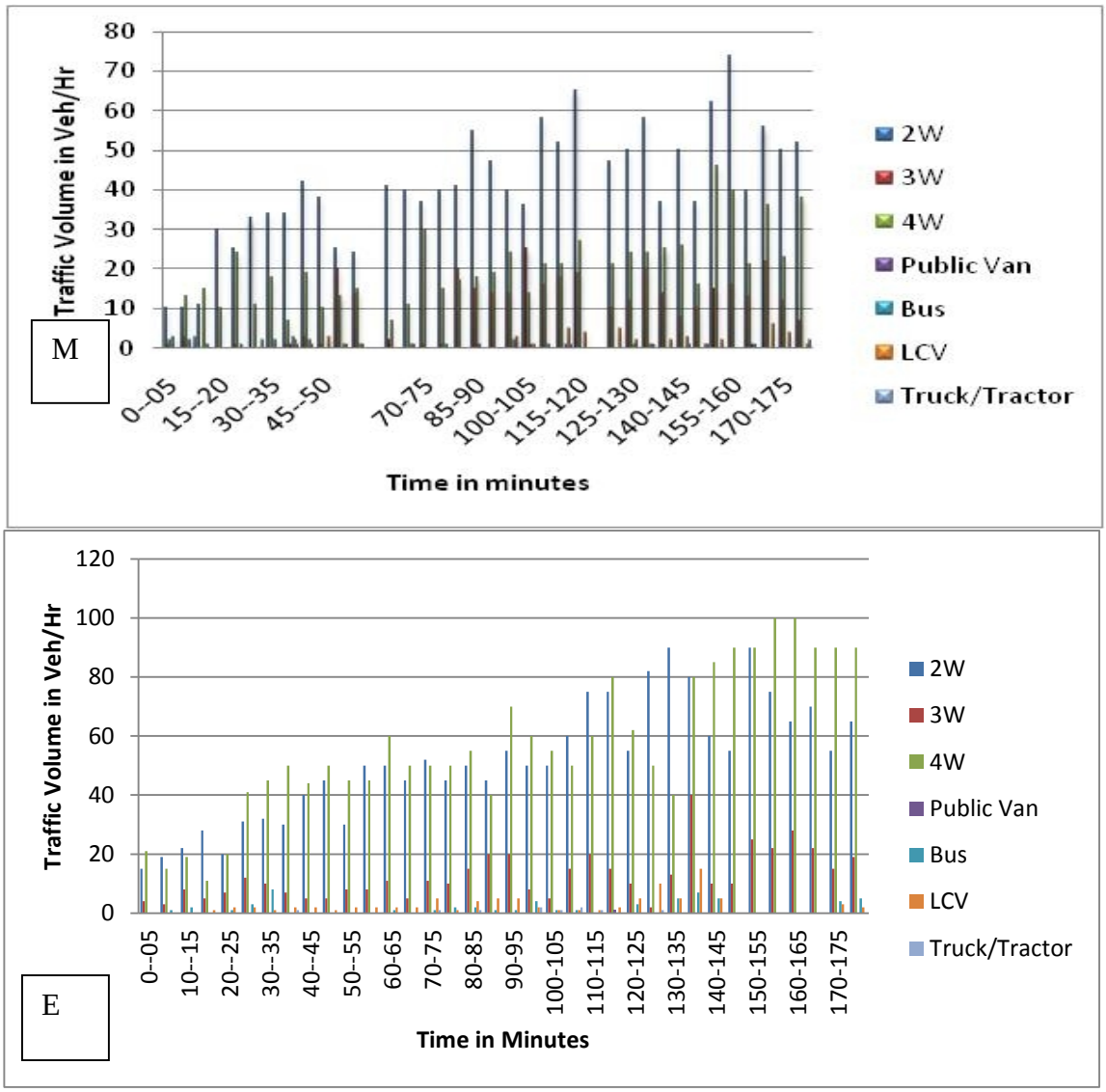

Fig: 2 Average Traffic Volumes in Vehicles/Hr during Morning and Evening

The survey was conducted during rush hour in morning and evening the peak hour factor was found to be 0.80 in morning peak and 0.83 during evening peak from Bharuch to Ankleshwar and 0.78 and 0.81 respectively for Ankleshwar to Bharuch. Since heavy vehicles are prohibited on the road the vehicles composition was majority 2W and 4W for both the direction as shown in Figure3, while 3W composition cannot be ignored.

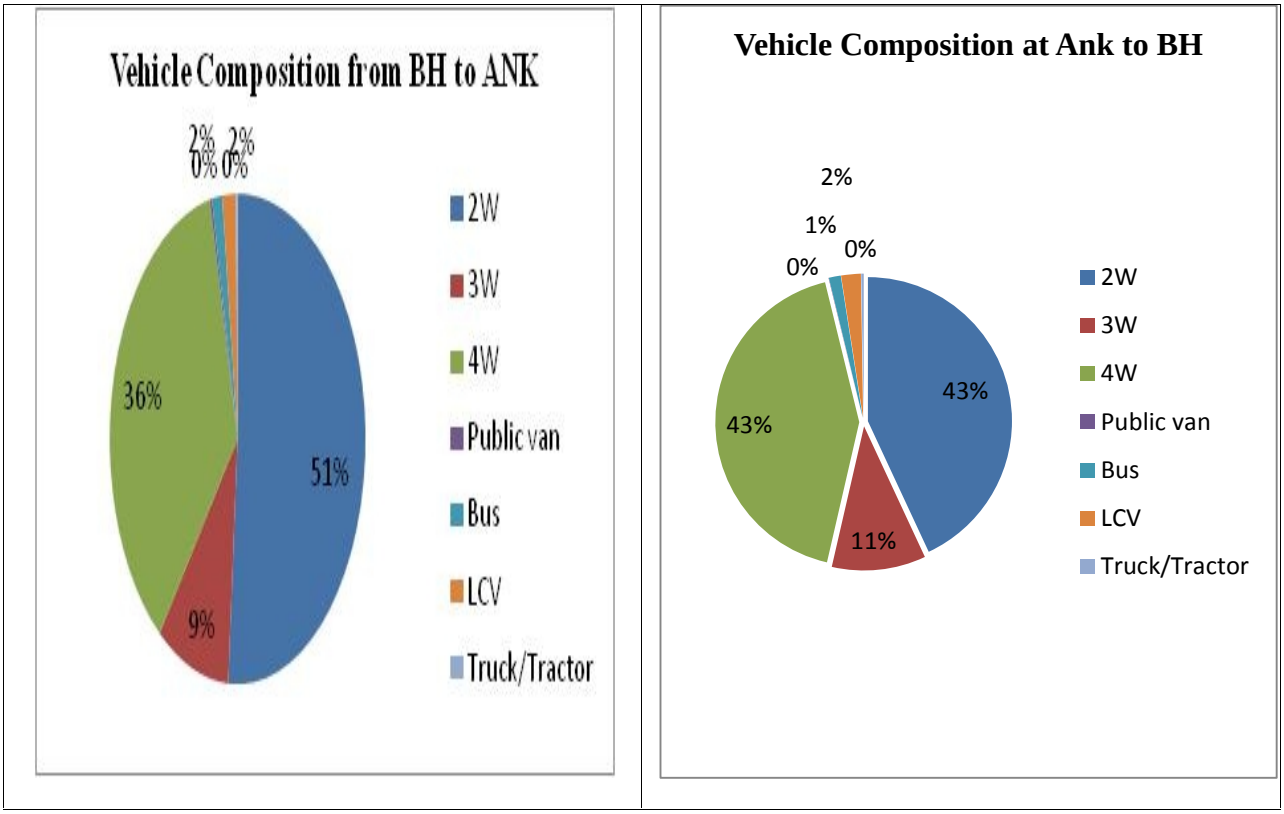

Fig3: Vehicle composition from Bharuch to Ank and Ank to Bharuch

SPEED MEASUREMENT:

In number plate survey method as soon as vehicle enters the start point time is noted and message is conveyed with the help of Watsapp or using mobile phone along with number plate at the end point data collector. From that time mean speed is calculated and with the help of that space mean speed is calculated. The maximum speed found is 53kmph and minimum speed is 37.2 kmph.

DENSITY MEASUREMENT:

As per US-HCM 2016, it suggests taking snapshot at half of the interval for which volume count is done but here we have simple relationship q=kv, where q is flow in veh/hr which is converted into PCU/hr, k is density veh/km and v is space mean speed km/hr.

Speed Flow Density Empirical Reationship From The Field Data

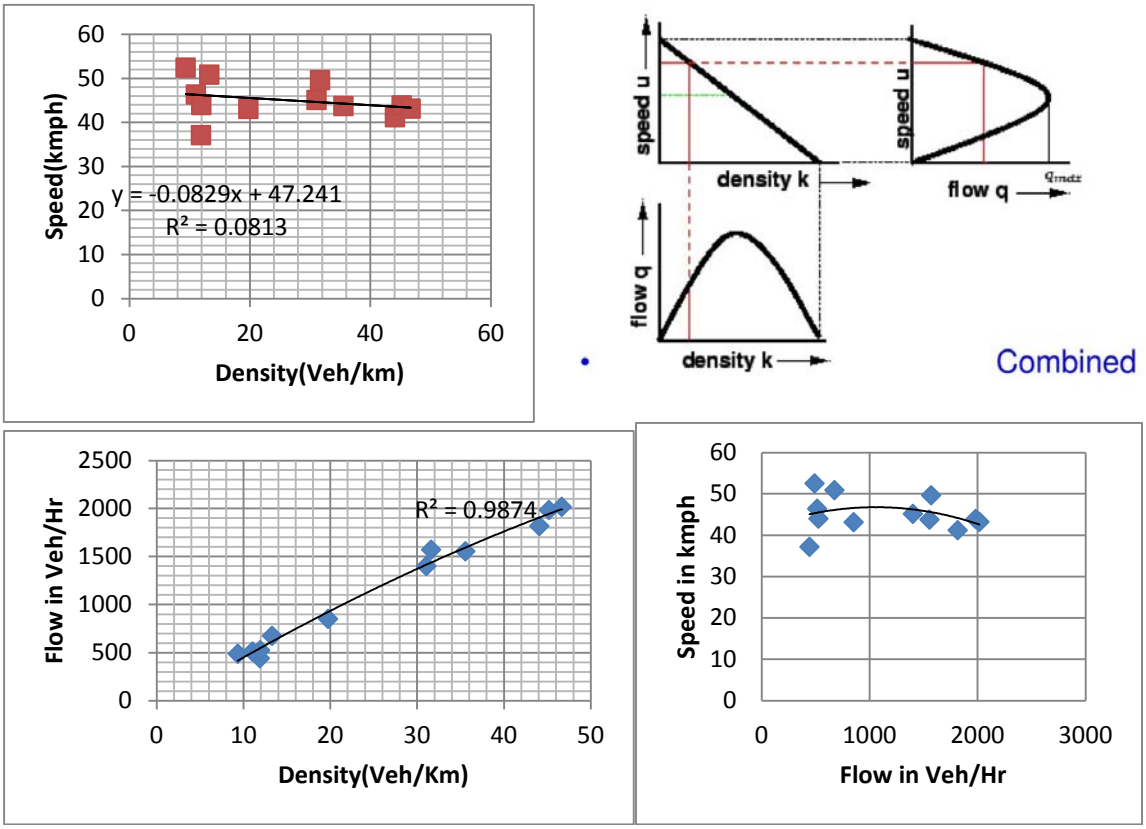

Fig4: Relationship between Speed, Flow and Density from the field data

Comparing with fundamental diagrams of speed-density-flow relationship which is given by B.D. Greenshields in 1934 and today there is drastic change in vehicular characteristics, speed of vehicle, roadway facility, traffic composition, driver behaviour, traffic management and geometric of roads. Due to this factor and also due to mixed traffic our observed road section.

ESTIMATION OF PCU

Estimation of PCU is very important as far as traffic flow is considered. Generally we used to describe traffic volume in vehicles per time but this will not give the perfect idea of vehicle type. Thus it becomes necessary to know vehicle type since all different types of vehicles have different characteristics such as speed, power, dimensions etc. In India traffic is mixed type and we cannot apply directly PCU formula from homogeneous traffic. In order to find PCU in heterogeneous traffic various methods such as: density method, Chandra method, headway method etc have been devoloped

In this work we are using Chandra's Method since other methods are based on homogeneous traffic with lane discipline, while country like India where there is no lane discipline and mixed traffic this works better.

PCU Estimation

To calculate PCU is Speed-Area method is used which is given by Dr Satish Chandra, Professor, IIT-Roorkee (Ex- director of CRRI). In Chandra's method speed is the basic factor for calculation of PCU. Hence, Chandra's method is adopted for the research work. In this paper Standard Car (4W) is taken as the standard design vehicle. According to Chandra's method PCU of any vehicle category can be found by using the following formula.

$$(PCU)_i = \frac{(V_c/V_i)}{(A_c/A_i)}$$

Where V_c= mean speed of standard vehicle, V_i= mean speed of i^{th} type of vehicle. A_c = Rectangular projected area of standard vehicle and A_i= projected rectangular area of i^{th} vehicle

Speed is the important parameter used in the numerator since speed of different vehicle depends on the volume of the traffic stream and also on the volume of different type of vehicle and volume of its own type. In denominator the projected area of vehicle is used which represents the area usage with respect to standard vehicle.

The physical dimensions of different vehicles are adopted as per table1.

Table1: Vehicle categories and their average dimension(S Chandra and Upendra Kumar,ASCE, 2003)

Category	Vehicles Included	Average Dimension(m)		Projected Rectangular area on ground(m^2)
		Length(m)	Width(m)	
Car	Car, Jeep	3.72	1.44	5.39
Bus	Bus,ST	10.1	2.43	24.74
Truck	Truck	7.5	2.35	17.62
LCV#	Chotta hathi	6.1	2.1	12.81
Tractor	Tractor tailer	7.4	2.2	16.28
Three-wheeler	Tempo, Auto	3.2	1.4	4.48
Two-wheeler	Scooty, bike	1.87	0.64	1.2
Cycle	Bicyles	1.9	0.45	0.85
Richshaw	Pedal Rickshaw/Cart	2.7	0.95	2.56

: LCV# indicates light commercial vehicle

Table2: Comparison of Calculated PCU with other researchers and IRC values

Vehicle Type	PCU Calcuated in this study(Vc/Vi) / (Ac/Ai)	Percentage composition of vehicle type in traffic stream		S Chandra & Upendra Kumar.2003			Biswas et. al,2017	Mondal et.al,2017	Fan (1990)	Yeung et al. (2015)
		5%	10% AND ABOVE	Min	Max	Mean				
4W	1.00	1	1	1	1	1	1	1	1	1
2W	0.25	0.5	0.75	0.41	0.51	0.46	0.21	0.23	0.4	0.65
3W	1.05	1.4	2	1.75	1.24	1.49	0.95	0.93	-	-
LCV	2.95	1.4	2	2.49	2.81	2.63	-	-	1.29	1.53
TRUCK	4.14	2.2	3.7	3.66	4.04	3.85	4.9	4.9	2.64	2.75
BUS	5.90	2.2	3.7	5.17	5.64	5.41	-	-	-	-

The present study also attempted to examine the variation in PCU across locations. Two separate studies (Biswas et al., 2017a,b; Mondal et al., 2017) which were conducted in the same year in two different metropolitan cities (New Delhi and Kolkata) of India, adopted the same approach (Speed based method) to estimate PCU under varying traffic conditions. These studies suggested two distinct sets of PCU for four different vehicle categories (viz. two-wheeler, three-wheeler, big car and heavy vehicle) on six lane divided urban arterials as given in Table 2. PCUs estimated by Fan (1990) and Yeung et al. (2015). This can be taken as evidence that PCU of different vehicle categories on a particular road facility may change over time due to the change in vehicular characteristics as a result of the development in the automobile industry.This work also compares with static values given by IRC-106-1990 values.S. Chandra and Upendra Kumar also get different values at eight locations here minimum, maximum and mean values are taken as measure of comparison.

Comparing with Biswas et.al,2017 and Mondal et.at, 2017 we find similar values for 2W,3W and Truck, while comparing with S Chandra and Upendra Kumar LCV and Truck have similarity. As compare with Fan(1990) and Yeung et.al(2015) values are quite different and IRC values are static so high difference are there.

CONCLUSION

- Empirical speed-flow-density relationship does not meet with fundamental relationship due to vehicle composition, vehicle characteristics, roadway width, traffic management, road geometric,
- The highest speed found to be 53kmph and flow 2019 veh/hr on study section.
- Majority 2W and 4W are observed, reason for this may be the dahej GIDC people having Home to Work trip and then Work to Home trip, .Heavy vehicles are prohibited the road. Only government truck for watering plants was allowed.
- In morning more traffic volume is observed from Ank to Bharuch and Bharuch to Ank in the evening
- IRC suggested static values of PCU for different vehicle categories. Static PCUs reported by these studies seem to be contradictory as it varies from 2.20 to 3.7 for truck and bus and 1.40 to 2 for 3W and LCV. Reason for this variation is the transform in traffic, road geometric and other conditions.
- The road geometric factors such as shoulder, gradient, horizontal curve, vertical curve etc. on PCU were reported in many studies. PCU irrespective of vehicle category tends to increase with the increase in carriageway width, shoulder width, gradient, length of the gradient and radius of horizontal curvature.

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An Experimental Evaluation of Emission Characteristics Of A Single-Cylinder Diesel Engine Fueled With Waste Plastic Oil

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Abstract. Biofuels are now being promoted as a renewable, sustainable, and alternative fuel for compression ignition engines to lessen the dependence on petroleum imports and the effects of global warming in the context of environmental deterioration and skyrocketing oil prices. Based on comparisons with normal diesel fuel, this research investigated the impact of Waste Plastic Oil (WPO) made from waste plastics on the emission characteristics of a single cylinder compression ignition engine. Although having increased kinematic viscosity and carbon elements, WPO was found to have physiochemical characteristics that complied with ASTM standards. Additionally, it is examined whether WPO may be used in place of conventional diesel fuel because of its similar fuel qualities and whether engines can run without modification in order to balance greenhouse gas emissions. The present study focuses at the emission behavior of waste plastic oil produced by pyrolysis of waste plastics with diesel in a 5.2 kW rated power single cylinder direct injection compression ignition engine. The experimental results with WPO were compared with base diesel fuel operation at all engine loads. The results showed that the engine could run with WPO resulted lower HC and CO with marginal difference of NOx compared to diesel.

Keywords: Diesel Engine, Pyrolysis, Waste plastic oil, exhaust emission.

INTRODUCTION

Due to its higher thermal efficiency, compression ignition engines are among the most frequently used prime movers in transportation, business, construction, agriculture, and power generation. Rising demand for fossil diesel fuel consequently causes the depletion of fossil fuels and worsening environmental conditions. The emitted greenhouse gases (CO, CO2, NOx, etc.) from the combustion of fossil fuels raise the temperature of the earth, resulting in global warming(1). As a result, increased attention is being placed on a new viable source of energy known as biofuels (mostly biodiesel), which has evolved as a result of rising energy demand, rapid crude oil depletion, and environmental damage(2). Biofuels have been shown to be a renewable, sustainable, and efficient fuel that can be made from a variety of feedstocks (edible and non-edible oils, as well as their methyl esters (biodiesel) and animal fats) for compression ignition engines. Biofuels can be made via a range of biological and thermo chemical processes, including transesterification, pyrolysis, gasification, and others(3). Many researchers have noted the impact of biofuels on engine performance and emission characteristics due to their increased thermal efficiency, higher cetane number, and eco-friendly nature and are deemed cost-effective(4). The production of synthetic polymers like polypropylene, polyethylene, polyvinyl chloride, and polystyrene has significantly increased over the last three decades. All plastic produced should be effectively managed at the end of its useful life to prevent further environmental contamination caused by dumping of discarded plastic in landfills or burning it. Plastics are becoming a severe hazard to the environment since they are present in practically every area of our lives. Globally, more than 100 million tones of plastic are produced each year, and overflowing bins and landfills are now frequently filled with abandoned products(5). Due to its beneficial characteristics, garbage plastic is a type of waste that is easily accessible and has a high level of energy efficiency. Despite various environmentally advantageous techniques being developed recently, millions of tones of waste plastic are still disposed of every day as opposed to being recycled(6).

Several techniques, such as gasification, hydrocracking, catalytic cracking, and pyrolysis, can recycle these plastic wastes into fuel(6).Pyrolysis is the most intriguing method for transforming plastic waste since it can result in tiny molecules of plastic waste with minimal environmental risk(7). By heating polymeric materials without oxygen, a process known as pyrolysis or thermal cracking, liquid fuel is created(8).Plastic pyrolysis oil, a liquid generated from waste plastics, has properties similar to those of petroleum products, making it a viable feedstock for diesel engines.Liquid, gas, and char are the three main products of those pyrolysis techniques, and the amount of each product significantly depends on parameters for the pyrolysis process, such as type of plastics, temperature, reactor type, pressure, residence time, heating rate, catalyst type etc(9).

In experiments using blends of Plastic Pyrolysis Oil (PPO) and diesel on a 4-cylinder DI turbo charged water cooled diesel engine (AKSA-A4CRX46TI), Kalargaris et al.(6)Discovered that BSFC increased at BTE was similar at lower load and decreased with increase of percentage of oil even under the lowest blending ratio. Kumar et al.(10) were able to generate plastic oil from the catalytic pyrolysis of high density poly ethylene allowed them to test various mixtures of plastic oil and diesel to see how well engines performed under varying loads. The investigation found that the BTE was lower than that of pure diesel under all loads. Waste plastic oil was added, and it was found that this increased the amount of fuel needed for the brakes. Bhatt and Patel(11) studied the results obtained using WPO on single cylinder diesel engine and reported that WPO's specific fuel consumption (SFC) had greatly increased and its brake thermal efficiency (BTE) was slightly better than that of diesel.

However, the main study compared the emission characteristics of single-cylinder diesel engines running on 100% WPO to those running on regular diesel fuel. The goal of this study is to identify the ideal operational circumstances and assess the viability of using waste plastic-derived plastic pyrolysis oil as a substitute fuel for diesel engines. The characteristics of the oil and its effects on emission metrics were carefully examined in order to accomplish this goal.

MATERIALS AND METHODS

Liquid fuel from waste plastics

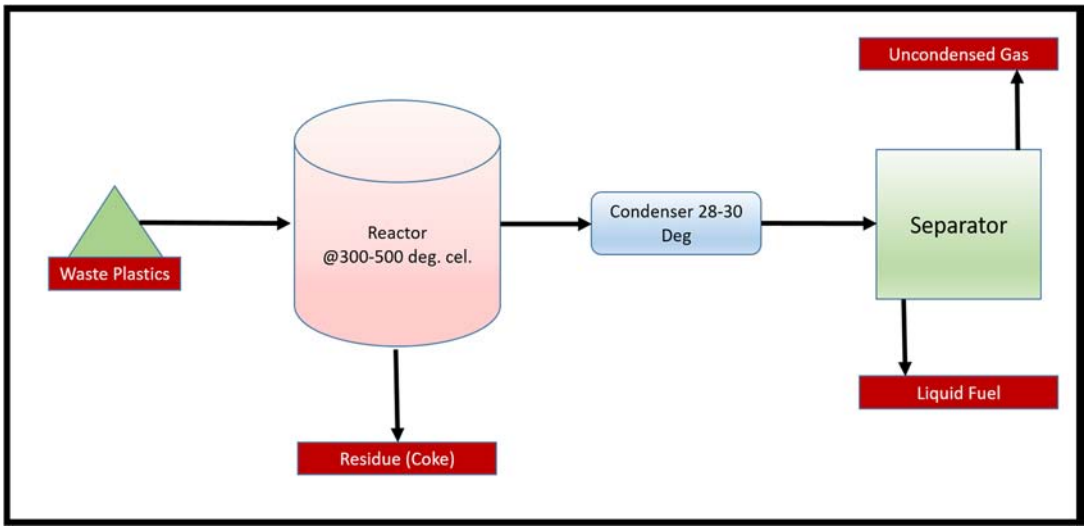

FIGURE 1. Schematic of Pyrolysis Process

Krishna Enterprise, G.I.D.C., Palej-Gujarat developed and supplied the test fuel (WPO). The process, which is commonly conducted at temperatures between 300 and 500 °C, yields a carbonised char as well as a volatile fraction that may be split into condensable hydrocarbon oil and a non-condensable high calorific gas(12). The proportion of each fraction and its precise composition are significantly influenced by the characteristics of the plastic garbage as well as the conditions of the procedure(13).The production flow process of converting WPO produced by pyrolysis is shown in Figure 1. Bottles, smaller micron bags, food sachets and wrappers, multilayered packages, and cable wraps made up the mixed plastic waste (MPW) that was collected from city dumps and roughly cut into identical-sized pieces (1-2 cm2). The MPW was cleaned, or the dust was removed without the use of water, prior to the thermal depolymerization process. After washing, the impurities in the plastic chips were removed, and the moisture content was completely dried off. In order to improve the output

product's quality and increase conversion efficiency, the MPW underwent additional cleaning to remove pollutants such tissue, oil, food debris, and grease. Long polymer chains in a closed reactor are broken by heat during the thermal depolymerization process to create plastic oil. In an oxygen-free catalytic environment, the reactor was loaded with the shred MPW and heated to temperatures between 300 and 500 °C. The catalyst helps polymer chains break down and release hydrocarbon vapours. these gases was sent into the condenser and it was condensed. The liquid fuel and the non-condensable gas (synthetic gas) were separated using the separator. The condensed liquid was cleaned and put through a filtration device before being stored. The synthetic gas was also cleaned in a scrubber before being used to create heat in the reactor. Using regular diesel, liquefied petroleum gas, or any other gas, the reactor was first heated. However, as a byproduct gaseous fuel during reactor operation, synthetic gas was used. The use of synthetic gas for supplementary heating considerably increased the efficiency of the overall conversion process.

TABLE 1. Physiochemical properties of WPO and Diesel

Property	Diesel	WPO	Method
Density @15^0 C (Kg/m3)	832	840	IS 1448 (Part-16) : 1990
Kinematic Viscosity @ 40 ^{0}C (cSt)	2.4	4.81	IS 1448 (Part-25) : 1976
Calorific Value (kcal/kg)	43000	39695	ASTM D4868
Cetane Number	54	53.2	IS 1448 (Part-9)

Table 1 shows the physiochemical characteristics of WPO and conventional diesel fuel. The physicochemical properties of the fuels used in the experiment were determined in accordance with ASTM and IS protocols.

EXPERIMENTAL SETUP

For the experiment, a single-cylinder, four-stroke, constant-speed diesel engine was used. Table 2 presents the engine's technical specifications. Fig. 2 displays a schematic illustration of the experimental setup. No alterations or adjustments were made to the engine arrangement throughout the test. All tests were run in the engine at rated speed of 1500 rpm with load changes using first diesel fuel and subsequently WPO. Exhaust emissions (HC, CO, CO2, and NOx) from the engine were measured with help of multi gas analyzer (NETEL make and NPM-MGA-1 model) and a temperature sensor was used for measurement of exhaust gas temperature. In order to remove any remaining plastic oil from the fuel line and the injection system after the test, diesel was used to run the engine for a bit. All necessary precautions have been taken to preserve the testing conditions; in particular, the temperatures of the engine lubricating oil and fuel are practically same in each instance.

TABLE 2. Engine Specification

Model	Single Cylinder 4 stroke Diesel Engine-TV1
Make	Kirloskar
Power output	5.2 kW @ 1500 rpm
Engine Capacity	0.661 CC
Compression ratio	17.5:1
Stroke	110 mm
Bore	87.5 mm
Dynamometer	Eddy Current Dynamometer
Rotameter	Engine cooling(40-400 LPH), Calorimeter 25-250 LPH

FIGURE.2. Diesel Engine Test Rig

RESULTS AND DISCUSSION

NOx emission

Nitric oxide (NO) and nitrogen dioxide(NO2) are among the oxides of nitrogen in the emissions. As the air-fuel mixture burns in the combustion chamber, nitrogen in the air is oxidized, resulting in the formation of nitrogen oxide. The air/fuel ratio and ambient temperature are the main contributors to nitrogen oxide generation. In the event of sufficient burning, the temperature rises and, as a result, more free oxygen atoms mix with nitrogen, increasing the rate of nitrogen oxide generation(10). Figure 3 depicts the variation in nitrogen oxide (NOx) emissions for WPO and diesel at various engine loads. It is observed that NOx emission is lower at loads when compared with diesel fuel. At full load condition, there is no significant difference of NOx emission. The reason for this may be the higher nitrogen content in the fuel thatpromotes the NOX formation by fuel mechanism.

HC emission

The major causes of the unburned hydrocarbon emissions in the exhaust are the wall flame quenching and the undermixing or over-leaning (bulk-quenching) zones. Figure 4 illustrates the variation in unburned hydrocarbon (HC) emissions for WPO and diesel at various loads. Comparing the test fuels, WPO combustion produced less HC emissions than diesel fuel combustion which is mainly due to the fewer amounts of aromatics in WPO and shorter ignition delay leads to more complete combustion.

CO Emission

CO emissions are a by-product of the intermediate stage of the burning of hydrocarbon fuels with an oxygen-free molecular structure. It forms mostly as a result of incomplete combustion, which is aggravated by a shortage of oxygen, the temperature inside the cylinder, and the duration of the combustion(9).As the engine load increases initially, it can be seen that CO emissions (Figure 4) decrease. CO emission for both fuels is observed similar at part load and full load. The increase in combustion efficiency as engine operating load increases may be the cause of these decreased CO emissions.

CO_2 Emission

When the carbon atoms in the fuel are completely oxidised during complete combustion, carbon dioxide (CO_2) is released. Although it is typically not subject to emission regulations and is not regarded as a dangerous gas, there is a strong requirement to minimise CO_2 emissions because it is a greenhouse gas(6).The variation of CO_2 emissions for diesel and WPO against load is shown in Figure 6. A nominal change of emission behaviour is observed for diesel and WPO. However it is slightly lower than diesel for almost all loads. This can be the result of late fuel combustion causing insufficient CO oxidation.

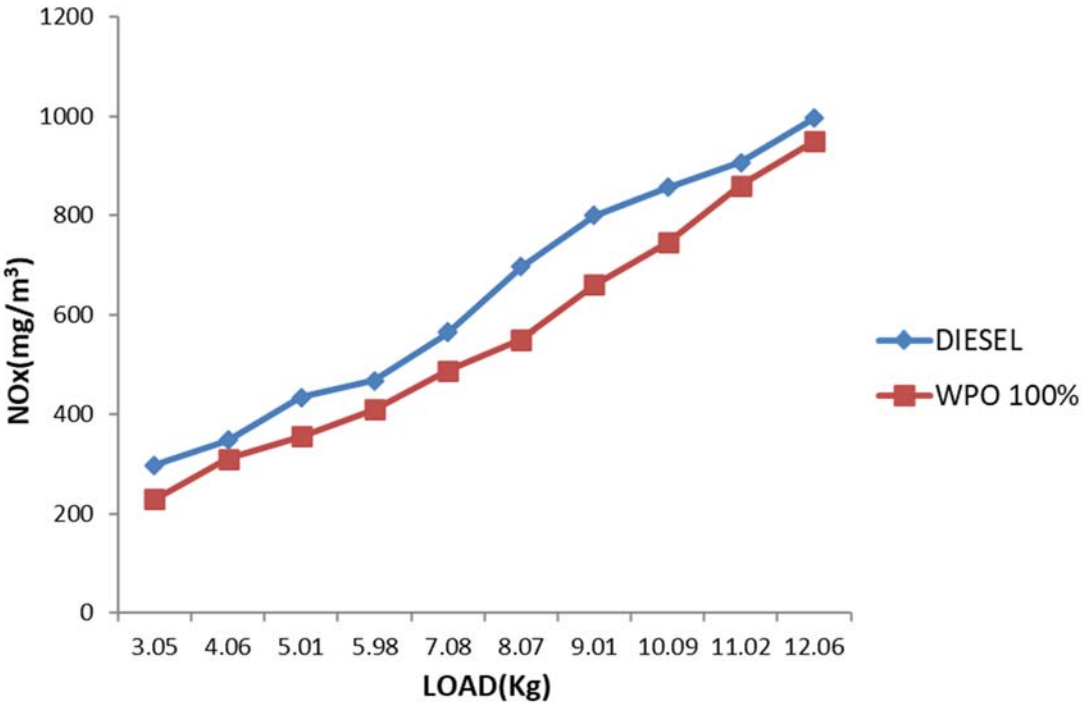

FIGURE 3. NOx vs. Load

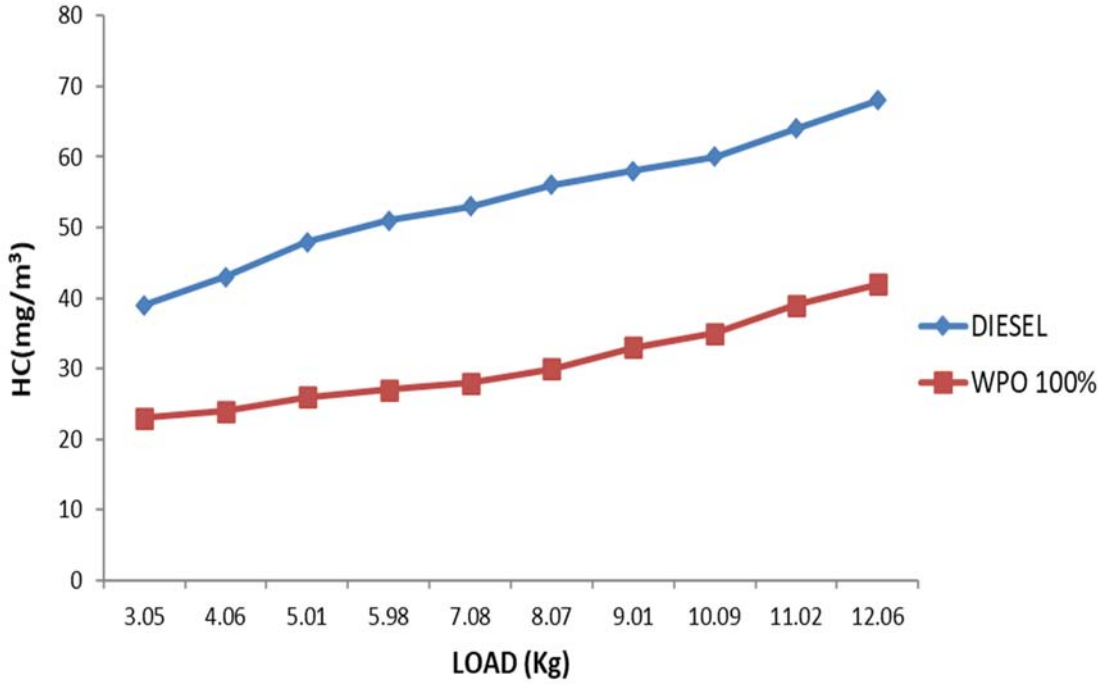

FIGURE 4. HC vs. Load

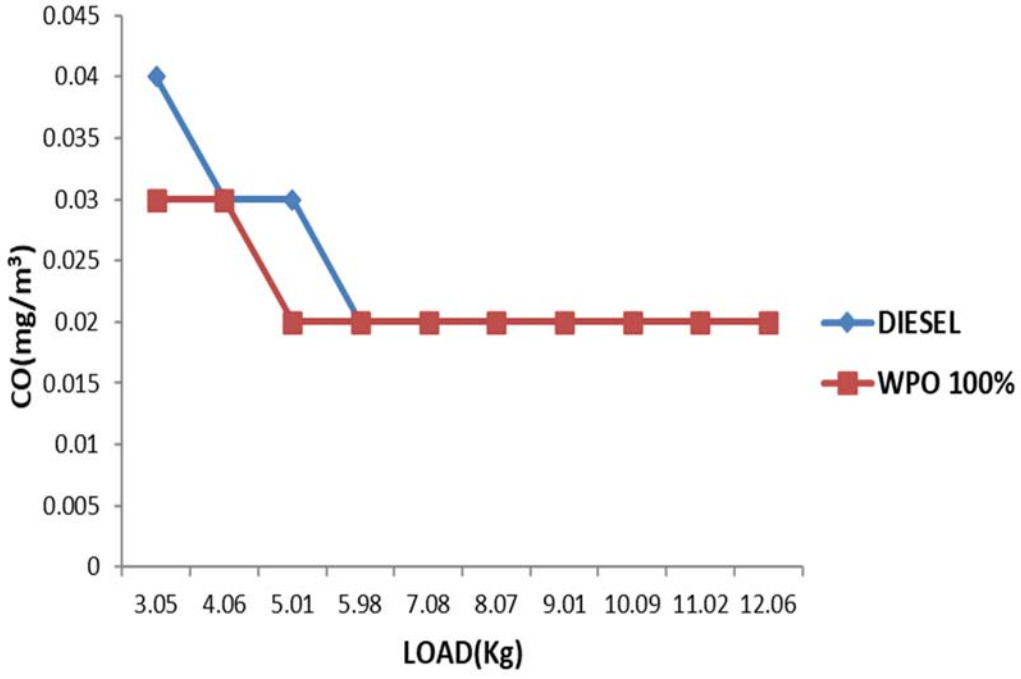

FIGURE 5. CO vs. Load

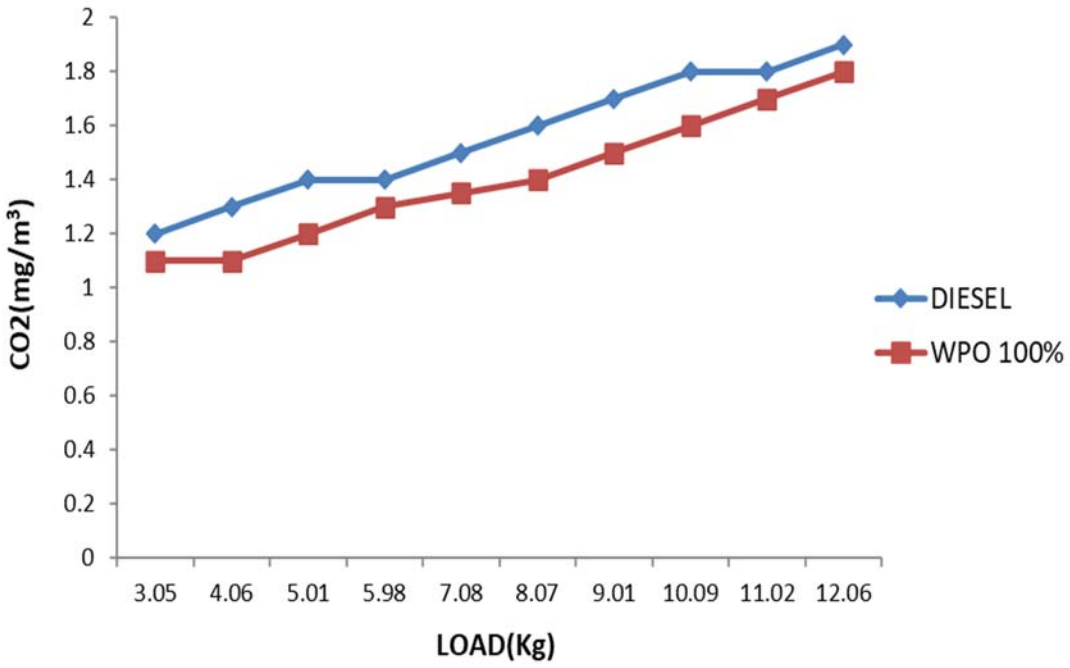

FIGURE 6. CO_2 vs. Load

CONCLUSION

An experimental examination was carried out to analyze and comprehend the emission characteristics of a single-cylinder diesel engine using pyrolysis oil generated from waste plastics. The experimental results have led to the important conclusions listed below.

- WPO 100 enabled the engine to run steadily under all loads.
- Greater viscosity was identified as WPO's physiochemical property, and it was found to be within IS and ASTM guidelines.
- NOx emissions were marginally greater at part load than they were at full load or lower load conditions. WPO was found to emit less HC and CO_2, but no discernible difference was seen in CO emission.

The report suggested additional research on emission long-run endurance test and life cycle analysis for WPO as a fuel in diesel engine.

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Evidence on the need for metrics for measuring Cyber Security

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Abstract. Analysis regarding the Upcoming trends in cyber security with respect to the difference and the potential threats that are hovering over our systems are observed and mirrored. There is an observation regarding the scattered trends in different countries in order to protect their systems, applications and the citizens' privacy and thefts. That will also describe which kinds of standards are enshrined for which threats.

The objective of analysis will be, to compare different types of Approaches that are applied in various fields according to their need in terms ofcyber security. Various subjects like critical infrastructure, cloud sensor nodes, Internet of Things, networks, and another software based security framework are taken into account. Outcome of different types of the thefts and extortions which the world is facing behind from the cyber threats and its vulnerabilities are encountered

Keywords—Cyber Security; Metrics; Cyber-attack; Cyber Security; Cyber Incidents; Ransom wares; Critical National Infrastructure Security; Internet of Things; Sensor nodes.

INTRODUCTION

Digital technology has greased the wheels of the economy all over the world. Digitization has accelerated the need for cybersecurity. There is an immense need to defend against cyber risks. The legal edifice for cyber security is needed. Not just One Single Country, but all around the world every country is facing similar challenges. The dark web has created a lot of troubles for the human kind.

There are many malware which intend to steal the users passwords, customer cookies and
Payment card data from the web browsers and are being sold via many channels or some websites. All such activities openup the windows for checking out all kinds of vulnerabilities which exist in the system.

For example, the objectives for national cyber strategies should be geared toward citizen and societal cyber skills improvement, safer society to conduct business, and education, skills and development. Conversely, organization cyber programmers are likely to focus on their business specific cyber objectives, such as protection of their systems,

The suit of the malware in itself includes worms, ransom ware, Clippers Steelers, denial of service along with distributed denial of service embedded within it. Such kind of threats is collectively implemented by some hacking architects and collectively works under certain projects.

If collectively the hackers can architect systems to hack our system or applications or operating system or network to reach to our privacy then collectively with the efforts of all the countries certain metrics can also be defined which well addresses the quality of a software in terms of security.

The key contributions of this paper are as follows:

1) We propose some universal standards to measure cyber security for increased security for all organizations.

2) We describe and discuss each applications security and justify to why we should select some protocols for thestandards.

3) We suggest some of National Cyber Programmes and Strategies which should be collectively implemented as aanswer to the dark web.

CYBER ATTACKS & CYBER SECURITY

Cyber Attacks are digitals attacks which are threats to the whole digital world. There are different ways in which the thefts related to data, privacy, identity are done by the hacker or attacker in order to harm the systems or the data.Some are such which just does not change the state of the data, but also by eves dropping in the system can retrieve important data from the sources which are highly confidential and harm the security of people. Different types of attacks are known to the cyber world, like Malware attacks, Phishing Attacks, Password attacks, Man in Middle Attacks, Denial Of Service, Crypto Jacking and many more such which can be categorized. Unauthorized penetration happens in the system or a framework for the existing loop holes or the network.

Importance of Cyber Security is growing in this Digi World it is necessary to protect the CNI and other personal data of the man kind. Due to the techniques of cyber defenders and the penetration testing and the methods to find the loop holes, we can secure the systems from the attackers or Hackers.

LITERATURE REVIEW

Some kind of standards or regulations in order to protect the hardware and the software based security. One kind of secure architecture was proposed by the author which was purely software based solutions. The stated overview of the SECURE model was an advisory model which targeted legacy issues unlike the new generation issues regarding the problem of no memory protection, single thread of execution, global interrupt disabling and having sufficient flash memory to store TCM. Also it is clearly mentioned by the authors that there is a need to standardize some kind of metrics by the regulatory bodies

Author has made a prototype of SECURE which has been implemented for one of the ECU, but that doesn't solve the question that how much security levels should be checked for the ECU in order to gain the secure levels for the vehicles.

This paper discusses the concept of cyber security sensor network (CSSN). The author clearly mentioned that there is a need to address some tough questions that should be answered in advance which steer the further design decisions in cyber security. Also it has been questioned that what is the right level of the search depth and how the confidential indicators should be dealt with.

Author initially focuses on CSSN, and the security which is adapted by them for the CSSN solutions, but also has mentioned the need to answer some critical questions, which should be cleared before implementing the design decisions for certain cyber security. This in itself states there is a need to standardize the norms so that, the quality of the security can be justified.

The UK critical national infrastructure has the objective groove to improve cyber security management capabilities in critical national infrastructure.

The need was well proved in the cyber attacks of Wanna Cry attack in may 2017which deal with a ransom ware worm that spread rapidly through a number of computer networks. It infected the Windows computer, and then it encrypted the file on the PC's hard drive. Because of which it became impossible for the users to access. It was like cyber extortion for ransom payment in Bit coin in order to decrypt it and then only allow access to the PC.

The other attack named as Ukraine power infrastructure attacks in 2016 was an attack on the whole power grid of Ukraine. As many as 230000 consumers went into power outage for around 6 hours in order to create pressure by Russia during the Russia Ukraine war. For these reasons and CNI are collaboratively working for the resilience to the cyber attacks. Resilience to the cyber attacks in itself states that the agencies are getting ready for the situations4 after the attack has already taken place. But according need is also there in order to standardize certain parameters or metrics before implementing the smart power grid.

Threats of Ransom ware which have moved the world a number of times, can be addressed by providing some kind of proactive measures.

Ransom ware somewhere was first discovered in 1989 although it is old yet it is new and has equally devastating effects. There is a significant rise in ransom ware attacks. It directly targets the government healthcare in the educational institutions. They are purchased on the dark web by amateurs giving them the same attack tools used by professional cyber attackers.

Ransom ware families or its trains are constantly hitting the world's digital assets. It is like a severe threat to the cyber world. Technical difficulty being posed by this malware is properly illuminated by the author.

The survey also mentions some kind of proactive approach or predictive approach or preventive solution needs to be made for the attacks from ransom ware.

According to sources from the web there are many IT Act that states laws to protect the number of incidents. Any criminal or administrative offences are subject to jurisdiction of these laws. Information Technology act of 2000 proscribes many laws related to computer system, computer networks, unauthorized access to computer, databases or any kind of extraction of sensitive data. Denial of service, phishing, infection of IT systems like ransom ware spyware, worms and Trojans Or anykind of identity theft. Many information technology rules and acts are given along with their amendments in order to focus on and regulate specific kinds of cyber security. There are also certain kinds of development and regulation acts given in order to prevent attacks.

For specific sectors there is no comprehensive cyber security legislation in India. Therefore they must either to the provisions of IT act and various rules promulgated under act.
There should be norms/ metrics/ standard rules/ or laws/ which state in detail the number of tests check marks through different systems should pass and then only be deployed. Some thresholds should be decided in order to rate the security ofthe application or website or a network or operating system, depending on the different environments they work.

Dramatic revolution in the world has taken place with the introduction of Internet of Things which is connected to a huge network of devices and it holds sensitive information as well around the surroundings these tiny IoT devices are capable of many ransom ware attacks like Wannacry can shatter the digital world by hacking it. Huge extortion takes place by the attacker to release the integrity, confidentiality and availability not only in the form of data but also in the form of monetary loss and sensitive information breach and life risks. Supporting to this theory there is again need to have certain factors on the basis of which the security tests should be done before deployment of this device is in the network.

It has been noticed that once the attack has taken place we have a system in order to pay justice to the customer which is kindly effective in the society. But what if we try to implement some kind of standards without which no applications or nosystems can be delivered until and unless they pass some kind of tests for the cyber attacks. We are trying to work for the resilience to the cyber attacks which are indeed necessary but what if proactive measures are taken and proactive standardsare insured in order to avoid some kind of cyber attacks so in hurry we do not have to act for resilience to that cyber attack.

ANALYSIS AND DISCUSSION

With the current scenario in the world, Critical National Infrastructure is the heart of any country for regular working as well as in the times of wars or other international circumstances. Investment in Cyber Security if done in proper way can bea fruitful effortful approach to the need. If the similar kinds of efforts are done in scattered way, there is a huge possibility that the countries may end up over spending on the cyber security infrastructure. Cyber security investment is a critical expenditure, which if spend collectively can be quite effective.

As cyber security being the key concern for the countries like India, the government has decided to raise the funds for the same and in spite of so much cyber spending, it isn't catching up the amid rise in the security breaches. Cyber security Regulatory landscapes in the countries are mandatory due to society's huge leap into becoming an "information society". Different diversities in the attacks are seen which range from simple computer viruses to sophisticated cyber attacks conducted for various purposes such as intelligence information gathering, sensitive

military information thefts, industrial espionage, crime or warfare. The investments are worthwhile or not are also question.

The challenge here, is agreeing on general metrics which can be used to describe and demonstrate RoI for all cyber investments.

The above evidences illustrate the protocols that need to be focused in the review and their discussions. Using the past attacks one can identify the research gaps that still exist leading us to the path way for future work.

CONCLUSION

In this paper we have discussed the need to proactively set up some metrics or rules in order to block the malwares and attacks. Also the need for some universal standards need to be introduced in order to set up some protocols through which the system on passing can be made more reliable to the attack prone environment.

It is yet a hazy picture about the investment on the proposed systems due to variable environments and devices and medium through which the whole digital system works.

Therefore in this paper we have tried to brief up about the threats and its effects which the world faces in the different forms of attacks that the countries faced recently. After India also being one of the countries which had faced the attack in One Of the Navratna Companies, is looking forward to build its Cyber Defender Army and also looking forward to some standards which set up the protocols for the secure systems to protect its digital area for the attacks.

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Delta Value-Based Algorithm to Control Loss in Option Selling Strategies for Volatile Indexes

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Abstract. In this age of technological advancement, every industry, including finance, has reached the pinnacle of development with fascinating tools and systems that make the execution of complex algorithmic trading more accessible than ever before. Accordingly, there are many kinds of algorithmic trading strategies available, but a significant proportion of them are not sustainably successful in all market conditions because they have been intended for market prediction, which is not successful in the case of intraday trading, according to statistics. This research aims to analyze the best hedging parameters for the straddle strategy to mitigate risk for long-term profit in all market conditions, including uptrend, downtrend, and range-bound markets, that used a mathematical model and a high-frequency computational trading system.

Index Terms - Quantitative trading, High-frequency trading, Auto trading, Algorithmic trading

INTRODUCTION

Because most AI algorithms fail to predict the trend in the intraday timeline for highly volatile indexes like Bank Nifty and Nifty50, and because technical indicators and linear regression models do not have high accuracy for the intraday timeline, it could not be added to the list of sustainable profit-generating strategies. As a result, only a dynamic strategy capable of absorbing market volatility [1] would be effective for generating noticeable and limited profit. Some option-based tactics work in the same way as previously explained. This approach involves the creation of two or more positions to profit from side movement. The strategies are mentioned below.

- **Future**:

  A derivative instrument is a standardized legal agreement between unrelated parties to buy or sell something at a predetermined price at a predetermined period in the future. Typically, the plus altered is a product or monetary tool.

- **Options**:

  An option is a contract that grants the buyer the right, but not the responsibility, to buy or sell an underlying asset or instrument at a certain strike price before to or on a specified date, depending on the form of the option.

- **Current Well-known Options Strategies**:

  1. Long and Sort Straddle
  2. Long and Sort Strangle
  3. Butterfly

4. Iron condor

In a strangle, the investor has positions in both a call and a put option with distinct strike prices but the same expiration date and underlying asset. If you believe the underlying asset will have a significant price movement soon but are unsure of the direction, a strangle is a solid trading strategy. However, the asset's price swings are what make it profitable in the main. While a straddle combines a call and a put with the same strike price, a strangle uses options with different strike prices.

A butterfly spread is an options strategy that combines bull and bear spreads with a predetermined risk and profit cap. These spreads are designed to be a market-neutral strategy that pays off the greatest if the underlying asset does not move before option expiration. They consist of four calls, four puts, or a combination of calls and puts with three strike prices.

An iron condor is an options strategy that consists of two puts (one long and one short) and two calls (one long and one short) with the same expiration date. When the underlying asset closes between the intermediate strike prices at expiration, the iron condor earns the most profit. The iron condor has a similar reward as a standard condor spread, but instead of only calls or only puts, it uses both calls and puts.

However, all these strategies have their own drawbacks, such as when the market moves within a range bound price, all of these strategies will lose money because the premium decreases over time, and if the position becomes out of the money at the end of expiry, it will be worth zero, which is extremely risky.

In the same case, if we develop the kind option strategy, a range-bound market will yield a fantastic return, but if the market moves beyond the regular average movement, we will suffer big losses.

One of the most useful concepts for dealing with loss scenarios is hedging. Hedging methods are used to limit risk exposure in the event that an asset in a portfolio has a sudden price decline. When utilized appropriately, hedging methods decrease uncertainty and limit losses without appreciably reducing the anticipated rate of return.

Typically, investors buy securities that are inversely correlated with a susceptible asset in their portfolio. If the vulnerable asset's price moves negatively, as a hedge against prospective losses, the inversely associated security should move in the opposite direction. Derivatives are financial products that certain investors purchase. When used intelligently, derivatives can limit investors' losses to a predetermined threshold.

This method controls the loss on opposite market movement by using the delta value of the strike price. Delta estimates how much an option's price may be predicted to move for every 100-point change in the price of the underlying securities or index. A Delta of 40, for example, suggests that the option's price will move 40 points for every 100-point movement in the price of the underlying stock or index. As you may expect, the larger the Delta, the greater the price change.

Traders frequently utilize Delta to forecast whether an option will expire ITM. So, a Delta of 30 indicates that the option has a 30% probability of becoming ITM at expiration at that point in time. This is not to say that higher-Delta options are always lucrative. After all, if you paid a high premium for an option that expires ITM, you may not profit.

Delta may alternatively be thought of as the number of shares of the underlying stock that the option behaves like. So, a Delta of 30 indicates that if the underlying stock moves 100 points, the option will likely earn or lose the same amount of money as 30 shares of the stock.

LITERATURE REVIEW

1. **In 2022, Zizhang Rao and Yuanguo Zhu [1]**, proposed that Options are adaptable derivatives that may be combined. to form a specific option with an underlying value or other types of options trading strategies that respond to the needs of different investors in different market environments. Given that the underlying asset's price is susceptible to both positive and negative shock, factors, we use uncertain differential equations with positive jumps, and Price fluctuations are described by negative leaps. In this paper, we value a frequently utilized trading method called bull call spread and examine its monotonicity in relation to each factor.

2. **In 2021, Ujjwal Anand and Dr. Manu K. S. [2],** presented a study in 2021 that was undertaken to analyze an optimum strike selection for naked options and assess an event strategy with options trading for the Bank Nifty and Nifty 50 options indices, and that study discovered that ITM options are more responsive to underlying movement than ATM or OTM options. The strike price, which has a delta (+/-0.7), must be considered while choosing a strike. The study also discovered that before any economic event, the implied volatility percentile rises, and once the event occurs, the implied volatility falls.As is the case with the option's premium. During the event, IVP and implied volatility tend to crash, and premiums begin to decay. As a result, setting up a short straddle before every economic event is quite profitable.

3. **In 2022, S.M. Ikhtiar Alam [3],** suggested four option-based strategies entitled Straddle, Strap, and Strip, which can make profit in the one-sided moving market without predicting the trade in advance. These algorithm makes 2 potions on opposing side and when markets move one of them are in bigger profit than others loss and in that way, it may generate profit, but in the range bounded market it could lead to losses as premium falls with time in option position

4. **In 2021, CMA(Dr.) Ashok Panigrahi, Kushal Vachhani and Mohit Sisodia [4]** presented a paper to provide a heuristic model in the form of a derivative trading technique to small retail traders. It is an attempt to provide an easy and profitable derivative trading strategy for ordinary traders, who frequently lose money in the stock market due to a lack of information and ineffective trading strategies. And discovered that it had a 60% accuracy rate, which is very impressive.

OBJECTIVES OF THE STUDY

- Determine the appropriate hedging delta value for option strategies.
- To control losses in options strategies, pick the highest profit-making target and the smallest stop loss values.

RESEARCH METHODOLOGY

The study estimated the delta value by collecting BANKNIFTY options and spot prices. The strangle option strategy with delta hedging is examined and tested with various delta values to determine the maximum safe position, as well as the best feasible stop loss for full positions.

Delta: Delta is simply the ratio of a change in an option's price to a change in the underlying's price. Delta is superficially similar to speed in that it gauges the rate of change in the option for a change in the underlying.

$$\frac{\partial C}{\partial S} = N(d_1) \quad \frac{\partial P}{\partial S} = -N(-d_1)$$

C = CE Price, P = PE Price, S = Spot / Index Price

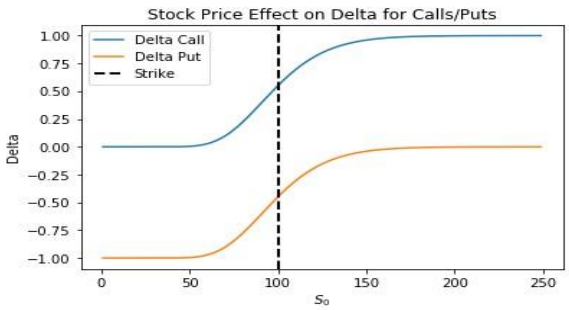

Figure 1

Option Chain: A list or table of all available option contracts is referred to as an option chain. It contains equities and indexes, as well as Put and Call options for each F&O listed security. For given expiration date, the table will show open interest, implied volatility, change in open interest, LTP (last traded price), change in price, bid-ask, and so on. [4]

In the Money (ITM) Options: In the money options are those options where Spot>Strike for call options. For Put options, It's spot<Strike. [4]
At the Money (ATM) options: These are those options where Spot= Strike price. Out of Money (OTM) **Options:** These are those options where Spot<strike for call & spot>strike for put options. [4]

PROPOSED SOLUTION

A short strangle has a much higher chance of success than a long strangle, but the position is infinitely dangerous because the BNKNIFTY price might move in any direction with uncertain value. However, this loss could be mitigated with a hedging strategy.

Long strangle: A long strangle is made up of one long call option with a higher strike price and one long put option with a lower strike price. Both options have the same underlying stock and expiration date, but their strike prices are different.

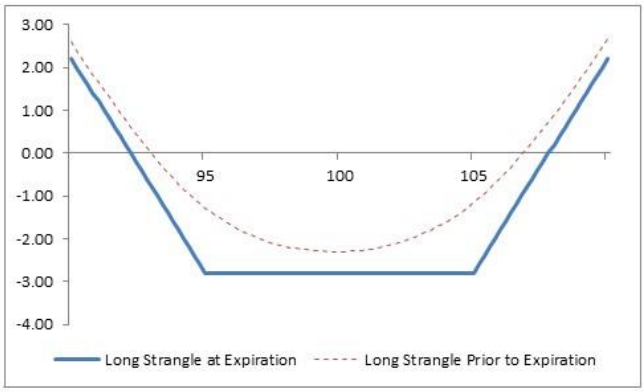

Figure 2 (https://www.fidelity.com/) Profit and loss stimulation graph for Long strangle

Explanation: If the BANKNIFTY price is 38600, the CE Strike price is 200 OTM (38800), and the PE Strike price is 38400. If the market moves more than (2*OTM), which is 400, this position will profit if the premium reduction is avoided. If the price of BNKNIFTY does not move out of this range, a loss will result. As a result, this approach is only applicable in the trading market. As a result, for this technique to work, the market must be in an uptrend or a decline, or it will result in a loss. [Figure 2]

Short strangle: Short strangle is the inverse of long strangle in that CE and PE are bought from the two ATM gap, but in the short strangle, PE and CE must sell at the opposite strike price.

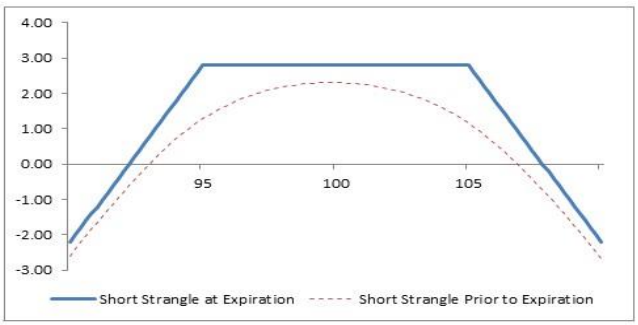

Figure 3 (https://www.fidelity.com/) Profit and loss stimulation graph for Short strangle

Explanation: The CE Strike price is 200 OTM (38800) and the PE Strike price is 38400 if the BANKNIFTY price is 38600. Premium reduction will result in a profit if the market does not move out of the strike price range. However, if the market moves outside of the range, one investment will remain profitable while the other would suffer a
massive loss. So, this is the inverse of the long position, but the possibility of profit is higher. [Figure 3]

TABLE 1 STRANGLE COMPARISON

Strangle	Probability of profit	Risk	Reward
Long	27%	Limited	Unlimited
Short	73%	Unlimited	Limited

TABLE 2 FROM TOPSTOCKRESEARCH.COM

Period	Price Range %	Average Price range
3 Day Period	2.90	1085.70
5 Day Period	2.51	944.90
10 Day Period	2.16	834.93
15 Day Period	2.01	791.73
30 Day Period	1.73	676.40
50 Day Period	1.55	596.80
5 Week Period	4.44	1734.15
10 Week Period	3.89	1497.98
20 Week Period	3.98	1435.24
50 Week Period	4.66	1667.54
3 Months Period	9.10	3406.55
6 Months Period	10.74	3692.52
9 Months Period	11.26	3852.86
12 Months Period	11.24	3867.90

According to statistics, the Bank Nifty index's average daily fluctuation is close to 1%. As a result, the daily price movement range is 300 to 500. As a result, the optimum strangle is one that can detect a 400-point shift in the bank nifty. Using this technique, the strangle with a 200 strike price gap is the optimum strike price to choose. If the bank nifty spot price is 38631, it will choose ATM-200 PE and ATM+200 CE.

Figure 4 (Profit and loss stimulation graph for PE and CE ATM-200 Strike price)

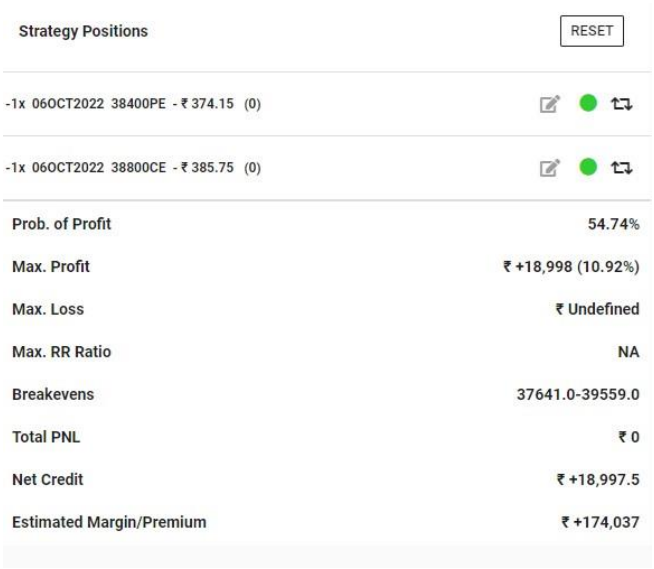

Figure 5 (Strangle position calculations)

Here is a screenshot of the simulation screen for the a forementioned strategy from the Opstra option strategy simulation.

Figure 6 (Profit and loss stimulation graph for PE and CE ATM-200 Strike price on 200 point movement)

So, this one is the normal strangle, and the main problem is that when the market moves more than 400 points in any direction, the position will lead to a loss. For example, if Bank Nifty moves to 39800, it will lead to a -6000 loss on the day of expiry. And if Bank Nifty moves to 37400, it will lead to a -6000 loss again on the day of expiry.

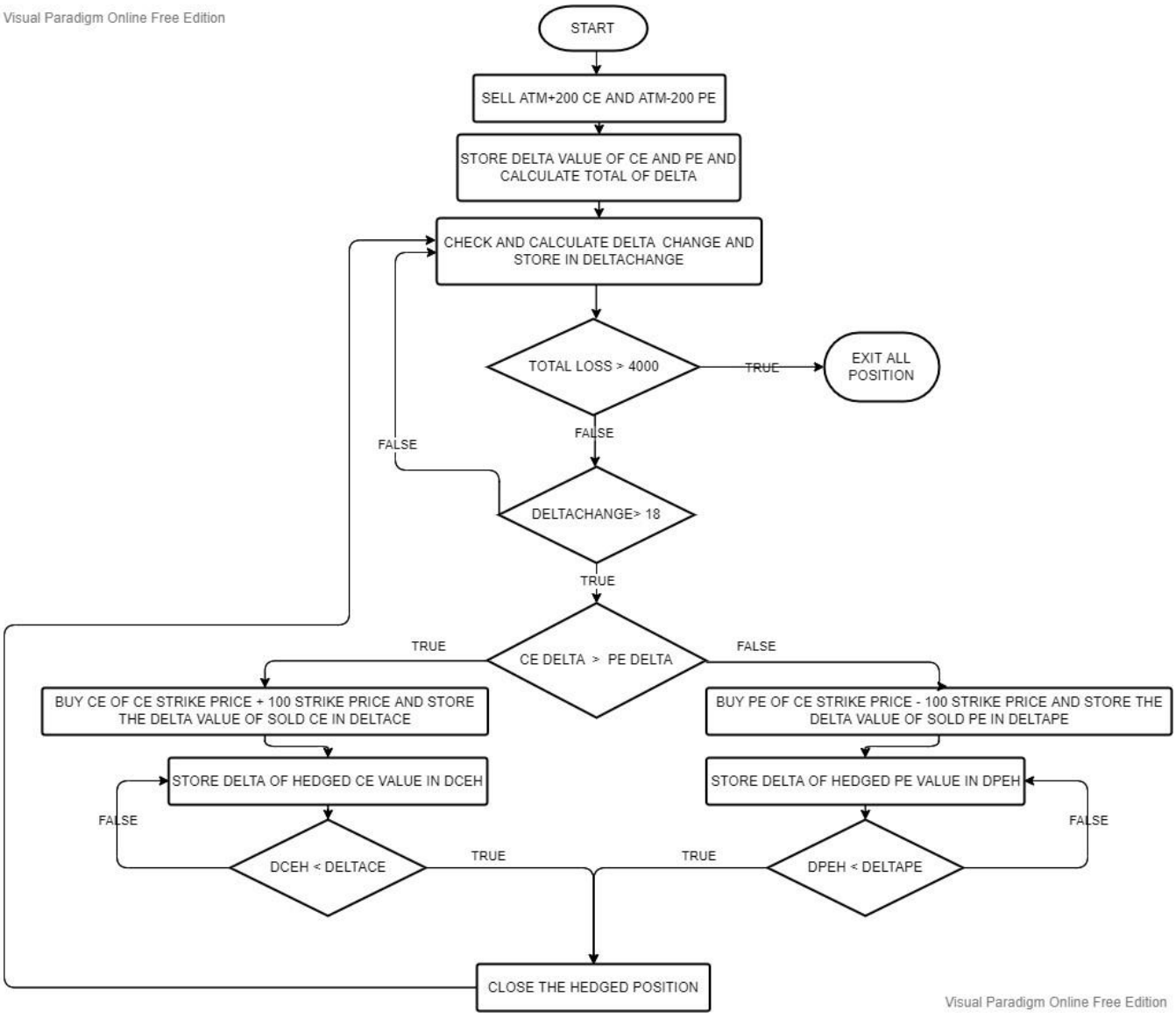

Figure-7 (Flow Chart-Delta Based Hedging Algorithm)

Why STOPLOSS 4000

According to Kotak Securities, the rule of thumb for intraday trading is to use no more than **2%** of your trading money in a single day. The required amount in this method is 200,000, so 2% of this amount is **4000**.

Why delta value 18

Data testing with various Delta values reveals that delta value 18 delivers the best return when compared to other delta values.

TABLE - 3 BACK-TEST RESULTS WITH DIFFERENT DELTA VALUE

No.	Delta	Profit in percentage
1	14	-8.4
2	15	-3.7

3	16	+6.1
4	17	+12.1
5	**18**	**+30.2**
6	19	+9.4
7	20	+4.6
8	21	+3.2
9	22	-1.5

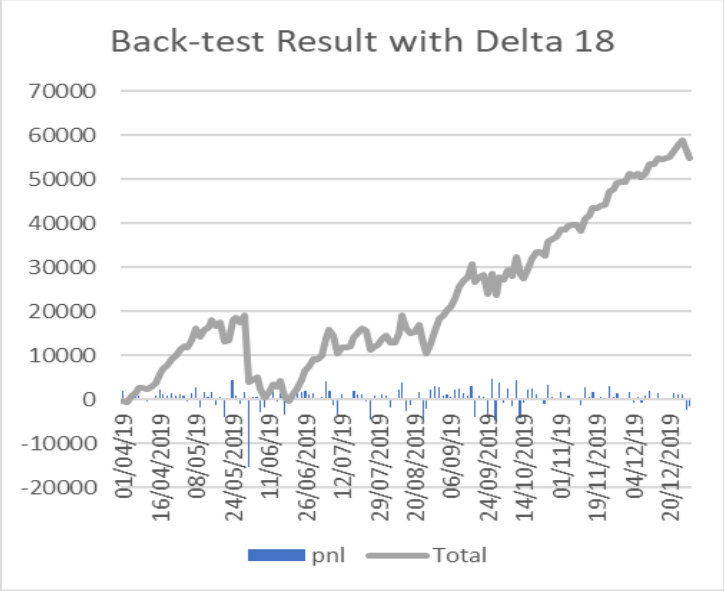

Figure-8 (Backtest Result)

TABLE-4 MONTHLY BACKTEST

Month	P&L	Orders
Apr-19	13510	45
May-19	-7396	51
Jun-19	3742	45
Jul-19	6896	61
Aug-19	3658	41
Sep-19	9888	48
Oct-19	9078	47
Nov-19	12581	46
Dec-19	5348	52

CONCLUSION

This paper presents comprehensive risk management parameters for option selling strategies using a delta hedging algorithm for highly volatile indexes. As a result, the basic option selling approach is discovered to only work in range-bound markets, whereas the hedging algorithm delivers a considerable return in practically all market scenarios. For the maximum stop limit, this method used Kotak Securities' 2% total capital stoploss thumb rule, and by running the same algorithm on previous data with different delta values, it was revealed that the best result could be recorded by utilizing 18 as the delta change hedging trigger value.

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A Vision Based Fall Detection Framework Using Key Points of Human Skeleton with CNN and Bi-LSTM

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Abstract. Fall detection in current scenario is very important as the number of elders are increasing in world day by day. Hence we need to implement an accurate fall detection technique which helps the elders to prevent from various serious injuries. Mainly, we can implement vision based system which is more effective then sensor based system because wearing device on body parts is not possible in case of elders every time. Here, we have proposed fall detection system using AlphaPose pre-trained network through which we have extracted the key points of human body which plays very important role in detecting fall. After extracting the key points, proposed 2DCNN and Bi-Directional LSTM is used to classify fall event. Here, spatial information is extracted through 2DCNN and temporal key features are extracted by use of Bi-LSTM model. We have tested our proposed system on UR FALL detection dataset and KFALL dataset which shows 99.08 % accuracy and 98.85 % accuracy respectively.

INTRODUCTION

Activity Recognition is one of the popular application in computer vision which involves various areas such as sports, retail marketing, gait analysis, home pose estimation, agriculture marketing etc. There are various types of devices are used for activity recognition like ambient based, Wearable Sensor based and Vision based. Among these devices, Wearable Sensor based devices are not effective in case of elder person because sometimes they might forget it to wear due to poor mental condition. In case of elders, Vision based devices are more effective compared to others as they captures pose of the person who are living alone in room using high resolution cameras. In our paper, we are going to use indoor area with high resolution camera which will capture the pose of the person to develop fall detection system.

Falls are one of the deliberate and fortuitously wounding among the elderly [1]. Almost 8% to 35% of people aged 65 and over fall each year, increasing up to 32-42% for those over 70 years of age. The fluctuation of collapse becomes more severe with age and deficit of strength amount. Senior people who are living alone at home fall quite often than those who are living in the territory. Roughly 30-50% of people living in long-term care facilities fall each year, and 40% of them encounter recurrent falls [2]. The estimation of injured admission due to falls for people aged 60 and older in Australia, Canada, and the United Kingdom (UK) ranges from 1.6 to 3.0 per 10,000 population. Fall injury rates consequent in emergency province visits of the same age group in Western Australia and the United Kingdom are greater: 5.5-8.9 per 10,000 population total [3]. An accidents they cause are major public health concerns that intermittently need medical attention. Falls are the cause of 20-30% of moderate to traumatic complications and 10-15% of emergency room visits. Over half of all injury-related hospital treatment is provided to those aged 65 and up. [2]. Hip fractures, traumatic brain injuries, and upper limb injuries are the most common root factors of fall-related hospitalization. [3]. The amount of people over 60 is expanding faster than every age category throughout the globe. In 2006, the number of people in this age group was expected to be 688 million, with an expected increase to over two billion by 2050[4]. For the first period in world history, the

number of elderly people will be substantially bigger than that of youngsters under the age of 14. Over and above that the eldest sector of the population, those aged 80 and up, is most vulnerable to falls [5].

For a number of decades, best effort has been taken for fall detection to improve the accuracy and lessen the fake alarm. On account of unbiased living, in absence of an automatic fall recognition system, the emergency providers cannot attain the destination immediately. This ends in excessive issues for a targeted group of the community. It could be very tough to make complete surroundings fall evidence because of negative overall performance and fake alarm. A fall may occur while person is walking, sitting, standing etc. A timely response of the fall is necessary to avoid serious injury. So there may be a need to broaden an automatic fall detection system that gives excessive overall performance and almost zero fake alarm rate.

Our main aim is to build vision based fall detection system by installing indoor cameras in house. Vision based models are also suffering from various limitations like occlusion, low illumination, motion blur, shadows, lighting condition in room. But it is more effective than other wearable devices as the person need not to wear any device on body parts. They not only identify the pose but also demonstrate the whole sequence of events due to which the fall has occur. We want to implement fall detection system which enhances performance in terms of accuracy and zero fake alarm by use of AlphaPose Pre-trained model. Here we are going to test our system with UR FALL and KFALL Dataset.

The rest of the paper is organized as follows: section 2 describes the related works, section 3 demonstrate proposed methodology , section 4 describes the Experiments and section 4 gives the Conclusion and Future Work.

RELATED WORKS

Machine Learning (ML) and Deep Learning have wide range of applications in today's world. In Deep Learning, nowadays Computer vision plays very important role when it comes to process video for different activities. The Convolutional Neural Network (CNN) as well as Long Short-term Memory (LSTM) are very popular when it comes to process Spatio-Temporal information.

In current decade, different deep learning architectures like CNN and LSTM have attracted major fields like image segmentation, machine translation, object recognition, activity recognition, natural language processing etc. which require various large dataset is very powerful algorithm to detect object in complex environment which is used by BO-HUA WANG [9] in paper. After detecting the object through YOLO, they have used Openpose to preprocess the target to find key points and position information of falling human. They designed dual channel sliding window to extract the dynamic features of the human body (centroid speed, upper limb velocity) and static features (human external ellipse). Experimental results shows that an accuracy of 97.33% and 96.91% is achieved when tested with UR Fall Detection Dataset to generate accurate output.

A study by Anitha Rani Inturi, V. M. Manikandan and Vignesh Garrapally [7] reveals that vision based approaches are more efficient than others and as a result they have used AlphaPose pre-trained model to find key points of fallen person and then after applied CNN architecture to analyse spatial information as well as used LSTM architecture to analyze ling term dependencies. They have compared the achieved results with Openpose framework and concluded that AlphaPose model is more precise in terms of accuracy than Openpose. Classification of indoor human fall events are performed by Arifa Sultana , Kaushik Deb , Pranab Kumar Dhar and Takeshi Koshiba [8] .They have proposed an architecture in which video frame generator is applied to extract features from different frames which is done by 2DCNN and then GRU is used to find the temporal dependency of human movement. Sigmoid classifier is used to identify the falls and obtained an accuracy of 99% which outperforms other state of the art models. The object detection model called YOLO and Le2i Fall Detection Dataset.

In paper [10] , the author has used an OpenPose model to identify skeleton information and identified the fall through three critical parameters such as speed of descent at the center of the hip joint, the human body centerline angle with the ground, and width-to-height ratio of the human body external rectangular and achieved a 97% success rate in fall activity. The author in [11] has used lightweight subgraph-based deep learning method to alleviate the problems such as complicated design, slow detection speed, and lack of timeliness. The key points of human body are extracted by Openpose and multi-scale temporal convolution module is also designed to extract and fuse multi-scale temporal features, which enriches the feature representation. They have tested the results with UPFALL and URFALL dataset and implemented lightweight and accurate method for real time application. In [12], the author has applied multi-person 2D pose estimation technique based on Openpose and retrieved 25 joint points locations of the human body and detects human movement through detecting the joint point location changes. They performed experiments with RNN, LSTM and GRU to learn the changes in human joint points in continuous time. The results shows that the fall detection accuracy of the proposed model is 98.2%, which

outperforms the baseline 88.9% with 9.3% improvement. Mohammadamin Salimi [13] reveals that image based solution are good compared to body worn solution .As a result, They have proposed a fast fall estimation method which uses Time-Distributed Convolutional Long Short-Term Memory (TD-CNN-LSTM) and 1-Dimentional Convolutional Neural Network (1D-CNN) models, to classify the data extracted from image frames, and achieved high accuracies: 98 and 97% for the 1D-CNN and TD-CNN-LSTM models, respectively. In [14], the authors have developed fall detection algorithm for seafarer using Blazepose to extracts the human body key point information. To detect the fall, they have applied LSTM and found behavior from URFall public data set and FDD public data set with an accuracy of 100% and 98% respectively.

The author in paper [15] have developed fall system based on video stream analysis which uses pre trained tensorflow light CNN based Posenet model to detect key points of subject. The model has extracted 17 joint points of human body through posenet and then used RNN based LSTM model to detect the fall of a person. They have developed dataset which is a combination of multiple cameras fall dataset and UR Fall Detection with total of 834 videos of fall and non-fall and achieved an accuracy of 91%. The authors in [16] have developed a system based on Lightweight Openpose and Spatial-Temporal Graph Convolution Network (ST-GCN) to solve the safety problems of targeted community. Human Skeleton information is extracted through Openpose and Spatio-temporal features are extracted through ST-GCN which will be used for fall detection. The alarm email will be sent to the owner or guardian, to provide a safer guarantee for the family member.

PROPOSED METHODOLOGY

Proposed Architecture

The activity of person is recorded through indoor camera and then after the frames are passed to Alphapose pre-trained network to find skeleton information. After finding key features, an array consisting of key points are passed to custom bi-LSTM model for finding long term dependencies among frames. Then after the information will be passed to dense layer and through softmax function we will identify the fall. We are going to use Resnet50 based AlphaPose network.

Alphapose network is earlier trained on COCO dataset and mainly used for multi person pose estimation in computer vision field. It consist of three components: Symmetric Spatial Transformer Network (SSTN), Parametric Pose Non-Maximum-Suppression (NMS), and Pose-Guided Proposals Generator (PGPG). In case of human pose estimation, it includes two types of algorithms. First is two step framework and second is part based framework. In two step framework, it first detects human bounding boxes and then estimate the pose with each box independently and accuracy is mainly depend upon the quality of bounding boxes. The part-based framework first detects body parts independently and then assembles the detected body parts to form multiple human poses [23].

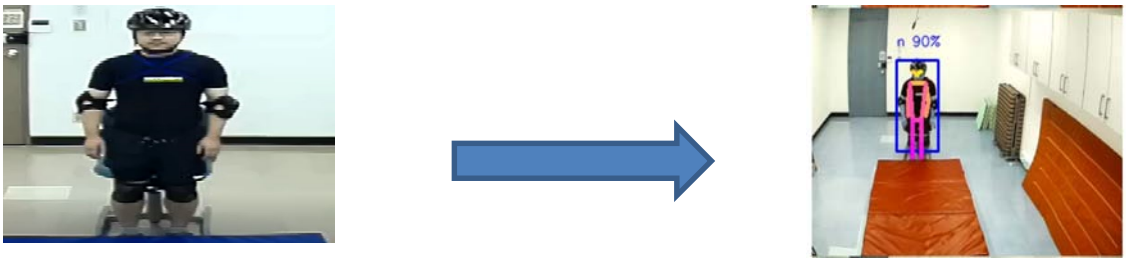

Figure 1: Key point after applying AlphaPose

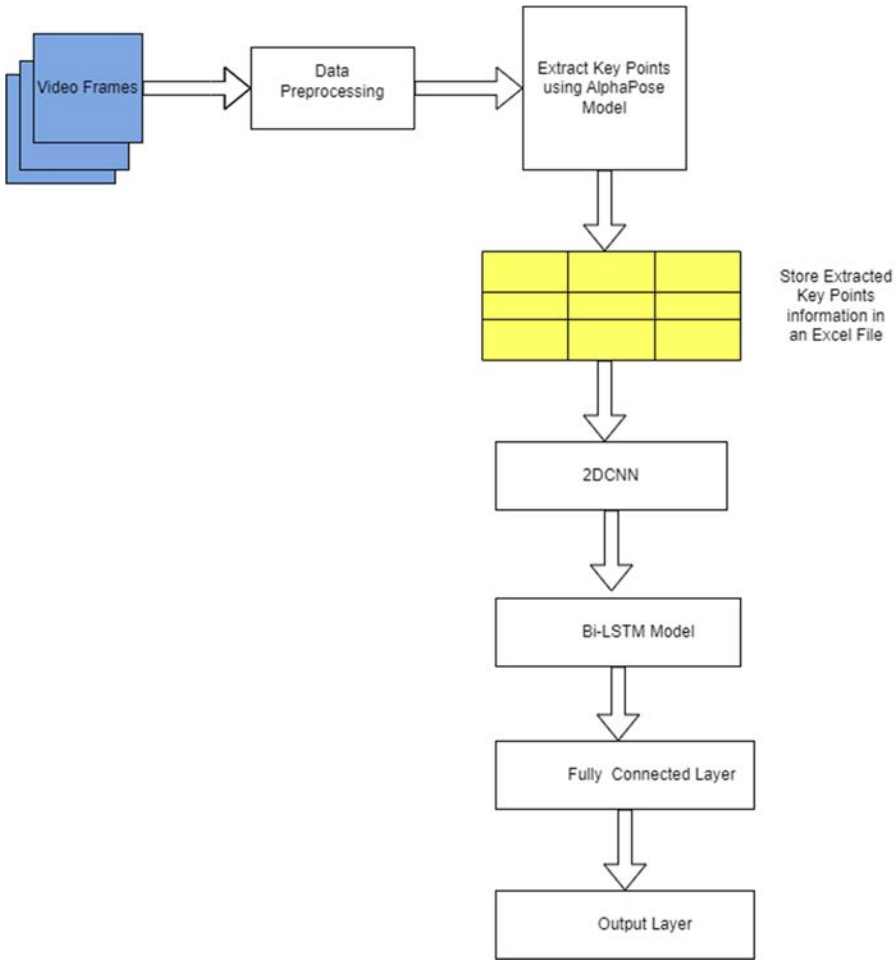

Figure 2: Proposed workflow of fall detection

Convolutional Neural Network (CNN)

CNN stands for "Convolutional neural network," which is a deep and feed-forward artificial neural network structure that is often used to evaluate images. [20]. The 2 dimensional features of CNN can effectively recognize the object. To find features of moving object, we need to extract spatial features of person which is possible with the use of 2DCNN model. Multiple filters are used at each convolutional layer to extract different types of features. The CNN has shown good performance in various classification problems such as image classification [19]. Here, the CNN model is built with sequential model. We are using 2DCNN variant of CNN which contains 2 convolutional layers followed by 1 Max Pooling layer and 2 dense layer. We have also added batch normalization between two convolution layers to normalize the data due to change of mean and variance during training time.

Bi-directional Long Short Term Memory Network (Bi-LSTM)

To classify the fall event, we need to process temporal features of targeted subject. The Recurrent neural network can process temporal features by remembering necessary information from the past. But the RNN network suffers from vanishing and exploding gradient problems which makes our system inaccurate. In our system, we have used Bi-LSTM [15] network to solve the problems caused due to use of RNN by taking care of sequencing of frame form both directions. Also compared to LSTM and GRU, it will learn from both side and

give great insight of frames data in case of fall detection event. Stacking two LSTM layers of opposite directions together in our network serves as the point of departure for the use of the bidirectional temporal structures of feature vector sequences. In contrast to the outputs of standard single-layer LSTM at time t, the combined outputs of Bi-LSTM layers are decided by not only the cues from previous vectors but also cues from upcoming vectors. Therefore, by integrating the extra information from future data, Bi-LSTM networks are capable of generating higher-level global context relationships of sequential data from videos [16].

Figure depicts the architecture of Bi-LSTM network. The forward channel output $\overrightarrow{ht}$, the backward channel output $\overleftarrow{ht}$, and the output of the whole cell y_t of the Bi-LSTM cell are listed as follows

$$\overrightarrow{ht} = \tanh(W_{x\overrightarrow{h}} X_t + W_{\overrightarrow{h}\overrightarrow{h}} \overrightarrow{h}_{t+} + b_{\overrightarrow{h}}) \quad [1]$$

$$\overleftarrow{ht} = \tanh(W_{x\overleftarrow{h}} X_t + W_{\overleftarrow{h}\overleftarrow{h}} \overleftarrow{h}_t + b_{\overleftarrow{h}}) \quad [2]$$

$$Y_t = W_{\overleftarrow{H}} y \overrightarrow{ht} + W_{\overleftarrow{h}} y \overleftarrow{h_t} + b_y \quad [3]$$

where the forward ($\rightarrow$) and backward ($\leftarrow$) arrows denote the parameters of the forward and backward Uni-LSTM cell. $Wx\overrightarrow{h}$ represents the weight matrix of the Uni-LSTM cell to the input, $W_{\overrightarrow{h}}\overrightarrow{h}$ symbolizes the weight matrix of the current Uni-LSTM cell to the next cell, $W\overleftarrow{h}y$ represents the weight matrix of the Uni-LSTM cell output to the Bi-LSTM cell, and tanh signifies the hyperbolic tangent activation function. In the end, the output y_t of the Bi-LSTM unit realizes the extraction of bidirectional information by fusing the output of Uni-LSTM in two directions [16].

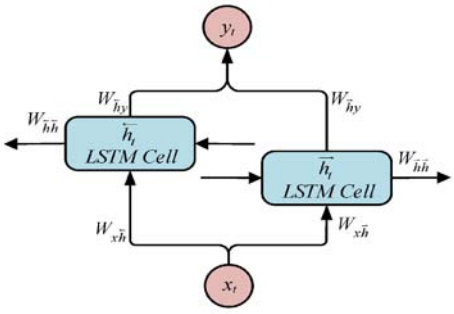

Figure 3: Bi-LSTM Architecture

In our system, we are using Custom 2DCNN+ Bi-LSTM model with learning rate of 0.001. For 2DCNN, we have used Adam Optimizer and binary cross entropy loss function. For Bi-LSTM, we have used Rmsprop Optimizer and binary cross entropy loss function. We have used RELU activation function for 2DCNN and sigmoid function for Bi-LSTM. We run the system for 100 epochs with batch size of 16. We have used filter size of 3x3 for 2DCNN.

Table 1: Parameters used in the implementation of 2DCNN+Bi-LSTM for fall detection system

Layer	Output Shape	No. of Parameters
conv2d_4 (conv2d)	(None, 3, 21, 64)	640
batch_normalization_4 (Batch)	(None, 3 ,21, 64)	12
conv2d_5 (conv2d)	(None, 3, 21, 64)	36928
batch_normalization_5(Batch)	(None, 3, 21, 64)	12
max_pooling2d_2(Maxpooling2)	(None, 1, 10, 64)	0
flatten_2 (Flatten)	(None, 640)	0
dense_7 (Dense)	(None, 512)	328192
bi-lstm_4 (LSTM)	(None, 1, 16)	33856

dense_6 (Dense)	(None, 1)	17

Total No. of Parameters: 399657, Total No. of trainable parameters: 399645, Total no. of non-trainable parameters: 12

The size of one filter is (3, 3), so the parameters are 9 and bias is 1 for each filter. So the total number of parameters for filter kernel of size (3, 3) is 9+1=10. The total number of filters are 64 in first convolutional layer which leads to total number of parameters are 10*64=640. The Number of parameter in batch normalization is 4*3=12. For second convolution layer, it will be (3*3*64+1)*64=36928 total parameters. The parameters in second batch normalization is same as previous according to equation 4*last axis value. In max pooling layer, there is no activation applied. So parameters will be 0. For dense layer, total number of parameters are 512*(640+1) = 328192. After applying, Bi-LSTM, we get 33856 parameters which are fed into the dense layer for output and the dense layer will generate total 17 parameters.

EXPERIMENTS

Dataset Description

We have conducted this experiment on the UR fall detection dataset and Kfall dataset in which 70% data are used for training and 30% used for testing.

UR Fall Detection Dataset: UR fall detection dataset [17] is one of the most benchmark datasets which comprises 70 indoor videos among which 30 fall events and 40 daily living activities. This dataset contains two different signals, namely depth maps from Kinect camera and tri-axial data from ADXL345 accelerometer. Here, fall activities are recorded using two Kinect cameras whereas daily living activities are recorded using only one camera. In this dataset, there are 30 frames per video. Each video possesses a resolution of 640 × 240.

Kfall Dataset [18]: It was acquired by 32 young subjects with 21 types of activities of daily living (ADLs) and 15 types of falls from an inertial sensor attached on low back. In total, it contains 5075 motion files with 2729 ADL motions and 2346 fall motions.

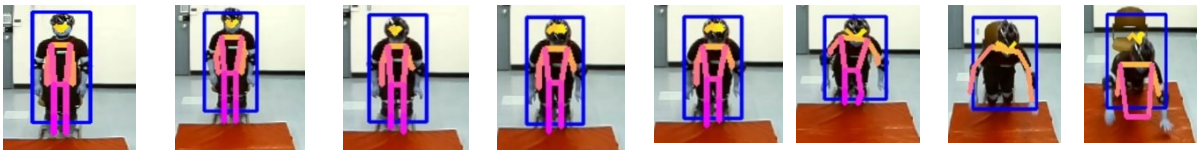

Figure 4: Falling process of person from start to end

Table 2: Accuracy with respect to no. of Epochs

No. of Epochs	Accuracy
20	97.6 %
40	97.9 %
60	98.1 %
80	98.6 %
100	99.08 %

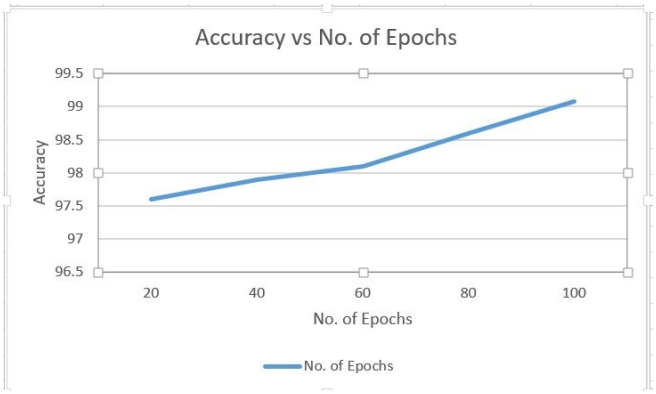

Figure 5: Graph of Accuracy with respect to No. of Epochs

Table 3: Fall detection results comparison between our proposed system and other implemented system for UR Fall Dataset [17]

Method	Accuracy (%)	Precision (%)	Sensitivity (%)	Specificity (%)	F_Score (%)
Proposed Method	99.08	99.86%	99.04 %	99.27 %	99.45 %
Alphapose [5]	98.59 %	91.08 %	94.37 %	98.96%	92.47%
Openpose [8]	98.2%	---	98.3%	95%	---

Table 4: Fall detection results comparison between our proposed system and other implemented system for KFALL Dataset [18]

Method	Accuracy (%)	Precision (%)	Sensitivity (%)	Specificity (%)	F_Score (%)
Proposed Method	98.85 %	92.5 %	95 %	98.80 %	93 %

Till date no any experiment has been done using different pose estimation Technique on KFALL dataset.

CONCLUSION AND FUTURE WORK

This paper proposes a fall detection framework using Alpha Pose Pre-trained network to filter the human skeleton information from video data and 2DCNN+Bi-LSTM architecture to detect fall based on skeleton data. The Bi-LSTM network is used here to identify long term dependencies between different frames in video which has boosted the overall performance of proposed system compared to existing. The vision based approach which we have adopted will give full scene understanding of running subject and will spike the performance in complex environment also. We are still facing the major difficulty in occlusion which will be our aim to overcome in future work.

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Solar, Wind and battery storage Energy Management and control for Electric car charging load

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Abstract. The Indian Ministry of Power has announced new guidelines and standards for electric car charging infrastructure to speed up the adoption of electric vehicles in India and make charging infrastructure safe, accessible, and affordable. Grid-powered charging infrastructure isn't enough to meet design objectives. The solution is to produce renewable energy, store it in a battery, and manage it with the grid. This research paper presents a solar, wind, battery energy storage, and grid-powered electric vehicle charging station. Many researchers have concentrated on EV charging station power management, but few have investigated the management and control strategy of RES with limited grid capacity. This project intends to build a better power management approach for RES, grid congestion, and ESU capacity limits, including an optimization algorithm. This study paper uses six-hour data sets of sun radiation, temperature, and wind speed to analyse a proposed system. A research paper's suggested strategy is implemented in MATLAB. The simulation results show that the proposed energy management system meets load needs even when there is intermittent RES power, limited grid capacity, and charging and discharging constraints on energy storage unit.

Keywords: Management and control of RES, PV and wind base EVCS, power management of EVCS, RES energy management

INTRODUCTION

Some researchers address the intermittent nature of renewable energy based EV charging station energy management under the dynamic load due to invariant charging of electrical vehicles and the intermittent nature of RES. A game with mixed strategies is built in a decentralised system [1] with the goal of reducing additional cost or penalties and mitigating the intermittent nature of the RESs. Incentive-based demand response systems were used in [2] to achieve the goal of lowering the cost of operating a microgrid with large-scale electric vehicles and renewable energy supplies. A genetic algorithm was used in order to achieve these aims. The goal of using stochastic dynamic programming (SDP) with a game-theoretic approach was to reduce the daily running cost of a microgrid and the net charging cost of individual EVs [3]. A rule-based energy management scheme was proposed in [4], in which an if-then rule was constructed for uninterrupted charging of electric vehicles by considering six modes of energy flow. The integration of various renewable sources such as wind, tidal, and biomass with PV is the best suitable approach for the effectiveness of the suggested system. In order to reduce billing charges, a power forecasting model was created to forecast EV power requirements. A hybrid HGAFMINCON algorithm was developed to minimise daily operating costs for residential load, grid, PV, wind, and battery energy storage system energy management [5]. A decision was used to illustrate energy cooperation among renewable energy sources and grid-based microgrids in [6]. The Lyapunov optimization was used to minimise the generation cost from renewable sources against the changing SOC of the PHEV. The cost-cutting method of EV charging The proposed method can save you up to 50.5 percent on your charging costs. [7]. A stochastic model was created in [8] for the optimal power sharing in PV-Wind-ESU and grid-powered EV charging stations based on the EV traffic profile, arrivals, and resource use pattern. This research formulates a stochastic optimization problem based on a queuing model to reduce the time average cost of non-renewable energy sources. In order to save money for charging infrastructure owners as well as distribution grids, a A mixed-integer linear model is built to frame the problem based on the energy management assignment criteria for EVCS [9] . The cost analysis of the proposed design was given for each season. When variable EV demands

were dispersed among renewable energy sources, the whale optimization method was employed in [10] to minimise grid operation costs. The goal of minimising the sizing of components of the solar wind hybrid model is addressed in [11] by applying ABC and PSO optimization approaches to include the least levelized cost of electricity (LCOE) and loss of power supply probability (LPSP). The charging algorithm[12] was designed with the goal of maximising charging station earnings by decreasing grid power purchases and selling power to the grid during periods of high solar availability. [13] focuses on lowering the cost of energy usage by optimising energy management using the GFO-VITG approach. To minimise the generation cost from renewable sources against the variable SOC of PHEV, a water cycle algorithm and a gravitational search algorithm were implemented in [14]. In [15], a cooperative decision-making technique was designed for the cost-effective operation of a virtual energy hub that incorporates PV-ESS and a grid-powered EV charging station, with active and reactive power flows scheduled using a novel three-stage algorithm. To address the issue of microgrid unbalance, as well as the intermittent nature of renewable energy, electricity pricing, and unpredictable EV demand, the researchers [16] devised a stochastic multi-objective optimization model. The epsilon-constraint method and fuzzy techniques were used to solve the problem. A two-stage game theory-based strategy was designed to address the problem of EV power allocation and charging [17]. The Lyapunov optimization was deployed for the cost reduction approach of EV charging. The proposed algorithm reduces the charging cost by up to 50.5% [18]. A renewable energy management strategy based on machine learning to reduce EV charging costs while increasing profit for charging station owners [19]. In [20], the load sharing between PV, BESS, and the grid was handled by employing the droop regulation method to limit RES penetration. A master-slave game model was designed to handle the problem of guaranteed consumption and loyal operation of renewable energy for EV charging by taking into account the charging behaviour features of EVs and the output characteristics of REGs [21]. The presented study [22] concentrated on tackling the issue of carbon emissions caused by EV dynamic charging during periods of high grid power demand. Using an optimization technique for the best use of renewable energy, carbon emissions were reduced by 63.7 percent. The researchers [23] reduced operational costs by using an energy management system based on demand response in a distribution network made up of many microgrids, where the loads were taken into consideration both electrically and thermally. Two control algorithms, SPLET and SAA SPLET, are presented in [24] in order to lower the operating costs of the office building. The suggested algorithms handle the supply and demand uncertainty, EV arrival time, EV departure time, and EV arrival SOC. The Lyapunov optimization method was used to reduce the cost of charging and the average delay time for finishing EV charging [25]. To reduce system operating costs, represent [26], a DC link voltage sensing-based control approach for energy flow modes in PV, ESU, and grid-based EV charging. The [27] employed the technique to reduce grid stress caused by quick charging in PV, BESS, and grid-tied systems. To meet all of the EV power demands, the proposed solution is put into action by analysing EV load profiles and selecting sources accordingly. The time-of-use adjustment strategy has been shown to lower the cost of PV-ESU connected electric vehicle charging. The LP optimization [28] was used to execute the simulation. A rule-based expert system was developed for energy scheduling of system resources. Using the ABC technique, the purpose of the suggested problem was achieved. A finite-horizon Markov decision process model was given to lower the cost of charging electric automobiles in [29]. In [30], a Crowd Search Algorithm (CSA) with PSO optimization was used to lower the operating costs of RES, BESS, and grid-based EVCS, increase profits, and reduce the amount of energy needed from the grid. The droop regulation approach was used to transfer load effectively among many sources. The charging and discharging power from the ESS, as well as the electricity drawn from the grid, are optimised in PV Integrated EV Charging Stations [31] according to price band allocation. The overall energy cost of a RES-ESS-Grid-tied PHEV charging station was reduced using an algorithm established in [32]. In [33], a Backtracking Search Optimization (BSO) method was created to lower the system cost during high penetration of EV load on WT, PV, FC, and MT-powered EVCS.

From the cited studies above, it is evident that the majority of researchers are preoccupied with the energy management of EV charging stations in parking lots with PV systems, with the result that the energy storage unit (ESU) is not adequately evaluated. In contrast to previous research, a newly developed energy management technique and an energy storage unit (ESU) are proposed to maximise the contribution of renewable energy to charging electric vehicles while keeping in mind the limited capacity of the grid.

PRAPOSED SYSTEM MODEL

The EV charging station has four charging points and is powered by solar, wind turbine energy, energy storage, and the grid. The microgrid operates at 600 volts dc. The PI Controller is used to control the charging at a predefined level. The DC/DC unidirectional converter is used to deliver power to the DC bus from the solar PV system. The MPPT boost converter is used to boost voltage as per DC bus voltage. The SEPIC Converter is used on the wind power generation side. The bi-directional DC/DC converter is used on the ESU side to draw and deliver energy by charge and discharge, respectively. The two-way AC/DC converter connects to RES to send extra power to the grid and draw power from the grid when there isn't enough power from RES to power EVs.

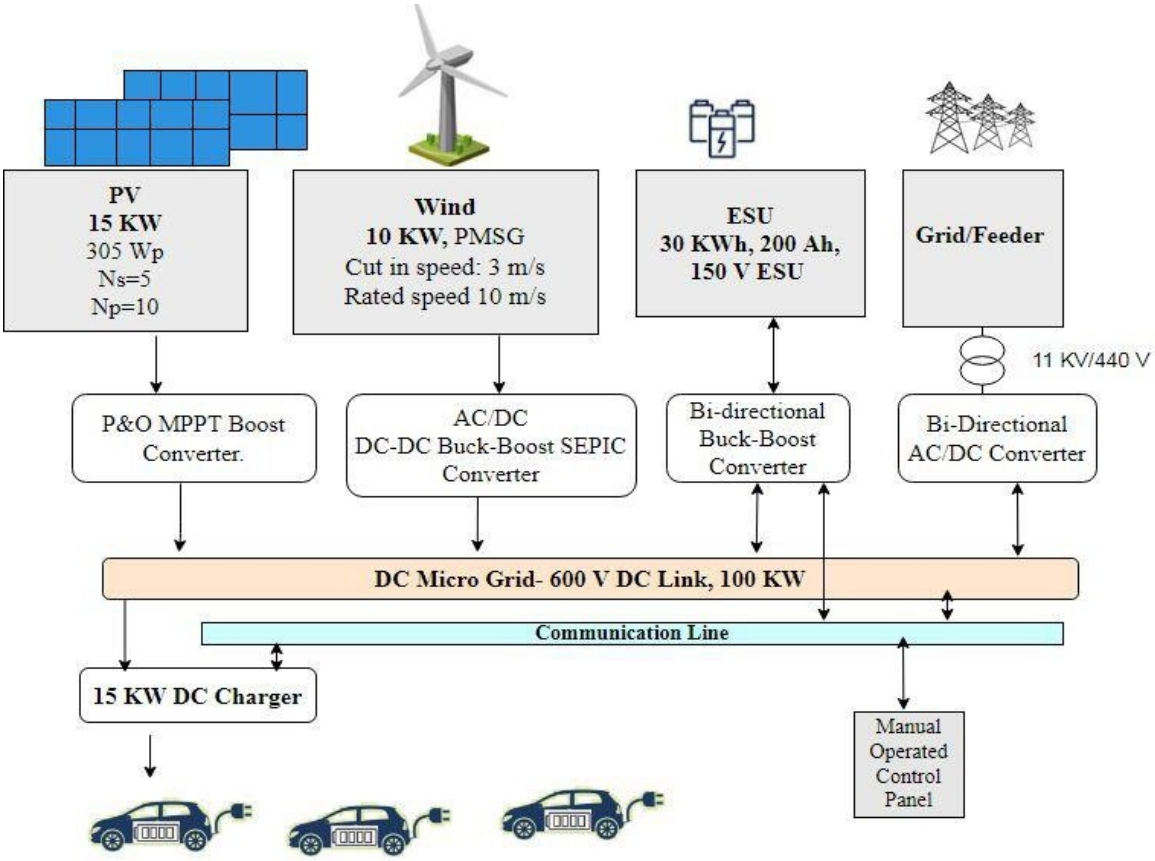

FIGURE 1. Proposed system model

PV System Power

The power generated from a solar PV array depends on site irradiation and temperature. In this work, irradiation and temperature data were taken from [34]. A unidirectional DC-DC converter is connected between the PV array and the DC link. The P & O Algorithm is considered for extracting maximum power from the PV.

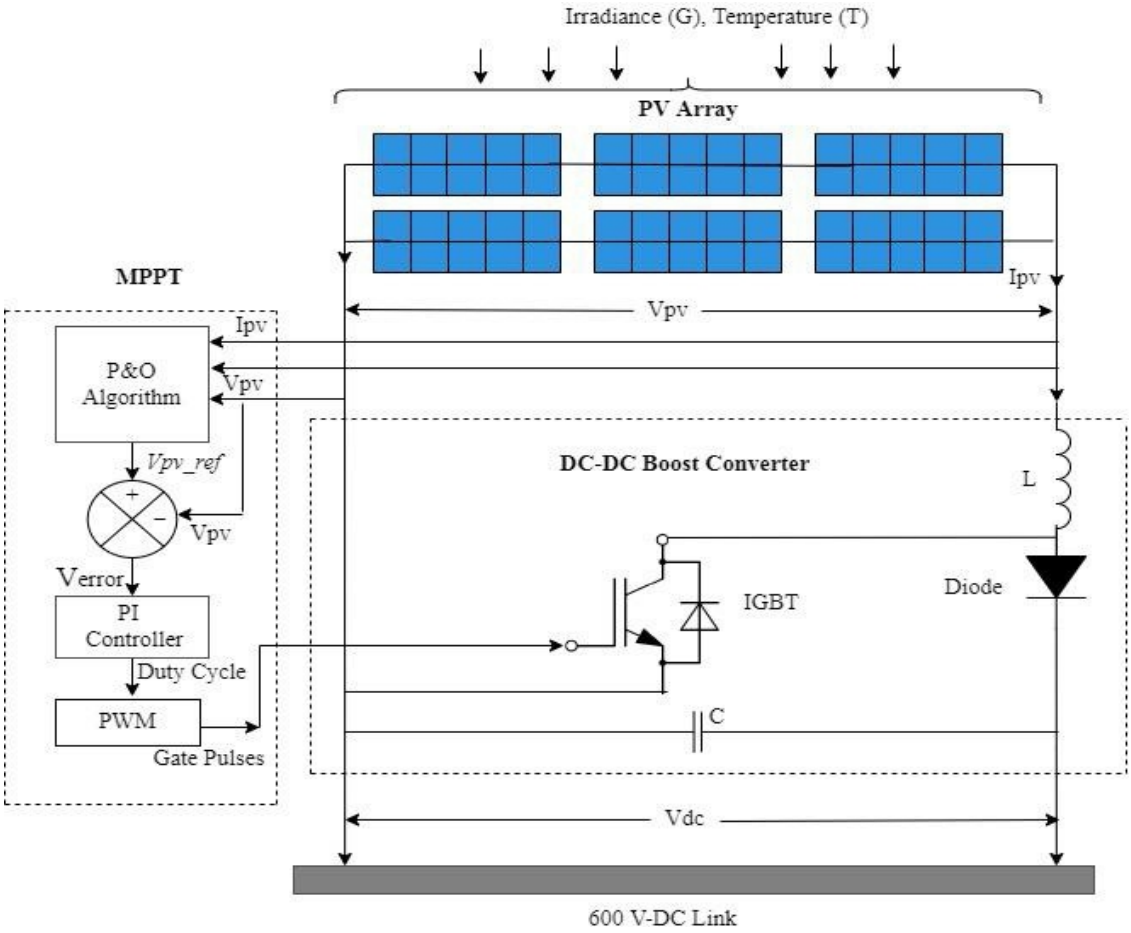

FIGURE 2. Solar PV system with MPPT and boost converter

Considered PV module rating: 300 Wp No. of modules in parallel: 10
No. of modules in series: 5 Voc: 37.3 V
Total instantaneous generated PV array output power

$$P_P = P_P \times N_P \quad (1)$$

Where Npv is total modules in the PV array

Wind Energy

The power generated from the wind turbines depends on wind speed at a given location; the force of the wind turns the turbine rotor blades, which are coupled to the turbine shaft to produce electricity. In this paper, the wind speed in m/s data was taken from the NASA Prediction of Worldwide Energy Resources at 10 Meters Hub Height [35].

Eq. (2) depicts a wind turbines power production based on wind speed [36].

$$P_w = \begin{cases} 0 & \nu \le \nu_c \; o \;\; \nu \ge \nu_a \\ P_r * \dfrac{\nu^k - \nu_c^k}{\nu_r^k - \nu_c^k} & \nu \;\; \le \nu \le \nu_r \\ P_r & \nu_r \le \nu \le \nu_a \end{cases} \quad (2)$$

In this equation, P_r represents rated electrical power; v_c stands cut-in wind speed; v_r for rated wind speed; and v_O is cut-out wind speed.

Energy Storage Unit

The lithium ion batteries considered for energy storage units are equipped with a bi-directional DC-DC converter and operate in buck or boost modes depending on operational mode. The ESU charges at constant current first, then converts to constant voltage when SOC reaches more than 70 percent.

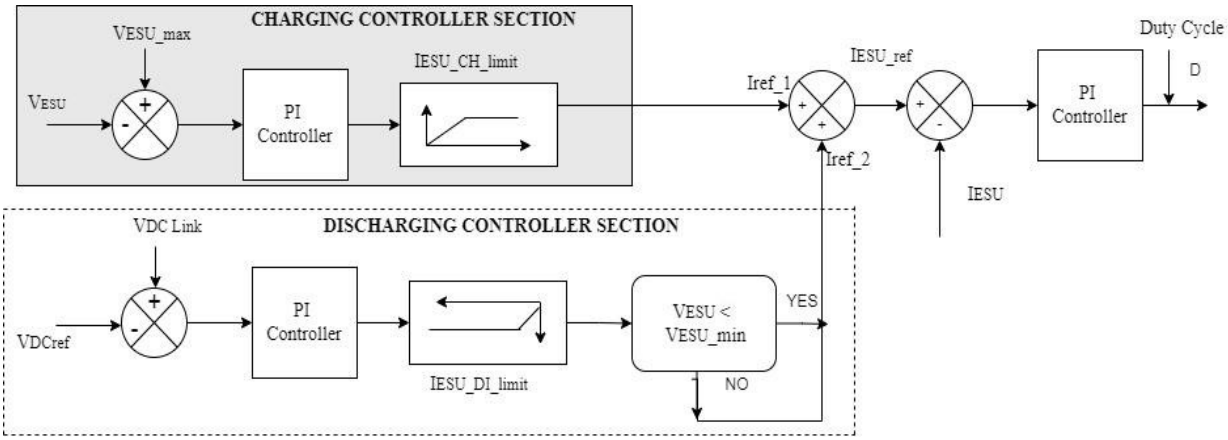

FIGURE 3. Control Diagram of energy storage unit

The PI control approach is used to govern the bidirectional converter to manage the difference in reference value and real value of current, and then a PWM method is used to convey the computed buck and boost switching pulses. One of the key goals of the newly developed EMS is to keep the DC link steady while keeping the SOC within safe levels [37]

Feeder/Grid

The grid capacity is assumed to be limited due to local ac load. However, when surplus renewable energy is exported to it, the bidirectional ac/dc converter operates in inverter mode, while when power is received from the grid; the converter on the grid side operates in rectifier mode. The EMS established an efficient power flow by allowing two-way communication between the EV charging requirements and the charging station owner. The dynamic charging of electric vehicles at charging stations creates high energy demand for the station, especially during peak hours. The proposed optimization algorithm ensures that issue, and it is considered a major contribution of work.

EV load

For evaluating EV load demand, the criteria such as rated battery capacity (KWh), EV charger capacity, and initial and required SOC are considered. In this paper, a total of three EVs for charging are considered. The initial and required SOC are assumed. The individual EV load and charging time calculations are adopted from [38].

$$EV_i load = \left(SOC_R - SOC_L\right) \times EV_{i_B} \quad (3)$$

TABLE 1. EV Load Assessment

EV Car Model	EV Rated battery Capacity (KWh)	EV Initial SOC (%)	Req. SOC (%)	Real Time Max EV Load (KW)
Mahindra e-Varito (C2,C4,C6)	13.91	15	68	7.3723
Mahindra e2o	11	25	72	5.17
TATA XPRES-T	21.5	20	55	7.525

METHODOLOGY

The proposed energy management strategy is designed in such a way that it quickly adjusts to energy needs when peak load demand emerges at the charging station. This is accomplished by monitoring real-time data from the manually operated control panel. The SOC of the EV and ESU batteries is also factored into the optimization process, which uses formulas to determine the most efficient energy flow for a planned EV charging event.

Eq. 4 shows the required charging power for the i^{th} EV:

$$P_E = \sum_{i=1}^{n} P_{E\ il} \quad (4)$$

When the i^{th} EV is connected, the newly developed energy management scheme gathers data from the manual operated control panel. The situation in which renewable energy sources are inadequate to meet the power demands of electrical vehicles results in a shortage of power given by energy storage units.

Eq. 5 gives an estimate of the power of ESU to make sure that the energy stored is sufficient to keep the required power.

$$P_E = \frac{(S_E - S_E) \times E_B}{\sum_{i=1}^{n} E_C} \quad (5)$$

Where S_{ESUi} is instantaneous SOC of ESU, $S_{ESU\text{-}m}$ stands maximum rate of SOC and ESU_{BC} is the ESU battery capacity. As per the EV charging requirement data inserted in the control panel, the power converter switches operated to meet the required energy needs. The grid, on the other hand, is controlled by converter switches, namely, GRon for grid to charging station and GIon for charging station surplus power to the grid. Additionally, the energy storage units are equipped with a proposed EMS that will disconnect them when they are fully charged. Typically, the ESUon switch is controlled by an expanded SOC margin. The charging status of an electric vehicle is referred to as an EVOni switch [39]. The EMS is always getting new information about how much power connected EVs need, which lets renewable energy sources take priority over ESU and the grid.

Operating Modes Algorithm

The power flow algorithm is presented here.

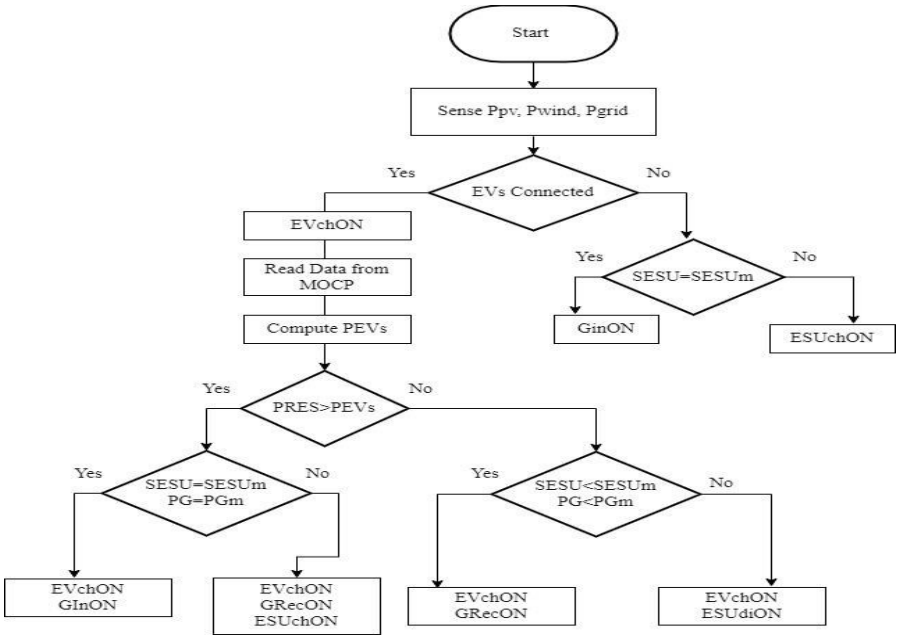

FIGURE 4. Power Management Flow Chart

TABLE 2. Energy Flow Modes

Mode No.	Mode Name	Conditions	EV Load Demand	Load Conditions
1	RE TO Grid	PRE > 0 SESU = SESUmax.	0	No load

2	RE TO ESU	Ppv > 0 SESU < SESUmax.	0	No load
3	RE TO EVC & REsurp TO Grid	PRES > EV Load SESU = SESUmax.	< PRE	Under Load
4	RE TO EVC & Grid TO EVCdef	PRES < EV Load SESU = SESUmax. PG < PGpeak	> PRE	Over load
5	RE TO EVC & Grid TO ESU (Valley Filling)	PRES > EV Load SESU < SESUmax. PG <Pgpeak (Grid off peak)	> PRE	Over load
6	RE TO EVC & ESU TO EVCdef	PRES < EV Load but PRES + PESU > EV Load SESU = SESUmax. PG = Pgpeak (Grid at peak)	< PRE+PESU	Under Load

SIMULATION AND RESULT DISCUSSION

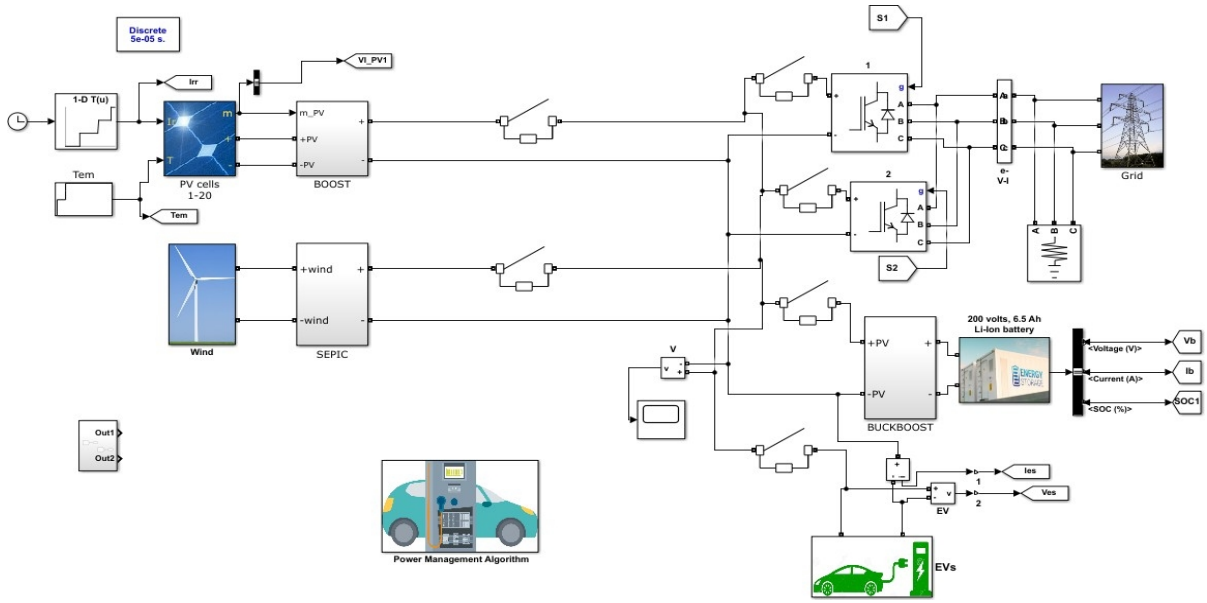

FIGURE 5. Solar/Wind/ESU/EV Simulink

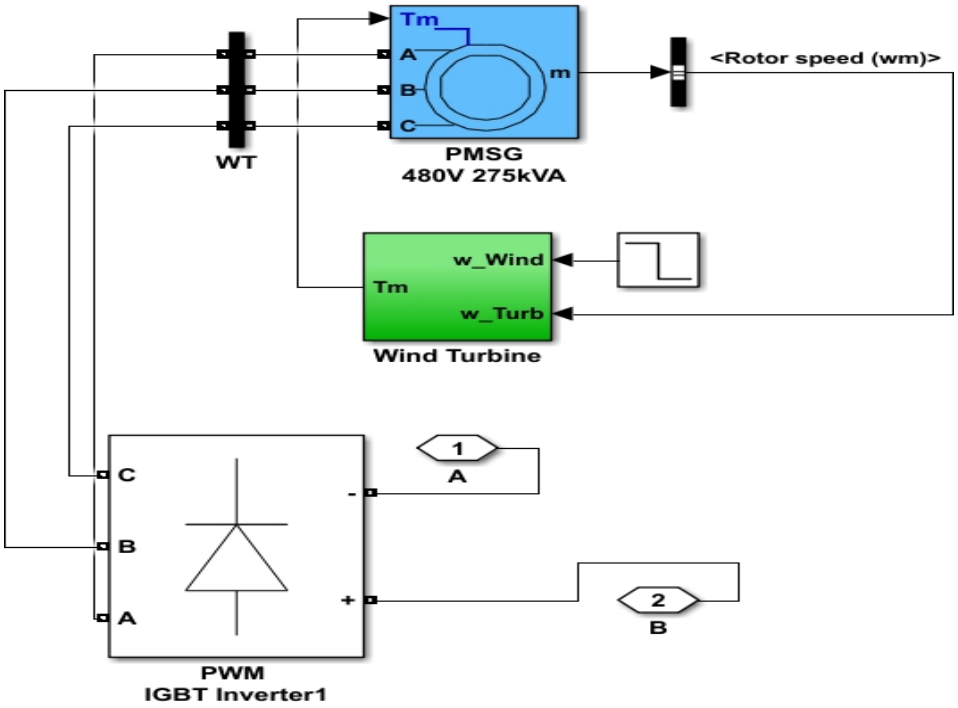

FIGURE 6. Wind PMSG Systems

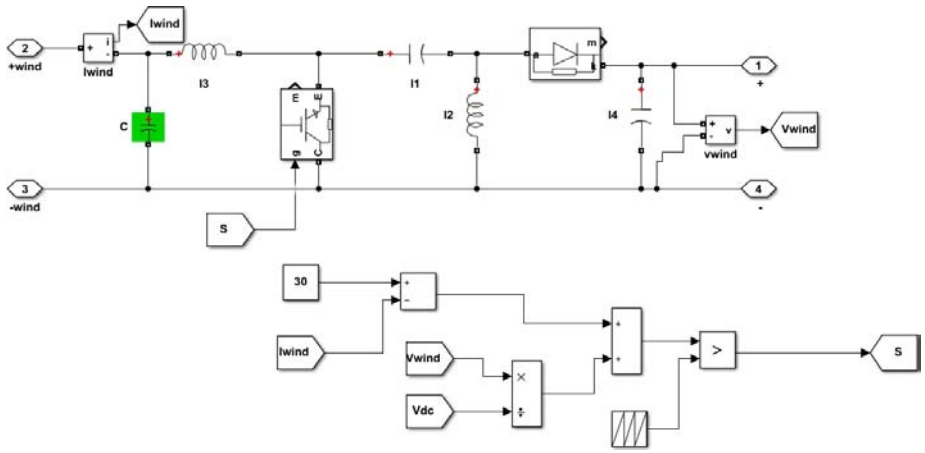

FIGURE 7. Solar/Wind/ESU/EV Simulink Wind-SEPIC Converters Internal Block

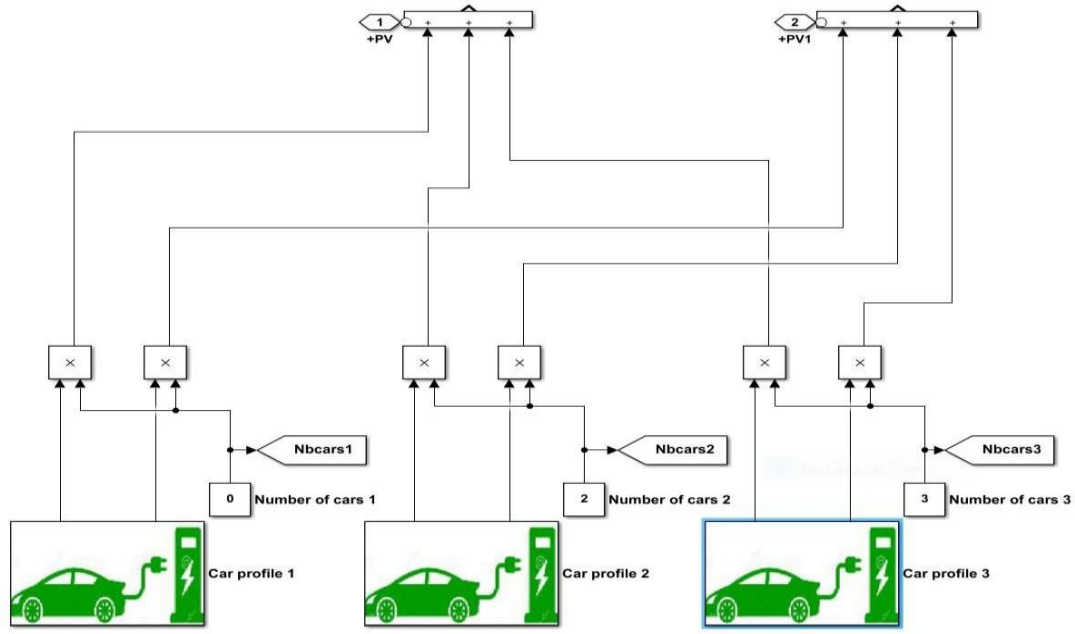

Fig.8. EV Charging Block

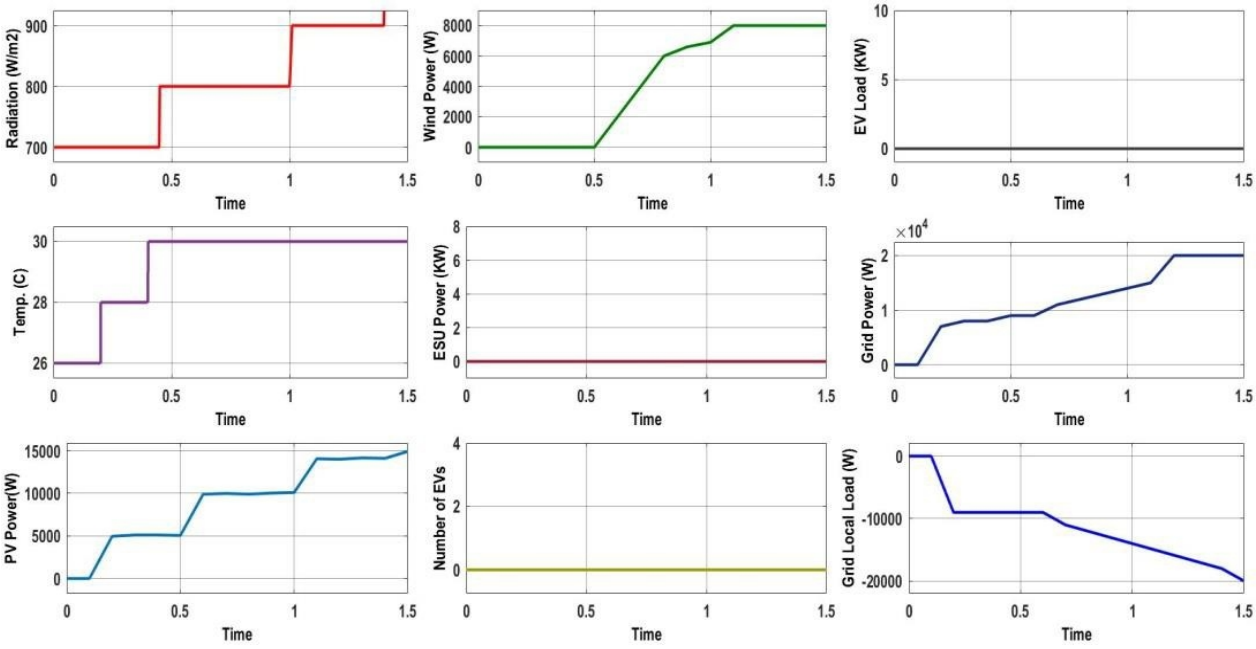

FIGURE 8. Mode-1 Simulation Results

RE TO Grid, PRES >0, SESU = $SESU_m$

In six hours of operation of the power management scheme, at the initial one-and-a-half-hour phase, it is assumed that there are no EVs at the charging station. Therefore, it is easy to get economic benefits, and total RES power (PV and wind) is exported into the grid. One main important task of the proposed energy management scheme (EMS) is to ensure that exported power does not exceed the optimal capacity of the grid. The possibility of overloading the distribution transformer could be overcome too.

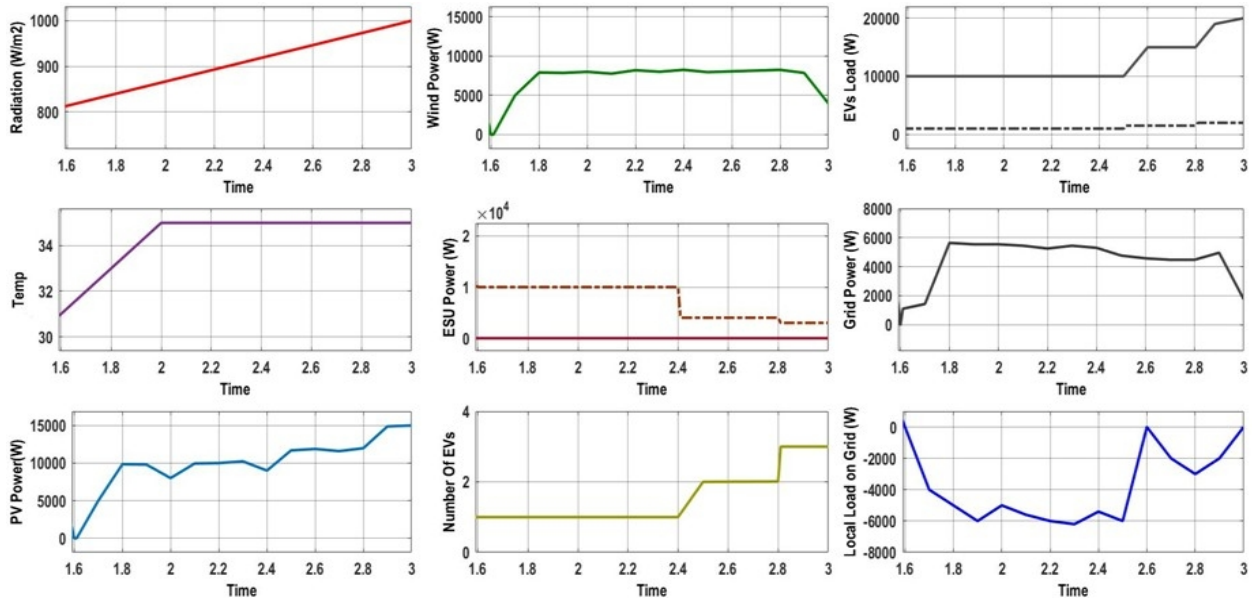

FIGURE 9. Simulation Mode-3 and Mode-6

Mode-3: RE TO EVC & RE_{surp} TO Grid, PRES > EV Load, SESU=$SESU_m$
In the further time phase, when RES power is more than EV load demand, the main thing designed at the time of surplus power injected into the grid is that injected power must not be more than grid maximum capacity.
Mode-6: RE TO EVC & ESU TO EVCdef, PRES <EV Load, SESU=SESUm
In the same phase, when RES power lacks EV load demand, this lack of power is taken from ESU. In that event, the controller ensures that the ESU has enough power to deliver it.

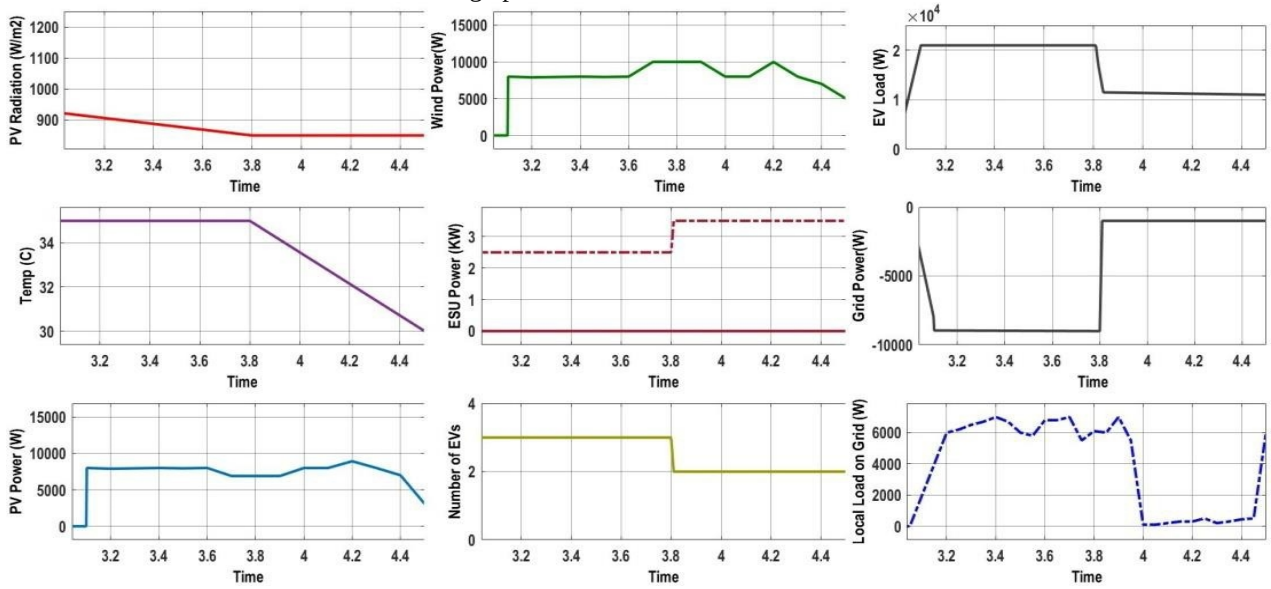

FIGURE 10. Simulation Result Mode-4 and Mode-5
Mode-4: RE TO EVC & Grid TO EV_{Cdef}
In this case grid at off –peak, Solar & Wind Power use to charge ESU Mode-5: RE TO EVC & Grid TO ESU (Valley Filling)
In this case, EVs charge from RES Power (max. 14 KW) delivered to charge EVs (20 KW), as the grid deficit for EVs is 7 kW and 2.5 KW for ESU charge at off peak.

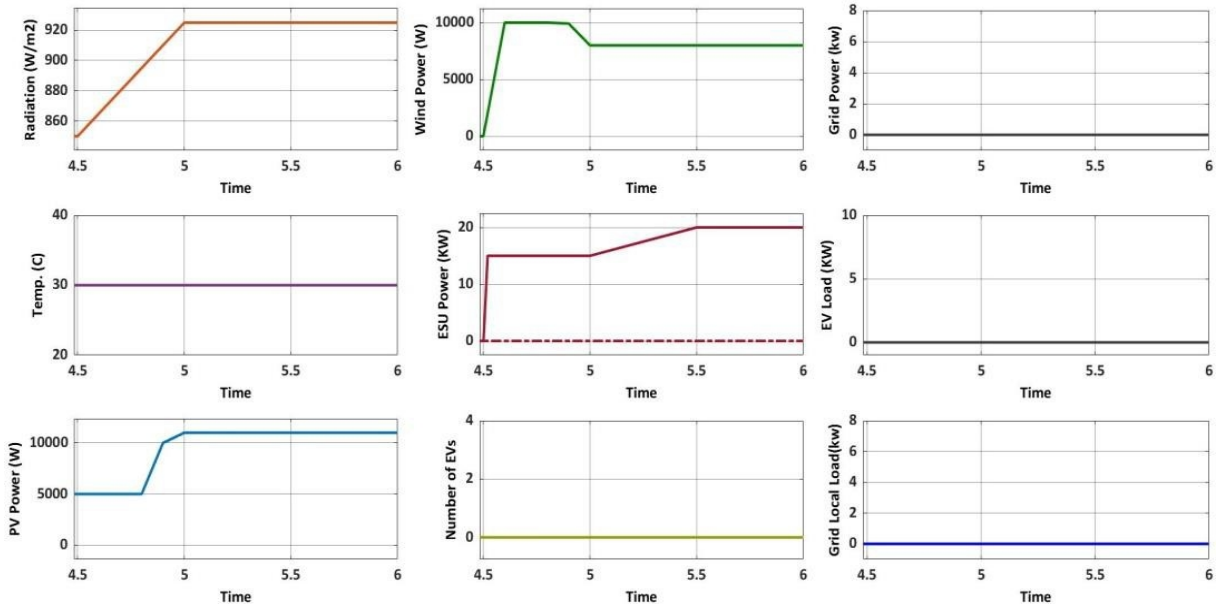

FIGURE 11. Simulation Results-Mode-2

Mode-2: Power Flow: RE TO ESU, Grid at Peak, No EV at CS, ESU < ESU_m

In second phase of six hour operation, in this mode, solar and wind power are used to charge the ESU. At t = 5 hours, the PV power go up to 12 KW, and the controller for the EMS lowers the wind power from its optimal level so that the ESU doesn't get over of its capacity.

CONCLUSION

Here, six modes of power flow have been proposed in the present research work.

- In mode 1, if there is no EV load and the ESU is at its highest level, the algorithm makes sure that RES power is added to the grid below the grid's maximum capacity so that the distribution transformer doesn't get overload.
- In mode 2, when there is no EV load and the ESU is at its highest level, the controller makes sure that the RES power delivered to charge the ESU doesn't go over its optimal capacity.
- In mode-3, the RES is more than the EVs' load. The proposed EMS design is in such a way that the surplus power of RES does not export more power than the instant grid capacity.
- In the event of high EV load in which RES is not enough to fulfill load demand, mode-6 results in the same graph as the dotted line, indicating the lack of load fulfilled by ESU.
- For economic and practical reasons, the proposed EMS is set to an EV load satisfied by RES and the grid in modes four and five. Also, the ESU charge by the grid power is called the "valley condition."

The proposed energy management and control scheme can be used for large scale systems.

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INTERNET OF THINGS (IOT) BASED WASTE DUMPING SYSTEM

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Abstract: Traditional physically managed provisioning is much higher in cost and effort than automated systems. Considering the facts, the hassle of a success waste control is one of the maximum essential troubles of our time., there is a most outrageous need to determine this issue. The system proposed in this paper is simply an improved solution with a superior intelligent waste level detection system, a higher-level design, which can immediately notify the officials of the status of the sorted city trash cans and monitor them in real time. It is time for remote control with Internet of Things (IoT). Imposing IoT improvements withinside the modern-day city waste control surroundings is critical and permits bi-directional conversation such as the rules conveyed withinside the town. Our Objective to achieve is a real-time monitoring system, a system that is centralized. That`s how, every the municipal and residents take advantage of an optimized Solution which ends up in primary financial monetary savings and plenty much less pollution that is metropolitan. A vital process of proper waste management is much needed for the sanitation society as an entire and the arena as an entire, also the automation of measures efficiently reduces the load on people.

Keywords: Internet of things (IoT), Smart waste level detection system, waste management, pollution

INTRODUCTION

The Internet of Things is nothing more than applications running over the Internet [1]. State-of-the-art technology that stores all your data in the cloud with fast real-time data access and intelligence [1]. Those with Internet access while data is stored in the cloud will provide unparalleled access to those involved in the same task from anywhere in the world. Detectors and routers used to collect and transmit data over the Internet have similar improvements. This area can be utilized in all place of ubiquitous computing and commercial organisation intelligence.

This paper acquaints you exactly how IoT may be utilized in these numerous locations, where clever rubbish detection the use of IoT may be a critical thing in changing cities into clever cities.

In concerning mortal wellbeing and the landscape from the implied perils of deferred garbage removal and natural contamination a completely directed and controlled running of these squanders is must. The sort of squanders which establish natural contamination and what this work highlights is its adaptation to household waste from degradable food waste, leaves, dead animals, and non-degradable bones, similar to plastics, holders, nylons, clinical waste and residential and commercial waste. The complexity of urban heavy waste management challenges necessitates the development and use of state-of-the-art devices capable of driving alternative mechanisms, numerical models and inputs for expert judgment in multi-standard decision scenarios [3]. Waste control is an ever-developing hassle in worldwide and non-preferred contexts. Solid waste arises from human and animal conditioning and is normally discarded as vain or unwanted. As accessories made from natural and inorganic waste, created by a lively public and lost value to the main masons.

Garbage bins are placed in public areas at specific places on site/road to collect municipal waste. The most crucial delicate challenge is the method of checking the rubbish can for rubbish collection. This is a common system that requires people to walk around and check the garbage collection point. This is a instead complex and time-consuming method**.** The waste that the current system represents is not as efficient as we would like it to be, given technological advances in the recent past. There is no guarantee of operation/disposal of garbage in all locations. To solve this problem, a new approach called IoT-based automatic waste disposal system has been proposed. Basically, it's a step that automatically makes garbage collection efficient. This is noticed via way of means of putting an ultrasonic detector at the bin on every occasion the bin is full, and it makes use of a Wi-Fi module to transmit it to the proper Garcon at a designated location in that area or location. The input signal indicates the status of the waste container in the monitoring and control system.

LITERATURE REVIEW

The idea of an intelligent waste detection system has been discussed for a long time [1]. The Internet of Things (IoT), the technology used to create this smart method, has also evolved. Each idea looks similar, but has a slightly different personality, and the work it proposes is no exception.

After the Internet of Things has settled into our lives, we plan to develop an intelligent scrap collection system that includes citizen participation and data analysis to make better timber decisions. The intelligent system is a waste container with ultrasonic detectors, microcontrollers and Wi-Fi modules for data transmission. Cloud Vision Enables Global Internet of Things to Proliferate [2]. This work exploits crucial operations and technologies that are likely to drive IoT exploration with unborn possibilities. However, there is a solid foundation that explains the basics and how Arduino boards work. It`s relatively intriguing It`s notably exciting as it implements a 'Get As You Throw' system thought as a manner to encourage recycling among residents [7]. As we cited later, the civic engagement a part of the association is surprisingly depending on their paintings.

APPLICATIONS

- Detects the magnitude of garbage inside the trash can.
- Wireless transmission of information to involved officials.
- The system can be accessed anytime, anywhere.
- Send and access data in real time.
- Overfilling of trash can is prevented.
- This system will help city authorities or other private companies to address the municipal waste collection problem.
- This system is not for personal use and may be used by any city, state, or country.
- With this system, efficiency in garbage collection and reduction in shipping costs can be observed.

HARDWARES

Arduino mega

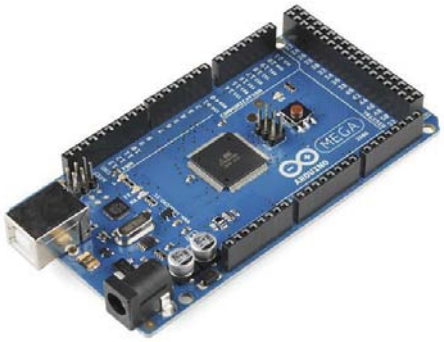

Figure 1: Arduino Mega

The Arduino is an open source project that creates microcontroller accessories for creating digital displacement and interactive objects that can sense and control physical displacement [4]. In Figs. 1 and 2 A microcontroller design based system from several vendors which uses different accessories. These systems provide a variety of digital and analog I/O branches that allow interoperability with a variety of extensions and other circuits. There are interfaces for cyclic communication, including some models of universal cyclic automatic machines for downloading programs on specific computers.

Microcontroller	ATmega 2560
Operating Voltage	5 V
›ut Voltage (recommended)	7–12 V
Input Voltage (limit)	6–20 V
Digital I/O Pins	54 (of which 15 provide PWM outpu
Analog Input Pins	16
DC Current per I/O Pin	20 mA
DC Current for 3.3 V Pin	50 mA
Flash Memory	256 KB (8 KB used by bootloader)
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHz
LED_BUILTIN	13
Length	101.52 mm
Width	53.3 mm

Figure 2: Technical Description

Ultrasonic sensor (HC-SR04)

Figure 3: Ultrasonic sensor (HC-SR04)

In Fig. 3 An ultrasonic sensor is an electronic gadget that converts the reflected sound waves into an electrical signal by evaluating the distance of an objective item by emanating ultrasonic sound waves. Ultrasonic waves moves quicker than the speed of perceptible sound. Ultrasonic sensors have two primary parts: the transmitter and the receiver.

To ascertain the distance between the object and the sensor, the sensor estimates the outflow of the sound by the transmitter to its contact with the collector by calculating the time it takes between them. For calculating distance, D = 1/2 x T x C (where C is the speed of sound, T is the time and D is the distance).

C. HC-05 (Bluetooth module)

Figure 4: Hc-05 (Bluetooth module)

Bluetooth serial port protocol module in an HC05 module is an easy to apply Bluetooth module, In Fig. 4 that provides clean wireless and serial communication. Serial port Bluetooth module is very good Bluetooth with 3Mbps modulation and full 2.4GHz wireless modulation and transceiver. A CMOS technology and AFH, which is adaptive frequency hopping which is used on an external chip, a separate system. It has small feet measuring 12.7 x 27 mm. Hopefully this can simplify the entire design/development cycle.

ESP8266 (Wi-Fi module)

Figure 5: Esp8266 (Wi-Fi module)

ESP8266 provides a complete and oneself- included networking with a Wi-Fi, allowing it to either discharge all Wi-Fi networking functions from another procedure processor or host the application. When in Fig. 5 ESP8266 hosts the applying form, so when it's the application that is only within the device, having the ability to boot up straight from a flash that is outside. It has intertwined cache to meliorate the performance of the system in analogous operations, and to minimize the memory conditions. Alternatively, serving as a Wi-Fi appliance, wireless access that's internet be included with any microcontroller- grounded design with easy connectivity through UART software or the CPU AHB ground screen.

IR array

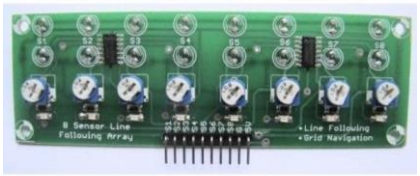

Figure 6: IR array

In Fig. 6 it shows IR detector array has six IR LEDs and six IR detectors. It can give two types of affairs.

- Analog Output (direct analog data from IR detector)
- Digital Output (using direct voltage comparator with potentiometer)

Servomotor

Figure 7: Servo motor

Servo rotary linear actuators that provide precise control of linear or angular position, acceleration and velocity. It actually consists of a suitable motor connected to a position feedback sensor. Servo machines in many cases are an assembly of mainly four things: position-sensor, a gearing set, a DC motor and a control circuit in Fig. 7. The career of servo motor can exactly be controlled more than those of standard DC engine, in addition they usually have three cables (power, ground & control).

The servo is controlled by sending a variable range electrical rate or pulse width modulation through a control line. There's a minimal palpitation, a maximum palpitation, and a reiteration rate. A mechanism of servo often just rotates 90° in either direction for a total of 180° movements.

L289N Motor driver

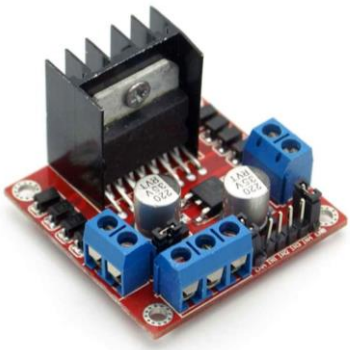

Figure 8: L289N motor driver

It shows in Fig. 8 that L293D is just a Motor that is customary driver Motor Driver IC allowing DC motor to work a vehicle in however. L293D is an IC that is 16-pin can handle a bunch of two DC engines all the while toward each path. In other words, one IC can control two DC motors. Binary ground H driver integrated circuit (IC).

The L293D IC gets signals through the microprocessor and transmits the sign that is relative the motors. It has two voltage legs, one of that will be utilized to draw present for the working associated with the L293D as well as the other is used to utilize a voltage towards the engines.

SOFTWARE

Figure 9: Arduino IDE

The Arduino is designed with the Arduino Integrated Development Environment (IDE), In Fig. 9 the written Java programming language for cross-platform operation. It all started with an IDE for processing and wiring. It is intended to provide an introduction to programming for artists and other non-software development beginners. It includes a program editor with similar functionality to syntax push, parentheses matching, automatic indentation, and provides a simple one-click medium to collect and upload programs to your Arduino board. Programs compiled in the full IDE for Arduino are called "sketches" [4].

The Arduino IDE helps each C++ and C languages with special conventions to structure the law. The Arduino IDE offers PC software that connects to a diffusion of not unusual input and output exercises. A standard Arduino includes two functions that are assembled and linked at the cease of the main ( ) program to the supervisor's loop execution.

setup (): This function is executed when the program starts and can initialize the settings.

loop (): A function that continues to be called until the board exits.

The Arduino IDE uses this technology to convert executable rules that are loaded onto the Arduino board using the board firmware's bootloader system after compiling and linking using the GNU toolchain into a hexadecimal encoded text file and also for IDE deployments. Included.

METHODOLOGY

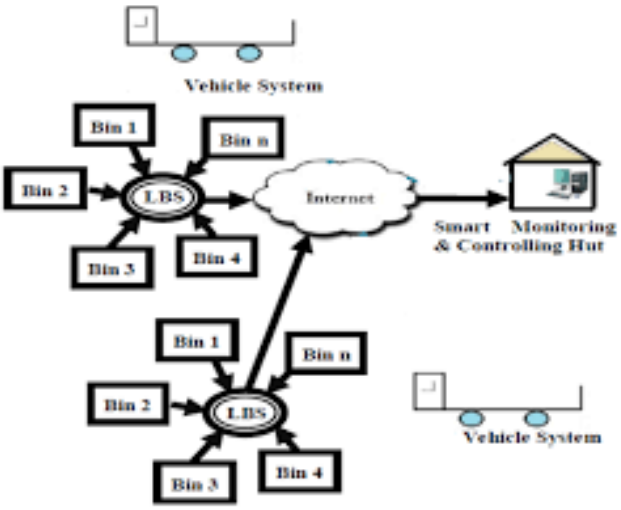

Figure 10: Architecture of Automatic waste dumping system

With this approach, the overall waste detection system is divided into four subsystems: the intelligent waste collection system, the vehicle system, the local base station, and the intelligent monitoring and controlling unit. In Fig. 10 it shows the Architecture of Automatic waste dumping system

Smart trash system (STS)

The IoT-based automatic waste unloading system is composed of 4 subsystems, and the main system that the rest operates is the Smart Trash System, and its functional unit is called the Smart Trash Bin. It consists of an ultrasonic detector, a Bluetooth module and a Wi-Fi module. Detectors are used to locate trash in smart bins. Whenever the smart bin is full, the detector works, outputting a high voltage 25V signal, which is transmitted via the Bluetooth module. This transmitted signal is entered by another Bluetooth module which is placed in the Vehicle System (VS).

Vehicle System (VS)

The line follower vehicle system is a microcontroller control robot that detects and follows lines drawn on the floor. Paths consist of black lines with white edges (or vice versa). The control system used should detect the line and guide the robot to stay on course, and use a feedback environment to continuously correct erroneous movements to create a simple but effective infinite circle system. The robot is designed to walk along a very steep corner towards the bin, receive a signal via the Bluetooth module that the bin is full, and observe the situation to dispose of the trash from waste container via ultrasonic sensor.

Local Base Station (LBS)

The Local Base Station is a base station for all the commerce match in which the transmission and receiving of data do between your Smart trash system (STS) together with Vehicle system (VS) which also inclusively deliver data to your Smart Monitoring and Controlling Hut (SMCH) for covering purpose. Local Base section correspond of Hc-05 and Esp8266.

Smart Monitoring and Controlling Hut (SMCH)

In the SMCH, the Wi-Fi module in the trash can receive the signal and then pass the signal over the internet to the cone controlling the cabin. Information and status are displayed in the monitoring and management site related to smart bins. Regarding Smart Monitoring and Hut interface control, important things such as status related to the entire smart bin are displayed.

CONCLUSION

This software shows a wise rubbish collection gadget the utilization of the Internet of Things guarantees that the site is wiped out rapidly while the scrap area reaches its most. However, this is not the only reason why we should use the Internet of Things. In addition to the above mentioned reasons, the Internet of Things helps us to save energy and reduce our carbon footprint. By using the Internet of Things, we can easily monitor the amount of electricity used by each appliance in our home. This way, we can easily find out whether we are wasting too much electricity or not. Also, we can easily control the temperature inside our house. For example, we can set the thermostat to turn off the air conditioner when we leave the house. This way, we won't waste any electricity. Furthermore, we can easily monitor how much water we are using every day. This way, we will know whether we are wasting too little or too much water.

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Weekly Rainfall Analysis Using Markov Chain Analysis of Rajkot District

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ABSTRACT: Planning and managing the agricultural ecosystem successfully requires knowledge of the patterns of dry and wet spells as well as the beginning and end of the monsoon season. Rajkot, Jamnagar, and Surendranagar districts are the low rainfall regions, receiving less than 500 mm of precipitation annually. The climate in Rajkot is hot and semi-arid. Between mid-June and October, there are two seasons: a monsoon season and a dry summer. Following the monsoon, rainfall in Rajkot is reduced. Using Markov chain analysis, it is possible to determine the likelihood of dry and wet weeks in this research region. In addition, probability analysis is used to identify the beginning and ending of monsoon weeks. The study will be helpful for water management of the crops grown in the district.

Keywords: Rajkot district, Morbi district, weekly rainfall analysis, Markov chain, Probabilityof dry and wet week, Crop planning.

INTRODUCTION

Water is a major factor in Gujarat's agricultural development. The agrarian industry in Gujarat State uses a significant amount of surface and groundwater for irrigation. 19.6 Mha, or 6 percent of the country, is the size of the state. Out of 10.7 Mha of cultivable land in Gujarat state, 33 are irrigated; the gross irrigated area in the state, as reported for the period 2015–2016, was 56.14 lakh hectares. With a probability of 31.55, the comparable net irrigated area was 29.79 lakh hectares. Groundwater contribution as a source of irrigation water exceeds 90% in the regions of North Gujarat, Saurashtra, and Kutch. The state's agricultural output is dependenton rainfall. As a result of the state's extremely irregular and uneven rainfall distribution, famines and cataracts are continuously occurring in various parts of the state. As a result, agricultural products are generally unstable.

Gujarat state, in India, has the Morbi district. It was established on August 15, 2013, India's 67th Independence Day, along with a number of other districts. The district's administrative centre is located at Morbi City. There are 5 talukas in the district: Morbi, Maliya, Tankara, Wankaner (which was formerly in the Rajkot district), and Halvad (previously in Surendranagar district). However, there are only

approximately 30 genuine rainy days peryear; the remainder is mildly warm to hot.

NEED AND OBJECTIVE OF THE STUDY

The Rajkot district's agriculture is primarily rain-fed, and water is in short supply. Cause Rapid urbanization, industrialization, and population growth. Improving crop output for the district's economic growth is difficult given the current climate. In addition to learning the dry and rainy weeks for planting and the crop's harvesting week. It will help Rajkot district's economy grow and its agricultural outlook would be improved. Farmers benefit from employing a Markov chain analysis to prepare the land for planting. The objective of the study is to probability of dry and wet weeks using Markov chains. To make analysis of weekly rainfall in Rajkot district from an agricultural point of view.

LITERATURE REVIEW

In Admasu [1] the current work, a Markov chain probability model was used to assess the long-term frequency of wet or dry periods of precipitation throughout the primary stormy season at Dhera, in Ethiopia's Central Rift Valley. The study analyzed 24-time rainfall data (1984–2010) and used daily rainfall data as the standard to examine the potential causes of dry and wet weeks. During this investigation, certain logical and substantial conclusions about the best times for further irrigation, soil conservation, and medication of the land were reached; spring water pullout comes first in the study region in terms of importance. The period of runoff water collecting for supplemental irrigation, building of soil corrosion control measures and humidity conservation procedures are all stated in this study.

In Paswan P.K. [2] study, the daily rainfall data from the Junagadh quarter in Gujarat were evaluated using a Markov chain model, with original and tentative possibilities predicted for 10 mm and 20 mm rainfall. The literal rainfall data covered a period of 37 times (1981-2017). Additionally, it indicates the unclear likelihood that rainy weeks will follow another wet week and dry weeks will follow another dry week. In Hirapara1[3] study analyses rainfall data collected over a 21-year period (1997–2017) in Gujarat's North and South Saurashtra region in order to identify and quantify the characteristics of south-west thunderstorms. The South Saurashtra season lasted 15 weeks, whereas the North Saurashtra region's season lasted 14.5 weeks. In the Saurashtra region, the contingent likelihood of a rainy week followed by another wet week ranged from 47.6 to
66.7 and 20.0 to 64.3, respectively, according to this study, which shows the initial chance of the wet weeks. SMW Results show the duration of field treatment and kharif crop sowing from the 24th to the 26th.

In Mandal & J. Padhi[4] study, an attempt is made to quantify 16 entries of rainfall (1995–2010) in the Daspallaregion of Odisha, eastern India, for a vaticinator using six probability distribution functions, ratiocinate the likely time of thunderstorm onset and withdrawal, quantify the situations of dry spells using a Markov chain model, and finally plan the region's crops. This study develops the findings that are applied to agrarian planning and drought mitigation in the Daspalla region of Odisha, India. It may be concluded from the research study mentioned above that a rainfall pattern is crucial for decisions about crop planning and water management. Additionally, for effective planning and management of the agricultural ecosystem, it is important to understandthe sequences of dry and wet spells as well as the onset and withdrawal of the monsoon season.

STUDY AREA AND DATA COLLECTION

District of Rajkot includes Rajkot city, which is on the Saurashtra peninsula and has 92 villages inside it, serves as the district's administrative center. The fourth most populated district in Gujarat, it is also the third most developed. Agriculture is the district of Rajkot's primary industry. Between latitude 22.180 N and longitude 70.510 E, it is located. According to a 2019 survey, there are 6448 ha of total cultivated land and 154.32 km2 of forest land. Study the daily statistics that are currently available for the Rajkot

district from the years 1986 to 2020. Two years' worth of data is not yet available. Gandhinagar is the source of the data gathering. The main crops grown in the agricultural district of Morbi is wheat, cotton, and cumin. Other important crops grown include groundnuts, sesame, wheat, bajra, and others.

Together with its tributaries, the Machhu flows 52% in steep regions and 48% in plain ones. The river feeds portions of Chotila taluk in Surendranagar district as well as Malia, Morbi, Wankaner, Jasdan, and Rajkot taluks in the Rajkot district. Over 75% of the 2515 sq. km that Machhu drains is located in Rajkot district. The Machhu basin receives 533.5 mm of rain on average. By the middle of June, the South West monsoon arrives, and it goes by the first week of October. The monsoon season, which lasts from July through August, brings over 90% of the total annual rainfall. The topographical features cause the climate to be unpredictable.

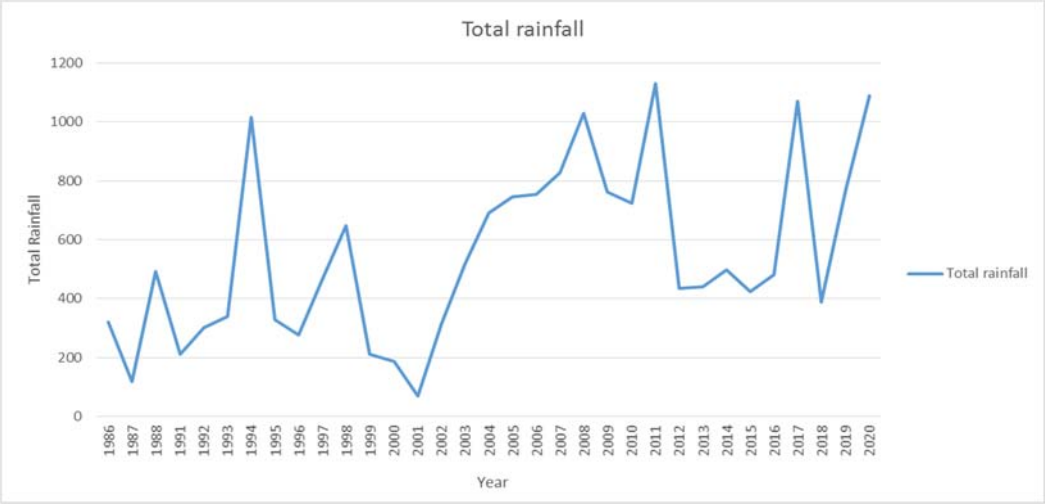

FIGURE 1. Total Rainfall in Rajkot District (1986-2020)

Crop	Water requirement (mm)	Crop	Water requirement (mm)
Rice	1200	Tomato	600 – 800
Wheat	450 – 650	Potato	500 – 700
Sorghum	450 – 650	Pea	350 – 500
Maize	500 – 800	Onion	350 – 550
Sugarcane	1500 – 2500	Chillies	400 – 600
Sugarbeet	550 – 750	Cabbage	380 – 500
Groundnut	500 – 700	Banana	1200 – 2200
Cotton	700 – 1300	Citrus	900 – 1200
Soybean	450 – 700	Grapes	700 – 1200
Tobacco	400 – 600	Mango	1000 – 1200
Beans	300 – 500	Turmeric	1200 – 1400

FIGURE 2. WATER REQUIREMENT OF DIFFERENT CROPS

METHODOLOGY

The State Water Data Center in Gandhinagar provided rainfall information for the Rajkot district over the period of 35 years, from 1986 to 2020. For 35 years, from 1986 to 2020, weekly rainfall data were gathered, although the years 1989 and 1990 were absent. The minimum rainfall occurred in 2001, while the maximum rainfall occurred in 2011, according to data analysis.

A time to process a finite number of states that have the Markovian property and some transition probabilities pij, where pij is the chance that the process will move from state I to state j, is referred to as a Markov chain. The first person to research this mechanism was the Russian mathematician Andrei Markov. Markov analysis is a technique for predicting a variable's value where the predicted value is simply affected by the variable's present state. Markov analysis' main benefits are its simplicity and out-of-sample forecasting precision.

METHODS OF COMPUTATION FOR ONSET AND WITHDRAWAL OF MAIN RAINYSEASON

Beginning, ending, and duration of the stormy season were all identified. For crop planning, crop selection, and crop planning, the date of the stormy season's onset, pullback, and length are crucial criteria that determine the crop product's decline season. The probabilities of the significant rainy term onset and withdrawal were determined using Weibull's equation. The highest rank offered for that particular week is chosen in order to compute each rank's percentage probability (P). The Weibull's equation has been used to determine the probability of onset and withdrawal as a percentage.

$P = m/(n+1)$

where, P = probability of occurrence, m = rank of the recorded rainfall value after they have been arranging order of magnitude, n = total number of years of data

PROCEDURE OF CALCULATION FOR INITIAL AND CONDITIONAL PROBABILITIES OF MAIN RAINY SEASON

The information on initial and constrained possibility is based on the first Markov chain model at the weekly level. While conditional probability, wet/wet or wet/dry, estimates by a given period I is wet or dry, then the chance of (i+k) th period is wet. The initial probability may be seen as a dry or wet week.

Initial Probabilities

$$Pd = Fd/N$$

$$Pw = Fw/N$$

CONDITIONAL PROBABILITIES

Conditional rainfall probability (%) of receiving less than 20 mm of precipitation during the following week along with when there was more than 20 mm of precipitation during the previous week.

$$Pww = Fww/N$$

$$Pwd = 1-Pdd$$

$$Pdw = 1-Pww$$

$$Pdd = Fdd/N$$

CONSECUTIVE DRY AND WET WEEK PROBABILITIES

Probability of 2 consecutive dry weeks starting with the week

2D= PDW1PDDW2

2W= PwW1 PWWW2

3D= PDW1 PDDW2 PDDW3

3W= PWW1 PWWW2 PWWW3

Where, PD - Probability of the week being dry, PW - Probability of the week being wet, N - Number of years of data, FD - Number of dry weeks, FW - Number of wet weeks, N - Number of years of data, PDD - Probability (conditional) of a dry week preceded by a dry week, PWW - Probability (conditional) of a wet week preceded by a wet week, PWD - Probability (conditional) of a wet week preceded by a dry week, PDW - Probability (conditional) of a dry week preceded by a wet week, FDD - Number of dry weeks preceded by another dry week, FWW - Number of wet weeks preceded by another wet week.

2D - Probability of 2 consecutive dry weeks starting with the week , 2W - Probability of 2 consecutive wet weeks starting with the week, 3D - Probability of 3 consecutive dry weeksstarting with the week, 3W - Probability of 3 consecutive wet weeks starting with the week PDw1 - Probability of the week being dry (first week), PDDw2 - Probability of the second week being dry, given the preceding week dry, PWw1 - Probability of the week being wet (first week), PWWw2 - Probability of the second week being wet, given the preceding week wet.

RESULTS

According to the above figure, the average number of rainy days in the Rajkot district is 28, the shortest rainy season lasts 8 weeks, and the longest is 24 weeks.

Table 1. Characterization of the main rainy season at Rajkot District (1986-2020)

Characterization of monsoon season rainfall in the Rajkot District	
Particulars	**Week No**
Mean week of onset of the main rainy season	25.5
Earliest week of onset of the main rainy season	23
Delayed week of onset of the main rainy season	28
Mean week of withdrawal of the main rainy season	40.5
Earliest week of withdrawal of the main rainy season	35
Delayed week of withdrawal of the main rainy season	47
Mean length of the main rainy season	15
Duration of the main rainy season	
Longest	24 weeks (168 days)
Shortest	8 weeks (56 days)
Normal Rainy Days	28 days

Table 2 Probability occurrence of the main rainy season at Rajkot District and Descriptive statistics on weekly rainfall data at Rajkot District (1986-2020)

week	RV	rank of RV(m)	T	P	SMW	Mean(m	Max(mm	Min(mm)	SD	CV (%)
22	3	24	1.13	92.31	22	0.09	3	0	0.52	17.41
23	283.3	18	1.5	69.23	23	31.48	68	0	18.97	60.27
24	551	16	1.69	61.54	24	32.41	133.8	0	29.89	92.2
25	1122.5	7	3.86	26.92	25	59.08	252	0	59.09	100.03
26	1149.5	6	4.5	23.08	26	60.5	182	0	51.51	85.14
27	1539.4	4	6.75	15.38	27	66.93	293	0	70.57	105.44
28	1754	1	27	3.85	28	70.16	375	0	91.85	130.92
29	1653	2	13.5	7.69	29	59.04	265	0	72.23	122.36
30	1104.5	8	3.38	30.77	30	48.02	231.5	0	49.65	103.39
31	1577.3	3	9	11.54	31	63.09	238	0	67.79	107.45
32	1070.7	9	3	34.62	32	44.61	212	0	50.22	112.57
33	1172	5	5.4	19.23	33	55.81	296	0	74.59	133.65
34	746.5	14	1.93	53.85	34	35.55	282	0	51.13	143.83
35	910	10	2.7	38.46	35	56.88	158	0	42.6	74.9
36	582	15	1.8	57.69	36	48.5	162	0	39.04	80.49
37	786.5	13	2.08	50	37	52.43	138	0	40.77	77.76
38	847.5	12	2.25	46.15	38	65.19	327	0	63.55	97.47
39	866	11	2.45	42.31	39	51.45	257	0	48.82	94.89
40	286.5	17	1.59	65.38	40	22.04	105	0	25.19	114.31
41	114.6	20	1.35	76.92	41	11.46	51	0	10.36	90.44
42	180	19	1.42	73.08	42	30	174	0	32.29	107.63
43	0	25	1.08	96.15	43	0	0	0	0	0
44	0	26	1.04	100	44	0	0	0	0	0
45	22	23	1.17	88.46	45	22	22	0	3.83	17.41
46	30	22	1.23	84.62	46	30	30	0	5.22	17.41
47	39	21	1.29	80.77	47	39	39	0	6.79	17.41

Table 3 Initial and conditional probabilities at 10mm and 20mm threshold limit of rainfall for Rajkot District

At 10mm threshold limit of rainfall								At 20mm threshold limit of rainfall							
Week	**Pd**	**Pw**	**Week**	**Pdd**	**Pww**	**Pwd**	**Pdw**	**Week**	**Pd**	**Pw**	**Week**	**Pdd**	**Pww**	**Pwd**	**Pdw**
22	100	0	22	0	0	100	100	22	33	0	22	0	0	100	10(
23	78.79	24.24	23	48.48	0	51.52	100	23	84.85	15.15	23	84.85	0	15.15	10(
24	60.61	36.36	24	30.3	0	69.7	100	24	72.73	27.27	24	63.64	6.06	36.36	93.9
25	54.55	42.42	25	30.3	0	69.7	100	25	60.61	39.39	25	39.39	6.06	60.61	93.9
26	48.48	51.52	26	15.15	3.03	84.85	96.97	26	51.52	45.45	26	36.36	24.24	63.64	75.7(
27	36.36	63.64	27	21.21	0	78.79	100	27	45.45	51.52	27	24.24	24.24	75.76	75.7(
28	42.42	57.58	28	24.24	0	75.76	100	28	51.52	42.42	28	27.27	27.27	72.73	72.7
29	36.36	63.64	29	21.21	0	78.79	100	29	48.48	48.48	29	30.3	24.24	69.7	75.7(
30	45.45	57.58	30	21.21	3.03	78.79	96.97	30	54.55	45.45	30	33.33	30.3	66.67	69.7
31	33.33	57.58	31	18.18	0	81.82	100	31	54.55	45.45	31	30.3	21.21	69.7	78.7
32	45.45	48.48	32	24.24	0	75.76	100	32	63.64	36.36	32	36.36	18.18	63.64	81.8
33	63.64	51.52	33	33.33	3.03	66.67	96.97	33	69.7	30.3	33	48.48	15.15	51.52	84.8
34	54.55	0	34	42.42	0	57.58	100	34	60.61	30.3	34	48.48	9.09	51.52	90.91
35	69.7	45.45	35	45.45	0	54.55	100	35	75.76	39.39	35	48.48	18.18	51.52	81.8
36	69.7	33.33	36	30.3	0	69.7	100	36	69.7	24.24	36	54.55	18.18	45.45	81.8
37	72.73	33.33	37	57.58	0	42.42	100	37	75.76	30.3	37	60.61	15.15	39.39	84.8
38	75.76	33.33	38	60.61	3.03	39.39	96.97	38	78.79	24.24	38	57.58	12.12	42.42	87.8
39	66.67	27.27	39	57.58	0	42.42	100	39	69.7	21.21	39	66.67	12.12	33.33	87.8
40	66.67	21.21	40	57.58	0	42.42	100	40	69.7	15.15	40	63.64	9.09	36.36	90.91
41	72.73	18.18	41	69.7	0	30.3	100	41	84.85	3.03	41	69.7	3.03	30.3	96.9
42	84.85	18.18	42	84.85	0	15.15	100	42	84.85	3.03	42	78.79	0	21.21	10(
43	100	0	43	100	0	0	100	43	100	0	43	84.85	0	15.15	10(
44	100	0	44	96.97	0	3.03	100	44	100	0	44	100	0	0	10(
45	96.97	6.06	45	96.97	0	3.03	100	45	96.97	3.03	45	96.97	0	3.03	10(
46	96.97	6.06	46	96.97	0	3.03	100	46	96.97	3.03	46	96.97	3.03	3.03	96.9
47	96.97	6.06	47	0	0	100	100	47	96.97	3.03	47	96.97	3.03	3.03	96.9

On the basis of weekly rainfall data, a Markov chain model was used to determine the probabilities of a sequence of dry and wet spells occurring. A week with less than 20 mm of rain was classified as dry, and one with 20 mm or more as wet. According to the process prescribed in Mandal et al. (2015), the analysis is completed for initial probabilities, conditional probabilities, and probability of successive dry and wet weeks.

Only the initial and conditional probabilities of dry and wet weeks during the primary rainy season are discussed by the initial and conditional probabilities calculated as 10 mm and 20 mm (26th week to 40th week). The initial and conditional probabilities of a dry week vary from 36% to 100% and 45% to 100%, respectively, when taking the 20 mm threshold limit into account. According to the Table's initial probabilities, there is a higher possibility of a dry week occurring early in the season than later, starting with the 38th week of the rainy season. Conditional probabilities and probability of successive dry and wet weeks are followed in parallel patterns. The likelihood of a dry week followed by another dry week (PDD) is lower throughout the monsoon season, especially from the 38th to the 44th SMW.

During the rainy season, there is a higher likelihood that a wet week will be followed by another wet week (PWW). The likelihood of a wet week followed by a subsequent dry week (PWD) is very low, whereas the likelihood of a dry week followed by a subsequent wet week (PDW) is very high. The examination of consecutive wet and dry weeks throughout the rainy season revealed that, aside from the rainy season, there is a strong probability that there would be two consecutive dry weeks beginning with week 2D.

CONCLUSION

In this study, when agriculture is so important to the expansion of the economy, analyzing rainfall is helpful for agricultural activity. For the meteorological weeks, initial and conditional probability of dry and rainy weeks are calculated. Planning water supplies to supplement rainfall for irrigation purposes will be made easier with the help of the results of the research. The monsoon season rainfall is the most significant; as a result, our assessments have identified its most likely onset and withdrawal of the effective monsoon. Growing high-value post-monsoon crops without irrigation would be problematic since post-monsoon rainfall is more unpredictable and variable than monsoon rainfall. Cotton, green gram, black gram, and groundnut are the crops that are grown during the kharif season under rainfed conditions. In the months of May, June, and July, which fall in the 20th through the 30th SMW, it is permissible to prepare the land and sow or plant. The 28th to 33rd weeks are by far the best for water management for runoff water harvesting.

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Scope of Waste Heat Recovery in Internal Combustion Engines: A Review

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Abstract. Currently, up to 65% of the thermal energy generated by Internal Combustion Engines (ICEs) is lost; this energy is available in low-grade form, making it challenging to use. However, a number of alternative approaches have been suggested throughout the years for recovering and using this energy, each with their own benefits and drawbacks. On the other hand, recently created thermoelectric generators can be thought of as a very good technique for recovering low grade energy. IC Engines offer an extremely intriguing chance to lower fuel use and CO2 emissions through waste heat recovery. The exhaust gases from an IC Engines are unquestionably the best prospects for possible recovery among the many heat sources. High power densities and minimal emissions had been the goals of IC engine optimization. However, engine efficiency has become more significant recently due to rising fuel prices and considerations about sustainability. Due to the daily depletion of oil reserves and the sharp rise in demand. This paper outlines knowledge about wastage of heat in IC Engines and summarizes the previous studies carried out with respect to various heat recovery methods in IC Engines.
Keywords: Waste Heat Recovery, IC Engines, Emissions, Exhaust Gases.

INTRODUCTION

Typically, Internal Combustions (IC) engines have brake power efficiency of 25% to 40% whereas rest of the energy provided by the fuel is utilized to run the auxiliaries such as fuel pump, cam mechanism etc. or is either wasted in the form of friction and heat generated at various places in the engine. Major amount of energy is wasted in the form of exhaust heat. Figure 1. Shows the energy distribution in an internal combustion engine. Thus, wastage of energy in the form of heat is the major reason for inefficiency in the IC engines if we can minimize this wastage or utilize this heat then overall efficiency of the IC engines can be very well improved.

TEG uses the seebeck effect. It is made up of n-type and p-type semi conductor material. When one end of TEG is heated and other end is cooled then voltage is generated. So TEGs can be used to generate power where temperature difference is available. Seebeck effect is shown in figure 1 [2].

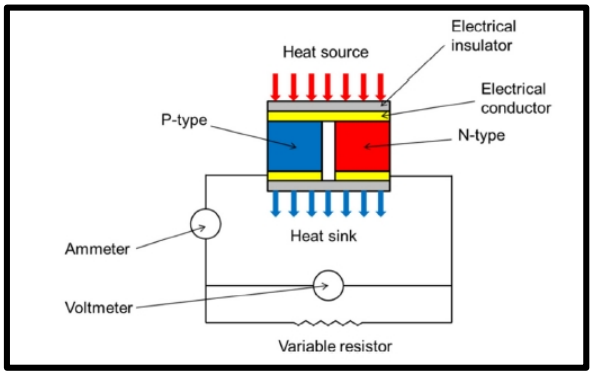


FIGURE 1 *Seebeck effect*

Waste heat recovery benefits can be i) Direct benefits and ii) Indirect benefits.

i) Direct benefits: Waste heat recovery can increase the thermal efficiency of engine and reduces the consumption and process cost.
ii) Indirect benefits: a) Waste heat recovery reduces the environmental pollution. b) Waste heat recovery also reduces fuel consumption which reduces the size of equipments. c) Reduced equipment sizes results in reduction of auxiliary energy consumption.

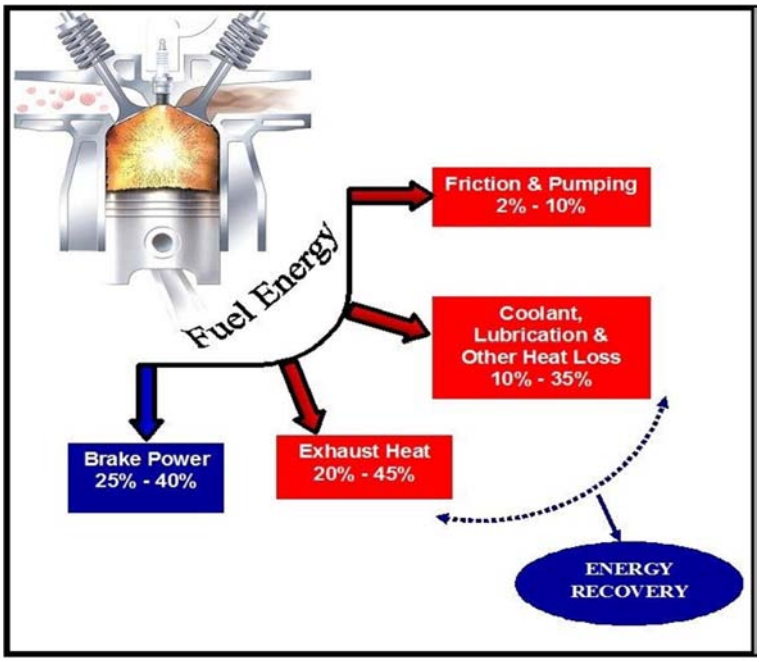


FIGURE 2 *Typical energy distribution in Internal Combustion Engines*

Waste heat recovery by TEGs is desirable compared to other waste heat recovery technologies due to compact size of TEG, silent operation, scalability and durability. Also there is less maintenance cost involved due no moving parts are involved.

PREVIOUS STUDIES AND RESEARCH

Xingyu Liang et. al [1] compared different waste heat recovery technologies named electric turbo compounding systems (ETC), thermodynamic organic Rankine cycle (ORC), thermoelectric generators (TEG), hydrogen generation by using exhaust gas heat energy, and hybrid pneumatic power systems (HPPS). They carried out analysis of these five technologies based on their technical, economic, and environmental parameters. They found that the HPPS framework can accomplish the highest fuel economy improvement among the five advancements. They also found HPPS as the most encouraging WHR innovation for vehicle engines and TEG for working conditions like marine engine and power plant and selection between HPPC and ETC is generally depend on environmental aspects.

B. Orr et. al [2] investigated waste heat recovery potential by using thermoelectric generators (TEG) and heat pipes. By using heat pipes, thermal resistance and pressure losses in the system can be reduced and design flexibility is increased. A totally solid state, passive waste heat recovery system might be made using these technologies. From this investigation they found that the best way to improve overall efficiency of fuel in car is to recover waste heat. They also found that heat pipes and TEGs are both solid-state, passive, silent, scalable, and long-lasting, the thermal resistance between the TEG and gases can be decreased by heat pipes, the pressure losses in the gas stream can be reduced by using heat pipes, the use of heat pipes allows for more flexibility in the design of the exhaust pipe.

Shaowei Qing et. al [3] developed an analytical model to optimize the performance of thermoelectric generators. To explore the internal and external attributes of the TEG, a thorough analytical model with non-identical temperature-dependent material properties and the effective heat transfer coefficient (EHTC) of both-sides heat exchangers was constructed. To optimize output power and efficiency across a wide range of EHTCs, fill factor, and thermoelectric (TE) element shape, parametric optimization of the TEG was used.Theyfoundthathe statistical parameters of TE elements exhibit nonlinear behavior, and the internal properties of TE elements have a high correlation with the external load resistance. While the cold junction temperature of the TE element falls as RL rises, the hot junction temperature rises monotonically.

António Domingues et. al [4] developed both a Rankine Cycle(RC) thermodynamic model and a heat exchanger model that used Experimental data from a car tested on a chassis dynamometer. They performed thermodynamic analysis for water, R123 and R245fa. Their examination demonstrated that improved evaporator is expected to get the most extreme WHR potential from vehicle RC systems. They found that the heat exchanger effectiveness for the natural working liquids R123 and R245fa is higher than that for the water and, thus, they can likewise be thought of as proper for use in vehicle WHR applications through RCs when the fumes gas temperatures are generally low. Their analysis confirmed that RCs have high potential to recover waste heat of vehicle exhaust.

Gaowei Liang et. al [5] carried out theoretical and experimental analysis to study the performance of parallel thermoelectric generator (TEG). They developed an analytical model of parallel thermoelectric generator (TEG) using thermodynamics theory, semiconductor thermoelectric theory and law of conservation of energy. They also built an experimental model to validate the analytical results. They measured the power output for different temperatures of source and sink and they found that experimental results are consistent with the analytical model, however due to assumptions of heat conduction in thermocouple, the experimental result values are slightly lower than the analytical values.

Faisal Albatati et. al [6] analytically and experimentally investigated validity of Thermoelectric Generator (TEG) to recover waste heat from exhaust of semi truck engines. They optimized TEG parameters to get maximum power output. They carried out experimental work on their own constructed experimental setup to validate analytical results. This setup is shown in figure 2. The inputs for the analytical model of semi truck engine were taken as exhaust gas properties. The temperature of exhaust gas with 0.032 kg/s mass flow rate

entering the TEG system was 550 °C. Ethylene glycol was used as cooling liquid at the sink with mass flow rate 0.237 kg/s and temperature 90 °C. TEG system developed 1.25 KW of power output which is 20% of alternator power requirement of semi truck engine.

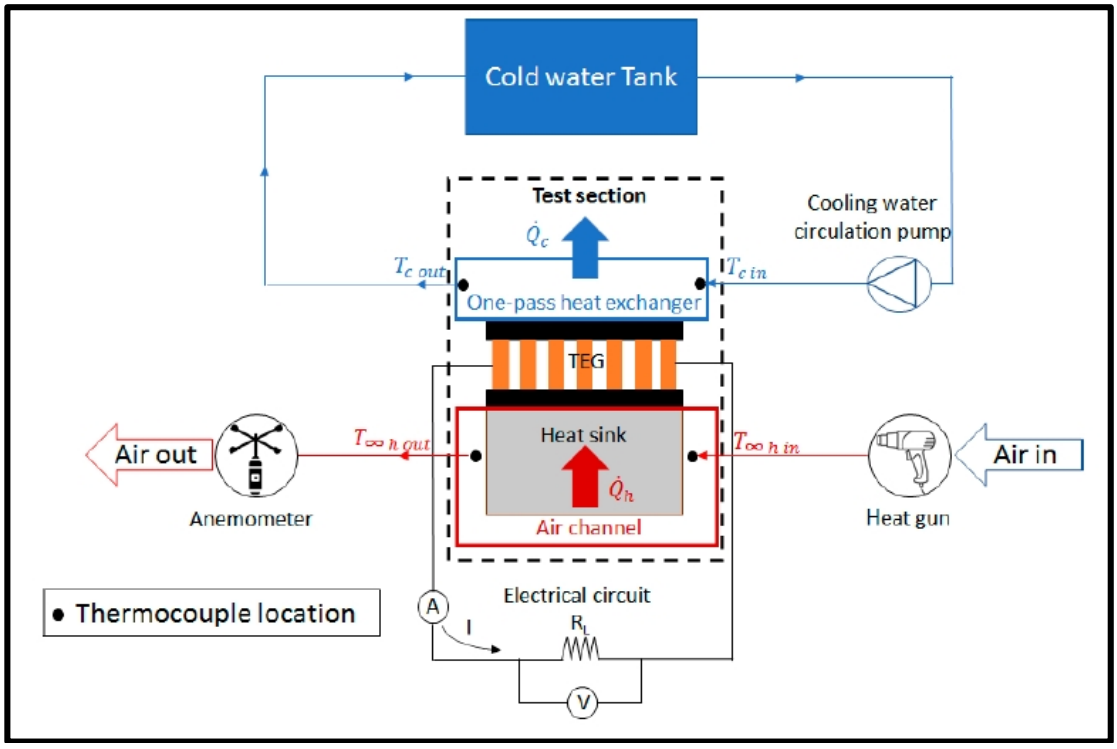


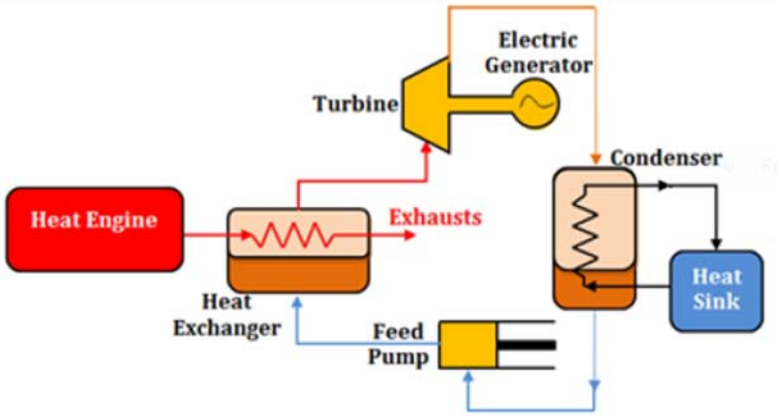
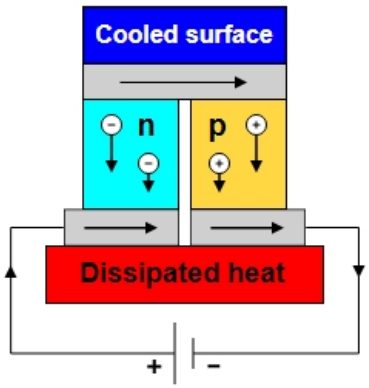
FIGURE 3. *Schematic diagram of the experimental setup*

Duraisamy Sivaprahasam et. al [7] reviewed the progress of Automotive exhaust thermoelectric generators (AETEG) done so far. They evaluated performance and cost analysis of AETEG. They reviewed all three methods of performance evaluation i.e. in a laboratory built test rig, in a simulated driving condition with laboratory test rig and in actual road driving condition. After careful study of above methods for performance and cost analysis they concluded that AETEG with innovative design and reduced overall weight improves efficiency and it is necessary for commercial success of this technology.

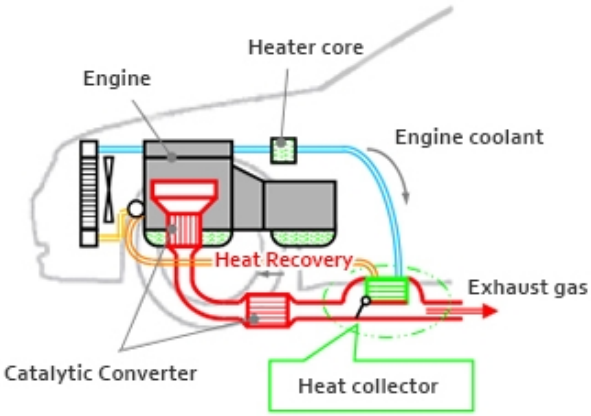
L Rauscher et. al [8] determined the efficiency of thermoelectric generators and verified it with calibration standards. They measured efficiency using fraction of electrical power output and the heat flow. They attached the heater for measurement directly to the top of generator module covered with a guarding heater. The efficiency data were compared to the data which were expected from semi conductor properties. It differs about 5% at the 150 °C and very small difference about 1% at the 280 °C. Extreme control over the thermal conditions is the major advantage is this presented approach. While validating with calibration standard, they found the presented method and apparatus very reliable and accurate.

Alessandro Romagnoli et. al [9] critically reviewed waste heat recovery methods available based on recent developments, research trends and economic aspects. They also discussed disruptive and ground breaking technologies of exhaust waste heat recovery for scientific and economic assessment. They have compared Organic Rankine Cycles (ORCs), Thermoelectric Generators and Turbo-compounding which is shown in table 1.

TABLE 1 *Comparative study of different exhausts energy recovery system*

<table>
<tr><th colspan="3">EXHAUST ENERGY RECOVERY SYSTEM</th></tr>
<tr><td colspan="3"> 
</td></tr>
<tr><th>WORKING PRINCIPLE</th><th>ADVANTAGES</th><th>DISADVANTAGES</th></tr>
<tr><td>• In the heat exchanger, a highly compressed organic fluid absorbs exhausts energy
• The organic fluid exits as superheated vapour and expands in turbine
The remaining energy discharges to the surrounding in the before it is compressed by a feed pump</td><td>• No increase in pumping work Large benefit in fuel consumption</td><td>• Installation problem
• Hazardous liquid
• Cost ineffective</td></tr>
<tr><th colspan="3">EXHAUST ENERGY RECOVERY SYSTEM</th></tr>
<tr><td colspan="3"> 
</td></tr>
<tr><th>WORKING PRINCIPLE</th><th>ADVANTAGES</th><th>DISADVANTAGES</th></tr>
</table>

• Electricity is generated from seebeck effect • Highly doped n-type and p-type semiconductor placed between the hot and cold surface Temperature difference between the surface of exhausts pipe and thermoelectric material produces electric current	• Lightweight • Large variety of application areas • No increase in pumping work • High reduction of BSFC	• Large temperature difference between surfaces(extra load on the cooling system) • Expensive Poor conversion efficiency

EXHAUST ENERGY RECOVERY SYSTEM		
		
WORKING PRINCIPLE	ADVANTAGES	DISADVANTAGES
• An additional turbine is installed downstream of the main turbine • At the exit of the main turbine, the exhaust pressure is low • Secondary turbine has to recover energy at low pressure • Recovered energy is used to power electric auxiliaries or to mechanically add energy to the engine	• Bolt-in unit which can be added to the power train • Low mass flow capacity	• Increase in pumping work • Low energy available • Electric generator limitation

Dr. Steven O'Halloran et. al [10] carried out experiment to measure the efficiency of commercial thermoelectric generator. They prepared experimental setup based on LabVIEW that measures instantaneous power generated and efficiency of thermoelectric generator. They conducted six different tests for voltages 12, 14, 16, 18, 20, and 22 volts. Temperature difference increased with increase in voltage. They calculated the efficiency for each test. With increase in change in temperature difference, efficiency also increased and efficiency was found maximum 2.22% at the highest change in temperature (68.1 °C) and power output was found to be 1.17 watts.

J. S. Jadhao et. al [11] reviewed the possibility to recover waste heat of an Internal Combustion (I.C) engine. They also described energy lost in exhaust gases. Internal Combustion engine generates large amount of hot flue gases and same amount can be converted into useful power and consumption of primary fuel can be reduced in considerable amount. The waste heat can be recovered in the form of space heating, refrigeration or power generation. Waste heat can be recovered using direct methods like thermoelectric generation,

Piezoelectric Generation, Thermionic Generation, Thermo Photo-voltaic and indirect methods like Rankine Cycle, Stirling Cycle. They identified that there is large potential to save energy through waste heat recovery.

A. S. Korotkov et. al [12] reviewed methods of modeling of thermoelectric generators (TEGs) using finite element method based on ANSYS software. They also compared analysis of different models with experiments. The modeling process consists of preprocessing, solving and post processing the results. Recent trends in TEG are compact design of TEG and improving efficiency. For compact design MEMS technology is used and to improve the efficiency of TEG numerical methods for optimization are used. Based on the experiments they found that the operating temperature range of TEG based on the discrete components is generally ranges from 0 to 250°C and it is double the operating temperature range for a TEG based on MEMS technology. They also found that for maximum power output, the absolute power output of TEG based on the discrete elements is higher than power for a MEMS-based TEG.

J. Yang [13] investigated the feasibility of thermoelectric waste heat recovery in cars and trucks for fuel economy. If the average heat energy per unit time in the vehicle exhaust tested is assumed as 10 kW then we can expect a power output of 700 W. This value is four times more than the actual measured values. It is due to the difficulty in optimization and design of heat exchanger. If exhaust gas is allowed to run freely in the pipe then heat transfer in TE generator will not be enough. So design should be such that the exhaust gases should remain in the heat exchanger as long as possible. In conclusion they found that waste heat recovery using TE has significant effect on fuel economy improvement.

P. Wang et. al [14] developed an analytical model to evaluate the performance of thermoelectric generators(TEG). Figure 3 shows typical TEG module which contains multiple thermocouples having p-type and n-type TE elements. When heat flows parallel to leg direction, it is absorbed at the hot end, where heat is converted into electrical power by thermoelectric effect. They derived an analytical model to measure efficiency as below formula:

$$\eta = \frac{I^2 R_L}{-\frac{A_n}{l_n}\int_{T_{hn}}^{T_c} \lambda_n(T)dT - \frac{A_p}{l_p}\int_{T_{hp}}^{T_c} \lambda_p(T)dT + I[T_{hp}\varepsilon_p(T_{hp}) - T_{hn}\varepsilon_n(T_{hn})]}$$

Where An is cross section area of n leg, ln is the length of n leg. Tcn, Thn, Tcp, Thp are temperature variables for cold and hot end for n leg and p leg respectively. Λ denotes thermal conductivity.
They validated this analytical model by experiments using two specimens. The electrical resistance for these two specimens was 235.3 mΩ and 89.9 mΩ respectively. They found this analytical model helpful in to find optimal leg length and leg cross section area in design of TE.

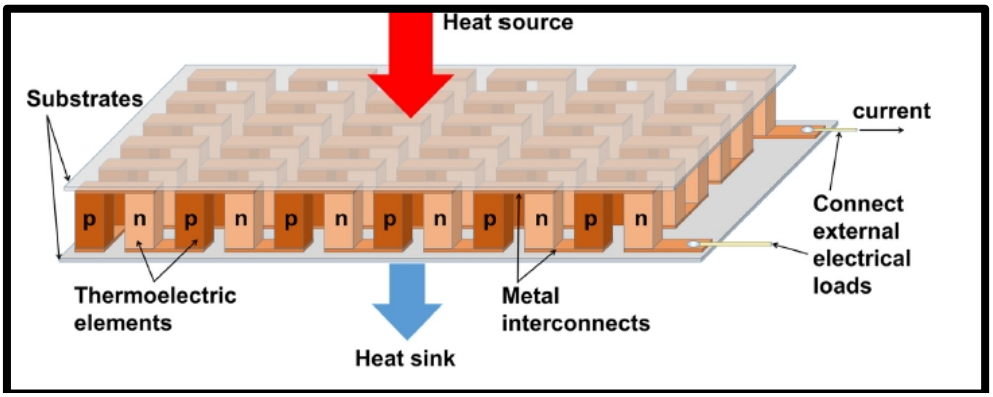


FIGURE 4 *Typical TEG module*

İlker Temizer et. al [15] worked on 'the performance and analysis of the thermoelectric generator system used in diesel engines'. They carried out experiment on 4-cylinder 4-stroke diesel engine. TEG system is placed between muffler and exhaust manifold and hydraulic dynamometer is used to measure the performance.

No failure was observed at the end of the test. The effect of variation in load and engine speed on TEG was also observed. They found that the exhaust flow rate first decreases and again increases at narrow structure. So engine speed, temperature and speed of exhaust gases together affects performance of TEG.

Charles Sprouse III et. al [16] reviewed the scope of using organic rankine cycle(ORC) to recover waste heat from Internal Combustion engine. In a rankine cycle, mechanical or electrical power is generated from waste heat by circulating working fluid using evaporator, turbo machine, condenser and pump. Rankine cycle offers the most appealing blend of effortlessness, part cost, and productivity. Choice of the working fluid and expander impacts the proficiency of the WHR systems. For high temperature and high output WHR systems turbines are preferred whereas for small applications reciprocating expanders are preferred. The selection of working fluid for ORC depends on operating conditions, environmental concerns and economic factors.

Hussam Jouhara et. al [17] presented analysis of TEGs with their applications, materials used and improvement techniques. Materials used for TEGs should have high electrical conductivity which reduces heating, good seebeck which ensures more electrical power from heat coefficient and low thermal conductivity for less thermal conduction from material. Since last two decades, researches have been made to produce environment friendly materials in large quantities for commercial use. TEGs have application in automobiles and industrial waste heat recovery. Despite of low efficiency TEGs improve overall efficiency and reduces pollution.

Chen Yue et. al [18] investigated vehicle fuel supply system based on thermal and economic performance at various engine load. They found that proposed vehicle fuel supply system has good results over conventional vehicle fuel supply system. In the various season, they found best performance in winter, the next is spring and worst performance in summer. They considered environmental aspects, safety, atmospheric lifetime, flammability, toxic etc assessment criteria. The vehicle engine load has the highest impact on thermal and economic performance. When they increased engine speed from 1500 rpm to 6000 rpm in spring season, they found efficiency increased about 8times thus decreasing payback period about 4 times.

Daniel Champier [19] reviewed the applications of thermoelectric generators (TEGs) in extreme environmental conditions, recovery of waste heat in automobile and industry..He also reviewed present and future materials for TEGs, design and optimization of TEGs. Low thermal efficiency of TEGs can be countered by using new thermoelectric modules having improved ZT, which allow high temperature differences. The heat sources are not changing significantly therefore materials are not under high thermal stress.

Georgios Konstantinou et. al [20] proposed thermoelectric generators for waste heat recovery in marine internal combustion engines (ICE). This thermoelectric generator has hot side as outside surface of the ICE manifold and cold side as induced water flow. They designed thermoelectric generator and identified the configuration that provides maximum electric power. They used modeling and simulation for design and analysis. They found that significant amount of exhaust gases can be recovered and converted into electricity using proposed design.

DISCUSSION AND CONCLUSION

It has been identified that large amount of energy can be saved using different waste heat recovery technologies. It improves the performance of engine and low emission. The waste heat recovery can be achieved by Rankine and Stirling and Brayton cycles and thermoelectric generators(TEGs) which has low efficiency. Though the TEG improves overall efficiency, its commercial implementation mainly depends upon cost benefits over life of vehicle. The major cost in TEG is cost of modules, heat exchangers for hot and cold side and power conditioning unit. This technology still has potential to the continued development of new materials with increased TE efficiency.

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Enhancement of Self-Healing Concrete Using Bacillus Subtilis Bacteria as an Ingredient: A Review

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Abstract. Research concerning the strong point, sturdiness, and stability of cement-based concrete structures. The interest in concrete's self-healing process is increasing, due to the rapid deterioration of that material which tends to crack and thus quickly deteriorate. This paper reviews the types of bacteria used in concrete and the ways they can be applied as a healing agent. The various properties of concrete vary with the addition of bacteria. A commonly used extensive building material, concrete has various limits of using it, one of which is crack construction. The construction of larger cracks lets water and CO2 enter the building materials which in turn react along with other chemicals causing an eye-catching reduction in strength and durability. If immediate remedies are not taken to heal the cracks might lead to more serious problems like bigger cracks, more leakage of water, reduced strength, and costlier repair. The best way to deal with such a situation to heal concrete even before it starts spreading is self-healing concrete. Concrete is the most widely used construction material in the world and maintaining concrete structures from premature deterioration is proving to be a great challenge. Early age formation of micro-cracking in concrete structures severely affects the serviceability leading to a high cost of maintenance. Conventional methods of repairing cracks with sealants and the concrete with bonding agent chemicals to prevent the cracks from widening, a microbial crack-healing approach has shown promising results. Concrete bears low tolerance for strain due to which cracks occur in it with time due to its brittle property utilized in most buildings. Bears low tolerance for strain due to cracks occurring in them with time. Self-healing concrete is an environmentally friendly solution to overcome these challenges, which consists of bacteria incorporated into the concrete and calcium lactate food to support those bacteria when they become active. This review focuses on the analysis of crack healing by bacteria, and the types of bacteria used. Micro-cracks are inherently present in concrete. This causes the degradation of concrete leading to the ingress of deleterious substances into concrete, resulting in the deterioration of structures.

Keywords: Self-healing, Micro-cracks, Crack healing, Bio-concrete, Modern Construction Era, Bacillus Subtilis

INTRODUCTION

Concrete is a strong and relatively cheap construction material and is therefore present the most used construction material worldwide. Its immense production exerts negative effects on the environment. Its main ingredients, i.e. cement and aggregate material, need to be produced and mined on a massive scale and

transported over considerable distances increasing energy consumption, greenhouse gas emissions, and landscape mutilation. [1] Cracking is a common phenomenon due to its relatively low tensile strength. High tensile stresses can result from external loads, obligatory deformations (due to temperature gradients, confined shrinkage, and differential settlement), plastic shrinkage, plastic settlement, and expansive reactions without immediate proper treatment, cracks lean to expand further and eventually require costly repair. [2] As it is strong, durable, and relatively inexpensive, concrete is the most used construction material worldwide. The presence of cracks may reduce the strength of concrete structures. Micro cracks are an almost obligatory feature of ordinary concrete. If micro-cracks form a continuous network they may substantially contribute to the permeability of the concrete, thereby reducing the concrete's resistance against the ingress of aggressive substances. [3] The advance in photocatalytic materials research has established a solid foundation for its extended applications in the field of construction and building materials. [4] The process of self-healing is directly related to the production of calcium carbonate which depends on many factors including pH of concrete, dissolved inorganic carbon, nucleation sites, and presence of calcium ions throughout the mixture Among the different bacteria capable of crack healing and its incorporation techniques in concrete used for self-healing purpose, there is need to identify the efficiency of bacteria namely, ''Bacillus subtilis", introduced in concrete by different merging techniques. [5] Bacillus Subtilis is a nonpathogenic and non-toxicogenic bacterium that does not produce any harm to humans or the environment. The self-healing property of concrete is achieved by introducing the Bacillus Subtilis bacteria into a concrete matrix during mixing. When a crack forms in the concrete surface, the ingress water reacts with the bacteria and which in turn produces Calcium carbonate (caco3) which is the main component of lime. [15] Microbially induced calcium carbonate precipitation (MICP) can be seen in the formation of calcite in many geological environments such as soils, limestone caves, seas, and soda lakes. [16] A crack length may be up to 1 km but the problem comes with the width and the bacteria can heal crack size even more than 0.8 mm with the calcite precipitation on the concrete surface. [20] The underlying chemical reaction is shown below: [31]

$$CO(NH_2)_2 + H_2O \xrightarrow{\text{Urease}} NH_2COOH + NH_3 \quad [1]$$

$$NH_2COOH + H_2O \longleftrightarrow H_2CO_3 + NH_3 \quad [2]$$

$$H_2CO_3 \longleftrightarrow H^+ + HCO_3^- \quad [3]$$

$$NH_3 + H_2O \longleftrightarrow NH_4^+ + OH^- \quad [4]$$

$$Ca^{2+} + HCO_3 + OH^- \longleftrightarrow CaCO_3 \downarrow + H_2O \quad [5]$$

A different strategy to achieve crack repair is the operation of non-ureolytic bacteria which form calcium carbonate as a result of their metabolic activity in the presence of a calcium source. The Equations. [6] And [7] summarize the non-ureolytic microbial self-healing. [31]

$$Ca^{2+} + Cell \longleftrightarrow Cell - Ca^{2+} \quad [6]$$

$$Cell - Ca^{2+} + CO_3^{2-} \longleftrightarrow Cell - CaCO_3 \quad [7]$$

To achieve better results in crack healing, an immobilizer for bacteria inclusion is necessary to enable their potential use in the sealing of cracks in cementitious materials. [31]

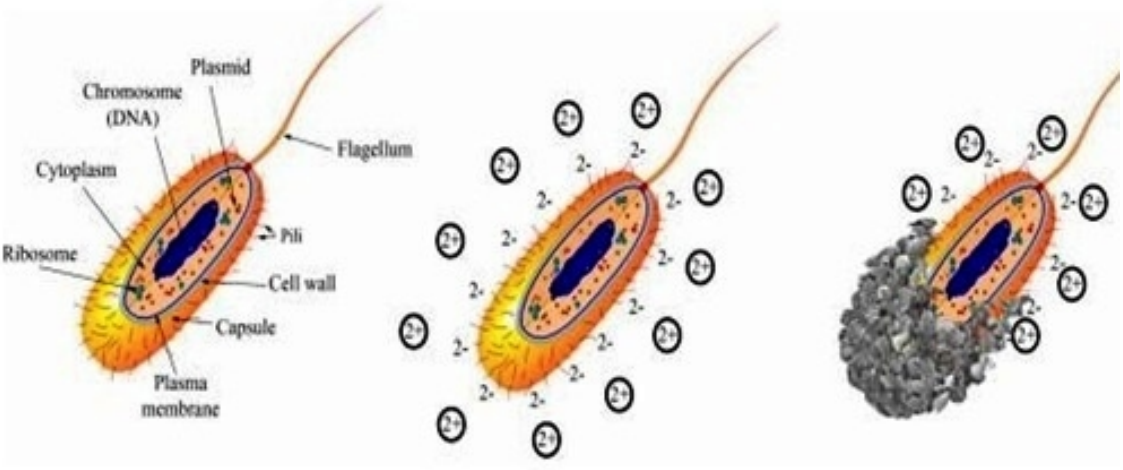

Fig. 1: Precipitation of CaCO3 by bacterial cells. [24]

This work aims to review the work done previously on self-healing concrete and to understand the influence of different bacteria on the mechanical properties of the concrete.

Definition
The "Bacterial Concrete" is concrete that can be made by embedding bacteria in the concrete that can constantly precipitate calcite. This phenomenon is called microbiologically induced calcite precipitation. [30]

MATERIALS

The cement used OPC 53 Grade (IS:269-2013 First Revision) of specific gravity 3.15. coarse aggregate 20 mm angular size as per IS:10262-2009. The coarse aggregate of specific gravity is 2.65. Fine aggregate as per IS 10262-2009. The specific gravity of fine aggregate is 2.60 with zone-I. The locally available potable water is used for mixing without any additives.

CLASSIFICATION OF BACTERIA

Bacteria are generally classified into three categories basis on shape, basis on gram stain, and the basis on oxygen demand which is shown if fig.3, and the subtype of each category also can be shown in fig. 3, fig. 4, and fig. 5.

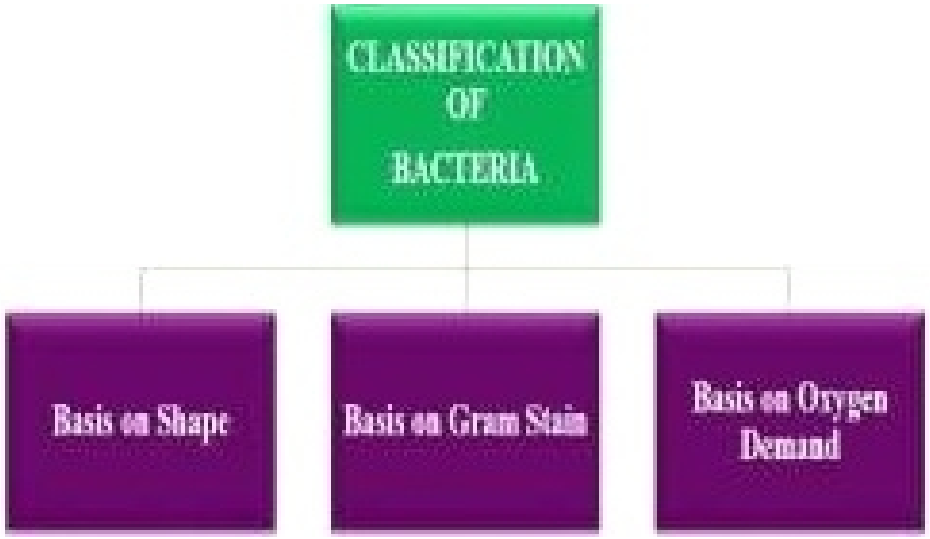

Fig. 2: Classification of bacteria [51]

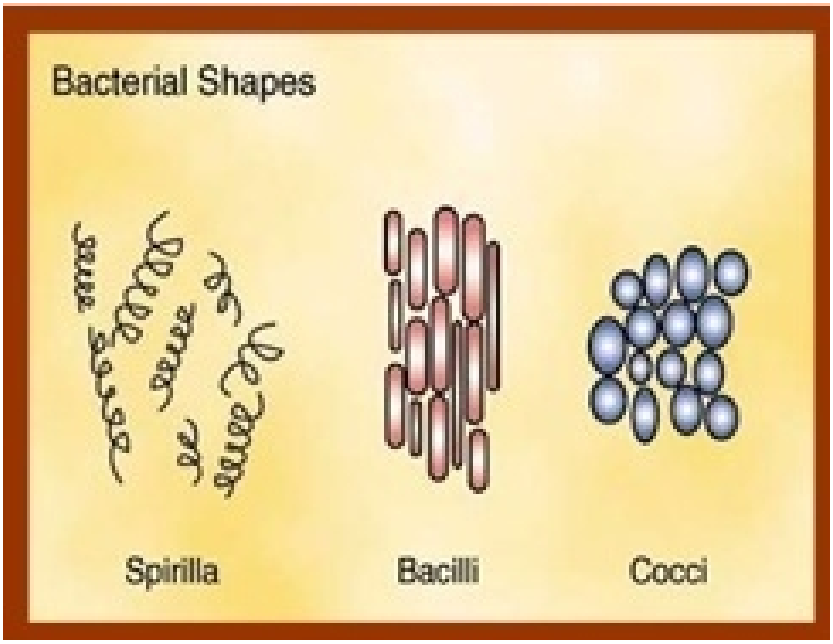

Fig. 3: Classification based on shape [51]

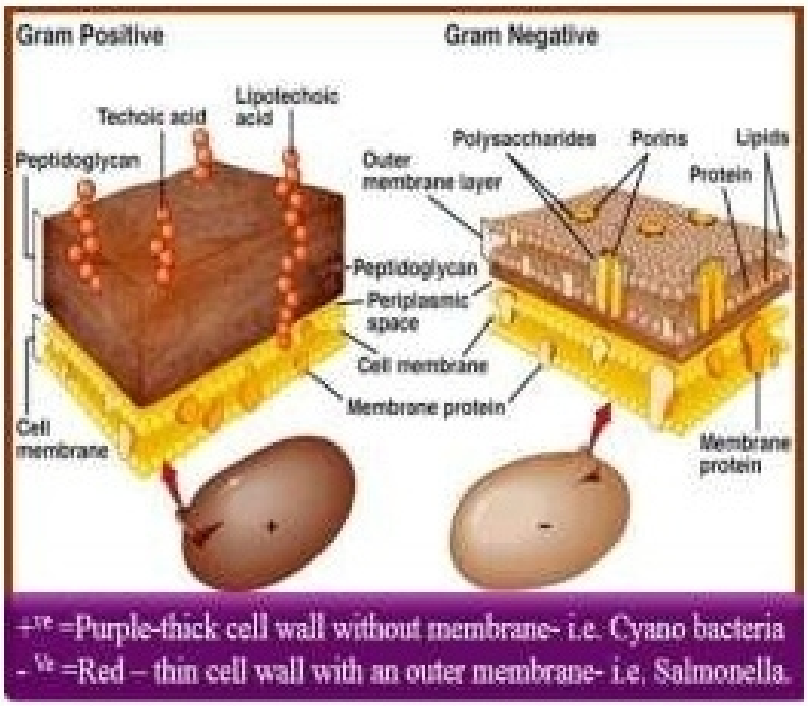

Fig. 4: Classification based on Gram Stain [51]

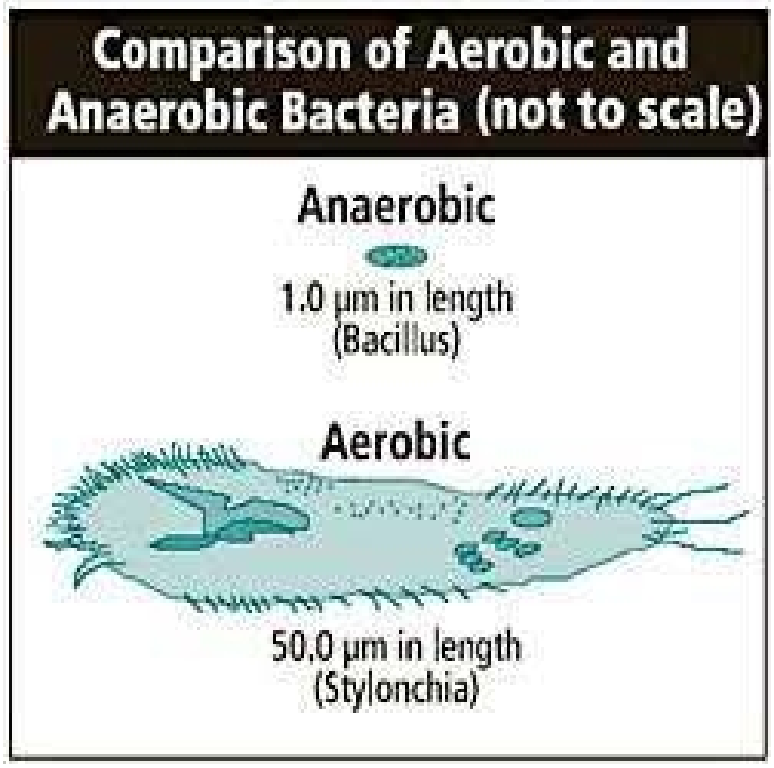

Fig. 5: Classification based on Oxygen Demand [51]

Types of bacteria used in concrete

There are various types of bacteria used in the construction area, from the literature review it is as shown in Fig. 6

Fig. 6: Types of bacteria used in concrete [51]

SELF-HEALING PROCESS AND BASIC MECHANISM

BACILLUS SUBTILIS

Bacillus Subtilis is a self-healing agent in concrete. According to previous research, bacteria are encapsulated using different materials and chemical compounds. Encapsulation is done to protect the bacterial spores. [36] Bacillus Subtilis is easy to classify in a group of wide varieties of bacteria species, because of its shape and moving nature. It is adaptable to rough environmental conditions. It is also commonly found in the soil and digestive tracts of humans and mammals. This bacterium takes 3–4 days to grow at an optimum temperature of 25-35^{0}C. [36]

SELF-HEALING PROCESS

The main idea behind using self-healing concrete in construction is to automate the finding of crack construction in its initial stage only so that it becomes easy to heal them primarily. When a mixture of concrete and bacteria is prepared, it results in forming a calcite precipitation layer, which helps in healing cracks. A general criterion for the selection of the bacterial species to be added is that it should be highly alkaline because concrete itself is alkaline and has adverse conditions. The calcite precipitation layer blocks the path and acts binds sand and gravel. [29]

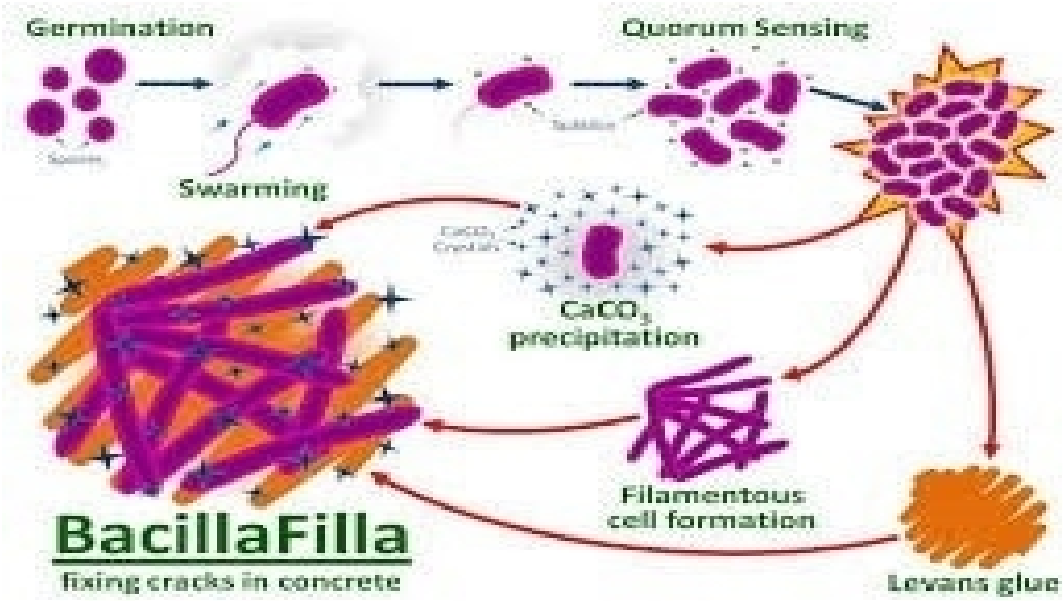

Fig. 7: Process of fixing cracks [51]

There are many processes of self-healing concrete technologies which are given below: [30]

(i) Natural process;
(ii) Chemical process;
(iii) Biological process.

NATURAL PROCESS

Some processes can partly fix the concrete fracture in natural methods. Following are the four processes that can block cracks in concretes The development of CaC03 or Ca0H is another method to prevent cracks. The crack is obstructed by impurities in the carriage of water Crack is further obstructed by hydration of the unreacted cement. Crack is impeded by the enlargement of hydrated *cementitious* pattern in the crack loins (such as the lump of calcium silicate hydrate gel). [30]

CHEMICAL PROCESS

The chemical healing process mainly refers to artificial healing by injecting chemical compounds into the crack for healing. Self-healing concrete is designed by mixing chemical liquid reagents (i.e. glue) with fresh concrete in small containers. The two common chemical methods that make use of glue addition to the concrete for healing purposes: are (1) Hollow pipettes and vessel networks containing glue and (2) Encapsulated glue. [30]

BIOLOGICAL PROCESS

The use of microorganisms to design self-healing concrete has been categorized as a biological strategy by several
researchers. Microorganisms can grow almost everywhere such as soil, water and oil reservoir, acidic hot springs, and industrial wastewater. Microorganisms are mostly separated into three important categories: bacteria, fungi, and viruses. Among these microorganisms, special strains of bacteria capable of precipitating certain chemicals are used to design the biological self-healing concrete. [30]

IMPACT OF BACTERIA ON THE PROPERTIES OF CONCRETE

COMPRESSIVE STRENGTH

The application of bio concrete to find out its true potential is quite a complicated area for research purposes. The inclusion of bacteria in concrete and mortar caused a significant amount of progress in the compressive strength of concrete. The underlying principle is that crystals of calcium carbonate would precipitate on the bacterial cell surface and gradually form a blockage to pores and cracks which would lead to shortening the supply of oxygen, water, and other nutrients, making it an unfavorable condition for bacteria to grow. The cells of the bacteria either become dead or turn into endospores to act as organic fibers which also help in the improvement of concrete strength. [29]

WATER PERMEABILITY

The permeability of concrete is the physical property that controls the rate of absorption of liquid by it. The durability of concrete mainly depends on this aspect as aggressive and hazardous materials mixed in water can penetrate it if the concrete mass is more permeable and vice versa. Porosity in concrete is formed due to improper compaction leaving air pockets, space left due to evaporation of water, inadequate water/cement (w/c) ratio, improper curing, and formation of micro cracks. The deposit of Calcium Carbonate (CaCO3) is found to help reduce the permeability of concrete specimens. [29]

CHLORIDE PERMEABILITY

Reinforced concrete structures get deteriorated by chloride attacks resulting in corrosion of reinforcing steel. The internal pore network of concrete plays a major role in accessing the ion of chloride into it. The pore structure depends on factors like mix design, use of admixtures, construction practices, degree of hydration and curing process, etc. A chloride permeability test is carried out by calculating how much electrical current is passing across a concrete specimen. Based on the charge passing across it, the concrete's permeability is assessed. Adding bacteria to the concrete, its resistance to chloride permeation can be enhanced. [29]

CORROSION

Large infrastructures fail mainly cause of the corrosion, which affects steel when reinforced concrete is mainly exposed to chloride ions, which essentially react with steel, eating it inside and creating a void. For this reason, necessary attention needs to pay to reducing concrete's permeability. To avoid corrosion, sufficient measures are needed to be taken to reduce the permeability of concrete. Because, the higher permeability of concrete allows unnecessary water, chloride ions along with chemicals which cause corrosion of steel within. [29]

ADVANTAGES AND DISADVANTAGES

ADVANTAGES

- Redressing cracks can be done efficiently.
- Excellent resistance against freeze and thaw attacks.
- It has lesser permeability compared to conventional concrete.
- The use of self-healing concrete extensively enhances its strength of concrete.
- The chances of corrosion of reinforcement are compact to insignificant.

- Overall destruction cost of this concrete is low.

DISADVANTAGES

- The investigation concerned to observe calcite precipitation is costly.
- The cost of this concrete is comparatively higher than conventional concrete; it's about 10-30% more than conventional concrete.
- No kind of design of bacterial concrete is mentioned in IS codes or any other codes.
- Bacteria which are used in concrete are not good for human health; hence usage should be controlled to the structure.

DISCUSSION

The work done previously on self-healing concrete is reviewed to understand the influence of different bacteria on the mechanical properties of concrete. The mechanical properties were better as the cracks were filled with calcium carbonate. As of now, the self-healing of concrete is being studied in the laboratory. The focus should be aimed at dropping the healing time and improving the productivity of materials used in the self-healing concrete.

When compared with conventional repair methods, self-healing of concrete can heal the micro-cracks present inside the specimen. Self-healing of concrete can be used in marine and subterranean concrete because of its healing ability. The presence of calcium ions is necessary, for the precipitation of CaCO3. Based on the work done previously, the water absorption, and permeability, reduce when compared to conventional concrete. The life span of the structure will be increased due to the utilization of calcite precipitation by the bacteria. Self-healing of concrete can also be done by the addition of admixtures, fibers, and polymers, which are capable healing of the cracks

CONCLUSION

Previously on self-healing concrete and from the above study on self-healing concrete, the subsequent important points are accomplished, The significance of this work is to recognize the study of different types of bacteria used for healing cracks. The implication of this research work is to be able to work out the use of concrete crack healing of a variety of isolates of urease-produced bacteria, such as Bacillus subtilis. Investigates various bacteria used for cracks. This review work also establishes that concrete compressive strength ability is a favorable effect on bacteria. Bacteria reduce water penetration and chloride ion permeability. Bacillus gives quick healing action in comparison to other bacteria. Make of strong bonding between molecules of filled crack by strengthening of ionic bond or intermolecular hydrogen bond. Bio concrete is eco-friendly but it increases human health-related issues when the contact duration is long.

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Automated control to find software weaknesses

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Abstract: Given its scalability and cost-effectiveness in comparison to a human expert-based solution, an automated system to identify, exploit, and patch software vulnerabilities sounds quite appealing. Also, the success of the DARPA-sponsored Cyber Grand Challenge (CGC) has brought a lot of corporate and academic interest to the subject of autonomous cyber reasoning systems (CRS). The basic technologies of a CRS, such as vulnerability detection, exploitation, and patching, are covered in-depth in this paper through an exhaustive survey of previous representative studies. The capabilities of machine learning technologies in this field are then reviewed in a number of key supplementary studies, and it is highlighted that machine learning is vital to the future development of autonomous CRS.

Due to the programmer effort and timing limitations, Software flaws need to be classified into those that are significant and those that are generally harmless. Security flaws are frequently of utmost importance, yet it can be challenging to determine whether an attacker can take advantage of a problem for sinister motives.

Key-Words: Deep neural network, cyber reasoning system, Software Vulnerabilities, vulnerability detection, vulnerability exploitation, vulnerability patching, machine learning, information gain, software security, vulnerability classification

INTRODUCTION

Software is becoming increasingly significant in many spheres of life around the world due to the rapid growth of information technology, including the military, society, economy, and others. Software security is simultaneously rising as a global problem. One of the main factors contributing to security issues is software vulnerabilities. High-level hackers are capable of doing a variety of unpleasant things with software flaws, including stealing users' private information and shutting down vital equipment. Less than 1600 software flaws were found in 1999, based on data supplied by the Common Vulnerabilities and Exposures (CVE) group. Comparatively speaking, the quantity of vulnerabilities now protected by CVE and the National Vulnerability Database (NVD) is close to 100,000 [1]. Massive software vulnerabilities exist, but developers lack the time and resources to address them all. Therefore, the question is: which defects can be exploited and should be corrected first?[2]. Because of this, the main objective of software security is to identify and correct security-critical flaws. Finding and fixing software vulnerabilities, however, need extensive expertise. In comparison to the quantity of software vulnerabilities, there are far too few developers who are capable of performing these tasks. Because there are millions of new software systems released every day nowadays, the demand for machine-speed vulnerability discovery and patching that is automated, scalable and it is growing critical. To this purpose, DARPA held the CGC in 2016. This event not only gave us a stunning glimpse of how well robots can hack one another, but it also significantly advanced the development of automated methods for finding, exploiting, and repairing software vulnerabilities. In the meantime, Google reported a huge advancement in artificial intelligence. [3], We now have new possibilities for using computing systems to automatically and intelligently address software security issues. From here, we provide a thorough analysis of prior sample research pertaining to the fundamental CRS approaches, such as vulnerability discovery, exploitation, and patching. Despite the fact

that some researchers favor Brooks [4] has proposed an investigation based on two CRS incidences—Mechanical Phish and Mayhem—in this area; nevertheless, our work differs from theirs in a number of ways. First, we examine these works from the standpoints of both chronology and classification.

Then, as a crucial complement, we cover a number of groundbreaking studies that look at the possibilities of machine learning tools in this area. The final section of our survey focuses on cutting-edge works. TABLE I provides a summary of various strategies.

OVERVIEW

DETECTION OF VULNERABILITY AUTOMATICALLY

Researchers are giving digging vulnerabilities more attention as a result of the prevalence of vulnerabilities and the significance of their effects. Vulnerability detection methods can be loosely categorized into three groups depending on whether to run the software being tested: static evaluation, dynamic evaluation and mixed evaluation.

Static Evaluation (analysis)

Without actually running the software, static analysis analyses it [4]. Figure 1 shows how binary static analysis works overall. And as Fig. 1 illustrates, From the perspective of program modelling, we classified it into two groups based on the modelling of static analysis.: static analysis based on graphs and modelling data while using static analysis. Then, we will give them a thorough introduction.

1) Static analysis based on graphs: Static analysis that models graph of program characteristics, such as (DFG)data-flow graphs, (PDG) program-dependence graphs and control-flow graphs (CFG), etc. To find problems in a program, these methods depend on building a model of bugs out of a group of nodes in the CFG or PDG [5]. For instance, BitBlaze's The Vine static analysis module provides a lot of crucial functions for identifying vulnerabilities, such as DFG, CFG and the weakest precondition calculation, etc [6]. Yamaguchi et al. [7] To achieve efficient vulnerability detection, create a code property graph that combines CFG and PDG. The CFG recovery techniques are shown by Angr in two analyses: CFGAccurate and CFGFast [8]. This essential element CFG gives the system the capability to evaluate all potential program paths in order to obtain high coverage for static analysis and also to minimize between 30% and 70% Various software security flaws from the original.

TABLE I
RECENT TECHNOLOGIES FOR VULNERABILITY DETECTION SUMMARY, PATCHING AND EXPLOITATION

		Particular Technology	**Advantages**	**Disadvantages**
Automatic Vulnerability Detection	Static Analysis	Graph-based static analysis	high code coverage	lack of program run-time information
		Data modelling with static analysis		
	Dynamic Analysis	Fuzzing: AFL, AFLFast, AFLGo, etc	fast	low code coverage
		DTA: DTA, TEMU, DTA++, Etc		
	Mixed Analys	concolic: DART, CUTE, Driller	fast, high code	path explosion

	is		coverage	
Automatic Vulnerability Exploitation	Patch-Based Exploits Generation	APEG	scaling up to multiple paths	Lack of ability to create control flow hijacking, patch dependent
	Control Flow Hijacking Exploits Generation	AEG, Q, PloyAEG, Rex, etc	construct hijacking of control flow	too many available defenses
	Data-Oriented Exploits Generation	FlowStitch, DOP	Turing-complete	better deep semantic knowledge is required
Automatic Vulnerability Patching	State-based Repair at Runtime	Monitor: Clearview, etc	fix a bug quickly	fix the bug without drastically
		Rollback: Rx, REASSURE, etc		
	Detect-based Repair	Input Filter: TAP,etc	higher calibre patches	extreme computation
		Repair based on Search: GenProg, PAR, etc		
		Statistical debugging metrics: SemFix, etc		
		Standard Semantics		
Machine Learning	——	Deep Learning: LSTM、GRU, etc	End-to-end, without intervention, and higher accuracy	sluggish and expensive

Model validation is a component of graph-based static analysis, which models a program's behavior as a graph. Tools like slam and cboc, among others, use model checking. Additionally, it has a comprehensive theory and a high level of automation, although it suffers from space-time overhead issues as a result of state explosion. Similarly, most graph-based static analysis methods run into the same problems: The model for solving is too big., making it impossible to compute a workable solution. Researchers suggest a novel approach to static analysis that bases its reasoning on abstractions of the data that a program operates on in order to increase computation efficiency [5], It will be explained in the paragraph that follows.

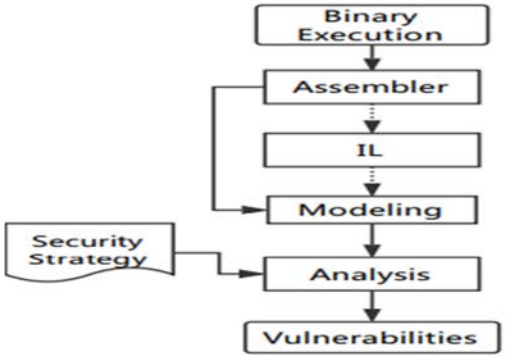

Fig. 1. General Binary Static Analysis Process

2) Modelling data while using static analysis: R. Cousot and P.Cousot [9] In order to streamline and approximatively calculate fixed points, a lattice theory-based Abstract Interpretation (AI) method was suggested in 1977. To enable AI to create a theoretical foundation for static analysis with data modelling, the primary objective is to achieve a balance between computational correctness and efficiency. To some extent, the state explosion issue can be resolved thanks to AI incorporated in the as tree static analyzer.
We discuss a well-liked AI-based technique in this area called Value Set Analysis (VSA). VSA's Its key feature is that it outperforms the values approximated by memory. Therefore, using an indirect jump statement as a target, VSA can be employed. Balakrishnan et al. put forth the VSA's original design. [10]. Later, Loong Checker [11] use an accurate VSA to identify addresses in order to resolve as many alias problems and indirect control transfers as possible. Afterward, Josselin Feist and co. [12] present GUEB, a static tool that searches for use-after-free vulnerabilities in binary programs by using free instructions based on an abstract memory model and VSA to analyze each variable in the assignment. Patch matching is the process of comparing how similar the original software and the program after patching are in order to determine where the differences lie, is another paradigm of static analysis with data modelling besides VSA. In recent years, patch matching has become a common technique. There is substantial theoretical and empirical support for it. For example, Li et al. [13] Offer a syntax-based approach that addresses the code clone vulnerability well. Sha et al. [14] show an automated Patch-based Vulnerability Description (PVD), and it showed that all Patch-related Bugs may be defined in PVD. Xu et al. [15] build the SPAIN patch analysis framework, which can detect and locate vulnerability fixes by automatically learning security patch patterns and vulnerability patterns. The scope of positioning will be reduced by patch matching, thus it is not necessary to find vulnerabilities across the entire application. Additionally, it has been extensively utilized in numerous tools, including Fortify, Clockwork, Prefix, and Clockwork. The advantage of static analysis is that the methods mentioned above may frequently reach a high level of code coverage of the program. The lack of crucial runtime data for the program is a weakness in the static analysis that is intrinsic to it. Dynamic analysis is proposed to obtain improved runtime information use.

Dynamic Evaluation (analysis)

The behavior of a program while it is operating in a certain environment is examined by the dynamic analysis. Two common dynamic analysis techniques are fuzzing and dynamic taint analysis.

1) Fuzzing: Fuzzing is an automated black box testing approach that involves supplying purposefully incorrect data to a product in an effort to cause an error condition or fault in order to identify any potential security flaws [16]. Fuzzing is quick and can provide several tests at once, but it has little coverage because it does not involve any program analysis. In the context white box testing automatically, SAGE [17] Microsoft Research recommends using the generational search algorithm periodically together with a coverage-maximizing heuristic design to strike a balance between code coverage and effectiveness. Godefroid et al. [17] use

it to find more than 20 previously unknown vulnerabilities in important Windows apps to verify its effectiveness. However, binary lifting and program analysis are required for white-box fuzzing, which could have a negative impact on efficiency. In light of this, researchers advocate grey-box fuzzing, a middle ground between white box and black box analysis. extra information about the interior structure but without the program analysis, White-box fuzzing and black-box analysis may not be as efficient as grey-box fuzzing [18]. The most advanced vulnerability detection technology is called grey-box fuzzing [19]. American Fuzzy Lop (AFL) is a well-known implementation, which has found many high-impact vulnerabilities. One of AFL's drawbacks is that its mutation engine lacks syntactic awareness, as a result, various technologies are attempting to expand AFL. For example, AFLFast [18] and AFLGo [19] extend AFL using knowledge of the Markov chain and the simulated annealing technique, respectively. We can observe a new trend in software security, which is the growing popularity and potency of methods based on machine learning, from the aforementioned extension of AFL.

2) Dynamic Taint Analysis: Denning initially suggested taint analysis in 1976 [20]. While James Newsome and Dawn Song first formally suggested the Dynamic Taint Analysis (DTA) in 2005 [21]. monitoring and evaluating the program's flow of marked data as it runs is referred to as DTA. TaintCheck is used to confirm the accuracy of DTA, and it is demonstrated that DTA is capable of identifying the majority of vulnerability types. To increase the DTA's adaptability and scalability, Researchers like Dytan and TEMU create generic frameworks. However, Schwartz et al. [22] mention the various fundamental difficulties that DTA faces in producing reliable analytical results. And under-tainting and over-tainting are the two fundamental problems. Numerous DTA optimization techniques are offered to address these issues. For instance, DTA++ [23] is suggested to discover a minimal set of implicit program processes that could result in under-tainting in order to fix under-tainting without producing over-tainting. DECAF [24] keeps track of taint labels in an asynchronous way at the bit level, that permits accurate along with lossless dynamic taint analysis. Also, Ma Jin-Xin et al. [25] propose a method to enhance DTA based on offline indices of the instruction trace, and the effectiveness of their technique is confirmed. It is 5 times faster on average and can find more vulnerabilities than TEMU.
By examining the runtime data, dynamic analysis is more accurate than static analysis but has lower code coverage [4]. combining static and dynamic analysis (i.e., mixed analysis) hereby establish the goal of achieving superior analysis.

Mixed Evaluation (analysis)

For all teams competing in the CGC competition, the mixed analysis has all but become a requirement, they show that mixed analysis is an effective method for software security. Researchers have suggested a wide variety of automated techniques. DART [26], CUTE [27], EXE [28], KLEE [29] and SAGE [17] are a typical example of this region. The cutting-edge method, known as concolic execution, is to let the symbolic execution be driven by the physical execution. A tangible state and a symbolic state are both maintained via concolic analysis. Starting with some predetermined or random inputs, a program is run, acting on conditional expressions to gather symbolic restrictions as it goes. Then, It uses a constraint solver to infer different values for the important inputs so that the program's execution might proceed in a different way [30].
The imprecision caused by the interaction with external code or constraint solving timeouts might be lessened by the usage of concrete numbers, which is a major benefit of concolic analysis tools. However, Path explosion remains a significant obstacle that they must overcome. There are two approaches to fixing the issue: To get the best of both worlds, the initial strategy is to combine online and offline (concolic) execution. Mayhem [31] utilizes a hybrid symbolic execution mechanism in this manner. During the online exploration, It may quickly switch between states, and extra states are shifted to discs to be investigated in fresh research [2]. The second is to use concolic analysis to support fuzzing analysis. For instance, Istvan Haller. [32] Create the new search technique Dowser that aims to minimize path explosion and maximize pointer coverage. And Driller, which was suggested by Nick Stephens et al., is the normal and well-liked instrument in this approach. [33] It

addressed the path explosion issue by combining concolic analysis and AFL. The two strategies discussed above attempt to prevent path explosion by simplifying the work of the constraint solver. It cannot, however, fundamentally resolve the problem, making it a challenging area for further study.

EXPLOITING AUTOMATIC VULNERABILITY

Only a set number of patches are available which can really be used because of financial constraints. Selecting the vulnerability to address is a difficult decision [34]. Therefore, finding security-critical defects and fixing them as quickly as feasible is the most crucial aspect of software security, for which automatic vulnerability exploitation is responsible. The automatic development of vulnerability exploits is a vital and useful tool for finding and validating program problems. The methods currently in use can essentially be divided into three categories: Creating Patch-Based Exploits, Control Flow Hijacking Exploits, and Data-Oriented Exploits [35]. These three techniques will be thoroughly explained in this section.

Developing Patch-Based Exploits

As a result of programmers frequently reusing code, vulnerabilities are frequently duplicated. Security updates are frequently not applied to all copies of the code, but they could be used to exploit newly discovered flaws [13]. An attacker may benefit from having early access to a patch. Researchers have proposed a patch-based exploit creation methodology, with the typical approach being Automatic Patch-based Exploit Generation (APEG). David Brumley and others have proposed the APEG [36], and it has been used successfully to produce exploits for 5 real-world vulnerabilities, demonstrating its viability. However, from a practical perspective, APEG mostly produces denial-of-service exploits, this cannot directly lead to a control flow hijacking, but can only result in the original program crashing. Therefore, then it is proposed to use Control Flow Hijacking Exploit Generation.

Exploitation of Control Flow Hijacking

The APEG's flaw of patch reliance and its inability to construct Methods based on control flow hijacking have been used to overcome both of these issues. Heelan [37] carries out the technique initially. Automatic Exploit Generation is the traditional approach (AEG) [38] Thanassis' suggestion. The fundamental idea of AEG may be broken down into four steps: Find the weakness first, then close it. Second, gather program run-time data, such as information on the stack layout. Thirdly, create exploits using the previously mentioned data. Finally, confirm the exploits. The first fully automated method to take advantage of control flow centered vulnerabilities is AEG. AEG has some drawbacks, such as a reliance on the source code, compiler limits on the exploit samples, and dynamic operating settings. To solve the problems listed above, Q [39] later serves as a suggested abuse a system's hardening. based on studies into AEG and Return-Oriented Programming (ROP) [40], Q was developed to circumvent memory protection mechanisms such as W†X Address Space Layout Randomization (ASLR), among other things. PloyAEG [41] is proposed that may quickly create a large number of exploits for a vulnerable program. Rex [42] keeps formulas for every register and memory variables in order to create a Proof Of Vulnerability (POV), and mechanical phishing uses it, that finished third in the 2016 CGC Final Event. AEG has been enhanced by each of them to some degree, increasing the viability of the technology. However, the majority of the attackers have shifted their focus away from control-oriented exploits and toward data-oriented exploits when it comes to the widespread use of defenses against control-flow hijacking assaults.

Development of Data-Oriented Exploits

Instead of changing the program's core control flow, data-oriented assaults change the direction of data flow. There are not many comparable defense techniques, and data-oriented attacks have not yet attracted considerable attention. Data-oriented exploit generation is therefore more adaptable and practical.

Given this research context, the Liang team proposed a novel method termed data-flow stitching, which is used by the tool FlowStitch [43]. FlowStitch is the first, successfully tested approach for automatically creating data-oriented attacks. However, It has various restrictions, such as the requirement that the program must first have there is at least one known memory error. Later, they offer the suggestion of Data-Oriented Programming (DOP) [44] that puts the method for locating, obtaining, and programming attack code blocks and code blocks for instruction scheduling assignment in the actual programs into effect. DOP is Turing-complete if it can run

arbitrary code and bypasses system safeguards like DEP and ASLR. Above all, Deep semantic comprehension is usually necessary for automatic vulnerability exploitation, which is challenging. Therefore, it is a hot topic, and more study is required to improve deep semantic machine analysis in the future.

PATCHING VULNERABILITIES AUTOMATICALLY

due to various practical factors, such the worms' quick spread [45], To ensure that software operates properly in its early years, researchers proposed a variety of automatic patch approaches. The fundamental purpose of these solutions is to stop malware from being hijacked. Prior to recently, nearly every element of software is rapidly using automatic patch technology. Now in this section, we will talk about automatic vulnerability patching techniques that mostly focus on automatic patch technologies for software security.

Process of Automatic Patching

The automatic patch technique frequently involves a number of standard phases, including fault detection, patch generation, and function verification.

1) fault-locating: Locating faults reveals where flaws or failures are located. the initial stages, Researchers used programs to track down failures, Some academics employ fuzzing to discover the inputs that cause problems, such as logging its operating states. Then, static analysis techniques, e.g., AST, are used. Software faults are found using semantic analysis-based techniques, and AST offers promising futures. AST examines a program's structure and offers information for patching. When source code is not supplied, monitoring the program's execution is still an effective option for defect location.

2) Patch-generating: The crucial stage is patch generation. Two different types of patches exist: vulnerability-eliminating and vulnerability-tolerant. For the patch that eliminates vulnerabilities, A patching technique based on semantics is suggested. Initially developed by a group under the direction of Goues C L. GenProg searches a patch-space created by semantic analysis for the appropriate patches using a set of patch templates. For the patch that tolerates vulnerabilities, two patching techniques are frequently employed. Implementing an input filter is the first step in eliminating trigger inputs. This strategy is used by VSEF [46] and TAP [47]. The adoption of a checkpoint system is the alternative. Before executing susceptible instructions, it is used to save states, and when an error occurs, it is utilized to roll back to a safe state.

3) Function-verifying: It is necessary to check the functionality of the patched program after patches have been implemented. Currently, the software testing phase of the verification process is primarily carried out utilizing a variety of test cases created from the software specification or provided by the software designer. GenProg's This type of checking tool is beneficial due to occurrence.

The study divides automatic patching techniques into two groups in terms of vulnerability patching strategies: and detect-based maintenance and real-time state-based maintenance. These techniques are thoroughly explained in the two subsections that follow.

State-based Runtime Repair

The following techniques will fix flaws or take steps to get around vulnerabilities while a program is running without stopping it.

1) Monitor: To fend off the swift spread of worms and other threats, VSEF [46] To achieve automatic software patching, binary-based whole execution monitoring and automatic input filtering are combined. DieHard [48] tries to fix heap overflow security holes. Randomization is used, the use of replication and other techniques to create a nearly limitless heap. equivalent to DieHard, Exterminator [49] By utilizing randomness to find faults and merging patches to create a new patch, the solution to buffer overflows and dangling pointers is provided. ClearView [50] is an

idea that Jeff et al. By automatically observing how registers and memory locations are used in x86 systems, it fixes binary problems. When errors are discovered, they are fixed by changing the variables and comparing the results to the typical runtime log. ClearView can reduce the risk of invalid change of control flow and memory write out of bounds vulnerabilities.

2) Rollback: Rx [51] is a technique for automatic repair suggested by F. Qin et al, this draws inspiration from the strategy for eliminating allergens used in allergy therapy. Considering this notion, Rx When errors occur, the program's execution environment is changed to restore health. Rx will then relaunch the application, and make an attempt back to the checkpoint-state, please. In contrast to past methods, ASSURE [52] explains the concept of Rescue Point (RP). RP is where the software is located that has to be restarted when it notices known faults. ASSURE can be seen as managing an exception. It analyses the causes of fixing issues like memory write out of bounds and improper transfer control using virtual execution to imitate the runtime environment, etc. REASSURE [53] is ASSURE-based, with the goal of streamlining ASSURE deployment and enhancing its functionality.

Repair based on detection

Detect-based maintenance fuzzing test is mostly used to construct a patch to correct the software, utilise genetic programming to filter the input that could cause the error after AST analysis or correct the flaw via constraint solution. The following subsections will introduce four different types of detect-based repairs.

1) Entry Filter: similar to other earliest automatic patch techniques, Vigilante [45] is also intended to defend against worms, and by self-certifying notifications, it automatically produces input filters. Regarding buffer overflow, TAP [47] creates two repair templates to automatically detect, produce, and insert source-level patches to filter input.

2) Repair based on Search: Researchers now focus on genetic programming for automatic patching techniques. GenProg [54] is a case of success, it extends genetic programming to automatically fix programming flaws without the requirement for formal specification, unique coding or software annotations. To further reduce the discrepancy between the patched and unpatched programs, structural differencing methods and Delta debugging are used, to provide automatic patching with minimal changes, (PAR) Pattern-based Automatic Program Repair [55], just looking at previously applied hand patches, one can spot healing patterns. Over 60,000 hand patches have been examined by researchers, who have discovered a number of typical repair patterns that PAR can use to produce patches automatically. Researchers claim that despite spending a lot of time personally constructing the repair templates, these templates are highly reusable, this can be applied to various situations. AE [56] is depended on GenProg, but it improves the effectiveness of the healing process. Due to AE's formalization of repair expenses as test executions and makes extensive use of techniques like syntax and data flow analysis to minimize patch search space. The order of tests has to be changed to increase the likelihood that patches would succeed. AE additionally gives the most likely to succeed or fail patches the highest priority. similar to AE, SPR [57] further reduces the search space and boosts search effectiveness by using subsection repair and conditional synthesis. Propht [58] creates accurate probabilistic models by learning from manual fixes. The test approach will rank patches based on these probabilistic models to determine the appropriate patch for flaws or vulnerabilities.

3) Metrics for Statistical Debugging: Recent years have seen the application of constraint solving to automatic patch technologies. SemFix [59] is an automatic repair technique based on semantics that combines symbolic execution, program composition and constraint solution. In this technique, Programs that require patching are expressed as constraints using a predetermined set of tests. Then, SemFix creates patches using dynamic symbolic execution and semantic program analysis. DirectFix [60] and Angelix [61] are depend on SemFix. DirectFix differs from all currently used repair techniques, it combines finding faults and creating patches. To provide the program modification that is minimized, DirectFix employs the MaxSMT solution. Angelix uses the angelic

woodland as its model. Angelix is more scalable and capable of high-quality and multi-line than GenProg and SPR.

4) Basic Semantics: Since fixing existing mistakes is likely to result in the addition of fresh errors, Gopinath et al. [62] suggest a code of behavior for automated patch technologies based on specifications, reducing future uncertainty and correcting misstatements via regulatory limits. They specify and resolve specification constraints using the SAT-based Alloy toolkit.

Regarding the review above, the field of automatic vulnerability patching has made significant strides. However, all problems cannot be fixed by it, and patching zero-day vulnerabilities is difficult. the most challenging component, better deep semantic comprehension is necessary for automatic vulnerability fixing. As a result, the most difficult research topic might be characterized as machine understanding of deep semantic, where machine learning will have a significant impact.

IN SOFTWARE SECURITY, THE USE OF MACHINE LEARNING

According to Sec.1, in light of CGC's 2016 accomplishments, we are at the beginning of an era where software vulnerability detection, Machines are capable of performing exploitation and patching in an automated and scalable way. Nevertheless, recent breakthroughs AlphaGo's use of Deep Learning (DL) [3] provide up new opportunities for DL and other machine learning-based technologies to be used to enhance the effectiveness of automatic software vulnerability detection, patching and exploitation. We present a thorough analysis of the developments in this area and go over the unresolved issues in this part.

Vulnerability Exploitation and Detection

Due to the fact that picture classification, speech tagging, and other common machine learning challenges are extremely different from vulnerabilities detection, etc. To close this intention gap is the key challenge for using machine learning to find software vulnerabilities. Some pioneering papers have recently been published in this direction. Some researchers attempt to import external data that is required for program execution in order to speed up the vulnerability detection procedure. As an illustration, Perl et al. [63] Describe a method for locating potentially dangerous commits using code repositories with meta-data and code metrics. They analyze data from 66 C/C++ GitHub projects, totaling 170,860 commits, includes 640 changes that contributed to vulnerabilities and were assigned CVE IDs. According to this dataset, A bag-of-words model is used to extract and jointly represent heterogeneous characteristics. On top of these attributes, The dataset is used to develop and train an SVM classifier to identify the commits that are said to contribute to vulnerabilities.

Some studies aim to improve profound semantic comprehension. In order to find vulnerabilities, the program's semantic information is extracted, Zhen Li. [64] implement the Vulnerability Deep Pecker deep learning vulnerability detection method (VulDeePecker). Deep learning makes automation possible since it can produce features without the need for expert input. However, Deep learning to find vulnerabilities still needs some direction. The writers express the software applications using a code gadget with many blocks code lines that aren't always sequential and have semantic relationships. A Long-Short Memory with Bidirectional Access (Bi-LSTM) In addition to these code devices, a neural network is constructed and trained using the initial deep learning-targeted vulnerability dataset. VulDeePecker the National Vulnerability Database has four newly discovered vulnerabilities (NVD) that attests to its efficiency.

In order to exploit vulnerabilities, Semantic information is also crucial. Wei You. [65] developed a novel method called Sem-Fuzz to automatically create an exploit by gathering the pertinent texts to vulnerabilities disclosed by Linux Git log and CVE. Details of the version, forms of vulnerability, and Functions of the vulnerability for the exploit which CVE offers. The vulnerability patch is described in the Linux git logs. SemFuzz is a semantic-based fuzzing solution that examines text linked to vulnerabilities rather than the actual code in order to extract semantic information. SemFuzz builds a call sequence to access vulnerable functions using this knowledge, after which the vulnerability is activated using seed mutation as fuzzing inputs. Review SemFuzz's dependability, in excess of 112 Linux kernel vulnerabilities disclosed by CVE over the previous five years were gathered by the author. Even zero-day and hidden vulnerabilities, which made up 16% of the vulnerabilities, were found.

Patching Vulnerabilities

Vulnerability patching still revolves around improving deep semantic information understanding. Two main tactics are listed below: semantics-driven approach and generate-and-validate approach. The research of machine learning used for vulnerability patching are then briefly reviewed. Ripon K. Saha et al. [66] ELIXIR is a generate-and-validate approach that is suggested for object-oriented programming. Utilizing method calls frequently is the key to this technique, to create and fix expressions, and to create patches for synthesizers. The authors rank the concrete repairs using machine learning, therefore it is possible to filter the resulting enlargement of the repair space. The semantic data surrounding the repair location, such as the code, is where the characteristics are derived. On two datasets, the authors evaluate ELIXIR: Bugs.jar and Defects4J. The findings indicate that, when the effective search and repair space was expanded, the number of bugs that were corrected dramatically increased.

Rahul Gupta et al. [67] suggest a programming error correction method called Deepfix that is semantics-driven and deep learning-based. Deepfix calling trained neural networks continually corrects many programming faults. The authors have created two different datasets with both accurate and inaccurate programs. In order to validate their methodology, the authors test 6971 incorrect programs using the Gated Recurrent Unit (GRU) model.

Unsolved Issues

Automation can be more effectively implemented using machine learning approaches, which suggests a fresh chance to strengthen the software's security. However, there are still obstacles to overcome when we try to integrate machine learning into this area of software security.

Following is a list of three typical difficulties:

1) Deep semantic comprehension: In light of the review above, we can infer that the importance of deep semantic knowledge for software security. better semantic comprehension, the higher the machine's capacity for automatic vulnerability detection, patching and exploitation. Therefore, improving deep semantic understanding through the use of machine learning will be a popular study area in the future.

2) The machine learning that is binary: Shin et al. [68] binary analysis using the recursive neural network method, but not directly for vulnerability discovery. While binary-based machine learning is uncommon, the majority of machine learning algorithms are created using source code. Consequently, further research into binary-oriented machine learning vulnerability identification is required.

3) The Datasets from open sources: The current datasets are built or temporarily gathered in accordance with particular special aims. It lacks open source datasets with broad coverage and abundant semantic information, such as ImageNet's [69] comprehensive data type. More crucially, it can be utilised for machine learning-based vulnerability identification and patching. Consequently, the open source datasets are required.

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A Survey on Prominent Load Balancing Techniques in Cloud Computing

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Abstract. Performing in the best way possible in a distributed environments requires load balancing. A distributed system is a group of autonomous systems in which data is spread among several nodes or locations. At these locations, a number of tasks are processed Given that one of the best platforms for data storage is cloud computing. Achieving an efficient load balancing result with today's requirement, requires constantly improving the latest Load balancing algorithms available, and with the increasing number of algorithms emerging every now and then, it's become very important to focus on a number of algorithms and achieve the best possible efficiency possible from each of them. In this Paper, Numerous algorithms were highlighted to point out which of them are effective mechanisms and algorithms to improve the Cloud's overall performance, and offer the user a clearer picture and overall understanding. In this paper, we look into the many algorithms put out to address the load balancing problem in cloud computing.

Key-Words: Cloud Computing, Load Balancing Techniques.

INTRODUCTION

Cloud Computing is mainly a technology that allows users to access computing services through the internet from centralized data centers. With the majority of the top website's databases being overload, and the increasing demand for better and more efficient storage options, Cloud Computing has become an apocalypse in the world of computing, attracting the majority of the companies by luring them with affordable prices and scalable services, it's truly the future of storage and other computing services. For proper load balancing, we must take into account a variety of ways and methodologies. In various methods, the load is moved from one node to another, or from an overloaded node to an underloaded node. Despite being an older method, it is still effective.

One of the popular ways to achieve load balancing is by using "Clustering", where a couple of Clusters are put together. Three parameters, minimum, maximum, and normal are considered for a better load balancing [2].

A popular technology used by both business and academia, cloud computing offers a flexible and effective means to store and retrieve materials. The primary challenge is scheduling incoming requests in a way that ensures a minimal response time,[1] effective resource usage, and at the same time prevents resource underutilization. Clustering of sites is another method for properly implementing load balancing, in which one or more clusters are built to balance the load.

We have different schemes to survey on the basis of static and dynamic load balancing. We have different schemes to survey on the basis of static and dynamic load balancing. To increase response time and resource usage, a widely used technique takes into account load distribution and load shifting. In most distributed systems

a load balancer is used, as it helps in improving the load handling and application usability. To receive incoming traffic and send calculated data to the client in a timely manner using various methods, a load balancer is placed between the client and server machines in a network. The phrase virtualization, which increases datacenter power efficiency and allows virtual machines to run on a single physical server, is frequently used in cloud computing systems.

A load balancer lowers each server's load in order to prevent a single point of failure and rescue overburdened nodes. Thus, load balancing helps the system as a whole. Internet-based computing is known as cloud computing. All services, including operating system, network, and storage, are dynamically delivered across the internet in response to user requests. resources, software, and also hardware. And these services are termed as Software as a Service, Platform as a Service and Infrastructure as a Service.

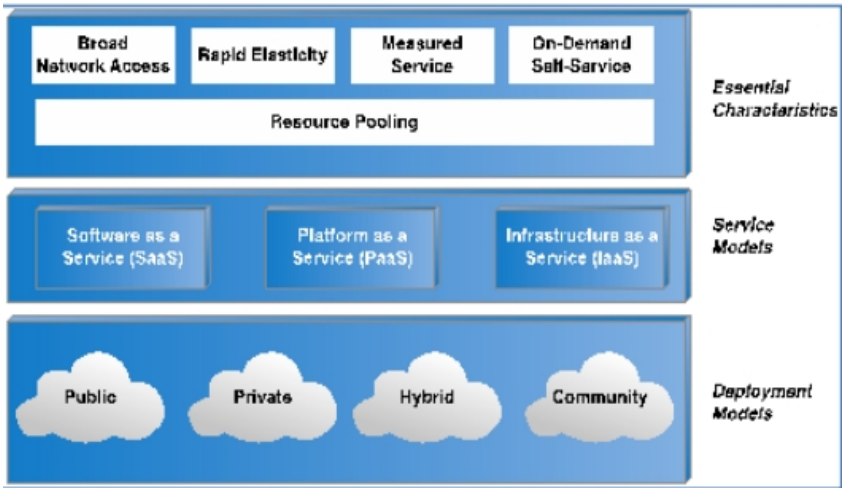

Fig 1: Cloud Computing Framework [2]

INFRASTRUCTURE AS A SERVICE

Infrastructure as a Service (IaaS) is the simplest cloud service model (IaaS). It provides the company with hardware as a service, including server space, network hardware, CPU time, physical virtual machines, and other resources.[2]

SOFTWARE AS A SERVICE

SaaS allows users to access a variety of services, including software applications from multiple cloud providers, over the Internet. Pay-per-use software is used by the consumer [2]. They call it "on-demand software."

PLATFORM AS A SERVICE

In PaaS models, cloud service offers an entire platform for various purposes like developing applications.[2].

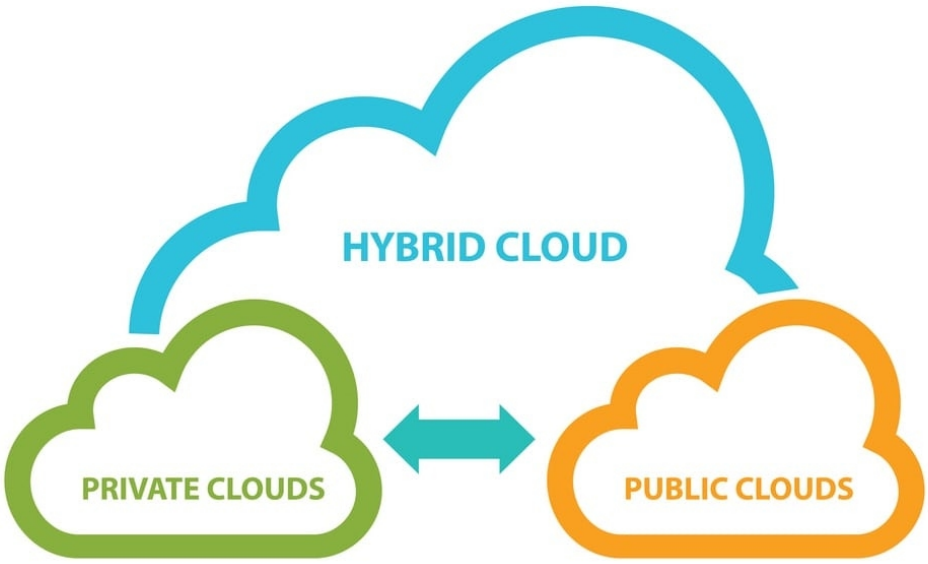

Fig 2: Types of Cloud [3]

Public cloud: A person will only requires a Computer device and a reliable internet connection to access this type of cloud. Examples of this type of cloud include Google's, which is accessible to everyone following a defined SLA between provider and user. It is accessible via subscriptions.

Private cloud: Employees of this type of cloud company have access to partner employment or the company's own data.

Hybrid cloud: It combines both public cloud and private cloud.

STATIC LOAD BALANCING

By providing earlier information in the system, static load balancing can be achieved. Under execution, the activity performance is processed. The load information is then processes at one node and sent to a far node for execution. Assign the workload based on the distributed work load calculation and begin the execution without taking into account the previous workload. Static load balancing produces non-pre-emptive nature. Although it demands resources and system weight, system load is independent of the system's current condition. The distribution of the load is completed earlier in a static workload load balancing algorithm. Some of the most popular methods:

Round robin Algorithm: One of the simplest approaches,[4] round robin load balancing distributes client data around a number of servers. In a small network with few servers, this strategy is used. We use numerous clients and several servers in this algorithm. The first server is given the request when a client initiate one and passes it to the server. The second server receives the second request when it is made, and the third server receives the third request. However, if a server receives a fourth request, the first server receives it and a ring type allocation is created. The server's capacity is limited in terms of the number of requests it can handle.

Randomized Algorithm: In randomized algorithms, the node is chosen at random rather than on a specific basis[8]. When a node has low load, a server will send that node the request so it can be handled there. The load balancer

is responsible for carrying out this specific task. Due to an overloading issue in this algorithm, any loaded nodes will move to the overloaded node.

a) ***Central Manager Algorithm:*** In the central manager algorithm for load balancing, we select a central node from a large number of nodes and base our selection on the number of requests this node can handle[8]. We handle the request after selecting the central node. In order to characterise the central node as performing the majority of the work, the load is transferred from the overloaded node to the lightly laden node.
This algorithm is not distributed-friendly. A central node must oversee all management functions. For a big, scattered network, this is ineffective.

DYNAMIC LOAD BALANCING

a. ***Cyclic Algorithm***: The result of the RAND algorithm is slightly altered in the cyclic based load balancing method to conduct. In a cyclic fashion, the load is assigned in the system. The benefit of this approach is that, unless the cycle is not finished in one spin, the process receiving the information won't receive a request for a specific time. The source process stores information. The information is sent back to a specific node if the source fails. The information transferred in this method takes place on a local level.
b. ***Min-Max LB Algorithm:*** In contrast to the min-min method, which executes the minimum node first, this algorithm will work the opposite way. After calculating the mean completion time for each node, this algorithm selects the nodes whose completion times exceed the mean value, and those jobs are then reprocessed to the node with the least completion times.
c. ***Never Queue:*** The never queue algorithm stands apart from the others. This algorithm does cost calculations after sending jobs to each destination via the sending server. This algorithm's primary function is to process urgent requests without having to wait in a queue. This method reduces the amount of time that delays cause in subsequent steps, which reduces delays throughout the entire process. The disadvantage of this approach is that it delays processing new requests until a quicker server is available to do so effectively. Therefore, the never queue technique is effective for speedy response**.**
d. ***Threshold and last***: Despite being independent algorithms, Threshold and Least Algorithm employed a similar methodology. These made use of the message exchange method's incomplete knowledge.
e. If there isn't a node available for transfer, the system is underloaded as a whole. We compute the load and look for a node to transfer after some time. When a certain amount of time has passed and no suitable node has been discovered to transmit the load, the process is carried out locally. Threshold algorithm includes the LEAST algorithm.
f. ***Minimum Execution Time:*** Regardless of the server's current load, this approach allocates each job to the one with the shortest execution time. This method seeks out a suitable job server pair. It may lead to an imbalance in the workload across the servers because it does not take into account the server's present workload.[5].
g. An approach for **two levels of hierarchical load balancing** was suggested by Geetha V. Megharaj [6]. To combat the high communication costs of distributed algorithms and the single point of failure issue of centralised algorithms, this technique uses Global Centralized Schedulers (GCS) at a higher level and Local Centralized Schedulers (LCS) at a lower one. A data centre asks GCS to determine the allocation of virtual machines when it receives a fresh service request. The GCS transfers a job to the proper LCS after gathering load information from each LCS. By gathering load data from the local computing servers, this LCS sends jobs to the appropriate computing servers, balancing the load on those local servers.
h. Wilhelm Kleiminger et. al [7] presents **Combined Stream Processing System** Here, the workload is adaptively balanced between a dedicated local stream processor and a cloud stream processor when the input stream rate varies. This method only makes use of cloud machines when the local stream processor is at capacity. The load is dynamically split between the local processor and the cloud processor by the load balancer.

DATA ANALYST TOOL

To carry out a problem simulation, check the results and performance analyst of a Load Balancing Technique, we use Data Analyst Tool.

Cloud Analyst tool is a user friendly tool based on the structure of cloud sim, CloudSim is a framework developed by the GRIDS laboratory of University of Melbourne which enables modelling, simulation and experimenting on designing Cloud computing infrastructures[16]. CloudSim enables modeling and simulation of Cloud Infrastructure. Modeler must concentrate on the complexity of the simulations, therefore Cloud Analyst separates the simulation experimentation activity from programming. The Cloud Analyst also enables modellers to easily operate over a number of simulation tests with little changes to the relevant parameters.

CLOUD ANALYST DESIGN

The capability of the Cloud Sim toolkit is extended by the addition of concepts that simulate the behaviors of the Internet and Internet applications to create the Cloud Analyst.

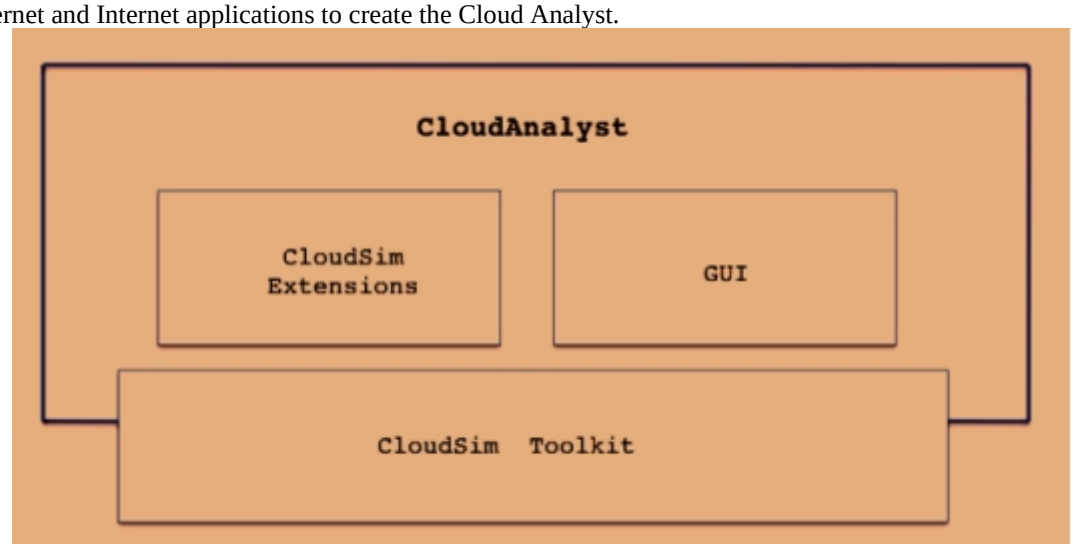

Fig 4: Architecture of Cloud Computing [2]

CONCLUSION

Application as a service, Platform as a service, and Infrastructure as a service are the main services that the cloud computing platform offers the user as a service. Load balancing is one of the main problems with cloud computing. We must constantly try to upgrade and work on in order to improve resource usage, enhance throughput, ensure fast response times, and improve energy consumption, load balancing is necessary to spread the load equally among all cloud servers. In the context of cloud computing, this paper covers several centralised and distributed load balancing approaches.

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IOT Sensing Environment with Cloud Based Data Storing and Processing - Review

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Abstract: In the current era all the technologies are using the concepts of IOT (Internet of things) with different sensors as per their usage to make human work and lifestyle much easier. Due to more demand for the success ratio of IOT in recent years, every industry is developing the task which is based on the internet of things. Further different sensors with other sensing environments can produce huge amounts of data. In which requiring much scale storage that can be costly, which led to exploiting the scalability in cloud resources to achieve the best practice with low cost, so to store large amounts of data solutions to handle and manage it smoothly cloud resources are used. Cloud service usage can make billing systems cheaper, and one can use the term "pay as you go", adding cloud computing resources to the IOT environment allow users to access the whole platform any time anywhere, involving cloud computing services to IOT system will definitely leads to much easier remoting system considering also the privacy and security offered by cloud computing platform which will take as benefits to the system.
This paper will represent a platform consisting of an IOT (internet of things) sensing environment which will have sensors and actuators only based on cloud services for data storing and processing. Even different reviews will be discussing the impact done by the platform and its pros and cons of the platform.

Keywords: Cloud Computing, IOT (Internet of Things), Sensors, Data Storage, Virtual Machine.

INTRODUCTION

In today's century of automated application and providing the easy solution for end users, IOT (internet of things) taking boost by achieving the efficiency with smooth technique, IOT has shown its benefits regarding many industries, medical [3] and monitoring applications [4], according to the need and use of it. The sensing environment have to applied which consists of sensors, actuators and smart devices, therefore in each and every solution we got to store and process the collected data generated by sensors which will be increased by the time of applying IOT solution, to manage, store and analyze this huge amount of data we need scalable and flexible resources to handle it, where we can exploit the different scalabilities of cloud computing resources .Cloud computing is the concept which allow us to use virtual resources remotely this resources can be storing or computing resources that allow to manage data [2] with help of tools, where cloud services [5]are different , SaaS (software as service), Paas (platform as a service), Iaas (Infrastructure as a service), simply we rent one of these services to store the data generated by IOT environment to get the flexibility in case of increased by the time , whatever solution applied in real time world it is for certain usage. Thus, the combination of IOT and Cloud services plays an vital role by providing facility of sensors and storing data on cloud resources which can make work easier.

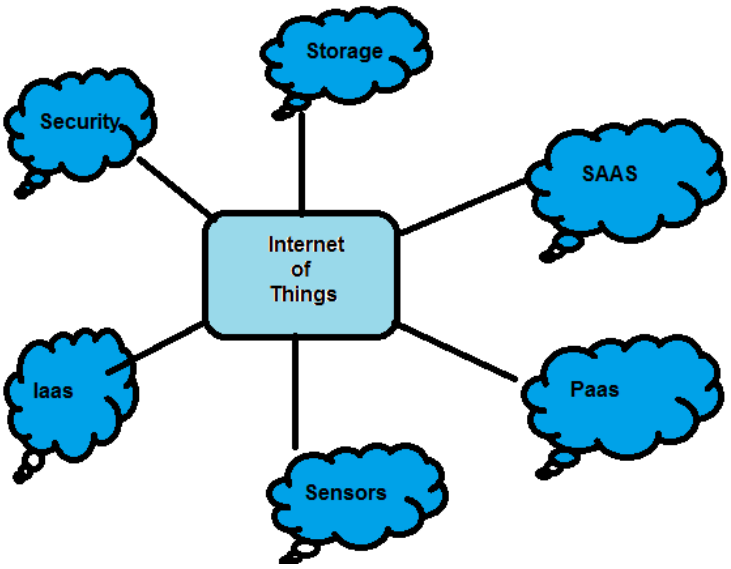

Figure 1. Internet of Things using cloud services

LITERATURE SURVEY

Different survey done on cloud storage and internet of things many researchers have done numerous works.

Nimbits[25] one of the study Cloud computing is an architecture which logs in servers and provides different services between IOT and data . With help of this once can record and share sensor data on cloud storage. Looking further it has shown that it gives an alert message if any mechanism has been done like sensor storage.

In one of the studies of Aazam et al [21] good reviews on internet of things and cloud services have been found. In this paper resources utilization and its benefits are being shared which help reviewers to know the exact knowledge about storing data in cloud base applications.

Further Amairah [16] have shown the study related cloud services and different usage of software as a work, platform, and infrastructure. Even it relates to cloud data storing in IOT applications. Security and risk sectors are being shared by the authors which can help to pass data through the internet using cloud.

The architecture of IOT and services of cloud are being easily explained by Malik and Om [19] which shows different comparisons about cloud computing and IOT. Even it shows the loop fall and benefits storing data on cloud computing. Further it shows different challenges faced on storing data from internet of things to cloud computing.

One of the studies of Paraimpu [27] shared that with the help of cloud computing people can be connected ,share things , use different services on devices and work with the help of the internet of things.Even user can connect sensors , use micro-controllers like Arduino,raspberry pi , espn8086 etc on internet and store data on cloud computing.It a social tool which allow user to communicate on network and share things on internet.The main advantage of this it avoid duplication.

Emeakaroha [16] has mentioned in state of art different tools and platform , and comparison between cloud platforms provided in the market to show the feature of each and help to pick one for use , by that we can inform that the most open source tool use textual interchange format where human is able to read and understand easily.

COMPARISON STUDY

Parameters	Internet of things	Cloud computing
Definition	It is a network of connected devices, to communicate and exchange data to perform certain tasks.[5]	The concept of providing computing resources virtually anytime anywhere on-demand.
Processing	There is limitation found	Unlimited to do
Storage	Limited	Unlimited
Usage	connecting and exchanging data with other devices and systems over the internet.	Providing tools, services, and computing resources over the internet [7]
Big data	Generate big data	Store and manage big data
Cost of improving capabilities	Very high cost	Less cost

Table 1. Comparison study of Cloud and Internet of Things

CLOUD OF THINGS

By focusing on the low abilities with IOT system like : cost and limitation of storage and processing performance which already mentioned in Table[1] , where we can see there is no limitation in cloud computing where we can assign very high performance processors and scale memory for our system in term of solution , therefor linking an IOT sensing environment with cloud storage and processors will be great solution regarding handling and managing data with low cost, this combination of IOT and Cloud computing know as (COT) cloud of things[6] ,Data transmission can be simply explained by linking the sensing environment with cloud storage over the internet figure[2] .

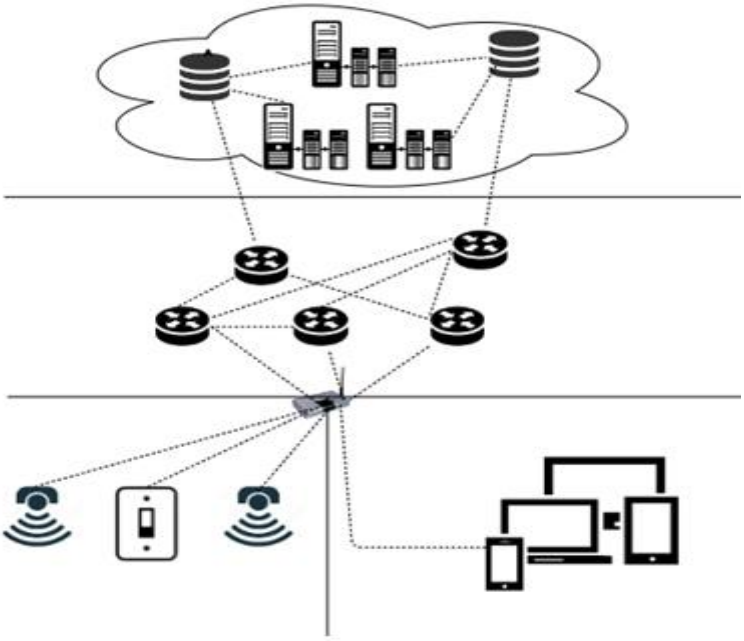

Figure 2. Three Layer Architecture IOT and Cloud

CONCLUSION

In this paper we gather information regarding internet of things, using different sensors and storing data on cloud computing. As per different comparison study and survey done on study of Internet of things and cloud computing data storing can be made much easier by using it. Further this would help to get data from the cloud whenever demanded or needed by the client for its use. As data is store on cloud services any natural calamities or disaster appears one can retrieve it. Still study is going on strong of data if it increases to large amount. If large amount of data has been stored then challenges face on security level, performance and resource utilization effects or not.

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An Infrared Photo Evaluation System for Mobile Remote Sensing

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Abstract: In order to monitor and map the heat distribution of regions in mobile remote sensing applications, this research offers an infrared image processing system. The processing system consists of five modules: picture projection, odd-even correction, trajectory segmentation, and display. It has been created to efficiently carry out thermal mapping and satisfy the unique needs of quick data processing. Thermal distribution can be seen using the processing system's 2-D map model.

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INTRODUCTION

Last few years, sufficient amount of specific attention has been, The accuracy standards for 2-d thermal scanning of guy structures and rough terrain were increasing noticeably as a result of the govt's and scientists' attention to our environment. Portable remote sensing instruments have been designed to create 2-d thermal mapping on airborne and space-based platforms. The most popular technique is a mobile scanning system utilised for a ground-based thermal survey.

It is recognised as an effective approach to survey a small location, such as thermal monitoring of things (such as buildings, trees, and plants in a field) in streets and small fields. A private infrared image processing system is described in this study. It is intended for mobile applications for remote sensing to track and map the temperature distribution of regions.

The processing system is built around five steps: trajectory segmentation, odd-even correction, picture projection, and Visualisation. The first step is non-uniformity correction. Both the unique requirements for quick data processing and effective thermal mapping can be met. The thermal data can be viewed in a 2-D mapping model in the meanwhile. The usefulness and effectiveness of proposed system are evaluated and tested using a variety of image processing tasks.

SOFTWARE SYSTEM DEVELOPMENT

Bosch et al. developed a helpful method for detecting forest fires by concentrating on infrared image analysis [1]. They put out a plan for automated forest surveillance that would involve the early diagnosis of any potential for fire. For processing infrared pictures, Wang et al. developed a unique layered architecture and pipelines based on field programmable gate arrays. Real-time processing of infrared pictures is possible with this technique [2].

NON-UNIFORMITY CORRECTION

Based on statistical equal-inaction analysis, Johann et al.published a thorough non-uniformity correction (NUC) technique for Infrared images [3]. It has the ability to process images produced by push-broom satellites or scanners. An alternative to synthetic model [4] that can characterise the strip noise produced during in the image acquisition for thermal imaging was proposed by Yapping et al. It uses a set of thermal calibrating experimental results to take use of the properties of the strip-type structure - borne noise. Through the use of high-frequency filtering techniques, Yanpeng has obtained another strip noise behavioural model [5]. Without significantly losing image details, one can acquire the desired photos by removing the strip-type noise. Compared to various other options, this strategy works better. Using a Gaussian scale mixture perceptual pattern denoiser, Good all et al.

INFRARED APPLICATIONS

A correction approach for images taken based on physical characteristics and statistical analysis of the atmosphere was proposed by Yi et al. [10]. By taking use of the characteristics of fuzzy infrared images, it can

optimise and enhance the performance of visual image haze removal. A weak thermal target extraction technique for segmenting images was proposed by Xiangzhi et al.

RELATED WORKS

Numerous works on infrared image processing have been published, including those on software system creation [1-2], non-uniformity correction [3–9], and applications [10–15]. We will provide a brief overview of the relevant works from each location in this section segmentation, odd-even correction, picture projection, and Photos of ships [11]. Jiayi et al. suggested a technique to combine infrared and visible images based on the concept of gradient transfer [12]. An enhanced super-resolution infrared image reconstruction technique based on visual process was proposed by Jing song et al. [13]. This approach can produce infrared images of superior quality with improved contrast, an average gradient, and a peak signal to noise ratio when compared to other conventional algorithms. A technique to more accurately determine the temperature of seawater was put out by Ruth et al. [14]. For the purpose of measuring surface soil moisture, Pei et al. constructed a useful statistical model [15].

THE ARCHITECTURE OF INFRARED IMAGE PROCESSING SYSTEM

The data acquired from a portable remote sensing system is processed using the proposed software for image processing. A mobile device (such an automobile) outfitted with an infrared sensor, an imu unit (IMU), and a position and rotation system makes up this system (POS). Figure 1 depicts the workflow of the image recognition process. There are various modules, including image projection, POS and image matching, trajectory segmentation, oddeven correction, and uniformity correction. Using the technique of line fitting, the trajectory segmentation divides the POS data into a number of brief trajectory, such as direct lines with minimal curvatures. Finding the correlation among images and POS data is the purpose of POS and matching job data on POS events.

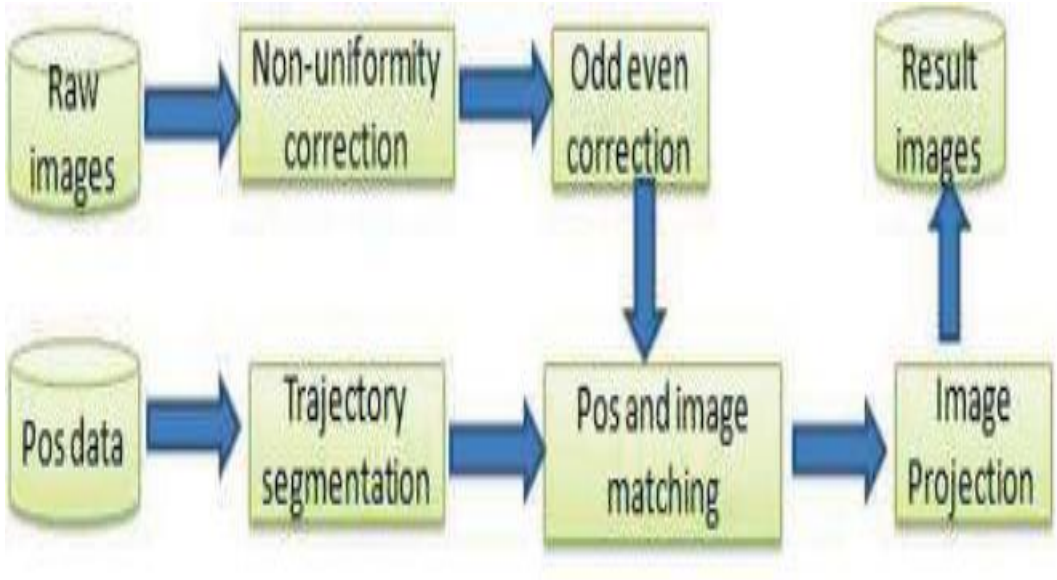


Figure. 1. The work flow of the image processing system

Model-View-Controller is the software system's chosen architectural style. Both application models and business logics are included in the model. The view consists of a graphical user interface and a 2D view implementation. QT panels with remote control are used to implement the controller. This software uses a multithreaded approach to benefit from multicore systems. Figure 2 depicts the event response's primary loop. The first loop creates a thread pool with more than 20 threads. A work flow is carried out by each thread, as seen in Fig. 1. We restart threads in the thread pool repeatedly until all of the image data has been processed. The processes in the task queue share a memory.

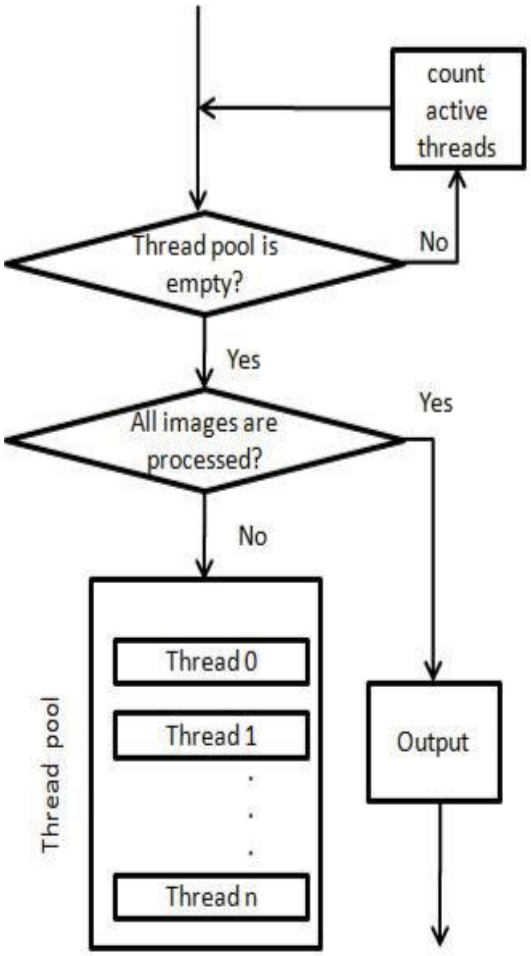


Figure. 2. The main loop of event response.

Information (latitude, longitude, altitude, pitching, rolling and yawing angle), exposure time, image pixel size, width, height and focal length. All these parameters will be useful for the image processing

NON-EQUALITY CORRECTION

For each infrared image, a multiple-point NUC technique is used. It is presumable that a linear equation can adequately represent the properties of a single micro bolometer (1). For every micro bolometer, the parameters offset B as well as gain K can be determined.

$$I(l, m) = K(l, m) \bullet I(l, m) + B(l, m)$$

We use a black body to collect responsive images I (l, m)t s at different temperature t, then get the average responsive image

$$I(l, m)t = \Sigma N\ s{=}0 I(l, m)t,s/N\ .$$

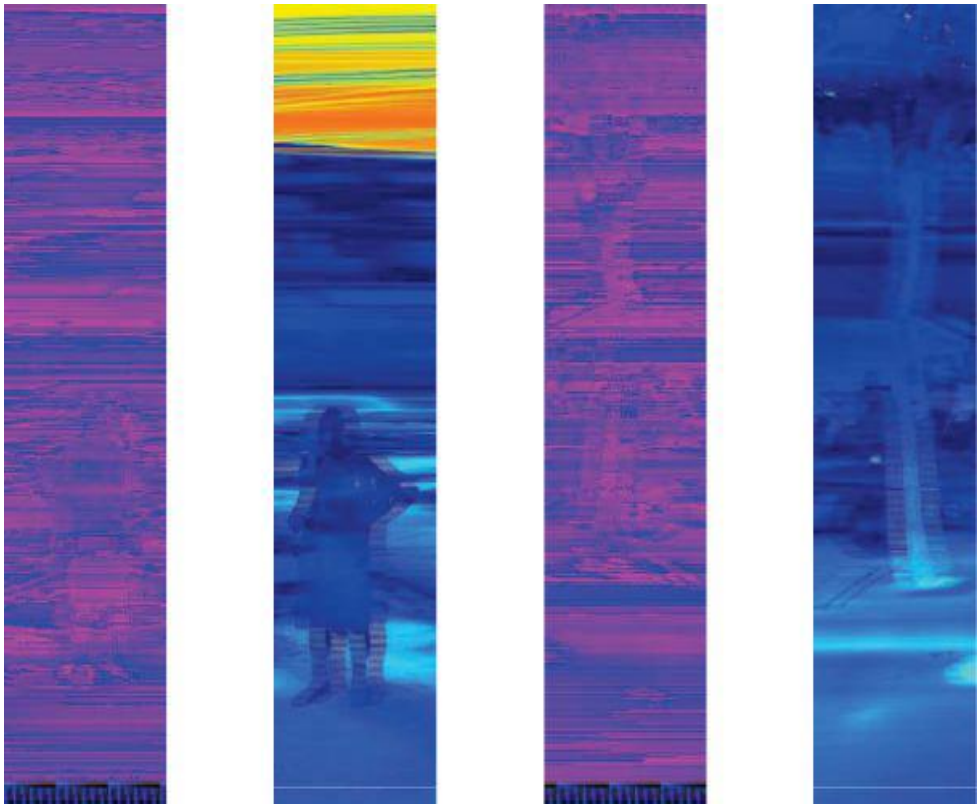
The offset B and gain K can be generated according to equation (2-4), where T is the number of temperatures tested, 0 <= t <= T and S is the number of images collected at the same temperature 0 <= s <= S.

$$K(l, m) = \frac{T \bullet S \bullet \Sigma I(l, m)t\ I(l, m)t,s - \Sigma I(l, m)t \Sigma I(l, m)t,s\ T \bullet}{S \bullet \Sigma I(l, m)2\ t,s - (\Sigma I(l, m)t,s)}$$

$$B0(l, m) = \Sigma I(l, m)t \Sigma I(l, m)t,s I(l, m)t \quad (3)$$

$$B(l, m) = \frac{T \bullet S \bullet \Sigma I\ (l, m)t \Sigma I(l, m)t,s\ 2 - B0(l, m)}{T \bullet S \bullet \Sigma I\ (l, m)t,s\ 2 - (\Sigma I(l, m)t,s)2}$$

The examples of raw images are shown in Fig. 3(a) and Fig. 3(c). The corresponding NUC corrected images arEe shown in Fig. 3(b) and Fig. 3(d).



(a) (b) (c) (d)

Figure. 3. Images of raw data and after NUC. (a),(c):raw data. (b),(d): corresponding NUC corrected images.

UN EVEN CORRECTION

Odd and even image rows of something like the picture are not produced simultaneously by infrared sensors. The former are produced before the latter. Therefore, certain pixels should move toward the odd pixel rows. With the use of an odd even correcting
(OEC) method, it is possible to determine in advance how many pixels need to be advanced.

Algorithm 1 An odd even correction algorithm for infrared images
Input: im before, im current, im after: the continuous im-ages. IEM [81]: the vector for image equality metric.
Output: im current corrected: im current after odd even correction.
Initialisation: IEM[i] =0, 0 <= i <= 81.
LOOP Process
1: **for** i = −40 to 40 **do**
2: **if** (i < 0) **then**
3: generate im current OEC through bringing forward the odd rows of im current by i pixels from im before.
4: **else**
5: generate im current OEC through bringing forward the odd rows of im current by i pixels from im after.
6: **end if**
7: calculate the image equality metric of im current OEC as IEM[i].
8: **end for**
9: find the smallest value of IEM[i] and the corresponding index id as the odd even correction number.
10: generate im current corrected through bringing forward the odd rows of im current by id-40 pixels
11: **return** im current corrected.
One example of the calculated vector for image equality metric (IEM) is displayed in Fig. 4, and the resulting OEC number is 7. The blurred images as shown in Fig. 5(a) and

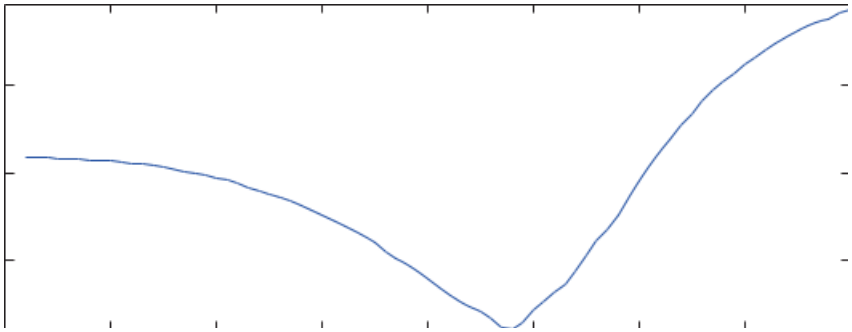
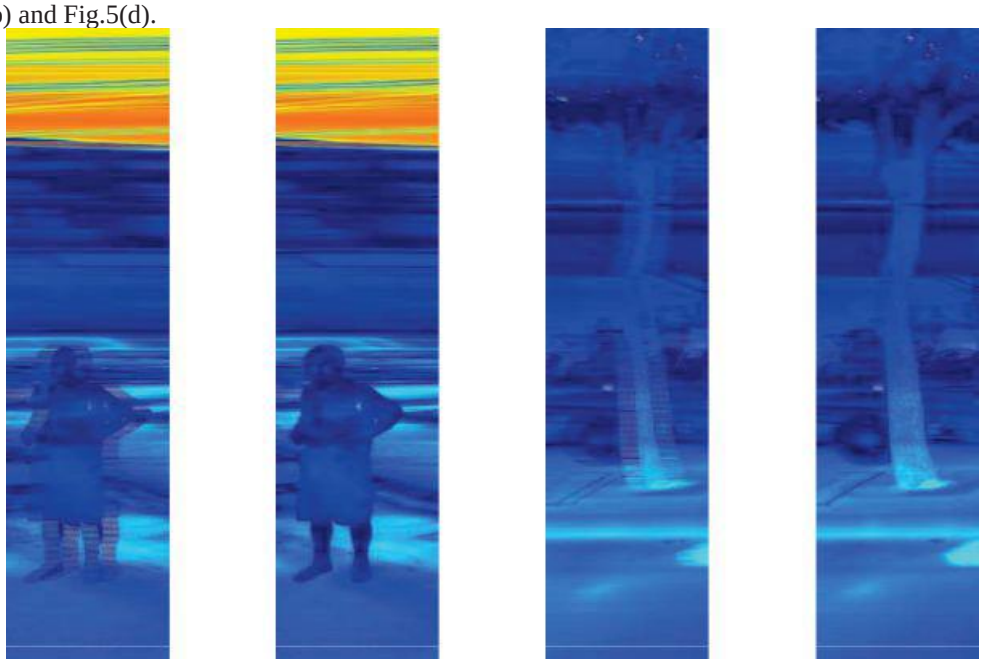


Fig. 4. Odd even correction

Figure. 5(c) are NUC corrected images in Fig 3(b) and (d). The corresponding OEC corrected images are shown in Fig. 5(b) and Fig.5(d).



(a) (b) (c) (d)

Figure. 5. Odd even correction. (a),(c): image after NUC. (b),(d): images after OEC.

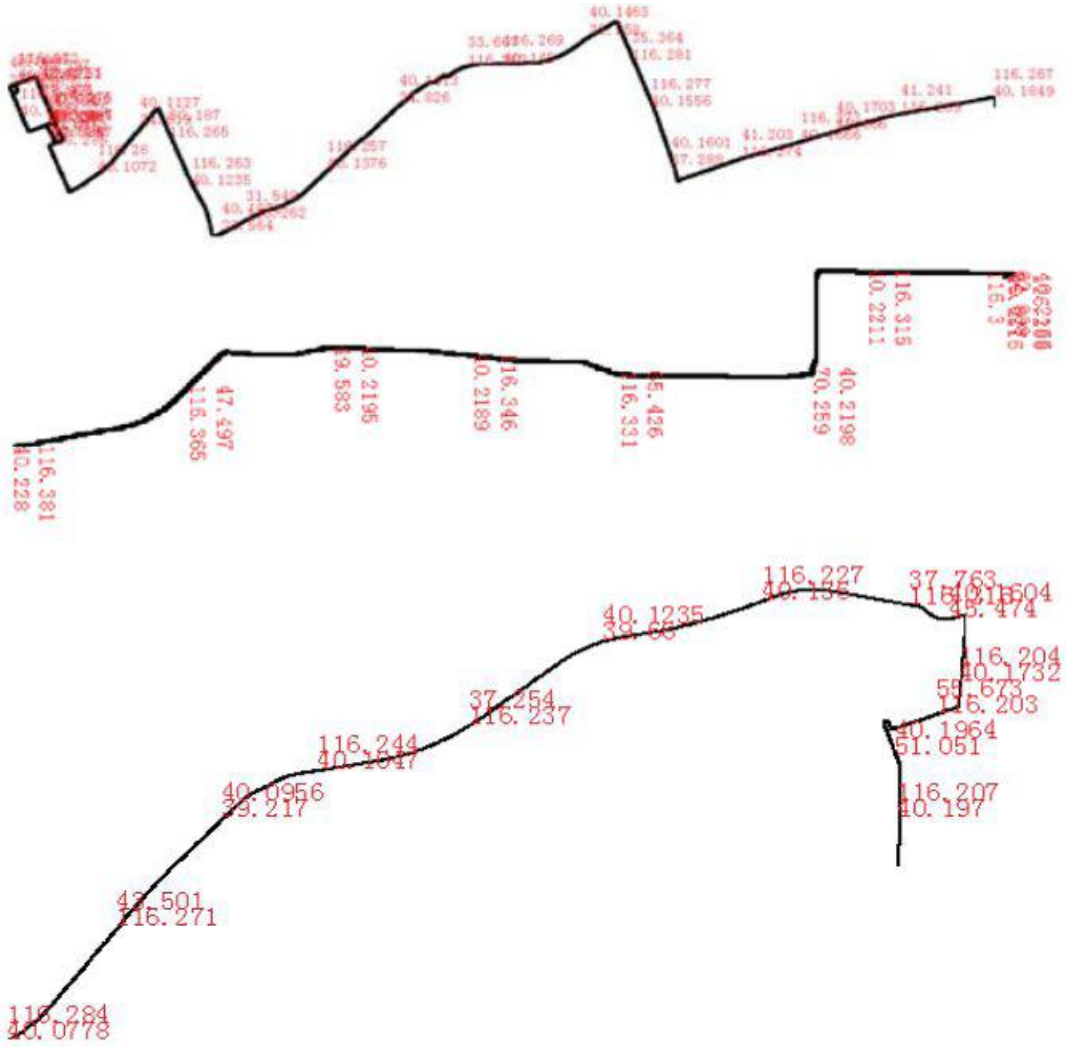
IMAGE PROJECTION

The position and orientation of each row in the image will determine how it is projected to something like an image plane. The role might be (x0, y0). In the WGS84 or GPS co - ordinate system, it is a point. The orientation parameters are roll, yaw, and pitch. γ angles. The projected point can then be obtained using equations (5), where Rx(), Ry(), and Rz() are rotation matrices about axes x, y, and z, respectively. N is the total number of scan lines, and 0=j=N is the index of the scan line. The rows index of a pixel is 0 = I = M, where M is the overall amount of pixels inside a row.

$$[\bar{x}_i \; \bar{y}_I \; \bar{z}_i]^T = [x_{j0} \; y_0 \; j \; 0]^T + Rz(\alpha)Ry(\beta)Rx(\gamma)[x_i \; y_i \; 1]^T \quad (5)$$

EXPERIMENTS AND RESULTS

A mobile infrared scanning system is used in our experiments. It is infrared enabled car system in use which captured the images by the car. Once the images is captured the all images are to be captured determine the object trajectory position of the object in images which is captured by the camera.



CONCLUSION

Research tells, we suggest a system for processing infrared images that may be used for mobile remote sensing applications to track and map the heat distribution of locations. The processor system consists of five modules: picture projection, odd-even correction, trajectory segmentation, and display. It has been created to carry out thermal mapping as effectively as possible and satisfy the unique needs of quick data processing. Thermal data can be viewed using the processing system as a two-dimensional map model. Several image processing tasks are used to assess and test the effectiveness and efficiency of the produced system. With a few modest adjustments, our software may be utilised to analyze the infrared picture data obtained from airborne remote sensing applications.

ACKNOWLEDGEMENT

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DESIGN AND FABRICATION OF PELTON WHEEL TURBINE

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Abstract: Hydropower turbines are revolving systems that transform potential energy into kinetic energy or useable kinds of energy like mechanical power or electric power. In general, Pelton Wheel Turbines are considered to be among the best for supplying low-flow power. To leverage the water velocity from an elevated tank, the design of a model Pico-size Pelton Wheel Turbine has been updated. An elevated tank and the altitude of the tank's bottom together provide sufficient head (Q) for the Pico turbine to revolve and subsequently produce a Pico watt of energy.

Key Words: Pelton Wheel, Pico Turbine, Structural Movement

INTRODUCTION

Turbines come in two forms: steam turbines and hydraulic turbines. The revolving hydraulic turbines convert potential energy into kinetic energy and alternative kinds of useable energy, such as mechanical energy or electrical energy. In hydraulic turbines, there are two basic types of turbines: reaction turbines and impulse turbines [1].

When water exits the end nozzle of the penstock in an impulse turbine, it is pushed to strike several buckets that are placed around the runner. Water is drawn into reaction turbines across all edges of the runner till it is discharged into the tail race through the draught tube [2].

The Pelton Wheel turbine represents the ideal example of an impulse turbine. The Pelton turbine generates tangential flow, which requires less water. The Pelton wheel has numerous buckets evenly distributed all the way around a circular disc. Each bucket has one symmetrical section and an elliptical cup shape, as shown in fig.1 [3].

- Large hydropower: These are facilities that have an output capacity greater than 30 MW.
- Medium hydropower plants are those with a capacity of between 1MW and 30MW.
- Small hydroelectric facilities: These can also be broken down into the following categories:
  1. Miniature hydroelectric power plants (100 to 1,000KW).
  2. Micro-hydropower infrastructure (5 to 100 kW)
  3. Facilities for Pico hydropower (below 5 kW)

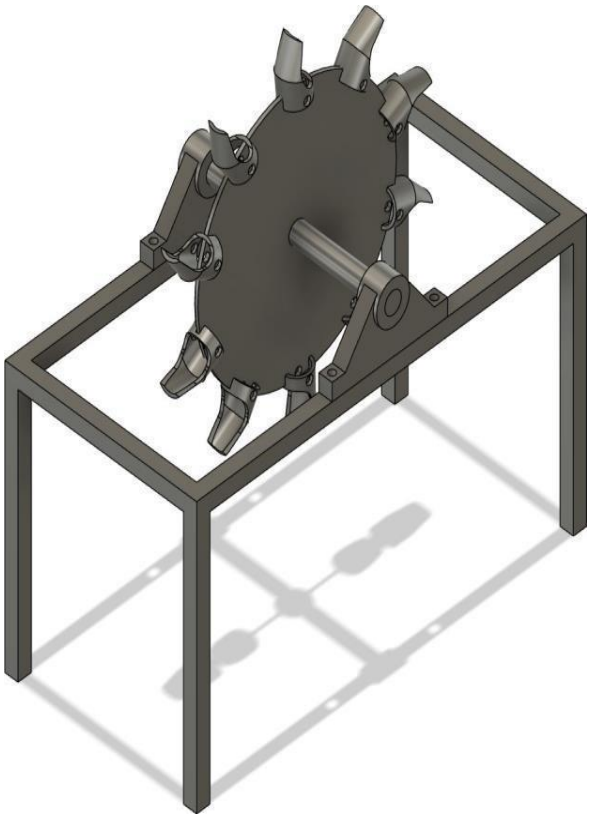

FIGURE 1. Pelton Wheel Turbine

PELTON WHEEL TURBINE COMPONENTS DESIGN SPECIFICATIONS

A head (H) of water drops at a flow rate (Q). To transfer torque (T) to the electric generator and generate power, the Pelton wheel must rotate at a specific speed (Ns) (P). The expected output of the system is Power = 100W. Between the bottom of the collecting tank and the jet nozzle, there is believed to be a head of 3.2 meters. Performance is impacted by pressure and flow in the hydraulic system [4].

CALCULATIONS

Calculation of Diameter of Pelton Runner

The performance in terms of Power can be expressed as follows in SI units:
P_{ti}= density x gravitational acceleration x Cv^2 x H x Q
Q= P_{ti} / density x gravitational acceleration x C_v^2 x H

Q = 100 / 1000 x 10 x 3.2 x 0.98

= 0.0032 m^3 /s

Where,
Q = flow rate
Density of water = 1000 kg / m^3
gravitational acceleration = 9.82 m/s^2

Head = 3.2 m
C_V = Nozzle (jet) discharge coefficient (0.98) Specific
Speed, N_s of the turbine

N_s= (85.49 x √n)/(H^0.234)

=65.119 rpm

While; n_j= number of turbine nozzle = 1

N= Speed of the turbine

= N_s x $H^{5/4}$ / √Pti

= 65.119 x $3.2^{5/4}$ / $\sqrt{100}$

= 30.06 rpm

3.2 Calculation of water jet velocity through the nozzle

Calculate the velocity (V1) in (m.s -1) of the water jet exits from the nozzle by using this formula.

$V_j = C_v$ x g x H

= 43.5 m/s

D_r= diameter of pelton runner = 300mm

D_j =diameter of jet = 20mm

3.3 Calculation the bucket dimensions

Calculations for the bucket's axial width include,

B_w= 40 mm

Calculations for the bucket's radial length include

B_l = 65 mm

3.4 Calculation of bucket depth

B_d =35 mm

3.5 Calculation the number of buckets

N_b = 10

The number of buckets in pelton wheel turbine is 10.

DESIGN PARAMETERS IN SUMMARY

Table 1. Below shows a summary of the calculated design parameters.

Sr. No	Parameters	Calculations
1.	Flow rate , Q	0.0032m^3 /s
2.	Calculation of water jet velocity through nozzle , V_j	43.5 m/s
3.	Diameter of pelton wheel , D_r	300 mm
3.	Diameter of jet , D_j	20mm
4.	Bucket width , B_w	40mm
5.	Bucket length , B_l	65mm
6.	Bucket depth , B_d	35mm
7.	Number of buckets , N_b	10

SELECTION OF MATERIALS

Special attention is paid to the low expense of the raw materials used to make the Pelton wheel. Plastic/metal sheet and PVC pipes in a range of sizes are less expensive and more readily available materials for case construction locally. For this reasonably priced Pico Pelton wheel, aluminum alloy was chosen as the material because it is lightweight, less corrosive, and easier to cast. Using Fusion 360, a model was produced. FIG. 2 and 3 simulates the structural displacement of the material under an applied force during analysis. [5].

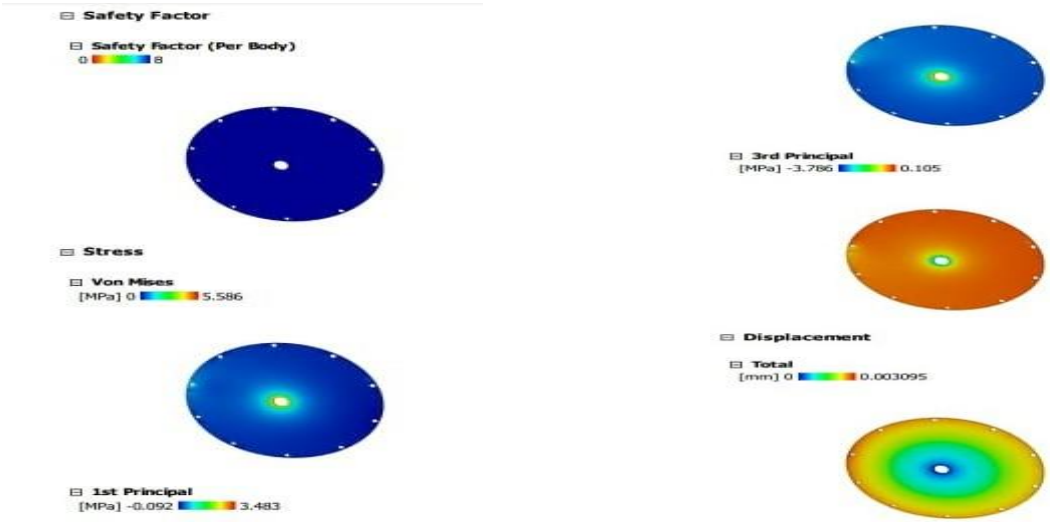

FIGURE 2:- Runner Total Displacement

FIGURE 3:- Bucket Total Displacement

6. FINAL DISPLACEMENT OF RUNNER AND BUCKET

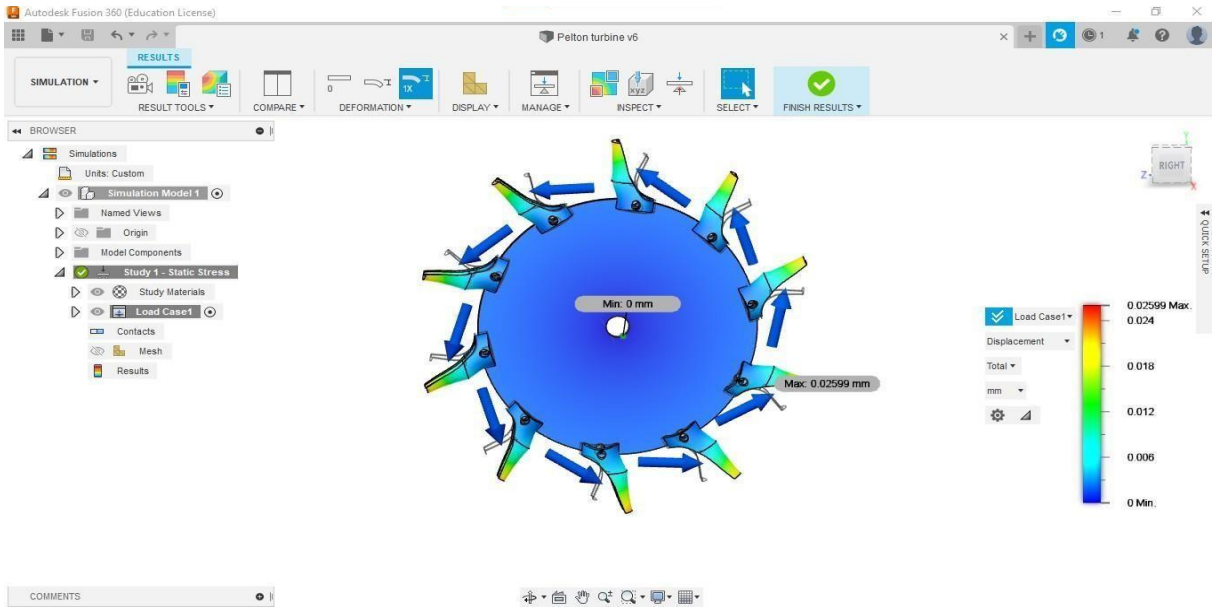

FIGURE 2. Pelton wheel displaying the displacement caused by the forces at work

CONCLUSION

Certain tasks that require relatively little power but are absolutely necessary include charging mobile devices and low-energy lights. These needs can be met by producing, storing, and using Pico-scale power instead of using fossil fuel able to generate facilities, which raise greenhouse gas emissions. This study designed and examined a Pelton wheel turbine model for a small hydropower system. [6].

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FEA SIMULATION OF HIGH FREQUENCY, HIGH VOLTAGE ISOLATION TRANSFORMER USED IN DC-DC CONVERTER

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Abstract: Now a days, large-capacity isolated DC-DC converters are adopted in a wide range of fields, such as energy storage systems, electric vehicles etc. With the increasing demand for small and cost-effective DC/DC converter, the power converters are expected to operate with high efficiency. In which magnetics component design is one of the biggest challenges at high voltage & high frequency. So, good magnetic component design is one of the key issue to implement high voltage DC/DC converter at high frequency. In this study, Novel design of 5000 W, 900 V, 1- ϕ transformer operating at 70 kHz is presented. Core scheme selection has been carried out using PExprt tool under high switching frequency operation. Core volume, area and configuration are studied to achieve the optimal compact and cost-effective transformer model in PExprt. Possible core material, winding type and their performance are analyzed. Effective no of turn, winding construction, magnetizing inductance, flux density, dc resistance & core loss has been done by using analytical calculation. This step will result in complete transformer electromagnetics design and modeling. Afterwards transformer 3D model is simulated in Ansys Maxwell 3D to optimized magnetics for high frequency transformer design.

INTRODUCTION

In order to reduce the pollution from automobiles, which is continuously growing, we are presently looking for alternative sources like electrical vehicles. Governments all over the world are confronting the immediate concern of air pollution emission by investing big resources to enhance air quality. Government and business sector investment in renewable energy technology is necessary to achieve the goal of improving air quality. It will be required to transition from conventional vehicles to electrical vehicles (EVs).

Electric vehicles have rapidly developed because of their higher efficiency and beneficial environmental factors. The need for technical components like DC-DC converters for on-board chargers must have increased as the number of electric vehicles has increased. Due to the interior insufficient space of electrical cars, onboard chargers (OBC) must follow a strict requirement for high power density, high charging efficiency, and effective heat dissipation.

Recently, in electric vehicles two of the main challenges are the charging time & high initial cost. To solve the problem associated with long charging time, the car manufacturers are moving from 400 V to 850 V battery EV (BEV). which enables the utilization of DC-DC converters in EV application.

PFC converter and an isolated DC-DC converter are both part of the two-stage onboard charger. The ultimate purposes of onboard converter research are to increase operational effectiveness and decrease volume in EVs. The PFC field of study is reasonably developed, and the efficiency of the current research is above 95%. Therefore, its overall efficiency is depending on the design and working of the DC-DC converter in EVs. At present, high voltage DC/DC converter at high frequency has been started in electrical vehicles. A converter's switching frequency is typically in the hundreds of kHz range. Due to a considerable portion of the magnetic volume in DC-DC converters, good magnetics component design is one of the primary challenges for obtaining high efficiency. A key component of isolated DC-DC converters is the high-frequency transformer, which has a big impact on the converter's volume and efficiency. Therefore, it is essential to design and maximize the high-power, high-frequency transformer's efficiency. Estimation of parameters such as flux density, current density, no of turn, core losses winding losses etc. are always a significant part of transformer design.

Recently, various research on isolation transformers for DC-DC converter designs at various power levels and operating frequency have been performed [3]-[9]. The operating frequency and core material type are selected based on the power level and efficiency. For the proper operation of zero voltage switching, this power converter also requires extra inductors. The transformer leakage inductance can be properly designed to minimize this extra inductance requirement. It improves the efficiency and decreases the overall cost of the system in electrical vehicles.

A transformer with 3 kHz, 7 kW comparatively high core volume and high leakage inductance is presented in [3]. Same switching frequency with 20 kW power is presented in [4]. But, due to the medium frequency & high core volume a core loss of transformer is obtained to be around 206 W. Resulting 93 % efficiency is achieved. In [5] design of 311/100 V at power rating of 1 kW at 25 kHz analyze and 94% efficiency was obtained. In [6] 20 kHz, 10 kW high frequency transformer is investigated with an efficiency around 97% can be achieved. Design of 330 kW single-phase transformer operating at 50 kHz is presented with 98.6 % efficiency [7].

As it can be seen, analyzed designs for transformer are with either low voltage output or medium/low frequency. In this study novel high power, high voltage (900 V to 850~400 V) at 70 kHz is designed by analytically and with FEA simulation. leakage inductance of transformer are carefully designed. Interleaved winding of transformer has been considered. AC resistance of transformer winding at this frequency is very high due to skin and proximity effect is analyzed. All of these factors play a vital role in the transformer efficiency as well as the power transfer capability. The complete system is simulated using ANSYS Maxwell-3D. General Design procedure for transformer is given in following block diagram.

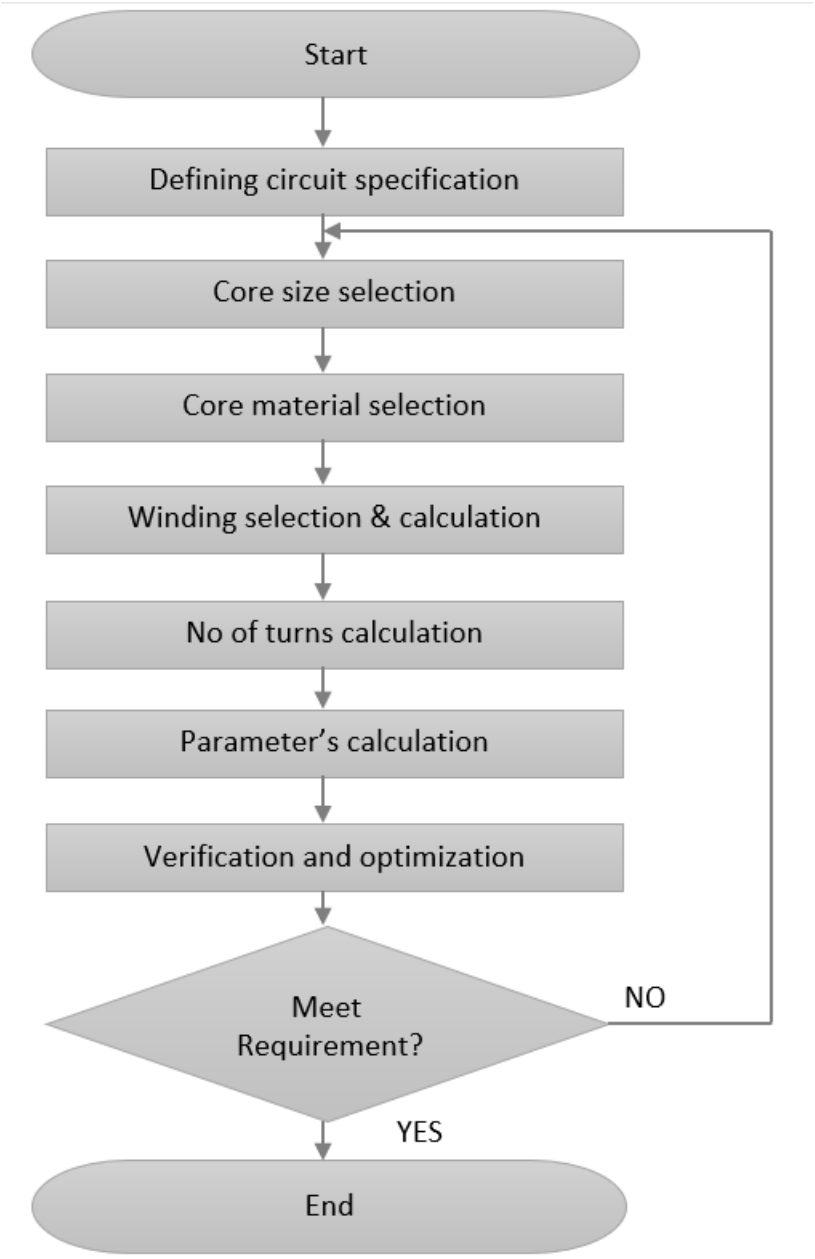

Fig .1: Flow chart for transformer design

TRANSFORMER DESIGN AND MODELLING

The proposed transformer specifications are given in Table I. As can be seen from the table, the transformer operates at frequency of 70 kHz with 5000 W power rating. The leakage inductance and parasitic capacitance existing in both windings affect the transformer efficiency, Converter functionality & EMI. In high frequency transformers, leakage inductance & parasitic capacitance value must be carefully designed and chosen. So, It is necessary to have a small leakage inductance value in-order to transfer maximum power from primary to the secondary side in transformer.

PARAMETER	VALUE
Input Voltage Level	900 V
Output Voltage Level	850 V – 400 V
Power level	5000 W
Operating frequency	70 kHz
Flux density	0.3 T
Conversion ratio	1:1

TABLE 1. DESIGNED HIGH FREQUENCY ISOLATION TRANSFORMER SPECIFICATIONS

TRANSFORMER DESIGN IN ANSYS MAXWELL & EQUIVALENT CIRCUIT

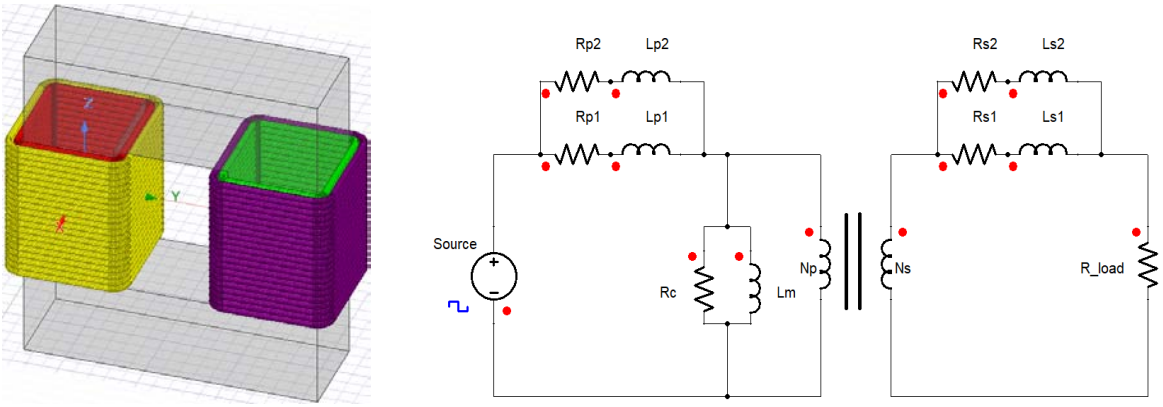

Fig.2: Created design in Maxwell 3D & Equivalent circuit of transformer

CORE SCHEME SELECTION

According to the aforementioned discussion, there are many design trade-offs and parameters that affect one another. Mainly, they are summarized by the number of turns, magnetic flux density, core volume, current density, core and copper losses. For this purpose, Ansys PExprt tool has been used to get the optimal parameters trade off and values. the numbers of design are analysed and finally two best design and parameter for that design are given in table no 2. From table we can conclude that loss of UU PM 114/93 and UU93/52/30 are almost same but volume of UU 93/52/30 is less. Core PM114/93 is better for cooling but for less volume UU 93/52/30 gives better results. so, considering this, UU93/52/30 design has been selected for high frequency isolation transformer in DC-DC converter.

Parameter	Design 1 (900 V- 850 V)		Design 2 (900 V- 400 V)	
Name of core	UU 93/52/30	PM 114/93	UU 93/52/30	PM 114/93
Volume of core	216720 mm^3	344000 mm^3	216720 mm^3	344000 mm^3
Power loss	15.82 W	17.64 W	17.36 W	18.94 W
Magnetising Inductance (Lm)	3 mH	12 mH	4 mH	10 mH
Current density (J)	2 A/mm^2	3 A/mm^2	4 A/mm^2	5 A/mm^2
Temperature	60 ºC	54 ºC	65 ºC	59 ºC

TABLE 2. CORE SCHEME SELECTION FOR HIGH VOLTAGE & FREQUENCY ISOLATION TRANSFORMER

CORE MATERIAL SELECTION

For high frequency transformers, a variety of soft magnetic materials can be employed as the core material. The shape of the excitation voltage waveform at high switching frequency also affects the copper and core losses. This scenario causes the temperature to rise, which has detrimental effects that reduce the transformer's efficiency. As a result, soft magnetic materials are used in the construction of isolated high frequency transformers. In the construction of high frequency transformers, soft magnetic materials like amorphous ferrite and nanocrystalline are frequently used. The transformer's design also takes into account the cost and availability of the core material. The primary factors used to choose the core material are the operating frequency, the desired flux density, and the particular core loss values

Table 3 demonstrates each of the material characteristics based on the high-power, high switching frequency application. In-order to minimize the core power loss and keep the efficiency as high as possible usually, ferrite and nanocrystalline are used for such applications. However, nanocrystalline is expensive compared to the ferrite core. In addition, different shapes and sizes are not available in the market as the ferrite ones. Furthermore, now days ferrite provides better efficiency characteristics at the desired frequency level (100kHz). Therefore, ferrite material with its immensity in the market with relatively cheap prices, low power loss, and moderate saturation magnetic flux density (up-to 0.5T) has been chosen as the core material for this transformer design.

Specific Parameter	Ferrite	Nanocrystalline	Amorphous	Si-Fe
Material code name	3C92	Vitroperm500F	2605sa1	6.5 % si-fe
Permeability (u)	1500-2500	5000-7000	1300-2000	800-1000
Saturation Flux density (T)	0.41	1.2	1.56	1.87
Mass Density (kg/m3)	4800	7200	7180	7650
Curie Temperature (ºC)	280	600	395	700
Core Loss (W/kg)	1.5	0.35	2.5	8

TABLE 3. COMPARISON BETWEEN PROPERTIES OF THE SOFT MAGNETIC MATERIALS

WINDING SELECTION AND CALCULATION

Winding Selection

Different type of winding can be used in high frequency isolation transformer like copper foil, solid wire, litz wire and planar wire. Planar wire use in planar type core. So here another three types of winding can be used for design. The operating frequency, temperature, and winding shapes are all affect the winding resistance, which is a distributed parameter. Therefore, the proper winding type must be chosen.

Winding made from copper foil will optimize space in better way. When a high cross-sectional area and minimal leakage are required, foil windings are used. When compared to wire wound components, it increased mechanical strength. Foil windings are not desirable in high frequency designs, because the Eddy currents can cause considerable heating, and any cross-foil flux will cause very high, local Eddy currents. Foil windings can be used for very low leakage and highly coupled windings.

With a single core the structure of solid wire is very simple which make it much easier to manufacture. Solid wire is the greatest option in terms of price, strength, and flexibility. Skin and proximity effect is high as compared to litz wire.

Because litz wire produces a more uniform distribution of current over the wire selection than solid wire at high frequency. Current losses caused by the proximity effect are reduced with Litz wire. The decrease of AC losses caused by the skin effect is what Litz wire can give over any substitute. For frequencies above 10 kHz, litz wire provide a significant reduction of both the skin and proximity effect. By using Litz wire in thicker cable sizes, cable impedance at high frequencies can be reduced and maintained.

Strand Diameter Calculation for Litz Wire

Strand diameter = 2*Skin depth(Ɛ) [1]

Skin depth (Ɛ) = $\frac{6.66}{f^{0.5}}$ * K (cm) (1)

Where (Ɛ) = The skin depth,
F = frequency in Hz
K = 1, for copper

TRANSFORMER DESIGN PARAMETER'S CALCULATION

According to Faraday's law, the induced voltage level of the transformer winding can be calculated as:

$$v(t) = N \frac{d\emptyset(t)}{dt} = N A_C \frac{dB(t)}{dt} \text{ [1]} \quad (2)$$

Where N = No of turn
A_C = Cross section area of core in mm^2
B = Flux density of core in T
v (t) = Induced voltage in V
Ø(t) = Magnetic flux in wb

According to (2), magnetic flux density (B_m) can be calculated as:

$$B_m = \frac{E}{4 * f * N * Ac} \text{ T [7]} \quad (3)$$

This equation is valid for an ideal bipolar square-wave excited transformer. However, a specific dead-time interval is required during the changeover of the ON/OFF transitions of the switches. Furthermore, if the

converter is designed for a specific duty cycle value, then this must also be taken into account. Thus, (3) needs some modifications according to this dead-time (Td) requirement.

$$B_m = \frac{E}{4 * N * Ac} \left(\frac{T}{2} - Td\right) \text{ T [7]} \quad (4)$$

where Td denotes the dead-time and T switching period. According to this equation, the number of turns (N) can be found as:

$$N = \frac{E}{4 * Bm * Ac} \left(\frac{T}{2} - Td\right) \quad (5)$$

Magnetizing inductance (Lm) for transformer is given by

$$Lm = \frac{\mu o * \mu r * N^2 * Ac}{l} \text{ H [1]} \quad (6)$$

Where μ_o= Permeability of air
μ_r = Permeability of core
l = Effective length of core in mm

DC resistance of winding is given by

$$R_{DC} = \frac{4 * m * N * l_e}{n_s * \pi * \sigma * d_s^2} \ \Omega \text{ [1]} \quad (7)$$

Where m = No of layer in winding
le = Effective length of M.L.T in mm
n_s= No of strand in winding
d_s^2= Diameter of strand in mm^2

Current density (J) of winding is given by

$$J = \frac{I}{A} \text{ A/mm}^2 \text{ [1]} \quad (8)$$

Losses are closely related to the number of turns, frequency, and magnetic flux density for a given core material. Due to the low magnetic flux density value, increasing the number of turns can help to reduce core losses; however, it also increases winding losses. Additionally, raising the operating switching frequency has an impact on core losses as well. Therefore, the optimal number of turns is chosen. We may determine the core losses (P_C) for a certain core material using the Steinmetz equation.

$$P_C = Cm * f^X * B^Y * \nu \text{ [1]} \quad (9)$$

Where Cm, X & Y are core loss coefficient. ν is volume of core in m^3

SIMULATION RESULTS & WINDING OPTIMIZATION OF TRANSFORMER

Flux density, current density, core loss, magnetising inductance, coupling coefficient & resistance parameter of transformer are analysed in Ansys Maxwell 3D and also validate analytically through above equation for both design 1) 900V-450V 2) 900V-850V at 5000 kW & 70 kHz. From simulation results we can see 3D plot of flux density & current density for both design is under limit so, no saturation of core & achieved desired results with reduced skin & proximity effect at high frequency respectively for transformer winding. Maximum core loss for transformer is achieved between 12~15 W. which is depend on flux density and frequency of transformer. Interleaving of transformer winding has been considered in simulation to achieve high coupling between primary and secondary winding. Because of this low leakage has been achieved. Resulting maximum power transfer from primary to secondary winding of transformer achieved.

Flux density plot of transformer

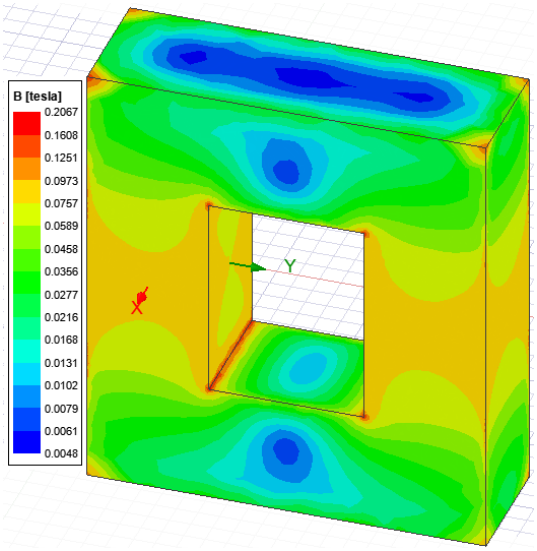

Fig. 3: Design 1) Voltage – 450 V

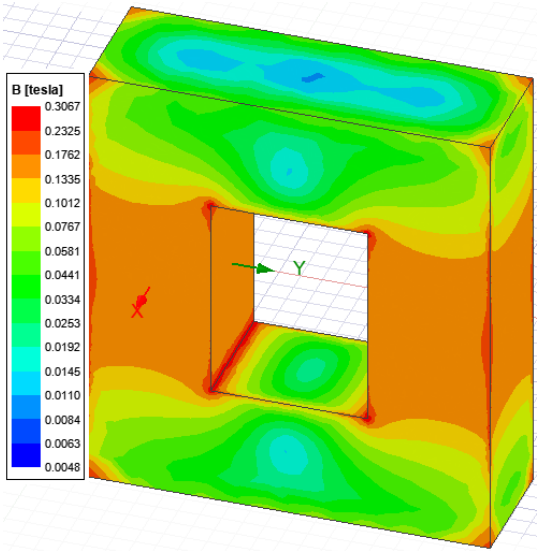

Fig. 4: Design 2) Voltage -850 V

Current density plot of transformer

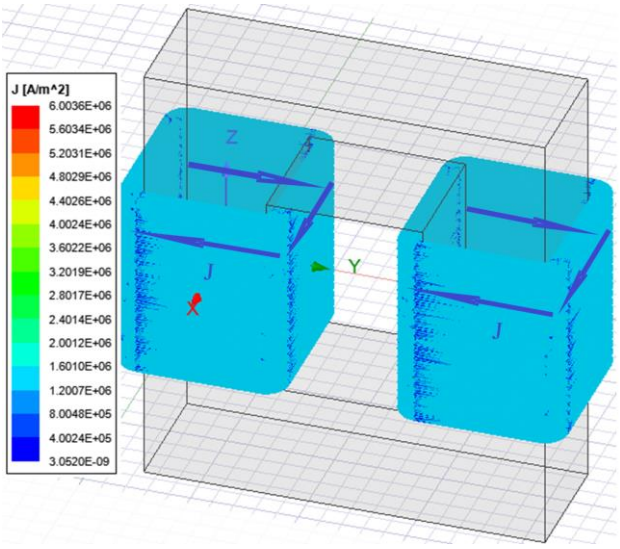

Fig. 5: Design 1) Current – 11.11 A

Fig. 6: Design 2) Current – 5.88 A

Core loss plot of transformer

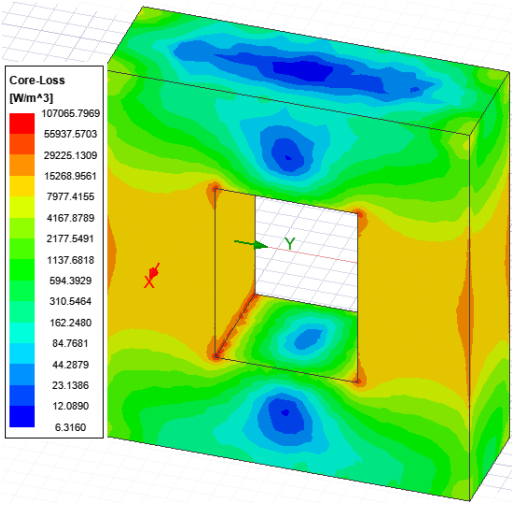

Fig. 7: Core loss for Design 1

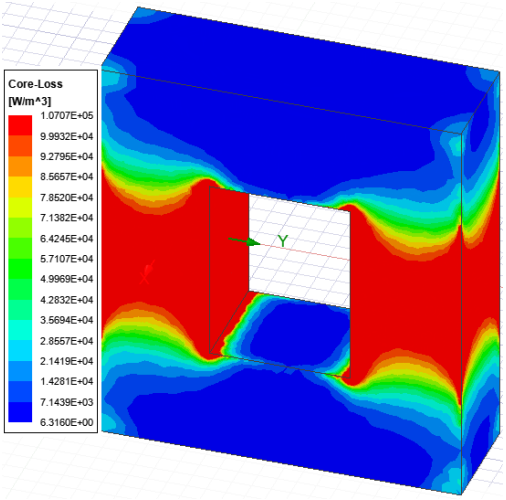

Fig. 8: Core loss for Design 2

Coupling Co-efficient and Magnetizing Inductance of Transformer

Layer	P1	P2	S1	S2
P1	1	0.97643	0.99947	0.97692
P2	0.97643	1	0.97692	0.99947
S1	0.99947	0.97692	1	0.9774
S2	0.97692	0.99947	0.9774	1

TABLE 4. COUPLING CO-EFFICIENT (K)

Layer	P1	P2	S1	S2
P1	3.0919 mH	3.019 mH	3.0897 mH	3.0199 mH
P2	3.019 mH	3.0919 mH	3.0199 mH	3.0897 mH
S1	3.0897 mH	3.0199 mH	3.0907 mH	3.0208 mH
S2	3.0199 mH	3.0897 mH	3.0208 mH	3.0907 mH

TABLE 5. MAGNETIZING INDUCTANCE (Lm)

Here, by using eq (1) diameter of strand = 0.5mm. if we consider current density 3~4 A/mm^2 diameter of conductor is 2 mm. so no of strand by calculating is 15. At this value, Resistance of conductor is very high due to skin and proximity effect due to high frequency. The simulation has been done in Ansys Maxwell 3D at 70 kHz and we can see its results from table 6. At 70 kHz primary and secondary winding has high value of resistance & because of this, transformer has high winding loss. Therefore, the efficiency of transformer gets reduced. Considering this, the diameter of strand is reduced and increase no of strand for minimal resistance at high frequency, so we get minimum loss of winding and increase efficiency of transformer. If we consider only low value of resistance and increase no of strand that wouldn't be cost effective solution. That's why by considering these both parameter we have chosen 0.1mm x 400 strand design for optimal design of litz wire.

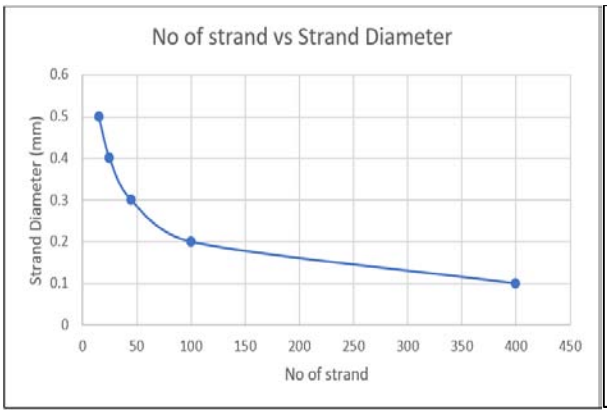

Fig 9: No of strand vs Strand Diameter

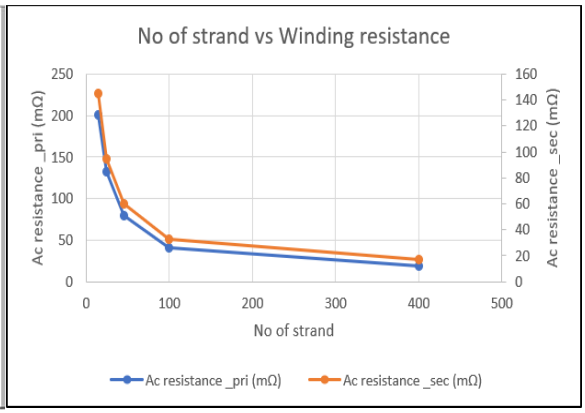

Fig 10: No of strand vs Winding resistance

CONCLUSION

In this paper, novel High voltage 900 V, 5000 W isolation transformer at 70 kHz is designed by analytically and with finite element analysis (FEA) simulation. Optimal size & type of core has been selected. flux density (B), current density (J), core loss (Pc), Magnetizing inductance (Lm) & leakage inductance (Lk) has been analysed. Interleaved winding of transformer has been considered to achieve high coupling between both winding and resulting low leakage has been achieved. which help in maximum power transfer from primary to secondary winding of transformer. By doing iterative FEA simulation, AC resistance has been reduced and resulting low value of winding loss has been obtained. which help to increase the efficiency of transformer.

ACKNOWLEDGMENT

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Enrichment of Power Quality for Non-linear Load Attached Hybrid Renewable Energy System by Employing UPQC

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Abstract: The quality of tangible electrical power produced by hybrid Renewable Energy System (h-RES) is scrutinized in this novel article. Additionally, solar-wind-hydro based h-RES is interconnected with unstable non-linear load. Power quality (PQ) of the proposed h-RES may diminish due to its connection with main electrical grid which includes variable non-linear and linear loads. To trim down this PQ issue, one of the CPD (Custom Power Device) can be used and most suitable CPD for this novel system is UPQC (Unified Power Quality Conditioner). This research work brings down harmonic distortions in voltage and current waveform generated from the proposed system by utilizing of UPQC. Moreover, voltage stability and transient state stability during various fault conditions are also enhanced in the same system. In solar-wind-hydro based h-RES, input energies are unpredictable and connected load on output side is also inconsistent & non-linear. This arrangement is similar as actual electrical grid system.

Keywords: *h-RES (hybrid Renewable Energy System); Solar-wind-hydro system; Non-linear load; Custom power device; UPQC (Unified Power Quality Conditioner); Harmonic distortion; Voltage stability; Transient stability*

INTRODUCTION

There is prime comprehensible that compare to conventional energy sources, the renewable energy sources are uncontaminated, effectual and unpredictable. In recent trends, governments of all the countries are attracted towards renewable energy resource (RER) for production of electricity to comeback climate change effect. Moreover, RER based electricity generation is most suitable at rural or isolated region where electrical grid connection doesn't exist [1]. But now-a-days it is also becoming popular at urban and metro areas with on-grid connection.

Electrical power production from h-RES is cost-effective and ecological gracious [2]. The performance of the same system may improve by selection of appropriate site and system design. This research work includes PQ analysis and enhancement for solar-wind-hydro based h-RES. Output power of solar PV sub-system is depends on solar irradiations, atmospheric temperature and plant capacity. Moreover, solar PV having efficiency is around 15 to 20%. Output power of 2nd sub-system (i.e. wind energy conversation system) is depend on wind speed, wind volume and plant capacity. Efficiency of the wind system is always less than Betz limit (i.e. 59.26%). Now, output of last sub-system (i.e. hydro-electric system) is reliant on kinetic energy of water (discharge flow rate), plant head and its capacity. Additionally, efficiency of the hydro system is about 65 to 85%. Net electricity generation of the h-RES depends on total plant capacity, average efficiency and environmental circumstances [3].

On other-end connected loads on the same system are uneven and non-linear. Thus, harmonic distortion in voltage and current waveform will produce. And to condense this effect accurate controlling and conditioning methodology is required. Hence, the proposed h-RES is integrated with CPD like UPQC which assist to reduce harmonics effect and also improve the voltage stability. Finally, this article is going to present mathematical modeling, MATLAB simulation and results investigation work for the proposed system.

PROPOSED MODELING

The modeling of proposed h-RES includes electrical power uniformity during unsteady environmental condition and the enrichment of PQ. This entire modeling includes the sub-modeling of solar PV system, wind energy conversation system and hydro-electric system with uneven non-linear load connected grid.

MODELING OF SOLAR PV SYSTEM

The modeling of Solar PV system includes the mathematical modeling of photovoltaic (PV) cells with PV array, DC to DC boost converter model, MPPT algorithm and DC to AC inverter (i.e. voltage source converter) model.

The PV cell is typically illustrious by a current supply model and a diode with stray resistor. A primary formula which precisely conveys the exclusivity of solar PV cell is,

$$\mathbf{I = I_P - I_D\left[e^{\frac{V+R_S I}{aV_t N_S}} - 1\right] - \frac{V+R_S I}{R_P}} \quad (1)$$

The current generated from SPV cells (I_{PV}) is directly depending on sun irradiation and atmospheric temperature [4]. The value of IPV can be achieve by,

$$\boldsymbol{I_P = \left\{I_{P,n} + K_I(T - T_n)\right\} S} \quad (2)$$

Here, I_{PV}, n is current produced by PV cells on standard test condition (i.e. 25°C & 1000 W/m^2); S is the regularized irradiance; I_{PV} is a current produced by solar radiation; T is PV cell's temperature; T_n is PV cell's temperature at nominal condition and K_I may define as a co-efficient of temperature. Moreover, I_D is diode current and V_t is diode terminal voltage.

To complete the interconnection with electric power grid, SPV array must rated with considerable power. The SPV array consist of a number of SPV cells coupled in series (N_{ss}) and parallel (N_{pp}) as per following modeling of the SPV array [5].

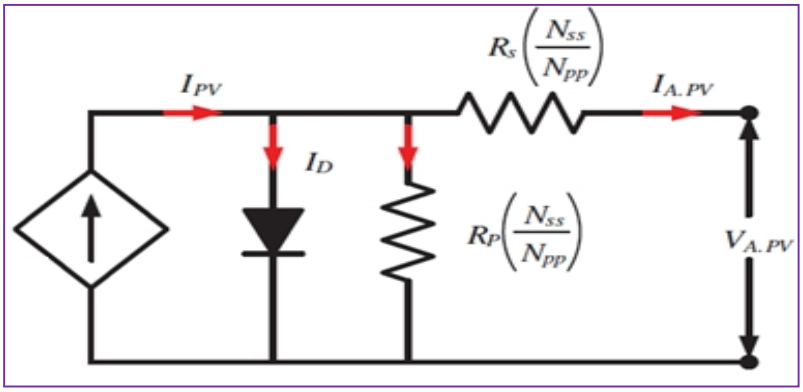


FIGURE 1.*Equilibrium modeling of the SPV array*

A performance and output of this model is reliant on various parameters like, technological abilities of SPV cells, numbers of series coupled SPV cells, numbers of parallel linked SPV cells, occurrence of sun irradiation on SPV cells and actual temperature of SPV cells [5]. The SPV array current can be define as below.

$$I_{A.P} = N_P I_P - N_P I_D \left[e^{\left\{ \frac{V_{A.P} + IR_S\left(\frac{N_S}{N_P}\right)}{V_t a N_S} \right\}} - 1 \right] - \frac{V_{A.P} + IR_S}{R_P} \quad (3)$$

In above equation, the value of $(V_{A.PV} + IR_s) / R_p$ can be ignored as at standard working situations, actually its value is extremely lesser than current produced by SPV cell [5].

The boost-converter is one of DC to DC power electronics converter which achieves an enlarged potential difference at its output side with reverence to its input side potential difference. And MPPT algorithm is mostly utilized to manage duty-cycle of DC/DC converter [6].

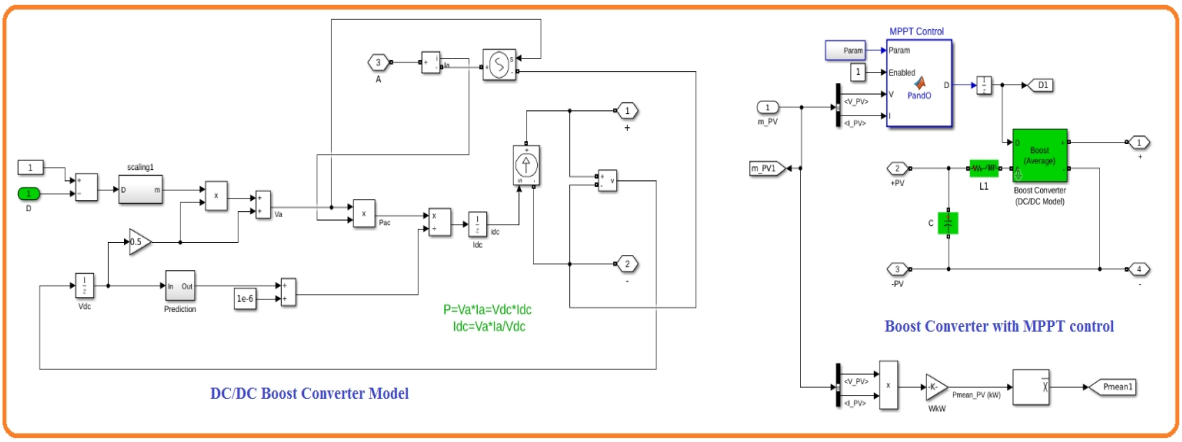


FIGURE 2.*Proposed model of Boost-converter*

In VSC modeling, 3-phase VSC based inverter associated to main grid voltage. The elementary value of current passing from VSC to main grid was defined as output current (I_{grid}). V_{dc} is called DC potential difference across specific capacitors. Output side voltage (V_{grid}) is potential difference at AC side of VSC, which may calculate through switching time.

The input or output power transmit among sending voltage node & receiving voltage node beside with VSC output current may analyze by applying the dq0 frame control utilizing equivalent formulas base on clarke & parke transformation [6].

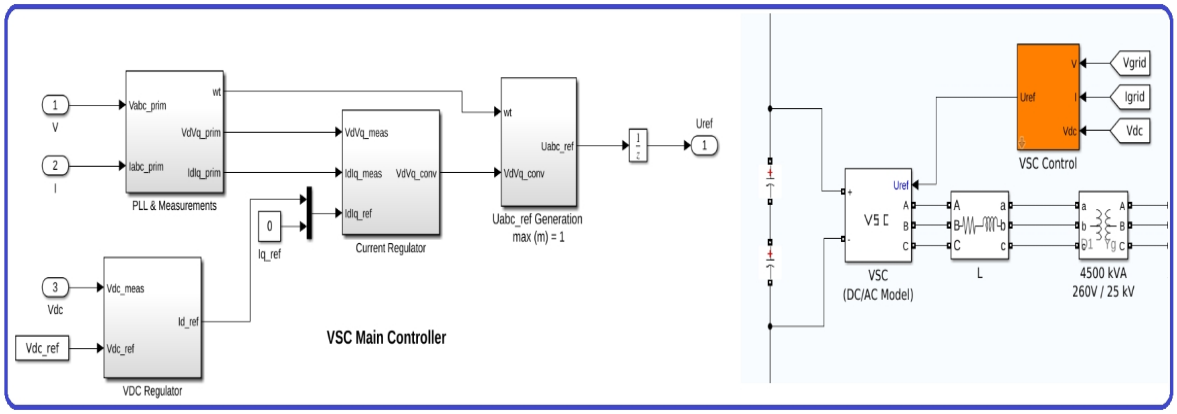


FIGURE 3.*Proposed model of VSC*

MODELING OF WIND ENERGY CONVERSATION SYSTEM (WECS)

Proposed modeling of WECS is divided in small sub-modeling of wind turbine (WT) model, drive train model, PMSG model, AC to DC converter model and DC to AC inverter model.

WECS modeling has horizontal-axis; three-bladed WT model & the blades of WT converts the incident wind power P_w into mechanical power P_m, where the maximum efficiency of WT cannot exceed the Betz limit. Moreover, efficiency of WT is called wind power co-efficient C_p which can written as per below formula [7].

$$C_P = \frac{P_m}{P_w} \tag{4}$$

Here, P_m = Mechanical power = $T_m \omega_m$; T_m = Mechanical torque; ω_m = Mechanical rotor speed; P_w = Wind power = 0.5 ρ_{air} A_b $(v_w)^3$; Where, ρ_{air} = Air density; A_b = Swept area of blades & v_w = Wind velocity.

The rated power output is produced from WT when the speed is about rated wind speed of the machine like, 14 to 15 m/s [7]. In addition, the cut-in speed for the WT is in the ranges of 2.5 to 3.5 m/s and cut-out speed ranges from 20 to 25 m/s. The power extracted by the rotor is described by P_{rotor} = 1/2 (ρ A V^3 C_p). Where, ρ = Wind density; A = Sweeping area; V = Wind before the turbine & C_p = Wind power coefficient.

The drive train of a WT Generator System (WTGS) consists of a blade pitching organism with a spinner, hub with blades, a gearbox with breaker, rotor shaft and A.C. generator. Now, look at combined modeling of WT and drive train as below.

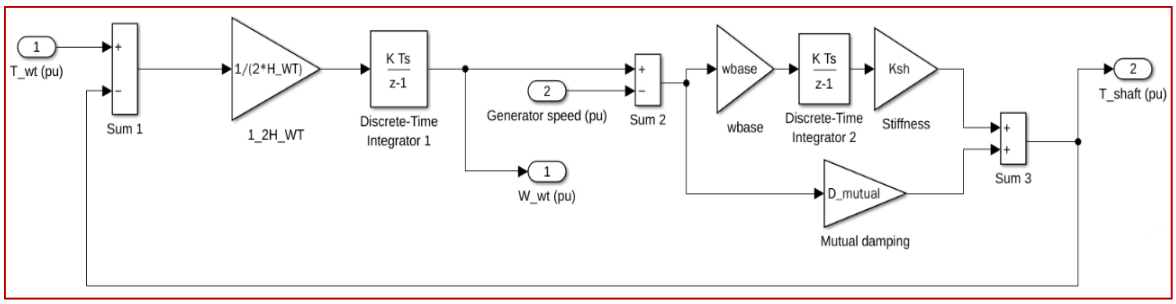


FIGURE 4.*WT with driven train based on 2-masse model*

In WT model, first input is the turbine speed in per unit of the generator base speed. Second input is the blade pitch angle in degrees and third input is the wind speed in m/s. The output of WT is the torque applied to the drive train in per unit based on the nominal power of the turbine and the base speed of the generator.

The outputs of WT are the inputs of driven train. The outputs of driven train are the transmitted torque of the shaft in pu based on the nominal power of the WT, the base speed of the generator and the wind turbine speed in pu value.

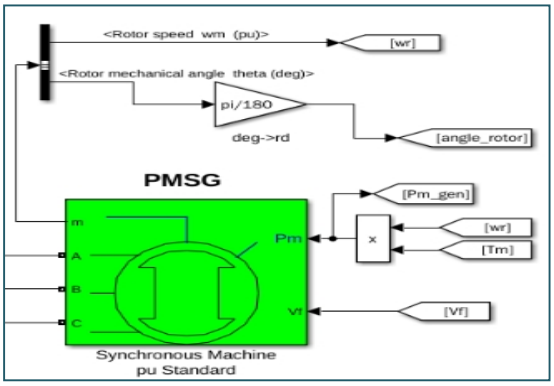


FIGURE 5.*PMSG model*

PMSG is driven by a wind turbine and the generated power is fed into the grid through 2 back-to-back power converters (rectifier/inverter) which share a common DC voltage link in between [7].

The implements a 3-phase synchronous machine (PMSG) modeled in the dq-rotor reference frame and rotor or stator windings are connected in star(Y) to an internal neutral point [7] [8]. This model considered salient pole type rotor and permanent magnet type stator.

AC to DC & DC to AC converter models includes two numbers of universal bridges and DC to DC boost converter circuit. One of the universal bridges is used to convert AC to DC and other is used to convert DC to AC [8] [9]. Output of first universal bridge is DC which is boost up by boost converter circuit and after that it is again convert to AC by using second universal bridge.

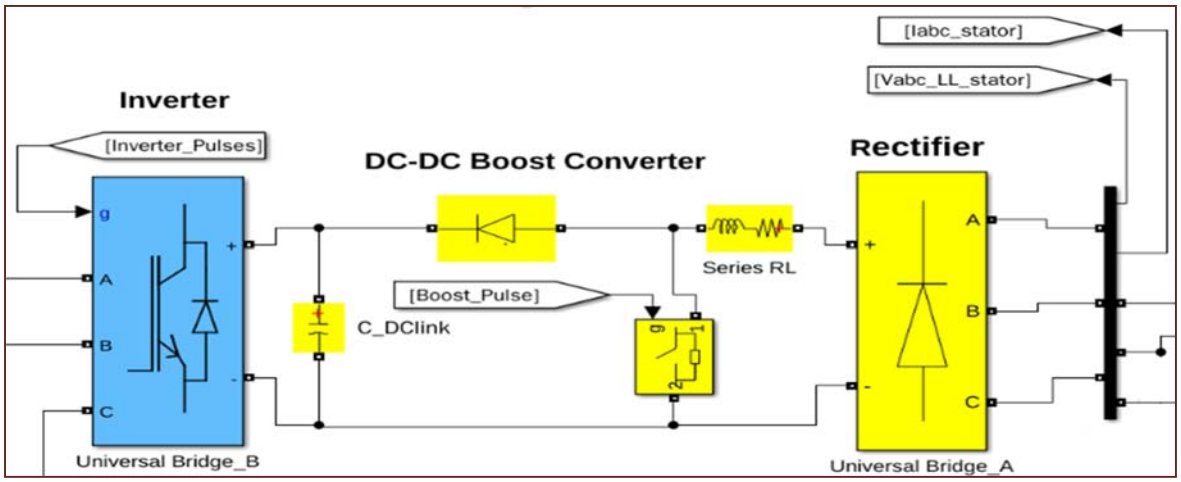


FIGURE 6.*AC to DC / DC to AC converter model*

In both the universal bridge model, 3 arms are used and 2 IGBTs are connected in each arm. The internal inductances of each IGBTs are set to zero value and diode internal impedance is infinite during off-state mode [9] [10].

MODELING OF HYDRO-ELECTRIC SYSTEM

The modeling of hydro-electric system includes the hydraulic turbine (HT) model, PMSG model and power electronic converter (PEC) model.

The proposed HT model includes the strong penstock with suitable tunnel, the water turbine and the head losses [11] as below,

$$T_w \dot{q} = (1 - h) - k_f q^2 \tag{5}$$

Here, q = normalized water flow on the penstock, h = hydraulic head, k_f = friction losses on the penstock & T_w is the initial water time on the penstock which is as below [11],

$$T_w = \frac{(L q_b)}{(A g_b)} \tag{6}$$

Here, g = acceleration of gravity, q_{base} = flow rate during gates are totally open, L & A = length & area of the penstock and h_{base} = static head of water line above water turbine. Now see the non-linear HT model as below.

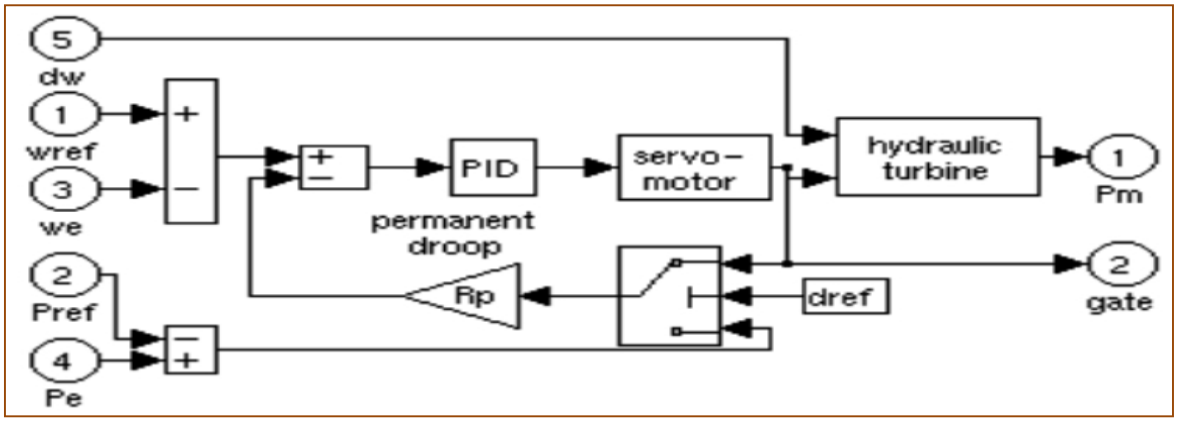


FIGURE 7.*Non-linear HT model*

The hydraulic head & mechanical power of the water turbine are termed [11] as below,

$$\mathbf{h} = \left(\frac{\mathbf{q}}{\mathbf{y}}\right)^{\mathbf{2}} \;\; ; \;\; \mathbf{P_m} = \mathbf{A_t}(\mathbf{q} - \mathbf{q_n})\mathbf{h} \tag{7}$$

Here, q_{nl} = no-load flow rate of water turbine, y = gate position and A_t = constant. The hydraulic type of servo model may describe by below formula [11] [12].

$$\mathbf{T_y}\dot{\mathbf{y}} = (\mathbf{u_g} - \mathbf{y}) \tag{8}$$

Here, u_g = input control which is build with PID type controls and T_y = servomotor's time constant.

Here, in PMSG the permanent magnets will help to produce magnetic field inside the rotor. Key benefits of PMSGs are higher power to weight ratio and excellent efficiency [12]. For PMSG model, dynamic behaviors of PMSG are given below in per-unit values.

$$M\dot{w_m} = (T_m - T_e) \tag{9}$$

$$M = \frac{(2H_g)}{w_0} \tag{10}$$

Here, H_g = inertia time constant of water turbine, W_m = rotor speed in rpm, M = mutual inductance, w_0 = angular speed of PMSG, T_m & T_e = mechanical & electrical torque as below [12].

$$T_m = \frac{P_m}{w_m} = \frac{q^2 A_t(q - q_n)}{w_m y^2} \tag{11}$$

$$T_e = [\square i_q] \tag{12}$$

Here, $\emptyset$ = permanent magnetic flux generated through rotor magnets (with constant value) and i_q = PMSG current in dq-reference frame.

PEC model includes back-to-back configuration with Voltage Source Converters (VSCs), which is employed to incorporate with PMSG to the AC main grid. The output voltages of PMSG can be defined as a function of the modulation indexes of the VSC [12] as formulate below,

$$\mathbf{v_d} = (\mathbf{m_{dq_g}})(\mathbf{v_d}) \tag{13}$$

Here, V_{dc} = voltage in the dc-link, m_{dq_g} = modulation index and subscript g refers to the VSC_g. The PMSG output voltages are represented as modulation indexes by the voltage in the dc-link. A dynamical modeling of the second VSC in the dq reference frame is defined here [13],

$$\mathbf{C}\dot{\mathbf{v}}_{\mathbf{dc}} = [\mathbf{I_s} - \mathbf{I_d}\mathbf{m_d} - \mathbf{I_q}\mathbf{m_q}] \tag{14}$$

Here, C = dc-link capacitor of the VSC, V_{dc} = dc-link voltage, I_s = current delivered by the PMSG, I_d & I_q = currents which flow through the transformer, m_d & m_q = modulation index of a VSC which attached with the AC main grid.

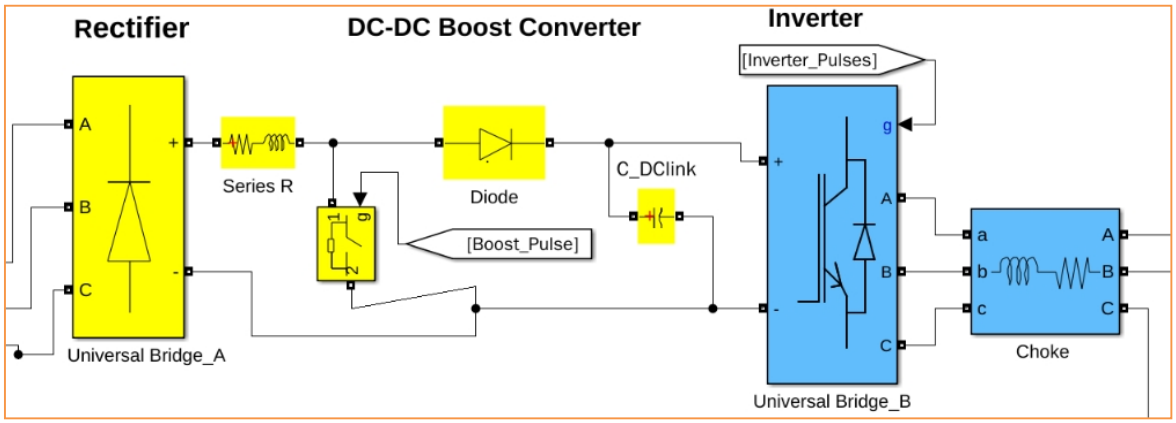


FIGURE 8.*PEC model*

In the rectifier block, internal inductance of thyristors and diodes are set with zero value. Moreover, the values of snubber resistance and capacitance are extremely small [13] [14]. The DC link capacitor was attached between inverter and rectifier blocks. In this case, inverter will work as a VSC. However, IGBTs are used as three arm bridge in inverter block. In this inverter, snubber capacitance is set with infinite value [14]. Final AC output is feed to the AC main grid through choke circuit.

MODELING OF UPQC

The proposed modeling of UPQC is including two numbers of 6-pulse IGBT based active power filter (APF). One is shunt and second series; both are interconnected by a common DC bus.

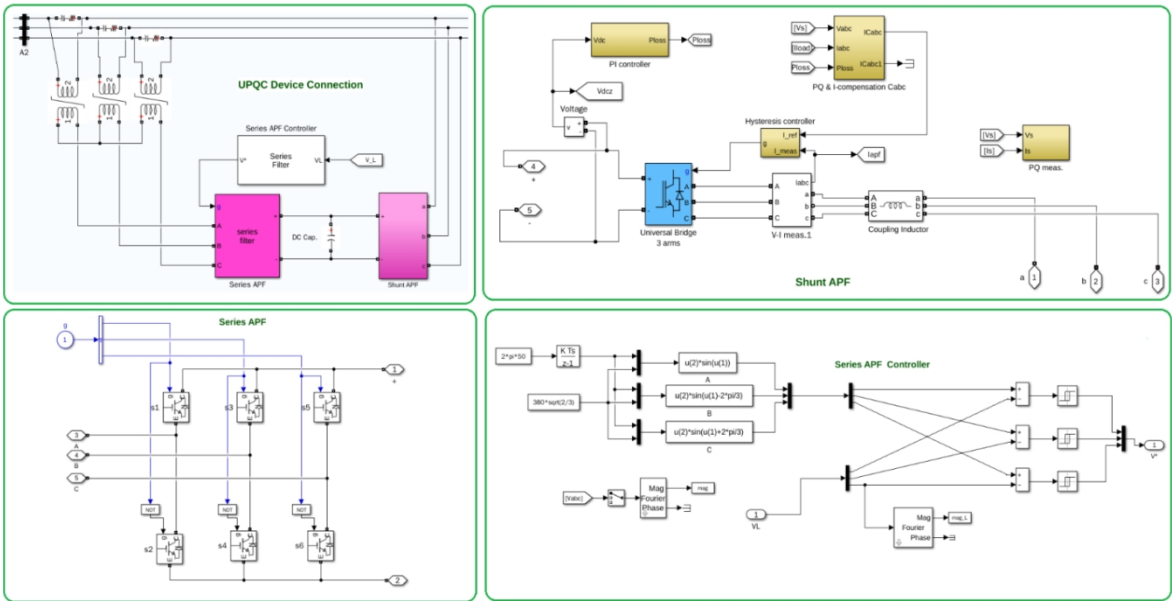


FIGURE 9.*Proposed UPQC model*

The shunt APF is always jointed in parallel with the sensitive load. It provides VAR support to the variable load & compensates the harmonic load currents [15]. The series APF always jointed in series with the variable load and which compensates the harmonic o/p voltage [16].

The shunt APF works as a controlled current source and its outputs are harmonics, reactive power and negative-sequence components. For compensate these quantities, the output current of shunt APF I_{sh} is kept to be equal to the component of the load as given in the below mathematical formula [17] [18].

$$\mathbf{I_L = I_1\ c\ (\omega + \theta_1)\ s\ (\theta_1) + I_L + \sum_k^{\infty} = (2\,I_L)} \quad (15)$$

Here, I_L = shunt converter current, I_{1p} = positive sequence current, θ_{1p} = initial phase of current for positive sequence, I_{Ln} = negative sequence current and I_{Lk} = constant.

To achieve a balanced sinusoidal load voltage with fixed amplitude, the final output voltages of the series APF can be given by below subsequent formula [18] [19].

$$\mathbf{V_S = (V - V_1)s\ (\omega + \theta_1) - V_L\ (t) - \sum_k^{t} = [2\,V_K(t)]} \quad (16)$$

Where, V_{SR} = series converter voltage compensation, V_{1p} = positive sequence voltage, V_{Ln} = negative sequence voltage, θ_{1p} = initial phase of voltage for positive sequence and V_K (t) = constant.

MATLAB/SIMULINK WORK

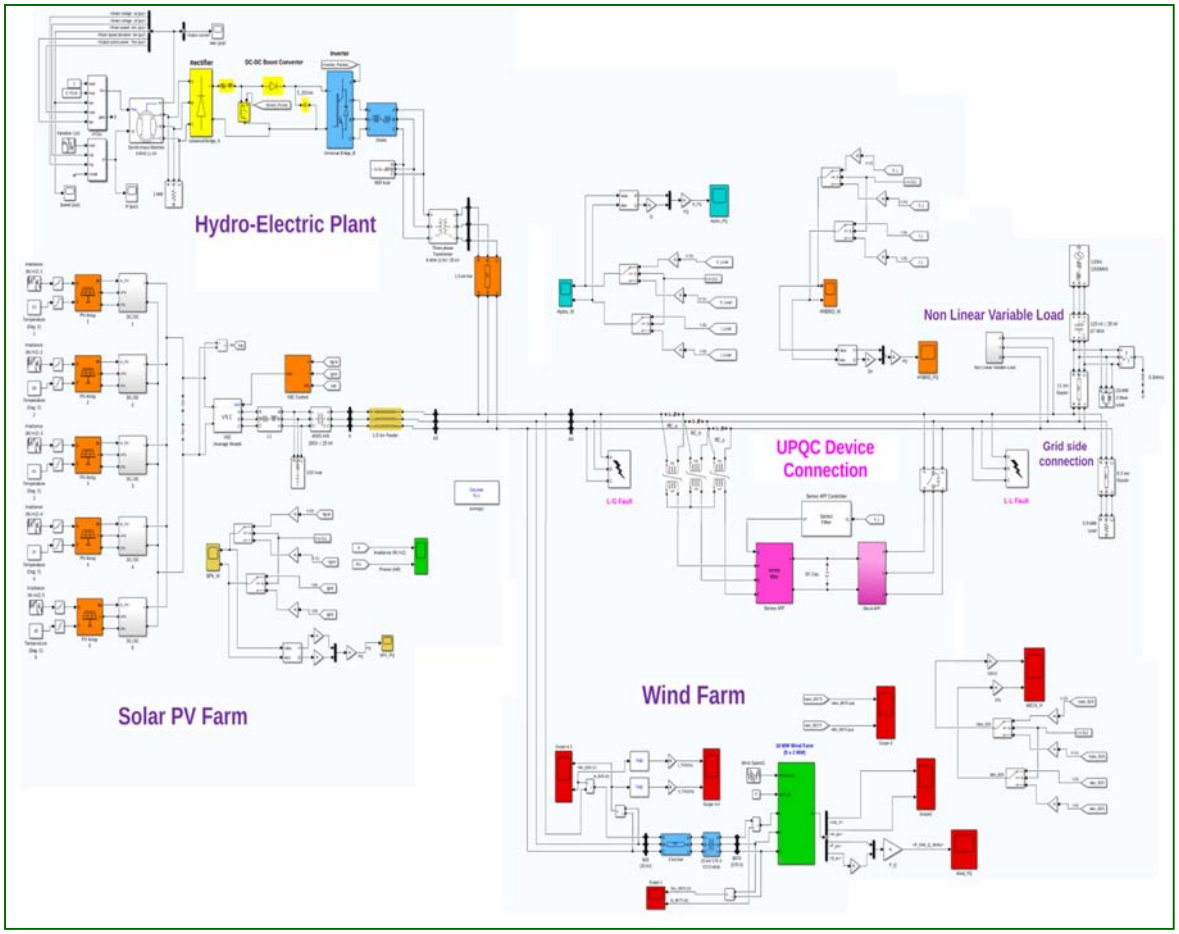


FIGURE 10.*Proposed h-RES with UPQC*

After modeling of various systems like, solar PV system, WEC system, hydro-electric system and UPQC, now it is time to integrate all together in common platform by using matlab/simulink based simulation. Moreover, variable non-linear load is also connected with the same platform. Now, see the entire proposed system using matlab as per figure 10.

In the proposed simulation common bus voltage is 25 kV and inputs of all the sub-systems are variable. Same way outputs are also variable and non-linear.

In the proposed system UPQC is used to enhance the power quality and system stability. Moreover, capacity of UPQC is always depend on the load capacity [19]. Furthermore, total VA capacity of UPQC is the sum of the individual capacity of series APF and shunt APF [20]. In the proposed system line to ground and line to line faults will occur to check the stability of the system.

The maximum output capacity of solar PV system, WEC system and hydro-electric system is 5 MW, 10 MW and 8 MW respectively. Moreover, net maximum output (i.e. 23 MW) is connected to non-linear variable load and main grid. The capacity of variable non-linear load is very from 5 MVA to 13.5 MVA. The capacity of UPQC device is fixed with 5 MVA.

RESULTS EVALUATIONS

The performance of proposed simulated systems may scrutinize by observing the wave-shape of output current and voltage as mentioned below. Furthermore, curve of output active power and reactive power is also highlighted in the result section.

RESULTS WITHOUT UPQC

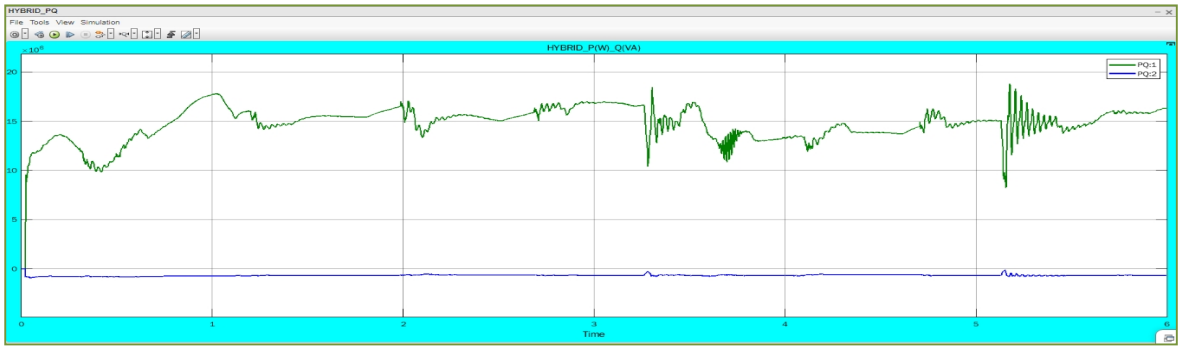


FIGURE 11*.Active & Reactive Powers on output side*

The output value of active power is continuously changing due to variable inputs are given as inputs are depends on environmental effects. Moreover, output reactive power is not zero due to interconnection of non-linear load. The value of reactive power is negative; it means reactive power is flowing from main grid to the generator side but it is very less compare to active power.

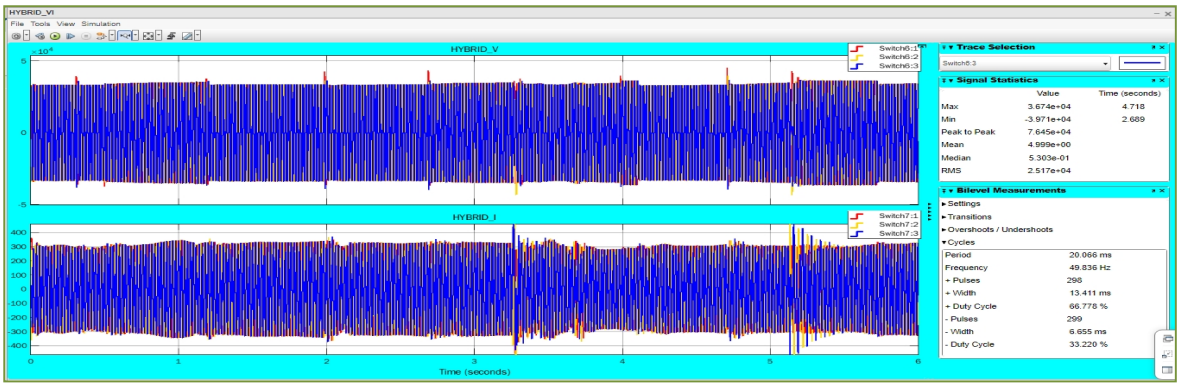


FIGURE 12.*Output voltage and current*

The value of output voltage is not being stable due to variable non-linear load and same way current is also unstable as because of variable load. The value of frequency is also fluctuate due to multiple fault occurs on the system. In this system, equilibrium load is applied hence no any unbalanced load conditions are occurs.

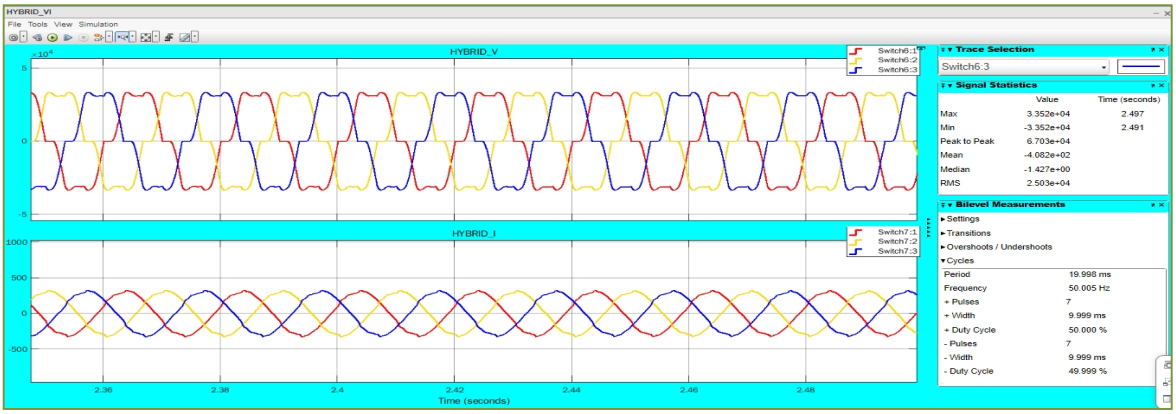


FIGURE 13.*Output voltage and current wave-shape*

The wave-shape of voltage and current is not sine-wave due to non-linear load which containing electronic components. The fundamental value of frequency is remaining 50Hz but the wave-shape of voltage and current having harmonic distortion due to electronic circuits interconnection with the load. Hence, due to harmonic distortion the wave shape of output voltage and current is not pure sine-wave.

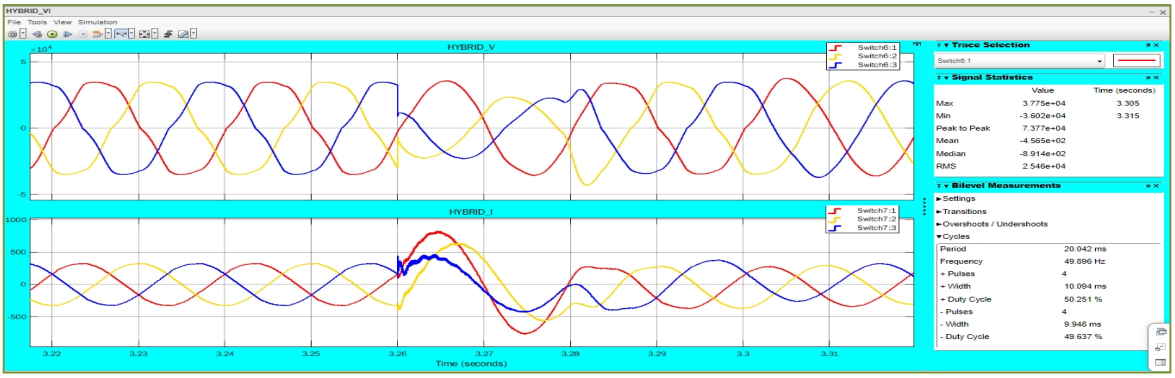


FIGURE 14.*Output voltage and current wave-shape during L-G fault*

During line to ground fault time, the stability of voltage and current is disturb for few milliseconds and supply frequency is also disturb as shown in above graph.

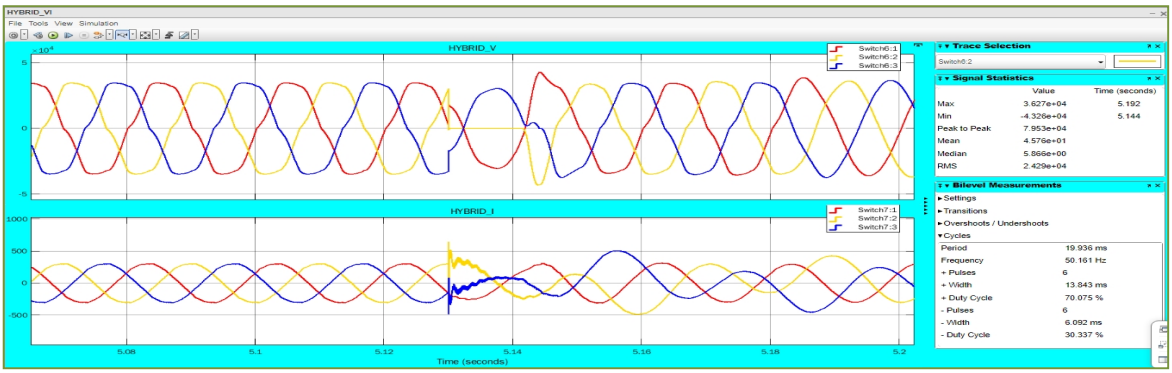


FIGURE 15*.Output voltage and current wave-shape during L-L fault*

In line to line fault duration, wave-shape of voltage and current may effected as per above figure. Moreover, supply frequency also disturb during fault time period.

Now, the total harmonic distortion (THD) of voltage and current is higher due to variable non-linear load interconnection with the HRE system. In this case UPQC is not connected and load is continuously fluctuating during entire time period. Furthermore, THD is also increase due to L-G and L-L faults. Let's see the FFT analysis for load voltage and current as below.

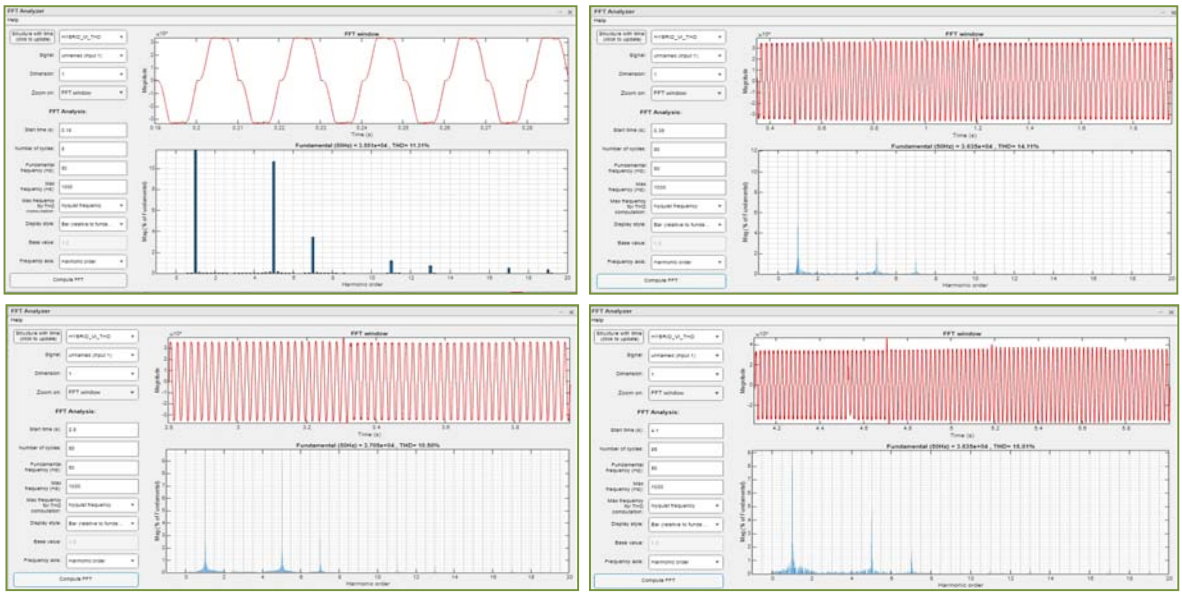


FIGURE 16.*THD values of Output voltage*

As per above FFT analysis, it is clear that, average THD value of load voltage is more than 10 % and it is not acceptable as per IEEE standards. Hance, active/passive filter or custom power device is needed to reduce the THD value. In this paper custom power device like UPQC is used to diminish harmonice and it also helps to reduce the voltage sag and swell effects.

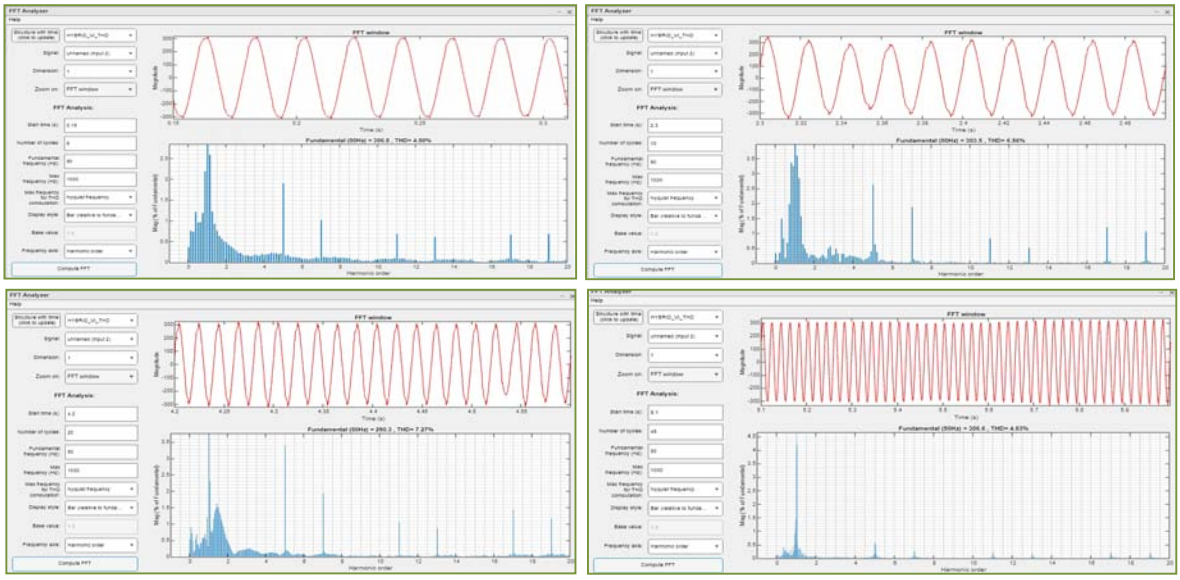


FIGURE 17.*THD values of Output current*

Same way, as per FFT analysis of load current, its average THD value is more than 5 % which is not acceptable as per IEEE standards.

RESULTS WITH UPQC

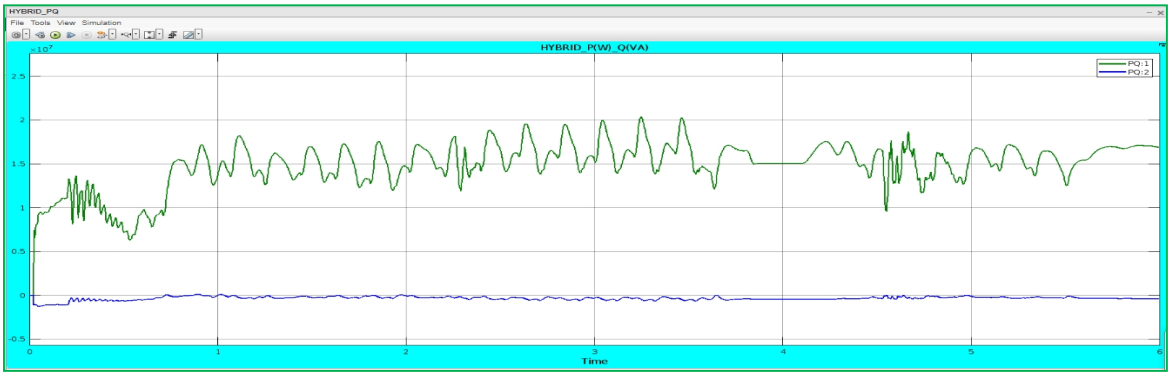


FIGURE 18.*Active & Reactive Powers on output side after UPQC*

The output value of active power is continuously changing and its average value is near to same as seen during isolated UPQC system. Moreover, output reactive power is not same as privies case but its value is decreased and reaches near to zero due to the connection of UPQC.

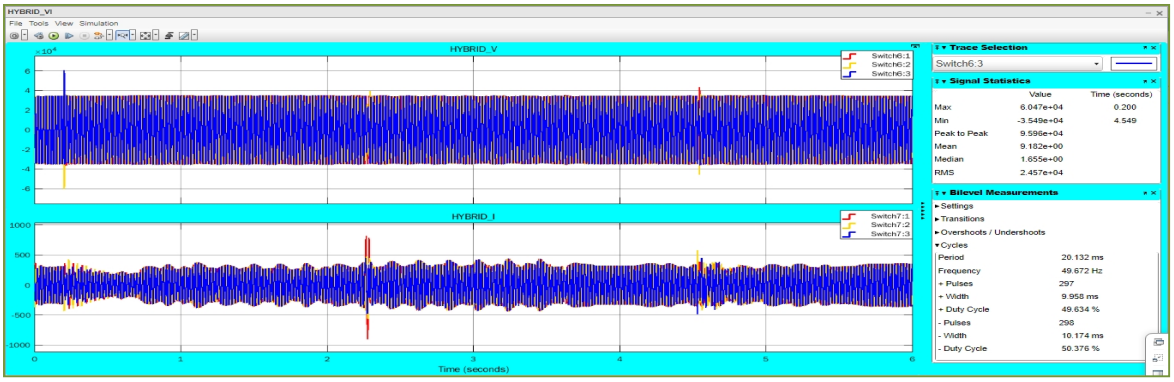


FIGURE 19.*Output voltage and current after UPQC*

The value of output voltage is now stable due to existence of UPQC and the value of output current is depending on the load. Hence, due to variation of load the current is unstable. During fault condition voltage and current became unstable after that again it becomes stable state. Frequency is also disturbed due to multiple faults occurrence.

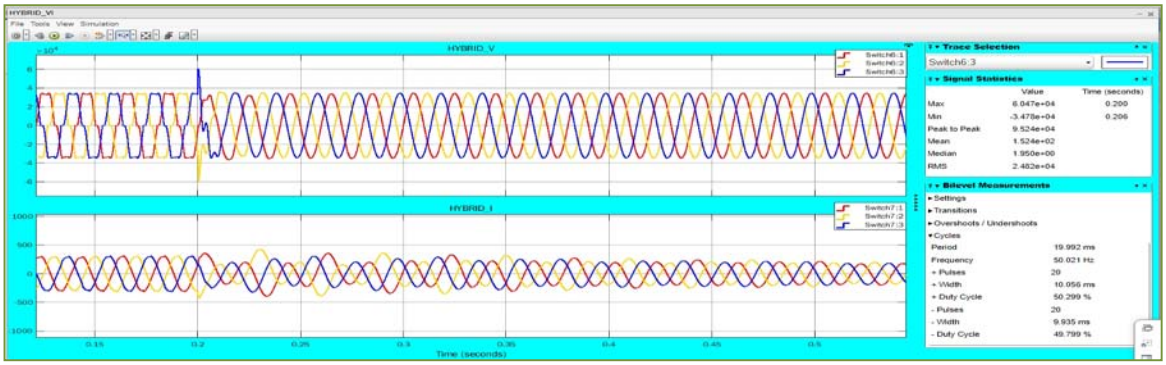


FIGURE 20.*Output voltage and current wave-shape before & after UPQC*

The wave-shape of voltage and current is not pure sine-wave before 0.2 second due to presence of non-linear load and isolation of UPQC device. After 0.2 second UPQC was connected and after that time the wave-shape of voltage and current was become sine-wave as shown in the figures. Hence, harmonic

distortion in voltage and current was highly reduced after 0.2 second and supply frequency is same as 50Hz.

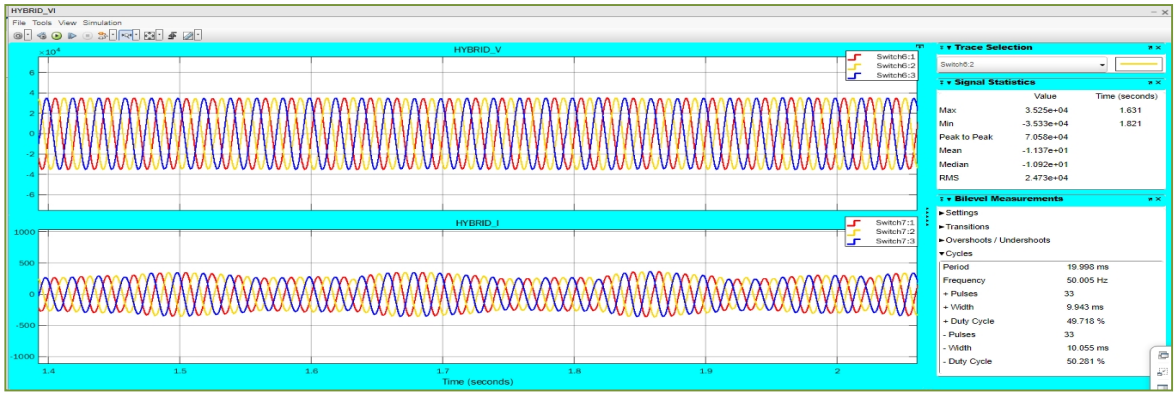


FIGURE 21.*Output voltage and current wave-shape after UPQC*

During line to ground fault time, the stability of voltage and current is disturbed for few milliseconds only and disturbance in wave-shape is nominal due to UPQC connection. After clearance of the fault, wave-shape again becomes sine-wave as shown in below figure.

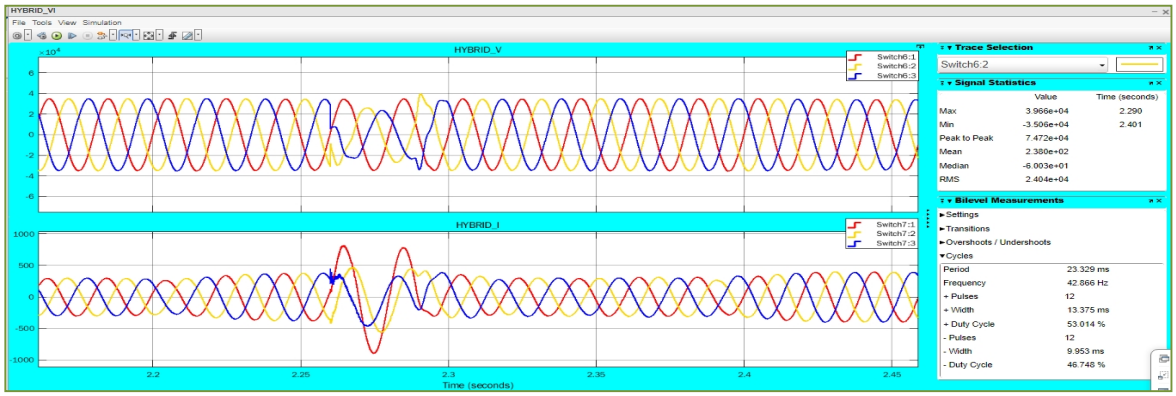


FIGURE 22.*Output voltage and current wave-shape during L-G fault after UPQC*

In line to line fault duration, the same phenomenon is occurred and during fault time, wave-shape is more disturb but after fault clearance, wave-shape again becomes sinusoidal.

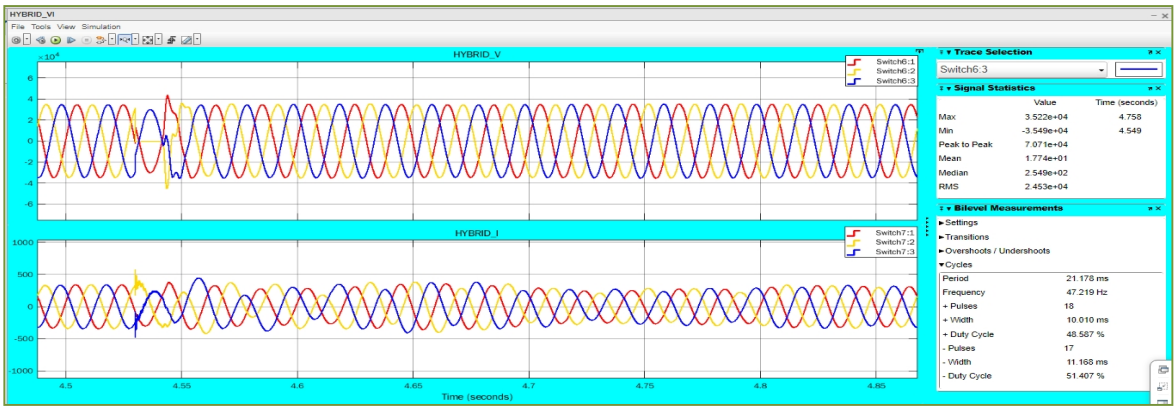
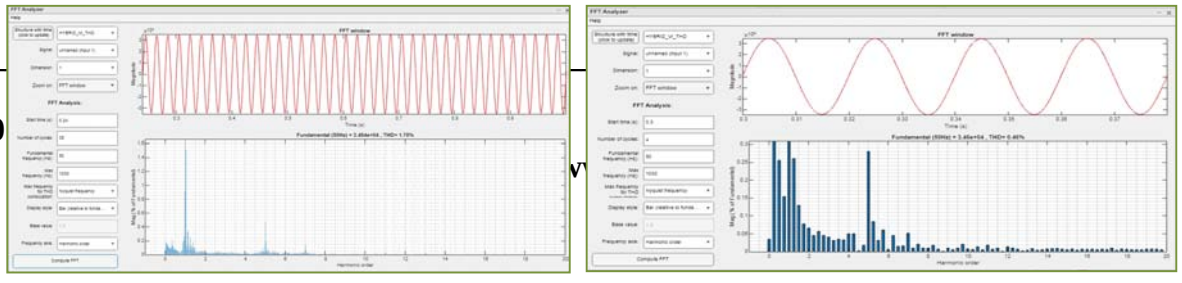


FIGURE 23.*Output voltage and current wave-shape during L-L fault after UPQC*

Now, the total harmonic distortion (THD) of voltage and current is very less due to interconnection of UPQC with the HRE system. Furthermore, THD is little bit increase during to L-G and L-L faults. Let's see the FFT analysis for load voltage and current after interconnection of UPQC device.



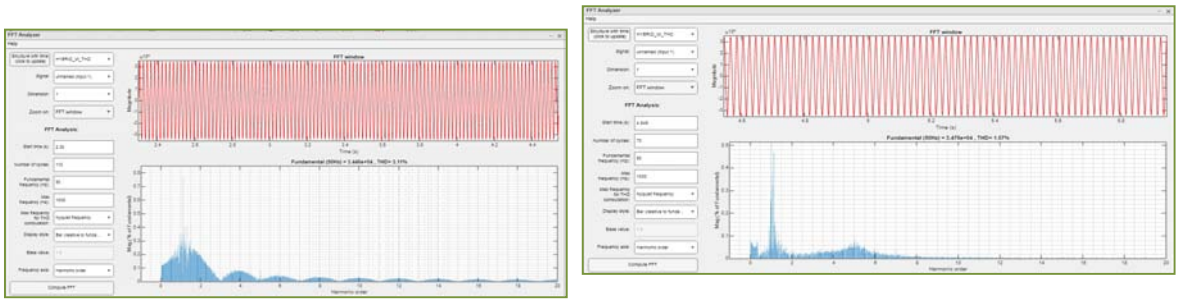


FIGURE 24.*THD values of Output voltage after UPQC connection*

As per above FFT analysis, it is clear that after the attachment of UPQC device with the proposed HRE system, average THD value of load voltage is less than 2 % and it is highly acceptable as per IEEE standards. Moreover, The value of THD can be differ as per the rating of UPQC and the installed location of the UPQC. But the value of THD is always less then previous case.

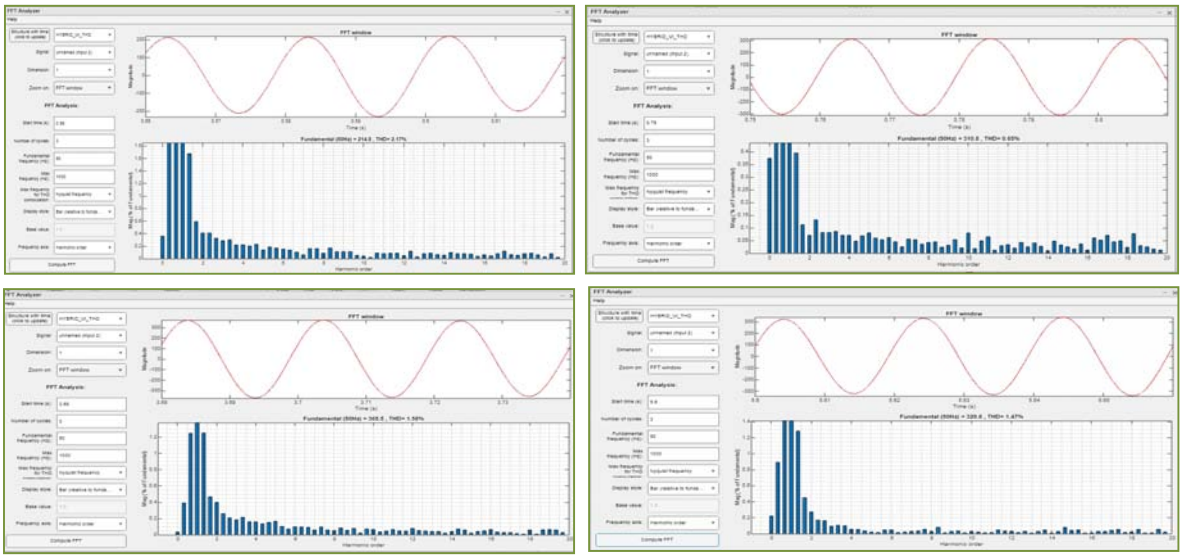


FIGURE 25.*THD values of Output current after UPQC connection*

Same way, as per FFT analysis of load current after the attachment of UPQC device with the proposed HRE system, its average THD value is less than 2 % which is greatly acceptable as per IEEE standards. Furthermore, the magnitude of current is always depends on the type of load and the value of the load. The value of THD is also varying by changing the load value, but it is always less than earlier stage.

COMPARATIVE RESULTS

The comparative investigation of both the cases may give the crystal clear outcome with respect to power quality, voltage stability and transient stability as presented in below table.

Sr. No.	O/P Parameters	HRE System without UPQC	HRE System with UPQC
1.	% Avg. THD of O/P Voltage	11.95 %	1.81 %
2.	% Avg. THD of Load Current	6.10 %	1.49 %
3.	Avg. O/P Reactive Power (MVAR)	– 0.6 MVAR	– 0.318 MVAR
4.	Avg. O/P Active Power (MW)	14.7 MW	14.9 MW
5.	Common Bus Voltage (KV)	25 KV	25 KV
6.	O/P Frequency (Hz)	49.95 Hz	50.04 Hz

7.	O/P Voltage Stability (KV)	23.85 – 25.68 KV	24.58 – 24.89 KV
8.	Transient stability (For LG/LL Faults)	Medium	Good

TABLE 1.*Comparative analysis of HRES*

CONCLUSION

By inspecting proposed variable non-linear load attached solar-wind-hydro based hybrid system, it is conclude that % average THD of output voltage and current of the system is higher due to absence of UPQC device. Moreover, output voltage is fluctuating during entire time span. But when suitable device like UPQC is attached with proposed hybrid system at PCC point, new % average THD of output voltage and current is reduced up to 10.14 % and 4.61 % respectively and these new values are fulfill the IEEE standards. Furthermore, output voltage is becomes almost stable state throughout the time period. Finally, PQ of new projected hybrid system is enhanced and transient stability during fault condition is also improved. At last, the rating of UPQC device is typically depends on the connected load value.

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Effect Of Terrasil For Stabilization On Black Cotton Soil

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Abstract. One of the main problems that harms the civil engineering constructions is the swelling and shrinkage phenomenon in expansive soil. The main mineral in expansive soil is montmorillonite, which responds strongly to changes in moisture content by changing its volume. Based on various sorts of study, a variety of procedures and strategies have been created and proposed for the stabilization of expansive soil.
This study used expensive soil samples for experimental testing to determine how Terrasil, a nanotechnology-based substance, would perform (Developed and manufactured by Zydex industries). Three separate locations in Gujarat provided soil samples, which were then categorized as CH type soil. The addition of Terrasil was found to dramatically lower the treated soil's liquid limit, plasticity index, and swelling potential.
The use of Terrasil lowers the ideal moisture level while increasing dry density. Terrasil should be used at a dosage of about 2-3% by weight of dry material, according to research. To analyze the changes that followed the mixing of Terrasil with soil, test results are compared. Terrasil dramatically changed the properties of expansive soil and can provide a remedy for soil swelling and shrinking.

According to the test results, Terrasil's presence reduced both its swelling characteristics and cohesive behavior. Obviously, as the dosage of Terrasil is increased, the UCS value of the treated soil decreases.

Keywords: *Nanotechnology, Soil stabilization, Expansive soil, Nano chemical – Terrasil*

INTRODUCTION

The first problems with expanding soil in civil engineering constructions were discovered at the end of the 1930s. Expanding soil shows a significant volume change when exposed to moisture variations brought on by artificial or seasonal climate changes [17]. The degree of expansiveness can be influenced by the presence or absence of active clay minerals in the soil mass. The typical active clay-mineral is montmorillonite. Variation damages infrastructure structures constructed on that soil mass by deforming the soil mass due to moisture's alternating expansion and contraction [23,4]. Stabilization is the most important way of soil reinforcement.

Because the stabilizer improves the physical or chemical characteristics of the soil, it performs much better and can be employed for a variety of building tasks. According to research, soil-based stabilization techniques

can be divided into four categories: mechanical stabilization, thermal stability, chemical stabilization, and electrical stabilization. Because they offer quick, effective, repeatable, and predictable modifications to the qualities of raw soil, mechanical and chemical stabilization are among these extensively utilized approaches. While chemical stabilization has altered chemical features, mechanical stabilization modifies the physical characteristics of the soil. By minimizing the need for expensive excavation and non-expansive material replacement, chemical stabilization is a time-saving method that allows the soil to reach increased density and strength [1,3].

Innovative technology, including nanotechnology, has evolved as a result of recent trends in geotechnical engineering research. The discipline of nanotechnology, which deals with tiny particles, is crucial to understanding how soil interacts and exhibits various qualities. For bulk content, the majority of characteristics are still largely the same on a micro level. For its enhancement, scientists have investigated a variety of nanomaterials; a few of these include silica [18], nanosilica [2], nanoclay, nanocopper, and nanoalumina [24]. The behavior of the material is radically changed if one or more geometric nano-scale measurements are absent. Therefore, the shear strength, maximum dry density, CBR value, permeability, and soil carrying capacity are all improved on the nano scale due to the high surface volume ratio and high cation exchange capacity. Nanoparticles can significantly change a substance's physical and chemical properties because of how well they interact with other particles and solutions. At the nanoscale, the gravitational pull can be disregarded. But the dominant force is electromagnetic. Researchers performed an experimental investigation on various soil types, including Terrasil [5,20,22], Terrasil with fly ash[6,] Terrasil with zycobond[21], and Terrasil with cement[10].

The study demonstrates that relatively modest amounts of Terrasil could change the behavior of soil particles. Terrasil alone could reduce UCS but when combined with Fly Ash or cement, the strength parameter such as CBR, the UCS increased with higher Terrasil dose. The liquid limit and plasticity index fell, OMC reduced, and MDD increased. This study aimed to investigate the effect of Terrasil nanochemicals on enhancing black cotton soils with various expanding properties. In order to use the treated soil as a sub-base material, the major goals of this experimental study are to lower the soil's expansive potential after stabilization and to optimize the dose.

MATERIALS

The following materials are used in the experimental program:

2.1 Black cotton soil. Problematic local expanding soil from the Gujarat, India, regions of Bhavnagar, Jamjodhpur, and Rajkot was used in experimental investigations. 1.5 metres of soil were dug up, and any organic or other wastes were removed before the soil was dried for 24 hours at 110 5 ° C, crushed, pulverised, and then homogenised. The results of the fundamental geotechnical tests on the soils are presented in Table 1. According to IS criteria, these three soils were categorized as CH-clayey soils with high compressibility and high swelling characteristics.

2.2 Terrasil. A stable solution based on nanotechnology, Terrasil uses organosilane, water as a solvent, ultraviolet light, and heat. Benzyl alcohol (25-27%), ethylene glycol (3-5%), and hydroxyalkyl-alkoxy-alkysilyl compounds (65-70%), are the constituents in Terrasil, a product made by Zydex Industries in Gujarat. It attempts to form bonds with the oxygen and silica atoms in the soil, which at room temperature chemically changes the silicon groups that absorb water into surfaces that are resistant to water. The chemical interaction between the soil particles and the Terrasil solution is depicted in Figure 1.

Table 1. Basic soil properties

Sr. no.	Properties	Bhavnagar Soil	Jamjodhpur Soil	Rajkot Soil
1	Particle size distribution			
	% Gravel	0	0	0
	% Sand	8	11	3
	% Silt	52	40	54

	% Clay	40	49	43
2	Atterberg's limits			
	Liquid limit (%)	65.11	75.06	73.50
	Plastic limit (%)	31.11	30.39	34.40
	Plasticity Index (%)	34.00	32.83	41.90
	Shrinkage limit (%)			8.11
	IS classification	CH	CH	CH
3	Compaction characteristics			
	Maximum Dry Density, (g/cm^3)	1.49	1.44	1.41
	Optimum Moisture Content, (%)	26.88	24.33	23.80
4	Unconfined Compressive Strength (kN/m^2)	53.94	105.33	60.93
5	Free Swell Index (%)	56.66	62.27	77.77

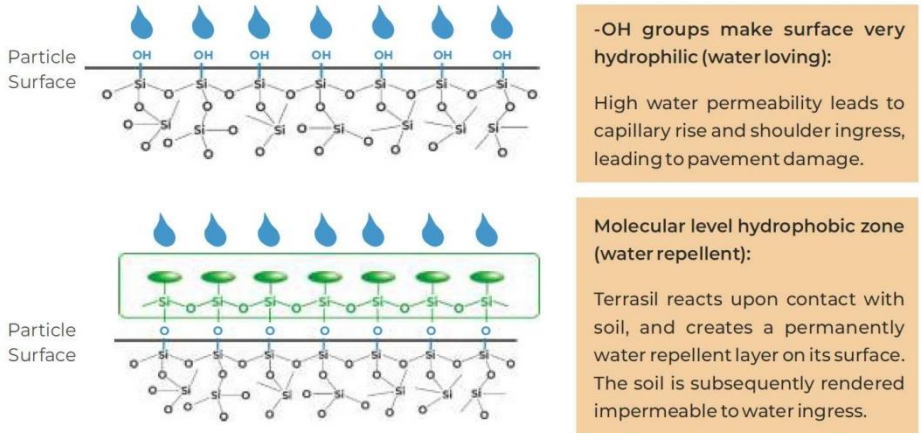


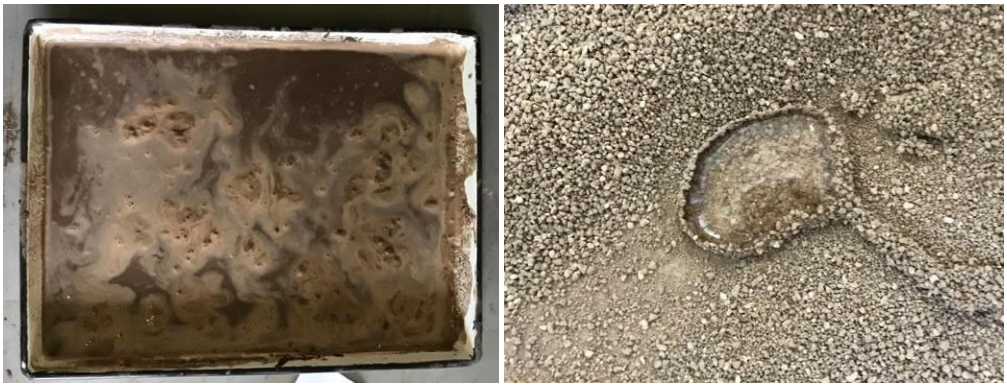
Fig. 2.1 Chemical action of Terrasil on soil particles

METHODOLOGY

SAMPLE PREPARATION

To break down large clay chunks into smaller ones, soil was oven-dried for 24 hours before being crushed with a wooden hammer. Terrasil was manufactured in a variety of concentrations, including 1%, 2%, and so on. To make 1% concentrate soil, combine 100 g of water with 1 g of Terrasil. Once the Terrasil and water are fully combined, add the Terrasil-water combination to 100 g of oven-dried soil.

The dry weight of virgin soil was used to calculate the amount of Terrasil. This Terrasil solution was completely combined with the oven-dried soil before being left in a humid atmosphere for 48 hours to mature. This soil-Terrasil sample was once again oven-dried and pulverised in accordance with different test standards.



(a)	(b)

Fig. 2. (a) Maturing process of Soil-Terrasil mixture, (b) Behavior of water droplet with Terrasil modified soil particles

RESULT AND DISCUSSION

In order to determine the effect of Terrasil on various expansive black cotton soils, all three soils were mixed with various dosages of Terrasil and investigated for consistency limits, free swell index, compaction parameters, and UCS tests.

EFFECT OF TERRASIL ON ATTERBERGS LIMITS

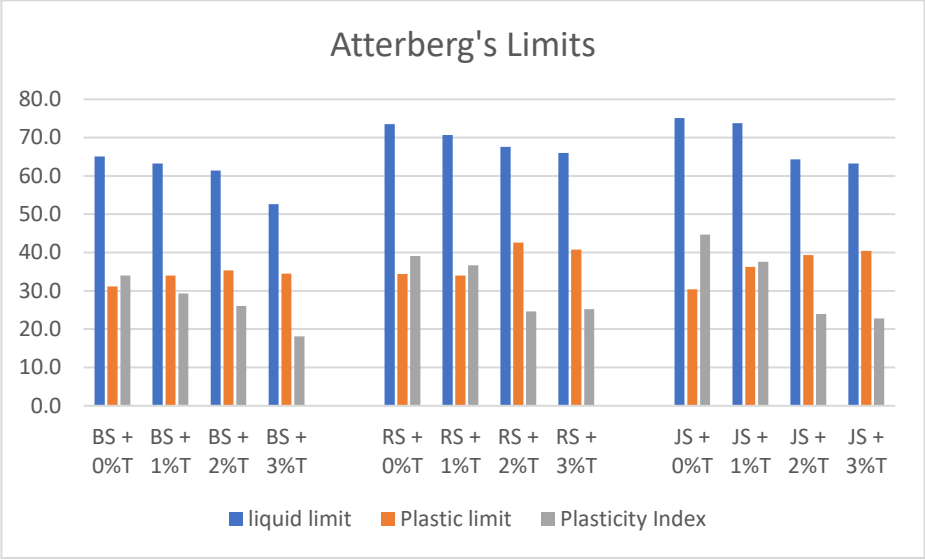


Fig. 4.1 Atterberg Limit test results of BS(Bhavnagar Soil) , RS(Rajkot Soil) , and JS(Jamjodhpur Soil) modified with Terrasil

With the addition of 1% terrasil, the figure initially displays a minor decrease in liquid limit and plasticity index, but with the addition of 2% and 3% terrasil, there is a large decrease in liquid limit and plasticity index. Atterberg's Indices have decreased, indicating that its index qualities have improved.

EFFECT OF TERRASIL ON FREE SWELL INDEX

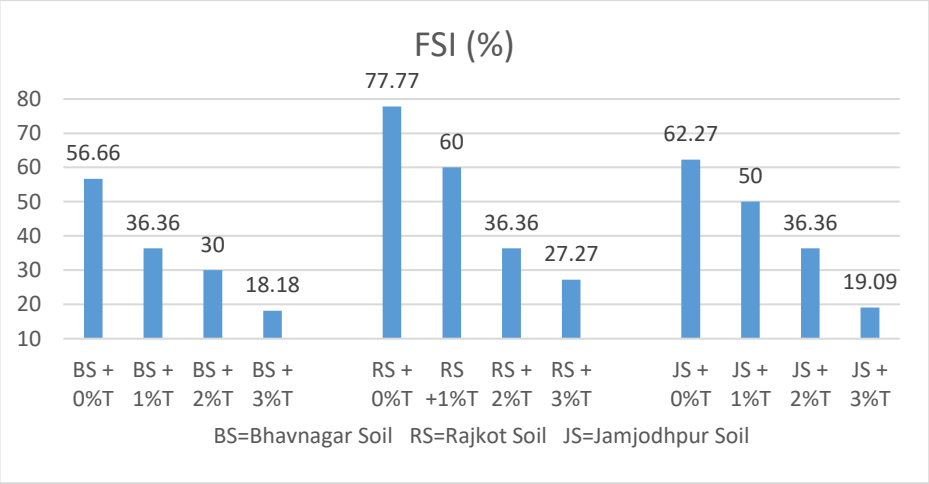
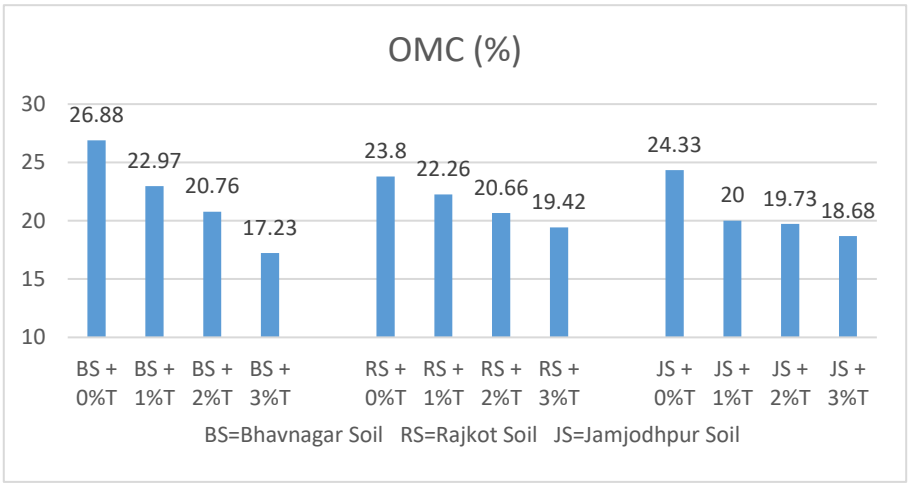


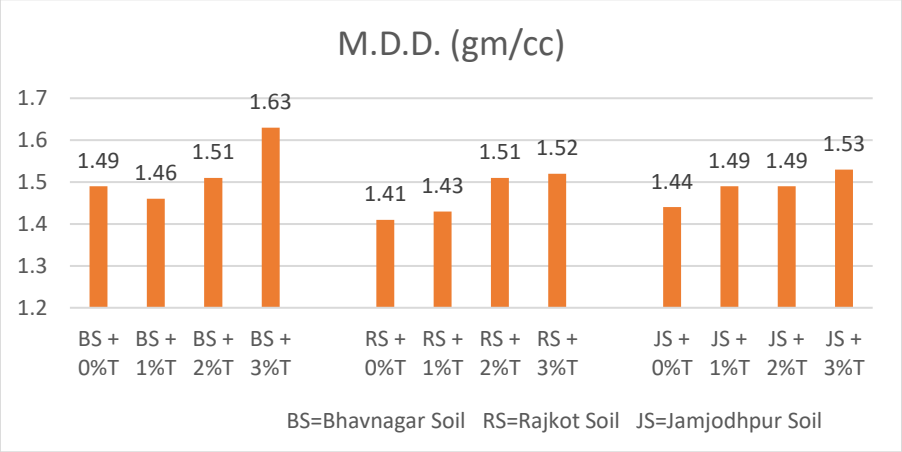
Fig. 4.2 Free Swell Index results of BS, RS, and JS soil modified with Terrasil

From the graph above, it can be seen that adding 3% terrasil reduces the free swell index by almost 70% when compared to virgin soil. This demonstrates that the expansiveness of soil decreases from very high to low with an increase in terrasil percentage.

EFFECT OF TERRASIL ON OPTIMUM MOISTURE CONTENT (OMC) AND MAXIMUM DRY DENSITY (MDD)



(a)



(b)

Fig. 4.3 Compaction Test results of BS, RS, and JS soil modified with Terrasil

The ideal value of OMC and MDD for the soil sample from Bhavnagar is 17.23%, and 1.63gm/cc was reached at a terrasil dosage of 3%. The best value of OMC and MDD was also attained at a terrasil dosage of 3% for the other two soil samples. The creation of siloxane bonding may have improved MDD as a result of the reaction between Terrasil and the silicates found in soil. A rise in the maximum dry density typically denotes soil improvement.

EFFECT OF NANO-CHEMICAL ON UNCONFINED COMPRESSIVE STRENGTH TEST (UCS)

To investigate the impact of Terrasil on the strength parameter, UCS tests were conducted using the OMC and MDD. Table 2 displays the UCS values for terrasil-modified soil samples. Here, the strength started to decline with just 1% of the Terrasil. The UCS sample was impossible to prepare and the samples failed to extract from the UCS mould after the dosage was increased.

Table 2. UCS values of Terrasil modified soil samples

S. no.	Soil type	UCS (kN/m2)			
		0% Terrasil	1% Terrasil	2% Terrasil	3% Terrasil
1	BS	53.94	47.72	NA	NA
2	RS	60.93	53.48	NA	NA
3	JS	105.33	47.66	NA	NA

BS=Bhavnagar Soil RS=Rajkot Soil JS=Jamjodhpur Soil

CONCULSION

The impact of Terrasil on soil samples from three different regions was investigated in this study. The present study presents the following conclusions:

• The soil's liquid and plastic limits are reduced as Terrasil is added. As a result, the clay becomes more workable and the plasticity index drops.

• Terrasil creates a layer of soil particles that is water-resistant, reducing the attraction between clay soil particles and water molecules. The findings of the free swell index tests demonstrate this.

• The amended soil sample's compaction parameter displays a higher MDD and a lower OMC, which may be a result of the water-proofing layer's combined effects with the soil's improved workability.

• As a result, Zydex Industries' Terrasil nanochemical, which can be used to waterproof roads, slopes, and canals to make them more durable, maintenance-free, and moisture-resistant, has been shown to be an efficient soil stabilizer.

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Development of Sustainable concrete using CWP and HDPE – A Review

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Abstract. So far as concrete is concerned it's been widely used material till date worldwide and also will be used with more intensity as construction sectors are in boom demand. Sustainable concrete structure is one that is constructed in such a way that the overall social impact of the entire life cycle is minimized. Sustainability in mind requires considering the structure's short-term and long-term effects. Such Concrete is also called Green Concrete. Use of unsafe waste in concrete will result in undesirable surroundings. kind of concrete may called sustainable concrete and some may call it Green concrete. In recent era use of different products and hence its by-products as waste growing tremendously which want right discarding , For environmental protection, the reduction of dependence on herbal compounds, the reduction of CO2, and the creation of greener concrete, its recycling, and reuse are essential. not pricey. The importance of sustainable concrete has turn out to be sizeable for educational Institutions, University and industries. The manufacturing of ceramics in India has increased to over 750 million m2 [1]. Each year, waste created from the production and transportation of ceramic products is generated. Hazardous metals such cobalt, vanadium, barium, manganese, lead, cadmium, copper, chromium and antimony are used in the clay, stains and glazes used to make CW and CWP. [2]. In recent time line such kind of ceramic waste is generally used to fill up nearby land which makes surrounding land unfertile as well as it makes sounding ground water contaminate. The main objective of the this review is to lookout for the different effects of CW and CWP as FA,CA and Combination. Also in present review Coarse aggregates have been partly replaced by High-density polyethylene granules (HDPE). Different concrete mix have been studied for M30 grade. CA have been replaced in the range of 1% to 5%. Numerous properties have been studied for durability and strength i.e. split tensile test, compressive strength, durability and flexural test as well as rapid chloride permeability test, alkaline test, acid test.

Keywords: Green Concrete, Ceramic Waste, CW, CWP, HDPE, LDPE

INTRODUCTION

In Recent era construction industries taking an important part for ongoing construction projects in at most all region. Use of concrete as building material have expanded due to its useful properties. Concrete is mixture of CA, FA and Cement (binder). Now a days exploitation of natural resources is booming for the development and uplifting the Civilization. Consequences of using cement in huge amount lead to produce green house gases. Cement production generates 6% of CO2 emission globally. 1.57 tonnes of Clinkers used per ton production of cement. Such clinkers contains shale, lime stone and clay[3]. Also waste from different industries have been increasing rapidly to overcome the demand of Humans for ongoing activity. Some of them are injurious to health. From many waste only few can be used as recycled and reused to produce another material. Ceramic waste and

HDPE waste are two of them. These both waste produced as by product from industry. Since ceramic industry is widely enhancing the production and by that consequences waste material generating more.

As per the data of 2011-12 approximately 600 M.Sq.m ceramic was produced by India[4]. Which was updated to 750 M.Sq.m[1]. If we look for Plastic Industries than it is also producing waste like HDPE (High density polyethylene) and LDPE (linear density polyethylene). Such material are light in weight but strong enough to take load. Among HDPE and LDEP, HDPE have less impact on surrounding environment because it is less chemically affected by other material. Aggregates were replaced partially by HDPE to increase the strength. HDPE were introduced in the form of Granules which has to deal with split tensile test, compressive test, shrinkage test, flexural strength, compressive strength etc. Generally HDPE is used to enhance the mechanical Property of concrete namely compressive strength.

LITERATURE REVIEW

Some literature have been studied thoroughly and CW and HDPW waste are discussed below.

Alves et al. [6] investigated the mechanical properties of recycled aggregate (recycled brick and sanitary ware aggregate) at 0%, 20%, 50%, and 100% of total natural aggregate volume for compressive strength, abrasion, modulus of elasticity, abrasion resistance, split tensile strength, modulus of elasticity, workability, the effect of super plasticizers fresh density and fresh density.

As per investigation of Willetta et al. [7] he investigates that by incorporating cement scraps (10%, 15% and 20% cement) into the mortar, the properties of concrete were modified in CW, improving its freeze-thaw resistance, consistency retention, bending and compression testing, workability Retention, and shrinkage were tested. Test results of 2, 7, 14, 28, and 56 days.

Jiménez et al[8] . examined with substituting Naturally available FA made of natural sand at 0%, 5%, 10%, 20%, and 40% with ceramic waste in masonry mortar at a ratio of 1:7 volumetric cement-to-aggregate.

The aim of this study was to find out if you could use recycled HDPE with the same degree of tensile strength as pure HDPE. To use pure and recycled HDPE in different plastics, the analysis of both materials' tensile strength was performed. In pHDPE and r-HDPE respectively, the maximum tensile energy changed into 26,843 MPa and 15,889 Mpa. Improved with advanced melting temperature, strain of injection and time of maintaining to reach the most efficient tensile energy price (16,058 MPa). The end result suggests that the decrease in r-HPDE tensile power value (sixteen,058 MPa). The result suggests that the decrease in r-HPDE ensile strength drops from 40.73% to forty three.478% (2017) [17].

Some of them have conducted research on the mechanical and thermal expansion performance of high density polyethylene composites reinforced with hybrid inorganic fillers. Their experimental study on HDPE fibre and glass fibre is concluded in this report. The tensile modulus and strength of various composite constructions served as the foundation for this study. It was discovered that putting a pure polypropylene (PP) or high-density polyethylene (HDPE) shell over a core of comparatively to non-coextruded materials, wood polymer composites (WPC) reduced humidity [3].

In addition to obtaining sawdust from a nearby sawmill, the post-consumer HDPE was gathered at a plastic recycling facility. The tensile and flexural properties of composites made from recycled HDPE are comparable to those of composites made from virgin HDPE. A study of the microstructure of MAPP-modified composites with broken surfaces and improved interfacial bonding is presented in [19].

In this publication, laboratory research on the alkali tolerance and fibre quality of recycled polypropylene (PP) fibres in concrete 25 MPa and 40 MPa, used for walkways and prefabricated boards, respectively, is presented. After cracking in concrete, the recycled PP fibre demonstrated remarkable performance, leading to significant ductility. Recycled PP fibre supplied reinforcement comparable to or slightly lower than that of virgin PP fibre since it has been discovered that the tensile strength of recycled PP fibre is lower but higher than that of virgin PP fibre. The recycled PP fibre produced superior reinforcement than the fresh PP fibre in the 25 MPa concrete because the Young's fibre module was stronger than their reinforcement's tensile strength [20].

Sr. No	Type of concrete	Form of ceramic	Replacement	Properties evaluated	Outcome
1	High-performance concrete	Waste ceramic powder	Cement (0, 10, 20, 30 and 40% 10 interval)	Slump and slump loss, setting time, XRD compressive strength, Frattini test, Permeable pores, Chloride ion permeability, electrical resistivity	**The addition of ceramic waste powder reduced the compressive strength of High-performance concrete (HPC). However, durability was enhanced.**
2	Concrete	Waste ceramic electrical insulator	Coarse aggregate (100% replacement)	Slump, Compressive strength, STS, Flexural strength and Modulus of elasticity	**The compressive strength, flexural strength, and STS of ceramic electrical insulator waste coarse aggregate (CEIWCA) concrete are lower by 3.8, 6, and 18.2% respectively to RC. However, the workability was higher.**
3	Concrete	Sanitary ceramic waste	Coarse aggregate (15,20,25%,5% interval)	Slump, consistency, bulk density, XRD, SEM, ITZ, compressive strength, and STS	**Compressive strength and STS was improved with sanitary ceramic waste aggregate, and ITZ between paste and sanitary ceramic waste aggregate was high compact, less porous and narrower better than RC**
4	Concrete	Ceramic wall tile and floor tile	Coarse & fine aggregate (100% replacement)	Slump, density, Air content, Compressive strength, Bending strength, STS, Bohme Abrasion value, Ultra pulse velocity (UPV), Thermal Conductivity, Shrinkage, Open porosity, Total porosity, and Water absorption	**The floor tile aggregate concrete found identical mechanical properties of the limestone concrete, and wall tile aggregate concrete mechanically properties compare to lower than limestone concrete(LSC)**
5	Concrete	Ceramic sanitary ware	Fine and coarse aggregate (100%)	Workability, consistence, Compressive, STS, Abrasion resistance, Resistance to high temperature,	**After heating in 1000 C, concrete with WC sanitary ware aggregate and alumina cement preserved its form and high strength**
6	Concrete	Ground ceramic powder	Cement (0, 10, 15, 20, 25, 30 and 40%)	Compressive strength, Water absorption	**The study settled that the slightly reduced compressive strength and water absorption capacity of concrete with ground ceramic powder compare to the**
7	Concrete	Waste ceramic + fly ash	Fine Aggregate with ceramic waste aggregate (0, 10, 20,30, 40, 50, 100% replacement) and fly ash with cement (0, 30%)	Compressive strength, XRD, SEM, EDS, Density, Workability	**The highest compressive strength of the concrete was obtained with a 50 % WC fine aggregate.**
8	Concrete	Ceramic waste wall and floor tile	Fine and coarse aggregate (0, 25, 50, 75, 100% interval 25%)	Slump, Compressive strength, and STS	**Concrete containing 100% fine and coarse ceramic aggregate better performed than that of RC.**
9	Concrete	Bone china ceramic	Fine aggregate (0–100%, 20% interval).	Voids percentage, Abrasion resistance, Freezing–thawing resistance, Drying and wetting resistance, Resistance to corrosion and chloride penetration	**The resistance to (chloride penetration and freeze and thaw) of the bone china ceramic fine aggregate (BCCFA) concrete was better to compare to the SCC.**
10	Concrete	Waste ceramic electrical insulator	Coarse aggregate (100% replacement)	Water absorption, Sorptivity, Volume of voids, Chloride diffusion,	**The study concluded that CEIWCA can be recycled for the manufacture of concrete.**
11	Concrete	Waste ceramic tile	Coarse aggregate (20%, 25%, 35%,	Slump value, Compressive strength, Flexural strength, STS and Modulus of elasticity	**Used WC as a feasible CA substitution material with a**

			50%, 65%, 75%, 80% and 100%)		**small change in mechanical properties.**
12	Concrete	Porcelain tile and Red ceramic	Coarse Aggregate (0, 25, 50,75, 100%, 25 interval)	Water absorption, Compressive strength, Flexural strength, Tensile strength	**Mechanical strength and water absorption of 100% (Porcelain tile and Red ceramic) containing concrete was more as compared to RC.**
13	Concrete	Waste ceramic aggregate	Coarse Aggregate(0, 10, 20 and 30%, 10% interval)	Compressive strength, workability, bulk density, water absorption Environmental impact	**The inclusion of WC aggregate in concrete mixes improved compressive strength. However, workability was reduced**

MATERIALS & METHODS

PROPERTIES OF CONCRETE ADDED WITH CERAMIC WASTE

Following are the results of test performed on concrete added with recycled ceramic waste aggregates.

Workability

Concrete that can be handled without segregating, put without losing homogeneity, and compacted with a specific amount of force is said to be workable. According to Wioletta et al. [7], the reference mortar had the highest liquid consistency, and the consistency and plasticity of the mortar decreased when the amount of ceramic filler was increased.

The results of the consistency and plasticity tests indicate that the time of workability retention increased along with the amount of ceramic filler in mortar.

This is a result of the hygienic ceramic filler's greater water absorption. To reach the desired consistency, even a small amount of replacement of CA with 4 mm retained and 12.5 mm passing aggregates made from Ceramic waste required more water to add. For all w/c (0.5, 0.55, and 0.60) ratios, Katzer [9] finds the linear relation, which is distinguished by very high correlation.

According to Mandavi et al. [15], slump value declines as replacement percentage rises. At 10% replacement, the value of the slump is 75, and at 50% replacement, it drops to 31.

Hunchate et al. [11] investigated that Slump value reduced when recycled coarse ceramic aggregate was used in place of coarse natural aggregate at constant weight-to-cement ratios for all mixes, but it remained the same at 20%, 40%, 60%, and 80%, or 110 mm and 100 mm, respectively. According to Tavakoli et al. [13], the slump value reduces as the ceramic sand replacement percentage rises up to 50%, after which it starts to rise. According to Anderson et al. [14], slump value climbed up to 35% replacement before starting to decline and finally reaching a higher slump value at 100% replacement.

Density

According to Katzer [9], the density of ceramic is 1.8 g/cm3, which is significantly lower than the density of cement (3.18 g/cm3). As a result, the density of mortar is significantly reduced when ceramic fume replaces cement. According to Hunchate et al. [11], The density of fresh concrete decreases at 0% or 100% ceramic coarse aggregate replacement as the ceramic coarse aggregate replacement increases from 2436 kg/m3 to 2328 kg/m3. Also Investigation have been done by Tabacoli et al. [13], According to that ready-mixed concrete decreases in density with increasing ceramic sand substitution, from 2441 kg/m3 to 2385 kg/m3 at 0% and 100%, respectively.

As per investigation of Katzer [9], ceramic has a density of 1.8 g/cm3, which is much less than cement's density of 3.18 g/cm3. As a result, when ceramic fume substitutes cement, the density of mortar is greatly lowered. Hunchate et al. [11] found that the density of new concrete decreased to 2328 kg/m^3 which was earlier 2436 kg/m^3 and its done by replacing ceramic coarse aggregate from 0% and 100% respectively, as ceramic coarse aggregate

substitution increased. Fresh concrete loses density when ceramic sand replacement rises, going from 0% to 100% we get density of 2441 kg/m3 to 2385, respectively, according to Tavakoli et al. [13].

Compressive strength

According to Wioletta et al. [7], the addition of ceramic waste aggregate caused a 2 day increase in compressive strength of up to 42%. Over the course of 56 days, there was an increase of 11%. According to Jiménez et al. [8], the mechanical properties of the masonry mortar were somewhat enhanced when up to 40% of the material was replaced with CW by its volume. The average of compressive strength for different five substitution levels at different curing times is roughly the same for each age. For the results exception of 180 days

Flexural Strength

According to Wioletta et al. [7], after the addition of ceramic waste aggregate, flexural strength increased by up to 50% after just two days. However, over the course of 56 days, only a 12% increase was observed. According to Jiménez et al. [8], all mean values of flexural strength during curing durations of 7, 28, 90, and 180 days are approximately the same for the five replacement levels. The highest flexural strength was attained at w/c 0.55 when 10% of the cement was replaced with ceramic fume, according to Katzer [9], and after that, the flexural strength started to decline.

According to Anderson et al. [14], 100% replacement of ceramic tile waste results in a 25% reduction in flexural strength. The diminished cement's ability to stick to surfaces.

Split Tensile Test

According to Medina et al. [10], mixes including ceramic material have narrower, more compact, and less porosity than ordinary concrete, which results in an improvement in split tensile strength with an increase in replacement ratio. Inclusion of ceramic tile waste increased the tensile strength of concrete, with the exception of 100% replacement, which showed a maximum 6.5% degradation in tensile strength, according to Anderson et al[14].

Modulus of elasticity

Incorporating discarded ceramic floor tile aggregate produces an elasticity modulus with a maximum value of 27.4 Gpa in 100% replacement, which is 26.9% higher than the 21.6 Gpa of the reference mortar, according to Anderson et al. [14]. The modulus of elasticity decreases as more ceramic waste is added, according to Alves et al. [6]. With 100% replacement, it is said that reductions of 33.8% take place.

SPECIMENS

M30 concrete was used to cast each specimen. The 150 mm 150 mm 150 mm cube and the 150 mm 300 mm cylinder were cast to develop compressive strength and split tensile strength for 28 days in order to achieve the best resistance of high density polyethylene granules. The 700 mm by 150 mm by 150 mm prism sample pieces are cast. 53-grade Portland cement was utilized as the standard. River sand is utilized as a fine aggregate in compliance with the requirements of IS 383-1970 and passes an IS sieve of 4.75 mm. The river's sand is devoid of dust particles and removes trash and microscopic debris. As coarse material, 10 mm sieve-length crushed angular gravel that is easily accessible locally is employed.

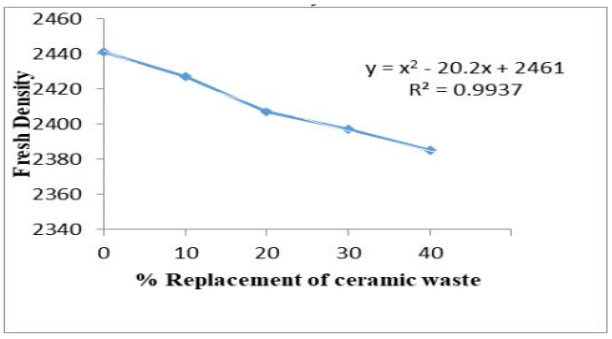
HIGH DENSITY POLYETHYLENE GRANULES (HPDE)

HDPE often replaces bulkier materials. Being strong and light could reduce the environmental impact. The density of HDPE ranges from 930 to 970 kg/m3. An LDPE-like white, semi-opaque, semi-crystalline thermoplastic polymer that is stronger, tougher, and even chemically resistant. Its crystallinity is typically between 70 and 80 percent. The effect tolerance is almost high and at low temperatures, while being significantly bigger than that of LDPE. HDPE granules are shown in Fig. 1.

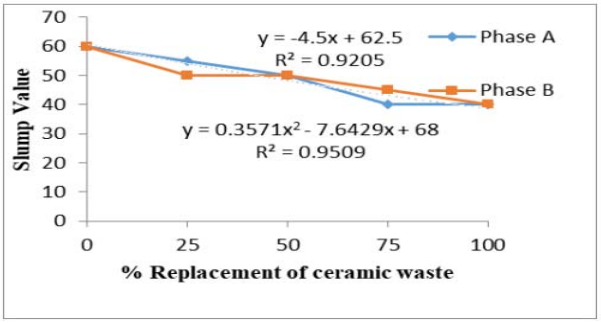
FIGURE 1 HDPE GRANULES

RESULTS AND GRAPHS

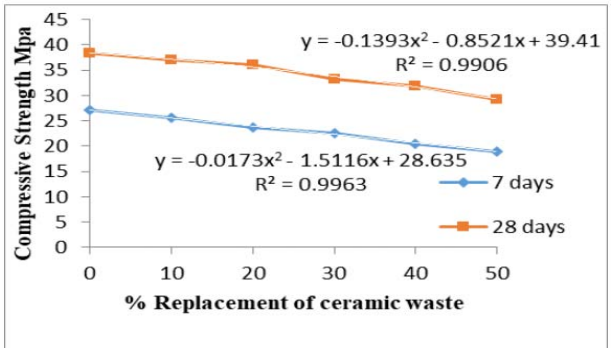
In this section Results in the form of Tables and graphs are represented. Starting from Density of Fresh Concrete which followed by Workability, Compressive strength, Split Tensile Test and Flexural test are given by various authors. They have performed test by replacing different concrete content by ceramic waste. Also tabulated results are also given for HDPE material which replace the CA.



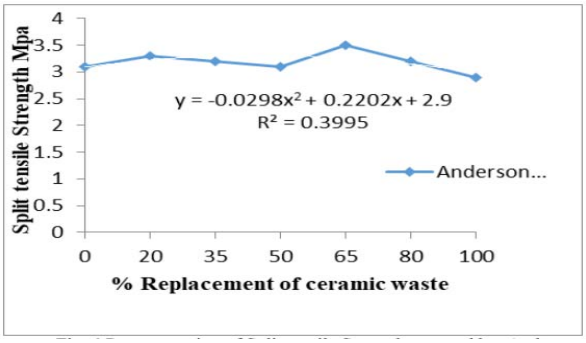
GRAPH 1. DEPICTION OF FRESH CONCRETE AS PER TAVAKOLI ET AL. [13]



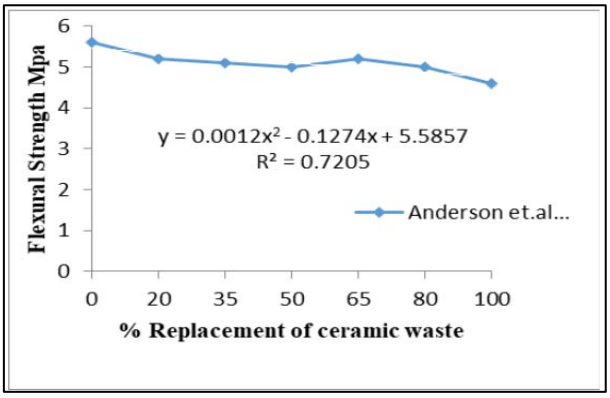
GRAPH 2. DEICTION OF SLUMP TEST AS PER BY TAVAKOLI ET AL. [13]



GRAPH 3. DEPICTION OF TEST RESULT FOR COMPRESSION TEST AS PER RAVAL ET AL. [12]



GRAPH 4. DEPICTION OF TEST RESULTS OF SPLIT TENSILE TEST AS PER ANDERSON ET.AL [14]



Specimens	Load (KN)	Compressive strength	Difference in %	%With C_1
C_1	520	23.1	-	-
C_2	550	24.4	5.62% increase	5.6% increase
C_3	570	25.3	3.68% increase	10.3% increase
C_4	600	26.78	5.84% increase	15.93% increase
C_5	470	21.1	21.2% decrease	8.65% decrease
C_6	450	19.97	5.35% decrease	13.64% decrease

TABLE 1. COMPRESSIVE STRENGTH FOR 7 DAYS.

Specimens	Load (KN)	Compressive strength	Difference in %	%With C_1
C_1	700	31	-	-
C_2	720	31.99	3.19% increase	3.19% increase
C_3	760	33.8	5.65% increase	9.03% increase
C_4	870	38.1	12.72% increase	22.9% increase
C_5	620	27.2	28.6% decrease	12.25%decrease
C_6	610	26.7	1.84% decrease	13.8% decrease

TABLE 2 COMPRESSIVE STRENGTH FOR 28 DAYS

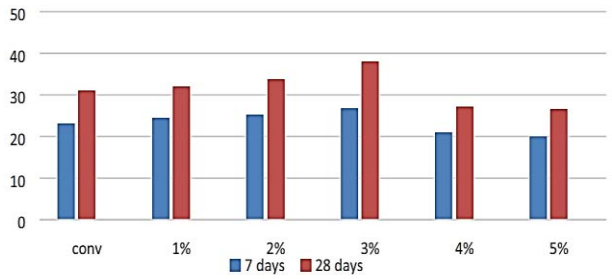
specimens	*Load (KN)*	*Compressive strength*	*Difference in %*	*% with C_1*
C_1	*210*	*2.92*	-	-
C_2	*230*	*3.06*	*4.79% increase*	*4.79% increase*
C_3	*220*	*3.15*	*2.94% increase*	*7.87% increase*
C_4	*250*	*3.48*	*10.47% increase*	*19.17% increase*
C_5	*170*	*2.44*	*2.9% decrease*	*16.4% decrease*
C_6	*140*	*2.07*	*15.16% decrease*	*29.1% decrease*

TABLE 3 SPLIT TENSILE STRENGTH FOR 7 DAYS.

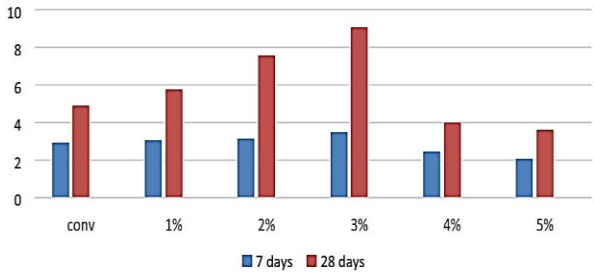
Specimens	*Load (KN)*	*Compressive strength*	*Difference in %*	*with C_1*
C_1	*350*	*4.9*	-	-
C_2	*410*	*5.75*	*17.34% increase*	*17.34% increase*

TABLE 4 SPLIT TENSILE STRENGTH FOR 28 DAYS

C_5	*280*	*4.00*	*55.8% decrease*	*18.3% decrease*
C_6	*260*	*3.62*	*9.5% decrease*	*26.1% decrease*



GRAPH 6. COMPARISON OF COMPRESSIVE STRENGTH FOR 7 DAYS AND 28 DAYS



GRAPH 7. COMPARISON OF SPLIT TENSILE STRENGTH FOR 7 DAYS AND 28 DAYS

CONCLUSION

The outcome of this experiment shows that it is definitely possible to partially replace traditional aggregate and binder material with recycled ceramic aggregate and ceramic fume. With regard to replacement ratio, only small positive and negative reactions were found in the characteristics of recycled ceramic concrete, which is sufficient for practical use. Fresh concrete loses part of its workability as the replacement ratio increases. As the replacement ratio rises, the compressive strength, split tensile strength, and flexural strength all decline. In conclusion, it can be seen that ceramic aggregate absorbs water readily due to its high porosity, which also makes it less workable and necessitates presoaking.

The characteristics of concrete are not appreciably changed when recycled ceramic fine aggregate replaces natural sand to the extent of 40% by volume. Concrete's characteristics are not considerably changed when 25% of the volume of natural coarse aggregate is replaced with recycled coarse ceramic aggregate. Concrete is unaffected greatly by the replacement of ceramic fume with binder material that contains up to 10% ceramic fine. It is simple to employ ceramic waste as a binder and fine or coarse aggregate in concrete without having an impact on the material's mechanical qualities.

Comparison of typical concrete and concrete granules that have been partially substituted. It was discovered that the strength of concrete grade M30 that had some of the coarse aggregate replaced with high density polyethylene granules was higher than the strength of concrete grade M30 as is.

The values are rising by 4% and 5% when the ideal number is 3%. It is seen as economically advantageous since HDPE GRANULES can partially replace coarse aggregate and improve concrete strength.

ACKNOWLEDGMENTS

Without the outstanding assistance of my supervisor, Dr. Sanjay Joshi, this work and the research supporting it would not have been possible. From my initial interaction with the research papers of the Reference Section gave the knowledge, and meticulous attention to detail served as an inspiration and kept me on course.

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A Review "Cyclic Performance of Beam-Column Joint under lateral loading"

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Abstract. Now a day there are fast developing of word population. Its required lot of housing space for living and growing of people on various filed due to less availability of land it's required to construction of tall structure in word. Due to seismic effect on structure damage of structure is very several problems. Out of this all problem beam column joint failure is one of the biggest problem.

In this paper we discuss various studies on problem about seismic effect of beam column joint in different shapes of high rise buildings. Here an overview of past experimental and analytical research carried out by different researcher across the world is presented. Along with this the several parameters affecting the performance of joints are categorized and discussed. Seismic behavior of RC beam-column joint depends on several parameters viz., concrete grade, column axial load, eccentricity, aspect ratio, joint reinforcement, bond strength and infilled frame.

INTRODUCTION

Moment-resisting frames comprise beams, columns, and beam-column joints. Common portion of this beam and column is call as bema column joint. The beam-column connection comprises the joint plus portions of the columns and beams. Bean-column joints are the very important part of reinforce moment resisting frame.

During a seismic activity, response of the structure is mainly affect by the behavior of the joints. The global response of structure depending on ingredient materials used during the contraction of structure, the joints have restricted lateral force carrying capability. Since, the joints have restricted lateral force carrying capability. Once forces larger than those are applied throughout earthquakes, joints occurs severely damages. Repairing of broken portion on joints is tough, and then harm should be avoided. So required proper design and detailing of joint for lateral loading by using standers codes.

If the joints behave in a ductile behavior, the performance generally will be ductile, whereas if the joints perform in a fragile fashion then the structure will display a brittle performance. The joints of old and non-seismically detailed structures are more defenseless and behave poorly under the lateral load.

Due to applying of lateral load, the beam-column joint is exposed to massive shear stress in the joint area. These sheet shear stresses are the result of moments and shear forces of opposite signs at the ends of the member on either side of the joint core. Therefore, high bond stresses are also mandatory for reinforcing bars extending into the joint. Axial pressure inside the column and shear stresses in the joint lead to principal tensile and compressive stresses. Due to this tension and compression at joint region cause of diagonal cracking or crushing of concrete within the joint core. These issues are highlighted in recent past by the injury discovered in devastating earthquakes in numerous countries. Out of this all major earthquake some earthquake history are noted here.

Turkey earthquake on August seventeen, 1999 is a typical example of a beam-column joint failure under the M7.4 earthquake at stricken western Turkey.[Rajagopal, 2014] A broken structure when the Kocaeli earthquake

is shown in Fig. 1. During this year, structure is designed for non-ductile behavior only. So Most of those joint failures Due to non-ductile performance and its poor anchorage of the most reinforcing bars or just inadequate cross reinforcement within the joints core of ferroconcrete moment-resisting frames. The Two major failure modes for the failure at joints are show in below fig. (a) Joint shear failure and (b) Finish anchorage failure.

(a) (b)

FIGURE 1: TURKEY EARTHQUAKE, 1999

On 26 January, 2001 Gujarat facing one of major earthquakes. Due to this Damage to RC building structures will be conjointly seen in major cities like Bhuj, Gandhidham, Anjar throughout Gujarat is shown in Fig. 2 of commercial two-story RC building in Bhachau. All columns have massive ratio so the within will be totally utilized as a commercial space. This type of columns, the anchoring of the beam reinforcement can't be secured in a very short distance of the weak axis direction and consequently ends of some beams utterly force out from beam column joints. The stiffness and strength in weak axis direction weren't enough and therefore the ground floor and therefore the second floor swayed within the wrong way.

FIGURE 2: RC BUILDING IN BHACHAU COLLAPSED DUE TO SWAY MECHANISM

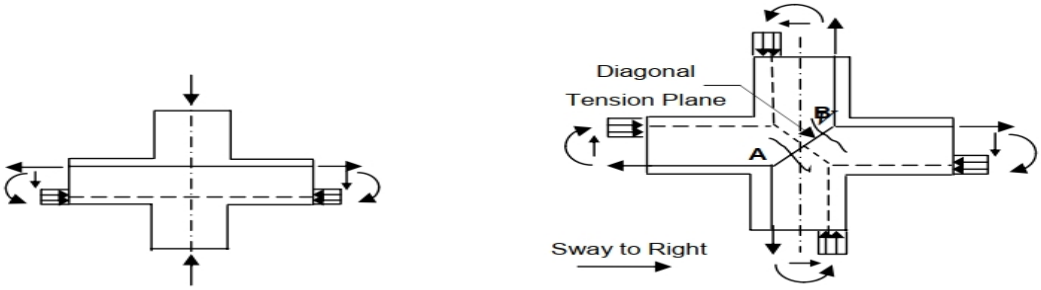
Third major earthquake with 7.9 magnitude Jolted Sichuan Province of China on 12 May 2008. Several buildings in Sichuan had inadequate construction quality together with too little reinforcement, poor detailing and poor quality concrete. A number of the poor detailing enclosed lack of reinforcement within the beam column joint, lack of crosswise ties within the beam and column and lack of embedment length for reinforcement anchorage. To assure a rise of the shear strength once the cracking of the joint core by diagonal tension and adequate move capability, joint shear reinforcement is required, that is thus prescribed by the newer style codes as ACI 318-2008; NZS 3101-1995; IS 13920-2002. Moreover, these codes order an oversized

anchorage length of the bars terminating just in case of exterior joints, in order that a bond failure could also be avoided. However, a huge majority of RC buildings worldwide accommodates structures styled before the appearance introduction of contemporary seismic design codes. It's been known that the deficiencies of joints square measure principally caused by inadequate crosswise reinforcement and too little anchorage capability within the joint.

SEISMIC BEHAVIOR OF BEAM-COLUMN JOINT UNDER LATERAL LOADING

The performance characteristics of connection due to factored seismic loading are quite unique and severe in seismic regions unlike joints designed only for gravity loading. Most international codes (ACI 318-05, NZS 3101 1995, EC8 2003) specify standard, design formulae and design factors mainly for moment resisting frames under seismic load. Though various codes attempt to clarify the design of joint, little attention was given to the design of reinforced structures. It appear that after the valuation of working stresses in adjacent part of building member, most designers normally assume that conditions within the joint, which often have somewhat larger dimensions than the members it joined, were not critical. The gradual adoption of the philosophy of limit stage design has exposed the weakness of this assumption. The truth is joints are often the weakest link in a structural system due to seismic loadings. Demand of joints is greatly affected by loading path in interior, exterior or corner type of joint and the type of loading system.

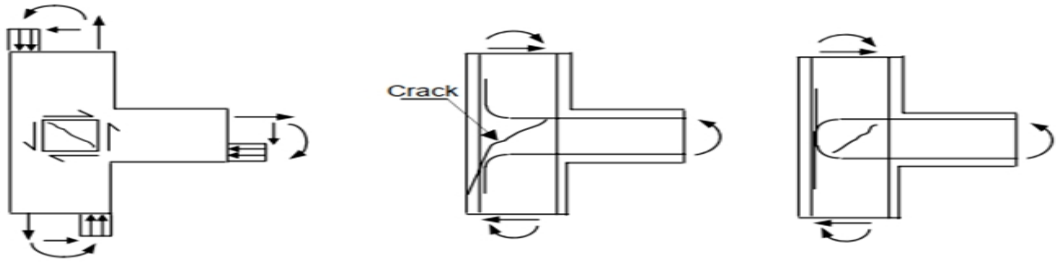
The gravity loading forces act on internal joint as per fig. 3(a) and the lateral loading impact shown in fig. 3(b). Cracks develop perpendicular to the strain diagonal A-B within the joint and at the faces of the joint wherever the beams frame into the joint. The compression struts area unit shown by dotted lines and tension ties area unit shown by solid lines. Concrete being weak in tension, thwart wise reinforcement's area unit provided in such some way that they cross the plane of failure to resist the diagonal tensile forces.



(a) Gravity Loading (b) Seismic Loading

FIGURE 3: INTERIOR JOINT

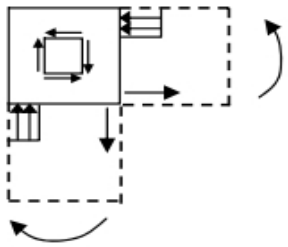
The forces performing on associate degree exterior joint may be idealized as shown in Fig. 4. The shear force within the joint offers rise to diagonal cracks so requiring reinforcement of the joint.[Uma] The particularization patterns of longitudinal reinforcements considerably have an effect on joint potency. a number of the particularization patterns for exterior joints square measure shown in Fig. 4(b) and Fig. 4 (c). The bars bent removed from the joint core (Fig.4 (b)) end in efficiencies of twenty five to forty take a while those passing through and anchored within the joint core show eighty five to hundred potency. However, the stirrups got to be provided to confine the concrete core inside the joint.



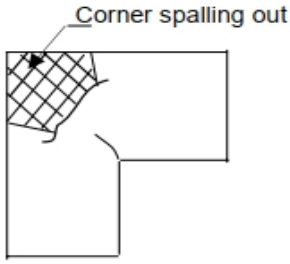
(a) Forces (b) Poor Detail (c) Satisfactory Detail

FIGURE 4: EXTERIOR JOINT

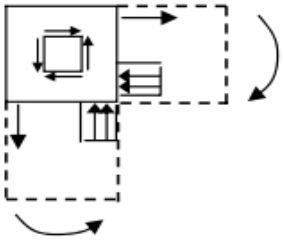
The forces in a very corner joint with a continual column on top of the joint (Fig. 5c) will be understood within the same method as that in associate degree exterior joint with regard to the thought of direction of loading. In, L-Joint connection, applied moment act on both side of corner likes open as well as closer side. Stresses and cracks developed in such joints of square dimensions shown in Fig. 5 (a).



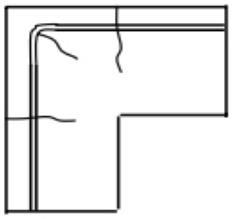
(a) Opening Joint (Top View)



(b) Cracks in an Opening Joint



(c) Closing Joint (Top View)



(d) Cracks in a Closing Joint

FIGURE 5: CORNER JOINTS

Corner joints produce crack at corner of connection due to a diagonal tensile on joint. The description of the longitudinal reinforcement considerably influences the behavior of such joints.[Uma] The force produced on closing and corner joint is exactly opposite to each other. The main crack is oriented on the corner diagonal. These joints show a higher potency than joint joints.

LITERATURE REVIEW

Many research papers have been published on the RC beam column joint of structure. A detailed review of some selected research papers is presented.

The seismic performance exterior beam column joint strengthen with unconventional reinforce have published by Venkatesan, Ilangovan and Sakthieswaranin 2016. They have do experimental studies to prove this beam column joint have do analysis studies by using software "ANSYS". There are two different sample have been selected among them. In that first specimen was non-ductility and study detailing about column joint have conducted by code India IS -456 2000 and second specimen was ductility and study in detail about column joint as per IS: 13920 1993.After the study and analysis of the all over study the result get ferrocement is needed for increased retrofitting to carelessly increased the energy of ferrocement and it use to increased strength of beam column joint in seismic region. The beam column joint showed higher strength in initial stiffness and tensile and non-ductile energy dissipation in detail.[Venkatesan, 2016]

After this study In, 2018 the author elmasry, abdelkarder and elkordy have published studied of various retrofitting technique and identity a suitable retrofitting for beam column joint. After this study and analysis of study the result get it the with carbon fibre reinforced polymer sheet strength use for increased serviceability of structure without get damage front of building.[elmasry, 2018]

In 2018 shaabanand Sid have published studied on the seismic performance of exterior beam column connection in ferrocement reinforced building frames using ANSYS software through nonlinear finite element analysis method . After analyzing of this studied the result found that's it's successfully help to increase capacity of joints in existing building through save time, money and lives in seismic zones. If ferrocement layer increased in strength scheme which led to increased resist higher level of axial load applied to column, in the bean column

joints and also the level of applied axial load to column, and longitudinal steel ratio in beam and comprehensive strength of the specimens has similar effect on their ultimate load, ultimate displacement and stiffness degradation before strengthening to different degrees. By change in orientation angle of expanded wire mesh from 60 and to 45 for per ferrocement layer which had minor effect on ultimate load but have higher effect on ductility specimens.[Sid, 2018]

The author johnson and hemalatha have published studied in 2017 ,seismic performance of exterior beam column joint to improve the joint ductility with non-conventional reinforcement and by using steel fibres during this data collection ANSYS software have used and verify by using experimental study by using different parameters. By this study they have found that cross diagonal bars and steel fibres at joint along with lateral reinforcement to prevented crack at edges of joint and it increased the ductility of the joint, yield load, ultimate load carrying capacity and energy absorption capacity but it decreased lateral reinforcement in beam in plastic hinge region and it higher effect on joint shear strength under higher load conditions.[Johnson, 2017]

In 2020 Ghosh have published study to and collected data through use experimental design and analysis data and dynamic behavior of exterior RC beam column joints. After study the result of experimental study have Been compare with model analysis by using ANSYS .In this study they find out that, under dynamic forces the joint that time it get linear and when it adequately load increased it behavior change into non-linear and exhibited where form of hysteresis loop get started.[Ghosh, 2020]

Vivek Kumar, Sadula have published study in 2020 ,The performance of high perform reinforced beam column joint replacement of cement with ground granulated blast furnace ,when worker for short period replace cement with glass fibre and use super plasticizer it requires work ability. After study on this ,The get to control specimen and specimen of beam column joint with 7.5%and 0.3%glass fibre replacement through IS 456:2000 and IS 13920:2016.The experimental study have down and numerically collect data by using software ANSYS. Then after they have found that's, directly load bearing ability of joints and also improve in specimen with GGBFS through glass fibre.[Vivek, 2020]

Majumder have published study in 2020 The effectiveness of geo-grid material on upgrade the cyclic performance of non-ductile exterior reinforced concrete (RC) beam column joint by take observation of experimental and non-linear finite element stimulation have use software ANSYS .After doing studies on it they have find out load displacement behavior and damage predicted form finite element through analysis study After all this the result get similar behavior assess by experiment result. Geo-grid through conventional steel bar used for hybrid reinforcement which have better ductile behavior for increased seismic performance of RC beam column joint.[Majumder, 2020]

Sivapriya, together with Sruthy, published a study in 2020 on improving the seismic behavior of stepped buildings by incorporating fibers into beam column joints. For well analysis of study step back for building by modified concrete is selected and structure through use software ANSYS, The transient analysis have done by using acccelerogram of EI-centro earthquake as loading .For modified efficiency have made by add steel fibres and PV fibre in vary percentage. A structure with modified concrete at the beam-column joints has a similar response as a conventional structure to study fiber efficiency. By embedding the fibers into the concrete, the seismic performance of the building has been improved in the time it can sustain a particular earthquake.[Shaaban, 2018].

Diro, kabeta published a study in 2020. A non-linear finite element analysis of a reinforced concrete exterior column beam joint subjected to lateral loading was performed to collect data on the shear failure mode of the joint in terms of joint shear capacity, deformation and cracking pattern while using ABAQUS Software. To analysis of study different parameters have been use for affect joint shear failure due to column axial load, beam longitudinal reinforcement ratio, joint panel geometry and concrete comprehensive strength have studied. After study they have concluded, this model included good comparison with test result in term of load displacement relation cracking pattern and joint shear failure modes.[Venkatesan, 2016].

In 2020, Balinen published to study behavior of precast concrete beam-columns joint connection using ABAQUS software. For analysis work, It’s use five number of models likes two dry, two wet and one monolithic types joint connection are used with include various changes on the variable likes light angles, use of dowels, and use of fiber reinforced concrete. After study they find out and have assess that dry connection perform less efficiency compared to monolithic and wet connections.[Elmasry, 2018].

CONCLUSION

From study of previous research papers, all research includes retrofitting technique, inelastic joint behavior, unconventional reinforcement detailing, bond strength, joint core shear deformation, transverse reinforcement etc. based on experimental and analytical investigation using ANSYS, ABAQUS, STAAD Pro, SAP2000. On

analysis of beam column joint there are different parameters have been use for affect joint shear failure due to column axial load, beam longitudinal reinforcement ratio, joint panel geometry and concrete comprehensive strength have studied.

From this research to increase capacity of joints in existing building through save time, money and lives in seismic zones and for increase capacity of joints it's found that various energy dissipation systems are used.

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Recent Scope of Ground Oil Expeller Machines for Small and Medium Scale Industries: A Review

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Abstract: Oil expeller machines are commonly used to extract oil from a variety of oil seeds and nuts. Numerous researchers have conducted an essential and effective studies on oil extraction utilizing Manual pressing, Hydraulic pressing, kneading, enzyme & solvent extraction, and mechanical worm screw pressing. Oil-expelling technology is well-known and well-researched, but current developments are leading to the creation of such mid-size machinery as screw pressing. The screw-type mechanical expeller pressing machine is comprised of components such as the barrel, screw shaft, and driving gearbox. The study provides a range of literature concerning the design, development, and performance assessment of several Oil expeller machines. This article organizes the relevant literature according to three broad themes: oil extraction technology, a parametric examination of the screw press, and the factors that affect oil extraction.

Keywords: oil expeller, screw press, oil extraction, worm screw press,

INTRODUCTION

Arachis hypogaea, sometimes known as groundnut or peanut, is the poor man's nut. Groundnut is the main source of edible oils in India and accounts for around 15 percent of the country's total oilseed production. It is estimated that 14 million farmers grow oilseeds and another million refine them into usable products. Oilseed products account for 14.4 and 48.8 percent of agricultural exports and imports, respectively, whereas they account for 1.6 and 2.2 percent of national export and import, respectively. The five largest Indian states account for over 90% of output, which is similar to the area under production in 2017–18. These states include Gujarat, Maharashtra, Andhra Pradesh, Tamil Nadu, and Karnataka. Gujarat and Tamil Nadu alone account for approximately 47.99% of total output. This much output is mostly aimed at the oil-producing industry. Customers are increasingly interested in purchasing less refined and processed edible oils for their improved health. To meet the demands of the trend toward moderate production rates with modest capital outlay, manufacturers are increasingly designing and developing machines of moderate and small scale. [1]

Two primary methods, pressing (Liquid & solid pressing) and solvent extraction, form the backbone of the oil extraction process. Thermal and Mechanical pre-treatments were used before these techniques to improve their performance. The oil recovery procedures might differ depending on the seed species. Figure 1 depicts various liquid & solid pressing changes in oilseed processing. [2]

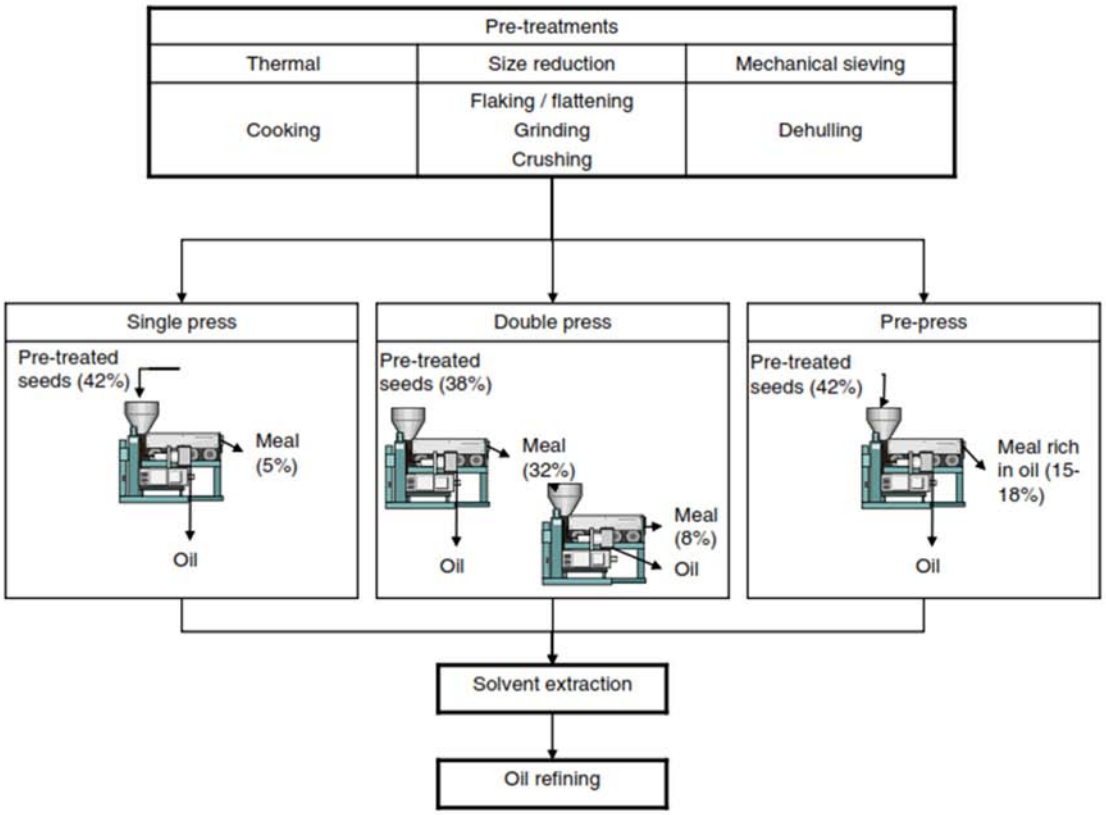

FIGURE 1 *Different oilseed expelling methods. Residual Oil in a cake is symbolic and is given for rapeseed excluding for double press [2]*

The oil content of oilseeds may be recovered using a mechanical screw press to the extent of 86% to 92%. Improving oil recovery is possible by adjusting pressing settings, such as raising the internal pressure, which reduces the amount of residual Oil in the meal. The oilseed can be pre-treated by cracking, dehulling, conditioning, flaking, and boiling to enhance oil recovery. There are many different raw materials that can be used to study the importance of raw material moisture content in the screw press. There has not been much research done on screw-pressing flaxseed for edible consumption. Oil recovery from screw pressing flaxseed can also be greatly affected by the moisture level and soaking treatment. [3]

This article concentrates on the extracting stage of oil yielding from oilseeds. Industrial oilseed pressing is achieved by use of continuous worm screw expellers. The expellers are fed either pre-treated or raw seeds. Each type of seed requires a unique set of preparation steps, such as heating, crushing, or sifting. There are benefits to using any seed preparation method. Dehulling is the process of separating the oil-rich almond kernel from the hull, which contains very little oil, and also of removing antinutritional elements that make the almond kernel unappealing as an animal feed. Flaking and crushing help the solvent-based extraction stage by modifying the permeability of the cake. Cooking has various advantages, including moisture conditioning of seeds, reduced oil viscosity, increased embryo flexibility, cell wall cracking, protein clotting by denaturation, sterilisation and inactivation of enzymes, and removal of hazardous components.

The process relied on the material travelling in an axial direction inside the screw press. The device may be powered by plugging into an electric motor. The seeds are preheated using either an electrical heater or a steam chamber linked to the heating compartment. The oil seeds are emptied into a hopper and fed onto a worm screw press that spins within the expeller. Once the power button is depressed, the electric motor will begin to rotate the main shaft, which in turn spins the auger, which propels and packs the hot seed along the tube to the other side. In order to create compression, the auger's pitch is lowered, turning the tool into a screw press. Oil is extracted from conditioned seeds by compressing them and releasing the contents via the device's slots. The oil content

was forced out due to the heating of the grain along the passage and the high pressure created at the expeller housing due to the extreme drop in volume.

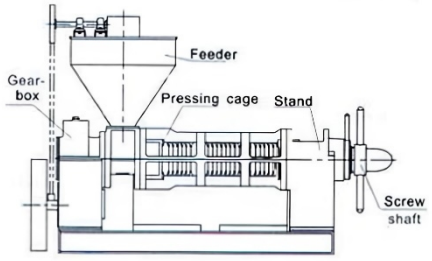

FIGURE 2 *Components of conventional oil expeller machine*

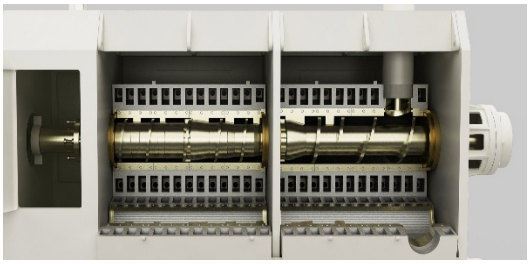

FIGURE 3 *Cross-sectional view of dual chamber oil expeller (image courtesy Kumar Expeller Machines)*

Important parts of the machine's construction are shown in **FIGURE 2** and **FIGURE 3**. The fundamental and central component of the equipment that extracts oil from oilseeds is the worm screw shaft. For the purpose of increasing pressure and allowing Oil to exit from the operation, the screw shaft is enclosed in a cage. The feeder gently warms the seeds to the ideal temperature with stirring action provided by a lay shaft driven by the main shaft. The gearbox is also crucial because it provides the torque necessary to increase the pressure in the screw barrel.

TECHNOLOGIES USED IN OIL EXPELLING

There are two main approaches that may be taken when attempting to extract oil from oil-bearing seeds. I. Methods Derived from the Past II) New and Enhanced Procedures. The traditional procedure is often carried out by hand, beginning with the processing steps and continuing with the pressing. Extraction by chemical means and expression by mechanical means make up the enhanced procedure. In addition to this, Mechanical Expression sees a significant amount of use all around the world. Additionally, there are a variety of forms that mechanical approaches might take:

TABLE 1 *Details of technology and its application*

Technology used	Explanation	Approximate Capacity	Application
Solvent Method	Industrial technology: oilseeds are roll pressed to reduce them to flakes and dissolved in a solvent that extracts the Oil.	150 tons/day	Mass Production
Worm screw expellers (Intermediate technology)	Oil seeds are continuously fed, preheated, crushed, and pressed to expel Oil as it passes through the machine. (Termed as power operated technology)	100 kg/hr	Batch Production
Oil plate method	Ram/cylinder presses, either hydraulically operated or screw powered	10-15 kg/lot	Domestic Purpose
Pedal powered Ram Presses	Manually operated mechanical expeller, seeds are fed continuously, and Oil separates from the cake.	50kg/swing	Domestic or micro-scale business
Native methods	Ancient domestic methods; boiling, pounding, and skimming.	Moderate output (A few kg/day)	Domestic Purpose

Worm screw presses are extensively used as a result of such technology, and some of the industries' machine data for worm screw and other technology utilization are as follows:

TABLE 2 Industries using worm screw machinery with its capacity and residual Oil

Industry Name	Machine Type	Output (tons/day)	Power Consumption (kW)	Residual Oil (%) Hot Yield
Khodiyar Oil Mill, Jamvadi GIDC, Gondal	Worm Screw, Multi-pass	10	100	7-8
Payal Oil Mill, Jamvadi GIDC Gondal	Worm Screw, Multi-pass	10	100	7-8
Shree Ram Oil Industries, Opp New Market Yard, Gondal	Worm Screw, Multi-pass	4.5	30	7-8
Khodiyar Oil Mill, Jetpur	Worm Screw, Multi-pass	3	25	7-8
Pramukh Oil Mill, Sultanpur	Worm Screw, Multi-pass	2.5	15	7-8
Satyajit Oil Mill, Sisak	Worm Screw, Multi-pass	2.2	15	7-8
Yogi Oil Mill, Mota Devaliya	Worm Screw, Multi-pass	2.2	15	7-8
Prabhu Ram Oil Mill, Kotda Road, Gondal	Worm Screw, Multi-pass	2.2	15	7-8
Riddhi Oil Mill, Jasdan	Worm Screw, Multi-pass	2.2	15	7-8
Real Oil Mill Dhrol	Worm Screw, Single Pass	1.5	7.5	10-12

The table above indicates that a higher production rate necessitates more passes through the same or additional equipment, raising capital investment, process cost, and workforce requirements.

PARAMETRIC STUDY OF SCREW PRESS

TABLE 3Parametric comparison of literature on the technology basis and critique outcome

Literature	Technology discussed/used	Type of Screw Shaft utilized	Observation	Critique Outcome
Raphaëlle Savoire (2013) [2]	Continuous Press	Continuous Worm, Single and Double Screw. Multipass	1. It can be used from farm scale (3 tons/day) to Industry scale (150 tons/day) 2. Only 7-8% residual oil is left 3. Process parameter affects the output and limits the Oil yielding up to 88 to 92%	It is an industry-ready technology, but it requires more passes for efficient oil yielding
Yun-ling Zheng	Mechanical Screw Press	Continuous Worm, Single	1. Process parameters	In various seeds,

(2003) [3]		Screw, Multi Pass	control the oil extraction from the oil seeds. 2. Dehulling of flaxseed increases oil yields by up to 92 to 94% 3. Dehulling significantly decreases the meal temperature.	various process control parameters must be followed to extract Oil more efficiently with good oil quality.
Ajao K. R. (2010) [4]	Continuous Screw Press	Continuous Worm, Single Screw, Multi Pass	1. Best oil yielding occurs at 60 rpm of the worm screw 2. Without pretreatment of seeds, no oil-yielding occurs	A small-sized machine that can fulfil a domestic or small family oil requirements only
Hassan U. B. (2022) [5]	Kneading of Seed Paste	A Vertical Chamber Paste kneader	1. Kneading achieves an efficiency of around 80.6% 2. Significantly reduced drudgery	A family machine, which requires a lot of preparation and effort before oil yielding.
I. O. Olaoye (2020) [6]	Continuous Screw Press	Continuous Worm, Single Screw, Multi Pass	1. Optimum performance was achieved at 47.6 rpm and 15% moisture content 2. More oil extraction could be there with 5-10% moisture content.	It would only extract 700 ml per hour for groundnuts, which is much less.
Olawale J. Okegbile (2014) [7]	Roasting and Hydraulic Pressing	Cylinder and Ram Pressing	1. Roasting increases oil extraction by up to 90%	Again it would extract a minimal amount of Oil per hour

			2. Machine capacity of extraction was achieved up to 6.1 x 10-3 m3/hr for groundnut	which is even significantly less for establishing a micro business.
Olatunde O. B (2014) [8]	Continuous Screw Press with the roaster	Continuous Worm, Single Screw, Multi Pass	Oil Yield decreased with an increase in moisture contents by 6-10% 2. 41.6% Oil was recovered with a moisture content of 6%	Roasting requires more electrical devices, which results in more time for heating and cost increment.
Agidi G (2017) [9]	Continuous Screw Press with tapper at two sections	Continuous Worm, Single Screw, Multi Pass	1. No oil can be extracted below the temperature of the seed to 30°C 2. Viceversa significantly less meal could be there if the seeds are preheated more than 30°C 3. Easy to operate by local artisans.	It achieves a goal of 0.8 tons/day but increases the processing time and workforce requirements.
Md. Habib Ullah Khan (2016) [10]	Continuous Screw Press	Continuous Worm, Single Screw, Multi Pass	1. Perfect clearance can be given with the help of ANSYS tooling. 2. Requires more considerable power for producing the required quantity of Oil.	The highest oil extraction was notified in Coconut scoops. Oil extraction efficiency decreases with the seed's size and high moisture content.

Government of India (MSME Insider) (2021) [1]	MSME Presence and development.	Achievements and statistics of the Government	1. Discussion on IDTR, CTTC and IDEMI 2. Discussion of self-employment and support	Discusses the scope of micro and small scale business and support from the government of India and other supports for state government.

INFLUENCE ON OIL EXTRACTION

PRESSURE:

One way to control the pressure in an expeller is to adjust the distance between the barrel and the throttling element. The hooper's maximum pressure and degree of criticality are often found around its muzzle. But this component is not independent, since it is seen that when pressure is increased, barrel temperature also rises. Whatever seeds are being processed; oil extraction efficiency improves with increased pressure. Less predictable behaviour is seen in regards to press capacity, which is dependent on both the expeller model and the raw material processed (seed type). Sunflower seeds have been pressed at their optimal capacity throughout a range of pressures, but rapeseed has been seen to demonstrate a decreased capacity with increased pressure. Similarly, to how capacity changes with pressure, the oil flow rate also changes with pressure. [2] The appearance of the cake varies as a function of the back pressure provided by the throttling device. The cake's crumbliness and look of crushed seeds increase as this opening becomes bigger. [3]

This pressure adjustment is conditional on variables like the speed at which the screw is rotated. The former increases the maximum pressure and decreases expeller efficiency when it is lowered. As a result, draw attention to the need of optimising procedures. [5] This optimization, however, changes depending on whether one is looking for a cake with a low oil content or a high capacity. Other aspects, such as barrel temperature (since excessive heat degrades the Oil), energy usage, and equipment damage due to high pressures, should be taken into account during the optimization process. Increasing the pressure during the discontinuous (hydraulic) pressing results in more oil being extracted. To assess the influence of pressure during continuous pressing of oilseeds, discontinuous pressing might be a useful method. [5]

TEMPERATURE:

The pressing performance is affected in several ways by temperature. As temperature rises, oil's viscosity decreases, making it easier to flow, but the material's cellular structure and permanence may also change (cooking). Knowing which temperature is being stated (feeding seed temperature, barrel temperature, or in this instance) might be confusing when thinking about how temperature affects the pressing. As the temperature of the seed grows, so does that of the barrel. Extraction yield increases with increasing temperature, according to the literature data, with the exception of walnut pressing, which exhibits a somewhat distinct characteristics. [6]

While simultaneous heating may enhance oil output and expeller capacity, it often comes at the expense of oil quality (complex fatty acids content, in specific). However, preheating the press is often seen as a vital step before pressing. As a result, press-blocking phenomenon was noted without the need of preheating. Unidirectional hydraulic pressing has a comparable influence of temperature on oil yield as continuous pressing. Generally speaking, higher temperatures result in a higher oil output. In this case, a continuous pressing mechanism like hydraulic pressing seems to be the best option. However, in continuous screw pressing, the oilseed's increased temperature may be the consequence of the mechanical energy expended inside the expeller owing to friction, whereas in hydraulic pressing, the oilseed needs be prepared before feeding. [2]

Moisture Content:

Oilseeds' ability to switch between their solid and liquid states is highly dependent on their water and, more precisely, moisture content. Expeller manufacturers account for this factor when determining the range of seed moisture content within which their products may function well. The oil yield changes in response to an increase in moisture content vary for different oilseed species. In most cases, the oil output drops noticeably as the moisture content rises. Thus, for Crambe, rapeseed flakes cooked cuphea, and flaxseed, an opposite link amid yield and moisture content has been discovered. However, the oil yield for walnuts rises from 61% to 83.5% when the moisture content rises from 2.4% to 7%. Indeed, it was noted comparable pattern while observing peanuts. The relationship between oil production and moisture content is linear for several seeds, including sesame and jatropha. Seeds crushed with hydraulic presses exhibited varying oil yields as a function of moisture level. [4]

The capacity of expeller may be affected by variations in the moisture content of seeds. Therefore, the optimal yield for rapeseed occurs at 5% moisture level, whereas for flaxseed, it occurs between 9% and 11% moisture content, depending on the variety. [3] The impact of moisture content on press capacity, as shown by Zheng et al. (2003), also varies with die diameter. For a given press capacity, a wider die diameter means less of an effect from moisture levels. The expeller capacity of crambe has been shown to rise together with its moisture level, and a similar pattern has been seen for jatropha. However, during the expression of flaking cooked cuphea seeds, the moisture content had minimal effect on the press capacity (between 3% and 5.4% water content, the capacity varies approximately from 74 to 80 kg/h). [5]

CONCLUSION

This study aims to investigate the applicability of oil expeller machines, taking into account the public's health consciousness and economical constraints, in order to establish healthy organic oil production. It was discovered that the modern developments had just two variety of machines, one with a mass production range and the other with modest production rates linked to its usage by small households. In addition, numerous researchers have built family-owned equipment that need extensive pre-preparation and maintenance to extract oil. It should also be emphasized that such equipment sits dormant for a whole year or a certain period of time after oil extraction. Furthermore, it requires maintenance before being used again. This motivates the design of a machine that, in comparison to conventional oil production equipment, may increase daily output while simultaneously using less room and fewer resources. In light of the present pandemic situation, limited financial resources are available for the development of such medium production rate, industry-ready machines, and high production rate machines do not fit within the framework. That directs the construction of machines in a middle range, which takes less resources but generates higher output per day with less energy and manpower input.

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Study on Security Issues and Threats for MQTT with IoT Paradigm

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Abstract. IoT contains a range of creative features and capabilities, but they also bring threats and security vulnerabilities. To prevent others from exploiting these technologies, these vulnerabilities must be researched. Application layer protocol named Message Queuing Telemetry Transport (MQTT) has a variety of known and unknow security holes. In order to identify the shortcomings of the current ideas, this review paper will look at and categories the security techniques that are now accessible and frequently employed as security solutions. The ideas of the MQTT protocol in the Internet of Things, typical security measures for the MQTT protocol in the IoT, and security levels for the protocol are all covered. This evaluation offers a collection of recommendations to help researchers select the best security method for various Internet of Things applications.

OVERVIEW OF MQTT

MQTT stands for Message Query Telemetry Transport Protocol. MQTT protocol is a set of rules that defines how IoT devices can publish and subscribe to data over the Internet. MQTT is widely used protocol within IoT environment, as it's light weighted protocol, it utilizes less energy to communicate within environment such as embedded system devices, sensor, industrial PLCs etc.

MQTT prefers Quality of Services (QoS) by providing high end acknowledgement of incoming requests. As far as QoS is concern, it manage two sides of message delivery.

- Message delivery form the publisher to the broker.
- Message delivery from the broker to the subscriber.

QoS LEVEL FOR MQTT

Let focus on each level of QoS implementation and about its functionality.

ZERO – DELIVERY AT MOST ONCE

Zero is the minimum QoS level. Best-effort delivery is ensured at this service level. No delivery assurance is provided. The communication is not kept or forwarded by the sender, and the recipient does not acknowledge

receiving it. The "fire and forget" approach to QoS level 0 offers the same assurance as the underlying TCP protocol.

FIGURE 1. Level-0 QoS MQTT

ONE – AT LEAST ONE

A message will be delivered to the recipient at least once, according to QoS level 1. Until the recipient sends a PUBACK packet acknowledging receipt of the message, the sender holds onto the message. A message may be transmitted or delivered more than once.

FIGURE 2. Level-1 QoS MQTT

The sender connects the PUBLISH packet to the corresponding PUBACK packet using the packet identifier supplied in each packet. The sender resends the PUBLISH packet if they do not receive a PUBACK packet in a timely manner. When a message with QoS 1 is sent, the receiver can analyse it immediately. For instance, if the recipient is a broker, the broker broadcasts the message to all clients who have registered before returning a PUBACK packet in response.

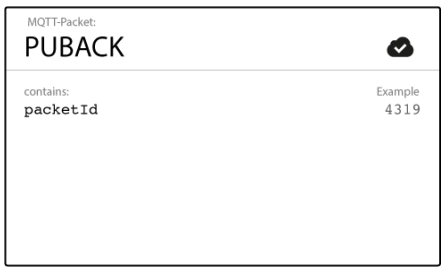

FIGURE 3. PUBACK MQTT packet

A duplicate (DUP) flag is set if the publishing client transmits the message several times. This DUP flag in QoS 1 is solely used internally and is not checked by the broker or the client. Regardless of the DUP flag, the message's sender sends a PUBACK.

TWO – EXACTLY ONCE

The highest level of service in MQTT is QoS 2. This level guarantees that the intended recipients only receive each message once. The slowest and safest quality of service level is QoS 2. A at least two request/response flows (a four-part handshake) between the sender and the receiver are required to provide the guarantee. The originating PUBLISH message's packet identifier is utilized by sender and receiver to coordinate message delivery.

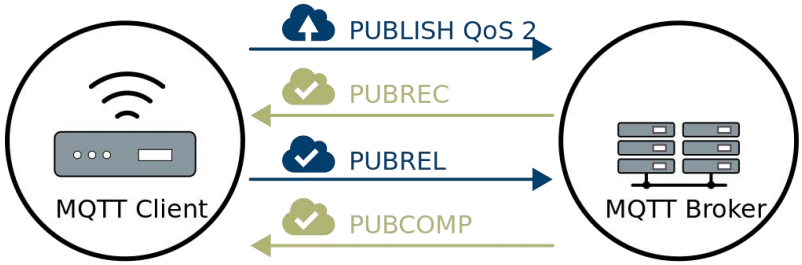

FIGURE 4. Level-2 QoS MQTT

When a system receives a QoS 2 PUBLISH packet from a sender, it answers to the sender with a PUBREC packet that acknowledges the PUBLISH packet and processes the publish message accordingly. The required to transmit the PUBLISH packet continuously with a duplicate (DUP) flag until it receives an acknowledgement if the receiver does not send a PUBREC packet.

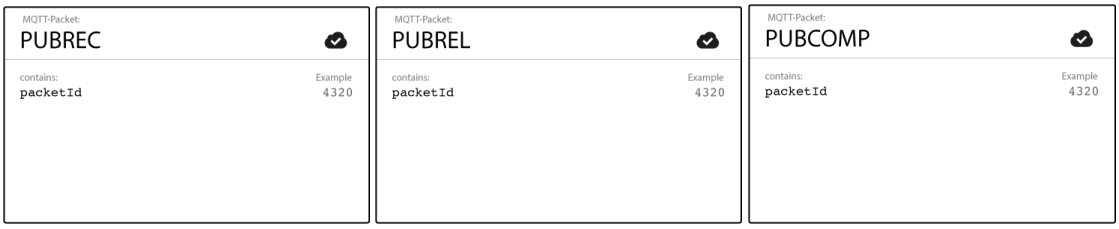

FIGURE 5. PUBREC, PUBREL, PUBCOMP MQTT packet

The initial PUBLISH packet can be properly destroyed after the sender receives a PUBREC packet from the receiver. The sender answers with a PUBREL packet before storing the receiver's PUBREC packet.

The receiver can discard any pre - stored states after obtaining the PUBREL packet and response with a PUBCOMP packet (the same is true when the sender receives the PUBCOMP). The receiver keeps a reference to the packet identity of the original PUBLISH packet up until the point at which it has completed processing sending the PUBCOMP packet back to the sender. To prevent processing, the message twice, this step is crucial. The packet identifier of the published message is eligible for reuse after the sender receives the PUBCOMP packet.

Both parties are certain that the message had been sent when the QoS 2 flow is all over, and the sender has proof of delivery. The sender is obligated to resend the message in a timely way if a packet is lost somewhere along the way. This holds true independently of whether the sender is a MQTT broker or a client. Each command message requires a specific response from the recipient.

EXISITING SECURITY METHODS

The research communities have given the privacy and security concerns in IoT a lot of thought, and they have dealt with these concerns to provide answers at various levels. MQTT is one of the security methods that have been suggested to secure IoT application layer protocols. It is one of the IoT protocols that is used the most frequently. Most security issues are connected to how the protocol operates by default. The earlier works that serve as the study's background are presented in this part. It displays works that implement various cryptographic algorithms for comparative study and developing new security solutions to safeguard the MQTT protocol in the Internet of Things. Fig. 6 displays the most recent security measures.

FIGURE 6. Existing Security Methods

CONFIDENTIALITY

Data confidentiality is a key concern for IoT solutions, particularly those that are business-related, according to the authors in [6]. Due to two major problems, the magnitude of created data and the efficiency of data access control for dynamic data flows, the current solutions for data confidentiality might not able to be enough. To achieve data confidentiality, the authors proposed implementing the proper identity management. Using cryptographic methods, the communications channel's confidentiality can be ensured. According to [7], existing asymmetric and symmetric algorithms must be examined in light of the IoT system's capacity, mission-critical nature, and application before being used. The scientific community has offered a variety of approaches to illustrate the confidentiality of sent data.

SCHEMA FOR UNBALANCED

In order to increase MQTT security, the authors of [8] state that using TLS/SSL with session key management and certificates is not practical in all IoT applications. In particular, a secure version of MQTT has been suggested; Attributes Encryption method is basically used for the same [8], [9]. The suggested method can application to various IoT environments.

SCHEMA FOR BALANCED

The characteristics and goals of various cryptography techniques. [11] It defines the resource restrictions that smart devices must adhere to while using asymmetric schemes to conduct authentication procedures and provides an authentication approach based on tools like hash functions or "OR" operations that can meet the restrictions. The IoT application layer can be protected by using dynamic key cryptography and Exclusive OR operations, according to [12]. Secure IoT, a straightforward encryption method, has been proposed [13]. The developed system is limited to a 64-bit key size and blocks cypher and uses hybrid techniques to utilize the Feistel structure and substitution-permutations network. However, it must be examined in relation to actual IoT applications.

SCHEMA FOR COMBINED

The hybrid method's architecture aims to bring together various methods in order to benefit from both asymmetric and symmetric techniques. Targeted by hybrid methods are specific applications like RFID tags, web servers, and portable electronics. By comparing various asymmetric RSA, ECC and symmetric AES 128, XTEA, HIGHT, RC5 and PRESENT algorithms to determine which lightweight algorithm is best to implement and late on changed schema to data account for sending data, the author in [15] proposed a new hybrid scheme that allows using smaller sized keys compared to existing cryptographic solutions.

By implementing both Key-policy attribute-based encryption [8] and ciphertext-policy attribute-based [9] and utilizing AES to encrypt the message, the authors of [3] and [16] have used ABE to encrypt the private key of the symmetric method AES. This plan succeeded in achieving broadcast encryptions and message confidentiality. To assure the security of publish-subscribe architecture based IoT, analysist [2] offered the ABE scheme offered in [3], and they evaluated various parameters such as memory space, processor utilization, and execution time to evaluate the scheme's various security levels.

The implementation of Advanced Encryption method dynamically S-box with ABE, where the MQTT payload are getting encrypted by AES and the secret or private key of AES is encrypted by ABE [17].

ACCESS CONTROL

Some authors have used alternative strategies. Additionally, some academics have attempted to address the widespread issues with IP-based protocols used by IoT devices, including MQTT. In these situations, the authors emphasize the security of this particular class of device as a component of a wider spectrum, addressing the layers of defense that can encircle the TCP/IP protocol as well as the security architecture and models that are most appropriate for IoT networks [18].

An intriguing strategy with the help of a model-based security toolkit called SecKit, the protocol is forced to use a number of security policies that are not included in the protocol's default implementation [19]. Without requiring protocol changes, the authors of [20] suggested a way to allow dynamic enforcement of use control (UCON) in MQTT architecture and workflow. This offered approach improved the security of the MQTT protocol. With new criteria and a key management architecture, the method, Authenticated Publish Subscribe, offers a secure pub-sub approach to protect MQTT.

LEVEL OF SECURITY FOR MQTT WITH IOT

Let's concentrate on security issues that are posed at various levels inside the IoT paradigm.

PHYSICAL LAYER

The sole built-in security option for MQTT was to run the systems on private networks when it first emerged and was made available for industrial use. A traditional MQTT can be utilised with the same security level in day-to-day scenarios. Others suggested point-to-point networks of nodes as a way to secure shared communication channels, while some scientists advocated using P-to-P structured networks on top of other solutions [21]. In all cases, security is achieved by physically separating the components, but this is not always possible if the sensors are placed in public areas or hazardous areas if the installation domain is not entirely secure.

NETWORK LAYER

It is advised to use Internet protocol security at the network layer to ensure secrecy and authentication. The additional headers do, however, cause an overload. These issues can be handled by utilising 6 LowPAN compression and robust cryptographic methods. The Host Identity Protocol is another effective method at the network level for separating broker and node identifiers from their locators. The benefits in this situation could include host mobility and multi-homing, while the disadvantages include difficulties with public key management and applying cryptographic methods.

TRANSPORT LAYER

Due to resource limitations, the increased burden necessary to create secure connections, and the requirement to encrypt every communication, it is not practical to deploy Transport Layer Security in the majority of MQTT devices. In these situations, it is significantly less necessary to redo the complete TLS Handshake process if TLS Session Resumption is utilised. The concerns with the computational load brought on by the ciphering techniques utilised could be reduced by using a hardware-based TLS implementation [24], but this would need the installation of an additional component, increasing the cost and power consumption of the device as a whole. To maintain secrecy, integrity, and authenticity, OASIS suggests using TLS and certificates whenever possible. [23], the first usage of TLS for IoT applications, lists the flaws. In essence, they concern:

- Because of incorrect or invalid cypher suites or limited utilization in the TLS layer configuration, the protocol security may be materially reduced and may be vulnerable to attacks.
- Some well-known assaults that have been launched against TLS [26]. The majority of these dangers are connected to weak cyphers that were suggested in earlier versions of TLS or SSL or that were kept backwards compatible with prior versions of the protocol.
- The management of the certificates is a key worry for the majority of researchers; upon finishing the initial deployment, it is an impossible task to do such revoking, updating, or maintaining the certificates on dispersed devices. The revocation and upgrading of certificates on remote devices frequently causes problems. Frequent encryption updating and configuration across unreliable networks on a large number of nodes is actually a difficult task, and analysis based on factors like energy consumption and throughput as more traffic must be taken into account is necessary. To further secure authentication and data security across all nodes, TLS usage can be introduced at commercial and open-source MQTT broker systems.

APPLICATION LAYER

When linking systems for many items, an external authentication system to the broker itself might be employed within the application layer. For these applications, the MQTT standard can be used to implement authentication systems like OAuth or LDAP. Based on the provided credentials, the external system will be in charge of authenticating users and granting access to tokens in both situations. When implementing such systems, an additional layer of complexity will undoubtedly be added, therefore pros and negatives must be fairly balanced throughout the design phase. Additionally, as was already said, adding LDAP and OAuth on top of a TLS connection may result in issues. Table I presents the protocol stack and the security options available at each stage.

Layer	Application	Transport	Network	Perception
Protocol used	MQTT	TCP	IPv6,RPL	IEEE 802.15.4 PHY, MAC
Security protocol	Not fixed	TLS	IPSec	IEEE 802.15.4 security
Confidentiality	No	Yes	Yes	Yes
Integrity	No	Yes	Yes	Yes
Authentication	Not fixed	Broker	Not fixed	Node
To be secured	Publisher to subscriber	Publisher to subscriber	Node -to-node	Air interface

TABLE 1. Security exist at different layers

LIMITATION OF TRADITIONAL SECURITY APPROACH

In order to safeguard the MQTT protocol in the Internet of Things, this section intends to offer researchers a framework for new security solutions. To compare the differences between the current security measures, various criteria are considered. Under various security levels, these requirements include execution time, memory usage, CPU usage, and energy consumption. The implementation of high computational cryptography authentication systems will be challenging due to node resource restrictions in various IoT applications. So, creating lightweight cryptography that is appropriate for IoT can resolve such resource-related issues.

We discussed a number of security methods that have been mentioned in the literature, including lightweight symmetric and asymmetric algorithms like ABE over elliptic curves, SIT, and AES. The security levels offered by the available security choices are insufficient. The symmetric technique can be used to show integrity and confidentiality, but it lacks authentication capabilities that might impair availability, whereas the asymmetric approach has a huge key size and is therefore rather sluggish. Existing MQTT protocol techniques have various limitations, which can be split into 3 primary groups as explained below and illustrated in Fig. 7:

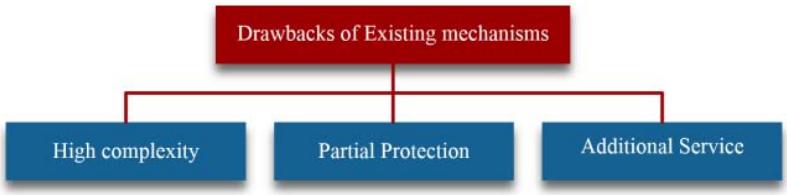

FIGURE 7. limitation of traditional approach

HIGHLY COMPLEX

Any system's execution can reveal its complexity through operations. As a result, a more complex mechanism needs more resources to function, such as those required for the MQTT payload encryption-decryption process used in the Internet of Things[27]. The paper claims that due to the structural makeup of existing approaches like traditional public key schemes, implementing message encryption-decryption throughout the publish-subscribe process in devices provides a high complexity barrier[28]. Asymmetric techniques can also be employed to guarantee secrecy, integrity, and authenticity; but, [25] because of their complex encryption algorithms and large key sizes, they will consume more power from IoT nodes. Security in MQTT is also impacted by the use case and broker selection.

PARTIAL PROTECTION

A security protocol for the Internet of Things has been developed in which a particular master key is imprinted in the devices that are either fixed or static, despite the fact that some of the current mechanisms, such as [29], have addressed the complexity difficulties. The key is then made dynamic by using a challenge-based shuffling algorithm on both the client and server sides. However, research [12] has demonstrated that these processes have created new weaknesses. The issue at hand is how client and server, who are separate and unfamiliar to one another, can select the same challenge for randomly rotating the key. Additionally, the dynamic session key is left out in the open for a long enough period of time that an attacker can easily decode the messages and compromise the entire network. As a result, an attacker can take advantage of these mechanisms and quickly decode messages using the publish-subscribe MQTT protocol.

REQUIREMENTS FOR ADDITIONAL SERVICES

By encrypting the MQTT payload at the application layer, some procedures were developed, such as conventional encryption schemes, to assure message secrecy of MQTT. Therefore, provided target devices have sufficient resources, any encryption strategy is viable. However, [2] continuously produces more data as a result of the enormous expansion in the IoT's connected device population. A sector's collected data, such as activity patterns and presence, are susceptible to assault and might be misdirected from its intended use. Privacy is therefore extremely important. Traditional methods of protecting privacy, however, have limitations in terms of flexible data sharing, fine-grained access control, and key management scalability. These limitations limit how the security methods for the MQTT protocol can be implemented. As a result, new security strategies are needed to protect MQTT publish-subscribe messages in the Internet of Things.

CONCLUSION

MQTT the only one of the OASIS-standardized protocols that is frequently utilised in the IoT world. Various security options and perspectives have been discussed in this book. IoT nodes' energy resources are depleted by the traditional public key techniques' enormous key sizes, which are used to secure MQTT publish-subscribe messages. As a result, it is impossible to deploy such methodologies on devices with limited computational power. The MQTT broker may be subject to distributed denial-of-service attacks as a result of MQTT pub-sub potential risks including spoofing. The TLS protocol seems to be a reasonable choice for protecting the MQTT protocol when the resources of IoT devices are not limited. This study has demonstrated the three types of limitations of the current solutions: limited protection, excessive complexity, and additional service requirements. The security solution alternatives for the MQTT protocol presented by the researchers do not provide integrated solutions because the bulk of them have a restricted emphasis. Multiple solutions must be integrated into devices with limited resources.

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Forensic Analysis on Facebook/WhatsApp

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Abstract: Facebook and WhatsApp are two of the most popular networks right now. Social networking apps for smartphones are becoming more and more common, and They are a great source for forensic experts. The appropriate study procedures can be used to conserve and derive potential. This article focuses on a forensic examination of well-known social networking smartphone apps like Facebook and WhatsApp. Finding out whether these programming operations are stored in the computer's internal memory is the aim of the forensic investigation. The analyzers will recreate the user's contact list and message timeline using the data supplied in this page. Additionally, they might discover some significant or vital WhatsApp relics with the aid of this paper.

Keywords: Social media forensics, digital forensics, Facebook forensics, WhatsApp forensics and mobile forensics tool.

INTRODUCTION

Social networking, a new kind of online communication, has expanded quickly in recent years. Customers who sign up for these services can network, share information and worries, submit suggestions and cautions, join in activities and projects, provide files and images, and take part in additional conversations and prompt informing. These advancements draw a significant number of customers from all around the world.

WhatsApp misuse cannot be separated from WhatsApp. A magnet can be utilised by many users and end-to-end encryption technology for those with illegal intentions, such as those involved in drug kidnapping, cyberbullying, trafficking, and other crimes.There are several cases involving applications for IM or WhatsApp.

The style of life of individuals is changing as a result of the pattern in interpersonal organizations. Recent programs should work with both PCs and cell phones to satisfy customers as they are connected to similar devices. Even if the once-thriving social media platforms like Facebook, Instagram, WhatsApp, Snapchat, and LinkedIn, among other places for informal contact, still have large user bases, their growth rates have gradually slowed. Long-distance social media platforms like Instagram and Facebook have replaced it, and as a result, examples of cybercrime have also evolved according to user behaviour. It is crucially critical to use appropriate quantifiable processes to recover these results and the evidence in order to identify wrongdoings. This analysis uses Facebook/Instagram and WhatsApp's informal communities as a starting point for further research.

The police investigating a criminal offence will share inquiry content on the social media. Forensic social media surveys can also be used to gather data on the case. Like Android, smartphones usually use social media.

The population of social media in 2019 was about 2.77 billion. And we should expect that these figures will rise much higher with smartphones and the Internet connection being cheaper and easier access. By 2021, social media will be used by more than 3 billion people. In Social media Facebook & Instagram popularity high level.

Social networking has since become a significant influence in modern culture. However, this has also aided in a profusion of illicit activities, such as identity fraud, social engineering, and cyberbullying, on social media. Depending on the following criteria, cybercrimes on social networks can be distinguished from other cybercrimes. To help the investigators, improve the quality of crime resolution, research into this emerging technology is necessary.

In a case involving mobile devices, the investigator wishes to perform mobile forensics. Mobile/telephone forensics is one of the forensic virtual divisions that finds ways to behaviour proof recovery from a phone. My research focuses on locating the remaining papers from Facebook and WhatsApp. We've already stated the literature review for mobile device forensics and WhatsApp forensics. Social Networking Forensic Artifacts, Social Application

Investigation, Facebook & Instagram Functionality Analysis Section II, and a comparison tools table for mobile forensics analysis are also included. Finally, Section III and Section IV Reference serve as our conclusion.

CASE SCENARIO PROCESS:

In the research, a mock pornographic crime case was run. While the scenario is depicted in the picture, the simulation is required to allow the researcher to understand how the case of pornographic offence occurs.

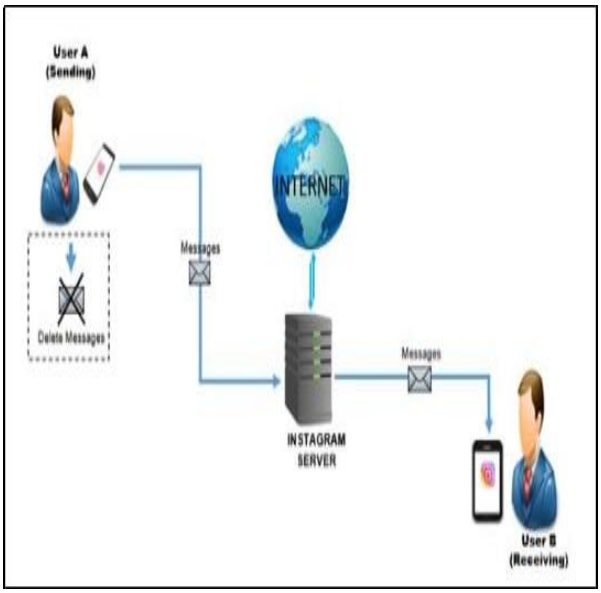

Figure: Chronology of communication and Client B using an Instagram messenger smartphone.

According to the scenario, two customers—Customer A and Customer B—will connect using the Instagram app. Customer A uses a Samsung World Star GT-S5282 phone, while Customer B uses a Samsung Universe GT-S7580 phone. Each of the two clients has a smartphone. The client's own account on Instagram is utilized to communicate with both via their social media accounts. After exchanging a chat and some pictures, the client sends user B sexual discussion and images, and user B deletes everything to get rid of the evidence. Instagram also has a conversation feature and a photo feature. User B notifies the appropriate authorities of the incident right away.

LITERATURE SURVEY

MOBILE DEVICE FORENSICS

The study's initial areas of emphasis were purchasing practices and general scientific investigation of novel devices. We discussed his work on programming and hardware for procurement, as well as the measurable audit of out-of-date Android forms. We also showed how to use hex editors and emulators, as well as other investigation techniques. Concepts from later research were vital for mobile phones in the modern era of scientific inquiry (for example Android and iPhone). The innovations utilized, the upkeep processes, and the typical stockpiling settings

have all been displayed for each item. Every device included scenarios for hoarding. These devices' internal storage could be accessed to retrieve call logs, SMS, MMS, email messages, Pages bookmarks, photographs, recordings, and schedules. Numerous smartphone models and methods for gathering and analyzing data from each device's internal memory have been the focus of recent scientific research. For the physical technique to function, the system must be disassembled, but this barely modifies the system data. The best forensics method is taking the iPhone and the NIST appraised. Android-based smartphones can be purchased physically or online, just like the iPhone. The device needs root access and is ordered to add a photo to the phone memory via the physical technique. Describe a technique for acquisition that entails utilizing specialist forensic acquisition software to overwrite the "Recovery" partition on the Android device card. Frequently recovered data includes:

- SMS Text Messages (SMS – Short Message Service)
- Multimedia/Photo Messages (Multimedia Messaging Service)
- Images and Pictures
- Emails saved on the device, Videos and Audio Recordings,
- Call History Logs (Missed Calls, Dialed Calls, Received Calls),
- Phonebook and Contacts,
- Calendar and Task List Entries,
- Internet Browsing History, and
- Social Networking Artifacts (Facebook, Instagram, etc.).
- Artifacts of application

SOCIAL NETWORKING FORENSIC ARTIFACTS

Social smartphone applications are the largest data source available to forensic investigators as they grow. Did you know that most visitors to social media websites are made using mobile devices? Additionally, this information can provide significant case leads with the appropriate inspection methods and tools. In this sense, they store a variety of facts that medium forensic experts may learn using the proper techniques.

We researched the computer programmes and methods that allow the retrieval of the items that social networking sites have left behind as part of our project. The extraction and reconstruction of Facebook and Instagram conversation objects from a computer's hard drive were the subjects of more research. Names, IDs, and phone numbers for every buddy on the list are stored in the database.

In social media forensics, data retrieval technologies and cyber forensics are used.

- Extract information from social media,
- Extract information from social media, YouTube, LinkedIn, and other websites. Save it for later use.
- preserving the Court of Justice's knowledge of the precise origins of electronic proof. Respect for all laws follows the unrestricted selection.

ANALYSIS OF SOCIAL APPLICATIONS

The National Institute of Standards and Technology defines a digital criminal case as having four main phases: recognition, compilation, organization, and introduction (NIST). The identification of an event or piece of evidence is implied by the identification stage. It creates inferential data, sculptures it, and then reduces the total amount of data by eliminating redundant information. The gravitated evidence is examined and related to the crime scene in order to get clear findings. Finally, the jury's interpretation of the evidence is adequately covered by the presentation process.

IDENTIFICATION OF EVIDENCE

To do this relocation, a comprehensive investigation of the problem's location is required to find any important hardware or software. A simple search for open networking profiles on this subject is also available. a complete lookup of friends, family, and workplace on social media.

Collection

Different techniques are used by forensic analysts to gather electronic data. Here are some ways to find information in user-friendly media.

- Manual referencing
- Screen scraping and screen capture; free software (HTTrack); and paid software (X1)
- Website hosting (page freezer)
- a medical-legal setting
- Content assignment

Additionally, there are numerous social media toolkits that may be used to rationally gather data on a smartphone. The internal memory of the smartphone must be logically photographed in order to complete the logical acquisition. Then, the files are examined to confirm the various operations.

EXAMINATION (ORGANIZATION)

Specialized decoding software and content visualization are required for the files acquired during the logical acquisition. They can access a variety of user data up until it is decrypted, including call history, SMS sending and receiving, calendar events, and address book entries. They provide access to a sizable database of social media signatures for forensic investigators. The case itself is next scrutinized and compared to these details.

Facebook Analysis Artifacts: Profile information, locations, and places visited are included. Activity logs, geographically localised Facebook archives, groups, Memories, Your Facebook activity, interests, and Stories are all included. All activity timestamps are also included.

Whatsapp Analysis Artifacts : Profile information, Status, messages, Archive, Stories, Locations Activity logs, pages, Groups, Text & Links.

ANALYSIS FUNCTIONALITIES OF FACEBOOK & INSTAGRAM, WHATSAPP

Analytical functions are utilised to pinpoint Instagram features that are important for research. This is a diagram illustrating Instagram's key research-related features.

Social networking forensic object analysis now includes the examination of artefacts left behind on computer networks and other resources by social networking platforms that help in retrieving these artefacts. The method of retrieving and restoring WhatsApp chat objects from a computer's hard drive was the subject of another study. A special identification number and name are assigned to each buddy on the list, and these details are all saved in the database. Social media forensics requires the application of cyber forensics and digital analytic methods in order to: Gather data from social media networks like WhatsApp, LinkedIn, etc. Any electronic evidence used to contest a legal claim is accompanied by information about the source that is recorded, analysed, and kept.

No.	Features	Function
1	Posting	Post pictures or videos. This feature can offer details about the user's lifestyle or serve as proof of a potential crime.
2	Stories	Share the daily tales of users. Only 24 hours after being submitted, this function remains available. This function can reveal whether deviant acts have been committed or not, and it can be used to find traces of potential crimes.

3	**Direct Message**	**Send private messages to other user accounts, including words, images, videos, and voice memos. Users can also make voice and video calls. Information about the user's communication documentation may be provided via this feature. Additionally, it provides a window into the user's perspective that can be used to detect indications of potential crimes.**
4	**Search & Explore**	**Look for accounts and stuff on accounts that have not yet been followed that you might enjoy. This feature offers information about user activity and is helpful for locating proof of impersonation and account identity theft.**

Table 1. Analysis Functionality of Facebook & Instagram

COMPARISON TOOLS FOR MOBILE FORENSIC ANALYSIS

	Andriller	**ANDROPHSY**	**Cellebrite UFED**	**Oxygen Forensics Suite**	**Paraben Mobile Forensic Tools**	**MSAB**	**Lime**	**Autopsy**	**MOBILedit Forensic**	**Belkasoft**
Open Source	☑	☑	☒	☒	☒	☒	☑	☑	☒	☑
Root required	☑	☑	☒	☒	☒	☑	☑	☑	☒	☑
Call Logs	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
SMS/MMS	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Contacts	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Browser History	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Photos	☑	☒	☑	☑	☑	☑	☑	☑	☑	☑
Facebook Messages	☒	☒	☑	☑	☑	☑	☑	☒	☑	☑
Instagram Messages	☒	☒	☑	☑	☑	☑	☑	☒	☑	☑

Deleted Data	☑	☒	☑	☑	☑	☑	☑	☒	☑	☒
Recovery of Data	☑	☒	☑	☑	☑	☑	☑	☒	☒	☒
Presentation	☑	☒	☑	☑	☑	☑	☒	☒	☒	☒

Table 2. Comparision tools for Mobile Forensic Analysis

CONCLUSION

Open-source digital forensic programmes like Mobiledit Lite and Autopsy can be used to preserve information for later analysis, including SMS, call logs, images, songs, videos, and files. To protect the integrity of the mobile phone and prevent tampering with the evidence, Mobiledit Lite has a write blocker (read only) feature. To recover deleted items, Mobiledit Lite and Autopsy 3.1.2 are insufficient on their own. They can be combined with other open-source or paid tools to perform further tasks including bypassing authentication, SIM cloning, and retrieving internet surfing data. The sequence of events can be determined using the Timeline Analysis report from Autopsy 3.1.2, which is helpful in event reconstruction. many tools for WhatsApp, including WhatsApp extract, oxygen forensics, and Belkasoft and its different path.

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A Review of Literature Related Failure of Clamp in Dynamic Loading Conditions

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Abstract: The document subtly clarifies a wide range of literature on component failure, which is largely caused by dynamic and hybrid loading circumstances. This essay is based on a case study of a business that manufactures its goods predominantly using powder metallurgy, and it hypothesizes that the filling station table's persistent, somewhat dynamic loading circumstances have a significant role in clamp failure. The firm is actually losing a lot of money because clamp failures, which happen about once every three to four months, frequently force production to stop. Therefore, identifying and fixing the issue's fundamental cause is crucial. To comprehend the characteristics that might lead to failure and how such scenarios can be addressed by implementing design adjustments, an examination of conditions that are comparable is conducted. Contrary to common assumption, in order to deliver a type of superior answer, the project must take into consideration the especially dynamic loading circumstances induced by vibrations. Using computer assisted engineering, a thorough analysis of a redesigned version of the design will be conducted.

Keywords: Dynamic Loading, Fatigue Failure, Vibrations, Stress Concentration.

INTRODUCTION

A prestigious multinational corporation that manufactures specialty refractories for the steel industry and has fully owned manufacturing facilities all over the world manufactures a variety of powder-metallurgy-based products for use in various continuous casting processes, such as monoblock stoppers, subentry nozzles, ladle shrouds, and Tundish Nozzle. In order to produce the aforementioned items, feed stock must go through a number of processes. Figures 1(a) and 1(b) depict the firm's final product.

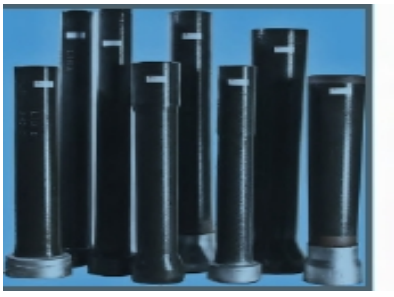

FIGURE 1, (a): Ladle Shroud Final Product

FIGURE 1, (b): Monoblock Stopper Final Product.

The filling station is a vertical column mould. To hold the material for mixing, and three clamping arms

connect the hub to the vibrating table's column. The holding column's role is to homogeneously mix the raw material and remove any voids. The circular plate that supports the entire vertical column will close from the top once the raw material has been poured into the mold. The clamping arm that holds the plate in place is attached to a downward-extending hydraulic cylinder, and the plate is mounted on a vibrating table. When the clam rises, the circular plate is in the free position. Clamping arms are placed along the column's edge to secure the entire column in place.

After 3 to 4 months of operation, the clamping arms degrade due to column vibration, resulting in gradual deformation and eventual failure. To optimize their manufacturing line, it is critical to identify the root cause of clamping arm failure and provide satisfactory results. A clamping arm malfunction that halted subsequent process production and impacted the entire manufacturing cycle. The following are the specifics of the process, product, and clamp model.

VERTICAL COLUMN MOULD POWDER FILLING STATION

By combining the powders of various metals, the mixes arrived at the filling station, where they were all filled in a vertical column. Column vibration is required for better compacting of the mixture and removal of voids contained in the mixture, thus the column mould is held on a vibrating table vertical column in fig 2a, column with circular plate on which clamp holds it from fig.3 sides in fig 2(b).

(a): Showing Moulds placed over a Circular Base Plant and Clamped With the Vibrating Table

(b): Closer View of the Circular Base Plate.

FIGURE 2 Mould Powder Filling Station

VIBRATING TABLE WITH HYDRAULIC OPERATED CLAMP (TOP AND BOTTOM).

A vibrating table's function is to correct for the mixing and eliminate any vacancies. The whole vertical column mould is installed on the vibrating table seen in Figure 3(a) Figure 3(b) depicts the bottom half of the vibrating table. The table's bottom section is made out of a hydraulic cylinder that clamps the whole column mould together.

(a): Top View of the Table Showing Hydraulically Operated Clamps

(b): View Showing the Working Mechanism of Clamps

FIGURE 3 Vibrating Table

COLUMN CLAMPING ARMS

The whole vertical column mould is held in place by three clamping arms, as seen in Fig 4. It supports a column by mounting a vertical column on a circular plate. Clamp is firmly linked into a hydraulic piston via its central hub; central hub carries three sides of the horizontal arm with vertical rod fitted into horizontal arm.

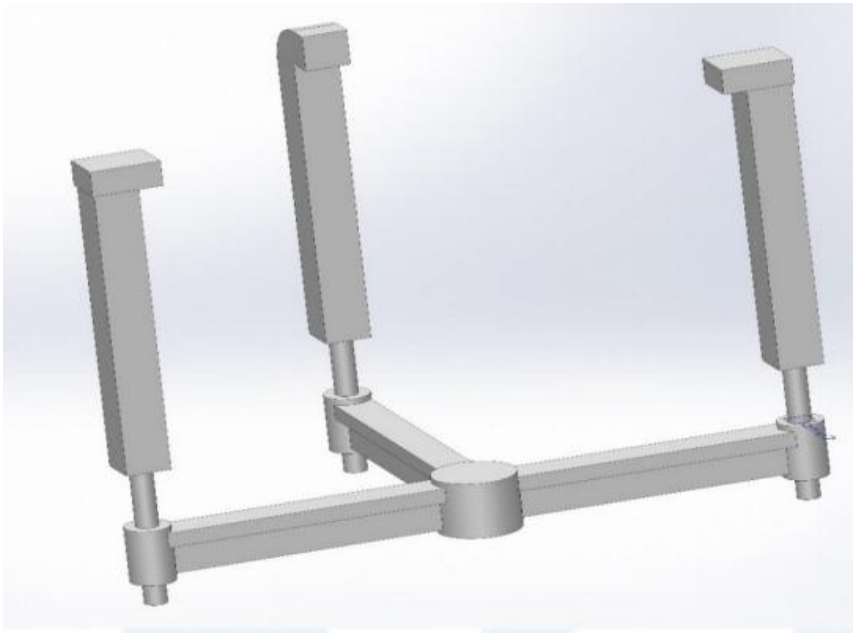

FIGURE 3 Computer Aided Design of Clamps for Visualization

LITERATURE SURVEY

Ibearugbulem et al. (2020) [1] The researcher had explored bending a thick plate with all four edges clamped. Total potential energy equation and three linked general governing differential equations were utilized to determine out of plane displacement and shear deformation rotation along the direction of X and Y coordinates. By solving these equations, an analytical solution was created, and it was validated by comparing it to numerical analysis. The recommended technique does not need shear correction parameters, which are connected to Mindlin's theory (FSDT) for the solution of the problem.

Qin et al. (2010) [2] An examination of frequently utilized clamp band joints for the coupling of dynamically loaded circular joints has been observed in this article and also taking into account the impact of touch and frictional slide. A nonlinear finite element analysis was performed, combined with a static experimental investigation on a scaled model for validation, to discover the model parameter. After that, the model is used to explore the dynamic characteristics of the clamp band joint system under axial harmonic excitation, as well as the effect of the wedge angle and clamp band joint preload on the response. The model proposed in this work may be used to simply explore the effect of structural and loading factors on the dynamic characteristics of this type of joint system. It can describe the nonlinearity of the clamp band junction.

Shi, F. F., et al. (2014) [3] This study aims to investigate the real testing conditions for plane shear tests under quasi-static and impact stress. It is primarily intended to investigate the function performed by the empirical correction coefficients that are typically used in tests of this type. For this objective, a full numerical model that incorporates the specimen and the clamping mechanism is built. In comparison to standard simulations of only a shear specimen used to create these correction coefficients, the proposed full numerical model enables for the examination of the clamping device's effect on the distribution of stress and strain fields. With the exception of the first loading period, it indicates that there are only a few consequences under static loading (elastic section). According to numerical simulations, the shear stress on the specimen is also primarily led by the compressive wave in the large clamping sections, with minimal shear wave propagation within the shear area. It also covers how to calculate equivalent strain from experimentally determined displacement. The idealized small strain shear assumption should be replaced with the euclidean accumulated strain definition, which is used in most commercial codes as the default large strain definition. The study's final finding demonstrates that when.

Zhang, L. J., et al. (2007) [4]This study intends to create a unique form of precision cropping system with variable-frequency vibration in order to obtain the correct clamping position for the bar during the cropping operation. The orthogonal approach was used to produce the simulation tests, and the finite-element method was used to create the mathematical model. The analytical results show that the diameter D of the bar has a substantial effect on the ratio of maximum tension stress to maximum shear stress towards the bottom of the notch. The influence of the length L2 of the second-segment bar and the clamping die extension on it may be minimal. The clamping bar's acceptable geometrical properties for a bar segment with a specified length to diameter ratio are as follows:L1 has a ratio of 0.3 to the bar's diameter D, while L2 has a ratio of 0.25 to D. A new measurement method is presented and used to evaluate the quality of the cross-section in accordance with the unique feature of the resulting cutting surface. Theoretical analysis and experimental results show that by carefully adjusting the clamping position of the bar, a high-quality cross-section can be produced.

Singha, M. K., T. Prakash, and M. Ganapathi. (2011) [5] This study examined about nonlinear behavior of functionally graded material (FGM) plates under a transverse distributed load is investigated using a high-precision plate-bending finite element. The plate's material characteristics are assumed to be sorted in thickness order using a simple power-law distribution of constituent volume fractions. The effective material properties are then evaluated using the rule of mixing. The formulation was built using first-order sheared formation theory while accounting for the specific physical neutral surface location. The energy equivalence idea is utilized to evaluate the shear correction factors. The transverse shear and transverse normal stresses are calculated using in-plane stress assessments derived from constitutive equations and

three-dimensional equilibrium equations.To forecast the relationship between lateral pressure load and center displacement, the nonlinear governing equations are constructed using a standard finite element procedure and solved using the Newton-Raphson iteration method.

Onyeka, F. C., and Edozie Thompson Okeke. (2021) [6] A unique polynomial shear deformation theory for static flexural analysis of an anisotropic rectangular thick plate was presented in this article. The dish that distributes food evenly. The opposite edge is unsupported, while the other three are clamped with scattered load. Determine the in-plane displacement, vertical displacement, bend and transverse shear stress, bending moment, and shear force. The Commander used a variation strategy to discover the direction of the x and y coordinates by minimizing the general governing equation and its related boundary conditions, followed by the shear deformation and coefficient of the energy equation. Based on a freshly developed concept.(1) As stress decreases, the plate's span-thickness ratio increases, according to the study. (2) As the plate ratio increases, so do the displacement and stress values. To support the theorem, numerical results are derived and compared to a solution now available in the literature. The findings were consistent with those found in the literature.

Hassanifard, S., et al. (2019) [7] In the current study, clamped rivet-nut joints with hollow plates are subjected to cyclic pressures to see how they respond to fatigue. Finite element analysis was developed to account for the clamping force-induced residual stress at the hole edge and (ii) analyze the local stresses on the joint caused by loading cycles. Using the local stress and strain data acquired from FE analysis, the original and modified Smith-Watson-Topper damage models were utilized to estimate the fatigue lives of joints. Because the stresses were greatest along the hole edge and mid-surface, the projected lifespan nearly matched the experimental results.

Ouaki, B., et al. (2003) [8] This study conducted that major cause of fatigue strength loss in aeolian vibration-prone overhead transmission wire lines is fretting fatigue. Fatigue tests on the Bersfort ACSR 48/7 conductor were carried out at various traction forces and vibration amplitudes. According to metallographic investigations, fretting causes microfractures to form between the conductor's last point of contact (LPC) between the suspension clamp's mouth and the keeper edge (KE). For the fatigue testing, many cross-sections of wires in the conductor's outer layer were instrumented with strain gauges. According to wire strain measurements performed close to the suspension clamp, the alternating stresses at the KE were predominantly traction strains, whereas the bending alternating strains became significant towards the LPC. The stress intensity variables were computed.Based on the results of fatigue testing and a simplified premise, stress intensity variables were calculated at the crack's tip. The estimated stress intensity variables account for the combined effect of traction and bending loads, as well as fretting behavior at contact points. The computed stress intensity factor ranges for low fatigue bending vibration amplitudes agree well with the conductor's endurance limit.

Shoghi, K., H. V. Rao, and S. M. Barrans. (2003) [9] In this work, which also evaluates stress in an at-section band clamp, predictions based on existing theory are supported by experimental results. The rigid cylinder was held in place by band clamps in the experimental investigation at section, and the strain and concomitant displacement were measured. The clamp nut was then tightened to an increasing tension until it failed. There is a 1-2% difference between the stress and corresponding displacement predicted by the theory and the actual results for the initial stage where the band is slack on the rigid cylinder, a 3-5% difference for the stage where the band makes contact with the cylinder, and a 5-7% difference for the post-yielding of the band material, according to testing.This inaccuracy could be attributed primarily to a property. Uncertainty. For instrument information and correctness. Is a co ef. The friction coefficient between the appropriate parts and the modulus of the elastic band material are important characteristics that influence the clamp's effectiveness. During the current trial work, the T-bolt broke.

Abd Rahman, Roslan, Mohd Nasir Tamin, and Ojo Kurdi. (2008) [10] This research presents a stress analysis of a heavy duty vehicle chassis. In fatigue research and component life prediction, stress analysis is critical for establishing the key location with the maximum stress. The research for a truck model was conducted using a finite element in a business application named ABAQUS. The model has a width of 2.45 meters and a length of 12.35 meters. ASTM Low Alloy Steel A 710 C (Class 3) is used to make the chassis, which has tensile and yield strengths of 552 and 620 MPa, respectively. The results show that the major site

of stress occurred at the chassis opening in contact with the bolt. The critical stress magnitude is 386.9 MPa.

Lin, X. B., and R. A. Smith. (1999) [11] A multiple degree of freedom numerical technique used to estimate the fatigue crack propagation of surface fractures in plates under combined tension and bending stress has been investigated by the authors. Using a fatigue crack growth relationship and a three-dimensional Finite element analysis to estimate the stress intensity components, this approach discovers the crack growth increments at a series of sites along the fracture front. A new fracture front is generated using a cubic spline approximation. Because of a remeshing methodology, the process may now be carried out automatically, and the trend of fatigue fracture formation can therefore be predicted.It is shown that the stress intensity factor results are sensitive to the shape of the crack front, that the cubic spline approximation to a crack front can eliminate the oscillation of the stress intensity factors around the crack front determined by the polygonal line and thus increase the accuracy of the stress intensity factor, and that, while normally preserved, the J-integral route independence is lost at the free surface in the case of a slightly nematic crack front.

Ortiz, Michael, Yves Leroy, and Alan Needleman. (1987) [12] An technique is given to improve the performance of generic classes of components in strain localization problems. The method makes advantage of localization information that is easily available at the element level. A bifurcation approach is used to examine the geometry of the localized deformation modes. When localization begins, element interpolation is improved by applying form functions that properly duplicate the localized modes. The extra degrees of freedom that indicate the amplitudes of these modes are removed via static condensation. The proposed approaches may be used to address any 2-D or 3-D issue that requires arbitrary rate-independent material behavior. As demonstrated by numerical examples, the technique can resolve the geometry of localized failure modes to the greatest resolution allowed by the mesh.

Senalp, A. Zafer, Oguz Kayabasi, and Hasan Kurtaran. (2007) [13] Human activity-related pressures on the implant generate dynamic stresses that alter over time and contribute to implant material fatigue failure. It is critical to safeguard hip prostheses from static, dynamic, and fatigue failure. The finite element approach has been used in orthopedic biomechanics to help in the design and study of complete joint replacements and other orthopedic devices. In this work, four stem shapes with varying curvatures for hip prosthesis were modeled. The static, dynamic, and fatigue properties of these developed stem shapes were investigated using the commercial finite element analysis tool ANSYS. Static tests were carried out under load. Walking was used as a load for the dynamic investigations.The xylem patterns were created using Pro/Engineer CAD software. The fatigue behavior of stem forms was predicted using ANSYS Workbench software. The performance of the stem forms was investigated for Ti-6Al-4V and cobalt-chromium metal materials, and the results were compared to those of a widely used stem shape created by Charnley.

Clifton, Rodney J. (2000) [14] The dynamic reactivity of materials influences the performance and failure resistance of many engineered systems. The reaction may now be tracked experimentally over a wide range of temperatures and strain rates. The use of these methodologies to study the dynamic reactions of metals, glasses, and ceramics has resulted in substantial advances in understanding while also identifying important difficulties that still need to be solved. This report describes a number of these problems, as well as some potential research avenues.

Bayraktar, Emin, Israel Marines Garcias, and Claude Bathias. (2006) [15] This research was conducted at several alloys used in the automotive industry that failed under high frequency fatigue settings. Steels heat-treated under various conditions, cast iron, and cast aluminum were among the alloys, with tensile strengths ranging from 220 to 2350 MPa. These alloys were tested under tension-compression conditions with a stress ratio of R = 1 at very high cycle-gigacycle fatigue (VHCF, >107) using a piezoelectric fatigue device (20 kHz). In the middle, a piece of each specimen was chilled with compressed air to keep the temperature at ambient temperature.The fatigue failure value range was typically between 107 and 1010 cycles. The effects of fault types on failure mechanisms in the extremely high cycle fatigue range are thoroughly investigated here, as well as fracture surface investigation using SEM (SEM).

Dasgupta, Abhijit. (1993) [16] This lesson shows design scenarios in which mechanical fatigue caused

by cyclic loading of one or more components can degrade system performance. With each load cycle, damage builds in this failure mechanism, eventually leading to a physical wearout failure mechanism. To predict the initiation (or start) of fatigue cracking in ductile materials, theoretical continuum length-scale models based on micromechanical factors are presented. Fatigue-crack propagation is studied using continuum fracture mechanics techniques. These models predict the number of load cycles required to produce failure. The methodologies for modeling the creep and fatigue relationships are briefly presented. Analytical physics-of-failure methodologies and examples are used to examine stresses and coping failure owing to cyclic exhaustion.These models can be used in engineering design settings. The accompanying stress analysis necessitates the use of numerous numerical finite-element techniques. The associated material property characterisation methods have evolved since the 1950s and are now described in engineering handbooks.

Witek, Lucjan. (2009) [17] The findings of experimental vibration testing on the compressor blades of helicopter turbo-engines are presented in this study. As a result of the engine's technical review, the investigation's blades were removed from maintenance. Investigations were carried out on a small number of whole blades that did not show corrosion pits or prior cracks. During the experiment, the blades were shaken transversely. The fracture propagation method was carried out under resonance conditions. During the fatigue test, the crack's growth was monitored. The stress state of the blade during vibration was determined using a nonlinear finite element approach in the second phase of the work. In this experiment, a first transverse vibration mode was considered. A high maximum main stress zone was identified around the crack on the blade.

FUTURE SCOPE

Ongoing study is mainly focused on hybrid loading circumstances, where a number of distinct pressures, as well as dynamic environmental factors, act on the component. To ensure that the design is valid for dealing with situations where numerous forms of stresses are created, a single computational equation that includes every type of stress and the influence of external circumstances may be established. This form of computational equation will be useful in the design of components for a variety of sectors, including automotive, aircraft, heavy engineering, and naval.

CONCLUSION

There is a ton of literature on the subject of clamp failure criteria that covers a wide range of topics including dynamic loading situations, vibrations, encompassing analytics, tests, and numerical analysis. The significance of validating a produced model by cross-checking it against another technique is demonstrated via a review of the literature. In the literature referenced, a variety of hybrid techniques are also described. However, further research is required to examine the effects of thermal stressors and synchronization with natural frequencies. Various design factors that might help to enhance the capacities to survive such dynamic settings also need to be given greater attention.

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The Present and Future problems regarding energy resources and what is the energy source of future

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Abstract: our world is facing a problem and we are at the stage where we need to do something to save our earth. There are also some problems stated as global warming, a lack of drinking water, an increase in the water level of the sea, extinction of species, air pollution, decrement in good quality food, disturbed season cycle, and temperature differences between day-night. Apart from that, we have one major problem which is the need for power in the near future. Here power is the only major problem because a human can't live without electricity or other electric tool but also because we need to fulfill the power demand of the world without disturbing the environment. We used too much amount of natural resources that are at the stage of extinction. Day by day there is an increase in the prices of natural resources and it is extinct in the near future. This thought makes the world think about renewable resources. Therefore in the field of renewable resources, some innovations are happening. Solar energy, hydro energy, tidal energy, wind energy, geothermal energy, and biomass energy. Solar energy is used widely by people at their houses or by other organizations. Where hydro energy produces a large amount of power and is located near a dam that converts potential energy into kinetic energy and kinetic to mechanical to electrical energy. Wind energy needs large open land to rotate wind plates and make energy from it. Where geothermal energy is not possible in all places and therefore it is less developed. In this paper we see the power demand the renewable and non-renewable resources, some other options for renewable resources, the economy of renewable and non-renewable resources, and how nations are moving in the direction of renewable resources.

Keywords: Renewable resources, non-renewable resources, future energy sources, pollution, global warming.

INTRODUCTION:

The 21st Century is leading toward climate change problems. Scholars have demonstrated that risks and uncertainties related to climate change can affect various dimensions of the global economic system [1]. Climate change is done by global warming, environmental pollution, and caused by greenhouse gas emissions. Also, co_2 emissions are driven by fossil fuels and non-renewable resources [2]. from 1990 the world moves from non-renewable to renewable energy. This transformation to renewable and other alternative energy sources has four aspects. 1st reason is the progress in technology, and the costs of new investments in energy sources have been significantly reduced [3]. 2nd reason is the government supports policies. 3rd is aspect is the climate change crisis [4]. 4th aspect is increasing price of crude oil due to geopolitical risks and market uncertainty has increased the interest in alternative energy sources [5]. Renewable energy resources are seen as future energy resources because natural resources are extinct and only renewable resources are left. Energy is vital for economic growth. To provide energy security, supply alternatives, job creation, and sustainable development, emerging nations must diversify energy sources. Growing population and industrialization are key factors contributing to high energy demand and therefore a strategic energy development plan is paramount to match the demand with the supply [6]. A total of 302 billion USD would have been invested in renewable energy capacity expansion by 2020, according to IRENA's Renewable Capacity (IRENA, 2021). A global renewable energy capacity expansion of 260 GW in 2020 exceeded earlier predictions and all previous records by almost 50% despite the COVID-19 pandemic [7]. Metro city's road source is local pollution and co_2 emissions. Design effectiveness and fair policies are needed to reduce such pollution. We estimate individual transport-induced pollution footprints by combining a travel demand survey from the Paris area with NOx, PM2.5, and CO2 emission factors. We find that the top 20% of emitters contribute 75%–85% of emissions on a representative weekday. They combine longer distances traveled, a high car modal share, and, especially for local pollutants, a higher emission intensity of car trips. Living in the suburbs, being a man, and being employed are the most important characteristics associated with top emissions. Among the employed, those commuting from suburb to suburb, working at a factory, with atypical working hours, or with a manual, shopkeeping, or top executive occupation are more likely to be top emitters. Finally, policies targeting local pollution may be more regressive than those targeting CO2 emissions, due to the different correlation between income and the local pollutant vs. CO2 emission intensity of car trips [8].

The world needs now some improved policies for climate protection and the decarbonization of economies. Research on clean energy will lead to technological breakthroughs and make it possible to reduce socially accepted technologies in a cost-effective manner [9]. Most of the new concepts developed are focused on energy storage. Power-to-X is a branch of technologies in this area bringing society closer to a fully energy-transitioned economy, and green hydrogen can be considered a fundamental factor in the power-to-X framework.

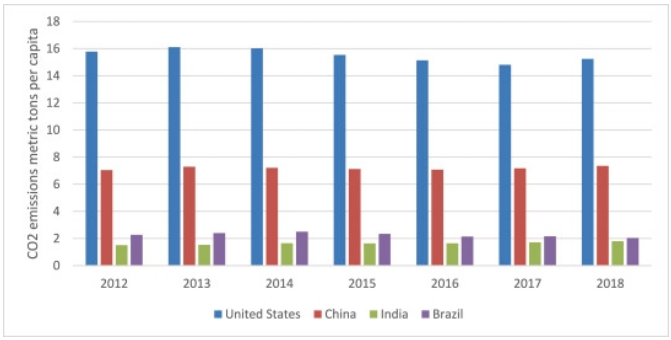

Figure 1 co2 emission per metric ton in the United States, China, India, and Brazil

From the above figure, we can say that the United States is a large consumer of power in the world and it is one of the advanced economies where fossil fuel consumption per capita is 60167 kWh in 2020. Where China is 23674 kWh at 4th, India is 57888 kWh at 9th. It shows that the economy like the United States is lagging behind other growing countries in increasing renewable energy investment and reducing fossil fuel consumption and carbon emissions. Moreover, renewable energy investment as % of gross domestic product (GDP) in 2015 was 0.2% for the United States, which is much lower than

other emerging countries, i.e., South Africa (1.4%), China (0.9%), India (0.5%), and Brazil (0.4%). Therefore, when the World is facing the threat of climate change and global warming, our study is timing one and motivates us to explore the determinants of non-renewable and renewable energy demand for the United States so that better climate change mitigating policy could be designed for sustainable environment in long-run [10].

THE IMPACT OF CLIMATE POLICY UNCERTAINTY ON RENEWABLE AND NON-RENEWABLE ENERGY DEMAND IN THE UNITED STATES

- This paper evaluates the impact of climate policy uncertainty on renewable and non-renewable energy consumption from 2000 to 2021 in the United States. In this paper, the crude oil price function as a control variable, and all considerations are done according to crude oil prices. This paper approaches some different types of methods for non-renewable and renewable energy demand. Here crude oil price is getting high which promotes more use of renewable energy sources. Surprisingly, the impact of economic growth on non-renewable energy consumption is positive but insignificant. It is also observed that economic growth promotes renewable energy demand, and crude oil prices reduce it. Furthermore, climate policy uncertainty positively affects renewable energy demand in the long run. Some policy implications are provided for reducing non-renewable energy consumption and promoting renewable energy use in the United States through climate policy implementation. From this paper, we determined the demand for non-renewable and renewable resources. [11]

DECISION OPTIMIZATION TECHNIQUES FOR EVALUATING RENEWABLE ENERGY RESOURCES FOR POWER GENERATION IN GHANA: MCDM APPROACH

- Renewable resources are future resources because non-renewable will extinct near future. This paper is in Ghana which is a country located in West Africa. This paper evaluated renewable energy sources such as solar PV, solar thermal, hydro, wind, and biomass against different criteria using multicriteria decision-making (MCDM) techniques. MCDM is one type of approach which some subtypes methods such as MOORA, TOPSIS, CRITIC & COPRAS. In addition, fuzzy AHP, TOPSIS, and qualitative pricing analysis are also used to select renewable energy sources in Polish companies. These mentioned methods are used to give a ranking of subtypes of renewable energy resources according to the Ghana region. After giving weightage to the all-methods total addition of each renewable sub-type is carried out. Then from the number, we can say that in the Ghana region this type of renewable resource gives optimal advantage. From all the analysis regarding Ghana the order of prioritization is obtained as hydro > biomass >solar PV > Wind> Solar thermal. This analysis is for Ghana if some other places are considered then there is a different order of renewable resources. From the paper, we can say that in Ghana there is more water available in form of rivers, ponds, and dams. The result ranking is done from Spearman's correlation coefficient and p-value to ensure that there are some positive correlations between the ranking techniques. This paper is helpful in the strategic implementation of renewable energy sources for improved sustainability. [12]

OPTIMIZATION OF RENEWABLE ENERGY PENETRATION IN THE REGIONAL ENERGY SYSTEM

- Rapid development of economy and energy consumption China faces a challenge in the balance between energy supply and demand. In 2016 the carbon emission of China is 27.3% of the world which is high among the countries. So, it is necessary to improve the structure of energy. The integration of renewable energy into the energy system is an alternative path. Thus, it is important to optimize the penetration of renewable energy,

i.e., to analyze the behavior of the energy system after integrating renewable energy, then the optimal energy penetration can be obtained consequently. Here Beijing-Tianjin-Hebei is taken as an example for all the consideration and calculations. In the year 2015 first, energy supply and demand based on the EnergyPLAN model was established in the Beijing-Tianjin-Hebei region. Second, the behaviors of energy in the Beijing-Tianjin-Hebei region at the different wind and solar power penetration were analyzed. This optimization analysis method of renewable energy penetration is suitable for the region, country, and area and is of great guiding significance for the sustainable development of energy in China and even the world. This paper is based on parameters analysis of CEEP and PES in different wind and solar power penetration levels, with the guarantee of energy supply and the optimum system efficiency, obtained the optimal penetration of renewable energy as last. The result shows that the total sum of wind and solar energy is more than 30% and wind penetration is less than 35%. In this paper, the example is taken as Beijing-Tianjin-Hebei but the method of analysis of renewable penetration in the energy system is used for any place it is universal for all places. [13]

GEOTHERMAL ENERGY PROVINCES IN INDIA: A RENEWABLE HERITAGE

- World is shifted from non-renewable resources to renewable resources and it is the same for India. Solar and wind energy are widely used renewable energy but geothermal energy is something different from renewable resources. Geothermal energy is explored with time. This paper states that geothermal energy in India is at starting stage and is not used over the pan India. Exploration of geothermal survey started long back but exploitation of the same is limited. However, at the preliminary stage Geological Survey of India has found around 340 hot springs across India. All the springs are divided into 5 major classes based on their different features. This paper reviewed papers on geothermal energy by various organizations in India. Geothermal energy production in India is Rajgir in Bihar, Manikaran in Himachal Pradesh, Tapoban in Uttarakhand, and Sohana region in Haryana. Government organizations like GSI, NGRI, and MNRE are the leading bodies for the exploration and exploitation of geothermal in India. The aim of this paper is to promote geothermal energy in India for societal benefits. The paper discusses the local development and use of geothermal water in various regions of India. It also narrates how geothermal water can be used for balneology, power generation, space cooling and heating, crop drying, honey processing, etc. for societal development. [14]

INVESTIGATION ON LOCAL GEOTHERMAL ENERGY ATTENUATION AFTER LONG-TERM OPERATION OF GROUND HEAT EXCHANGER WITH CONSIDERING AQUIFER EFFECT

- Geothermal energy is green energy. It is renewable energy. The usage of geothermal needs a long-depth excavation in the earth’s core. Sometimes geothermal energy is too deep and this deep excavation becomes a problem. And this problem can be led to earthquakes and an increase in water vapor. The long-term operation of deep-buried ground heat exchangers (GHE) for heat extraction would attenuate the local geothermal field. In this paper, the heat transfer between GHE and surrounding geological strata including aquifuge and aquifer layers is modeled and numerically solved to investigate the variations of GHE performance and attenuation behaviors of the ground temperature field. The results show that the reduction ratios of GHE performance in the aquifer and aquifuge layers between the 1st and 8th years are 1.3% and 8.9%, respectively, due to the convective heat transfer induced by groundwater in the aquifer layer. Taking the ground transient and initial temperature difference greater than 0.5°C as the threshold to characterize the attenuation region, the geothermal field attenuation area of the eighth year in the aquifer is

about 4.5 times that of the first year, while it is about 5.1 ~ 5.5 times that of the first year in the aquifuge layers. The analysis of variations of GHE performance and ground temperature field quantitatively evaluates geothermal attenuation behaviors in the aquifer and aquifuge layers subject to the long-term operation of GHEs. [15]

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RECENT DEVELOPMENTS IN SOLAR MANUFACTURING IN INDIA

- From some years India become one major deployer of solar PV having installed about 50 GW. Since 2021, there has great deal of interest to set up the solar manufacturing chain in the country from polysilicon and wafers to cells and modules. In India government also gives subsidiaries and policies to the public to use solar energy. Indian Government also gives subsidiaries on the solar plant for house usage. As per rough calculations, India will generate around 40 GW by 2025. By so India becomes the world's 2nd or 3rd manufacturer. This paper describes and recommends technology options available for manufacturing in India and the cost-effectiveness of manufacturing compared to the world's countries. The paper further outlines the requirements for ancillary manufacturing units and for concerted R&D and training to support and enable a fully integrated modern solar manufacturing ecosystem in India. The focus of this paper is on India, the challenges and opportunities would also be relevant to other countries of the International Solar Alliance (ISA). [16]

THRESHOLD EFFECTS OF RENEWABLE ENERGY CONSUMPTION BY SOURCE IN THE U.S. ECONOMY

- With the climate challenges and the depletion of fossil resources, the renewable energy option seems to be a wise choice; this renews the debate on the relationship between renewable energy sources consumption and economic growth. This study relies on a threshold effects regression model to explore and evaluate the non-linear relationship between the series in the United States during the period 1984Q1–2021Q3. Using the threshold detection method proposed by Hansen and Seo (2002), the results of this method show that the renewable energy sources consumption/GDP relationship is non-linear. They also reveal, for all the different sources, an optimal renewable energy sources consumption/GDP threshold of 5.535; 2.715; 1.988, and 8.925% for BIO, GEO, Solar, and HPower, respectively. The results indicate the presence of mixed directions of causality between the renewable energy sources consumption and GDP, using the Threshold Vector Error Correction model (TVECM). The findings of this paper suggest that if the United States aim to realize positive economic growth from its investment in renewable energy, they need to surpass a certain threshold of renewable energy sources consumption. [17]

INVESTIGATION ON GREEN HYDROGEN GENERATION DEVICES DEDICATED FOR INTEGRATED RENEWABLE ENERGY FARM: SOLAR AND WIND

- This paper established the study on comprehensive methodology to evaluate plants that integrate renewable energy sources and hydrogen generation devices. The paper focuses on presenting the methods for devices' operation taking into account the annual operation. On the basis of experimental investigation with the hydrogen generator, the methods for

assessing its operation during the start-up phase and sudden change in the supply current were proposed. The mathematical model of the experiment gives the information that the dynamics of the hydrogen generator should be considered while selecting suitable device cooperation with variable energy. It is especially important for multiple start-ups throughout the day due to significant differences in the amount of hydrogen produced by devices characterized by the same efficiency, yet various time constants. A methodology for selecting the optimal nominal power for hydrogen generators to cooperate with given renewable sources was developed. Analysis showing hydrogen generation costs considered the prospects of green hydrogen generation in various locations in Poland. From research, it is proven that optimal power depends on the type of renewable source and nominal load on the hydrogen generator. Several case studies, including the integration of wind and solar energy farms to yield a 10 MW renewable energy farm were considered and the minimal load of the hydrogen generator impacts the annual operation of the device has been presented. This paper gives the proper tool to contribute to the development of energy plants. In this paper used methods are universal and can be used for various renewable energy resources. [18]

CONCLUSION

Today's world is facing a problem of fuel consumption and the high price of fuel. Natural resources like coal, petroleum, and natural gas are at the edge of extinction, this point makes the whole world think of alternate sources like wind turbines, solar panels, and hydraulic turbines which are called green energy. Green energy is one option for producing power without emissions of gases which reduces the global warming effect and makes the environment clean. But green energy is not enough to fulfill the power demand of the world. A large hadron collider (LHC) is one solution of it but still, it's not practical. LHC needs a large tunnel and it's t placed deep at about 175 m. LHC produces approximately 13.6 TeV collision energy. LHC becomes costly, handling is complex, radioactive medium, and transmission of power are not practical therefore this option is not sufficient for future needs. Another option is nuclear energy. Nuclear energy is produced by nuclear particles which are expensive and hard to handle. Due to radioactivity human harm is possible. Also, skilled manpower is needed to operate. Therefore, it may not be used in the future. If in the future the invention of something new like LHC or nuclear power which can need a small area for power generation anis d less costly or we can say an arc reactor is possibly built then and only then do we have not to worry about future at all.

Apart from the above discussion, we need to find something which can not be complex as LHC or nuclear reactor. There are many effects of physics that have some amount of potential or kinetic or electrical energy which can be used for power production. But that energy is not high so we do not concentrate on it. We need to concentrate on the possible prevention of waste of energy. If natural or non-renewable resources are extinct tomorrow then we do not have something to fulfill the energy demand of the world. Recently, one concept is created if it is possible practically then the world sees things differently and humanity take step towards the future.

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Developing Improved Robust Apriori Method for Frequent Pattern Mining

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Abstract. Apriori algorithm is not only the most widely used but also the first method of association rule mining among all mining methods that rely on association rules. According to research, classic Apriori algorithms have two fundamental drawbacks: 1) regularly scanning the database; 2) creating a huge number of candidate sets. Some modifications are made based on the inherent flaws of the Apriori algorithm: 1) Utilizing a novel database mapping method to prevent scanning the database again; 2) further trimming frequent itemsets and candidate itemsets to increase joining efficiency; and 3) counting support using an overlap technique to achieve high efficiency. Under the same conditions, the findings show that the proposed enhanced Apriori algorithm outperforms previous improved algorithms in terms of operational efficiency.

Keywords - Apriori, Association rules, Frequent Pattern Mining

INTRODUCTION

Data mining is the process of finding interesting patterns and hidden information in databases. Association rule mining is one of the most important subfields of data mining. It identifies associations and frequent patterns among a set of items in a given database.There are two subproblems within it:1) Determine a frequent itemset based on a threshold that has already been established;2) Create association rules that adhere to the confidentiality restriction.

Using the Apriori algorithm, which was created in 1994 by Agrawal and Srikant, buying performance analysis in a supermarket was the first application of association rule mining. Since then, association rule mining has been successful in locating intriguing patterns and associations in numerous other fields, such as the identification of new service opportunities and the analysis of medical data, in addition to playing an important role in commercial data analysis.

It is important to note that, despite the fact that more and more managers are realizing that data analysis based on associate rules mining techniques can assist them in creating more appealing products or services for customers, thereby improving service quality and gaining an advantage over rivals, the association rule mining algorithms that have been developed up to this point either lack efficiency or are overly complicated. An association-rules-mining algorithm that is both user-friendly and highly effective is the goal of this research.

LITERATURE REVIEW

The association-rules-mining fundamental search strategies can broadly be divided into two groups: Generation of candidates and pattern development Strategy known as candidate generation-based (CGB).A breath-first search strategy is used. Based on frequent k-itemsets, CGB-algorithms generate candidate (k+1)-itemsets. The frequency of each itemset is counted and recorded in each transaction. This frequency should be compared to a predetermined threshold to determine whether or not this itemset will be kept. At the conclusion of the algorithm, the frequency of any possible itemset has been established, and all itemsets that are frequent can be chosen. In 1994, Agrawal proposed the Apriori algorithm, which was the first algorithm based on CGB strategies. PGB (pattern growth basis) strategy. A FP-tree-like data structure is used in this Depth-Frist search strategy.

By recursively finding every frequent 1-itemset in the conditional pattern base, which is effectively constructed with node links and is represented by the Frequent-Pattern-tree (FP-tree), algorithms employing the PGB strategy can identify frequent item sets. The FP-Growth algorithm, developed by Han et al., is the first algorithm based on the PGB strategy.in 2000. Even though the modern depth-first approaches outperform the classical Apriori algorithm in terms of performance, the Apriori algorithm is always regarded as an important association rule mining algorithm due to the fact that its fundamental idea of finding all frequent item sets in a given database is universal and simple to implement for any association rules mining problem. On the other hand, depth-first approaches are hindered not only by the complexity of creating an FP-tree but also by the need for storage for recording nodes. The objectives of this study are to inherit the advantages of the Apriori algorithm and boost mining algorithm efficiency in the following ways: Reduce the size of candidate itemsets, speed up the joining and pruning processes, and avoid rescanning the database.

In large databases, association rule mining identifies intriguing associations and frequent patterns among a set of items. Formally, the following should be the function of Association-Rule-Mining algorithms: An item can be an event or a product. The set of all products or events that are involved in this problem is represented by X = "i1, i2,..., in. "Let T = t1, t2,..., tm be a collection of transactions, with each transaction consisting of a collection of items. Let itemset refer to any subset of the item base X. The association rule X => Y indicates a particular relationship between two itemsets X and Y. An association rule X => Y is supported if the percentage of transactions in T that contain both itemsets X and Y exceeds a particular threshold, which is referred to as the support threshold.

The percentage of transactions containing itemset Y out of transactions containing itemset X defines the confidence for the association rule X => Y. The Apriori algorithm investigates candidates in two steps: a) Create all of the frequently used itemstets. An itemset is considered frequent when its frequency exceeds a predetermined threshold of minimum support; (b) After all of the frequent k-itemsets have been explored, an a priori pruning operation is used to exclude all of the infrequent k+1-itemsets by creating a new itemset based on the first. The study's main contributions are as follows:1) proposing a new method for searching to speed up the process; 2) Using a compacted vector structure to cut down on the cost of storage.

METHODOLOGY

The following new approach was proposed in the paper to avoid repeatedly scanning the database:

→ Get the set transaction identifier (TID) for each item by scanning the transaction database once;

→ Further prune Lk1 before the candidate items Ck emerge: Count the times that each item occurred in Lk, and if this number is less than k 1, remove the item sets. Counting the support of candidate itemsets Ck based on the TID set of Lk1 and the TID set of L1 using the overlap strategy;

→ If the number of |Lk| is less than k[17], the algorithm should be stopped. With the above-described proposed algorithm, it is obvious that not only the number of candidate items will decrease. However, the time required to count the support will also be significantly reduced.

The Proposed algorithm examines the following frequently used itemset: * L1 = find_frequent_1_itemsets(T); * C2 = L1-L1; * L2 = items in C2 min _sup; * For (k=3;Lk. 1 G;K + +) Lk. 1 * Prunel(Lk. 1); * $L \in Lk$, $L \in Lk$; * if (L [1] = L [1] ^ L [2] = L [2] ^ … L [$k-2$] = L [$k-2$]^ L [$k-1$] < L [$k-1$]) * $c = L \cup L$; * If (k 1) are subsets of c, * then remove c from Ck; * $C = c \cup C$; * Lk = New_quick_support_count(Ck, TID_Set); * A wer =Uk Lk; *New_quick_support_count(Ck, TID_Set); "for all itemsets C Ck C." TID_Set = Lk

1.*T* _*Set* ß *L*1.*T* _*Set C*. *S* = *Len h*(*C* . *T* _*Set*);if C. Sup min_sup, remove C from Ck; Lk = C Ck|C. Sup min_sup Prunel(Lk) for all itemsets L1 Lk;if *cou* (*L*1) i*n L*k ≤ *k*; then remove every Lj from Lk;
reti ' *L*k;

CONCLUSIONS

By reducing the number of transactions to be scanned and the amount of time spent scanning transactions for the generation of candidate itemsets, the improved Apriori algorithm achieves excellent performance. In general, as the group of transactions and the value of the minimum support rise, the Proposed algorithm performs significantly better in terms of time consumed. As a result, proposed algorithm is significantly more effective than its predecessor. From the perspective of space complexity, this improved algorithm can be improved further in the future.

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Comparative Analysis of Spanning Tree Protocol and Rapid Spanning Tree Protocol using Packet Tracer

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Abstract. In today's world as population increases, they want more resources. In networking field as many as resources are increases, it becomes a large or complex network. Implement a network with some criteria such as provide redundancy and fault tolerance. To design a network based on customer demand it requires some protocols like Spanning Tree Protocol (STP) and Rapid Spanning Tree Protocol (RSTP). This protocols provides redundancy in case of link failure. Link failure is not accepted at any kind of situation. It requires redundancy or back up path when failure is happened. if provides redundancy to the network it creates a loop and network quickly goes down. To overcome this type of situation STP and RSTP protocols are used. This research is based on comparison of STP and RSTP. From simulation we can easily compare the RSTP is more efficient then STP in terms of packet loss.

Keywords **-** Redundancy, Fault Tolerance, STP, RSTP, Link Failure, Packet Loss

INTRODUCTION

Networking provides connectivity in all over the world. in real time any link goes down is not acceptable. Link failure is not only happen in large network but also in small and medium network. This is the responsibility of network administrator to configure a network by considering all parameters. To make more reliable network, it requires more redundancy in the network. If provide more redundancy in network it creates a loop, due to the loop network creates multiple packets. Layer 2 devices like switch, broadcast the packets when it received. the link is over saturated and one point of time whole network goes to down. To prevent the network from creation of loop requires some protocols such as STP and RSTP. It provides redundancy and fault tolerance. Redundancy is to provide extra path for packets, which goes from source to destination.

STP and RSTP protocols provide redundancy without link of failure. Packet tracer simulator automatically provide STP protocol, when creates a loop in network topology. in this research take one network topology to compare both protocols. By theory know that STP takes more time to converge the network failure link to the alternate link or back up link, Where RSTP takes less time than STP in terms of packet loss.

This paper is organized in four sections. Section I provide the introduction of research work. If link failure is happened in network failure recovery protocols are explain in the section II. The network architecture implement in packet tracer simulator describe in the section III. Section IV gives the simulation result after doing the configuration of network. And in the last concludes the research work.

FAILURE RECOVERY PROTOCOLS

SPANNING TREE PROTOCOL

Spanning Tree Protocol is applicable on layer-2 devices. This protocol is use to prevent loop in redundant path. it creates redundant path as an alternate path, when one link fails it will automatically switch over to the alternate path to transfer packets.

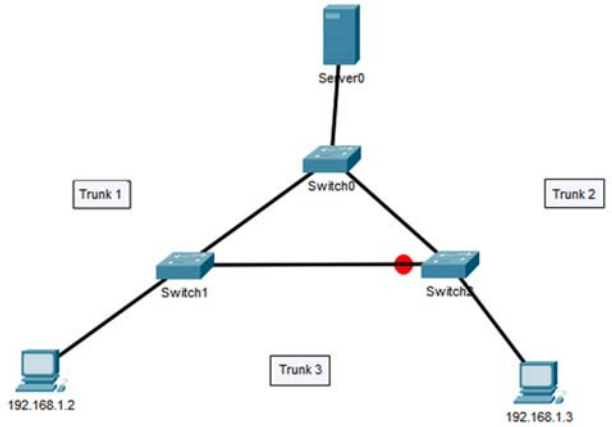

FIGURE 1. Spanning Tree Protocol

Figure 1 shows how to apply STP on network. in this topology three switches creates loop. to prevent the network from loop creation STP can apply, Trunk 3 is an alternate path, indication given by red circle.

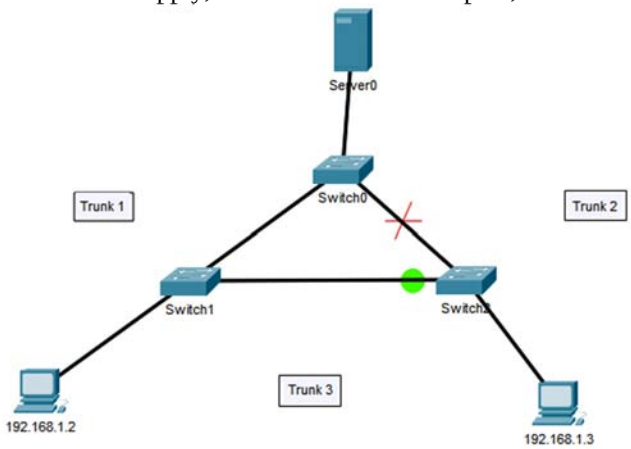

FIGURE 2. Spanning Tree Protocol Recalculation

Figure 2 shows the STP recalculation, here Trunk 2 goes to fail now Trunk 3 is automatically open to transfer packets, indication given by green circle.

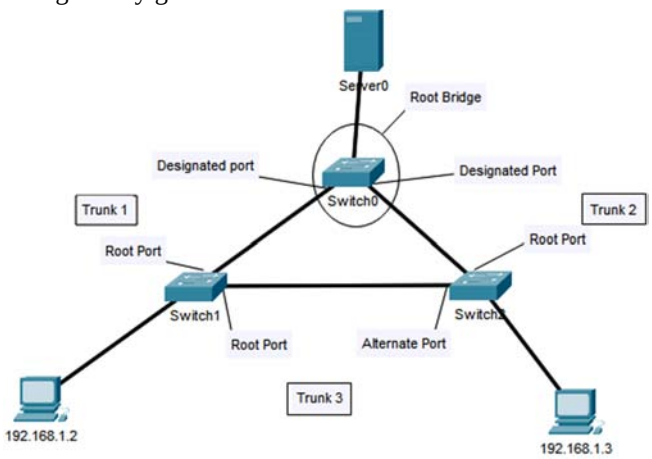

FIGURE 3. Spanning Tree Protocol Ports

Figure 3 shows STP ports, Switch 0 is consider as a root bridge. A Root Bridge is a reference point for all switches in a spanning-tree topology[6]. It shows different ports in STP, root ports, designated ports and alternate ports.

STP Ports,

- **Root -** Non root bridge switch, which can be forward data to root bridge.
- **Designated** - Ports of root bridge will be designated ports.
- **Alternate** - It is a back up port, if any link is fail alternate port will be ON.

STP is calculating path in four steps,

- Selecting a Root Bridge
- Block Redundant Paths
- Create a Loop-Free Topology
- Recalculate in case of Link Failure

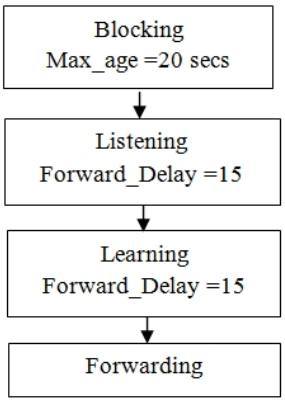

FIGURE 4. Spanning Tree Protocol States and Timers

Figure 4 shows four operational port states of STP and times, First state is blocking when some failure happens to the topology it will wait for 20 seconds. The port will not get the packets after 20 seconds then it goes to listening state and learning state from these states it will get the information regarding full topology. In the last state path convergence can happen and alternate port is ready to forward the packets in forwarding state.

- **Blocking** - A very first time device is connected, port enters in to blocking state.

  Max Age Timer - Time required for a switch waits before attempting to change the STP topology. Default value of max age timer is 20 seconds but it can be modified between 6 seconds to 40 seconds.

- **Listening** - Switch is send Bridge protocol data unit (BPDU).

- **Learning** - Switch is receive the BPDU and stop sending BPDU.

  Forward Delay Timer - Time required for listening and learning state. Default value of forward delay timer is 15 seconds but it can be modified between 4 seconds to 30 seconds.

- **Forwarding** - Forwarding state is forward the data.

To calculate STP convergence time formula is,

STP Convergence Time = Max_age + 2 (Forward_Delay) = 20 seconds + 2 (15 seconds) = 15 seconds

RAPID SPANNING TREE PROTOCOL

RSTP is easily configured if users are familiar with the STP. RSTP has same port roles and topology to be determined. The main difference is the speed of recalculation when topology changes. It can be achieve higher speed of convergence by applying perfect configurations. If one port is configured as an alternate port it can immediately converge to forwarding data whenever the failures happened. It will detect the failure by sending BPDUs (Bridge Protocol Data Units). BPDU has been exchange to control the flow of traffic and prevent looping.

Figure 5 shows the RSTP states, Here only three states are there. Blocking and listening stages are not preset in RSTP this is the reason behind the speed of convergence. Discarding state, learning state and directly forward the data.

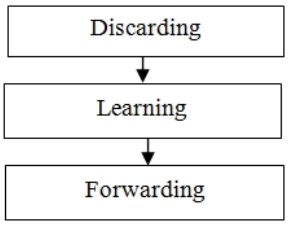

FIGURE 5. Rapid Spanning Tree Protocol States and Timers

- **Hello Timer** -The hello time is the interval between BPDUs. The default is 2 seconds.

To calculate RSTP convergence time formula is,

RSTP Convergence Time = 2 (Hello Timer) = 2 (2 seconds) = 4 seconds

NETWORK ARCHITECTURE

Network topology created in packet tracer simulator. Five layer-2 switches connected in ring topology. five end devices are connected to switches. one server and four computers are taken as an end devices. Switches are connecting in STP networks. Trunk mode configured between interconnected switches.

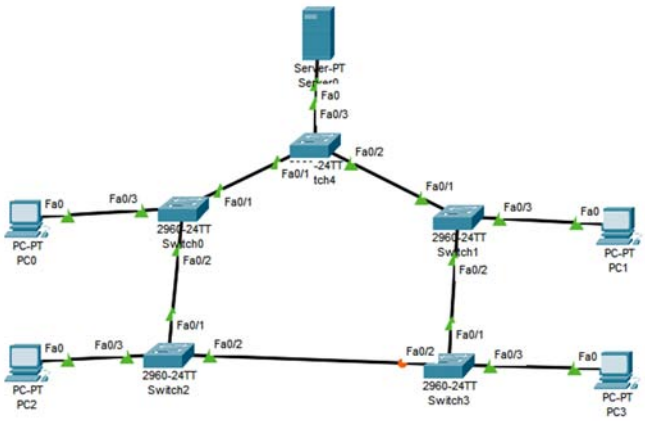

FIGURE 6. Network Architecture for Research

Figure 6 shows the network topology, all devices are connected through copper cables. The ip address of end devices are in the range of 192.168.1.1 to 192.168.1.5. based on ip address subnet mask is calculated as 255.255.255.0. Here the green arrow represents the cables are ready to transfer data. The orange notation is an alternate port. Whenever any link goes fails the orange notation will be convert into green arrow and ready to transfer data.

SIMULATION RESULTS

Simulate given network topology in packet tracer simulator. First configure STP, make central switch as root bridge because all path have same length from the center. To make center switch as root bridge the command is,

spanning-tree vlan 1 root primary

Next step is Ping from command prompt of the computer having ip 192.168.1.2 to the server ip 192.168.1.1. For ping command is,

ping -t 192.168.1.1

Now manually fail the link, in figure 6 f0/1 port of switch 2 by shutdown that port. Here no any particular failure pattern described, but only a working link goes off or shutdown then the alternate path will transfer the packets. Off the link by manually commands are,

Interface f0/1
shutdown

Now open the command prompt of computer result shows 12 packets are lost between the convergence happen failure link to alternate port f0/2 of switch 3 as shown in figure 7 and 8.

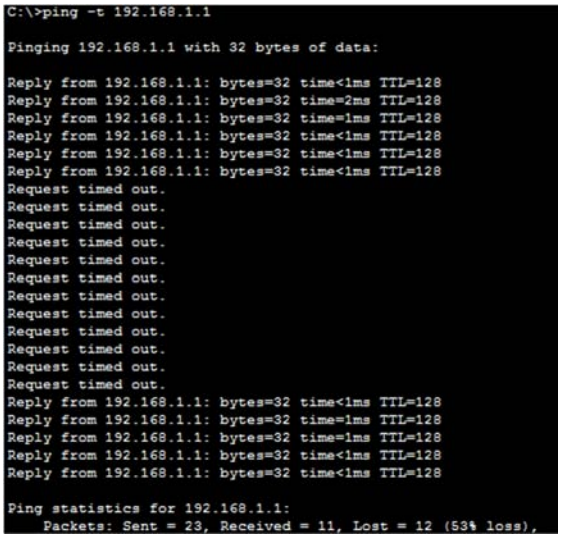

FIGURE 7. Simulation Result of STP

Figure 8 shows the simulation result of RSTP, To configure RSTP command enters in to the all the switches,

spanning-tree mode rapid-pvst

Now Ping from command prompt of the computer having ip 192.168.1.2 to the server ip 192.168.1.1. For ping command is,

ping -t 192.168.1.1

Now manually fail in figure 6 f0/1 port of switch 2 by shutdown that port. For manual failing link commands are,

Interface f0/1
shutdown

Now open the command prompt of computer result shows 1 packet is lost between the convergence happen failure link to alternate port f0/2 of switch 3 as shown in figure 7 and 8.

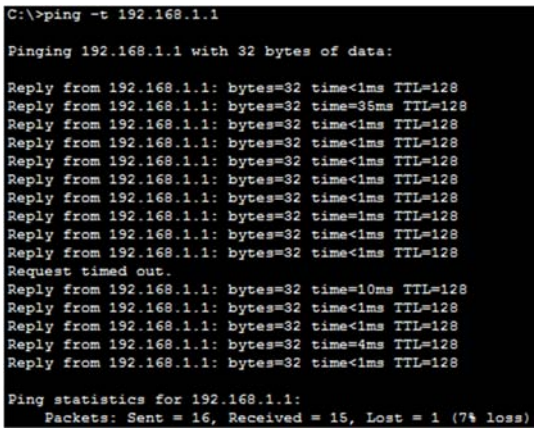

FIGURE 8. Simulation Result of RSTP

TABLE 1. Comparative Results of STP and RSTP

Parameters	STP	RSTP
Standard	IEEE 802.1w	IEEE 802.1D
Number of Packet Sent	23	16
Number of Packet Received	11	15
Number of Packet Lost	12	1
Convergence Time	50 seconds	4 seconds
Loss	53%	7%

Table 1 shows the comparative results of STP and RSTP, the first parameter compares is IEEE standards, which are different because it has two different protocols. The second parameter is numbers of packet sent from computer to server. STP sent 23 packets and RSTP sent 16 packets. The third parameter is numbers of packets received from server to computer. STP receives 11 packets and RSTP receives 15 packets. Forth parameter is numbers of packets lost between the convergence failure link to alternate link. STP lost 12 packets and RSTP lost 1 packets. Fifth parameter is convergence time, when failure happen how much time take to recover the network, STP has 50 seconds and RSTP has 4 seconds. The last parameter is total loss when convergence is happen. STP packet loss is 53% and in RSTP packet loss is 7%.

CONCLUSION

This research is a comparative analysis of layer 2 networking protocols, which are STP and RSTP. One network topology created in packet tracer simulator. Simulate this topology for both protocols and simulation results should compare. By theory know that RSTP is having fast converge when failure is happen, now simulation results can also shows in STP packet loss is 53% and in RSTP packet loss is 7%. The convergence time of RSTP is lesser than the STP. From the result conclude that RSTP is fast converge then STP when failure is happen.

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Fracture Mechanics in Concrete: A Review

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Abstract: The study of crack initiation and propagation in materials is the focus of fracture mechanics, a branch of mechanics. There are numerous causes of structural crack formation. Analysis of structures and their behavior under loading requires a thorough understanding of fracture mechanics. This article covered the history of fracture mechanics, an introduction to fracture mechanics, and theoretical and experimental research on fracture mechanics in concrete. Additionally covered was the use of nanotechnology in concrete and the creation of "nano concrete," a modified kind of concrete that incorporates various nanomaterials.

Keywords: Fracture Mechanics, Mode of Fracture, Historical aspect of Fracture Mechanics, Fracture Mechanics in Concrete, Nano Concrete.

INTRODUCTION

INTRODUCTION TO FRACTURE MECHANICS:

The study of how cracks spread across materials is the focus of the mechanics discipline known as fracture mechanics. The driving force on a crack is calculated using analytical solid mechanics techniques, while the material's resistance to fracture is described using experimental solid mechanics techniques. The stress becomes infinite in theory ahead of a sharp crack tip; hence it cannot be utilized to represent the situation surrounding a crack. Using a single parameter to describe the entire loading condition at the crack tip, fracture mechanics is used to characterize the loads on a crack. There have been established several different parameters. The stress state at the crack tip is caused by elastic forces within the material and is referred to as linear elastic fracture mechanics (LEFM) and may be described using the stress intensity factor K when the plastic zone at the crack tip is small relative to the crack length. The fracture tip's state is described by the characterizing parameter, which may subsequently be compared to experimental circumstances to ensure similarity. When the parameters regularly surpass specific critical values, crack growth happens. When the corrosion stress intensity threshold is exceeded, corrosion may cause a crack to slowly spread. Like this, tiny faults that are subjected to cyclic loading may cause fracture propagation. It was discovered that for lengthy cracks, a phenomenon called fatigue occurs where the pace of growth is substantially controlled by the range of the stress intensity K that the crack experiences as a result of the applied loading. When the stress intensity is greater than the material's fracture toughness, fast fracture will result. The core of the damage tolerance mechanical is the crack growth prediction.

In a structural component, a crack front is a line that typically has different curvatures. As a result, the level of tension at different locations around the fracture front varies. According to Fig. 1, a section of the crack front can be separated into three fundamental modes. The displacement is normal to the fracture surface in mode I, which is the opening mode. Sliding mode II has a displacement that is in the plane of the plate, an antisymmetric separation, and a relative displacement that is normal to the crack front. Even though the displacement in Mode III is parallel to the fracture front, it still results in sliding motion and tears the material.

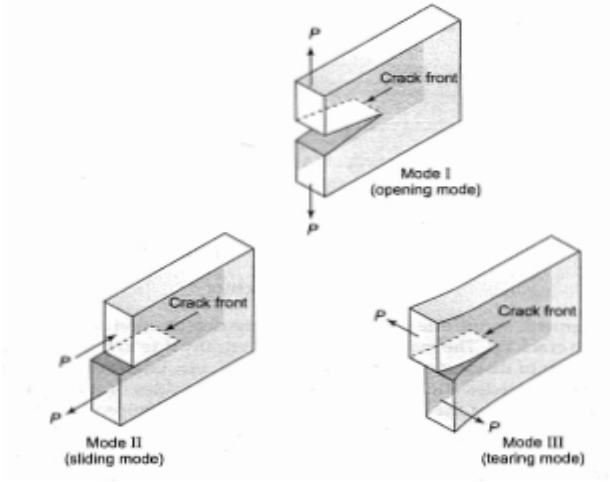

FIGURE-1: The three modes of fracture [Source: Prashant Kumar by Element of fracture mechanics, McGraw Hill Education (India) Private Limited]

HISTORICAL ASPECT OF FRACTURE MECHANICS:

EARLY FRACTURE RESEARCH

Some hints as to the primary cause of fracture were supplied by experiments carried out by Leonardo da Vinci several centuries earlier. Iron wires' strength was measured, and he discovered that strength varied inversely with wire length. These findings suggested that the strength of the material was influenced by flaws; a longer wire correlated with a bigger sample volume and a higher likelihood of sampling a region with flaws. Griffith's work, which was published in 1920, established a quantitative relationship between fracture stress and flaw size. He used a stress analysis of an elliptical hole that Inglis had completed seven years prior to analyses the unstable crack propagation. This theory states that a flaw becomes unstable, and fracture occurs when the strain-energy change caused by an increase in crack propagation is sufficient to outweigh the material's surface energy.

THE LIBERTY SHIPS

Because of what happened to the Liberty ships during World War II, the mechanics of fracture developed from being a scientific curiosity to an engineering subject. [2]

POST WAR FRACTURE MECHANICS RESEARCH:

Dr. G.R. Irwin oversaw the Naval Research Laboratory's fracture mechanics research team. After reviewing the early research of Inglis, Griffith, and others, Irwin came to the conclusion that the fundamental instruments required to analyses fracture were already in existence. Irwin's first significant contribution was to extend the Griffith method to metals by considering the energy lost during local plastic flow. Orowan independently came up with a comparable adjustment to the Griffith theory. The Griffith theory was expanded to include a rapidly spreading crack during this time. The energy release rate idea, which was drawn from the Griffith theory but presented in a way that was more helpful for solving engineering issues, was created by Irwin [51] in 1956. Soon after, several Irwin's colleagues made him aware of a 1938 paper by Westergaard [108] that they had read. In order to analyze stresses and displacements prior to a severe break, Westergaard created a semi-inverse approach. Irwin [51] shown using the Westergaard method that the stresses and displacements close to the crack-tip could be accounted for by a single constant that was connected to the energy release rate. Later, this crack-tip defining characteristic was referred to as the "stress-intensity factor." Williams used a somewhat different method during this time to come up with crack tip solutions that were nearly identical to Irwin's findings. Fracture

mechanics' reputation in the engineering world was raised by several early, prosperous applications. In 1956, Wells used fracture mechanics to demonstrate that fatigue cracks that had grown to a critical size were what caused the fuselage failures in several Comet jet aircraft. Due to inadequate local reinforcement and square corners that created a high stress concentration, these cracks started around windows. (Recall the Liberty ships' terrible hatch design.). Irwin's energy release rate approach was used by Winne and Wundt to analyses the failure of big steam turbine rotors. They used their ability to foresee the bursting behavior of sizable discs taken from rotor forgings to prevent fracture in genuine rotors. Paris and his colleagues attempted to apply fracture mechanics principles to fatigue crack growth in 1960, but they were unable to attract an interested audience. It appears that design engineers were not yet prepared to give up their S-N curves in favor of a more rigorous approach to fatigue design, despite the fact that Paris et al. gave compelling practical and theoretical grounds for their approach.

Clearly, two different periods in the history of fracture mechanics are separated by the Second World War. The division of the time between the conclusion of the war and the present, however, is not entirely clear. Around 1960, when the fundamentals of linear elastic fracture mechanics were largely understood, one conceivable historical boundary may have been reached and crack-tip plasticity became the focus of research. When considerable plastic deformation precedes failure, the linear elastic fracture mechanics (LEFM) no longer holds true. Including Irwin, dug ald, Barenblatt, and Wells [107] are only a few of the scholars who created studies to account for yielding at the crack tip within the relatively brief time-period (1960–1961) [84]. While Dugdale and Barenblatt each created considerably more complex models based on a small strip of yielding material at the crack tip, the Irwin plastic zone correction [52] was a rather straightforward extension of LEFM. When considerable flexibility precedes failure, Wells [107] proposed the displacement of the crack faces as a substitute fracture criterion. Wells and Irwin had previously collaborated at the Naval Research Laboratory while Wells was on leave. When Wells resumed his position at the British Welding Research Association, he made an effort to apply LEFM to structural steels with low and medium strength. Although Wells observed that the fracture faces migrated apart with plastic deformation, these materials were too ductile for LEFM to be applied. The crack-tip-opening displacement parameter was created as a result of this observation (CTOD). Rice created a new parameter in 1968 to describe nonlinear material behavior before a crack. Rice was able to generalize the energy release rate to nonlinear materials by imagining plastic deformation as nonlinear elastic. He demonstrated how the J integral, a line integral assessed over any arbitrary contour surrounding the crack, may be used to express this nonlinear energy release rate. Eshelby had previously published several "conservation integrals," one of which was identical to Rice's ☺integral, which Rice found at the time his work was published. However, Eshelby did not use his integrals to crack problem. The fracture tip stress fields in nonlinear materials were connected to the integral by Hutchinson, Rice, and Rosengren in the same year. These analyses demonstrated that can be considered as both an energy release rate and a nonlinear stress intensity parameter. Begley and Landes, research engineers at Westinghouse, came across Rice's article in 1971 and, in spite of resistance from their colleagues, chose to utilize the J integral to describe the fracture toughness of these steels. Their tests were a great success, and ten years later a standard protocol for ☺testing metals was published. Characterizing material toughness is just one component of fracture mechanics. It is necessary to know a quantitative relationship between toughness, stress, and flaw size in order to apply fracture mechanics concepts to design. Despite the fact that these relationships were well known for linear elastic issues, a fracture design analysis based on the ☺integral wasn't made possible until Shih and Hutchinson in 1976 gave the necessary theoretical groundwork. A fracture design manual was later released by the Electric Power Research Institute (EPRI) based on the Shih and Hutchinson methodology.

Beginning in the late 1960s, Well's CTOD parameter was widely used in the United Kingdom for fracture analysis of welded structures. Fracture research in the U.K. was mostly driven by the development of oil resources in the North Sea, whereas fracture research in the U.S. was predominantly pushed by the nuclear power sector throughout the 1970s. Burdekin and Dawes created the CTOD design curve, a semi-empirical fracture mechanics methodology for welded steel structures, in 1971 by combining many concepts that Wells [106] had put out a few years before. The strip yield model of Dugdale and Barenblatt served as the foundation for the fracture design analysis the UK nuclear power industry created. [2] Shih showed a connection between the CTOD and J integral, suggesting that both parameters are equally useful for describing fracture. The U.S.-based techniques to material testing and structural design and the British CTOD methodology have started to converge in recent years, combining the best features of each approach to provide results that are more accurate. Currently, both metrics are used globally on a variety of materials. Between 1960 and 1980, a large portion of the theoretical underpinnings of dynamic fracture mechanics were produced. Several researchers made substantial contributions.

In the final two decades of the 20th century, the field of fracture mechanics reached maturity. Instead of producing significant improvements, current research frequently yields small improvements. Because of how

frequently this technique is used to solve real-world issues, fracture mechanics is today regarded as a well-established engineering discipline. Analysis of fracture mechanics is using more complex models for material behavior. Even though plasticity was the main issue in 1960, more recent work has taken things a step further by including time-dependent nonlinear material behavior like visco-plasticity and viscoelasticity. The demand for robust, creep-resistant high temperature materials drives the first, while the second is a reflection of the growing use of plastics in structural applications. The characterization of composite materials has also made use of fracture mechanics, sometimes abusively. The creation of microstructural models for fracture and models to relate local and global fracture behavior of materials is another contemporary research topic. The efforts to define and forecast fracture toughness's geometry dependency are a related subject. When conventional, so-called single-parameter fracture mechanics fail, such methods are required.

Both the development and use of fracture mechanics technology have benefited from the ongoing explosion in computer technology. A typical desktop computer, for instance, can carry out intricate three-dimensional finite element evaluations of structural components that have cracks. Fracture mechanics study has also expanded significantly because of computer technology. Active research is being done in interfacial fracture and Nano scale fracture because of issues that have arisen in the microelectronics industry. [2]

FRACTURE MECHANICS IN CONCRETE-THEORITICAL

INTRODUCTION:

Concrete is a material that is frequently used in structures like roads, airports, bridges, and maritime structures because it must survive numerous cycles of repeated loading. The most recent state-of-the-art for constructing such structures against distress brought on by fatigue loading is mostly empirical and based on years of experience. The performance can be accurately predicted as long as the designer is working with constructions composed of materials that are similar to those for which the relationships were determined. But as circumstances alter, a rational approach is required. In general, concrete has many defects that can lead to cracking, including holes or air pockets, aggregates that are already cracked, a lack of link between the aggregate and matrix, etc. The direction in which cracks often spread is perpendicular to the highest tensile stress. Cracks in heterogeneous materials typically follow the material's weakest path. Even though the crack's shape is most likely highly uneven, it is anticipated that the irregularities will be smoothed out and the cracks will grow slowly to a straightforward pattern along which the stress intensity factor (SIF) is practically uniform. A fast-growing field with a lot of potential for use in concrete structural design is fracture mechanics (Karihaloo 1995; Shah et al 1995; Van 1997; Bazant 1998, 2002).

Up to the maximum stress, the stress-strain curve of a perfect brittle material is linearly elastic; after that point, a little fault spreads catastrophically and leads to failure. Figure 2(a) shows a typical tensile stress-elongation curve for an ideal brittle material that is valid for linear elastic fracture mechanics (LEFM). Concrete has high nonlinearity before the maximum stress because it is a quasi-brittle material. What causes deformation to happen over the proportional limit fy [see figure -2(b)] is unknown.

Initially, many microcracks are formed at random. At some time prior to the peak load, microcracks begin to localize into macrocracks that propagate critically. Strain softening is observed during the steady-state propagation of this crack. In a closed loop displacement-controlled testing environment, the displacement during the post-peak phase is observed to consist of the major crack opening and the remaining portion of the specimen being unloaded.

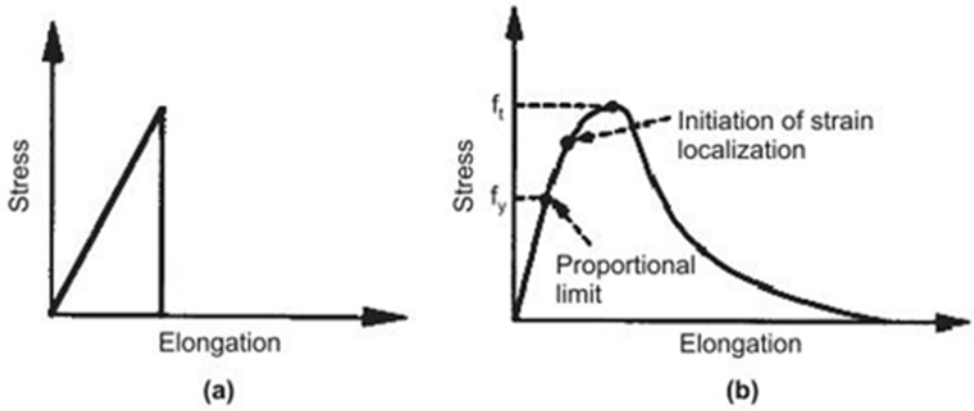

FIGURE-2: Tensile stress-elongation curves for (a) linear elastic material, (b) quasi-brittle material
(Source: Chandra Murthy A.R., Palani G.S. and Iyer N. R., fracture analysis of concrete structural components- State-of-the-art review, Sadhana Vol.34, Part 2, April 2009, pp.-345-367)

Concrete's ability to fracture is significantly influenced by the Fracture Process Zone (FPZ). The FPZ, defined as the region in which the material experiences softening damage (tearing), which happens in concrete and rock fracture, covers the non-linear zone almost entirely. These substances are now known as quasi-brittle materials. Usually, the variation in thickness or width along a structure is ignored. The inelastic fracture reaction caused by the presence of FPZ can thus be explained by a cohesive pressure acting on the crack faces. Figure -3 shows FPZ in brittle-ductile and quasi-brittle materials (Bazant 2002). In order to represent this behavior using discrete crack fracture mechanics, it is assumed that an initial crack begins to propagate at the proportional limit fy and continues to do so gradually until the peak stress. When the crack in the concrete widens, new crack surfaces are produced along the path of the initial fracture tip. When newly formed crack surfaces touch, FPZ toughening mechanisms, like aggregate bridging, take place. A relationship between material tensile stress and separation suggests that they may also continue to sustain some regular tensile stress.

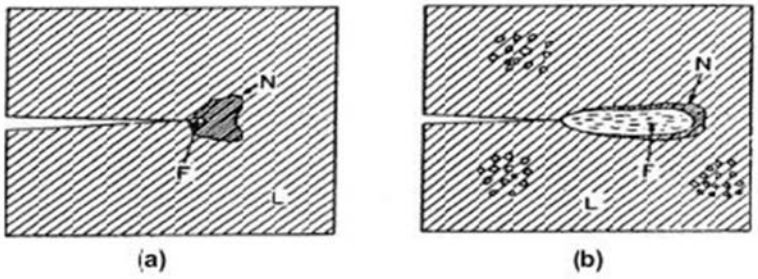

FIGURE-3: FPZ in brittle-ductile materials. (a) Ductile-brittle (metals), (b) Quasi-brittle (concrete)
(Source: Chandra Murthy A.R., Palani G.S. and Iyer N. R., fracture analysis of concrete structural components- State-of-the-art review, Sadhana Vol.34, Part 2, April 2009, pp.-345-367)

How the tensile stresses are distributed on the newly formed crack surfaces depends on the specification of the FPZ prior of the initial fracture point. If FPZ ignores the impact of micro cracks ahead of the newly formed crack tip, as shown in figure 4(a), the normal tensile stress progressively develops from the original (open) crack tip and reaches the material's tensile strength, ft, toward the end of FPZ (Bazant 1998).

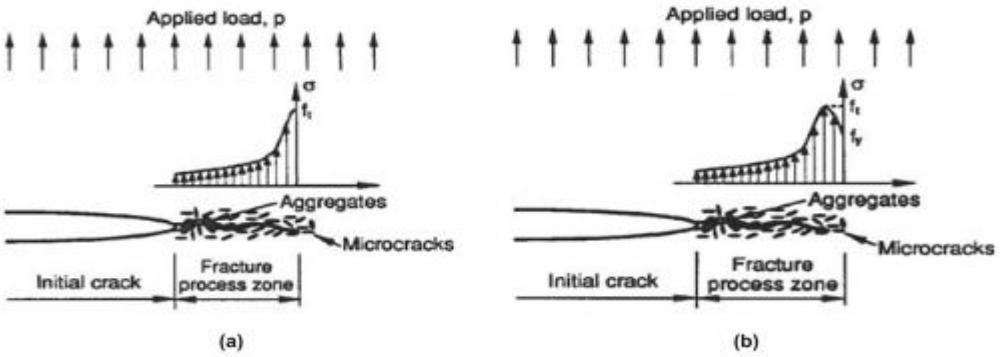

FIGURE-4: Concrete crack and: (a) not including effect of crack-tip micro-cracks, and (b) including effect of crack-tip micro-cracks.

(Source: Chandra Murthy A.R., Palani G.S. and Iyer N. R., fracture analysis of concrete structural components-State-of-the-art review, Sadhana Vol.34, Part 2, April 2009, pp.-345-367)

The tensile strength, ft, should be noted as being distinct from the normal concrete tensile strength determined by doing a typical tensile test. While the latter depends on the material as well as the size, shape, and testing procedure of the tested specimen, the former is regarded as a material fracture parameter. As seen in figure 4(b), the proportional limit fy corresponds to the start of the material's micro-cracks. The normal tensile stress gradually increases from the initial crack tip to its maximum value (the tensile strength of the material) before decreasing to the proportional limit fy at the end of FPZ. This concept of FPZ takes into account the consequences of little cracks that develop before the main crack point.

FRACTURE OF CONCRETE: THEORETICAL WORK

In 1776, Coulomb became the first to study how stones fracture under compression. Galilei (1638) looked on how structure fracture was influenced by size. Griffith came up with the initial theory of fracture energy (1920). According to Griffith's idea, a material's compressive strength is eight times greater than its tensile strength. Later, Irwin (1957) offered an extension of the Griffth theory to a crack of any size and established a crack growth criterion. Additionally, Irwin shown using Westergaard's approach that the quantity K, also known as the stress intensity factor, totally determines the stress field in the vicinity of the crack tip (SIF). Kaplan (1961) used LEFM techniques to apply fracture mechanics to concrete for the first time. Friction between crack faces was first discussed by Clintock & Walsh in 1962. The first attempt to incorporate the cohesive forces at the fracture tip region within the confines of elasticity theory was undertaken by Barenblatt and Dugdale in 1959. In order for the faces to close smoothly, Barenblatt (1959) postulated that cohesive forces operated in a narrow region close to the fracture ends. In general, it is uncertain how these forces are distributed. According to an elastic-perfectly plastic material, the distribution of the closure forces is known and constant for Dugdale (1960). Hillerborg et al. made a significant advancement in concrete fracture (1976). In Hillerborg's (1976) model, the tension softening process zone is accessed through a fictitious crack that extends forward of the existing fracture and whose lips are subject to closing pressures, preventing stress concentration at the extended crack's tip. The results of Walsh (1972, 1976), who examined geometrically comparable notched beams of various diameters, confirmed Kesler et al (1972). they conclusion that the traditional LEFM of acute cracks was insufficient for regular concrete structure. Rice (1968), Smith (1974), Knauss (1973, 1974), Wnuk (1974), Palmer & Rice (1973), and Kfouri & Rice produced models for materials other than concrete that were inspired by the softening and plastic models of FPZ that were first introduced in the works of Barenblatt (1959) and Dugdale (1960). A smeared crack model was developed by Bazant (1976) and Bazant &Cedolin (1979) to simulate concrete cracking. The stresses that close FPZ faces are modelled in this model as a stress-strain softening law, and the crack front is assumed to be composed of a diffuse zone of microcracks. Characteristic lengths were first discussed by Hillerborg et al. in 1976. They are distinct material properties. Initially, the energy brittleness number was presented by Carpinteri (1980) as a criterion for measuring the structural brittleness of concrete. Lattice model numerical modelling of fracture and size effect in plain concrete has undergone extensive research (Hrennikoff 1941; Roelfstra et al 1985; Burt & Dougill 1977;

Herrman et al 1989; Herrman 1991; Schlangen & Van 1991; 1992; Raghuprasad et al 1994; Ince et al 2003; Arslan et al 2002; Karihaloo et al 2003).

The idea of a lattice model is the discretization of a continuum by means of force- and moment-transferring line elements, like bar and beam elements. The benefit of using a lattice model is that the heterogeneity of the material may be simulated or represented by giving each individual lattice member a variable strength or stiffness value. This model also has the advantage of being able to detect microcracks, crack branching, crack tortuosity, and crack bridging.

Hillerborg (1983, 1985) enhanced and customized the cohesive crack model for concrete. The cohesive crack model, also known as the fictitious crack model, predicts a deterministic size effect, as opposed to the Weibull statistical size effect, for the flexural failure of plain concrete beams without notches, according to the results of the finite element analysis. By Petersson, this conclusion was strengthened, and the model was improved (1981). A roughness parameter and fractal dimension were computed by Lange et al. (1993) using image analysis techniques to quantify the texture of fracture surfaces. It was shown that fracture toughness and fracture surface roughness are positively correlated. Sundara Raja Iyengar et al. (1996) used the fictitious crack method to calculate the load deflection diagrams of a notched plain concrete beam subjected to three-point bending while using different types of strain softening, and they concluded that a more realistic relationship needed to be established.

In 1976, an analytical investigation on the size effect brought on by the localization of scattered cracking was started. Later, Bazant developed a straightforward formula for the size effect that captures the size effect for quasi-brittle failures followed by massive stable crack growth and enables the estimation of material fracture parameters from maximum load experiments (1983, 1984). The cohesive crack model can be replaced with the Bazant (1982, 1983) crack band model in a manner that is almost similar. The brittleness of concrete elements can be measured using the Bazant size effect law from 1984. This model has been shown to be practical for programming and to be in good agreement with the fundamental fracture data and size effect data (Bazant 1984; Bazant & Schell 1993; Bazant & Kazemi 1990). The effects of pre-crack, aggregate, and specimen sizes on the fracture of concrete were investigated in experiments carried out by Nallathambi et al. in 1985. To account for all three size dependent effects, a straightforward formula was proposed based on the experimental results. The size effect formula for diagonal shear was refined by Bazant & Sun in 1987. The two areas of improvement were to cover the impact of stirrups on concrete's shear capacity as well as the influence of maximum aggregate size as different from the impact of relative beam size. In the context of the size effect, Bazant (1996) presented three fracture testing techniques, outlining their advantages and limitations.

In 2002a, Appa Rao and Raghu Prasad looked at the fracture characteristics of high strength concrete. With an increase in compressive strength, concrete was shown to become brittle. Furthermore, it was discovered that fracture energy rises when concrete's compressive strength and coarse aggregate maximum sizes rise. Research was done to test the bonding power of the mortar-aggregate interface by Appa Rao and Raghu Prasad (2002b). The mortars showed more strength, but it was found that the interface's binding strength in stress is noticeably low. As the roughness and phase angle of the aggregate surface rise, so does the bond strength of the contact in shear (mode III). Bazant and Yavari (2005) examined at the ideas of energetic statistical scaling and fractal geometry about the size impact. The benefits and disadvantages of using fractals to describe the structural size effect are examined. Design considerations and codal provisions that take the size effect into account were highlighted. The effect of the cracks' tortuosity on various fracture characteristics was examined by Ragu Prasad and Renuka Devi in their 2007 proposal of a modified fictitious crack model for a plain concrete beam with a vertical tortuous crack. Carpinteri et al. (2008) developed the finite fracture mechanics criterion and applied it to structures with acute V-notches. The anticipated values were discovered to be in strong agreement with the experimental findings.

In order to examine crack propagation from fatigue loading, mechanistic approaches that make use of the idea of fracture mechanics have also been put forth. For instance, Perdikaris and Calomino (1987) demonstrated that compliance measurements offer a convenient method for determining the length of the traction-free fracture in specimens of fatigued concrete. Since then, numerous experimental studies on the spread of fatigue cracks in concrete have been published (Baluch et al 1987; Ramsamooj 1994; Stuart 1982; Subramaniam et al 2000; Takashi et al 1999; Toumi & Turatsinze 1998; Slowik et al 1996; Bazant & Xu 1991).

Following a first deceleration stage, the rate of fatigue fracture propagation in concrete reveals an acceleration stage. While the rate of fracture propagation increases steadily up until failure in the acceleration stage, it reduces with increasing crack length in the deceleration stage. They have made an effort to use the fracture mechanics principles to describe the crack growth during the acceleration stage of fatigue crack growth in concrete (Baluch et al 1987; Ramsamooj 1994; Stuart 1982; Subramaniam et al 2000; Takashi et al 1999; Toumi & Turatsinze, 1998; Slowik et al 1996; Bazant & Xu 1991). It has been noted that the Paris law coefficients depend

on the composition of the material, which may help to explain why there are so wide variations in the values of the Paris law coefficients.

FRACTURE MECHANICS IN CONCRETE: EXPERIMENTAL WORK

Nanotechnology is an emerging field of research that has been increasing in the last decade which has a potential impact in several areas including construction. Nano technology has a potential to develop a nano material at nanoscale which is used to partially replace it with cement in concrete. So, this way various nano materials (such as carbon nanotubes (CNTs), nano-SiO2 (NS), nano-Al_2O_3 (NA), graphene oxide (GO), nano-TiO_2 (NT), nano clay (NC), nano-ZnO2 (NZ), nano- $CaCO_3$, and nano-Fe_2O_3 (NF)) are incorporated in concrete to enhance the mechanical and durability properties of concrete on the past research work. Concrete is affected by various durability properties during its lifespan.

Testing notched beam specimens has been used by many to estimate the Mode I fracture toughness of concrete. It has been found that the value of KIc depends on the dimensions of the beam when it is calculated using the measured values of the maximum load, the starting notch length, and using the formulas generated from LEFM. The slow fracture propagation and nonlinearity brought on by geometrical interlock effects are too responsible for this size and geometry dependence. Numerous researchers have conducted studies on the mechanics of fracture in concrete in past; here, some of the recent work on the subject is presented.

NANO CONCRETE:

Muhd Norhasri, M.S. Hamidah, A. Mohd Fadzil,2019 [70] There is growing interest in construction as a result of studies on the use of Ultra High-Performance Concrete (UHPC) customized with nanoparticles. Nano meta clay UHPC mixes were utilized as an ingredient in this study in amounts ranging from 1, 3, 5, 7 and 9 percent of the weight of the cement. In comparison to regular UHPC and metakaolin UHPC, the impact of nano meta clayed UHPC was assessed in terms of its physical, workability, strength, and morphology of the microstructure. MWCNTs were examined by Yu Hu, Danni Luo, Penghui Li, et al.2014 [106] for their impact on cement paste compressive strength and fracture toughness. Various amounts of ordinary MWCNTs or MWCNTs with a carboxyl group (MWCNTs-COOH), ranging from 0% to 0.1% by weight, were added to cement mortars. While compressive strengths did not significantly increase with the addition of common MWCNTs, it was noted that fracture toughness of composites increased. Furthermore, MWCNTs-COOH greatly increased the compressive strengths, fracture toughness, and fracture energy of cement pastes. According to Jing Yu, Min Zhang, Gengying Li, et al. 2020[55], fiber-reinforced high-volume fly ash cement mortar can have its mechanical and fracture properties improved by utilizing nano-silica. They used four PVA fiber volume dosages of 0%, 0.2%, 0.5%, and 1.0% to examine the impact of NS on the fracture and mechanical properties of polyvinyl alcohol (PVA) fiber-reinforced HVFAM with fly-ash/binder ratio fixed at 50% by weight and NS/binder weight ratios of 0%, 0.5%, 1%, and 1.5%. It has been determined that the addition of 0.5 wt% NS could, enhance the brittleness index, critical crack tip opening displacement, fracture energy, fracture toughness, and flexural strength by 3-5%, 8-29%, 17-28%, and 18-38% and 34-95% respectively. Researchers Huiheng Lian, Xinjian Sun, Zhenpeng Yu, et al. 2022[47] investigated the fracture mechanical performance of basalt fiber Nano $CaCO_3$ concrete incorporating contents of Nano $CaCO_3$ (0%, 1.5%, 2.5%, 3.5%, and 3.5% for determining mechanical properties) and BFNCC with various contents of basalt fiber (0%, 0.1%, 0.2%, and 0.3%) for determining fracture mechanical properties. The influence of basalt fiber content on the fracture mechanical properties of BFNCC was systematically investigated, revealing the full-stage fracture damage of BFNCC throughout the failure process. This was done in conjunction with observations of the displacement field and microstructure of the three-point bending specimen with prefabricated notch based on DIC and SEM. It has been discovered that the optimal dosage of nano-$CaCO_3$ for improving concrete's pressure and clearance performance is 2%. NCC's mechanical qualities are significantly reinforced by basalt fiber. The compressive strength, split tensile strength, and flexural strength all increased by 7.15 percent, 15.46 percent, and 9.6 percent accordingly under the BFNCC-0.2% working condition, which also has the best effect. Additionally, it said that the peak load, fracture toughness, and fracture energy of BFNCC are all generally better than the specimen without basalt fiber. The operating condition with the maximum peak load, fracture toughness, and fracture energy is the BFNCC-0.2%.

FIBER REINFORCED CONCRETE:

The [7] study by Andrea Carpinteri, Giovanni Fortese, Camilla Ronchei, et al. 2017 investigated at the fracture behaviors of fiber-reinforced concrete. Fiber content of 0.5% and 2.5% by volume was added to a concrete mix. The author proposed a modified two-parameter model to determine the quasi-brittle material's Mode-I plain-strain fracture toughness. It was noted that the concrete's fracture toughness increased with an increase in the volume fraction of fibers. Additionally, it suggested an equation to compute the increment of fracture toughness for a given kinking angle value and to compute the parameter of concrete's fracture toughness and its evolving fracture toughness by taking crack propagation under pure mode-I loading into consideration. The fracture properties of concrete in mode-I circumstances were studied by Marta Kosior-Kazberuk and Julita Krassowska.2019[71] Concrete was created using two types of cement and basalt fiber that had varying concentrations of 2.0, 4.0, and 8.0 kg/m^3 in place of coarse aggregate by volume. They assess how the basalt fiber content affects the concrete's tensile strength and post-cracking behavior. In a three-point bending test, the fracture characteristics KIc, CTODc, and GF were assessed using a beam with initial notches. It has been determined that adding basalt fibers had a small impact on the strength characteristics but a big impact on the fracture parameter. The mechanical and fractural properties of structural lightweight fiber-reinforced concrete were studied in a study by Jamshid Esmaeili, Mahdi Ghaffarinia, Mehrab Nodehcedi, et al.2022[56]. Between 0 and 1.15 vol% of hooked steel fiber was used in some concrete mixtures. Concrete fracture energy was assessed utilizing a three-point bending test on concrete notched beams that were put through the bending test recommended by Rilem TC 162. Increases in fracture energy and characteristic length have been seen to be about 20 times, respectively. It also finds that important and mentions how using hooked steel fiber allowed for the development of extremely ductile, structural-grade lightweight fiber reinforced concrete.

FLY ASH CONCRETE:

In concrete with fly ash addition, G L Golewski 2018[37] analyses the fracture toughness (in all three modes of cracking) at different fly ash levels (0%, 20%, and 30%). It has been noted that adding fly ash up to 30% of the cement mass improves the concrete's fracture toughness in all modes of cracking. Additionally, it was discovered that composite with a 30% addition of FA had low compressive strength and generalized fracture toughness whereas concrete with a 20% addition of FA is characterized by the most favorable mechanical properties. Grzegorz Ludwik Golewski,2019[38] explains the investigation into determining the ideal amount of fly ash to use in concrete by examining how fractures are measured using various methodologies. By examining the linear and nonlinear characteristics, they added fly ash (0%, 10%, 20%, and 30%) to a concrete mixture. The DIC system, MTS 810 press, and ARAMIS Software were used to calculate these characteristics. It should be emphasized that in this investigation, the concrete with fly ash addition was characterized by regular fracture toughness up to 23%, and above this level, the fracture toughness becomes poor. Additionally, it was discovered that the ideal amount of fly ash addition is 17%, at which point the concrete's fracture toughness value is at its highest and the test results are most evenly dispersed. Additionally, it was discovered that the metrics fcm, KS1c, and CTODc have a qualitative relationship.

SELF COMPACTING CONCRETE:

H. Salehi and M. Mazloom.2018 [72] By considering various w/c ratios, describe analyses the relationship between fracture toughness and compressive strength of self-compacting lightweight concrete (0.37, 0.42, and 0.47). To calculate the fracture toughness of mode I, the size effect approach was used. The fracture toughness and mechanical characteristics of concrete were observed to increase as the w/c ratio decreased. They looked at the critical crack-tip opening displacement (CTODc) improved by 60%, the KI_C of SCLC increased by 56%, and the w/c ratio decreased from 0.47 to 0.37. Using the SEM approach, it also assessed whether there was a reasonable correlation between the SLCC's compressive strength and fracture toughness.

CONCLUSION:

This paper presents a comprehensive review and findings on earlier research studies and current trends in fracture mechanics in concrete. The conclusion based on above studies is summarized below.

1. Recent work mainly focused on modification of concrete by using various materials like fly ash, fiber and nano materials.

2. The properties of concrete in terms of mechanical and durability properties should be improved by partial replacement of cement-based material with nano materials or any other materials which can be reduce the CO_2 emission for sustainable environment.
3. Most of the studies of fracture mechanics in concrete is focused on partial replacement of cement-based material with nano materials and other types of materials to check the fracture properties.
4. There is a great effort applied by various researcher in fracture mechanics in concrete for study about crack resistant capacity of concrete for sustainable construction and maintenance of structure.
5. It was observed based on literature fracture parameter was increase by partial replacement of cement with nano material or other types of materials comparing with normal concrete.

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Coal Gasification as a Cleaner Technology -A Scoping Review On Technology, Process and Environment Issues

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Abstract. Coal gasification for various types of fuel production can perform an essential strategic requirement in those emergent countries where coal is the primary fuel resource and oil and gas energy security is a problem. Coal gasification is accepted as a cleaner technology compared with the conventional method of power generation, hydrogen, methanol, and other liquid fluids. This paper presents a review of current research carried out on coal gasification technologies, gasifier performance, and environment-related issues.

INTRODUCTION

The gasification technology is now marching towards development with a history that dates back to the 1800s. In the year 1887, LURGI GmbH registered first patent in Germany. Later, coal gasification technology was used to supply “Town gas” for streetlights in both Europe and the United States. Coal gasification technology have come up for the downstream applications for production of various chemicals like ethanol, methanol, olefins, etc., and combined cycle power generation globally. Selection parameter for coal gasification depends upon the physical and chemical properties of coal and the end process product required from the coal gasification process. Various products can be produced based on coal gasification technology.

Produced syngas from Coal gasification can be use in producing liquid fuel (methanol & ethanol), ammonia for fertilizers,Synthetic Natural Gas (SNG) and petrochemicals. These products will facilitate movement towards independenceunder Atmanirbhar Bharat Abhiyaan. In line with the above purpose, the Ministry of Coal has taken project for utilize coal through coal gasification, and as such this National Coal Gasification Mission [1] has been prepared to achieve 100 MT coal gasifications by the year 2030.

Gasification is a conversion process that converts any carbon-containing material, coal for example, into synthesis gas. Carbon reacts with water in the form of steam and oxygen at comparatively high pressure morethan 30 bar, and at temperaturereach up to 1500 K for production of syngas, a mixture of carbon monoxide and hydrogen and some minor byproducts. The byproducts are removed to produce clean syngas that can be used as a fuel to generate electric energy or steam, as a basic chemical building block for a large number of uses in the petrochemical and refining units, and for the production of hydrogen. Gasification is important for lowor negative-value feedstocks by converting them to viable fuels and products. In the study of Ronald W. Breault [2], the historical development of gasification has been discussed along with the comparison with the combustion process. The hydrodynamics and kinetics of different types of gasifiers are also presented along with the most likely gas composition from each of the

technologies when using a variety of fuels under different conditions from the air blown to oxygen blown and atmospheric pressure to several atmospheres.

GASIFICATION CHEMISTRY

Gasification is defined as a process of thermo chemical conversion of carbonaceous material (biomass or solid fuel) to an energy gas (syngas), through partial oxidation with air, oxygen, and/or steam at high temperatures. The composition of the syngas always consists of a mixture of hydrogen (H2), carbon monoxide (CO), methane (CH4), water (H2O), other hydrocarbons, inert gases, soot, tar, and ashes [3].

National Energy Technology Laboratory [4] working under the Department of Energy in the United States of America represents gasification technologies and also explained different types of gasifiers developed in the Energy field. The gasificationchemistry is very complex and is accomplished through a number of physical transformations and chemical reactions within the gasifier. In a gasifier, the carbonaceous feedstock undergoes a number of different processes and/or reactions:

- Dehydration – Any free water element of the feedstock evaporates, leaving dry material and evolving water vapor which may enter into afterward chemical reactions.
- Pyrolysis – This occurs as the feedstock opens to rising temperature in the gasifier. Devolatization and breaking of the weaker chemical bonds occurs, releasing volatile gases such asmethane, tar vapors, and hydrogen, along with heavy char which will undertake gasification reactions.
- Combustion – The volatile products and some of the char react with partial oxygen to form carbon dioxide (CO_2), carbon monoxide (CO), in such a way it provides the heat needed for succeeding gasification reactions.
- Gasification – The remaining char reacts with CO2 and steam to generate CO and hydrogen (H2).
- Water-gas-shift and methanation – These are separate reversible gas phase reactions taking place simultaneously based on gasifier conditions. These are negligible reactions which play a small role within in the gasifier. For required product, the syngas may experience further water-gas shift and methanation processing downstream from the gasifiers.

Gasification reactions are reversible in nature. Theconversionand direction of the reaction are subjected to the constraints of thermodynamic equilibrium and reaction kinetics. The combustion reactions basically go to completion (to the right).

$$C + ½\ O_2 \rightarrow CO \quad \text{--- (-111 MJ/kmol)}$$
$$CO + ½\ O_2 \rightarrow CO_2 \text{ ---(-283 MJ/kmol)}$$
$$H_2 + ½\ O_2 \rightarrow H_2O \text{--- (-242 MJ/kmol)}$$

The thermodynamic equilibrium of the gasification reactions arecomparatively well defined and collectively impose a strongly effect thermal efficiency and the produced syngas composition of a gasification process.

$$CO + H_2O \leftrightarrow CO_2 + H_2 \quad \text{Water-Gas-Shift Reaction" (-41 MJ/kmol)}$$
$$CH_4 + H_2O \leftrightarrow CO_2 + 3\ H_2 \quad \text{Steam-Methane-Reforming Reaction" (+206 MJ/kmol)}$$

GASIFIER CONFIGURATION

P.Rannditsheni et al.[5] represented a detailed review on coal gasification as part of the transition in SA thermal coal power generation. A gasifier is the most important device for the process of coal gasification, as it is where all the changes of coal to gas occur and the type of gasifier used influences the final gas produced. There are mainly three types of gasifiers, namely, the bubbling gasifier, commonly known as fixed bed gasifier, fluidized bed gasifier, and entrained flow gasifier. Each type offers a diversity of merits and demerits, deciding which to use depends on the desired product, (Fig.1) shows the above-stated gasifier types and fluid movement in each**.**

The bubbling gasifier or fixed bed gasifier is the oldest technologyin the gasification process, opposing to its name fixed the fluid within the gasifier moves due to gravity flow. The gasifying agent is introduced at the bottom of the component at high temperatures, while the coal is added at the top of the gasifier, this design results in the maximum heat economy where the conditions of low temperatures and oxygen at the top result in gas with a high

composition of methane, therefore, a higher heating value. However, the gasifier is limited to a specific feedstock as it is incapable to process coal with a moisture content greater than 35% as these cracking coals tend to swell when heated and lead to mal distribution further causing process failure.

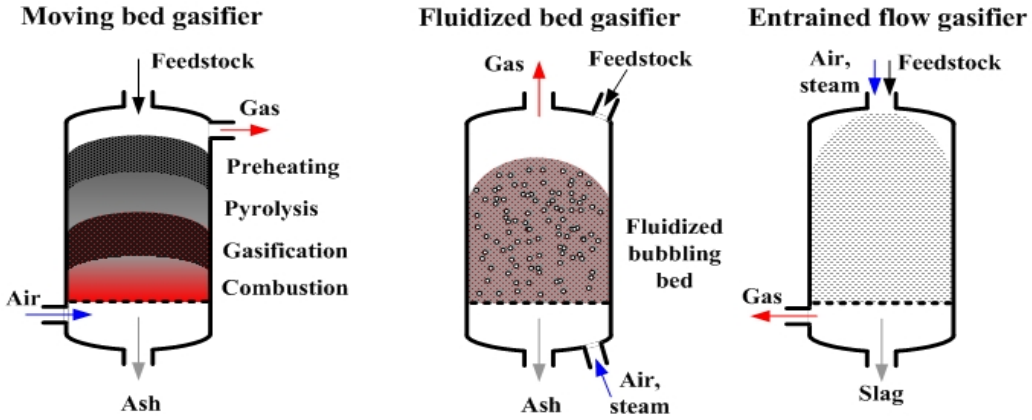

Figure 1. Types of Coal Gasifiers[5]

Entrained flow gasifier offers extreme mixing of the coal and gasifying agents as the gasifier maintains uniform values in temperature and coal mass. This allows the system to use a range of coals including cracking coals, however, the configuration of the gasifier affects the carbon conversion during gasification, and till date the best existing fluid bed has a carbon conversion of 97% which is much lower than the other bed each at 99% carbon conversion. The advantage of the entrained bed is that it can handle any coal feedstock while producing clean tar-free gas. However, this comes at a cost of more coal preparation work and very high oxygen consumption. Although these gasifiers work in a different way the general working principle is the same.

PERFORMANCE ANALYSIS OF COAL GASIFIER

Coal is an economic source of energy but not a consistent source as it results in high CO_2 emissions. Power plants are likely to decrease CO_2 emissions to stop global warming. Coal gasification is a process that reduces CO_2 emissions and introduces as a cleaner coal technology. The coal gasification process is controlled by several operating parameters. A Number of experiments have been carried out to improve gasification efficiency. A critical review of the work done by several researchers in the field of coal gasification has been presented by Akanksha Mishra et al [6]. The effect of several operating parameters such as coal rank, temperature, pressure, porosity, reaction time, and catalyst on gasification has been presented as follows:

- Carbon conversion increases with an increase in reaction time irrespective of different operating atmospheres.
- With increase temperature, gasification rate also increase.
- Pressure also affects the gasification process but still its relationship not been found.
- High rank coals are less reactive then low rank coal.
- Porosity of char controls the gasification reaction rate although it is not a controlling factor for highly reactive chars.
- Percentage of catalyst effects the reactivity of char i.e., reactivity increases with increasing catalyst percentage up to a certain limit beyond that it is not significant. The rank of coal controls the catalytic reactivity.

SNG production based on coal gasification starts with the gasification of coal to generate crude syngas implying that coal rank and gasification technology would have a significant impact on the process efficiency and quality of product. In research by Jingpeng Zhang et al [7] a series of coal-based SNG processes with different coal ranks and gasification technologies were investigated and analyzed based on rigorous process modeling and simulation. Sensitivity analysis was carried out to optimize key parameters and explore their effects on process performance.

The results indicate that the low-rank coal with the Lurgi gasifier could effectively improve the energy conversion efficiency when compared with various combinations of coal ranks and gasification technologies.

The lignite coal with the Lurgi gasifier could improve the energy efficiency by up to 61% with a Wobbe index of 52 MJ/m3, a carbon yield of 44%, and a minimum CO_2 emission of 3.5 kgCO_2/kg-SNG. The economic analysis suggests that the total equipment investment for the process based on lignite is 20% and 27% lower than that based on bituminous and anthracite, respectively. However, the Lurgi gasifier could save 12% on equipment investment compared with the Texaco gasifier when the process is based on the same coal rank. The research provided quantitative direction for the design and optimization of coal-based SNG processes.

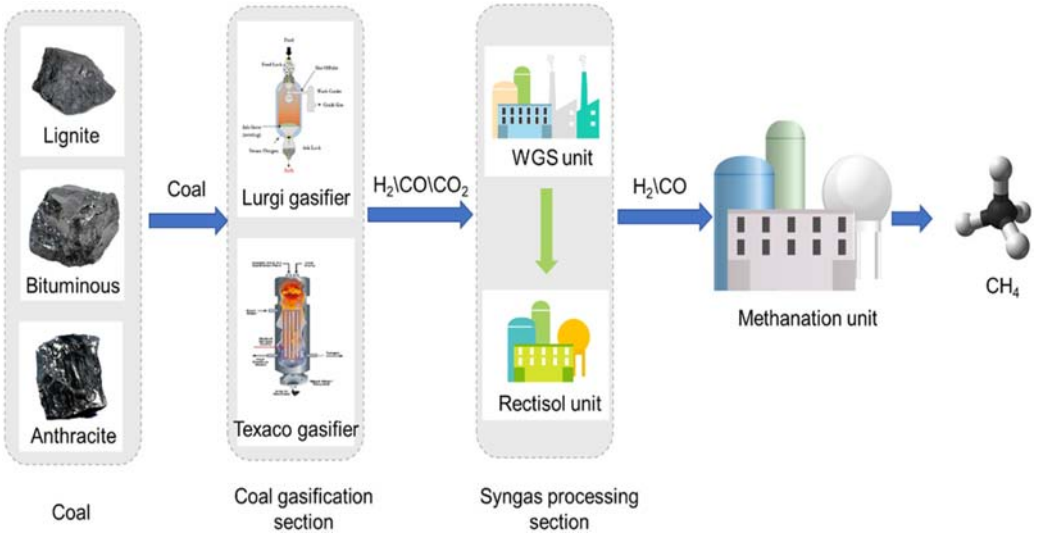

Figure 2. – Flow Sheet of Coal-Based SNG Process [7]

According to the research of Alka D. Kambleet al.[8] Co-gasification of coal and biomass is rising as potential clean fuel technology to attain high thermodynamic efficiency with relatively low CO_2 emission. Coal and biomass have been exclusively gasified for more than a century to obtain gas–liquid fuels and the production of chemicals. Co-gasification has higher efficiency than solitary coal gasification because the cellulose, hemicelluloses, and lignin content of biomass help to ignite and enhance the rate of gasification. It is suggested that extensive research on carbon reactivity patterns, heat release, reaction kinetics, etc. may support reducing the uncertainties in the co-gasification performance of coal and biomass blends, particularly in India. The prospects of co-gasification technology in the Indian context have been discussed considering the great quantity of varieties of coal and biomass. The appropriateness of existing gasifier procedures and their limitations with working parameters like feed rate, temperature, agglomeration intensity, residence time, density optimization, , the tar formation, and techno-economics involved are described.

DESIGN AND OPTIMIZATION OF COAL GASIFIER TECHNOLOGY

The coal technology that has progressively more attracted attention in recent years is the gasification of coal to produce hydrogen. Coal gasification may offer a greater potential for CO_2 sequestration, for reduction of other pollutants such as NO_x and SO_x, and also for conventional electricity generation than other hydrogen production processes. When a water gas shift (WGS) reaction is carried out in two adiabatic reactors, a low-temperature shift (LTS) reactor and a high-temperature shift (HTS) reactor in series, H_2 purity increases. Apart from HTS and LTS reactors, a high-performance catalyst with stability in the presence of sulfur impurities is also important for the production of hydrogen in the coal gasification system.

In the research of Yun Ju Lee et al.[9], the conceptual design of a coal gasification system for the production of hydrogen was undertaken using the PRO-II Simulation program. The working conditions for the gasifier were tuned to between 1200ºC to 1,500ºC, 15atm- 30atm, and to a feed molar ratio of $C:H_2O:O_2$=1:0.5-1:025-0.5. The refinery temperature and pressure were kept at 550 C and 24.5 atm. The syngas produced goes to water gas shift (WGS) reactors operated at temperature 400ºC, pressure 24 atm-HTS, and at temperature 250ºC, pressure 23.5 atm-LTS. It is observed that the production of hydrogen was found to be independent of the concentration of steam in the feed as gasifying agent. However, when other operating conditions are constant, the hydrogen output changes dramatically with changes to the concentration of O_2 in the feed. In this research optimized operating conditions for the production of hydrogen by the gasification of Drayton coal were found to be: 1500ºC, 25 atm, and a feed ratio $C:H_2O: O_2$ = 1:0.58:0.43.

Gasification processes with complex reaction systems typically involve stable operating conditions. However, variations in feedstock flow, the composition of the feedstock, and environmental factors, as well as other factors, may cause abnormal operating conditions. In the research work of Zhikai Cao et al.[10] proposed a novel systems modeling and analysis method by combining computational fluid dynamics (CFD) and process simulation for the Shell pulverized coal gasifier. The projected method considers the Shell pulverized coal entrained-flow gasifier with two parts: a gasification core zone and a heat exchange and water gas shift zone. High-fidelity CFD models of gasification core zone are developed to obtain characteristics of the flow field, temperature field, and composition profiles within the gasification core zone. An equation-oriented process simulation model is further developed for the heat exchange & water gas shift zone. The proposed hybrid method was validated by comparing it with industrial operating data. Three cases of abnormal operating conditions were further investigated with the proposed hybrid model. The most important factors that influence the process operability were found to be the characteristics of gas and particle hydrodynamic behaviors of the inner layer of the gasification core zone.

Methanol is an important feedstock and it is mainly produced by coal route the coal-to-methanol suffers from serious CO_2emissions .In the study of Dong Xiang et al [11] a novel coal-to-methanol process integrated with coke-oven gas chemical looping hydrogen and chemical looping air separation was designed and analyzed to improve carbon utilization efficiency, methanol production, and reduce CO_2 emissions.

The major benefit of the novel process is that the integration between coal gasification and chemical looping technology can eliminate the water gas shift unit and reduce fuel consumption. To produce one-tonne methanol, the coal consumption is 1.45 tonne for the coal-to-methanol, while the coal consumption for the novel process is reduced to 0.75 tonnes at the cost of additional 0.35-tonne coke-oven gas under optimized operating conditions. By parameter optimization and process integration, the carbon utilization of the novel process is increased from 38.4% to 56.1%, and the CO2 generation of the novel process is therefore reduced from 1.47 to 0.71 kmol/kmol methanol. The novel process also possesses quite large prospects in terms of economic performance.

Robert Mota et al[12] described an experimental and computational fluid dynamics (CFD) effort toward optimizing: hydrogen-rich syngas production and cold gas efficiencies during the thermochemical conversion of lignite coal using oxygen and steam as gasifying agents. A bubbling bed gasifier was systematically designed, constructed, and commissioned to achieve these objectives. The bed temperature was maintained at 1023 K during the gasification testing of the highly reactive lignite coal. The hydrogen levels in the syngas were examined as a function of oxygen, coal, and steam flow rates. A maximum hydrogen concentration of 50% (dry-basis) was achieved at low oxygen to carbon ratios and the cold gas efficiencies were in the range of 80-90%. The observed experimental trends in syngas compositions and cold gas efficiencies were reasonably well represented by the CFD simulations and compared favorably with data obtained from a transport reactor integrated gasification system. Simulations predicted that the major product gases at the reactor outlet were close to their equilibrium levels. The decrease in hydrogen concentrations in the syngas at high oxygen and steam flow rates resulted from changes in the oxidation reaction rates, hydrodynamics, and steam levels. The levels of steam were attaining saturation conditions.

ENVIRONMENTAL IMPACTS OF THE GASIFICATION PROCESSES

In the study of D. Vamvuka[13] on the Environmental Impacts of Coal utilization on the Ecosystem, various aspects of emissions of pollutants linked with coal combustion and conversion facilities have been discussed. It reviews the key impacts on the environment, health, and safety from coal processing and utilization and describes briefly the control technologies and protective strategies applied, to mitigate the dangerous effects of these activities.

ENVIRONMENT POLLUTION

With the increase in the global use of coal, as a source of energy, may be expected to make worse certain environmental, health and safety problems. Despite of the conversion process (combustion, gasification, or liquefaction), large amounts of pollutants will be emitted, the nature of which will be determined both by the characteristics of the fuel and the process conditionsinvolved. Such pollutants include various gases (No_x,Co_x, So_x, CH, etc.), tar, soot, ash, much different liquid and solid wastes, as well as toxic polycyclic aromatic hydrocarbons and trace components.

AIR POLLUTION

Compared to a coal combustion plant, a gasification plant generatesfewer amounts of the traditional air pollutants, such as Co_x, So_x, No_x, and hydrocarbons. The well-known gaseous effluents of coal gasification facilities consist of H_2S, COS, SO_2, and NH_3, among the secondary air pollutants, which occur in gaseous streams in gasification units, the most important ones are sulfur compounds, reduced nitrogen compounds, and trace elements.

A wide variety of toxic trace elements, such as Hg, As, P_b, C_d, and Se, have appreciable volatility, under the high-temperature conditions present in gasification. Among pollutant gases exhausted by coal plants, environmentally the most dangerous are acid gases, i.e. So_x, NO_x from coal combustion, and H_2S from coal gasification and liquefaction. These gases are extremely toxic, even when diluted to concentrations deemed safe for short exposures.

WATER POLLUTION

The major liquid waste streams in coal gasification aplantincludes gas liquors process condensate blow down and raw gas and ash quench water. This processgenerates high concentration of tars, oils, phenols, naphthas, cresols, sulfur, and nitrogen compounds (mainly hydrogen sulfide, ammonia, and hydrogen cyanide), particulate matter, and dissolved solids. Also, various other compounds, such as fluorides, sulfates, and chlorides, which build up in reuse systems, call for careful consideration. Water discharged into natural water resources like rivers or lakes, after use in the cooling systems of the plants, has two potential ecological effects. First, the return of water used for direct cooling raises the temperature of the receiving waters, altering their nature as a habitat, and second, the water returned from evaporative cooling systems, though creating less thermal pollution, mainly contains twice the initial salt concentration. Because wastewater dilution, treatment, and recycling appear to be mandatory for coal utilization facilities, releases of toxic effluents causing immediate death to fish and other aquatic organisms probably will not occur, of possible concern however are chronic, sub-acute stresses.

CONTAMINATION OF GROUND

From coal gasification about 10 to 30% of supplied coal volume is generated as solid waste. The range of these wastes includes bottom ash and fly ash.It also includes carbonaceous char or residue, that can be burned, gasified, or used for activated carbon, but will ultimately require disposal. Other solid wastes include high concentrations of Hg, Se, As and other elements, and spent activated carbon. It must be noticed, that the major differences between the ash from gasification processes and from combustion are expected to be the presence of organic matter in residues from coal conversion and the existence of the elements in a reduced, rather than oxidized form. The method of treating these residues before disposal is very much essential to prevent land pollution.

ASSESSMENT METHODS OF THE ENVIRONMENTAL IMPACT

Coal gasification technology is a better technology because of the low cost for the removal of CO_2 compared to conventional energy systems rooted in direct coal combustion Coal gasification technology is an integrated way that produces electricity, chemical products, fertilizer, etc. It also includes hydrogen, methanol, and liquid fuel such as diesel, etc. It is the most significant technology for the production of hydrogen economy as coal gasification is a dominant way to produce hydrogen gas coal gasification has a scope and demand in India. However, harmful gases which are produced at different stages of coal gasification affect the environment. Thus, it is important to assess the environmental impact of these gases. Life cycle analysis (LCA) is a method used for evaluation of the impact on the environment It is a process to quantify the greenhouse gas emission and fossil energy consumption systematically.

CONCLUSION

This paper presents a review of the literature on coal gasification technologies. The main three types of gasifiers fluidized fixed bed, fixed bed, and Entrained flow were discussed. The effect of various operating parameters such as coal rank, temperature, pressure, porosity, reaction time, and catalyst on the performance of coal gasification is also presented. The gasification of coal is seen as a promising technology for clean development, allowing greater economic, social, and environmental sustainability.

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Head Motion Controlled Smart Wheelchair

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Abstract: As we know that some mass of population of this world is suffering from full or partial disability and they need medical gadgets in order to live their life normally , but these gadgets are costly and also it is difficult for quadriplegics people to use these gadgets. So we go for planning a financially effective and easy to use wheelchair. Traditional wheelchairs have certain limitations like heavy weight, limited functions, and dependability on third person. In our wheelchair control system is divided into transmitter side and receiver side, node MCU and arduino UNO is being used to transmit and receive signal via Wi-fi. And Accelerometer is used to give appropriate tilt position of head according to the direction given by head, wheelchair moves in LEFT, RIGHT,FRONT, and BACK with the aid of DC motors. In additionally we have introduced infrared sensor and buzzer in order to detect any hurdle in patient's path.

Keywords: DC Motor Driver, Arduino UNO, Node MCU, Infrared Sensor, Accelerometer.

INTRODUCTION

Regular growing technology has become a significant part of our lives. Futhermore, advanced technologies are taking the market in bulk and the people are getting used to them in no time. In our project we have attempted our best to correlate the technology and patient's comfort while keeping the cost minimal. This project is designed for physically challenged people who can't utilize their hand to drag the wheels of the wheelchair. In this system we have used head motion to recognise the motion of the user for controlling the direction of wheelchair. The prototype of this wheelchair is built on Node MCU, as one the best feature of it is that it can be connected via Wi-Fi reducing the complex connections and therefore overall cost.

The objective of this study is to build a smart appliance flexible to most electric wheelchairs currently in use , with an easy to use control interface and a semi-autonomous control system.

EXISTING SYSTEM

Traditional wheelchairs are utilized by physically disabled person for transportation system. A few sorts of smart wheelchairs are available in market which depends on motion, eye position, voice controlled , but this type of wheelchair can't be used in crowded place due to it recognize numerous number of voices.

- **Disadvantages of Existing system are:**

- **Eye Position:** The capturing of eye ball movement is not accurately done by the system and also it is time taking, the person should concentrate in a particular direction continuously which increases the stress level of eye.

- **Voice Based:** These types of Wheelchairs are trained for the voice of an individual person and sometimes that person is not the patient itself so it creates problem for the patient and second drawback is that it can't be used in crowded place. These types of wheelchairs are major threat to patients is someone else's voice frequency matches with the patient's voice frequency.

- **Joystick Based:** High concentration needed and effort to move the joystick. The cost of repairing and maintaining power wheelchair can be higher than a normal wheelchair and difficult to move. The rapid movement given to the joystick will make the joystick weak and broken.

PROPOSED WORK

The wheelchair operates with head movement, taking motion as an input through accelerometer for the movement of wheelchair in a particular direction.
Output of accelerometer is fed in the transmitter side of Node MCU which is connected via wi-fi through receiver side, further receiver node MCU here act as microcontroller,based on the program it takes decision about motion and directs the motor driver accordingly.

BLOCK DIAGRAM

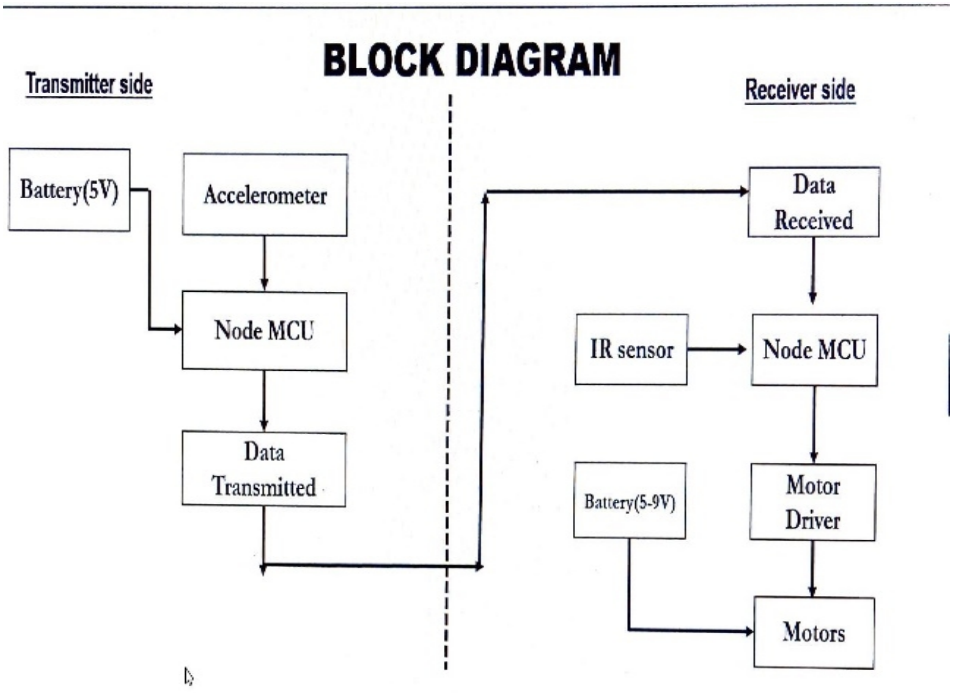

FIGURE 1: Block Diagram

- **Accelerometer:** Here accelerometer works as sensing element, in this, microcontroller unit makes decision based on the tilt position of accelerometer and allows motor driver to move motors in the particular directions.

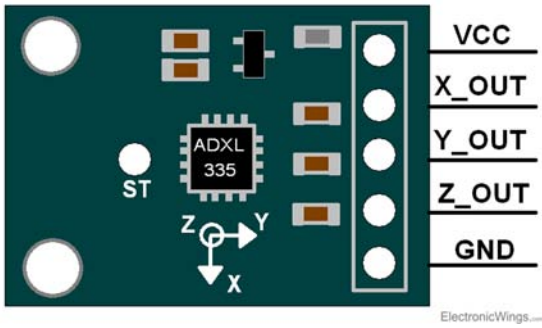

FIGURE 2: Accelerometer

- **Node MCU:** The NodeMcu is used where we need an open source software and hardware development environment it is built as a low-cost System-on-a-Chip (SoC) labelled as ESP8266. The term "NodeMCU" is made up of "node" and "MCU" (micro-controller unit). This hardware typically used in a circuit board functioning as a dual-in-line- package (DIP) which incorporates a USB controller with a smaller surface attached board encompassing the antenna and MCU.

FIGURE 3: Node MCU

- **Arduino Platform:** Arduino UNO is a 14 pin (digital input/output pin) microcontroller based on ATmega 328P.It has 16 MHz quartz crystal, a power jack, a USB connection, an ICSP header and a reset button. It comprises of everything required to support the microcontroller; merely connect the arduino to a computer via a USB cable or also can provide power to arduino by a AC-to- DC adapter or battery to get started. We can fiddle with our arduino uno without worrying too much about doing anything wrong, worst case scenario you can substitute the chip for few money and you are ready to start again.The arduino is a great platform for constructing the devices that can sense and govern the physical world. IOT is one of the great example of implementation of arduino.

FIGURE 4: Arduino UNO

- **Voltage Regulator (7805)**:IC7805 is a voltage regulator combined circuit. The voltage regulator IC keeps the output voltage at a constant value. It provides +5V regulated power supply. The IC7805 arrangement of three terminals controllers is accessible with a few fixed output voltages making them helpful in wide scope of utilization.The voltages accessible enable these controllers to be utilized in rationale framework, instrumentation, and other strong state electronic hardware.

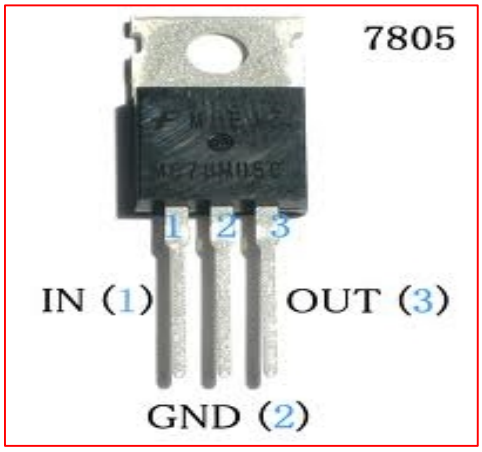

FIGURE 5: Voltage Regulator

- **DC Motor:** It is a inexpensive DC motor appropriate for most robotic and general applications. It has a output shaft with a hole for easy mounting of wheels or pulleys.
  It's specifications are:
  Stall Current: 500-600 mA
  Input Voltage: 6-12 V
  Shaft length: 2.4 cm

FIGURE 6: DC Motor

- **Motor Driver:** The L293 and L293D are quadruple high-current half-H drivers. It is intended to provide bidirectional drive currents of upto 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V.

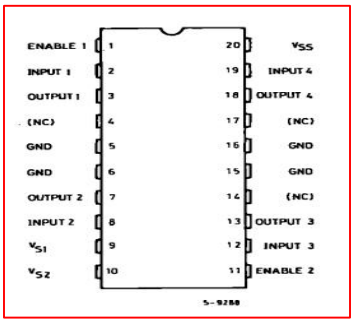

FIGURE 7: L293D Motor Driver

- **IR Sensor:** An infrared sensor is an electronic device, its feature is that it emits in order to sense some characteristics of the surroundings.
  This sensor can amount the temperature of any object as well as senses the motion. IR sensors deals only infrared radiation, rather than radiating it that is known as a passive IR sensor. The Passive Infrared (PIR) sensor is used to sense the presence of any human.

FIGURE 8: IR Sensor

- **General Constraints:** The sensors used shouldn't fluctuate a lot and they should be located appropriately in order to get the accurate measurement. Proper Wi-Fi connection should be offered since the treated data is directed to cloud and a trigger is generated for email/sms. PC should be accessible to user to switch on/off the activate conditions.

HARDWARE REQUIREMENTS

- NodeMCU
- Arduino UNO
- Accelerometer
- DC Motor
- Motor Driver(L293D)
- Voltage Regulator(7805)
- Battery(9V)
- Capactior
- IR Sensor
- Buzzer
- Laptop Configuration

SOFTWARE REQUIREMENTS

- Arduino IDE Software: The Arduino Integrated Development Environment or Arduino Software (IDE) comprises of a text editor for writing code, a message area,a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.
  Programs written using ArduiNO Software are called sketches.

- **Performance Requirements:** The system necessitates constant internet access.

WORKING

The feature of its working is given below.
Step 1: During the immobile position the variations along the x, y and z direction will be zero so during stationary position wheel chair will not move.
Step 2: During the lean of the head in the up state. The x-axis of the accelerometer will change in positive direction so our wheel chair will start moving in the backward direction.
Step 3: During the lean of head in the down state. The x-axis of the accelerometer will change in negative direction so our wheel chair will start moving in the forward direction.
Step 4: During the lean of head in the left direction. The y-axis of the accelerometer will be change in negative direction so our wheel chair will move in the left direction.
Step 5: During the lean of head in the right direction. The y-axis of the accelerometer will be change in positive direction so our wheel chair will move in the right direction.
Step 6: Now, when we tilt head 90 Degree in right or left direction then the z-axis of the accelerometer will move in respective positive or negative direction .
Step 7: After taking input signal from the tilt position, accelerometer feed information to transmitter side of NodeMCU, and transmitter feed this information to receiver side of Node MCU .
Step 8: As we have already programmed the Node MCU for motions described above ,so it can decide accordingly that which motion is going to take place according to tilt position and gives signal to motor driver for further action.
Step 9: IR sensor is also connected and it's programming is done to make alarm when any obstacle comes in wheelchair's path.

RESULT AND OUTCOME

All programming is done through Arduino IDE software. This wheelchair is made for physically disabled person who can not use their hand and leg to move their wheelchair. By the help of this wheelchair patient may not feel need of any companion to operate their wheelchair. This can further modified in future.

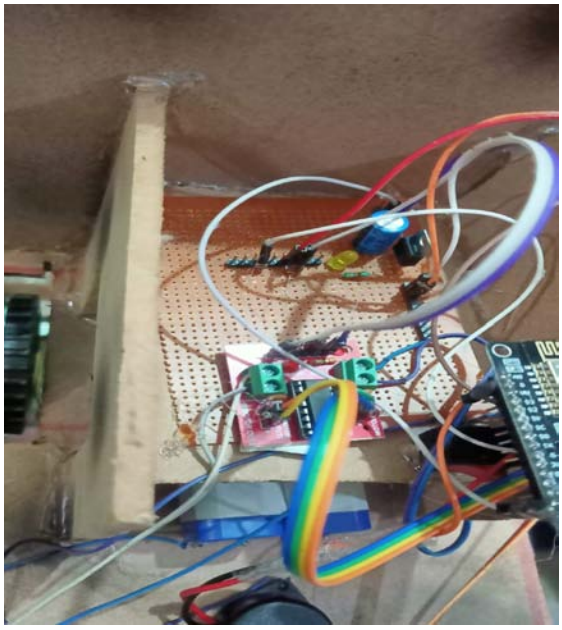

FIGURE 9: Prototype of wheelchair

FIGURE 10 : Prototype of Transmitter

FUTURE SCOPE

- We can implant GSM in to the present work to encompass its feature such as sending messages during emergency.
- Instead of accelerometer, other sensors can be used like optical sensor to detect movement of retina and direct wheelchair accordingly.

- On road driving other parameters are also need to be taken in effect like speed regulation .
- In this voice command feature can also be included.
- Can also be driven through Raspberry pi instead of node MCU and arduino UNO.
- Researches are going on to make wheelchair run according to waves received by nervous system.
- Can be used in hospital Bed Control.
- Can be used in Robotic Arm Control.
- Further it can be used in Self Controlled Humanoids.
- In future this technology can be used in Gesture Controlled Cars .

CONCLUSION

The head motion based wheelchair is designed with the help of node MCU and arduino UNO. All control system is divided into two parts that is transmitter side and receiver , both the sides were successful in completing their tasks. This wheelchair is developed to make the paralysed patients move with ease without depending on others. In the present work the wireless system is successfully developed to move the wheelchair in various directions and other feature of obstacle detection is also implemented successfully.

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CDM Modeling for Fatigue Life of a Neoprene Rubber Sandwiched with Bidirectional Carbon Fabric

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Abstract: The purpose of this paper is to investigate the fatigue behaviour of rubber composite using dumb-bell test specimens under uniaxial loading. The material used is neoprene rubber sandwiched with bidirectional carbon fabric. Fatigue tests are conducted under the displacement controlled condition with a sine waveform of 0.1 Hz and the load ratio of zero. In modeling fatigue damage behaviour, a continuum damage model is presented based on the function of the strain range under the cyclic loading. The Ogden strain energy potential is used to define the constitutive relation of the neoprene rubber. A good agreement is obtained between fatigue experimental data and theoretical predictions. Fatigue analysis and lifetime evaluation are very important in design to ensure the safety and reliability of rubber components. The design of rubber against fatigue failure is an important topic that must be considered for safety during operation.

Keywords: *Fatigue Life, Modeling, Elastomer, Rubber, Bidirectional*

INTRODUCTION

Rubber as an engineering material is used in many industries, such as the automotive industry and in a wide range of applications, including engine mountings, tires, vibration isolators, seals, hoses, belts, impact bumpers, medical devices and structural bearings. Rubber is an ideal material for many applications because it can withstand very large strains with no permanent deformation or fracture. The earliest Fatigue Damage Model based on CDM is proposed by Chaboche. In recent years, there has been increasing interest in the fatigue life prediction of the rubber parts because it is essential for extension of the warranty period of automotive components. The design of rubber parts versus fatigue failure is important in preventing damage or failure during operation.

Fatigue life prediction in rubber is still limited, in comparison to the fatigue behaviors of linear materials (metals and ceramics) and despite the increasing application of rubber in industry. Fatigue life research for elastomeric materials is at an early stage, because of the complex reactions among polymers, fillers, softeners and other additives. Most studies in this field concern the growth of a pre-cracked specimen based on fracture mechanics, but there has been little discussion about fatigue crack initiation in un-pre-cracked specimens.

MODELING USING CONTINUUM DAMAGE MECHANICS THEORY

In this study, the mechanical behavior of the material is defined by the Ogden model. The experimental methodology for determining the material properties is presented here using uniaxial stress-strain data. In the following, the Ogden model is presented and reformulated in terms of the uniaxial stress-strain relation. The relation of the Ogden strain energy potential is given by:

$$U = \sum_{i=1}^{n} \frac{2\mu_i}{\alpha_i^2} \left(\bar{\lambda}_1^{\alpha_i} + \bar{\lambda}_2^{\alpha_i} + \bar{\lambda}_3^{\alpha_i} - 3 \right) + \sum_{i=1}^{n} \frac{1}{D_i} (J - 1)^{2i}$$

....…….(1)

Where,

$\bar{\lambda}_i = J^{-1/3}\lambda_i$, $J = \lambda_1 \lambda_2 \lambda_3$ *and* λ_i = the principal stretches.

J = the Jacobean determinant.

n = the number of terms in the series.

μ_i *a* α_i = the shear behavior of the material (constants).

D_i = the compressibility.

When the material is assumed to be incompressible,

$$J = \lambda_1 \lambda_2 \lambda_3 = 1 \quad \text{……(2)}$$

In the uniaxial stress state, the principal stretches in the uniaxial loading condition are presented by:

$$\lambda_1 = \lambda_U , \lambda_2 = \lambda_3 = \frac{1}{\sqrt{\lambda_U}} \quad \text{…….(3)}$$

Where,

λ_U = the stretch in the loading direction.

λ_2 *a* λ_3 = the principal stretches on the planes perpendicular to the loading direction.

The stretch ratio is described as the ratio of the extended length of a specimen to the original length. Therefore, the nominal strain can be defined based on the principal stretch ratio as :

$$\varepsilon_U = \lambda_U - 1 \quad \text{…...……..(4)}$$

To determine the stress and strain relation under uniaxial tension, the uniaxial nominal stress ($\boldsymbol{\sigma_U}$) can be considered as follows.

$$\boldsymbol{\sigma_U = \frac{\partial}{\partial \lambda_U}} \quad \text{…...……..(5)}$$

Using the Ogden strain energy potential of order 1 (n = 1), the strain energy potential (U) for the uniaxial stress state can be obtained in the form of:

$$\boldsymbol{U = \frac{2\mu_1}{\alpha_1^2}\left(\lambda_U^{\alpha_1} + 2\lambda_U^{-\alpha_1/2} - 3\right)} \quad \text{…...……..(6)}$$

By substituting equation (3),

$$\boldsymbol{U = \frac{2\mu_1}{\alpha_1^2}\left[(1+\varepsilon_U)^{\alpha_1} + 2(1+\varepsilon_U)^{-\alpha_1/2} - 3\right]} \quad \text{…...……..(7)}$$

Therefore, the nominal stress and strain relation under uniaxial tension ($\boldsymbol{\sigma_U}$) will be defined as:

$$\boldsymbol{\sigma_U} = \frac{\boldsymbol{2\mu_1}}{\boldsymbol{\alpha_1}}\left[(\boldsymbol{\lambda_U})^{(\boldsymbol{\alpha_1-1})} - (\boldsymbol{\lambda_U})^{-(\frac{\boldsymbol{\alpha_1}}{\boldsymbol{2}}+\boldsymbol{1})}\right] \quad \text{…...……..(8)}$$

By substituting equation (3),

$$\boldsymbol{\sigma_U} = \frac{\boldsymbol{2\mu_1}}{\boldsymbol{\alpha_1}}\left[(\boldsymbol{1+\varepsilon_U})^{(\boldsymbol{\alpha_1-1})} - (\boldsymbol{1+\varepsilon_U})^{-(\frac{\boldsymbol{\alpha_1}}{\boldsymbol{2}}+\boldsymbol{1})}\right] \quad \text{…...……..(9)}$$

where material parameters $\boldsymbol{\mu_1}$ and $\boldsymbol{\alpha_1}$ can be obtained by fitting the experimental stress-strain curve into equation.

The coefficients $\boldsymbol{\mu_1}$ and $\boldsymbol{\alpha_1}$ can be obtained by using the least square method available in Excel software, and these coefficients are 1.2 and 2.9 MPa, respectively.

According to the CDM theory, the effective nominal normal stress is defined as

$$\overline{\boldsymbol{\sigma_U}} = \frac{\boldsymbol{\sigma_U}}{(\boldsymbol{1-D})} \quad \text{…...……..(10)}$$

Using the effective nominal stress concept through the damage variable D. Therefore, the nominal stress-strain relation of a damaged material resembles a material with no damage and is expressed by the following using the Ogden model as a constitutive model:

$$\overline{\boldsymbol{\sigma_U}} = \frac{\boldsymbol{\sigma_U}}{(\boldsymbol{1-D})} = \frac{\boldsymbol{2\mu_1}}{\boldsymbol{\alpha_1}}\left[(\boldsymbol{\lambda_U})^{(\boldsymbol{\alpha_1-1})} - (\boldsymbol{\lambda_U})^{-(\frac{\boldsymbol{\alpha_1}}{\boldsymbol{2}}+\boldsymbol{1})}\right] \quad \text{…...……..(11)}$$

$$\overline{\boldsymbol{\sigma_U}} = \frac{\boldsymbol{\sigma_U}}{(\boldsymbol{1-D})} = \frac{\boldsymbol{2\mu_1}}{\boldsymbol{\alpha_1}}\left[(\boldsymbol{1+\varepsilon_U})^{(\boldsymbol{\alpha_1-1})} - (\boldsymbol{1+\varepsilon_U})^{-(\frac{\boldsymbol{\alpha_1}}{\boldsymbol{2}}+\boldsymbol{1})}\right] \quad \text{…...……..(12)}$$

By considering the hypothesis of isotropic damage, the constitutive equation for damage evaluation is given by:

$$\dot{D} = -\frac{\partial \phi^*}{\partial} \quad \text{…...……..(13)}$$

where $\boldsymbol{\phi^*}$ and y are the dissipation potential and the damage strain energy rate, respectively:

$$\boldsymbol{\phi^*} = \frac{\boldsymbol{b}}{\boldsymbol{\alpha+1}}\left(\frac{\boldsymbol{-y}}{\boldsymbol{b}}\right)^{\boldsymbol{\alpha+1}} \quad \text{…...……..(14)}$$

In this equation, a and b are material parameters. The damage strain energy release rate (y) in the uniaxial stress state is expressed by the following, in which the damage strain energy is a function of the effective nominal normal stress:

$$-y = \frac{\partial}{\partial D} = \frac{\partial\ (\overline{\sigma_U})}{\partial}$$

It can be rewritten as the following by using equation (5),

$$\boldsymbol{-y} = \frac{\boldsymbol{\partial}\ (\overline{\boldsymbol{\sigma_U}})}{\boldsymbol{\partial}} = \frac{\boldsymbol{\partial}}{\boldsymbol{\partial\lambda_U}}\frac{\boldsymbol{\partial\lambda_U}(\overline{\boldsymbol{\sigma_U}})}{\boldsymbol{\partial}} = \frac{\boldsymbol{2\mu_1}}{\boldsymbol{\alpha_1}}\left[(\boldsymbol{\lambda_U})^{(\boldsymbol{\alpha_1-1})} - (\boldsymbol{\lambda_U})^{-(\frac{\boldsymbol{\alpha_1}}{\boldsymbol{2}}+\boldsymbol{1})}\right]\frac{\boldsymbol{\partial\lambda_U}(\overline{\boldsymbol{\sigma_U}})}{\boldsymbol{\partial}}$$

……...…….(15)

Taking partial derivative of equation (10) with respect to D:

$$\frac{\partial \lambda_U(\overline{\sigma_U})}{\partial} = \frac{\alpha_1 \sigma_U}{2\mu_1 (1-D)^2} \frac{1}{\left[(\alpha_1 - 1)(\lambda_U)^{(\alpha_1 - 2)} + (\frac{\alpha_1}{2} + 1)(\lambda_U)^{-(\frac{\alpha_1}{2}+2)}\right]} \quad \text{……...…….(16)}$$

By substituting equation (16) into equation (15) the damage strain release rate is defined as:

$$-y = \frac{2\mu_1}{\alpha_1 b(1-D)} \frac{\left[(\lambda_U)^{(\alpha_1 - 1)} - (\lambda_U)^{-(\frac{\alpha_1}{2}+1)}\right]^2}{\left[(\alpha_1 - 1)(\lambda_U)^{(\alpha_1 - 2)} + (\frac{\alpha_1}{2} + 1)(\lambda_U)^{-(\frac{\alpha_1}{2}+2)}\right]} \quad \text{...…….…….(17)}$$

Equation (12) can be rewritten by using equation (13) & (17) :

$$\dot{D} = -\frac{\partial \phi^*}{\partial} = \left\{ \frac{2\mu_1}{\alpha_1 b(1-D)} \frac{\left[(\lambda_U)^{(\alpha_1 - 1)} - (\lambda_U)^{-(\frac{\alpha_1}{2}+1)}\right]^2}{\left[(\alpha_1 - 1)(\lambda_U)^{(\alpha_1 - 2)} + (\frac{\alpha_1}{2} + 1)(\lambda_U)^{-(\frac{\alpha_1}{2}+2)}\right]} \right\}^{a} \quad \text{…….…….(18)}$$

The number of cycle n_f is presented by:

$$n_f = \left\{ (1+a) \left\{ \frac{2\mu_1}{\alpha_1 b} \frac{\left[(\lambda_U)^{(\alpha_1 - 1)} - (\lambda_U)^{-(\frac{\alpha_1}{2}+1)}\right]^2}{\left[(\alpha_1 - 1)(\lambda_U)^{(\alpha_1 - 2)} + (\frac{\alpha_1}{2}+1)(\lambda_U)^{-(\frac{\alpha_1}{2}+2)}\right]} \right\}^{a} \right\}^{-1} \quad \text{……...…….(19)}$$

By using,

$$\Delta\lambda_U = 1 + \Delta\varepsilon_U$$

The fatigue life can be expressed as a function of the strain range ($\Delta\varepsilon_U$) for elastomeric materials under cyclic loading:

$$n_f = \left\{ (1+a) \left\{ \frac{2\mu_1}{\alpha_1 b} \frac{\left[(1+\Delta\varepsilon_u)^{(\alpha_1 - 1)} - (1+\Delta\varepsilon_u)^{-(\frac{\alpha_1}{2}+1)}\right]^2}{\left[(\alpha_1 - 1)(1+\Delta\varepsilon_u)^{(\alpha_1 - 2)} + (\frac{\alpha_1}{2}+1)(1+\Delta\varepsilon_u)^{-(\frac{\alpha_1}{2}+2)}\right]} \right\}^{a} \right\}^{-1} \quad \text{…….…….(20)}$$

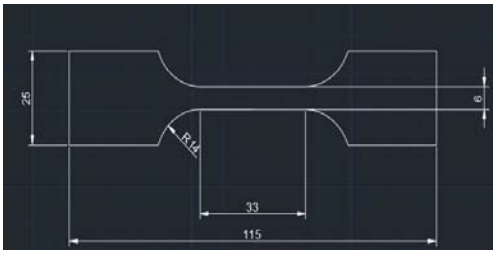
In equation, a and b are determined by the experimental fatigue life as a function of the strain range. Based on the experimental results and curve fitting, two material properties including a and b are obtained as 2 and 2,163 MPa, respectively.

EXPERIMENT PROCEDURE

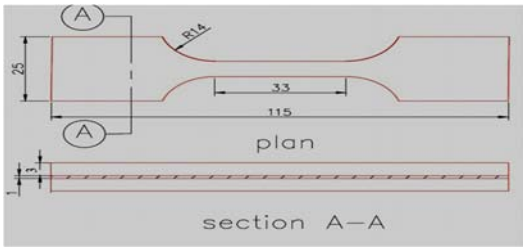
SAMPLE PREPARATION

The dimensions of the composite were selected according to the ASTM D412-16. The die was made of selected dimensions at the contacted fabrication industry. Each layer of neoprene rubber and carbon fabric were cut by using the dies and mechanical equipments at the industry.

The composites were sticked by super -wiz glue. It was applied on single side of two specimens of neoprene rubber and one piece of bidirectional carbon fabric in between them. It was kept under a constant load (weight) for 24 hours for proper bonding of the composite. It was also taken care that there were no air bubbles in between the laminates of the composite.



Here, we selected only 2 layers of neoprene rubber and 1 layer of bidirectional carbon fabric for the composite specimen for our convenience of testing.



Strain gauge was sticked on the composite specimen along longitudinal direction with use of the adhesive. the wires of the strain gauge were connected to the 1 mm ϕ wire by soldering process. After 24 hours of the sticking and soldering process the composites were ready for testing.

This strain gauges are specially used for elastomeric material.

Resistance: 350 Ω

Gried Size: 20 X 3.0 (mm)

Base Size: 25 X 4.5 (mm)

Wire Length: 30 mm

ting it in tension. While Conducting a
ge length i.e., 33 mm for our specimen.

Place the specimen in the MTS machine with the proper loading system The load applied by the MTS is measured using a load cell. The change in Gauge length is recorded as a function of applied load on specimen. The ratio of increase in length (ΔL) to the original length (L) is termed as in strain. and this strain readings are obtained from the strain indicator which displays digital output on digital display board. Plot stress v/s Strain Graphs.

Figure 3. Experimental set-up for n_f – bidirection

Fatigue Test

Fatigue tests were conducted with a MTS machine. Strain gauge which was fixed on composite was connected to the Wheatstone bridge by wire. Wheatstone bridge was directly connected to the strain indicator for strain measurement. In this experiment, the specimen design was the same as the tensile stress-strain test samples. The tests were performed under displacement-controlled loading conditions and a sinusoidal waveform. The strains were measured from the displacements and the initial gauge length between two grips. For all test samples, a frequency of 0.1 Hz was selected due to limitations of the fatigue test machine for the displacement of the grips. Furthermore, this frequency was applied for failure caused by the initiation and growth of cracks and to avoid large increases in temperature on the specimen surface, which would consequently cause thermal break-down.

Figure 3. (a) Bidirectional composite specimen for n_f – before test

Figure 3. (b) Bidirectional composite specimen for n_f – after test

RESULT

All output data of axial force , axial displacement , axial segment , cycle (n_f) , stress and strain are given here for bidirectional specimen B_1, B_2, B_3, B_4 & B_5.

Table I. Calculation table for bidirectional specimen

COMPOSITE SPECIMEN	NO. OF CYCLE AT FAILURE (n_f)	STRAIN
B_1	112835	1.2917
B_2	10127	2.4554
B_3	1020	3.4817
B_4	102	6.8688
B_5	10.5	10.0815

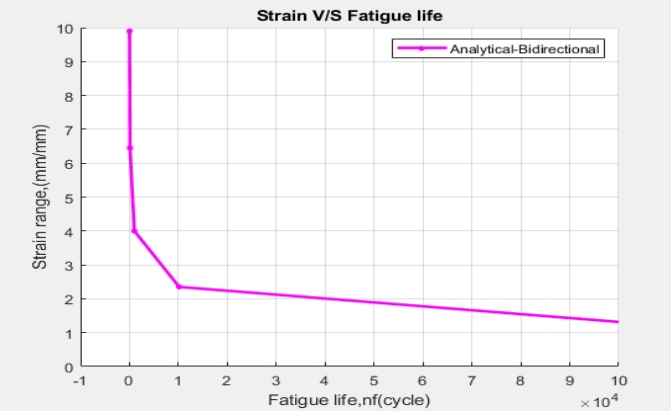


Figure 4. (a) Strain versus fatigue life graph from analytical-bidirectional

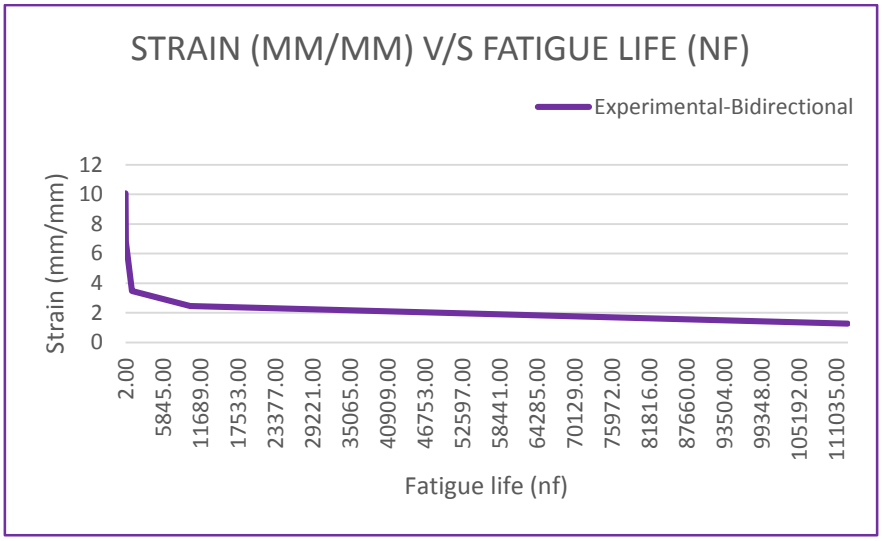


Figure 4. (b) Strain versus fatigue life graph from experimental-bidirectional

CONCLUSION

The CDMs approach was used to predict fatigue life. The correlation of the predicted life with the experimental data is strong. This supports the idea that the CDMs-based model can be applied to study fatigue life for neoprene rubber.

Table II. Validation of bidirectional specimen for n_f

VALIDATION -BIDIRECTIONAL			
ANALYTICAL DATA		EXPERIMENTAL DATA	
NUMBER OF CYCLE'S [NF]	STRAIN	NUMBER OF CYCLE'S [NF]	STRAIN
10.76	9.9	10.5	10.08
97.82	6.45	102	6.86
989.47	4	1020	3.48
10158	2.35	10127	2.45
105805	1.25	112835	1.29

Table II displays the Validation of Analytical and Experimental for Bidirectional Specimen. According to the table, material fatigue life is 10.63 and 11 cycles for analytical and experimental data at high strains of 6.6 and 6.84, respectively, and 107020 and 104024 cycles for analytical and experimental data at low strains of 0.45 and 0.51, respectively. Our analytical and experimental results are essentially the same, as shown in the table.

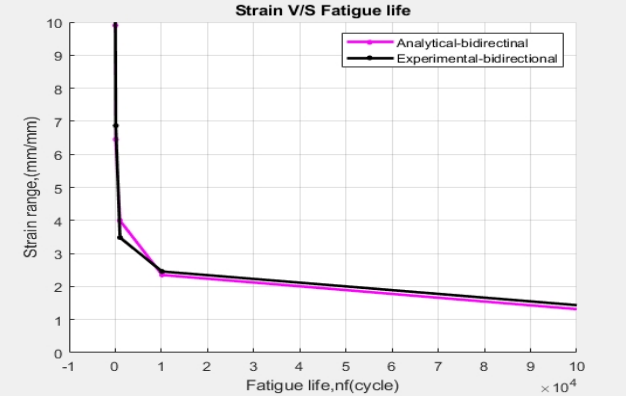


Figure 5. (a) Output from MATLAB - bidirectional

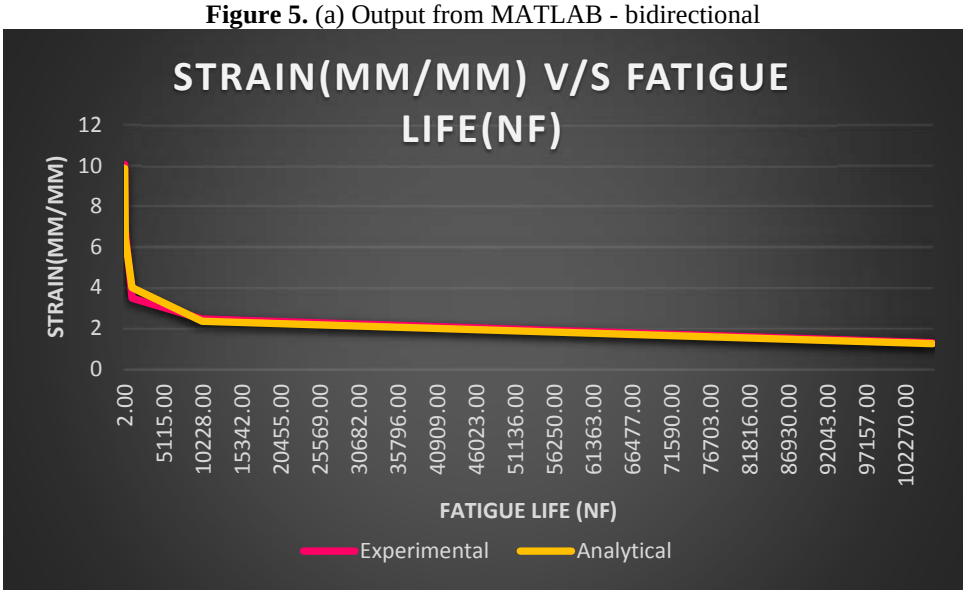


Figure 5. (b) Curve fitting from excel – bidirectional

By performing the aforementioned experiment, we may infer that the results of the analytical evaluations and the experimental evaluations are strikingly comparable and fall within the allowed range.

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The Design & Fabrication Of Spiral Vortex Turbine

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Abstract: This paper examines the concentrate on the improvement of possible energy in level stream waterways utilizing Vortex turbines and a techno-monetary review. As of now, a little and medium scale hydroelectric power plant is creating by using an extremely low head waterway. The sort of turbine that can be applied to the extremely low head type is Vortex turbines. The Vortex turbine is a turbine that uses a whirlpool as a middle person for energy. The consequences of the review uncovered that the Vortex turbine is very potential to be created in light of the fact that Indonesia has numerous streams with a level stream design so it fits with the Vortex turbine. Specialized investigations are led to decide the potential power produced, the kinds of parts utilized, and the speculation cost per kW.

Key word : spiral, vortex, hydro

INTRODUCTION

The assembly of equipment's that produces mechanical energy utilize the available energy source convert in to the electrical energy is define as a power plant. Types of turbines :(1) Francis Turbine (2) Pelton Turbine (3) Kaplan Turbine (4) Cross flow Turbine (5)Steam Turbine (6)Hydraulic Turbine. Hydraulic turbines are the prime players that convert the energy of the falling water into a rotational mechanical energy and subsequently to an electric energy using the generators that are associated with the turbines. The hydraulic turbines are rotating devices that transform potential energy into kinetic energy or usable forms like mechanical energy or electrical energy. Reaction and impulse turbines are the two different types of turbines used in hydraulic turbines.

The increasing electricity demand can be fulfilled by small and medium scale hydroelectric power plants (MHPP) as one of the renewable energy sources that can be applied to supply energy. The miniature hydropower plant is a power age framework that changes over the capability of water into power utilizing water turbines and generators. MHPP can utilize water sources that are not too large with a maximum generated power capacity of 120 kW [1]. Water turbines are one of the principal parts of a hydroelectric power framework. Water turbines can be partitioned

into two gatherings, to be specific turbines working at high head and low head. MHPP type extremely low head utilizes an exceptionally low head type water turbine with a head around 1.5 - 4.5 m. Turbines that can be applied to flat streams are Propeller turbines as in a US patent number US7,972,108 B2 entitled "Turbine and Hydroelectric Power Plant for Very Low Head" [2].

$F \quad 1.S \qquad V \qquad T \qquad$ [3]

HYDRO POWER PLANT

Humanity has involved the energy of falling water for a long time, at first in mechanical structure and since the late 19th century by additional change to electrical energy.By and large, hydropower was created on a limited scale to serve territories nearby the plants. With the development and expanding load move capacity of transmission networks, power age was moved in progressively bigger units and to profit from the economies coming about because of improvement for a bigger scope.

Hydro electric power plant types :

1. Large-hydro: more than 100 MW
2. Medium-hydro: between 15-100 MW
3. Small-hydro: between 1 - 15 MW
4. Mini-hydro: Power above 100 kW, but below 1 MW
5. Micro-hydro: between 5kW - 100 kW
6. Pico-hydro: output power is 100 W - 5kW

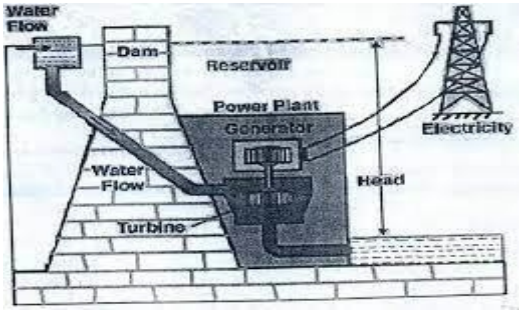


Fig 2. General Layout of a dam based hydroelectric plant[4]

VERY LOW HEAD MHPP TECHNOLOGY

The first step taken in designing the MHPP system is to conduct a site survey to find out the magnitude of the electrical energy potential. The amount of generated power (P) in watt (W) that can be generated by MHPP is calculated using Equation**(1)**

$$P = \rho . g . Q . H \quad . \eta \ (1)$$

where ḍ is the density of water (kg/m3), g is gravity (= 9,81 m/s2), Q is water discharge (m3 /s), is net head (m), dan Ş = efficiency system (%),. Measurement of water discharge is done by measuring the speed of water (v) in (m/s) and the cross-sectional area of water (A) in (m2). From these two parameters, water discharge is calculated using Equation **(2)**

$$Q = v.A \ (2)$$

By calculating the operating time of MHPP and generating factors (= 88.62%), the amount of annual electrical energy (E) in (kWh) generated by the plant can be calculated using Equation **(3)**

$$E = P \ . \ 24 \ .365 \ . \ \text{generator factor} \ (3)$$

WORKING PRINCIPLE

The Vortex turbine is a turbine that uses a whirlpool as a go-between for energy. Vortex turbines utilize a series of water turbines with vertical shafts, stuff or pulley transmission frameworks, and generators mounted on a mounting outline. The mounting outline on the structure establishment beneath is a winding delta channel that capabilities to upgrade the stream of water disturbance toward the turbine edge. The functioning guideline of the Vortex turbine is that stream water is moved through the admission to the transporter channel, which is on the riverside to a whirlpool tank or bowl. The whirlpool tank, which likewise works as a turbine house, has a round opening at the base. Low strain in the opening at the base of the tank and the speed of the water at the passage point of the whirlpool tank will influence the strength of the emerging vortex stream. The potential energy is totally changed over into rotational active energy in the vortex core and afterward removed through a turbine with an upward pivot. Water emerging from under the opening in the whirlpool tank will stream back into the waterway through the power source. In basic terms the functioning rule of the Vortex turbine as displayed in Fig. 1[6]

CALCULATION

The power generated can be calculated based on the following formula:

P = $\rho . g . Q . h$

P = theoretical output
power (watts) ρ = fluid
density (kg / m3)
Q = water discharge
(m3 / s) h =
effective height (m)
g = gravitational force (m / s2)

- electric power before entering the turbine:

$P_{in\ t1} = \rho \times Q \times h \times g$

- turbine output power:

$P_{t1} = \rho \times Q \times h \times g \times \eta$ turbine

- real power generated from the generator is:

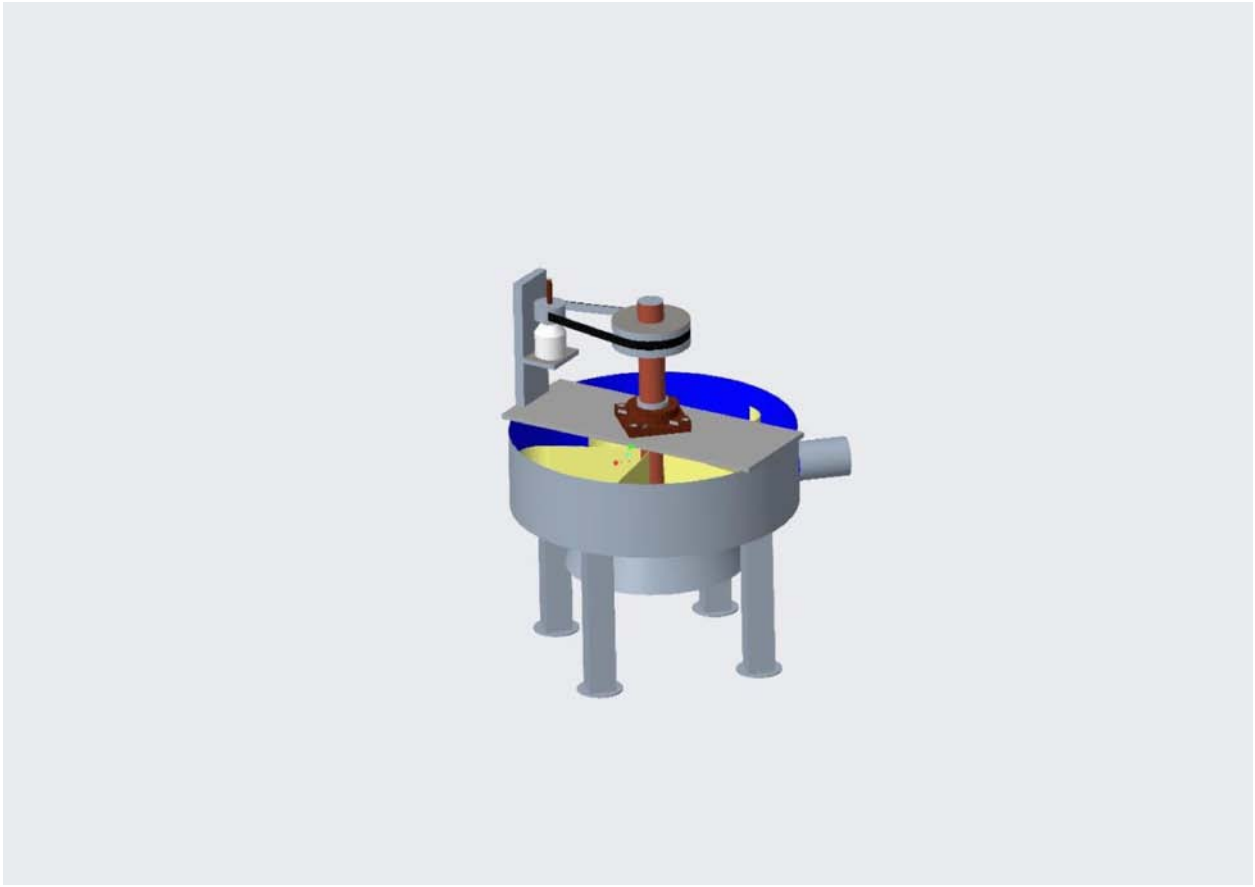
$P = \rho \times Q \times h \times g \times \eta \times \eta \times \eta_{t}$ on

- Flow rate at outlet (Q o) =0.48 Lit/sec (FULL GATE OPENED)*
- Flow rate at outlet (Q o) =0.25 Lit/sec (HALF GATE OPENED)*
- Inlet velocity at full gate opening = 12.88 m/sec*
- Inlet velocity at half gate opening =7.80 m/sec*
- Outlet velocity at full gate opening = 9.36 m/sec*
- Outlet velocity at half gate opening =4.87 m/sec*

*data assumed[7]

Part name	Dimension
Shaft diameter	R25
Outer frame diameter	R250
Blade length	203 mm
Frame length	909 mm
Pulley – 1	80 mm
Pulley – 2	20 mm
Frame height	150 mm
Frame width	150 mm

MODEL



CONCLUSION

By design and research of spiral vortex turbine which is eco friendly that produce no green house gases. Which is harmful for the environment and it also diversify energy supply and reducing decency upon fossil fuel. This turbine can also work on low water head. In this turbine there is no need to built big infrastructure as well as no need of people displacement and other harassment.

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Facial Recognition System by Using Novel Artificial Intelligence System: A Survey

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Abstract: Criminal identification is very important for the police. Nowadays, CCTV cameras are installed everywhere, but it is a difficult and time-consuming task to have a look through each and find them. In this fast-growing world, most of them are smart enough to not leave any biological evidence at crime scenes. Face detection is the only way to identify them. A Face Recognition System identifies the person's facial features comparing the raw data obtained in the form of images or video frames and the information from the already existing datasets which include images and details of citizens and criminals of a particular area/state/country. There are a lot of new technologies introduced already on this project because this tech has a lot of benefits.

Therefore, we are proposing a literature review on various research papers based on the face recognition system in the forensics and security branch [1]. This allows us to Analyse different technologies and tools used commonly in this system. We also come to know that there are different pros and cons for a particular model depending on the characteristics they choose to focus on. This will later help to overcome the limitations or problems generated in the near future when our system is practically implemented. So, we can develop a model that is capable enough for being used in the crime branch.

INTRODUCTION

Various types of wrongdoings and the overall idea of the coverage and safety of citizens in any standard public are massive segments that count on a vital element straight-forwardly withinside the nature of the existences of inhabitants [2].

A face recognition [3] system is a system capable of identifying or verifying a person from a digital image or a video frame from a video source. One of the ways to perform this is by comparing selected facial features from the image dataset. Recognizing the facial details from the available database.

A method of recognition or verifying a person's identity using their facial features is facial recognition. People can be recognized using facial recognition technology in real-time or in images and video frame. Facial recognition is a subcategory of biometric security. Voice, fingerprints, eye or iris recognition are examples of further biometric software. Although there is a growing interest in using the technology in other areas, security and law enforcement still account for the majority of its uses.

The use of this technology to stop ID fraud and identity theft is widespread in the modern world. For example, passport offices use it to check for passport and travel visa fraud, airports use it to screen passengers, police departments use it to check criminal records, ATMs and banks use it to ensure user security, businesses use it to monitor employee attendance, and so on.

Additionally, certain mobile devices, social networking sites, and web applications use this technology to stop data misuse. In order to unlock it, your smartphone also has a face recognition feature. No matter where this technology has been applied, its purpose has always been to confirm a person's identification and stop fraud.

A FEW COMPANIES WHICH ARE MAKING THIS SYSTEM:

FECEX

Founded in 2018 by Safeer Usman in Bangalore India, FeceX is a small team that is doing big in the facial recognition field. This company's model implements state-of-the-art tracking technology which detects people even under low illumination and pose variety. Apart from that, it also spots people from far distances, even when the face appears very badly to the human eye. Further, it recognizes faces with an accuracy rate of 94%. This startup has achieved a good amount of success in a short span of time. Today, the company works with a large number of clients — from brokers to big companies. It also works with over 100 developers whose work deals with facial identification applications. [4]

LIMITATION

Face captured with poor image quality than it will difficult to find face If face recognize beyond of the of angle than difficult to find persons More difficult to store data at one center.

ZERONE

Zerone developed state-of-art facial recognition software that captures the facial features of criminals and records them in the database. At the entrance of restricted areas itself, officials are able to identify if an individual is a criminal or not by simply cross-checking their facial ID to the criminal datasets. The combination of face identification technology and AI makes it easier to detect, with more security and impermeable to tamper with IDs.[5]

LIMITATION

It is a rather frustrating job for the government bodies to link various identity proofs of the criminals onto a central database. Verification of identity proofs is not always accurate and sometimes not feasible. Also, there was a chance of plagiarism. Mapping a criminal's ID to their record consumed a lot of time too.

PARELLELDOTS

ParellelDots, founded by a trio Angam Parashar, Ankit Narayan Singh, and Muktabh Mayank, claims to be one of the best applied AI research groups in the world. Speaking of facial recognition, the company's image recognition API finds the label(s) (names) of objects in the image along with its probability score. It is skilled enough to identify at most 6,000 commonly appearing objects from just one image along with various human emotions from facial expressions. This API by ParellelDots can be used to monitor emotions associated with visual content shared on social media or photo-sharing apps or build interactive video chat applications. [6]

LITERATURE SURVEY

SYNOPSIS OF THE MODELS EXAMINED:

MODEL 1

In this Paper [7], datasets are used to construct detection models to spot possible criminal actions. This project mainly focuses on age and gender recognition and applied criminal control and surveillance. Some of the tools and technologies used in this process are deep learning, Artificial intelligence [8] and Software libraries/frameworks like DLIB [11], OpenCV and CNTK. The benchmarked datasets provide information to find criminals using tools like CIFAR-10, ImageNet. The benchmarked datasets contain 60,000 32 x 32 colored images in ten different classes. Using the automated tech above, this system is capable of analyzing large amounts of information to compare and give out video analysis and image, audio and text in several languages. Thus, this project's main purpose is age and gender recognition but its drawback is that it cannot tell the confirmed age of a specific person. Fig.1) shows the experimental result of this model.

TABLE 1: Details of the results obtained [7]

	Model	Train		Test	
		Average	Std. Dev.	Average	Std. Dev.
Age	ResNet50	92.3%	0.8976%	73.7%	4.5253%
	ResNet152	96.2%	0.4128%	73.5%	4.5669%
Gender	ResNet50	98.6%	0.3436%	90.5%	8.4179%
	ResNet152	99.1%	0.169%	90.4%	8.3994%

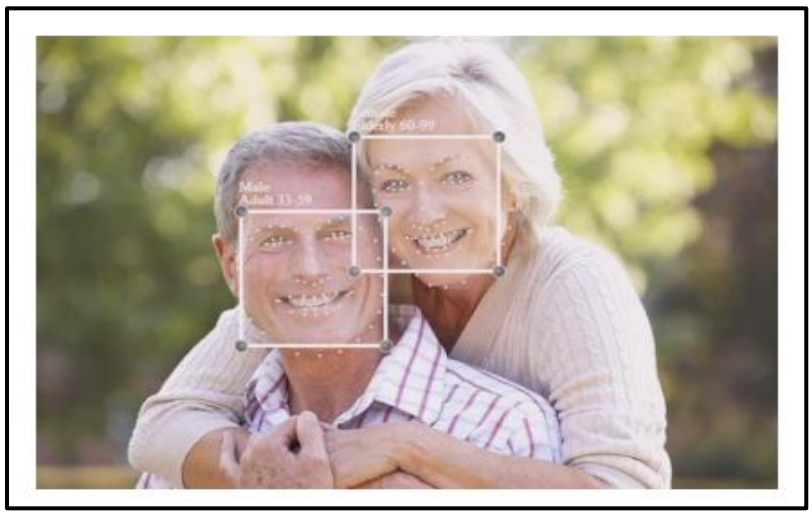


FIGURE 1. An example prediction using this developed model [7]

MODEL 2

This paper [12] proposes a real time face recognition [13] system using an automated surveillance camera. Automated surveillance spots people who are on the watch list or database in the image and video frames. It comprises of four steps: (1) Creating a database (2) Face detection (3) Comparison with datasets (4) Results based on the comparison. Fig.2) shows the methodology of proposed system. This system uses three databases including the images and details of all citizens of the given country, criminals/suspects of that particular country and criminals/suspects who do not belong to that country. Next, the video recorded in the surveillance camera is obtained and converted into frames. The faces are detected using one of the most common tools – Haar classifier [14] and XML files. The OpenCV library provides the class for both the Haar classifier system and XML files to recognize objects such as face, eyes and mouth.

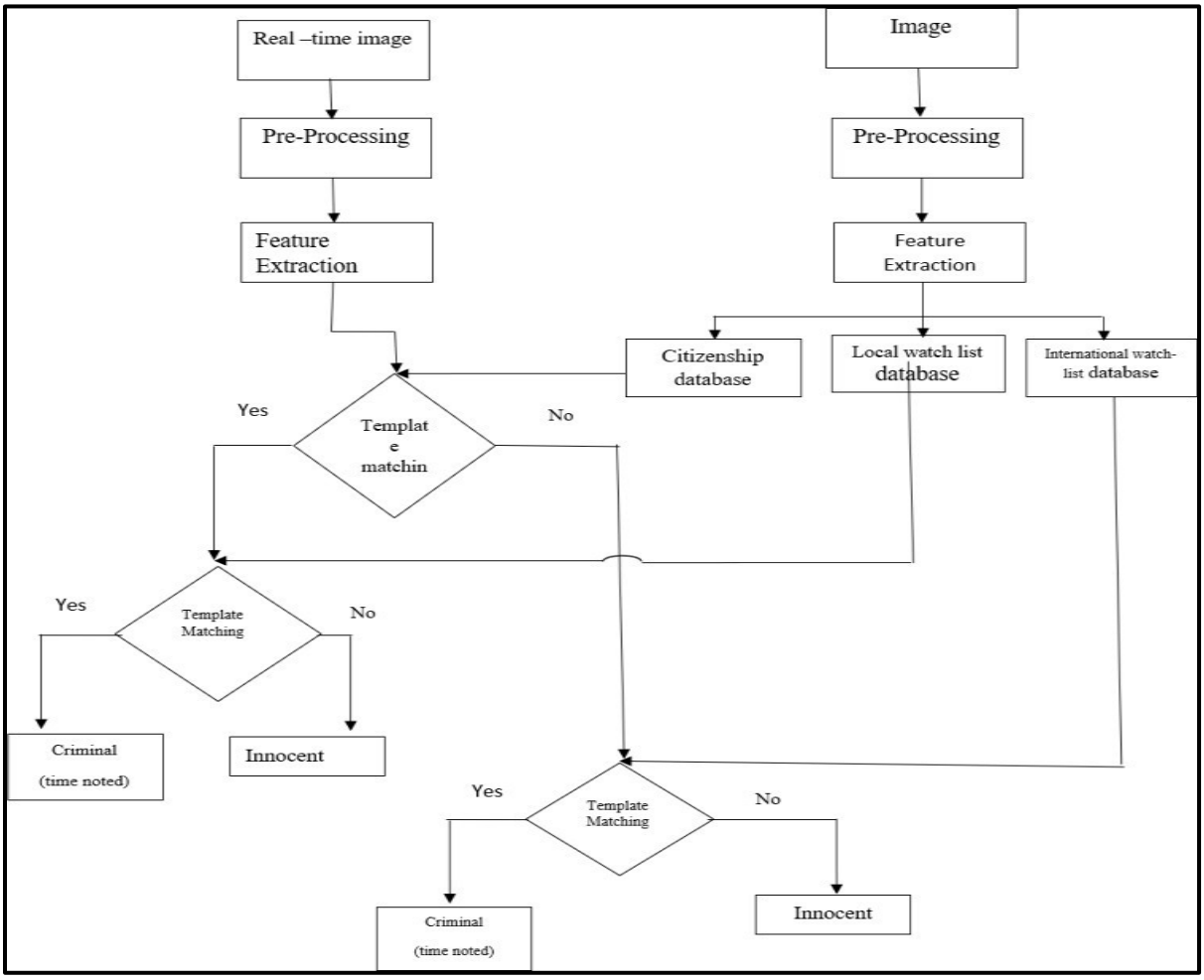


FIGURE 2. Flowchart of proposed methodology [12]

MODEL 3

The system developed in this paper [15] detects the face of the criminal. It is able to verify and display its information from the database. Local Binary Pattern Histogram (LBPH) and LBP algorithms are used in this system. There are 5 steps of LBP algorithm, 1. Parameters (Radius, Neighbor, Grid X, Grid Y), 2. Training, 3. Applying the LBP, 4. Histograms extraction, and 5. performing the recognition of face.

They used radius and neighbor [16] to better describe the original image by first highlighting facial features using LBP. Grid x and Grid Y are used to divide the generated image into multiple grids. It compares the input image with the histogram of each image to find the criminals data and displays the matched image as output.

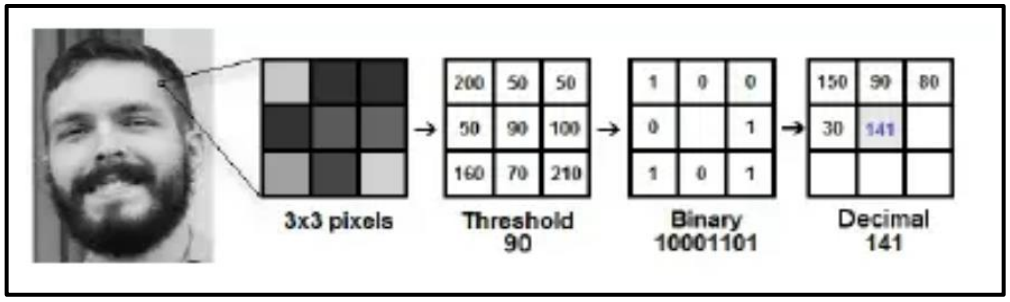


FIGURE 3. Process of applying the LBP [15]

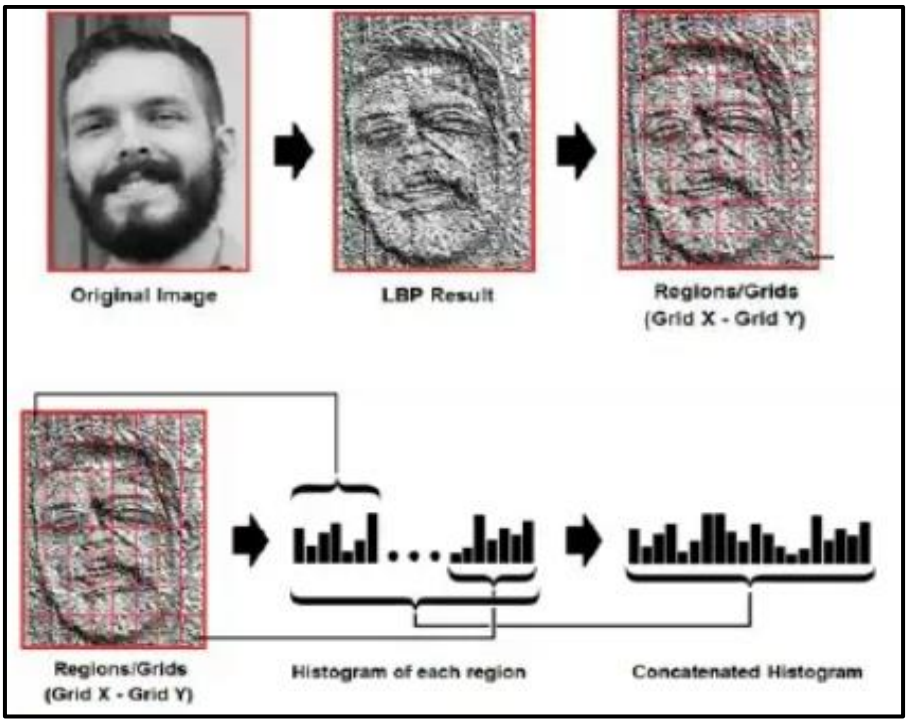
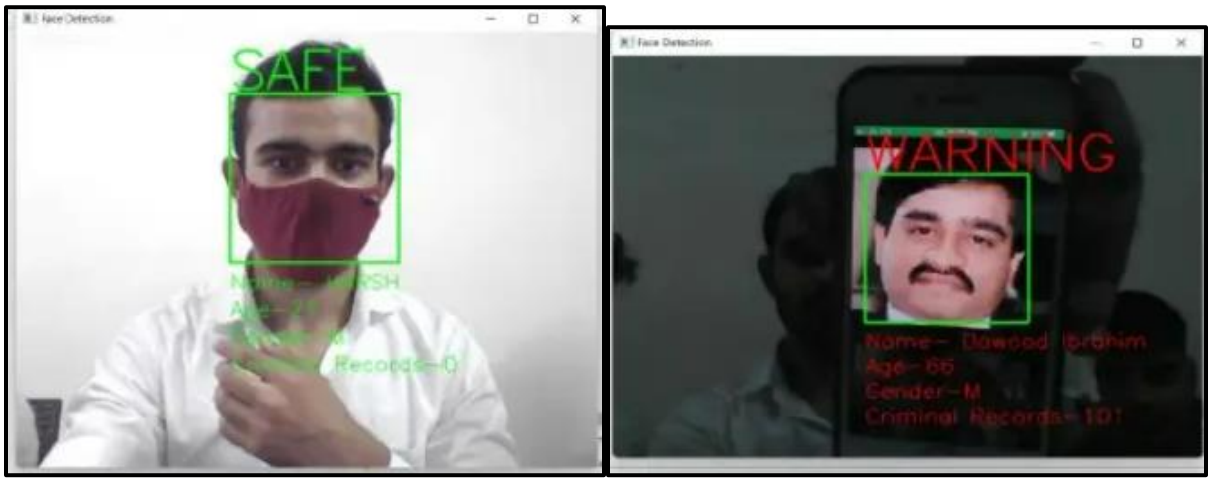


FIGURE 4. Histograms extraction process [15]



(a) (b)

FIGURE 5. Experimental result [15]

MODEL 4

In this paper [17] the author has done face recognition by Deep learning [18] using OpenCV. This experiment has been done on image and real time video. For face recognition the author has used Haar cascade classifier and CNN classifier along with TensorFlow framework. The main focus of this system is on distance and lighting. If distance is less than 60 as in Fig.7) then face identification is non-feasible and if the light is low, as shown in Fig.9). then the model's accuracy is also decreased. The overall result or accuracy of this system of face recognition on image is 86.7% and in real time video, it is 91.7%.

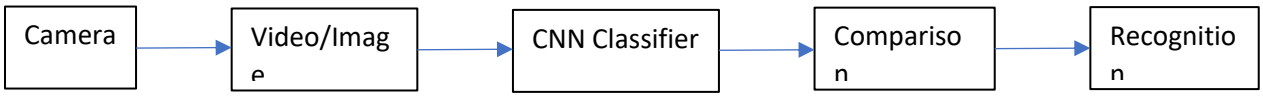


FIGURE 6. Flow chart of face recognition [17]

FIGURE 7. Distance between face and camera <60cm [17]

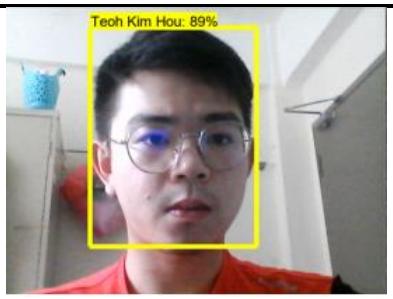


FIGURE 8. Distance between face and camera >60cm [17]

FIGURE 9. Low lighting intensity [17]

MODEL 5

This system [19] identifies criminals [20, 21] on the basis of age, gender, facial expression suspicious clothing like hoodies and masks. It is made up of three phases Requirement analysis, Design, and Implementation. The database here is created using MySQL, the face recognition process is done using deep learning-based CNN i.e., Convolutional Neural Network approaches and suspicious physical appearances are detected using LeNet architecture. The image classification and identifying face regions detected using Convolutional Neural Network, DLIB and keras (an open-source library). It is also capable of detecting face Irregardless of age using the hessian filter which eliminates the wrinkles that appeared on the faces and thus makes the recognition process easier. There is a whole another dataset used for emotion and gender identification too, called the IMDB WIKI dataset which consists of the largest database having good quality images of both male and female citizens separately, using the CNN approach. Overall, end-to-end steps are performed in order to spot the criminal.

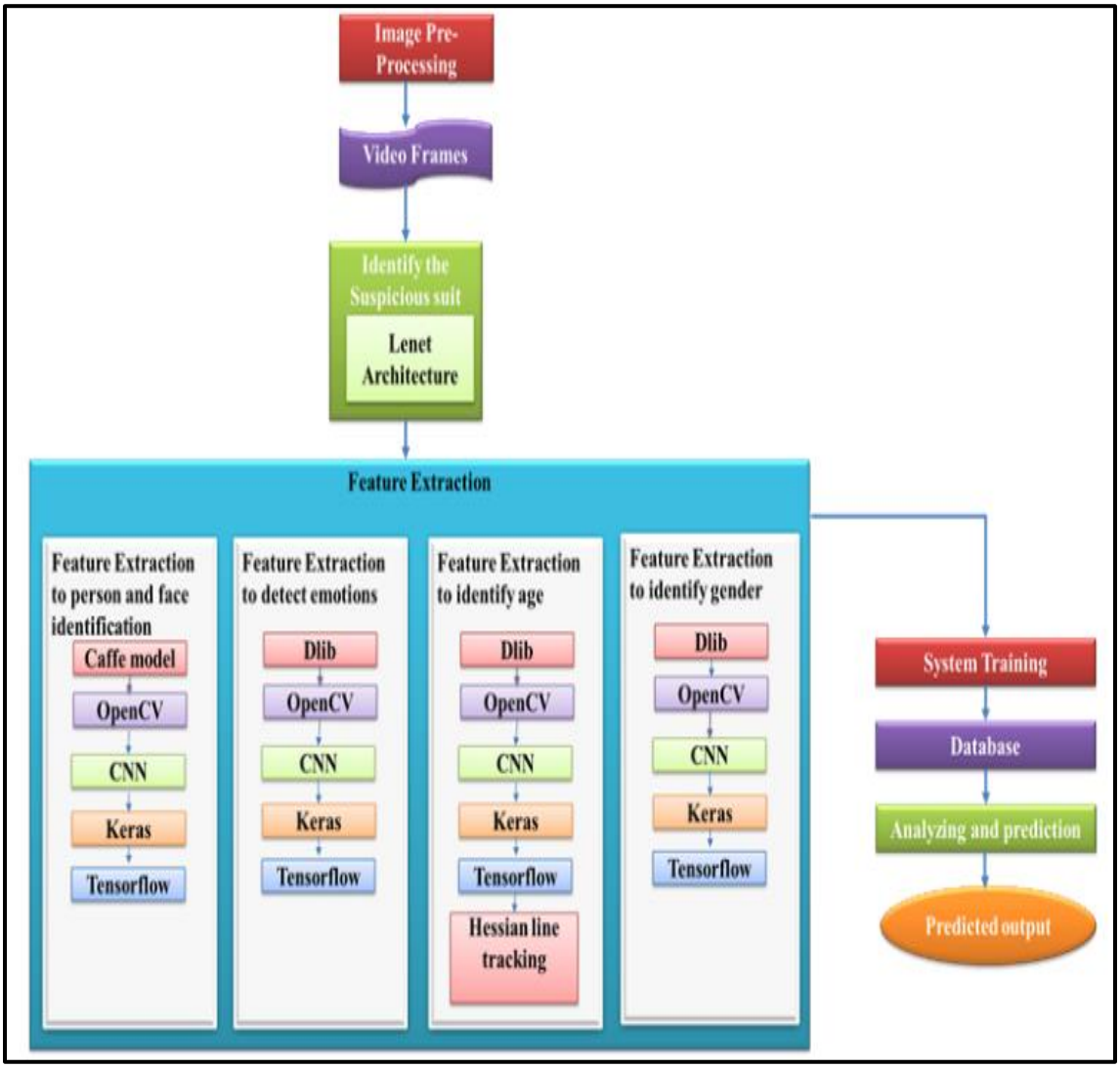


FIGURE 10. Criminal Identification System Diagram [19]

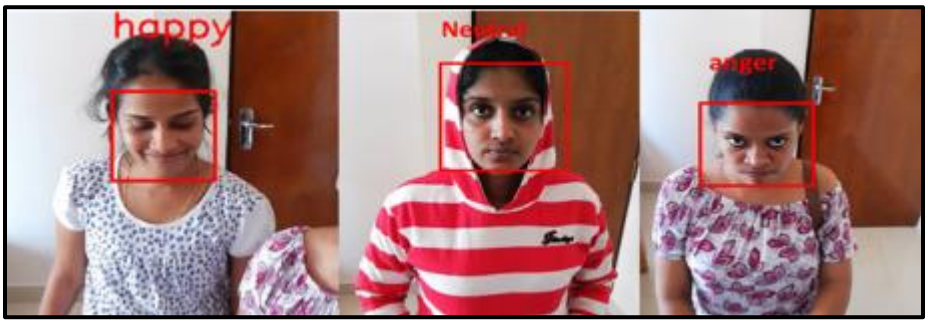


FIGURE 11. Samples of detected Facial Expressions [19]

FIGURE 12. Person and Hoodie Identification Results [19]

FIGURE 13. Samples of Age and Gender identification Results [19]

MODEL 6

This paper [22] proposes an approach to recognize faces using mug shots of criminals. These mug shots are then converted into frontal and side views along with its 3D-modeling to help spot the criminals in the image and video frames captured at any angle. This project handles a variety of poses which have great potential in forensics and scientific research applications for police. Fig.14) for pose-invariant face recognition. The mugshot datasets used in this paper are obtained from the common police database. To benchmark these datasets, the CMU-PIE database [23] model is used. This project is divided into three steps (1) a branched 3-D face model [24, 25] which improves the shape reconstruction at multiple resolution levels. (2) analyzing two gallery images and combining them under arbitrary viewing conditions. (3) Final recognition step where the compared images are augmented and synthesized into views at various angles. Fig.15) shows the flow chart of face recognition procedure.

FIGURE 14. The two orthogonal face views used as gallery images. [22]

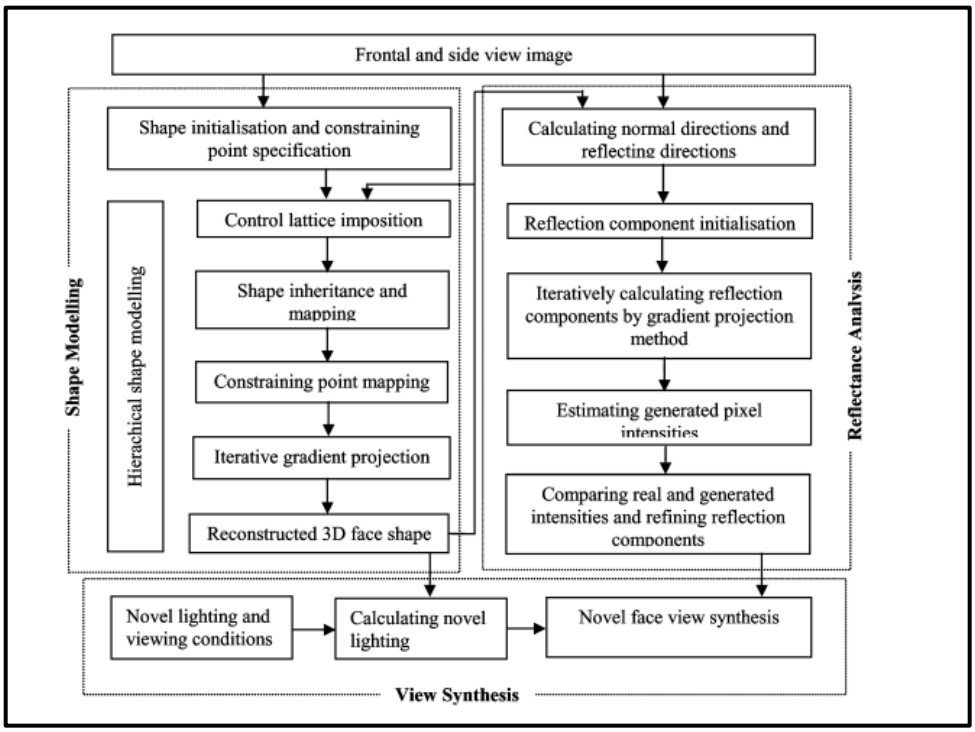


FIGURE 15. Flow chart of procedure [22]

MODEL 7

The biggest drawback of FRS is disguises that prevent face recognition. This paper [26] mainly comprises of masked or disguised face identification. It also deals with person-re identification and face image quality reassessment. Person re-identification is associated with the human body features rather than human face only. Therefore, this paper deals with full biometric recognition. The datasets contain over 11000 images of 1000 identities with variations across

a variety of disguise accessories. Test results include the GD-HASLR [28] algorithm which is immune to any kind of shape and size of obstruction and DiFRuNNT [29], which is a deep learning-based algorithm, used for the same. Ultimately, the paper gives high accuracy results and thus provides us with a feasible solution to the problems created due to masked faces.

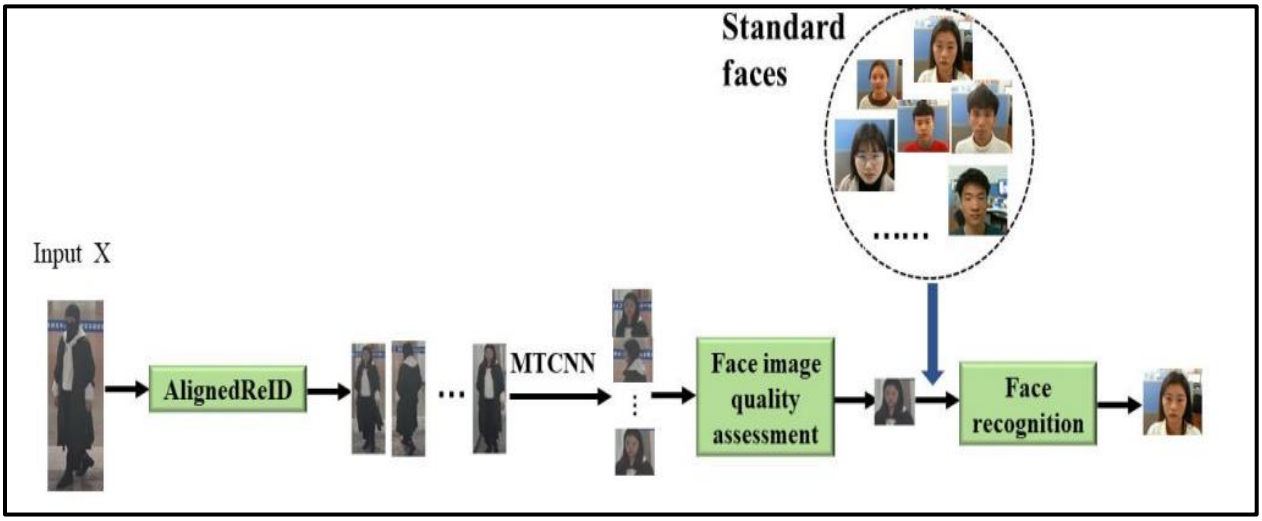


FIGURE 16. The outline of the proposed method. [26]

MODEL 8

According to the authors [30], this project is capable of recognizing criminals on the basis of four steps: 1) Two datasets are used; first using Fisher face [31] to extract features and the K-nearest neighbor (KNN) [32, 33] method to use as a classifier and for second the SVD-based technique. 2) spotting a face and comparing to the two datasets 3) Verifying the compared faces 4) Displaying the obtained outputs. The predicted results are said to be at least 95% accurate, which is pretty high. The paper also contains a literature review of two papers which use the same tech used here. Applications include fields like security and surveillance. Fig.17) Shows the methodology of this system.

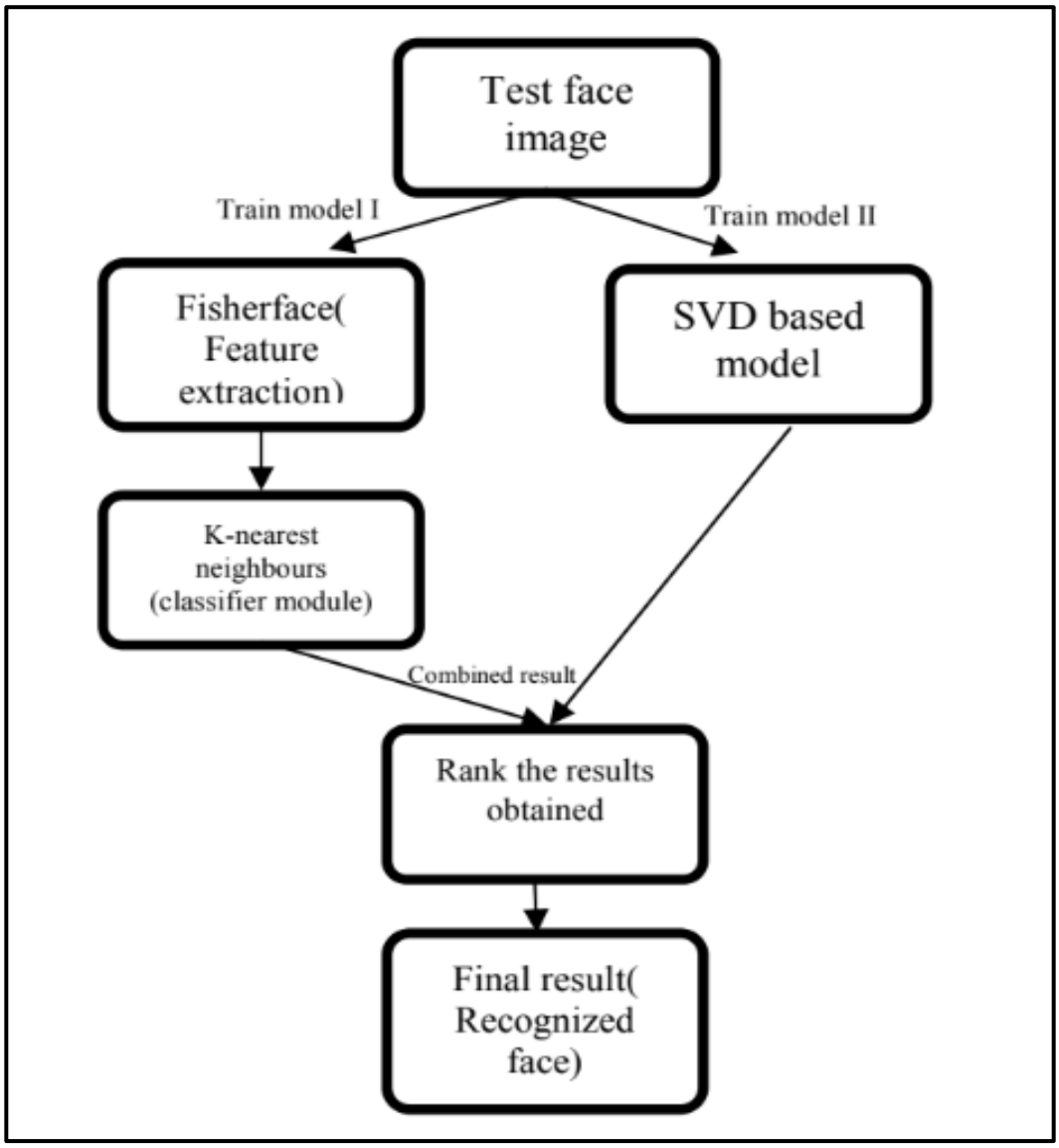


FIGURE 17. Flowchart of proposed methodology [30]

MODEL 9

This system [34] decomposes the image or video frames captured into small fragments of facial features which is a crucial part of the face identification process. These little fragments are called “Eigenfaces”. The principal component analysis (PCA) has been used for this purpose. Then these eigenfaces are compared to the datasets that are made using the ORL database of faces. It is divided into two parts the training sets and test. The faces of people are stored in the training sets which are then compared using the popular distance classifiers namely, Euclidean [35],

MahalaNobis [36] and Cosine [37]. Based on the training sets the MahalaNobis had the highest accuracy rate and cumulatively Cosine had a pretty good recognition outcome too.

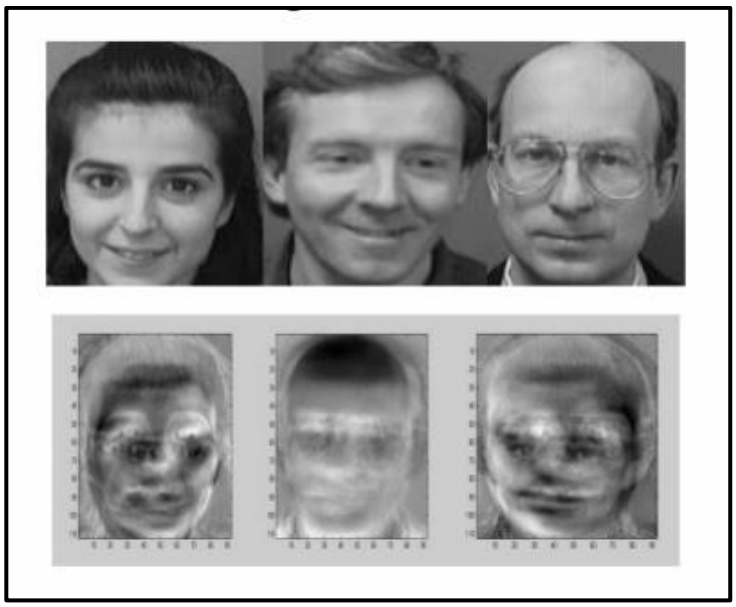


FIGURE.18. The first row is some of the images used for training while the second row shows the eigenfaces with significant eigenvectors. [34]

MODEL 10

With this system [38], the problem of noisy images and blurred images because of relative motion between the camera and the object scene can be solved easily. In this system the author is going to detect face by facial deblur inference (FADEIN). By this we can characterize the point spread function (PSF) [39] of blur. Here they are using the concept of image characteristics along with the direction and parameter motion. Correct Identification of the PSF feature allows better performance and accuracy of the blurred image. And compare eye, mouth, and face boundaries to verify each face. These algorithms are improving the face recognition rate 97.4% and also enhance accuracy.

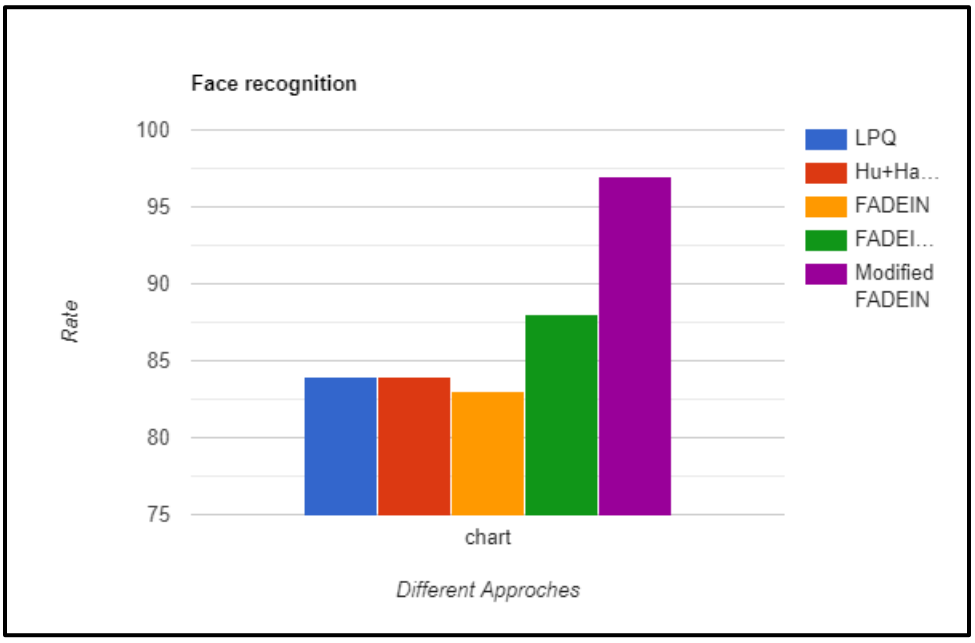


FIGURE 19. Comparison Charts of Different Approaches. [38]

MODEL 11

In the modern world, almost all people understand the significance of CCTV film, but a good deal of the time, this recording is being applied for examination purpose after a wrongdoing/occurrence has occurred. The proposed system [40], process as shown in Fig.20), has the benefit of recognizing and getting hoodlums earlier than they perpetrate another wrongdoing. The steady CCTV film is being accompanied and investigated. The effect of this examination is if within the occasion that the framework distinguishes the crook when the individual position to make any movement. Henceforth this may be halted. Fig.21) show the identification page and the text message alert that concludes the detected action may lead to a possibly violent crime. Despite the truth that the proposed framework is confined to the scholarly region, this may likewise be applied to differentiate hoodlums in daylight or personal spots. The version may be applied in any scenario in which any violent actions are certain to occur. Rather than searching through the entire dataset to investigate the faces, program execution may be progressed via different means of thinking like some exclusive qualities such as the age and gender of an individual.

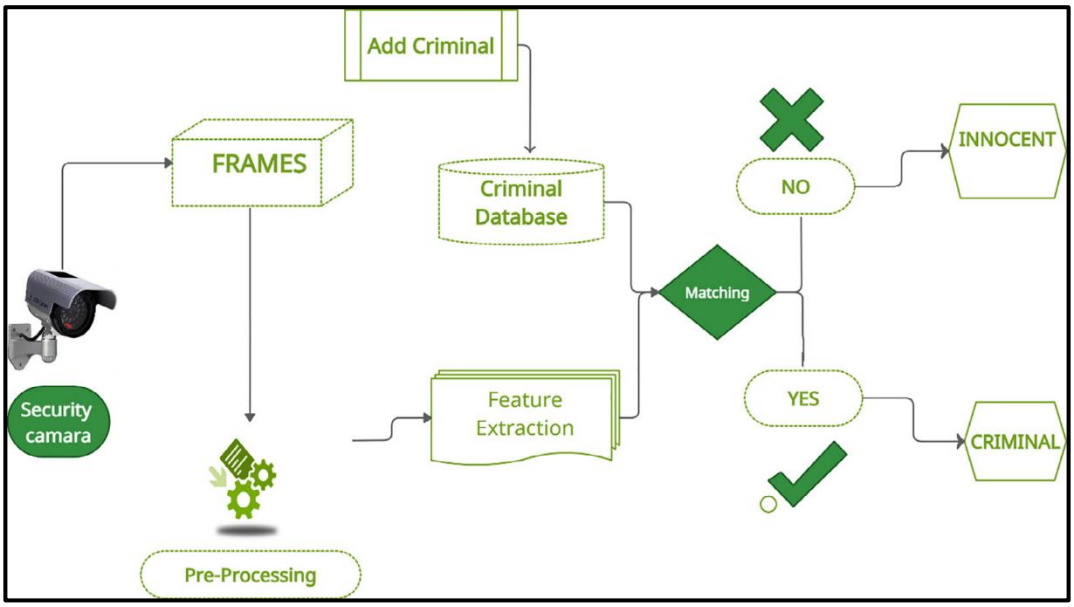
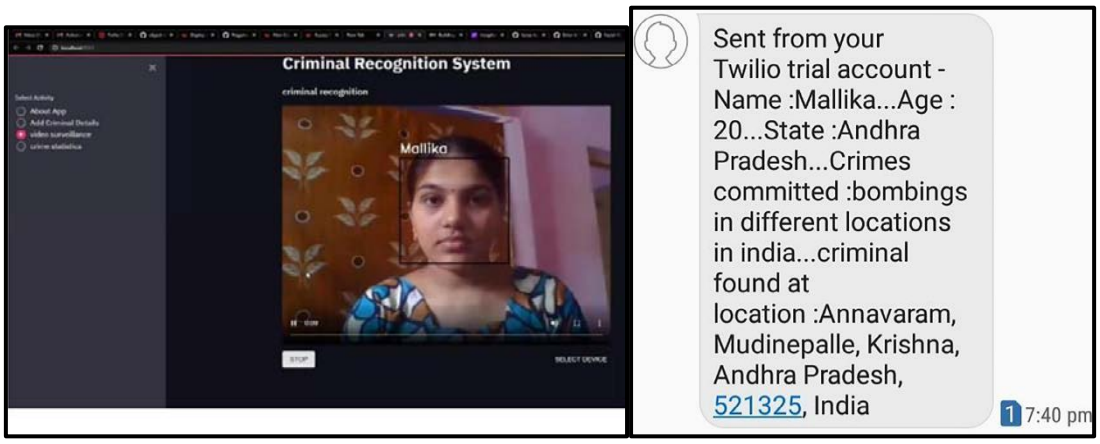


FIGURE 20. Face recognition process. [40]



(a) (b)

FIGURE 21. (a)Video Surveillance for real-time criminal identification page. (b) Instance when the criminal is identified. [40]

MODEL 12

Although Deep Neural Network or simply, DNN is quite successful in the field of face recognition techniques, but it only works on small models comprising of small set of training data. To overcome these challenges, this paper proposes a machine learning methodology called Successive Subspace Learning (SSL) that is almost as capable as DNN but is better in comparison to the size feature. According to the author, it is lightweight, low-resolution, has good data efficiency and works in resource–constrained environments.[49]

TABLE 2: Rank-1 identification rate (%) for frontal and slightly non-frontal face images (±15◦) in Setting-1. [49]

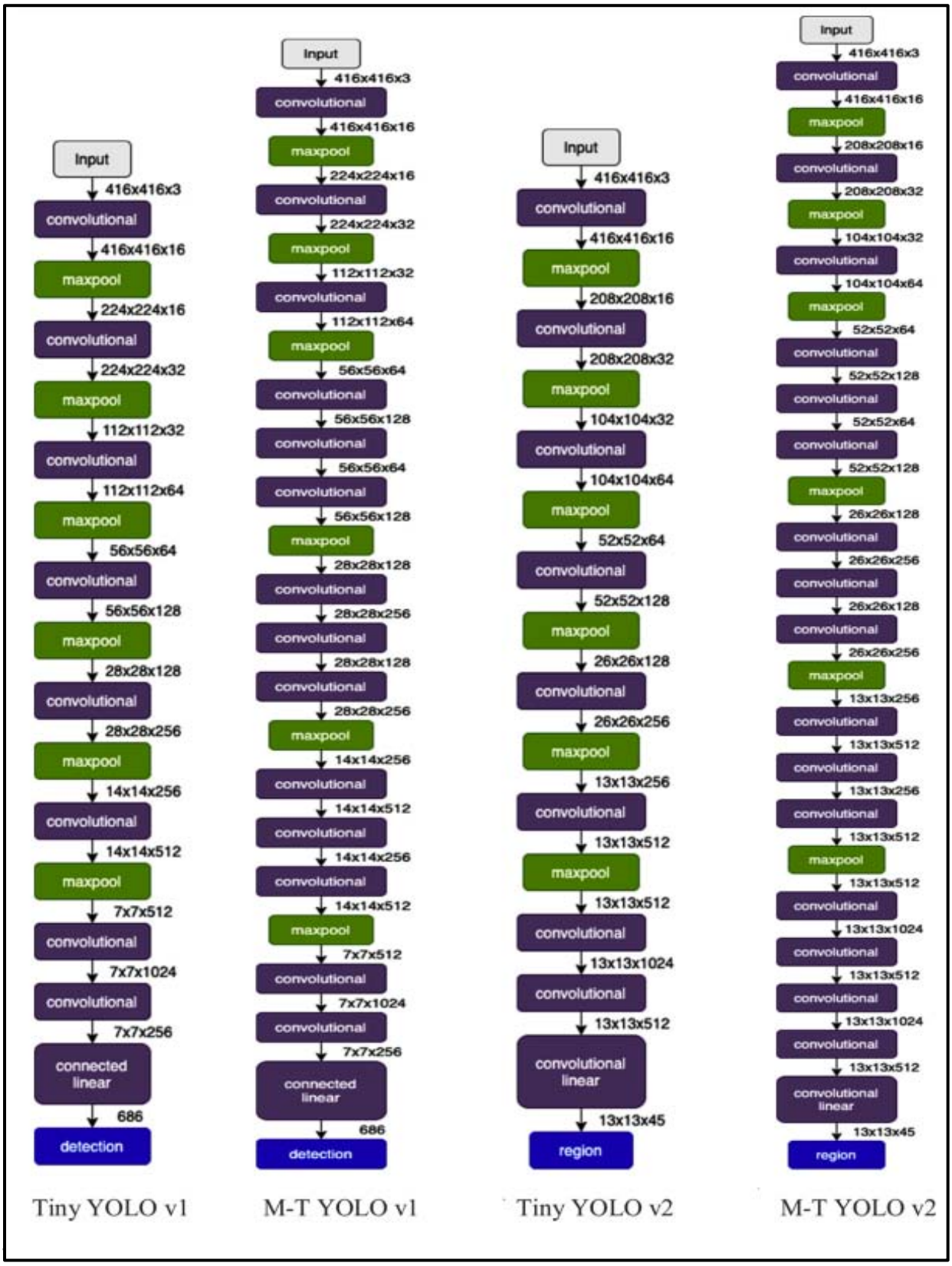
Method	Resolution	Acc (%)
CPF [41]	60,60	89.45
HPN [42]	256,220	84.23
c-CNN Forest [43]	-	96.97
Light CNN-29 [44]	128,128	99.78
TP-GAN [45]	128,128	99.78
LRFRHop	3232	89.48

TABLE 3: The number of parameters of each component in LR FRHop. [49]

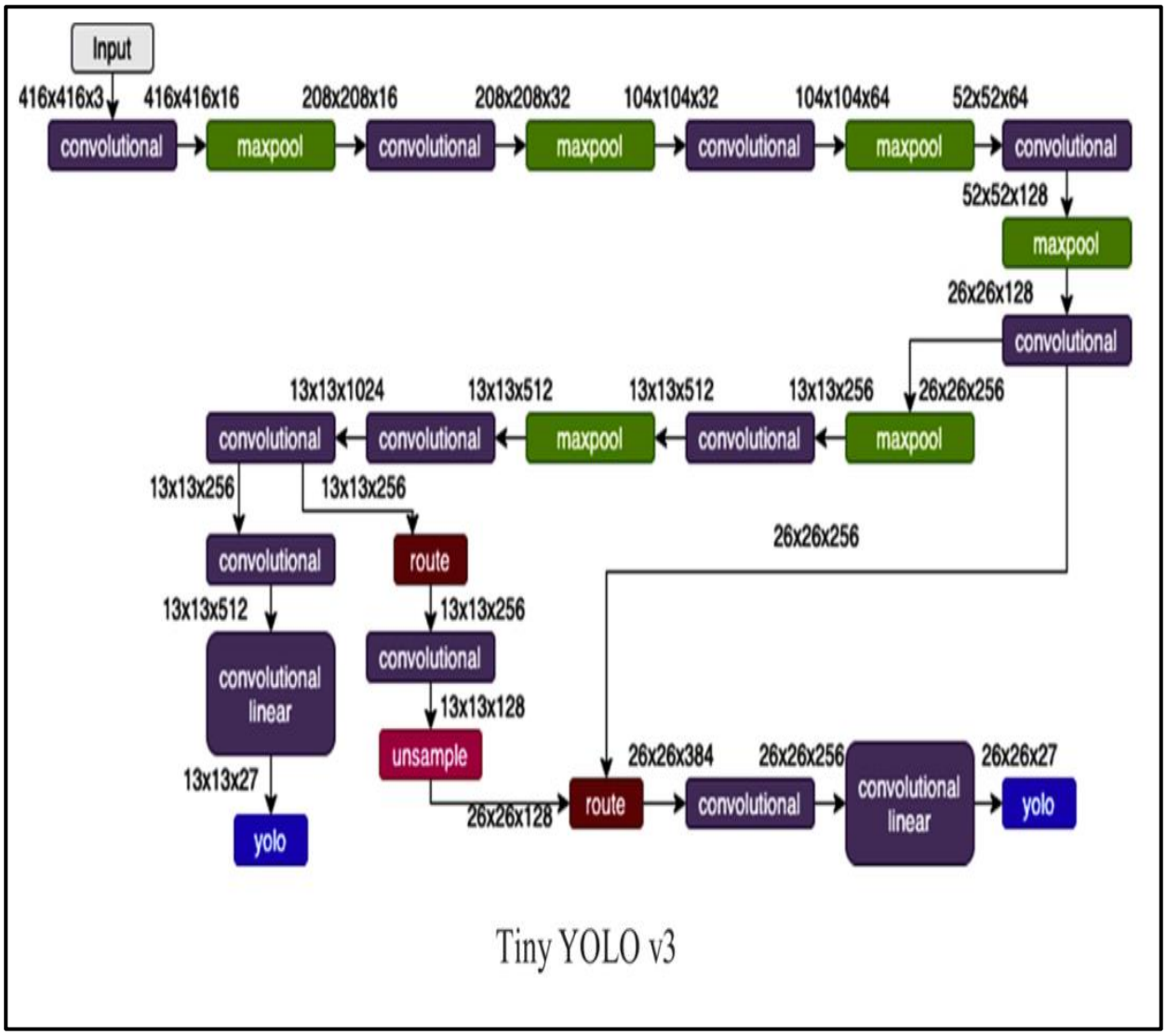
Subsystem	Num. Of Param.
M_y	451+2543+2969
Pairwise Feat. Gen. - Y	470
LR Classifier - *CY*	341
MCrCb	476+1369+1348
Pairwise Feat. Gen. - CrCb	432
LR Classifier - *CCrCb*	242
Meta Classifier	3
Total	10914

MODEL 13

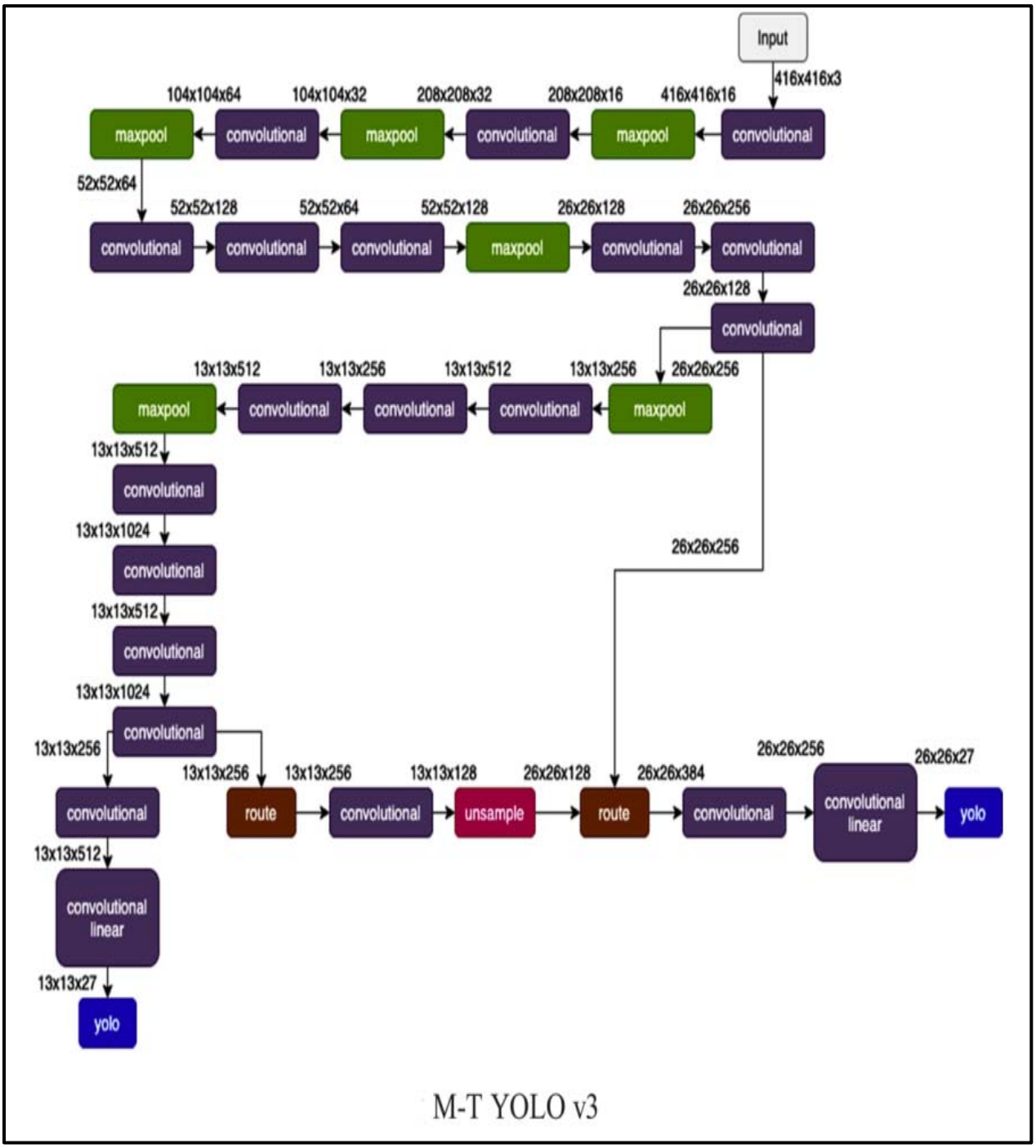
This paper [46] has undertaken to clear up the face mask detection hassle through presenting a brand-new modern dataset this is considerably characteristic wealthy than to be had datasets within the hassle domain. The proposed dataset includes 52,635 pictures with extra than 50,000 tight bounding containers throughout lessons with mask, without mask, mask incorrectly, and mask's location that resource in accomplishing correct and dependable outcomes outperforming current modern. The dataset has been examined and proven on unique and tiny editions of YOLO to carry out face mask detection. The outcomes received display unique YOLO v4 because the correct item detection set of rules accomplishing mAP of 71.69 %.


Input
416x416x3
convolutional
416x416x16
maxpool
224x224x16
convolutional
224x224x32
maxpool
112x112x32
convolutional
112x112x64
maxpool
56x56x64
convolutional
56x56x128
maxpool
28x28x128
convolutional
28x28x256
maxpool
14x14x256
convolutional
14x14x512
maxpool
7x7x512
convolutional
7x7x1024
convolutional
7x7x256
connected
linear
686
detection
Tiny YOLO v1
Input
416x416x3
convolutional
416x416x16
maxpool
224x224x16
convolutional
224x224x32
maxpool
112x112x32
convolutional
112x112x64
maxpool
56x56x64
convolutional
56x56x128
convolutional
56x56x64
convolutional
56x56x128
maxpool
28x28x128
convolutional
28x28x256
convolutional
28x28x128
convolutional
28x28x256
maxpool
14x14x256
convolutional
14x14x512
convolutional
14x14x256
convolutional
14x14x512
maxpool
7x7x512
convolutional
7x7x1024
convolutional
7x7x256
connected
linear
686
detection
M-T YOLO v1
Input
416x416x3
convolutional
416x416x16
maxpool
208x208x16
convolutional
208x208x32
maxpool
104x104x32
convolutional
104x104x64
maxpool
52x52x64
convolutional
52x52x128
maxpool
26x26x128
convolutional
26x26x256
maxpool
13x13x256
convolutional
13x13x512
maxpool
13x13x512
convolutional
13x13x1024
convolutional
13x13x512
convolutional
linear
13x13x45
region
Tiny YOLO v2
Input
416x416x3
convolutional
416x416x16
maxpool
208x208x16
convolutional
208x208x32
maxpool
104x104x32
convolutional
104x104x64
maxpool
52x52x64
convolutional
52x52x128
convolutional
52x52x64
convolutional
52x52x128
maxpool
26x26x128
convolutional
26x26x256
convolutional
26x26x128
convolutional
26x26x256
maxpool
13x13x256
convolutional
13x13x512
convolutional
13x13x256
convolutional
13x13x512
maxpool
13x13x512
convolutional
13x13x1024
convolutional
13x13x512
convolutional
13x13x1024
convolutional
13x13x512
convolutional
linear
13x13x45
region
M-T YOLO v2

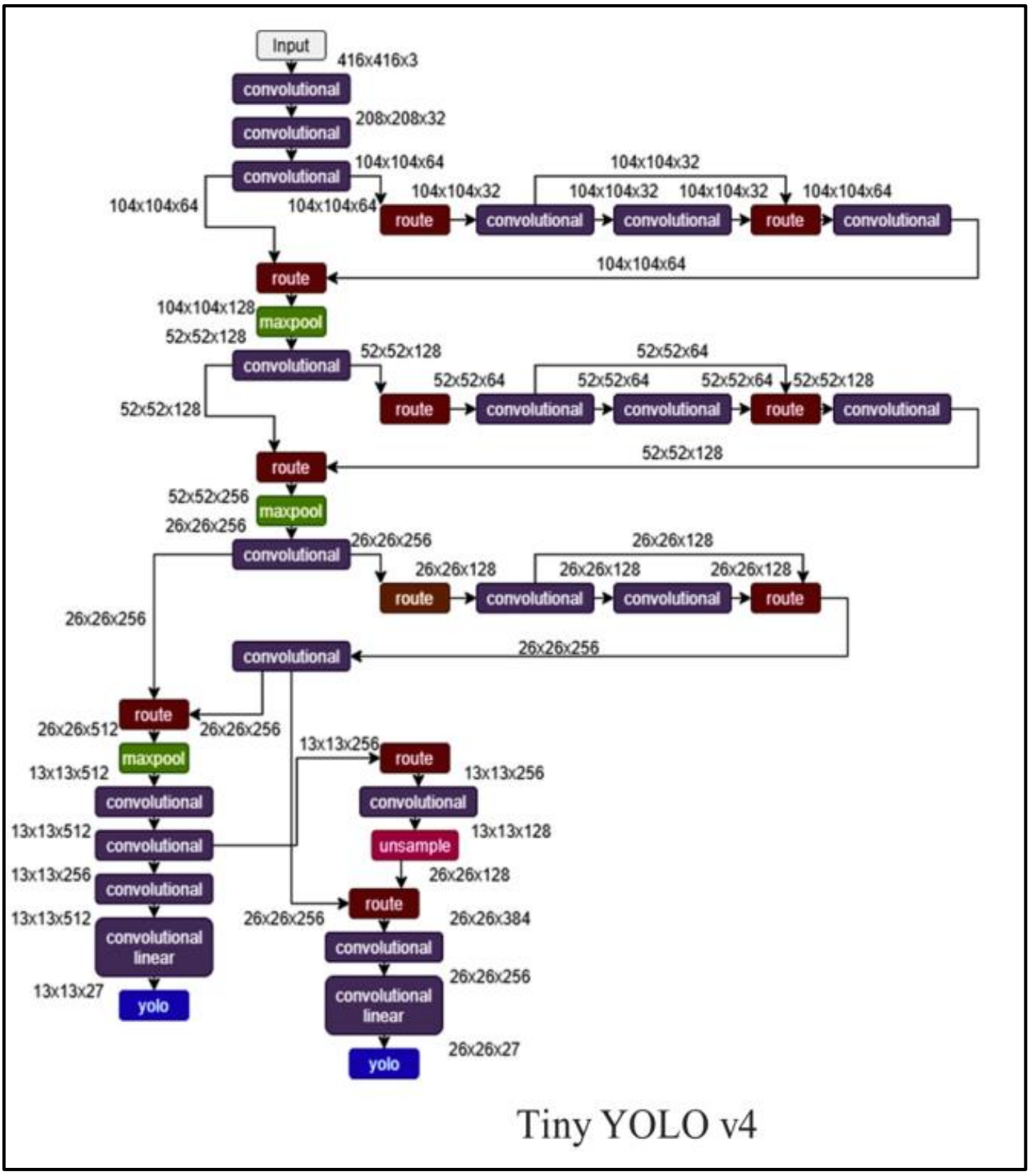
(a)


Input
416x416x3
416x416x16
208x208x16
208x208x32
104x104x32
104x104x64
52x52x64
convolutional
maxpool
convolutional
maxpool
convolutional
maxpool
convolutional
52x52x128
maxpool
26x26x128
convolutional
13x13x1024
13x13x512
13x13x512
13x13x256
26x26x256
convolutional
convolutional
maxpool
convolutional
maxpool
13x13x256
13x13x256
convolutional
route
26x26x256
13x13x512
13x13x256
convolutional linear
convolutional
13x13x128
unsample
13x13x27
26x26x384
26x26x256
26x26x27
yolo
26x26x128
route
convolutional
convolutional linear
yolo
Tiny YOLO v3

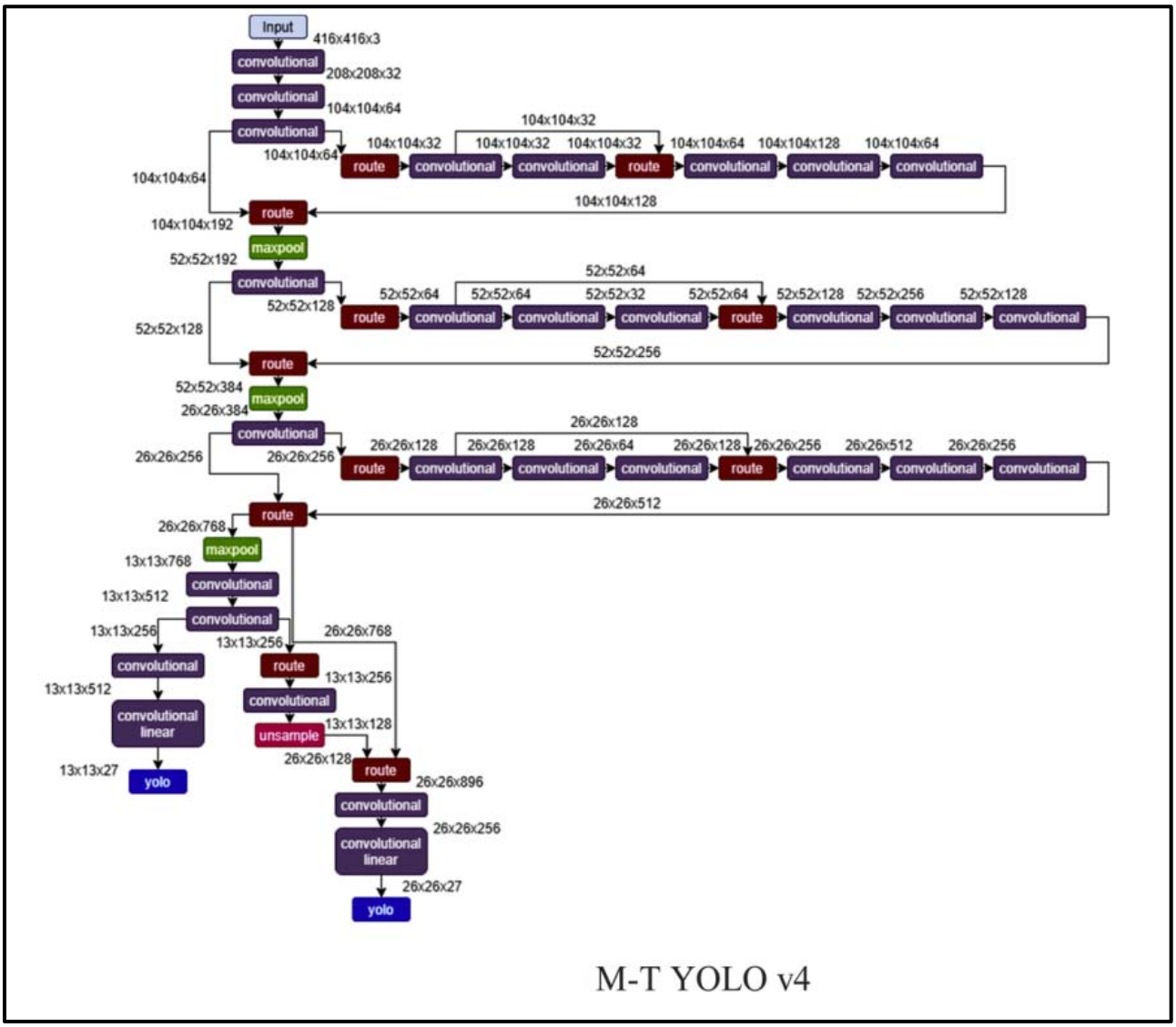
(b)


Input
416x416x3
104x104x64
104x104x32
208x208x32
208x208x16
416x416x16
maxpool
convolutional
maxpool
convolutional
maxpool
convolutional
52x52x64
52x52x128
52x52x64
52x52x128
26x26x128
26x26x256
convolutional
convolutional
convolutional
maxpool
convolutional
convolutional
26x26x128
convolutional
13x13x512
13x13x256
13x13x512
13x13x256
26x26x256
maxpool
convolutional
convolutional
convolutional
maxpool
13x13x512
convolutional
13x13x1024
convolutional
26x26x256
13x13x512
convolutional
13x13x1024
convolutional
13x13x256
13x13x256
13x13x256
13x13x128
26x26x128
26x26x384
26x26x256
26x26x27
convolutional
route
convolutional
unsample
route
convolutional
convolutional linear
yolo
13x13x512
convolutional linear
13x13x27
yolo
M-T YOLO v3

(c)


Input
416x416x3
convolutional
208x208x32
convolutional
104x104x64
convolutional
104x104x32
104x104x64
104x104x32
104x104x32
104x104x32
104x104x64
route
convolutional
convolutional
route
convolutional
104x104x64
route
104x104x128
maxpool
52x52x128
convolutional
52x52x128
52x52x64
52x52x64
52x52x64
52x52x128
route
convolutional
convolutional
route
convolutional
52x52x128
route
52x52x256
maxpool
26x26x256
convolutional
26x26x256
26x26x128
26x26x128
26x26x128
route
convolutional
convolutional
route
26x26x256
convolutional
26x26x256
route
26x26x512
26x26x256
maxpool
13x13x512
convolutional
13x13x512
convolutional
13x13x256
convolutional
13x13x512
convolutional linear
13x13x27
yolo
13x13x256
route
13x13x256
convolutional
unsample
13x13x128
26x26x128
route
26x26x256
26x26x384
convolutional
26x26x256
convolutional linear
26x26x27
yolo
Tiny YOLO v4

(d)



(e)

FIGURE 22. Architectures of original tiny YOLO and proposed modified tiny YOLO variants. [46]

TABLE 4: Comparison with existing similar work. [46]

Method	**Performance based on mAP on MOXA dataset**					
YOLO variants	YOLO v3	YOLO v4	Tiny YOLO v3	Tiny YOLO v4	M-T YOLO v3	M-T YOLO v4
Roy et al. [50]	63.99 %	-	56.27 %	-	-	-
Proposed	64.50 %	65.13 %	57.78%	61.70 %	59.78 %	63.17 %

MODEL 14

Here authors [47] use Face anti-spoofing detection system which has a critical function in face popularity systems. Many faces anti-spoofing detection algorithms had been designed for picture graph and replay attacks. Still, the face anti-spoofing detection strategies devised for the high-quality silicone masks assault continues to be rare. This study proposes a visually prominent and facial movement characteristic-primarily based on face anti-spoofing detection approach, which extracts units of facial movement functions from spatial and temporal domains, respectively. The obtained facial movement functions enter into a SVM classifier to distinguish the actual and silicone masked faces. Moreover, to validate the overall performance of the face anti-spoofing strategies, they have, in addition, constructed a silicone masks face movement video dataset. The proposed approach consists of a few spotlights in assessment with the competing face anti-spoofing algorithms. First, the overall performance of the proposed approach is advanced over the modern-day competing strategies beneath neath intra-dataset check environment. Second, our VSFM generalizes nicely among special silicone masks datasets compared to different competing algorithms. For the future work, they have proposed to extend the mentioned dataset and in addition layout a deep learning-primarily based totally face anti-spoofing approach for detecting silicone masks faces.

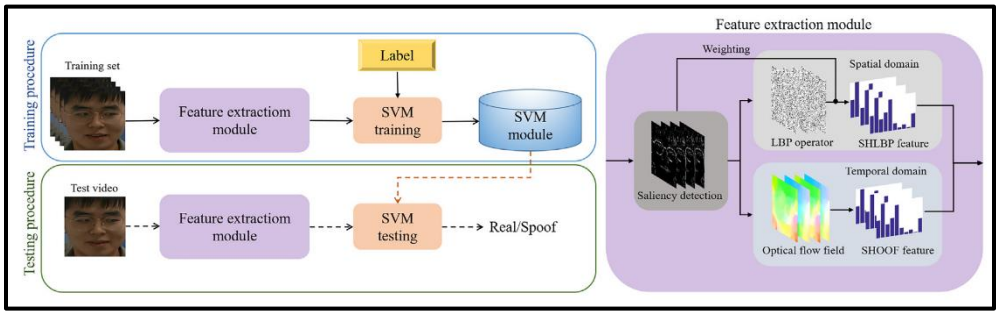


FIGURE 23. The framework of the proposed face anti-spoofing detection system [47]

MODEL 15

This article [48] introduces exploratory consequences for stay and pretend face discrimination method in frequency area, in which 2D and three-D DFT are computed over a hard and fast of selected face frames recorded via a number of means of a regular CCD and Kinect V2 camera. High Frequency Energy discriminator is used to show off the biometric traits of stay face. In can be concluded that three-D FFT is appropriate for processing the video and counter the replay attacks. The measured electricity content material due frequencies within the aforementioned hole cylinder within the frequency area defines accurately the required threshold. The facial video flow trivially reveals huge adjustments in μE. All the μE containing films are captured in enormously managed environments. The lights circumstance is eight saved synthetic and the topics aren't allowed to transport their heads freely in addition to need to preserve a near-frontal pose for the duration of the recording phase. Both the stay and pretend films captured are of 2D and 2.5D types. The function descriptors are experimentally demonstrated to correctly understand diverse sort of real and pretend attacks. The proposed approach is fast, robust, and achieves an excessive wonderful detection charge, even as preserving the fake wonderful detection charge low. The process, rather than acting on 2.5D may be prolonged to three-D overlaying datasets designed in IDIAP. As the Selection of database performs a critical function withinside the experiment, greater validation units might be designed, in future, on actual time to boom the robustness of the procedure.

TABLE 5: Dataset-I on 2D faces. [48]

Validation set	Training set	Test set	High frequency content in %	R-index	Live/Fake verdict (%)	
					Attack-1	Attack-2
1	10	20	75	3.5-4.5	90.5	75
2	15	15	80	5.5-6.0	91	77
3	20	10	85	4.5-6.0	87	78
4	25	10	75	6.0-10	86.5	80

TABLE 6: Dataset-II on 2D faces. [48]

Validation set	Training set	Test set	High frequency content in %	R-index	Live/fake Verdict (%)	
					Attack-1	Attack-2
1	10	20	37	3-4.5	85.5	75
2	15	15	45	3.5-4.0	90	77
3	20	10	65	4.5-6.0	87	78.5
4	25	10	49	6.0-7	88	77

TABLE 7: Dataset-I on 2.5D faces. [48]

Validation set	Training set	Test set	High frequency content in %	R-index	Live/Fake Verdict (%) Attack-2
1	10	20	60	3.5-4.5	88.5
2	15	15	58	4.5-6.0	92
3	20	10	45	4.5-6.0	87
4	25	10	60	6.5-8	82.5

TABLE 8: Name of the authors of the models considered; Keywords and technologies used in the respective models and system accuracy.

Model No.	Author name	Key words	Technology	System accuracy
1	Paulo Brito, Joao Pedro Fontes, Nuno Miquelina, Miguel Angel Guevara	Criminal Surveillance, Artificial Intelligence, Deep Learning, Gender Recognition, Age Recognition	Deep learning, Software libraries/frameworks- DLIB, OpenCV, CNTK; CIFAR-10, ImageNet, Pascal VOC, Microsoft COCO, Histogram of oriented gradients (HOG) [10], CNN's (R-CNN) [9]	86.466% accuracy achieved by DLIB framework. For ResNet50 backend 90.5 ± 8.4179% and for ResNet152 backend 90.4 ± 8.3994% accuracy in gender classification model.

				In age classification model for ResNet50 backend 73.7 ± 4.5253% and for ResNet152 73.5 ± 4.5669% accuracy.
2	Apoorva P, Impana H.C, Siri S.L., Varshitha M.R, Ramesh.B2	Automated surveillance camera, face detection, face recognition.	Haar cascade, OpenCV, XML files, AdaBoost.	-
15	Harsh Chaudhary, Ankit Shukla, Arusha Sharma, Alok Yadav	Face, Recognition, algorithms, identification, image, software	Local Binary Pattern Histograms (LBPH), LBP, OpenCV	-
10	KH Teoh, RC Ismail, SZM Naziri, R Hussin, MNM Isa, MSSM Basir	Face recognition, face detection, Deep learning	Open CV, Python, Deep Learning, Haar cascade classifier, TensorFlow, CNN classifier	face recognition on image is 86.7% and real time video is 91.7%.
4	Kavushica Rasa Nayagam, Kumarasiri S.D.D.C, Tharuka W.A.D.D., Samaranayake N. T, Dr. Pradeepa Samarasinghe, Samanthi E.R. Siriwardana	Criminal Identification, Gender identification, Age identification, Person and suspicious cloth identification, facial expression Identification.	CNN, Xceptional, Keras deep learning library, IMDb datasets, Haar Cascade, HOG (Histogram of Oriented Gradients), Neural Networks Deep Learning, LeNet architecture, Caffe model, MySQL database, NVIDIA CNN, CUDA toolkit, PyCharm IDE, DLIB.	95% for Suspicious hoody and mask detection. 92% for emotion detection. 85% for age identification and 96% for gender identification.
3	Xiaozheng Zhang, Yongsheng Gao, and Maylor K. H. Leung.	Appearance-based recognition, mug shot, police database, pose variation, virtual view synthesis, 3-D modelling.	3-D morphable model, Phong model, CMU-PIE database, principal component analysis (PCA), local binary patterns (LBP), Nearest Neighbour (NN).	Frontal view vs. probe view result is 46.67% and virtual view vs. probe view result is 100.00%

5	Qi Hong, Zhongyuan Wang, Zheng He, Nanxi Wang, Xin Tian, Tao Lu	Face recognition, person re-identification, face-masked disguise, face image quality assessment.	DiFRuNNT , GD-HASLR, MTCNN, l FaceNet, Deepface, FaceID3, PyQt5, AlignedReID method [27], MAFA dataset.	Accuracy for face masked-pedestrian: Rank-1=91.46%, Rank-5=95.51%, mAP=85.62%. This method has achieved considerable recognition accuracy in 64.23%
6	Jalendu Dhamija, Tanupriya Choudhury, Praveen Kumar, Yogesh Singh Rathore	Face recognition, Live video feed, Face detection, Biometrics.	Principal Component Analysis, SVD (Single value decomposition)-based algorithm, FisherFace, ORL database	Leaving-one-out method: 1. PCA= 80.7% 2.Fisherface= 98.4% 3.SVD= 96.6% 4.PCA+SVD+Fisherface = 99.5% Hold-out method: 1. PCA= 76.6% 2.Fisherface= 83.2% 3.SVD= 88.98% 4.PCA+SVD+Fisherface = 93.92 %
7	Manjunath Na, Anmol Nayaka, Prathiksha N Ra, Vinay.Ab	Distance Classifiers, Eigenface, Face Recognition	PCA (Principal Component Analysis), ORL database; Euclidean, MahalaNobis and Cosine distance classifiers	Cosine classifier: 79.19%. Euclidean classifier: 78.83%. Mahalanobis classifier: 62.50%.
8	Ratnesh Kumar Shukla, 2 Dipesh Das, 3Dr. Ajay Agarwal	Blurred and Noise Image, Deblur Inference Technique, Wiener Filter, RANSAC algorithm, Templates, Data storage, Surf and Matching Functions and Face Recognition Systems.	Deblur Inference Technique, Wiener Filter, RANSAC algorithm, Templates, FDEIN, point spread function (PSF)	Face recognition Accuracy is 97.4%.
9	K. Kranthi Kumar, Y. Kasiviswanadham, D.V.S.N.V. Indira, Pushpa Priyanka	Crime Detection, Neural network, Deep learning, Algorithm, Multi-task	MTCNN (Multi-task cascade neural networks), Samese Neural Network, Deep learning, CNN	The criminal database with 50 records is collected and trained. The accuracy achieved is 86%.

	palesetti, Ch.V. Bhargavi			
11	Mozhdeh Rouhsedaghat, Yifan Wang, Shuowen Hu, Suya You, C.-C. Jay Kuo	Low-resolution face recognition Small model Small data SSL Pixelhop++	Deep learning, Machine learning (ML), CNN, LRFRHop, PixelHop++, SSL (Successive Subspace learning), Entropy method, QBC (Query by Committee), Core-set method	By LRFRHop model accuracy is 89.48% with 3232 resolutions
14	Akhil Kuma, Arvind Kalia, Kinshuk Verma, Akashdeep Sharma, Manisha Kaushal	Face masks detection Deep learning YOLO Face masks dataset	mAP (mean average precision), MOXA dataset, tiny YOLO variant, M-T YOLO v1, M-T YOLO v2, M-T YOLO v3, M-T YOLO v4, tiny YOLO v1, tiny YOLO v2, tiny YOLO v3, tiny YOLO v4	YOLO v3: 64.50%, YOLO v4: 65.13%, Tiny YOLO v3: 57.78%, Tiny YOLO v4: 61.70 %, M-T YOLO v3: 59.78 %, M-T YOLO v4: 63.17 %
12	Guangcheng Wang, Zhongyuan Wang, Kui Jiang, Baojin Huang, Zheng He, Ruimin Hu	Silicone mask Face anti-spoofing Visual saliency Facial motion	Anti-spoofing algorithms, Silicone Mask Face Motion Dataset (SMFMVD), Visual Saliency mechanism with Facial motion characteristic (VSFM), ACER	Attack Presentation Classification Error Rate (APCER): 4.00, Bona Fide Presentation Classification Error Rate (BPCER): 2.00, Average Classification Error Rate (ACER): 3.00, Equal Error Rate (EER): 1.15
13	Dhiman Karmakar, Rajib Sarkar, Madhura Datta	Facial spoofing Micro-expressions Multidimensional Fourier domain Replay attack	Multi-dimensional Fast Fourier transform (3D-FFT, 2D-FFT), Multi-dimensional DFT, modified high frequency descriptor (MHFD), 𝜇E Score Indicator Component Dependent Descriptor (CDD), Histogram Oriented Gradient (HOG), Local Binary Pattern Variant (LBPV), Difference of Gaussian LBPV (DoGLBPV), Hough Transform of Blinking Analysis (HTBA), Hidden Markov Model (HMM), Discrete Cosine Transform (DCT) and Two-Dimensional Fast Fourier Transform (2DFFT)	-

TABLE 9: The pros and cons of the models examined

Model no.	Pros	Cons
1	Face detection (High accuracy), face recognition and object recognition (i.e., cars and guns). Age and gender recognition.	Large amounts of datasets take up a huge amount of space. If the object size is unknown, the scanning has to be done several times at different scales. Although this project's main purpose is age and gender classification, the results of the age model are not as capable as gender classification model.
2	Recognition precision and better discriminatory power, computational cost because smaller Images with only main features require least processing to train the Haar wavelets. The main advantage is that we use citizenship database which already exists.	The XML files do not spot rotated-objects. To recognize rotated-object, the Haar-Classifier needs to be trained to produce suitable XML files. This process is a bit complicated and takes a long time.
15	If database increased then the system accuracy rate is also increased.	In this system image is uploaded by internet so, there is no internet access then system not work. Cannot achieve very high recognition rate.
10	The author uses deep learning so the time consumption is law then Matlab.	If the distance is less than 60cm then system not work. If light is law, then accuracy is decreased.
4	Emotion detection (7 emotions approximately by 65%), Recognition using biometrics of face, aging, gender, large dataset	Hoodies and masks are included in suspicious clothing which are worn by common people and thus innocent people can be caught, insufficient information (people who commit crime for the first time)
3	Pose variation, face angles, 3-D modelling	Face aging, masked faces, light-effects, blurred images, insufficient datasets.
5	Masked or disguised face and unmasked recognition, accessorised face recognition, Person re-identification.	If the position of the occlusion is unknown, then the recognition rate drops drastically due to a big loss of facial features. Another drawback is the distance; a body or face will appear blurred in the image or video frame and therefore due to loss of sharpness, the results are not accurate.
6	Face identification, Facial features classification and identification using live video feed-based recognition	Illumination, Translation, Angle of The Photo, Rotation, Hairstyle, Accessories, Makeup, Background, Distortion etc. It has been tried to solve but to a limit which again does not give proper results and only adds to the complications and there is a chance of innocent people being caught.
7	MahalaNobis and Cosine distance classifiers produce high accuracy comparison results.	Face aging, the Euclidean tool used in this project is more of an ordinary tool and doesn't give high accuracy so only increases the number of results and consumption of time and resources.
8	This system improved accuracy up to 92% and face recognition up to 97.4%. This system can work with blurred and noisy images. Proposed	This algorithm works on images with natural and varying degree of artificially created motion blur up to blur direction 45 and blur length 60 respectively.

	algorithm gives best matching result. It worked well in Low Phase Quantization.	
9	The system considers threshold (which tells how accurate faces should be compared) parameter which can be adjusted according to our requirement. 24 hours monitoring is not required due to automatic SMS alert system	The criminal database with 50 records is collected and trained. The accuracy achieved is 86%.
11	A lightweight data-efficient low-resolution face recognition Model for resource-constrained environments, called LRFRHop, was proposed in this paper.	This system is not enough capable for detecting face ethnicity, age, and gender recognition.
14	In order to build a robust biometric system many safeguard approaches have already been developed by the researchers to nullify spoofing activities like print and replay attacks	Distance of face object from camera is kept 70 to 90 cm on average. The camera has an image resolution of 4616 X 3464 pixels with optical image stabilization. It has 20 MP resolution along with LED flash and high dynamic range mode (HDR).
12	This research proposes a visual Saliency and facial motion characteristic-based face anti-spoofing detection method,	This model has limited set of information so it requires to extend the proposed dataset and further design a deep learning-based face anti-spoofing method for detecting silicone mask faces.
13	The live videos naturally contain micro expressions like eye movements, small changes in muscle movements and other smooth and obvious changes in face sequences	As the Selection of database plays an important role in the experiment, more validation sets could be designed, in future, on real time to increase the robustness of the procedure.

CONCLUSION

The purpose of this review paper is to provide a well-organized and intensive literature review on facial recognition system. Summarizing all the models, the most common technologies used in the field are deep learning, DLIB, OpenCV, CNN etc. Combining all the results, we know that every project has its own specialty. Some of them focus on facial and other features extraction like face aging, angle, gender, expressions, accessories, mask, sunglasses, marks, beard, moustache, etc. while the others give high accuracy comparison results because of large datasets. Many of these models overcome problems like time consumption, image size and quality and improved resolution, image type-grayscale or RGB, distance, night light; suspicious actions, pose, clothing, objects etc.; low resolution and low light, large datasets of national and international criminals, detection of faces from a crowd of people. Irregardless of which, this technology in the contemporary world has achieved capability of recognizing face irrespective of age, expression, gender, lighting, low resolution, large datasets, masked faces, recognition in blurred and noisy images caused by camera and scene motion and is still being worked on so much more to improve its accuracy.

PROPOSED WORK

Every research has proposed work on a particular aspect but separately and thus has one or the other disadvantage that might lower the accuracy of the system. Therefore, we hereby propose a system which is capable enough to combine and cover all the flaws as much as possible and give the best possible outcomes in the least amount of time. The most important part of this job is to take necessary actions to alert the government / police, army or navy if required, as soon as possible, which will definitely be endeavored by us in future.

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Design And Development of Small Scale Solar Microgrid

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Abstract. Development of solar microgrid is beneficial the population that lives in the rustic and hilly. Arranging transmission cables will involve high cost. For the better management of the clean electricity, installation the solar microgrid will be a better choice, as environmental concerns are the one that take the number one in priority list now a days. It is obligatory for isolated solar microgrids to be able to deliver constant, reliable power as compared to grid-connected microgrids. Additionally, an energy management control scheme will be required to enhance the charging and discharging operations of the microgrid. This paper proposes model for installation of small scale microgrid with its cost analysis.

Keywords—microgrid, energy management, cost analysis

INTRODUCTION

A microgrid is a small-scale localized grid which works autonomously, making it an ideal power system for providing electricity in close proximities [1]. Whatever we do first of all we have to check whether it is good or bad for the environment. For the better management of the clean electricity, requirement of present scenario is installation of solar microgrid.

In a full day sunlight is not available in a constant form. It varies with time but if a solar microgrid is formed then it should supply constant power. As solar is intermittent energy source, a battery system should be incorporated and for the constant frequency, special type of controller should be designed. For the utilization of maximum sunlight energy, all the components need to be in synchronism in a good manner and all the components should be selected with the accurate rating [2]. For improving the utilization of the solar energy, the management of solar energy is important and for this we have to find the clear picture of what type of components is been used for the transfer of energy [3].

Solar microgrids play an important role for people who lives in remote areas [4]. Since rural areas are more prone to light cuts and people have to wait for longer time for power to return design your own, independent grid gives people who don't have access to 24-hour of electricity Solar grids in rural areas will also give a sense of the popularity of renewable energy sources, contribute lower carbon to the nature and a healthier planet. As we know that India is rich in sunlight this can also be seen in this given diagram in which the red part and yellow part indicate the maximum sunlight present in this area. Gujarat and Rajasthan have the highest solar radiation that's why solar project is highly effective in this area. Fig. 1 shows the scenario of solar potential in India while Fig. 2 shows the monthly average solar radiation in India.

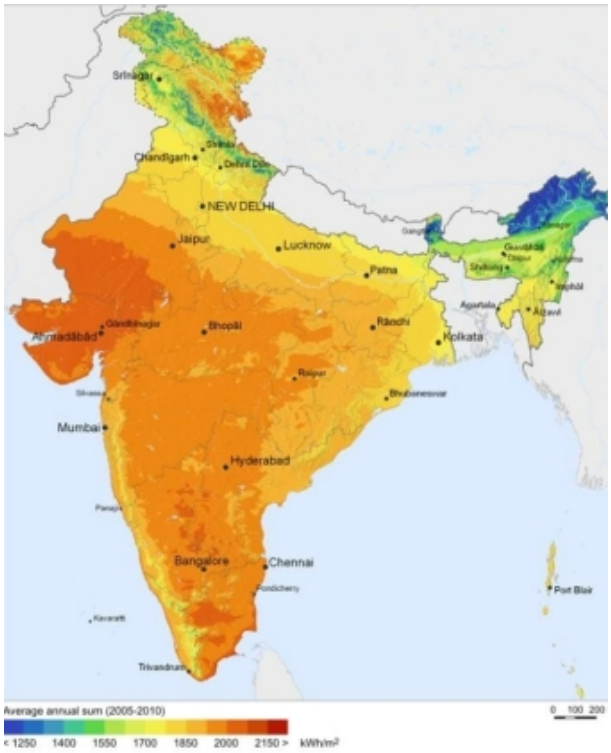

FIGURE 1. Solar potential in India (Source: helioscsp.com)

FIGURE 2. Monthly average solar radiation [1]

This paper gives an idea that how 24 hours of supply to all the connected loads can be provided? An isolated solar microgrid has been considered here in which battery bank is incorporated for back-up. The remaining paper is organized as follows. Section II provides a brief illustration of the commercial planning of microgrids with practical available resources. Section III presents technical aspects of microgrid designing. Section IV presents cost analysis & results. Lastly, Section V concludes the paper.

PLANNING OF MICROGRID

COMMERCIAL PLANNING OF MICROGRID

Modern energy system is highly complicated and unreliable due to the old infrastructure & new loads like electric vehicles, distributed generation system, the emergence of energy storage devices etc. Therefore, the planning, operation and control of microgrid (MG) becomes more technically challenging [5-6].

So, it becomes essential to work on different and important technical challenges to introduce microgrid model in power industry as commercial product. Currently MG is in its initial stages so it might take time to function vastly in country. There is need of permission from utilities for power transmission by using infrastructure of existing grid.

In the microgrid planning, economic issues are the highest priority. The efficient operation of microgrid depends upon the of success (efficiency) of small parts of different technology grouped with storage devices and other

reliability-based factor such as fuel or availability of source. Main problems at economic planning are power source selection, sizing and siting, selection of the energy storage devices, calculation of the real output power for the generating stations so that the total cost of the system can be controlled or minimized [7-8].

The microgrids are specially designed to supply its locally generated electrical (power), electrical and heat load in a nearby small remote area [9]. As generating area and service area comes under in small region, so the weather conditions like solar radiation and wind speeds relatively similar. consequently, it creates substant spatial relationship between renewable power generation and electrical load. For the improvement of the accuracy of modelling, the possible spatial correlation should be investigated.

There is need to resolve more issues by conducting research like economic transition between conventional grid and microgrid, agreement on use of infrastructure. Also, utilities and government need to provide support and encouragement to microgrid systems. It will be beneficial for both utilities & consumers because consumers are capable of producing power.

PRACTICAL DATA OF MICROGRID INSTALLED IN INDIA

Currently the Government of India (GoI) is taking steps to promote microgrid in India. In a draft issued by GoI on microgrid based on renewable energy, it proposes to establish at least 10,000 renewable microgrid and some mini-grid projects across the country, with total of 500 MW of the generation capacity to be generated by private company by 2022 in order to serve around 237 million people experiencing energy shortage badly in India.

The ministry of new and renewable energy (MNRE) financially supports in installation of solar microgrid by 30 percent of the project cost in around 63 villages so far, with aggregate capacity 1899 KWP [4].

The MNRE offers Rs 105/Watt for 10 KW DC current microgrid and it offers Rs 90/Watt for systems with module capacity of 10-250 kW [10]. The minimum warranty for systems is five years in the rural and remote areas of the country. In India, there are many keys player in the microgrid industry like MERA GAO POWER, DESI POWER, GRAM POWER, OMNIGRID and OORJA solutions. Most of these are solar-based microgrids established in states like Karnataka, Maharashtra, Uttar Pradesh and Bihar with smart grid technologies.

TECHNICAL ASPECTS OF MICROGRID

SOLAR CELL

Solar cell is a transducer which convert the radiation directly into the electricity. The I-V and P-V characteristics of a solar cell is shown in Fig. 3.

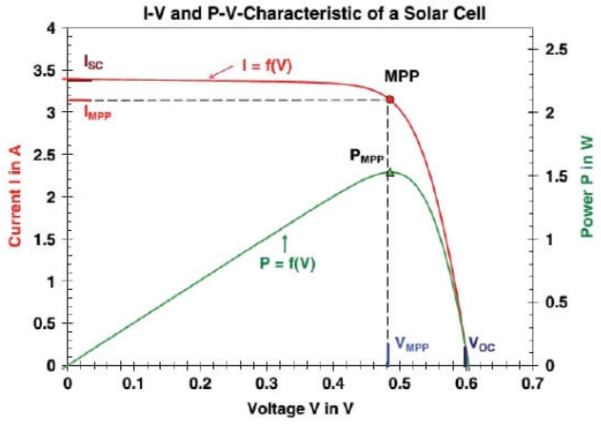

FIGURE 3. I-V & P-V characteristics of a solar cell

For Maximum Power, $P_{max}=V_{max}*I_{max}$

For maximum cell quantity, the fill factor should approach unity. Where the fill factor (FP) is expressed as -

$$FP = \frac{V_m I_m}{I_{sc} V_{oc}}$$

Where, V_{oc} = Open circuit voltage

I_{sc} = Short circuit current

Maximum efficiency $\eta_{max} = \frac{V_m I_m}{I_s A_c}$

Where, I_s = Incident Solar Flux

A_c = Cell Area

When temperature rises, short circuit current increases and open circuit voltage decreases.

DESIGNING SMALL SCALE MICROGRID PRACTICAL MODEL

The design of off-grid microgrid system generally consist of a generic photovoltaic cell, storage batteries, converters and loads as shown in Fig. 4 in this system the PV cells are illuminated to the sun lights for the absorption of the sun rays this solar energy converted into electrical energy by PV cells and stored in to batteries. Later it is transfer to the load by using converters.

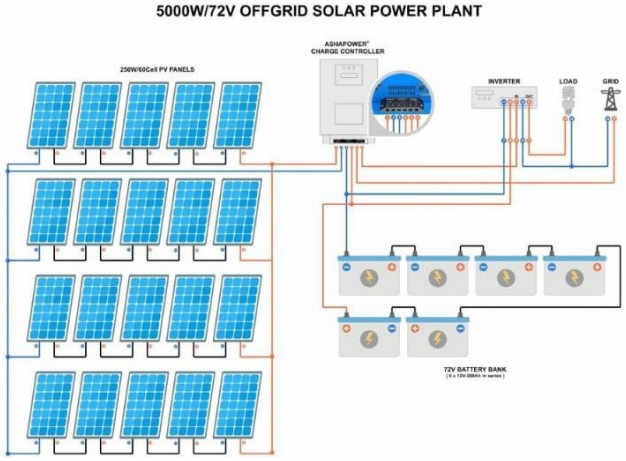

FIGURE 4. Off-grid Solar Microgrid

The renewable generation system will consist on photovoltaic solar panels connected in series and parallel, all of them building a PV system controlled by a central inverter. In this hybrid design, a Generic 5KWflat is considered. The capital cost and replacement cost are taken as Rs. 48750 and Rs. 44700 respectively. The maintenance cost is assumed to be Rs. 400/yr. De-rating factor of 90% is considered.

First, 5 panels are connected in series and after this group of 5 panels are connected in parallel. Total 20 solar panels and 60 cells are there and each panel is of 250 watt.

Total V_{oc} = 189 V

Combination current = 34.8 A

Power Developed by Solar Panel in kwh = Peak sun hour * 5kw * efficiency

1. Specification of Solar Panel
   - One panel: 250 watt.
   - Open circuit voltage: 37.82 V

- Short circuit current: 8.71A
- Maximum power current: 31.51 V
- Maximum power voltage: 7.93 V
- Solar cell efficiency: 17.2%
- Tolerance: ±3
- Operating temperature: ±40℃ - 850℃
- Maximum system voltage: 1000 V_{DC}
- Dimensions: 1650mm* 40mm.
- Weight:17 kg.

2. Battery

The batteries are used to store the electrical energy. The battery used is storage batteries. A battery bank not only provides the backup power but also helps in maintaining constant voltage across the load. Its capacity should be sufficient enough to store energy for operating the load during cloudy days and night times. It is a source of Energy. Electrical energy can be changed in to chemical energy and vice versa.

- C10 battery is used in proposed solar microgrid system.
- Capacity of each battery is 150 AH.
- Total 6 batteries are used in proposed system.
- All batteries are connected in series, and final voltage of battery system is 72 V.
- Fully charging time of battery is 2.11 hours.
- AH = [POWER*TIME] ÷ VOLT.

3. Net Meter

Net meter is used to record all the import and export data, with date and time.

- Net reading= Power export - Power import
- Cost of single-phase net meter = ~ Rs.2700

4. Hybrid Inverter

The controller ensures the stability of the microgrid and it also helps in reducing the operational cost within microgrid. It optimizes the optimizes performance and economics through least cost dispatch of assets and offers site-specific solutions with features such as configurable quiet hours and low-state-of-energy load shedding.

The converter is used for converting the electric power from ac to dc and dc to ac.it is used as bidirectional electrical power converter. A controller also controls the flow of power between the generation and the load in microgrid.

- Charge control - (MPPT 0 type)/(50A)
- Panel V_{oc}: 200V.
- Weight: 50Kg.
- PCB-20-MOSFETHS88X 340
- Output 230V 50HZ

RESULTS AND ANALYSIS

LOAD AND GENERATION ANALYSIS

The maximum amount of sunlight in a particular area for a particular period of time this is known as peak sun hour.

The net power generated by solar microgrid is equal to the summation of the total power generated by solar microgrid and total power consumption by load.

Power Developed by solar panel is:

kwh= Peak sun hour * 5kw * efficiency (0.85)

The efficiency of solar microgrid system is 0.85

The net power available to export in a month is shown in the graph shown in Fig. 5. The for peak sun hour, generation and consumption is also represented in Table 1.

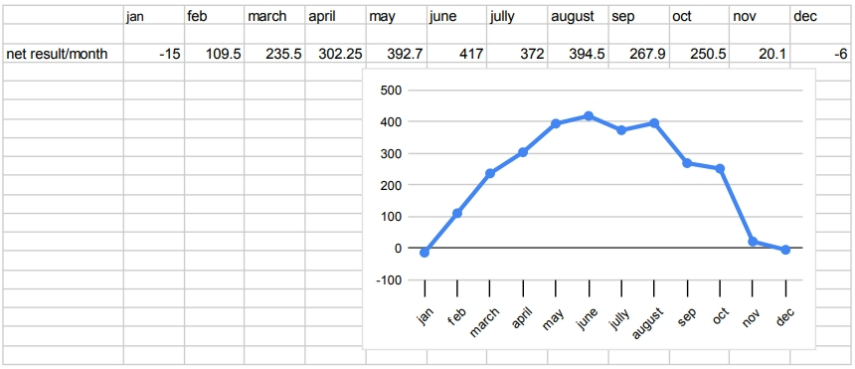

FIGURE 5. Monthly net available power

TABLE 1. Monthly Data of Peak Sun Hour and Power

	1 JAN	**1 FEB**	**1 MAR**	**1 APR**	**1 MAY**	**1 JUN**	**1 JUL**	**1 AUG**	**1 SEP**	**1 OCT**	**1 NOV**	**1 DEC**
Peak Sun Hour	2.8	3.8	4.9	5.9	6.6	6.7	6.4	6.5	5.4	5.02	3.1	2.8
Power Developed	11.9	16.15	20.825	25.975	28.09	28.9	27.4	27.90	22.93	21.35	13.17	11.8
Power Consumption	12.00	12.50	13.00	14.00	15.00	15.00	14.50	14.00	13.00	13.00	12.50	12.00
Net Result Per Day	-0.50	3.65	7.85	10.07	13.09	13.90	12.40	13.15	8.39	8.35	0.67	-0.20

COST AND ECONOMIC INDICATOR

In Table 2, cost analysis data is shown which can be considered as a benefit after operating this microgrid for 25 years. In this cost analysis, one time installation cost is considered. Rs. 7.5/unit for 10 years and for next 10 years Rs. 8.5/unit and for next 5 years Rs. 10/unit is assumed as electricity charge which will be paid by consumers for their usages.

TABLE 2. Cost Analysis Data

Year	**Initial Capital (in Rs.)**	**Battery Replacement (in Rs.)**	**Maintenance (Solar Microgrid) (in Rs.)**	**Total electricity consumption (Unit)**	**Total electricity Produced (unit)**	**Profit (in Rs.)**
0	300000			0		
1	0	0	1000	4830	7632	2267
2	0	0	1000	4830	7632	22674
3	0	0	1000	4380	7632	22674
4	0	0	1000	4380	7632	22674
5	0	0	1000	4380	7632	22674
6	0	0	1000	4380	7632	22674
7	0	0	1000	4380	7632	22674
8	0	0	1000	4380	7632	22674
9	0	0	1000	4380	7632	22674
10	0	0	1000	4380	7632	22674
11	0	45000	1000	5475	7860	18273
12	0	0	1000	5475	7860	18273
13	0	0	1000	5475	7860	18273
14	0	0	1000	5475	7860	18273
15	0	0	1000	5475	7860	18273
16	0	0	1000	5475	7860	18273
17	0	0	1000	5475	7860	18273
18	0	0	1000	5475	7860	18273
19	0	0	1000	5475	7860	18273

Year	Initial Capital (in Rs.)	Battery Replacement (in Rs.)	Maintenance (Solar Microgrid) (in Rs.)	Total electricity consumption (Unit)	Total electricity Produced (unit)	Profit (in Rs.)
20	0	0	1000	5475	7860	18273
21	0	50000	1000	7990	7990	14200
22	0	0	1000	7990	7990	14200
23	0	0	1000	7990	7990	14200
24	0	0	1000	7990	7990	14200
25	0	0	1000	7990	7990	14200
						Total = Rs. 480470

In above table 2, cost analysis is presented which shows yearly profit. In first year of installation, profit is Rs. 2267 only which is saving of electricity cost of that year only. After 10 years of operation, battery replacement cost has been considered as Rs. 45000 and Rs. 50000 for another subsequent 10 years.

CONCLUSIONS

- After the study of solar microgrid, it can be concluded that after installation of solar microgrid by assuming life of a solar panel as 25 years, an ample of money can be saved by selling power generated by prosumers.
- After installation of solar microgrid, environment harm will be decreased in a way that dependency on conventional grid will reduce. Power generation from the conventional source damages the environment by producing harmful gases into the nature.
- From calculations shown in previous section, it can be observed that installation of solar microgrid gives net profit of Rs. 480000. Apart from this, a saving of total Rs. 675000 will be there which was the extra expense of electricity when consumer was not a part of microgrid.
- After the installation of solar microgrid, consumers will have security of electricity 24*7 which makes it reliable.

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A Case Study Based On Evaluating Time to Collision For Traffic Safety

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Abstract: Safety on the road is essential, especially on urban streets with heavy traffic. Traffic problems are also common. Therefore, developing a formula for calculating traffic safety is crucial. The issues with the study are as follows: The street is used by both automobile traffic and many talented road users. Conditions are poor, and it's not very safe to drive along that section of the road. the time Prior to the accident, samples were collected using traffic recorders from Kotecha Circle to Indira Circle (TTC). This article begins by reviewing various places' traffic situations. However, field study findings show that in busy traffic situations, lateral separation between the leader and follower happens regularly. So, by incorporating lateral separation in the collision equation, we redefined the time to resolution (TTC). Three categories—dangerous situations, moderately safe scenarios, and entirely safe scenarios—are used to classify examples of TTC. The evaluation results for urban road traffic safety are then represented using the proposed traffic safety indictor.

Keywords: Time to collision, traffic safety, spot speed study, vehicle headway

INTRODUCTION

The urban expressway is the highest level of urban road in Chinese cities and is an essential vehicular route for drivers and commuters. Almost always, the amount of traffic accidents and the severity of the injuries and fatalities they cause are used to gauge how safe an expressway is to drive on. While accidents happen at random times and places, making it challenging to measure, evaluate, and compare this idea, transportation safety is a particularly challenging issue to study.

The TTC is the amount of time that would remain before a collision assuming both cars kept travelling in the same direction and at the same speed. Therefore, the amount of time required traveling the distance between the lead and following vehicles at their respective speeds is known as the following distance to follow time. This idea was first presented by Hayward (1972), and it is widely studied, for instance, in Hydén (1987). The involved vehicles must be on a collision route, though not necessarily in a car-following scenario, for the TTC computation to be possible. According to research, there is a clear statistical correlation between proximate safety indicators and accidents2–7. For research on expressway traffic safety that aims to evaluate how safety levels change over time in response to various road settings or traffic circumstances. It is essential to apply proximal indirect safety indications. These "safety

indicators" are typically described as traffic measurements that have a statistical relationship with the amount of accidents on the roads in a specific area. These numbers are based on how close people were to one another in time and space during safety-critical situations.

LITERATURE REVIEW

It is challenging for researchers to measure TTC threshold value under various traffic conditions since it is related to TTC distributions. According to Sheng Jin [1], the idea of a traffic safety indicator and assessment method that can be indirectly utilized to evaluate expressway traffic safety needs to be developed primarily for this reason. The TTC value is generally recognized in these indicators as a very valuable and reliable safety indicator for traffic conflicts on highways.

The car-following theory, according to Sheng Jin[2], Leading drivers are more aware of a leading driver's lateral movement or the lane-changing behaviour of a nearby car when there is a lateral separation between them (NV). As a result, the main principle of the car-following hypothesis, according to which vehicles move in the middle of the lane, is unfounded. The lateral separation between the leader and following is the result of the off-centerline effect, and the lateral separation distance may rise with increasing lane width. The term "time to collision" (TTC) was coined to describe how following drivers detect changes in the lateral distance between the leader and the follower. This new model, which is based on the stimulus-response concept, models driver behavior more accurately.

The car-following theory, according to Sheng Jin [3], The TTC is a commonly utilized visual function that is frequently used to avoid obstacles, analyze driving behavior, and assess potential conflicts. TTC describes how the following motorist feels about the safety of the leading car while driving. Deceleration and acceleration are closely tied to the TTC, according to various psychological principles, facts, and research. On the one hand, a smaller TTC causes a faster foot to brake pedal movement and a greater deceleration. A negative TTC, on the other hand, causes the following driver to accelerate in order to keep up with the leader's speed.

METHODOLOGY

The principle of “car following” refers to the precise movement of vehicles moving side by side in a single lane. Such a concept is predicated on the idea that every driver responds to a stimulus from the vehicle in front of them in a particular way. The inputs of the majority of car-following models are believed to be distance, speed, and relative speed. However, it is essential to remember that car-following behavior is a human activity and that drivers do not directly access parameter data like distance and relative speed. Michaels was the one who first proposed modeling cars using the LV’s visual size (11). Car-following models based on visual parameters have already been proposed by a few researchers. Car-following modeling uses visual data more and more. When there is a wide gap between the two cars travelling side by side, it is difficult for video to record the positions and speeds of both the leading and the following vehicle at the same time. As a result, TTC should be computed using.

DATA COLLECTION

The field data used in this study came from a video study done in Rajkot. Obtaining traffic information, such as speed, volume, and time occupancy, is simple with the use of video image processing technologies. The movie was Similar to this; the dataset used to calculate TTC is obtained and includes information on speed, headway, vehicle length, and vehicle type classification. Data was collected under a range of traffic conditions between 7:00 a.m. and 10:00 a.m. (including morning peak hour) (including evening peak hour). There are three prospective study locations chosen. While Location 3 is located halfway between the kotecha circle and the indira circle, Locations 1 and 2 are on the kotecha

circle's entry side. The dataset for TTC computations, which contains fixed traffic metrics for each station such speed, headway, vehicle length, and vehicle categorization, is obtained using similar methods.

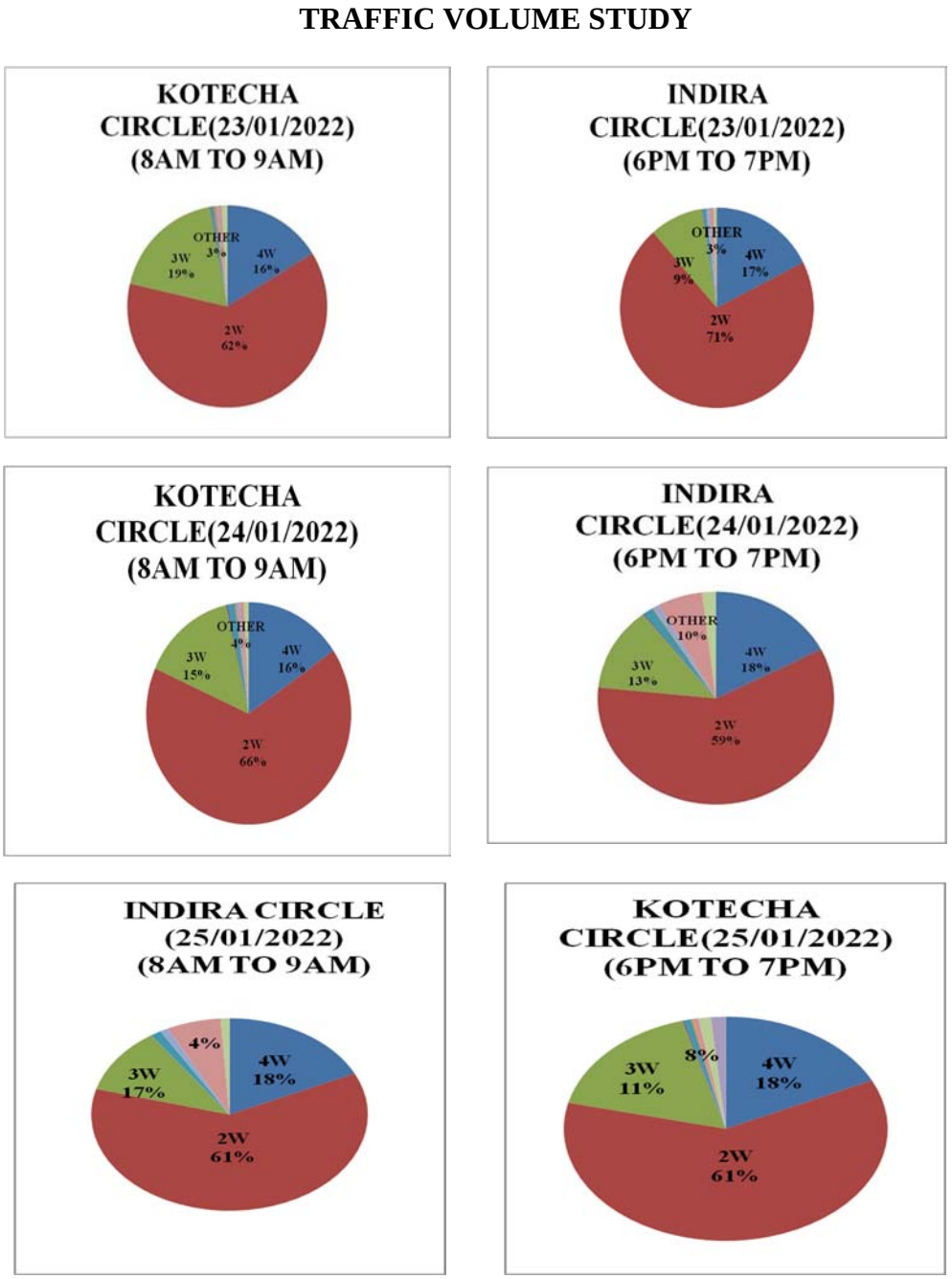
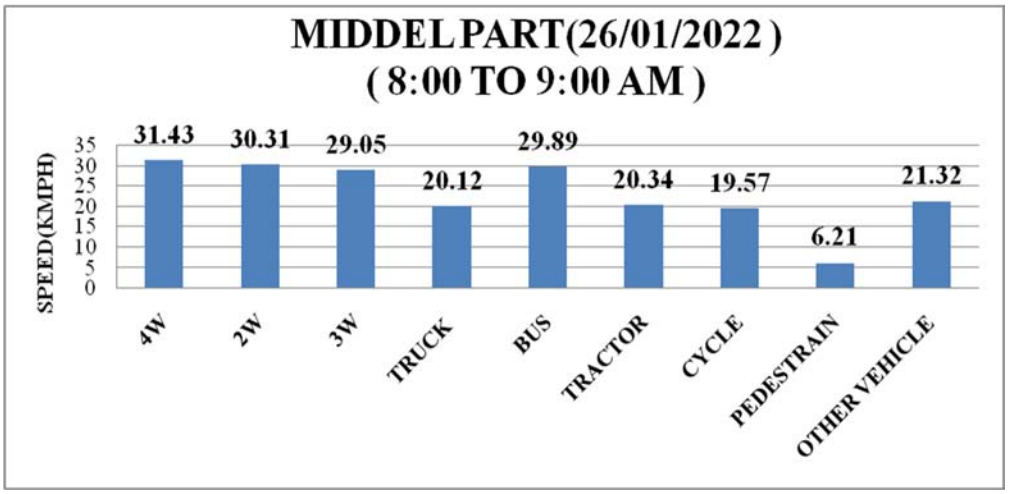
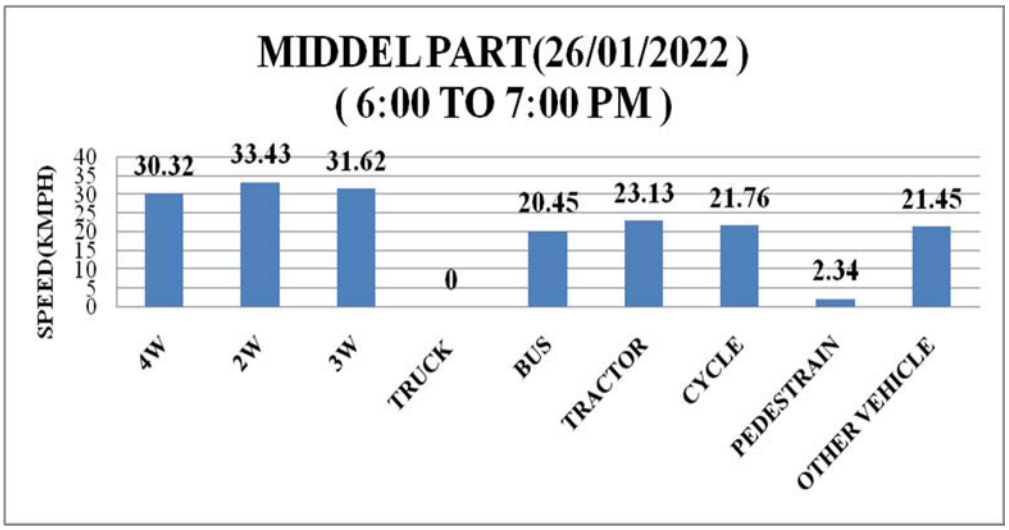


FIGURE 1. traffic volume data at different location and time

SPOT SPEED STUDY




MIDDEL PART(26/01/2022)
(6:00 TO 7:00 PM)
SPEED(KMPH)
40
35
30
25
20
15
10
5
0
30.32
33.43
31.62
0
20.45
23.13
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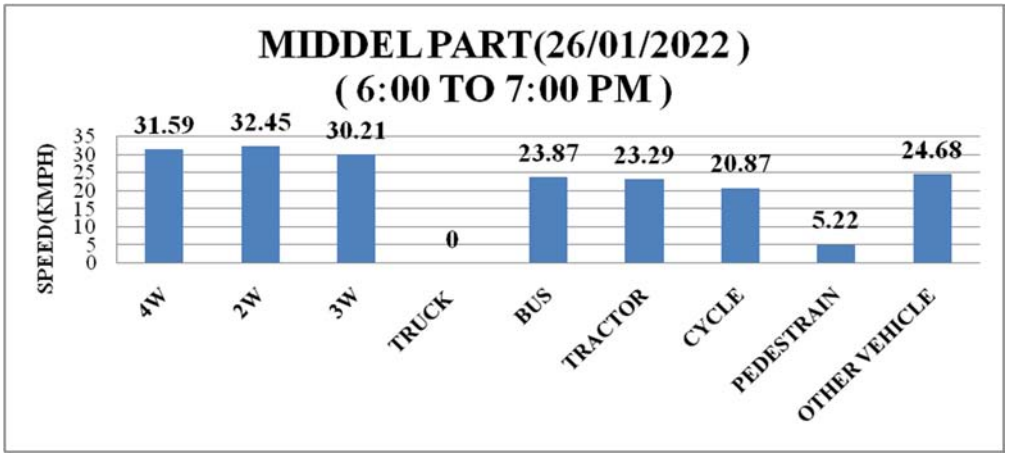
TRACTOR
CYCLE
PEDESTRAIN
OTHER VEHICLE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SPEED(KMPH)
35
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32.45
30.21
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23.87
23.29
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TRUCK
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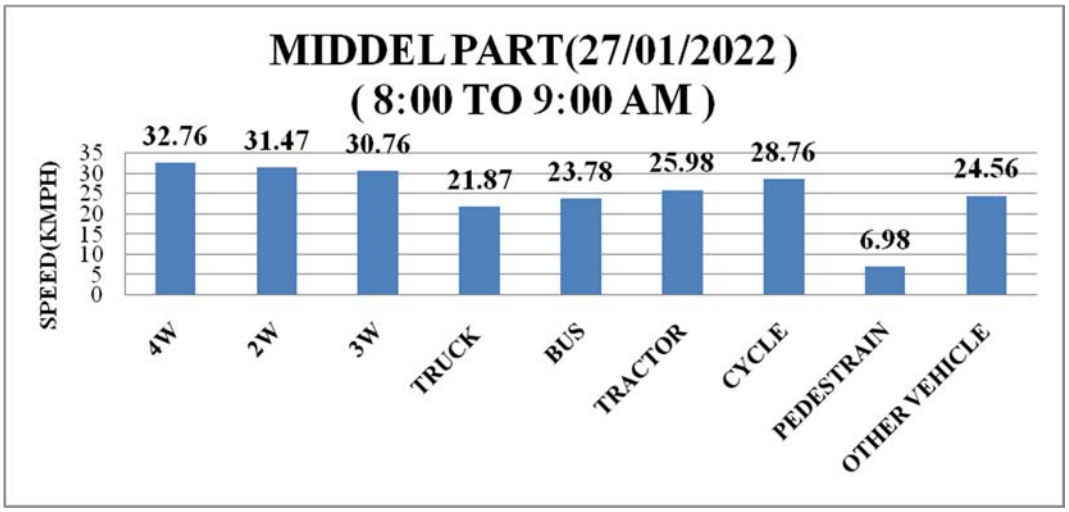
PEDESTRAIN
OTHER VEHICLE


MIDDEL PART(27/01/2022)
(8:00 TO 9:00 AM)
SPEED(KMPH)
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20
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32.76
31.47
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21.87
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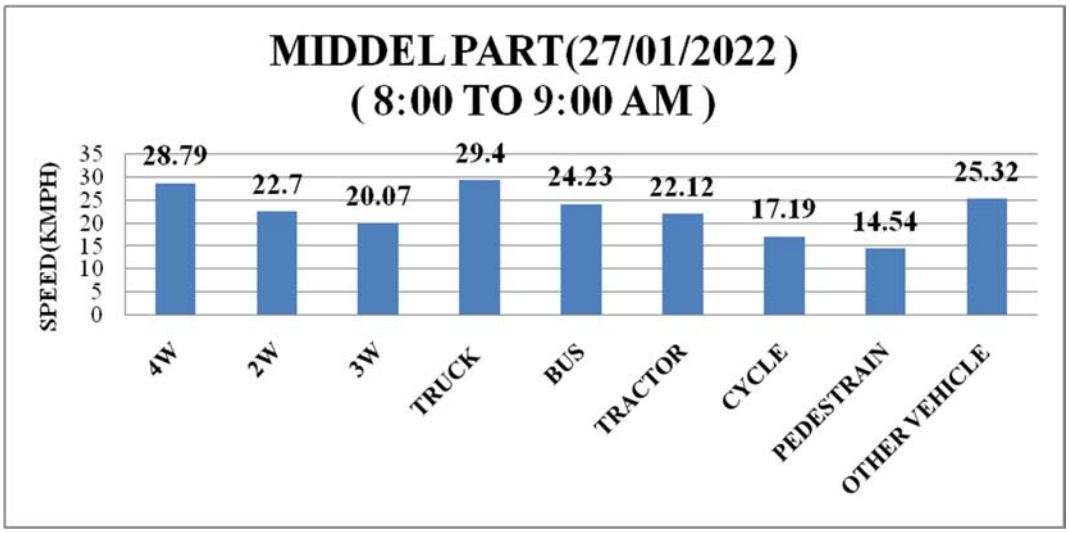
BUS
TRACTOR
CYCLE
PEDESTRAIN
OTHER VEHICLE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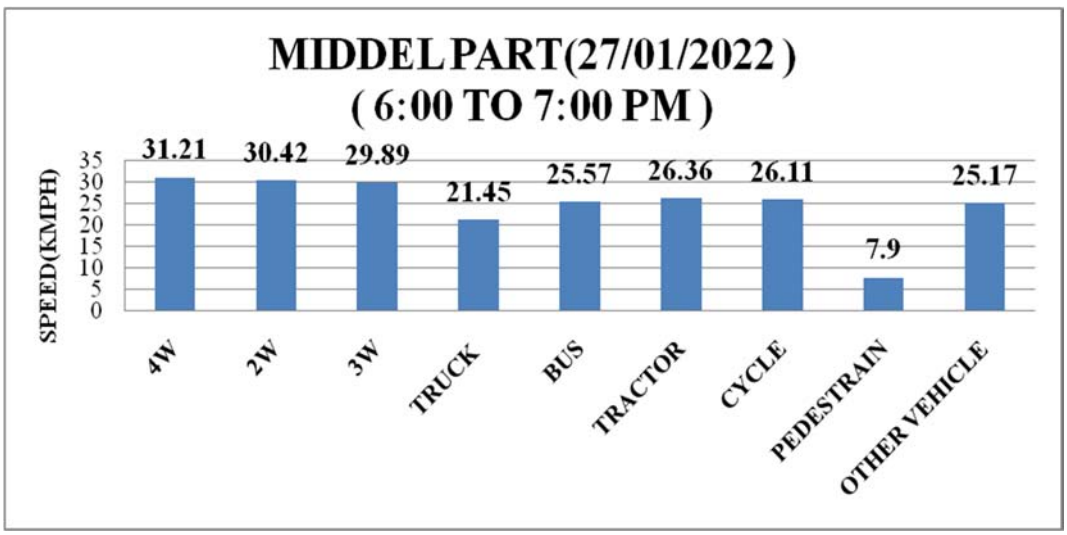
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OTHER VEHICLE

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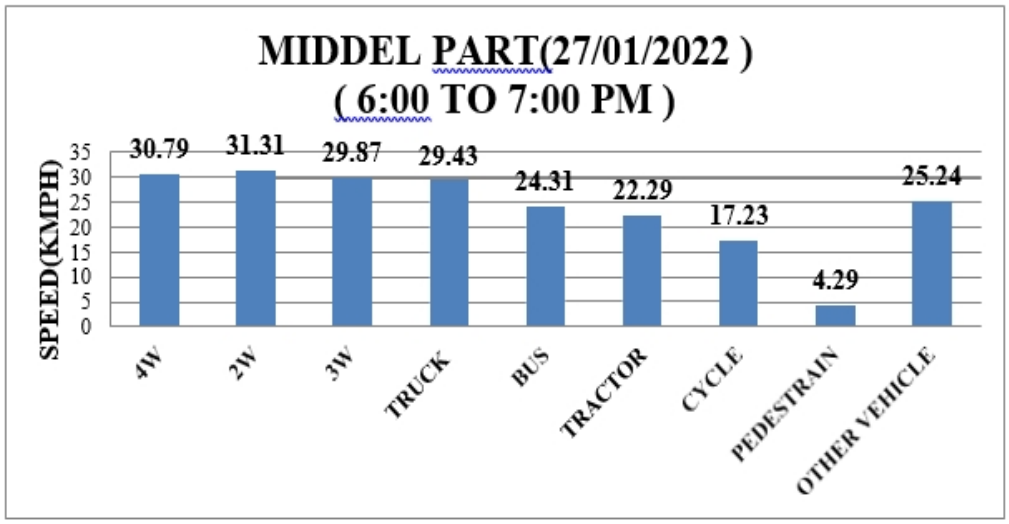

FIGURE 2. Spot speed study data at different location and time

TIME TO COLLISION

Calculation Car to Bike

$$TTC_i = \frac{TH_i \cdot v_i - VL_{i-1}}{v_i - v_{i-1}} \quad \forall v_i > v_{i-1}$$

Where, "Total Vehicle headway(TH_i) =1.56, car speed (v_i)= 36.61 kmph, bike speed(v_{i-1})=27.63, standard vehicle length of car(VL_{i-1})=3.7m", so as per the form

$$TTC_i = (1.56*36.61)-3.7 / (36.61-27.63) = 5.95 sec$$

CONCLUSION

The most important contribution of the current work is the inclusion of lateral pain in car-following models, which was previously mainly neglected. The study's findings point to a number of significant conclusions. This study analyses the frequency of vehicle crashes under various conditions using an assessment method for evaluating urban road traffic safety. Two urban highways were used to collect TTC sample data. Since the average vehicle headway samples are all more than 2, I come to the conclusion that this system is secure enough to prevent potential conflicts.

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IoT-based saline level monitoring system

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Abstract. Saline treatments for dehydration and other medical conditions are frequently used during the course of medicine to help patients feel better. Nursing staff must constantly monitor the saline level when patients are fed with saline. Patients are frequently injured as a result of staff negligence because they fail to recognize when the saline level in the container has reached its maximum. There are many cases where patients are being harmed due to the staff's inattentiveness, as their absence does not notice the completion of the saline level in the container. As soon as the saline in the container is finished, an issue with blood backflow occurs. So, an IoT-based saline level monitoring system was created[9] to prevent injury to the patient. The suggested variant has a sensor built in that continuously detects the saline droplets. In order to keep track of patient safety, the sensor buzzes the medical staff whenever it fails to detect drops for a predetermined amount of time.

INTRODUCTION

The node MCU microcontroller is a programmable circuit; unlike other circuit boards, the node MCU does not need additional hardware to upload a code and is crucial in creating monitoring systems [8]. When patients are fed with saline in hospitals as part of the treatment procedure, they must be closely watched. The nurse may frequently neglect to check on and replace the saline bottle as soon as it is empty due to the busy continuous routine of the personnel attending to the high number of patients. Because of the imbalance between the blood pressure and the pressure within the empty saline bottle, the blood rushes back to the saline bottle through the intravenous tubing. This may cause the backflow of blood from their vein through the cannula resulting in the reduction of patient hemoglobin levels and shortage of red blood cells.

In hospitals, patients encounter this issue quite commonly. This might possibly result in the patient's downfall. Therefore, creating a saline-level monitoring system that reduces patients' reliance on nurses is necessary in order to solve this issue.
This technology buzzes the alarm of the nurse's or the appropriate authorized person's mobile phone once the saline in the bottle is 90% empty (empty percentage adjustable). Additionally, a mobile application displays the patient information and bed number (patient name, current fluid name, fluid list, Reaming Percentage of current fluid)

LITERATURE REVIEW

Applications in the sector of medicine. alleviating dehydration, injecting it into veins, and thinning various medications for injection. It is most frequently used as anticipated saline, a sterile solution containing 9g of salt per liter (0.9%). High and low focuses may occasionally be used as well. Saline is acidic with a PH of 5.5 (mainly due to carbon dioxide that has been broken down).
The patient's intravenous fluid intake is the responsibility of qualified medical professionals or nurses. There is currently no automatic technology that can identify when the saline in the saline bottle has been used up when

treating a patient. This paper does more than just alert the nurses that it is finished; it also focuses on managing the outflow flow of blood into the empty saline bottle[6].

EXISTING APPROACH

Nurses are in charge of caring for patients in the current healthcare system. They are the ones that manually control the flow of saline by using a roller clamp and checking the saline level. The tube is compressed and the saline flow is stopped or slowed when the clamp is rolled upward. It releases the tube and accelerates the flow of fluid when it is rolled downward. There is currently no method in place that will lessen the need for nurses to check the saline levels. Therefore, the creation of an autonomous saline-level monitoring system is required [5].

PROPOSED METHODOLOGY

SYSTEM REQUIREMENTS

Load sensor:- The load sensor is mapped initial weight and with the node MCU, it will store the initial value in the firebase (real-time Database)[3].

NODE -MCU:- Node-MCU mapped every 30 seconds with a current weight with the initial weight and calculate the percentage[7]

Android Application:- Android Application runs its background service if the level of the bottle is 90% empty (empty percentage if flexible) at that time android application buzz the default alarm of the mobile phone and also will provide multiple bad management systems [4].

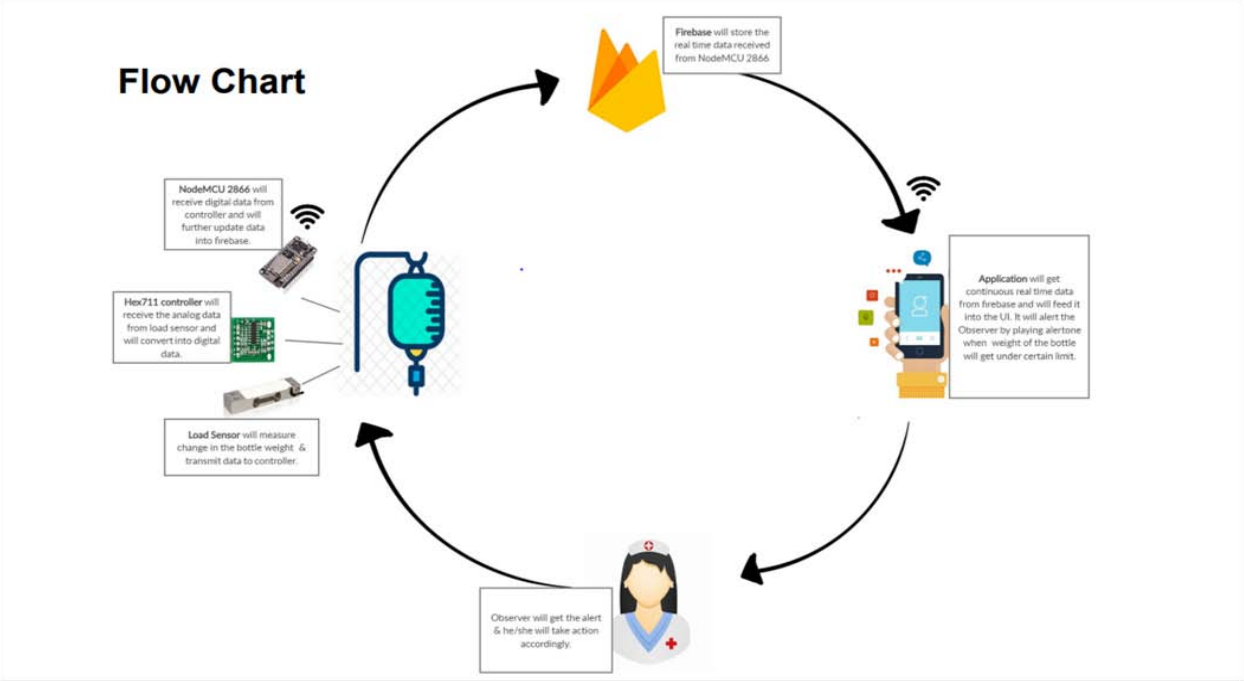

Figure 1. System architecture

An algorithm of working of the system

- Obtain 5 voltage from the battery's power supply.
- Input 5 Voltage to Load sensor.
- store initial value in DB and Update every 30 seconds(This time can be updated)
- If (Current Percentage >= Defined Percentage)
  Ring the buzzer for 5 minutes on their mobile or the user can stop

CONCLUSION

Nurses will spend less time manually monitoring patients who have received saline injections when using an automatic saline monitoring device. The suggested structure is entirely automated, therefore there is very little need for human intervention or efforts in the middle. As there won't be a need for the nurses to periodically check the level of saline in the saline container, which is a risky task, it will be more helpful at night. Additionally, it prevents the backflow of blood into the saline container, which can occasionally have the deadliest effect, from harming the patients. This will make the medical caretaker's concern about ongoing observation at an affordable cost lessened.

FUTURE SCOPE

In the future, it can be implemented with more features With hardware that will pull out the needle automatically with some CV models.

The smart health system, which provides data on body temperature, blood pressure, heart rate, and pulse rate, may also be a part of it. This assists in determining whether or not the patient needs another saline bottle[2].

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Demand Side Management in Electrical Network: A Review for Theoretical Framework

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Abstract. This paper presents a detailed literature review of Demand Side Management (DSM) methods. The existing methods are analyzed on the basis of proposed techniques' merits and demerits. A summary for the application areas of each method of literature is presented in this paper. Many existing DSM methods are proposed in context of residential load management which is a part of smart home automation. Various DSM methods are proposed for optimal scheduling and energy management in electrical network. The objectives of DSM, performance parameters and challenges faced in DSM are discussed. This paper presents a study of existing DSM techniques from theoretical aspects.

Keywords: Demand Side Management, Smart Grid, Load analysis, Energy efficiency, Demand Response

INTRODUCTION

Demand Side Management (DSM) are the methods that influence consumers' choice of electricity usage pattern. [1] is a review-based study that discusses opportunities for implementation of Demand Side Management (DSM) programs by: structural changes, integration of grid and financing capabilities. In [2], Glow-worm Swarm Optimization (GSO) and Support Vector Machine (SVM) aims to minimize electricity tariff and peak hour demand for a battery-based energy storage system and a solar photovoltaic (PV) generation storage system. In [3], DSM strategy accounts for environmental impact and customer satisfaction. The objective to minimize operation cost, emission pollution, load curtailment cost and power output deviation cost is successfully achieved. In [4], an energy management program implemented by a DSM algorithm, aims to increase system stability by damping out oscillations using electrical springs, improve power quality and provide power optimization to the system, for a grid-tied photovoltaic system. In [5], a proposed price-based DSM scheme minimizes consumer cost for a residential scenario. [5] presents extensive analysis of rooftop PV system using pilot survey, with an aim to study the mindset, motivation and fears of consumers and prosumers, the whose distinction has been clearly analyzed. [6] is a review work of an extensive study of Artificial Intelligence (AI) and Machine Learning (ML) for use in Demand Response (DR) techniques. The application of Artificial Neural Network (ANN) and Reinforcement Learning (RL) has been detailed along with the best suited applications. Various types of AI methods have been studied including Game Theory, Automated Negotiations, Unsupervised Learning, Supervised Learning, Reinforcement Learning, deep ANN, hidden layer ANN, Swarm AI, Evolutionary AI, etc. The work of [7] presents optimization algorithm to reduce consumer cost and greenhouse gas (GHG) emissions for low-voltage residential load. The aim is to apply load shifting to non-critical loads. In [8], by the use of game theory approach, an algorithm is developed for a load billing scheme that makes the connected consumers to compete for minimum load bill. In [9], game theory with objective to optimize the cardinality to minimize the peak to average ratio. As in [8], [9] also utilizes the existence of Nash equilibrium and Newton method. [10] uses game theory approach with the use of blockchain technology for distributed energy management, making the system robust and efficient.

To implement game theory, a special network evolutionary game could be developed, as in [11], with custom algorithms. In [11], For some communities working as controllers, intermittent control is designed, in an open loop manner. Another networked evolutionary game, implemented in [13], uses the theory of semi-tensor product. In a networked smart grid, where all users and utilities are constantly communicating, a closed loop feedback-based system keeps system stable and oscillation-free. In [12], an initialization-free based algorithm is used to minimize unpredictability and abrupt changes in the smart grid system. In [14], a Day Ahead (DA) load shifting approach is used to modify energy demand profile. This approach uses Symbiotic Organism Search (SOS) algorithm that is tested on various consumers- residential, commercial and industrial. [15] demonstrates an approach based on stochastic linear programming game with focus on user interaction and energy trading decision. In [16], an automation-based particle hopping algorithm is used for load shifting. The concepts of load particle velocity and particle density help to establish the model in an energy storage system and then to test it by simulation over multiple scenarios. [17] presents Policy Driven Demand Response (PDDR) scheme based on Deviation maximization algorithm. The analysis and simulation are performed over energy usage data of Nanjing City, China. The system aims to integrate multiple methods into one with the objective of maximizing efficiency and minimizing cost. In [18], demand response is tested for two electricity market, which are, day-ahead market and real-time markets. The system performs simulation in form of Markov Decision Process (MDP) problem solved by row generation algorithm. In [19], five schemes have been presented that aim to minimize- cost function and total energy function of the system. An optimization algorithm is proposed through which each subscriber's DSM module is used to schedule its schedulable load. The consideration for rebound peak in the system makes it stable and Applicable to centralized as well as distributed demands.

In [20], evaluation of generating capacity is performed based on Reliability Test System of IEEE-RTS. Based on the inferences, the analysis and application of load shifting algorithm is performed for multiple sectors: agriculture, large user, residential, industrial, commercial and finally for a combined total system load. [21], demonstrates a DSM system that aims to minimize demand and cost, and tests it over residential, commercial and industrial loads by simulation. [22] has uses a thermal energy management system (TEMS) for peak load shifting of electricity demand, especially for ground source heat pump (GSHP). In [23], a two-level optimization algorithm is proposed that works over: edge cloud and core cloud, to reduce cost and improve performance respectively for an autonomous DSM system. In [24], the reduction in peak to average ratio and in cost have been achieved by genetic algorithm. Current trends in smart grid and DSM have been analyzed. [25] proposes a system in which peak shaving helps optimize demand response while Fixed Series Compensation (FSC) ensures efficient utilization of transmission capacity. The strategies of- demand shifting, curtailing the peak, and onsite generation are used to minimize cost function. In [26], particle swarm optimization algorithm (PSO) and grasshopper optimization algorithm (GOA) are used to reduce peak hour demand and consumer cost. In [27], the proposed day ahead voltage profile improvement is works by shifting flexible loads using demand and generation forecast information. [28] proposed a demand response strategy that uses Reinforcement Learning (RL) and Fuzzy Reasoning (FR) for residential consumers. The RL is used for learning by feedback and FR for reward functions. In [29], the proposed DSM scheme based on hybrid bacterial foraging and particle swarm optimization (HBFPSO) algorithm has been used to minimize electricity cost, Peak to Average Ratio, user discomfort, and carbon emissions due to electricity generation. [30] has proposed a DSM based smart energy management system (SEMS) that works with Internet of Things (IoT) to control tariffs and encourage users for participation. In [31], a peak scheduling problem is solved by a proposed algorithm which is a combination of ant colony optimization (ACO) and teaching learning-based optimization (TLBO). In [32], a flexible scheduling framework has been proposed using which a study of social and technical factors that influence smart grid optimization has been done. In [33], a load scheduling algorithm has been proposed for residential load to maximize efficiency of power consumption. This objective is achieved as a combination of reduction in electricity consumption cost and cost due to user discomfort. In [34], pricing and consumer preferences are accounted for using a proposed forecasted day-ahead DR technique based on home energy management controller (HEMC) and day-ahead grey wolf modified enhanced differential evolution algorithm (DA-GmEDE) for residential buildings. [35] provides and extensive study of review on Demand Response Management (DRM) based programs, strategies and models for application of 5G technology in Smart Grids. In [36], a hybrid heuristic-based algorithm has been proposed for DR program to implement DSM strategy in residential sector, especially in smart homes. The objective has been to minimize electricity bill costs, carbon emissions, PAR, delay time, and maximize user comfort. In [37], a contract-theoretic DRM strategy has been proposed for residential consumers. Labor economics principles have been used to maximize market profit and consumer profit. [38] has proposed a DSM program based on blockchain strategy in which integration of smart meters, IoT devices and use of renewable sources of energy generation takes place within a microgrid.

In [39], the proposed strategy of AI-empowered Recommender System for Renewable Energy Harvesting (AI-RSREH) works in a Solar PhotoVoltaic (SPV) system and a wind energy system that could be used in residential houses. In [40], a Demand Response algorithm is used to integrate renewable sources of energy into smart grid system. The proposed strategy aims to minimize stability by converging system solution to optimal values at a much faster rate than conventional methods. In [41], an unbalanced distributed smart grid was addressed using a Pareto efficient model. The model worked using real time pricing based on user incentives. Energy consumption scheduling (ECS) based on a Stackelberg game algorithm helped by maximizing profit to the utility and minimizing cost to users. In [42], a tariff-based Demand Response strategy has been proposed that could integrate Renewable Energy Sources (RES) with utility, battery storage systems and Diesel energy systems especially in rural regions. [43] has proposed a heuristic-based programmable energy management controller (HPEMC) for energy storage systems when connected with Renewable Energy Sources (RES) in residential buildings. [44] has proposed an internal market-based cloud computing strategy minimize revenue for virtual power plants (VPPs) and for users. In [45], peak load shifting and load scheduling have been addressed using real time pricing scheme based on heuristic algorithms for a smart building infrastructure for residential loads. In [46], the proposed Demand Response model based on deep learning works by load scheduling in residential sector. In [47], the proposed demand response strategy based on genetic algorithm aims to minimize electricity cost, operating power of equipment, and dynamic pricing for household management. In [48], load billing and load monitoring have been addressed to detect fraudulent customers. In [49], power management is addressed in a Virtual Power Plant (VPP) using artificial neural-network and federated learning strategy for Electric Vehicle (EV) platforms. In [50], the proposed fast and accurate hybrid electrical energy forecasting (FA-HELF) framework is used for forecasting of energy demand in a smart grid. [51] aims to fulfil multiple objectives of improving electricity bill, waiting time of appliances and peak to average ratio using nature inspired techniques of: binary multi-objective bird swarm optimization, and a hybrid of bird swarm and cuckoo search algorithms. In [52], a Time of Use (ToU) based energy pricing mechanism has been proposed to reduce cost of generation and cost to the consumers for low energy consumers. In [53], a smart controller for demand side management in smart grid has been proposed that optimizes reactive power of the grid. An elephant herd optimization–firefly (EHO–FF) evolutionary algorithm is used to provide demanded electrical power while minimizing the flow of power by increasing the number of distributed generation (DGs) units at the best suited locations. In [54], a reinforcement learning framework and a two-stage Demand Response Management (DRM) optimization strategy are used to establish a power company selection and the DRM processes in a competitive market scenario. In [55], demand response management has been addressed by the use of a proposed competitive algorithm that takes into account user choices and flexibility of operation. [56] presents a Smart Residential Electricity Distribution System (SREDS) that uses Flat Rate tariff, Time of Use tariff or Real Time Pricing to implement DR strategy in Smart Residences (SR). In [57], the proposed hybrid GA–PSO algorithm aims to reduce PAR load demand ratio and save electricity bill of day ahead market. In [58], the proposed hybrid power system (HPS) automates and integrates the use of multiple renewable energy sources: PV system, solid oxide fuel cell (SOFC) with Ni-MH battery with a variable load. [59] has proposed use of fuzzy logic controllers for the coordination of charging and discharging of Electric Vehicles (EVs) in smart grid. In [60], the proposed energy management system aims to reduce electricity cost and increase user satisfaction in residential homes. The use of Power Limit Management (PLM) and Smart Electrical Task Scheduling (SETS) algorithms automatically switches the loads on and off depending on available electricity by load scheduling method. In [61], the pricing schemes of Critical-Peak-Price and Real-Time-Price have been used to reduce electricity cost, energy consumption and peak demand while improving user comfort. [62] has proposed a meta-heuristic based home energy management (HEM) that aims to optimize energy consumption, electricity cost and PAR for residential complex of multiple homes. In [63], the proposed Fuzzy Long Sort Term Memory based Crow Search Optimization Algorithm (FLSTM–CSOA) is used to provide best communication technology in terms of spectrum available with minimum delay. In [64], a calibration-based energy distribution has been proposed that uses Horizontal Block Shifting and Vertical Column by Column Shifting to balance load on a daily basis in a tree network. These methods and techniques applicable to any of the system, but it is not so. Thus, some system may support renewable energy system and others not. Some are suitable for cost analysis and some for power system analysis. This requires thorough experimentation and analysis. Therefore, this paper presents the systematic study of the techniques, schemes and strategies of Demand Side Management in electrical network.

REVIEW SUMMARY

The various works of literature involve different methods and have different merits and demerits. This has been summarized in Table 1 for each corresponding literature.

TABLE 1. Review summary

S.No.	Ref. No.	Method	Merits	Demerits
1	[1]	Review of Demand Response Management opportunities	It points solutions to emerging challenges	Does not discuss cost of implementation of DR strategies
2	[2]	Glow-worm Swarm Optimization (GSO) and Support Vector Machine (SVM)	High efficiency and cost-effectiveness	Based on assumption that all users have battery storage system
3	[3]	General Algebraic Modeling System (GAMS) optimization	Customer choices accounted for	Costly implementation
4	[4]	Mamdani fuzzy decision making algorithm	High stability, potential for scalability	Limited application
5	[5]	Price-based DSM scheme	High scalability	Statistical analysis lacks simulation results
6	[6]	Review of Artificial Intelligence (AI) and Machine Learning (ML)	Consumer motivation considered	Execution time and cost analysis not accounted for
7	[7]	Multiobjective optimization algorithm, including customers' comfort among the priorities	Customer satisfaction and environmental considered	Limited range of testing done
8	[8]	Game theory approach	Reduces consumer bill	High computation time and cost
9	[9]	Game theory approach	Fast and efficient response	Renewable energy sources not considered
10	[10]	Game theory approach	Low-cost implementation	Based on assumption that all customers and willing to participate and share their data
11	[11]	Network evolutionary game	High scalability	Renewable energy sources not utilized
12	[12]	Initialization-free based algorithm	Economic use of active power	Renewable energy not considered
13	[13]	Network evolutionary game	Model uncertainties and fake users are detected	Multiple energy sectors not studied
14	[14]	Symbiotic Organism Search (SOS) algorithm	High efficiency	No distinction made between schedulable load and non-schedulable
15	[15]	Stochastic linear programming game	Robust system	Power consumption not studied
16	[16]	Automation-based particle hopping algorithm	Efficient and robust system	Not considering unpredictability
17	[17]	Deviation maximization algorithm	Security and stability of system considered	Instantaneous changes not considered
18	[18]	Markov decision process (MDP)	Increase in profit	Imbalances are not accounted for
19	[19]	Row-generation-based solution algorithm	Stabilizes the system	Based on assumption of only single energy source
20	[20]	Load shifting algorithm	High efficiency	Unpredictability not accounted for

21	[21]	Price modification algorithm	Decrease in cost	Oscillation damping is not performed
22	[22]	Thermal energy management system (TEMS)	Considers user comfort	No distinction made between schedulable load and non-schedulable
23	[23]	Two-level cloud based optimization algorithm	High scalability	Requires costly high communication infrastructure
24	[24]	Genetic algorithm	High efficiency	No distinction made between schedulable load and non-schedulable
25	[25]	Generation and transmission expansion planning (G&TEP)	Fast response and robust nature	Applicable only for large grids
26	[26]	Particle swarm optimization algorithm (PSO) and grasshopper optimization algorithm (GOA)	High efficiency and scalability	High computation time and cost
27	[27]	Voltage controlled strategy	Voltage level improvement	Unpredictability is not accounted for
28	[28]	Reinforcement Learning (RL) and Fuzzy Reasoning (FR)	Low cost and high efficiency	Based on the assumption that all users have battery storage system
29	[29]	Hybrid bacterial foraging and particle swarm optimization (HBFPSO) algorithm	Accounts for environmental consideration and user comfort	No consideration to renewable energy and energy storage systems
30	[30]	Smart energy management system (SEMS), iot devices	Detailed cost analysis	Narrow scope for implementation
31	[31]	Ant colony optimization (ACO) and teaching learning-based optimization (TLBO)	Accounts for environmental consideration and user comfort	Multiple energy sectors not considered. Cost analysis not performed
32	[32]	Socio-technical Smart Grid optimization	High efficiency	Renewable energy and tariff system not considered
33	[33]	Residential power scheduling algorithm based on cost efficiency	User satisfaction considered	Not included battery storage systems and distributed generation
34	[34]	Day-ahead grey wolf modified enhanced differential evolution algorithm (DA-gMEDE)	Stability in system	Commercial and industrial sectors not analyzed
35	[35]	Review on Demand Response Management	Consideration provided to environmental factors and user satisfaction	Does not account for integration of Artificial Intelligence
36	[36]	Hybrid heuristic-based algorithm	User comfort and renewable energy sources considered	Application limited to small scale level
37	[37]	Contract-theoretic Demand Response Management (DRM) strategy	High potential of scalability	Only statistical evaluation and no simulation
38	[38]	Blockchain strategy, IoT devices	High efficiency and transparency in system	Load sharing not considered
39	[39]	AI-empowered Recommender System for Renewable Energy Harvesting (AI-RSREH)	High efficiency	Renewable energy supply not accounted for

40	[40]	Demand Response algorithm	Fast response	Application for practical appliances not considered
41	[41]	Stackelberg game algorithm	Increase in profit	User choice not considered
42	[42]	Particle swarm optimization (PSO), bat algorithm (BA), and social mimic optimization (SMO)	High efficiency	Testing of industrial and commercial sectors not conducted
43	[43]	Heuristic-based programmable energy management controller (HPEMC)	High efficiency and robustness	Renewable sources and multiple energy sectors not analyzed
44	[44]	Cloud computing strategy	High savings and reduction in cost	Data privacy and safety not considered
45	[45]	Heuristic algorithms	Environmental consideration with high efficiency	Commercial and industrial not analyzed
46	[46]	Robust Adversarial Reinforcement learning	Highly efficient and learnable model	Various energy sectors not considered
47	[47]	Genetic algorithm	Reduces power surge and users receive choice of comfort level	Electricity tariff not studied
48	[48]	Ensemble-based deep-learning	Trainable system	Multiple sectors not considered
49	[49]	Artificial neural-network and federated learning	Increases safe and accountable communication	Limited communication technology
50	[50]	Fast and accurate hybrid electrical energy forecasting (FA-HELF), modified enhanced differential evolution (mEDE)	High efficiency	Only short duration analysis performed
51	[51]	Binary multi-objective bird swarm optimization, and a hybrid of bird swarm and cuckoo search algorithms	Reduced electricity bill	Scalability of the system has not been discussed
52	[52]	Fair pricing scheme (FPS) and machine learning	Reduce cost to utility and users	Unpredictability and system instability not considered
53	[53]	Elephant herd optimization–firefly (EHO–FF) evolutionary algorithm	Minimizes power loss	Cost analysis not performed
54	[54]	Reinforcement learning framework and two-stage Demand Response Management (DRM) optimization	Satisfaction of customers and companies considered	User choices not accounted for
55	[55]	Competitive algorithm	High efficiency and applicability	Cost analysis and dynamic pricing not performed
56	[56]	Smart residential electricity distribution system (SREDS)	Multiple communication technology considered	Various energy sectors not considered
57	[57]	Genetic Algorithm–particle swarm optimization	Reduction in operational costs	Limited study of energy sectors conducted
58	[58]	Proportional-integral (PI) and adaptive neuro fuzzy inference system (ANFIS)	Efficient control even with unstable supply	Limited energy scenarios considered
59	[59]	Fuzzy logic controllers	Smooth control and robustness	Incentive-based system not utilized

60	[60]	Power Limit Management (PLM) and Smart Electrical Task Scheduling (SETS) algorithms	High user comfort and reduction in electricity cost	Integration of renewable energy sources not considered
61	[61]	Harris-hawks optimization algorithm	Increase in user comfort	Battery storage system not studied
62	[62]	Meta-heuristic based home energy management (HEM)	Cost reduced	Storage systems not integrated into the system
63	[63]	Fuzzy Long Sort Term Memory based Crow Search Optimization Algorithm (FLSTM–CSOA)	Allocates communication spectrum with minimum delay time	Cyber attacks not considered
64	[64]	Horizontal Block Shifting and Vertical Column by Column Shifting	High fairness and calibration	Integration of renewable energy not applied

From Table 1, it is clear that many literatures are based on the method of swarm optimization. In many cases the method of genetic algorithm has been put to use. Many of these techniques are hybrid of multiple methods while others involve a single method. Next to it, algorithms based on Fuzzy Logic have been put to use. Other than that, the use of network evolutionary game has been utilized in many literatures.

OBJECTIVES OF DSM

Implementation of DSM involves the use of following six main objectives.

- **Peak Clipping:** By the use of peak clipping, the flexible loads of consumers are switched off by direct load control during the peak hours of electricity consumption. The limit to which the load could be switched off is decided by prior cooperation between utility and consumers. It is used in [25, 26, 32].
- **Valley Filling:** Valley filling is used for increment in electricity consumption during off-peak hours, as in night hours for industrial load. The surplus generating capacity is better utilized. This process improves load factor and economy of utility. It is used in [28, 29].
- **Load Shifting:** Load Shifting is used to schedule the operation of some electrical appliances to off-peak hours, there were previously supposed to operate during peak hours. It is mainly used in residential load. Load shifting improves the peak to average ratio of system. It is used in [7, 9, 14, 16, 17, 20, 22, 25, 26, 27, 28, 29, 45, 59].
- **Strategic Conservation:** The utility achieves this objective directly or indirectly by motivating the consumers to use as many high efficiency equipments as possible. This may include using photosensitive switches for conventional lighting systems. The technique results in reduction in load and cost. It is also beneficial for the environment.
- **Strategic Load Growth**: This technique is used with support of valley filling. During strategic load growth, the load is increased in a manner that is suitable for the utility to maintain a smooth demand curve. It consequently increases the total load and electricity sale. It is used in [3, 7, 31, 35].
- **Flexible Load Shape:** In this technique, the utility directly changes the load shape. The consumers are encouraged by the use of incentive-based schemes. The loads are interruptible and require devices that could limit or increase power and energy when required. This technique helps utility meet reliability constraints of the system.

The above objectives and their characteristics, elaborated in [65], are shown in Figure 1.

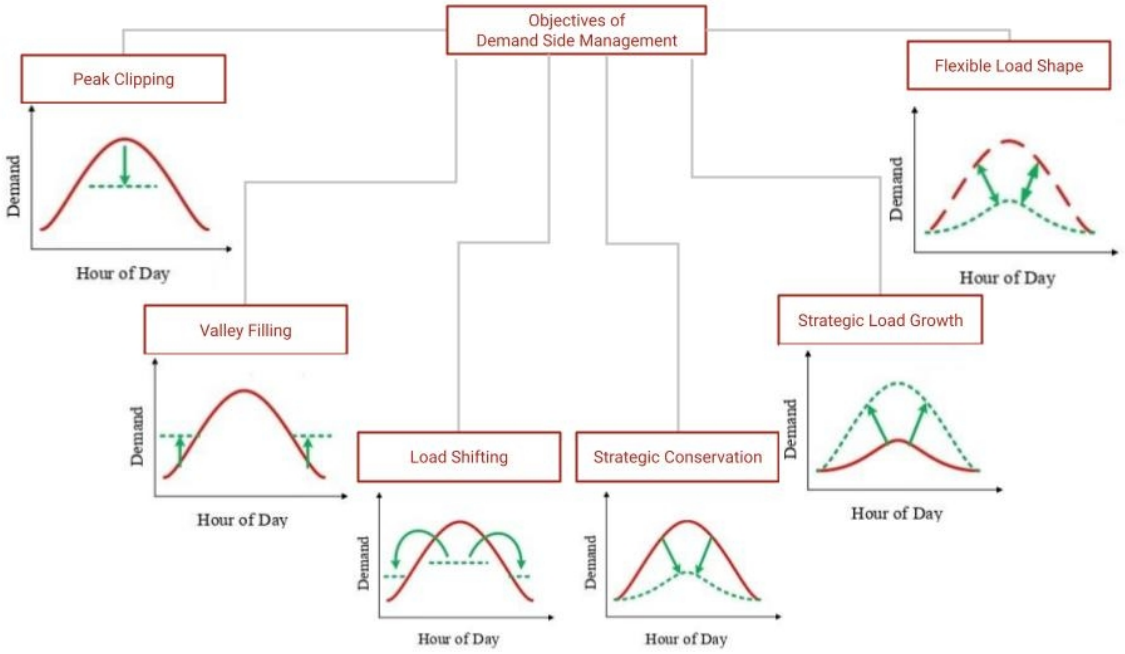

FIGURE 1. Various objectives of DSM

PERFORMANCE PARAMETERS OF DSM TECHNIQUES

The DSM techniques are implemented by aiming to optimize one or more of certain parameters. These parameters also help to analysis the performance of the technique applied. These parameters help to check and compare one technique to another. The knowledge and analysis of these performance parameters help to identify the best suited application of each technique.

- **Peak to average ratio:** It refers to the ratio of power consumption during peak hours to the average power consumption and is measured in decibels (dB). The DSM system aims to minimize it. It is used in [9, 10, 23, 24, 29, 31, 34, 41, 43, 45, 47, 51].
- **Peak demand:** It is the highest magnitude of load demand that occurs in a given time interval. The higher the peak demand, higher is the operating cost of generating stations. DSM strategies aim to minimize the peak demand so as to smoothen the demand curve. It is used in [32, 61].
- **Unpredictability:** Unanticipated changes to the system or unavailability of data at any time could alter the response of DSM system which relies on consumer data. The feature that is preferable in the network is the one that compensates for such changes and still get the algorithms to optimize the required parameters. It is used in [12, 15, 16, 21, 27, 52].
- **Stability and damping of oscillations:** Oscillations, transient disturbances, etc. could keep the system away from producing fast and efficient response. It is desired that the system is self-balancing and stabilizing such that it gives regard to power imbalances in the network. It is used in [13, 19, 58].
- **Security:** When bidirectional communication between utility and consumer takes place, the user data of electricity consumption pattern is at risk of loss of privacy. A good system keeps the data safe and secured. It is used in [17, 49].
- **User comfort:** While minimizing electricity bill in DSM, often the user suffers by lack of choices. By considering user comfort, the system accounts for various actions that lead to better user satisfaction and choices. These may include thermal comfort by heating elements, visual comfort by lighting elements, air quality by air filters, etc. A better system is one that tends to enhance user comfort. It is used in [22, 29, 31, 33, 34, 36, 43, 45, 47, 60, 61].
- **Efficiency:** The main aim of all the DSM systems is to increase the overall efficiency of the network over a large time interval. Efficiency of the network is ensured by cooperation of the users with needs of utility and also by choice of efficient user appliances. It is used in [2, 7, 14, 17, 18, 20, 22, 26, 28, 29, 32, 33, 38, 43, 45, 51, 52, 53, 54, 55, 57, 58, 62, 64].

- **Robustness:** A robust system is one that could be applied to various scenarios of load type and still provide fast and efficient response. A robust system precisely accounts for the stability and reliability aspect of a network. A better DSM method is one that provides highest robust system. It is used in [9, 10, 15, 16, 25, 43, 46, 55, 59].
- **Scalability:** A system has potential of high scalability if it could be applied to a large network of users and supply stations. The higher the number of users and supply stations that could be included while maintaining reliable response, the higher the scalability. This applies to large scale residential and industrial loads. DSM techniques must aim to provide potential of scalability of the system. It is used in [4, 5, 7, 11, 12, 22, 23, 26, 51].
- **Electricity bill to user and cost to utility:** When DSM strategies are implemented, they tend to reduce consumer bill by the use of incentive schemes and methods to encourage users to participate in DSM programs. Also, the operating cost of base generation power plants and peaking load power plants would be minimized when the user demand is correctly timed with a smooth demand curve. The overall cost to the utility as well as to the whole network would reduce. Higher the reduction in electricity bill, better is the system. It is used in [3, 5, 7, 8, 14, 15, 17, 19, 21, 22, 23, 24, 25, 26, 28, 29, 31, 33, 34, 36, 38, 41, 43, 45, 47, 48, 49, 51, 52, 57, 59, 60, 61, 62].
- **Speed of response:** The demand changes in fraction of second, thus it is important to get a timely response from the system. A fast response ensures reliability and increases efficiency of the DSM system. It is used in [25, 40, 42, 49, 50, 58].
- **Number of iterations required:** When an algorithm requires to use regression to reach an optimum result, it is better to choose the system that achieves the same in least number of iterations. The number of iterations save time and computational capacity. It is used in [42].

APPLICATION AREAS OF DSM METHODS IN EXISTING WORK

Various methods are suitable for different scenarios. For example, low voltage load is suitable for residential scenarios and high voltage load for industrial scenarios. According to the choice of the scenario only the method applied and the optimization technique to be utilized is decided. Table 2 presents the application area of DSM methods in existing work.

TABLE 2. Application area of DSM methods in existing work

S. No.	Ref. No.	Classification of loads
1.	[2]	Residential and non-residential cases
2.	[5]	Residential load
3.	[7]	Low-voltage residential load
4.	[8]	Distributed network of competitive consumers
5.	[9]	Residential smart appliances
6.	[10]	Distributed residential energy network
7.	[11]	Class of networked smart grids
8.	[12]	Integration of the renewable generation and the distributed load
9.	[13]	A general networked system
10.	[14]	Residential, commercial and industrial loads
11.	[15]	Distributed energy storage system
12.	[16]	Homogeneous density incompressible loads
13.	[17]	Data of Nanjing City, China
14.	[18]	Agriculture, large user, residential, industrial, commercial and for a combined total system load
15.	[19]	Residential, commercial and industrial loads
16.	[20]	Agriculture, large user, residential, industrial, commercial and finally for a combined total system load

17.	[21]	Residential, commercial, and industrial loads
18.	[22]	Ground source heat pump (GSHP)
19.	[23]	Residential load
20.	[24]	Residential load
21.	[25]	IEEE-RTS 24-bus systems
22.	[26]	Residential, commercial and industrial loads
23.	[28]	Residential consumers
24.	[30]	Residential, commercial and industrial loads
25.	[31]	Heating, ventilation and air conditioning (HVAC) system
26.	[32]	Residential load
27.	[33]	Residential buildings
28.	[35]	Residential load
29.	[36]	Residential load
30.	[37]	Residential load
31.	[38]	Residential house
32.	[39]	Residential house
33.	[41]	A general distributed smart grid
34.	[43]	Residential buildings
35.	[45]	Smart building infrastructure for residential loads
36.	[46]	Residential load
37.	[47]	Residential household
38.	[50]	Home appliances
39.	[51]	Low energy consumers
40.	[53]	Competitive market of smart grid networks
41.	[54]	Competitive market scenario
42.	[55]	Work job where identical machines work for a fixed processing time
43.	[56]	Residential load
44.	[57]	Hybrid load system
45.	[59]	Electric vehicle Systems (EVS)
46.	[60]	Residential homes
47.	[61]	Residential complex of multiple homes
48.	[62]	Residential complex of multiple homes
49.	[64]	Distributed tree network

From the analysis of Table 2, it is clear that most of the load used is based on residential load. In some cases, it is in the form of residential buildings, residential houses, residential household appliances, etc. In many other cases the load is a combination of multiple scenarios. Next to this application, a distributed network is in use. The most considered multiple scenarios include the combination of residential, commercial and industrial load.

CHALLENGES TO THE IMPLEMENTATION OF DSM PROGRAMS

From the analysis of the existing, it is found that the following challenges hinder the implementation of DSM techniques.

- **Lack of efficient machinery and appliances in the network:** Efficient machinery, equipment and appliances cost much higher with respect to their less efficient alternatives. Most consumers tend to invest on short term and purchase low cost and less efficient equipments. This increases the operating cost, maintenance cost and replacement cost of the appliances. The DSM programs encourages the consumers to use the high efficiency equipments. The government policies also tend to favor the idea.

- **Lack of reliability and high quality of power supply:** When an electrical network possesses large number of users and generating stations, then a change in the load or supply at any node of network affects the whole network. In absence of proper oscillation damping devices and compensators, the power quality could deteriorate due to such changes. Some appliances that are highly sensitive to voltage and current changes tend to alter efficiency and reliability of the system.
- **Small scale sector appliances:** The personnel in small scale sector industries lack funds and long term vision to enhance the electricity costs. Many inefficient devices are manufactured and used in small scale including ballasts, pumps, small motors, lighting fixtures, coolers, etc. The lack of check and surveys enables them to not follow norms of Bureau of Indian Standards (BIS).
- **Replacement of inefficient equipments:** For a highly efficient system of electrical network, the equipments used must also be highly efficient. But all appliances tend to deteriorate in terms of efficiency with respect to time. Their replacement is a necessity at regular intervals. But due to lack of planning and energy efficiency engineers, even substandard, inefficient and old equipments tend to be used for duration much greater than the proposed time interval. This decreases overall efficiency of the system and should be checked by making rules for energy efficiency in every system of network.
- **Lack of specialized personnel:** The implementation of DSM techniques requires the assistance of highly skilled personnel who specialize in energy efficiency and DSM strategies. Such staff is either unavailable or the industries tend to avoid hiring them to save expenditure. If any of the step in the procedure to implement DSM: identification, installation and maintenance is interrupted, then the whole system is rendered inefficient.
- **Lack of informed consumers:** The community of consumers who know and realize the significance of DSM implementation is very less. The constraint of information gap about DSM techniques and their implementation leads the consumers to lose the opportunities to improve electrical efficiency in their systems. Education through workshops and government policies help inform the consumers and motivate them to participate in DSM programs.

CONCLUSION

In this paper, the existing DSM methods have been analyzed with their merits, demerits and applications of DSM methods. Several literatures have been proposed with respect to residential loads. Evolutionary algorithms like particle swarm optimization and genetic algorithm are widely used for implementation of DSM. Some authors have applied game theory also for DSM. The literatures reveal that there are multiple techniques of DSM implementation, but still various challenges exist in full scale installation of DSM in a large network. From study presented in this paper, it can be concluded that DSM can be efficiently used for cost optimization in electrical network.

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Fabrication and characterization of metal matrix composite by Friction Stir Additive Manufacturing (FSAM): A Review

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Abstract: Lightweight structures have evolved into the material joining technique known similar to friction stir welding (FSW). A novel method of joining metals that are impossible or challenging to fuse using conventional techniques is friction stir welding (FSW). This process will have always environmentally friendly, that have different technology for manufacturing with high efficiency of energy. In this manufacturing process approach tool shoulder with rotating tools applied. The tool shoulder will be applied to workpiece with a required pressure, that's generates heat around the tool probe, and plastic deformation found that place. The spinning tool firstly pushes in lateral direction, plasticizes, and after cooled it will be mixed in stir zone, and finally got a non- fusion junction.

Friction stir processing (FSP) is a novel method of dealing with metal that may enable regionalized microstructure manipulation and control in near-surface layers of treated metallic components. That is founded on the fundamentals of friction stir welding (FSW), a solid-state joining method developed originally for metal alloys. The FSP results in considerable microstructural improvement, residential development, and homogeneity of the treated area as a result of significant material mixing, heat exposure, and plastic deformation.

Friction stir additive manufacturing (FSAM) is a method of solid-state joining. This method takes innovation approach to multiple plates additive manufacturing. Few of these technologies are highly established, while others are in the process of emerging. And the FSAM has Several types of metal plate and several forms of reinforcement using metal plate and reinforcement particles are used in this technique. The reinforcement particles are nanometres in size and are employed with metal in the form of melting and other physical and chemical combinations of the tool material, as well as the influence to parameters use as tool profile angle, rotational speed and traverse speed of tools.

We explored friction stir processing (FSP), friction stir welding (FSW), and friction stir additive manufacturing in the preceding abstract (FSAM).

Keywords: Friction stir additive manufacturing, Reinforcement, metal matrix, structural performance, process, parameter nanoparticles, deformation, microstructure etc.

INTRODUCTION

Friction stir welding by utilising a revolving, non-consumable welding equipment to locally soften a workpiece by friction and plastic works. As a result, the tool can vibrate the joint surface. Because the heat source is based on friction and plastic works, considerable melting in the workpiece is minimized, as are many of the problems associated with a change in condition that commonly affects fusion welding techniques, which including variations in gases solubility and dimensional change. [1]. The tool is often composed of a material that has adequate strength at the FSW temperature while not chemically reacting with the work components. Finally, the tool dimensions are

engineered to withstand breaking during the FSW process. Specific design characteristics of the FSW tool are frequently based on basic assumptions, the details of which are frequently concealed [2].

Friction stir processing (FSP), microstructural modification based on the fundamental ideas of FSW, was recently introduced. In this scenario, the parameter of tool, A single piece of material is put on a rotating tool with a pin and shoulder for focused microstructural modification to enhance certain qualities.[3]. FSP, for example, that has been employed to produce a perfectly alright substructure that enabled the high-strain-rate method frequently used in the commercial 7075Al alloy.

The FSP approach is developing as a very successful solid-state processing technology capable of providing targeted microstructure alteration and control in the near surface layers of treated metallic components.[4] Friction additive manufacturing technologies have been covering the most regions alloy metal additive that are accessible technology will be fusion based [5]. These techniques have been used to weld alloys that are similar and different alloys. This technology may be used to construct structures made of pure metals, non-ferrous and ferrous alloys, composite materials, and metals [6]. Due to fusion-based limitations, these techniques can be employed to tackle additive manufacturing applications that are difficult to reach [7]. Increasing low weight requirements, particularly in industries such as aeroplanes, automobiles, and marine [8]. Friction Stir Additive Manufacturing (FSAM) used as a customised way of friction stir manufacturing in which many layers are added repeatedly to obtain the required thickness. [9]. Friction stir is a method that plastic deformation or dismembers a material by producing heat to its melting temperature [10]. Where the rotating tool with the required dimension shoulder and pin traversed the desired path on the composite surface [11]. The tool pin is put into the metal composite and provides the tool with both rotational speed and traversal speed. Heat is produced by the tool, and plastic deformation is observed [12-13]. By drilling desired holes and creating holes, reinforcement particles were cemented in the matrix surface. Due to the considerable reinforcing particle waste caused by the use of shoulder and pin type tools during friction stir additive manufacturing [14]. FSAM are characterized by shearing and compression with deformation state, this effectively lowers the possibility of internal flaws during deposition [15In comparison to others AM process, it lessens re-solidification and any other melting defects including porosity, shrinkage, and micro voids caused by microstructure [16]. For effective joining, the depth of the pin is typically designed to enter 25–30% of the bottom plate; other parameters are modified as necessary. [17]. In fig.2 Because of the complexities involved with heat exposure deformation, and material movement from the deepest layer to the highest layer, microstructural characterisation is of particular relevance for FSAM. The material is strongly mixed, plastically deformation, and then dynamically recrystallized (DRX) during FSAM. Welding four plates in a lap arrangement to construct a structure, the various stirring zones, formed in different stir zone 1, 2 and 3rd have distinct microstructures [18-21].

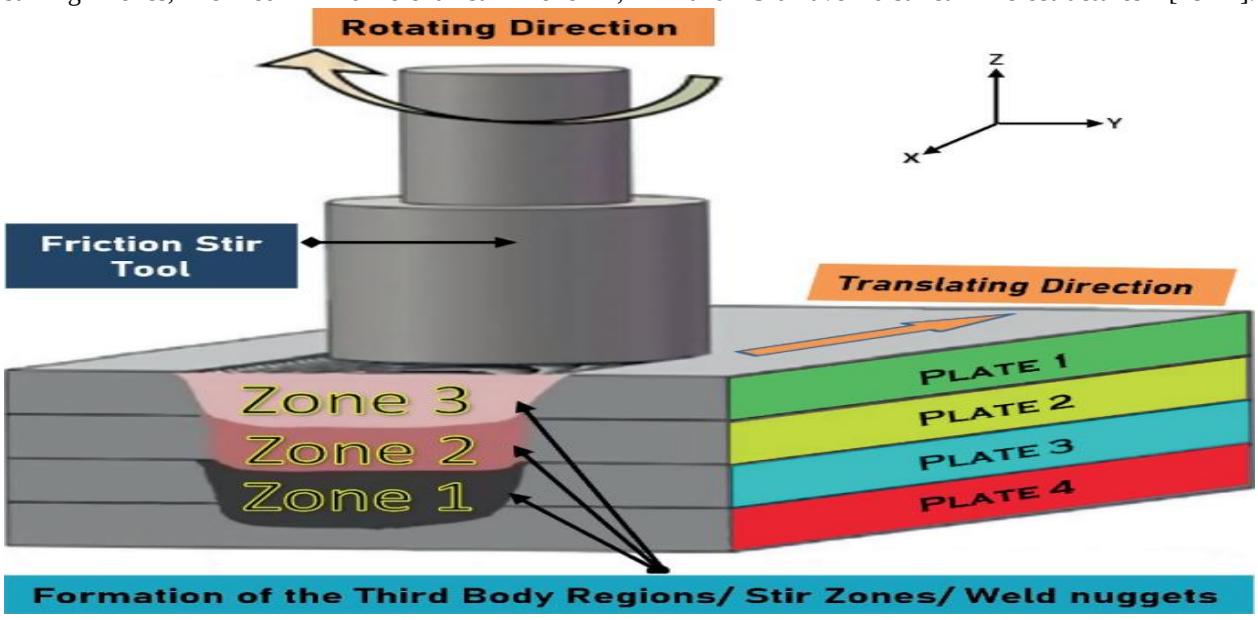

Figure.1. Schematic process for multiple plate additive manufacturing, with different stir zone [17-19].

INNOVATION

The rapid industrial revolution a rise in the need for a new class of specially engineered materials with certain properties. This manufacturing approach seemed quicker and more effective than the earlier one procedure employed throughout both the first and second industrial revolutions. The first industrial revolution occurred in the 18th century, from 1760 and 1840 [20]. The initial or first industrial revolution will be known as Industry 1.0. It was defined by profound developments that disrupted several continents' current economies. However, as the revolution increased rapidly, industries began to change toward new production techniques, corporations, and automated production. Additionally, new industries emerged that utilised modern systems, cutting-edge power sources, and even novel organisational structures for different corporate divisions. [21]. The 1870s had seen start of the second industrial revolution, known as Industry 2.0. Additionally, Industry 2.0 uses a more effective technique for mass production. This happened when the first production line was created, which made it simpler to make items in bigger quantities and with higher quality. Mass manufacture of items was then seen as normal procedure [22]. The "Digital Revolution" or "First Computer Era" are other names for the Third Industrial Revolution. It began in the 1970s of the 20th centuries. Industry 3.0 began with partial automation, a technological procedure carried out using simple computers and Control System Processors (or memory-programmable controls) [23]. Earlier in the revolution, some minor automated systems had been built. Industry 4.0 refers to the current industrial development in our modern world. The current age of change has dramatically impacted how people work. It facilitates more productive work by connecting individuals in smarter networks. The manufacturing industry is practically completely digitalized, making it easier to provide information to the right people at the right time. Additive manufacturing (AM) would be a fast-expanding manufacturing technique that is one of the primary resources offered by Industry 4.0. In vital technology areas such as medical, construction, aircraft, and automotive, additive manufacturing is exploding [24]. Following extensive development and research in the fields of substances, mechanisms, applications, machinery, and incorporation, additive manufacturing is used in a variety of ways to produce prototype components with adequate material properties for testing and evaluation, as well as tooling, dies, and moulds. In AM technology, direct manufacture of functional endues objects is becoming the dominating trend. particularly for polymeric and metallic materials, and it is rapidly being used to make parts in small or medium numbers [25].

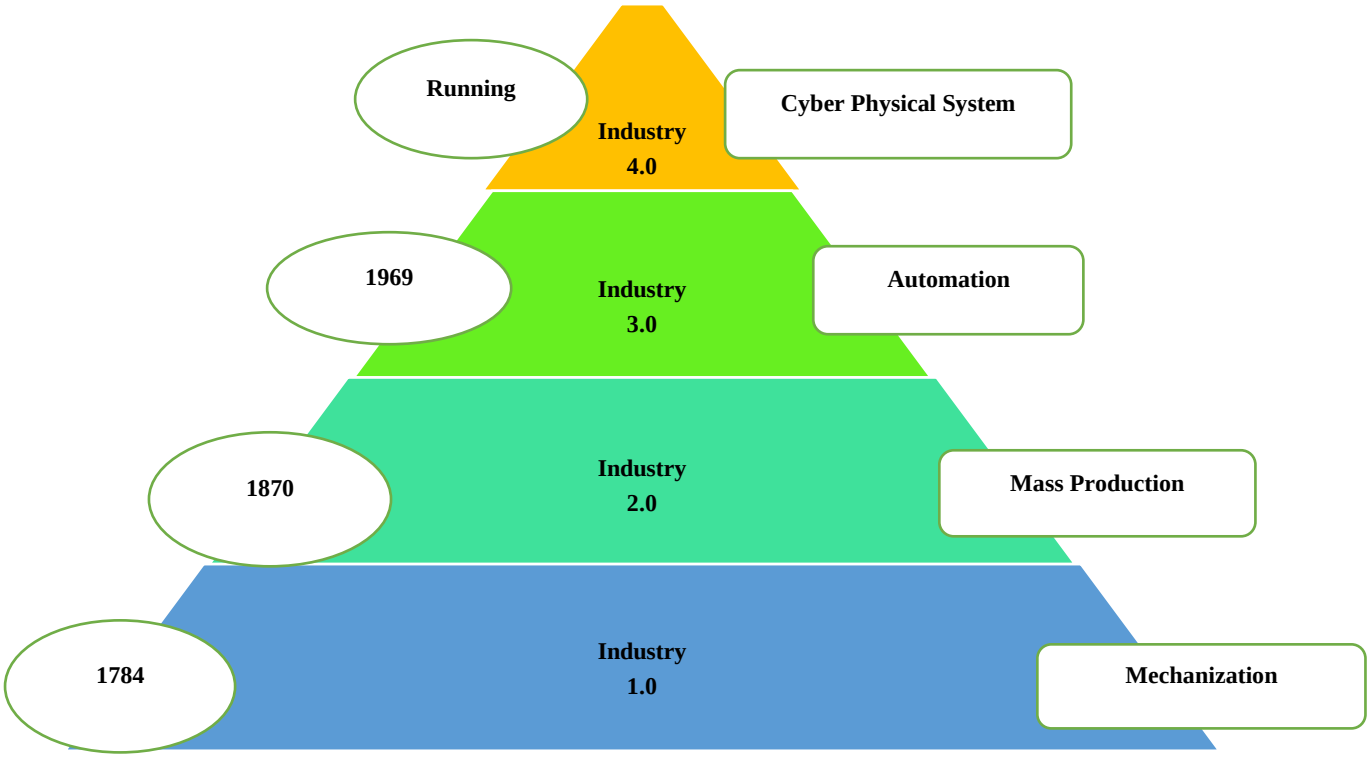

Fig.2. Industrial revolution in manufacturing sector.

LITERATURE SURVEY ON FRICTION STIR WELDING (FSW)

J. Sai Sashank et.al studied the effect of friction stir welding on the structural, mechanical, and physical characteristics of an aluminium alloy 6063 is primarily studied. They used to foundation material was 300mm*80mm*3mm with square edges. The welding was done at the parameter of rotational speeds 700, 1000,1500 rpm, as well as traverse rates of 60,100 mm/min with a tool shoulder diameter of 15 mm. For AA 6063, the best friction stir welding conditions were determined. When the weld was conducted at a traverse speed and rotational speed 60 mm/min,700 rpm respectively, the specimen's tensile strength increased. According to this rate of stirring action and higher heat input, tensile strength was observed to be decreased at 1500 rpm [26].

Sunil Sinhmar et.al Explored the effect of the weld heat cycle on the mechanical and corrosive characteristics of a friction stirred weld joint constructed of AA2014 aluminium, For the FSW, plates of AA2014 aluminium with dimensions of 70mm length, 27.5mm width, and 6mm thickness were utilised. Four distinct rotational rates with constant traverse speeds of 41 mm/min, as well as four distinct traverse speeds with a continuous rotating speed of 931 rpm. Increased rotation speed (508 rpm - 1216 rpm) and decreased traverse speed (90 mm/min - 13 mm/min) created considerable -Al matrix grain and coarse precipitates in the nugget zone and heat impacted zone. [27]

Matthieu B. Lezaack et.al In their research Kept aberrant grain formation using aluminium alloy T6 past-heat treatment by thick aluminium alloy using friction stir welding. This investigation used the 7475-aluminum alloy in the T7351 condition. The material received would be a rolled plate with a thickness of 12 mm. The composition of the alloy is determined using the remote sensing applications coupled radiofrequency optical emission spectroscopic (ICP). Make usage of a separate FSW machine. For FSW, the machined conical pin tool is manufactured of H13 tool steel. The pin is 10 millimetres long, 6 mm in breadth, and has a root diameter of 10 mm. Previously, the tool shoulder was 22 mm in diameter. The resultant morphology becomes substantially more uniform throughout the weld nugget. The initial structure is the most crucial. If the starting grains be smaller than a 2.5m threshold, none of the SHT criteria can prevent coarsening or AGG. [28].

Arameh Eyvazian et.al Experimented the rectangular 200*150*5mm^3 plates were AA5182 aluminium and metal sheets were cross-sectioned using a universal sawing machine, tool shoulder 20mm, conical bore range 10to 6mm, and a length of 7.6mm tool tilt angle 20, plunge depth 0.4mm. The tool rotates at 950,1300,1650,2000rpm, and the tool traverses at 40,70,100 mm/min. A model used for this process known as 3D volume of fluid. Experiments were also carried out to ascertain the impact the influence of UFSW processing factors on the microstructure and mechanical characteristics of various weldments. These essential processing parameters of tool rotation traverse velocity (40,100 mm/min) and speed (950,2000 rpm) have a substantial influence on According to the simulation results, thermal history, material movement, and intermixing [29].

Gurmeet Singh et.al Evaluated the weld connections with identical dimensions, a comparison of the friction stir welding technique and the TIG welding process for the aluminium alloy 6082-T6 AA-6082-Ts651 Al alloy plate 300mm*75mm*6mm was performed. There are numerous parameter combinations available, including tool rotation speeds of 300,700,500rpm and welding speeds of 25,15,35mm/min, with an axial tension of 6KN constant throughout the operation. Following sample preparation, the sample was cut into precise structure for microstructure study. The joint strength of FS welds was equal to the underlying material's strength. An FSW weld with a joint efficiency of 85% was created in this study. In comparison, TIG welds have a combined efficiency of 65%. The impact strength of FSW joints was about double that of the base metal, but TIG weld joints were roughly half the impact strength of the base metal [30].

Jianing Li et.al Observed the Mechanical attributes and characterisation of friction stir-welded 7A04-T6 aluminium alloys Process specifications for 7A04-T6 aluminium alloy plate 160*75*3mm3 shaft shoulder press 1.5-2.5kN, rotational speed 600-1200rpm, and traverse speed 40-200mm/min. Mechanical attributes and characterisation of friction stir-welded 7A04-T6 aluminium alloys Process specifications for 7A04-T6 aluminium alloy plate 160*75*3mm3 shaft shoulder press 1.5-2.5kN, rotational speed 600-1200rpm, and traverse speed 40-200mm/min. The 7A04-T6 Al alloys may be restricted using the FSW technique at a rotating speed of 1000rpm and a travel speed of 120mm/min, resulting in a tensile strength of 77.93% of the base metal and an elongation of 4.24 percent, exhibiting great dependability. NZ fine grain is the consequence of dynamic recrystallization [31].

Mahmoud Abbasi et.al Explored the effect of the fabrication environment on the flexible re - crystallization concept Superior fatigue resistance when an aluminium alloy is being friction stir welded AA-6061-T6 alloy plate cut in 200*100*3mm3 with parameters speed of rotation 1200rpm, traverse speed 95mm/min, tool tilt angle 20 and axial load 3.9kN was investigated. The grain size drops from roughly 57m in the FSW to 34m in the SZ. While conducting FSW underwater, workpiece vibration produces material deformation in the SZ and promotes dynamic recrystallization [32].

Kethavath kranthi kumar et.al studied the effect of the friction stir additive parameter on the material flow, mechanical characteristics, and rust behaviours of a heterogeneous AA-5083 and AA-6061 junction, dimensions 300*70*6mm3, H13 tool shoulder diameter of 18mm, pin tip 4mm, pin length 5.5mm, tilt angle 1degree , This traverse speed has values of 40,60, and 80mm/min while keeping the rotational speed constant at 800rpm, and the other has parameters of 1100,1400, and 1700rpm while maintaining the traverse speed constant at 60mm/min. The ultimate tensile strength (UTS) is about 197Mpa with a 67 percent efficiency during the tensile test when the rotation speed is 1000rpm and the traverse speed is 60mm/min. The notch tensile strength is active and offers stronger mechanical resistance when the rotation speed is 1400rpm and the traverse speed is 60mm/min. The corrosion resistance of weld joints decreases as traverse speed increases; however, at 1400rpm, there is greater corrosion resistance owing to fragmentation and dispersion of intermetallic phase [33].

M. Ilangovan et.al Evaluated the Stir-welded connections between dissimilar aluminium alloys AA-6061 and AA-5086: microstructure and tensile properties There are numerous combinations for the first one in this method, including AA-6061 with AA-6061, AA-5086 with AA-5086, and AA-6061 with AA-5068 alloy characteristics. rotating speed 1300rpm, 500rpm, and 500rpm, correspondingly, traversal speed 35mm/min, 5mm/min, and 10mm/min, Under the microscope, black spots form in each pit after combining two comparable alloys AA-6061 with AA-6061 and AA-5086, and the shoulder- and pin-influenced parts of the two dissimilar alloys AA-6061 and AA-5086 have bigger grain sizes than the unaffected portions [34].

R. Pandiyarajan et.al Experimented reinforcement was % ZrO2 and% C, the rotation speed was 800rpm, the transverse speed was 50mm/min, the axial force was 5KN, and the weld nugget hardness was discovered during the characterization of AA6061-ZrO2-C in FSW composite joins. At 800rpm, 4mm/min, and an axial force of 6KN, the maximum microhardness of 62.3HBR was observed [35].

D. A. Dragatogiannis et.al Observed with Different Friction Stir Welding Using Tic Nanoparticle Reinforcement Between the Alloys Al-5083 and Al-6082, The best parameters were obtained by altering the tool tilt angle (2°), rotational speed (1150 rpm), and traverse speed (85 mm/min). This specimen was also used as a control to see how nanoparticle dispersion affects mechanical behaviour. The goal of this study was to assess the strengthening of friction stir welds produced of various alloys. The use of nanoparticles increased the percentage of elongation, Young's modulus, yield stress, ultimate tensile strength (UTS) [36].

P.N. Korkes et.al Studied the influence of Sic and Tic nanoparticles mostly microstructure, microhardness, and tensile behavior of a friction stir weld made of Al-6082-T6, using AA-6082-T6 alloy to join the two specimens with Sic and Tic nanoparticle reinforcement between them; Sic has higher elongation while Tic has higher microhardness. The process settings are 750 rpm and 75 mm/min. The tool has a 3° tilt angle and dimensions of 200*100*3mm3. The Sic reinforcement specimen has a higher elongation, making it ideal for applications requiring a more ductile material, whereas Tic specimen has a greater microhardness value, making it suitable for applications requiring a server surface. During FSW, the dynamic recrystallization phenomenon results in significantly smaller grain sizes [37].

PROCESS PARAMETER

S.N.	Rotational speed (rpm)	Traverse speed (mm/min)	Tilt angle (degree)	References
1.	700,1000,1500	60,100	0	[26]
2.	508,1216	90,13	0	[27]
3.	300	100	0	[28]
4	950,1300,1650,2000	40,70,100	0	[29]
5.	300,700,500	25,15,35	0	[30]
6.	600,1200	40,20	0	[31]
7.	1200	95	0	[32]
8	1100,1400, 1700	40,60.80	1	[33]
9	1300,500 500	35,10,5	0	[34]
10	1150	85	2	[36]
11	750	75	3	[37]
12	1000	300	0	[38]

Table.1. process parameter of FSW

Shengke. Zou et.al Observed parameters for microstructural and mechanical processing of 2024-Aluminum alloy multi-track friction stir lap welding are 1000 rpm and 300 mm/min, with a depth of 0.2 mm. The best result was obtained after one pass at 300 mm/min rotation, and the hole flaws were eliminated after two passes. This repeated pass achieved a high ductility of elongation of around 35.05%. [38].

Literature survey on Friction stir processing (FSP)

Akbar hadarzadeh et.al studied in-situ Friction stir processing produces Zn ionic compounds in the Cu-Zn matrix, the Cu-30Zn plate has a dimension of 100*100*2mm3. For the H13 tool, maintain a rotation speed of 1120rpm, a traversal speed of 50mm/min, a tool shoulder diameter of 12mm, a tool pin diameter of 3mm, and a length of 1.75mm. The FPS is divided into two main stages. After closing the surface of the groove with the rotating pin less, The material and manufacturing line both received the pin and the shoulder. The microstructure zone of the sample exhibited a

larger average grain size. Because of the action of Al2O3, the stir zones differed greatly, with the SZ having the maximum strain and temperature [39].

Li Zhoo et.al. Observed stir methods for friction's mechanical characteristics TA5 alloy and their microstructure, TA5 plate (Titanium alloy) with dimensions of 250*150*5mm 3 rotating speed 150mm-300rpm and tool shoulder 12mm, plunge depth.02mm, root diameter 4.5mm 75mm/min, tilt angle 3 The microstructure looks inhomogeneous when the rate of rotation is 150rpm; when the rotational speed is 200rpm, the FSP creates a high strain rate and a homogeneous surface; and when the rotational speed is 250rpm, it forms a tiny overlap retreating side[40].

W. Cheng et.al Evaluated the Al-Si alloys' mechanical properties can be improved via rolling and the friction stir process, Al-7Si and Al-12Si pure alloys at tool rotation 800rpm, traverse speed 100mm/min, at this alloy the evenly distributed in metal matrix after FSP The structure of FSP samples arises the unpolished grain and low density of dislocation during deformation due to their optimised crack and high work hardening rate [41].

Lakshay Tyagi et Experimented AA-7075 alloy additional reinforcement Alovera AA-7075-T6 metal matrix composite reinforcement was created via friction stir processing and is a naturally occurring medicinal plant with ceramic particles and Alovera ash. The H13 tool shape is square and flat, with rotating speed of 600,900 rpm, groove length 160mm, width 2mm, depth 3.5mm, and tilt angle 2. When a 20N load was applied to the Al+Si at 600rpm, the Alovera ash composite was found to have the superior wear resistance at higher tool rpms. Microhardness improves with reinforcement as tool rpm increases due to finer grain [42].

S. Arokiasamy et.al Observed mechanical characteristics of a magnesium-based hybrid metal matrix composite were explored experimentally using Mg-alloy and Sic/Al2O3 reinforcement rectangular plates with dimensions of 200*80*12mm3 and varying rotational and traversal speeds of 220,360,540rpm and 10,20,30mm/min, respectively. Whenever Mg and Sic are combined, a heterogeneous the tool has a tool shoulders diameter of 16.5 mm and a pin diameter of 5.5 mm produced. The Mg-bas hybrid composite has a microhardness of 59.3HV. It improved the composite's resilience to wear [43].

Hongmei chen et.al Explored the effect of ZrO2(20-50m) addition on FSP manufacture of ZrO2/Mg composite, the base material cut into a specimen of 300*160*4mm3, groove depth 2.5mm and breadth 0.6, 0.8, and 1mm along its centreline, tool shoulder diameter 16mm, pin diameter 4mm, and height 3.8mm. The rotation speed was 1500rpm, the travers speed was 50mm/min, and also the tilt angle was 2.50 degrees. The sample's grain, microhardness, and mechanical properties improved when the reinforcement was introduced. In the strain damping test, the damping behaviour of ZrO2/Mg composite matched the G-L theory, with 0.8mm groove width having the best damping capabilities [44].

K. Sekar et.al Evaluated Stir and squeeze casting AA-6082/Sic/ZrO2 hybrid composite fabrication mechanical and welding characteristics, The current investigation sought to investigate the weld strength of an AA-6082/Sic/ZrO2 hybrid composite junction using FSW. With a rotating speed of 1000rpm and a transversal speed of 20mm/min, this hybrid composite prepares for microstructural examination, hardness, impact, compression, and welded tensile testing. When 1% Sic and 0.5% ZrO2 are added to a hybrid composite reinforcement, the ultimate tensile strength rises when compared to the base alloy. When 1% Sic and 1% ZrO2 are added to the welded composite, the hardness rises by up to 17% when compared to the basic alloy [45].

Shivalisingla et.al Experimented WE43/Tic surface composite development and characterization using friction stir processing, Mg base alloy, rotation speeds 800rpm and 1700rpm, travers speeds 30mm/min and 60mm/min. Taper cylinder, square, and triangular tool pin geometries were used. The specimen measures 100*50*6mm3, has a hole diameter of.5mm, and a depth of 5.2mm. The diameter of the tool pin was 5mm and the depth was 4mm for taper cylinder, 5mm*5mm for triangular and square tools, and the tilt angle was 20 after the FSP the grain size of the composite was greatly decreased from 22.42 to 6.6m [46].

Thangarasu et.al Studied theAA-6082 Al alloy composite synthesis and characterisation utilising FSP, 100*50*10mm3 and groove 5mm deep using Tic (0,6,12,18,24% volume), rotating speed 1200rpm, the composite has a traverse speed of 60mm/min, an axial load of 10KN, a tool shoulder diameter of 18mm, a pin diameter of 6mm, and a length of 5.5mmThe microhardness as well as ultimate tensile strengths (UTS) have been tested using a pin on disc

apparatus, and the wear test research study will focus. As the quantity as the number of Tic particles increased, the rate of wear reduced. Tic particles were evenly dispersed throughout the composite [47].

Thangarasu et.al Experimented the influence of traversal speed on the microstructure and mechanical characteristics of friction stir-processed materials. materials AA-6082/Tic surface composites. In this process, Tic particles and AA-6082 alloy were used as reinforcement, The traversal speed varied between 40,80 and 20 mm/min, while the other operation needs to be considered as groove width and tool rotating speed—were constant, and axial load— were maintained. Tool length is 5.5mm, thread pin profile is M6*1mm, and shoulder diameter is 22mm. The surface composite's Tic particle distribution was impacted by the traverse speed, which decreased as traverse speed increased. The surface's microhardness and wear rate were modified by the traversal speed, composite, with 112HV being discovered at 40mm/min and 135HV being found at 80mm/min [48].

Sudarshan Kumar et.al Studied the Al- alloy used Because of their excellent Al-alloys show potential for structural applications due to their high strength-to-weight ratio and corrosion resistance, and light weight; 3.5 micrometre size was used as Tic reinforcement with 2%, 4%, and 6% by volume, Degradation characteristics of an Al-7075/Tic composite treated by friction stir. The axial load is 10KN, the tilt angle is 20, the tilt speed is 30mm/min, and the rotation speed is 1200rpm. The groove had three distinct widths and a depth of 3.4mm (0.5mm,1mm and 1.5mm). The size and hardness of the nugget zone range were found to be 2 to 5 m greater than those of the heat impacted zone and thermo-mechanical zone [49].

Zinjun Zhao et.al Observed the interfacial bonding property of the friction stir additive was created for the 2195-T8, Al-Li alloy, using the parameters of 800 rpm and 100 mm/min. The Al-Li alloy's highest tensile strength. Its 56.6% of the ultimate strength properties of the base metal, and the composition of the alloy's hardness profile is asymmetrical [50]

PROCESS PARAMETER

Table.2. Process parameter of FSP

Literature survey on Friction stir additive manufacturing (FSAM)

Mounarik Mondal et.al Observed the parameters 800rpm and 50mm/min were set to proceed with the combination of light weight material such as Al-1060 plate and reinforcing Al-7075 powder in order to locally improve the material qualities of aluminium sheets. That there is excellent bonding between the matrix and the assistive

S.N.	Rotational speed (rpm)	Traverse speed (mm/min)	Tilt angle (degree)	References
1	1120	50	0	[39]
2	150,200,250	75	3	[40]
3	800	100	0	[41]
4	600,900	50	2	[42]
5	220,360,540	10,20,30	0	[43]
6	1500	50	0	[44]
7	1000	20	0	[45]
8	800,1700	60	0	[46]
9	1200	60	0	[47]
10	1200	40,80,20	0	[48]
11	1200	30	2	[49]
12	800	100	0	[50]

manufacturing layer at the interface between the Al-1060 metal and the layer used in additive manufacturing, and that no tiny flaws were found in the stir zone [51].

Abhay Sharma et.al Studied a novel method for creating functionally graded composites on demand using friction stir additive manufacturing, commercially available pure aluminium plate, Tic reinforcing particles mixed with ethanol, and parameters of 1000 rpm rotation speed, 50 mm/min traverse speed, and H13 tool, after several passes and stirring removal, voids and cracks were identified. Hardness diminishes as the percentage of Tic decreases. Because of the large stored energy, the continuous dynamic recrystallization encourages grain formation, which is supported by the crushing of the original matrix grain, during high-temperature distortion in consecutive passes. [52].

Ahamad Araddanniy et.al Explored the aggregation of reinforcement particles diminishes as the traverse speed increases from 40 - 100 mm/min at the 800-rpm rotation speed while building the lamination Al-Zn-Cu(p)/Al-Cu structure using friction stir additive manufacturing. However, travers speed well be 40 mm/min, raising the rotating speed from 800 to 1250 rpm reduces agglomeration of reinforcement particles and improves reinforcement dispersion. The fundamental reason for a dramatic shift in the hardness profile is the build-up of copper-rich reinforcing particles close to the laminated composite's interface. [53].

Zhijum Tan et.al Observed the size of Al2O3 nanoparticles has to have a direct influence on microstructure and hardness. The tool rotates at 1000 rev/min and moves at 100 mm/min. Temperatures are determined using an infrared radiation thermometer during the FSAM technique (IRT). This particle size drops from 100mm to 10nm, the grain size drops from 14.8 to 12.12 micrometres, and the rigidity improves from 50 to 87.34HV in the friction stir additive fabrication of nanoparticles matrix composite. In FSAM, materials manufactured with Al2O3 nanoparticles exhibit finer grain distributions and greater hardness than samples without Al2O3 nanoparticles. [54].

R. Joey Griffiths et.al A studied of MELD Al-6061 reinforcement using Al-Sic in solid-state additive manufacturing of an aluminium matrix composite. A board range alloy, such as an addition to aluminium alloy, should be able to be deposited by it variables in the process, such as tool diameter frequency, travel speed, rotational speed, Heat movement related flow of material processes may be affected by temperature, layer thickness, and other factors, which are crucial in regulating aperture, good adhesion, and reinforcement distribution. Because relate the conditions to the temperature progression and rapid modulus of elasticity of AMCs, a real production relationship must be developed. When compared to pure metal additive manufacturing utilising MELD, problems develop due to the presence of reinforcing particles with high strength that might obstruct the flow of the matrix metal. [55].

S. Palanive et.al Observed through microstructural Mg-based WE43 alloy parameters 800 to 1400rpm and 102mm/min, friction stir additive manufacturing for superior structural performance. The origin of the high uniform elongation of 10% FSAM at 1400rpm and 102mm/min residual stress is immoderate, Superior strength, comparable to Al alloys, is the consequence of exceedingly fine, homogeneous, and densely packed coherent precipitates with sizes ranging from 2 to 7 nm. [56].

J. Jehkrishman et.al Studied the used of stir Al-6082 and titanium dibromide, fabrication and characterisation of an aluminium di-bromide metal matrix composite (TiB2), By adding 6% TiB2 reinforcements to Al alloy, better attributes may be generated, including tensile strength, flexural strength, hardness, and impact strength. However, when the TiB2 particle weight increases, the mechanical characteristics tend to decline. The flexural stress was high in original sample and decreased further as the TiB2 particle concentration increased, as a result of excellent assignment of TiB2 particles. [57].

R. Joey Griffiths et.al Studied of MELD Al-6061 reinforcement using Al-Sic in solid-state additive manufacturing of an aluminium matrix composite. It should be able to deposit an alloy for use in boards, such as an addition to aluminium alloy. Process factors such as feed rate, layer thickness, tool rotation frequency, and transverse speed can affect heat flow and material flow processes, which are critical for controlling porosity, interfacial bonding, and reinforcement distribution. [58].

Mao Yuiging et.al Used of Al-7075 alloy, the friction stir additive manufacturing technique had utilised to develop the microstructure and mechanical performance of the aluminum-based composite. Dynamic recrystallization produced fine and equiaxed grain, significantly increased tensile strength, and decreased elongation in the agitated

zone. The strength eventually grew to a high of 279 MPa. The fractography indicate that the upper specimen has several dimples of various sizes and shapes, as well as thicker ripping ridges, whereas the bottom slice has a brittle failure pattern of semi with river patterns. [59].

Z. Zhang et.al Evaluated the Mechanical proportional operations of re-stringing and re-heating in friction stir additive manufacturing have already been investigated both experimentally and numerically. The temperature field in the FSAM is tracked using an in (IRI) infrared radiation images system that uses AA-6061 T6, Mg-based Al+Tic, and all parameters of 1000rpm and 100mm/min. Because of the re string action in FSAM, at the peak temperature freshly added layer decreases as increases. [60].

Hang.Z.Yu. et.al Explored the AA-5083, Al-Mg-Si was routed under tool head with severe deformation with the tool head material sliding at full conditions for additive friction stirring installation deformation method for the preparation to metal additive manufacturing. Instead of producing a rigid interface, co-plastic distortion and mixing between the new fully material and the layer underneath will result in a diffuse interface with progressive changes in composition, microstructure, and phase fraction. [61].

R. Joey Grifftish et.al Observed as demonstrated by a gradual transition from the AA-7075 plate elongation grain, Solid-state additive manufacturing was enabled by additive friction stir for the restoration of Al-7075 alloy, T055 plate the parameters 400rpm and 0.42mm/min. Adding friction Stir deposition successfully fills the whole volume of through-holes and broad grooves in AA 7075. This is notably noticeable in the later situation, when the groove width is 33% more than the feed rod width. [62].

Zijun Zhao et.al Studied the friction stir additive manufacturing design for 2195-T8 Al-Li alloy, with a perimeter 800rpm, has an attribute called interfacial bonding. The weak bonding faults caused by improper tool stirring are typically linked to the presence of oxide at the lap contact and may be seen in the hardness profile of a five-layered inhomogeneous material. By using a welding technique where the welding orientations of two adjacent layers are opposite, the interfacial bonding characteristics and material mixing of the whole NZ may be somewhat enhanced. [63].

Akash Mukhopadhyay et.al Explored the average ultimate tensile strength of the deposit was somewhat greater than that of the solution both in longitudinal and transverse directions when created by friction stir additive manufacturing, according to mechanical parameters of pure aluminium AA-6061 T6 alloy depositions. The deposit's average ultimate tensile strength was marginally higher in both the longitudinal and transverse directions than that of solution zed aluminium 6061 alloy. The readings in both directions were comparable, demonstrating the deposit's isotropic nature. In comparison to Al6061-O, which has a value of 64 HV, the deposit's average Vickers's micro-hardness was determined to be 60.25 and 70.25 HV in both the longitudinal and transverse directions. [64].

H. Aghajani Derazkola et.al Evaluated the order to evaluate a Friction stir additive manufacturing (FSAM) was used to create a polymer-steel laminated sheet composite structure, A poly-methyl-methacrylate (PMMA) sheet with such a thickness of around 5 mm was provided. Prior to application, the material was chopped into tiny pieces with 60 * 100 mm2 dimensional cross-sections. The optimal operating parameters are as follows: The rotational speed (w) is 850 revolutions per minute, the traverse velocity (v) is 45 millimetres per minute, and the tool tilting angle is 2.5 degrees, and the material feeding rate is 420 rpm through mandrel rotation. Later microstructural studies demonstrated the influence of steel fragments when the weld nugget strengthens the layered composite structure was fed with PMMA materials. use of a stir tool to provide friction to promote the evaporation-related loss of polymer material [65].

PROCESS PARAMETER

Zinjun Zhao et.al Experimented the interfacial bonding property of the friction stir additive was created for the 2195-T8, Al-Li alloy, using the parameters of 800 rpm and 100 mm/min. The Al-Li alloy's highest tensile strength has the alloy's hardness profile is asymmetrical, with 56.6% of the maximum tensile strength of the base metal. [66].

Application of FSAM

AM is widely utilised, notably in the consumer products industry, automotive, aerospace, biomedicine, and many others. It is anticipated that new uses and advantages will emerge over time. We'll give a quick overview of AM's uses in the aerospace, automotive, and biomedical industries even though its applications are spreading into a variety of industries, including food engineering [67]. Other related studies and papers have more details on applications. The assemblies of aerospace components have been complex geometry and incorporate complicated material such as nickel alloy, titanium alloy, or many more alloy that are typically made by more laborious, while using FSAM reduces the all-consuming process [68]. Also, the aerospace industry has been produces a smaller number of components, have limited number of plants. Automotive Additive manufacturing technique have been applied to reduce manufacturing and production cost [69]. AM is being used to build a limited number of components for premium, low-volume vehicles such as marathon, racing, homologated sports cars, and race trucks, such as exhaust valves, start-up motors, gear boxes, drive shaft systems, and braking systems. In addition, AM has been used to create components that can be produced to function and perform effectively. Companies and research organization have also used AM method to effectively build functioning components for automobile. Vehicles for racing, as opposed to passenger automobiles, typically use lighter alloys (e.g., titanium), has extremely complicated construction, and limited manufacturing quantities.[70].

S.N.	Rotational speed (rpm)	Traverse speed (mm/min)	Tilt angle (degree)	References
1	800	50	0	[51]
2	1000	50	3	[52]
3	800,1250	40,100	0	[53]
4	1000	100	2	[54]
5	700	35	0	[55]
6	800,1400	102	0	[56]
7	800	80	0	[59]
8	1000	100	0	[60]
9	850	45	0	[61]
10	400	.42	0	[62]
11	800	100	0	[66]
12	850,420	45	0	[65]

Future scope

Technologically, additive manufacturing (AM) has allowed for incredible flexibility over through the structure, content, and operation of manufactured objects, as well as a high degree of personalisation for people. This new manufacturing technology offers amazing potential for a revolution in manufacturing technique [71]. Additive manufacturing has ability that can reduces the cost effective which cannot be manufactured easily using conventional techniques, that can have greatest control out over design, content, and operation of created products because to additive manufacturing. AM techniques, called the "Fourth Industrial Revolution," [72].

This has the possibility to change the cost-effective mass customization of complicated things that are difficult to produce using current technology. AM is capable of producing objects with a wide variety of dimensions (with nanometre/micrometre), components (materials, polymeric, ceramic, nanocomposite, and organic particles), and functions [73]. In general, additive manufacturing enables the manufacturing of complicated structures with variable compositions and active functionality. AM can specifically enable part manufacturing with functionally graded materials (FGM). Some AM procedures may transport diverse materials to the construction regions (often via several feeding units) and can produce components with FGM, which is one of the key benefits of AM technology that conventional manufacturing techniques cannot do.[74].

It’s having capacity enables composition control in order to provide versatility (for increasing the ductility compare to other material) and to manage the characteristics of the manufactured component. A pulley with more carbide around the hub and rim to make it tougher and more wear resistant, and less carbide in other regions to promote compliance, is one such use. With terms of economy and environment, additive manufacturing (AM) provides various advantages over conventional manufacturing processes, such as decreased material waste and energy consumption, quicker duration, kind of production, and manufacture of previously unattainable structures. [75].

Adding materials individually in order to make 3D things, in particular, decreases waste significantly. Titanium pieces, for example, are cut to size from large platinum slabs in standard aerospace manufacturing, producing in more than 90% waste products that cannot be economically utilised. AM has the potential to significantly minimise waste formation, hence lowering the energy required to manufacture titanium material and components. [76]. Furthermore, because AM is digital, firms will be able to implement innovative product designs without paying the additional expenditures associated with old approaches. It could be noted that for some applications, additive manufacturing is neither materially neither resource. [77].

It must be expected that FSAM will be a viable additive manufacturing technique option for a wide range of implementation based on historical data, present circumstances, and future projections, and that its growth will accelerate in the near future with research-based advancements. Based on prior data and outcomes, Figure.4 indicates the predicted expansion of the FSAM process. According to recent times, it is presently relevant for 28% of engineering goods that can be efficiently created using this technique, and by 2030, it is expected to viable replacement for more than 50% of existing products with exponential development [78].

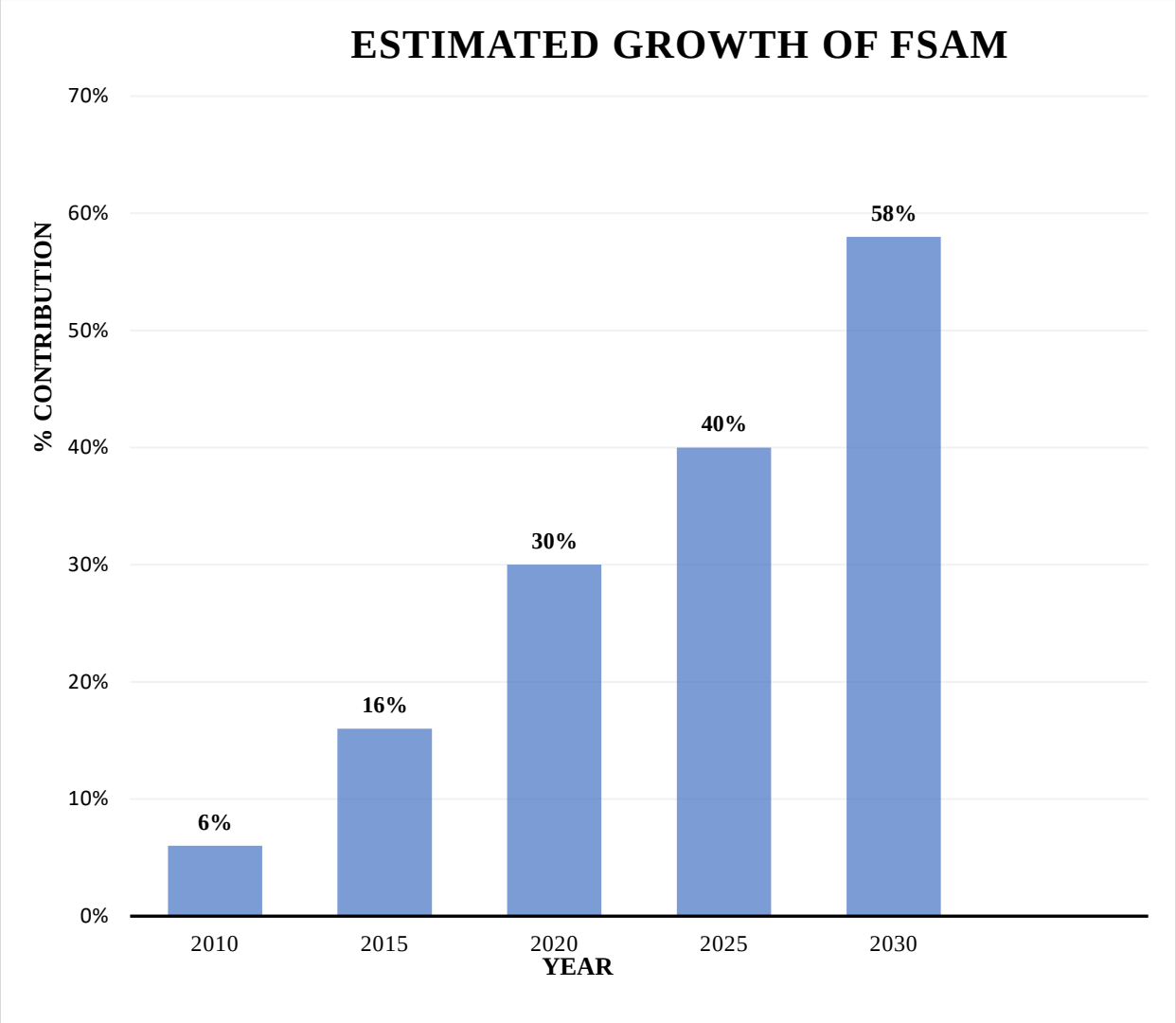

Fig.3. Estimate growth of FSAM in future

CONCLUSION

To be widely recognised by industry, manufactured components must be repeatable and consistent over the whole range, between produces on using several types of manufacturing machine. To be widely employed in industry, additive manufacturing technology must be capable of ensuring spending contributed. However, new AM techniques must be studied and developed, such as those for biomaterials as building blocks, as well as those for nanoscale and micro, in order to broaden and generate new applications. To meet these objectives, additive manufacturing technologies and applications will design, materials, production procedures and machineries, simulation, process improvement, and sustainability and energy applications will necessitate significant more research and development. Friction stir additive manufacturing (FSAM) is the very fine method for the production of surface composite, after review the above articles found that Al-alloy is widely used for this process and several types of reinforcement particles, work with their suitable parameter. And tool use for this process has highly melting point compare to their alloy sheet and reinforcement matrix.

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Analysis of Cardiovascular Disease Prediction using different techniques of Machine learning

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Abstract: Cardiovascular illnesses have been the leading cause of mortality in both advanced and emerging economies during the last several decades. Early diagnosis of heart disorders, as well as continuous clinical monitoring, can help to prevent mortality. However, reliable identification of cardiac illnesses in all situations and 24-hour consultation by a surgeon is also not an option because it requires more intellect, time, and ability. In this study, a basic notion of a computerized heart disease diagnostic was established to identify impending heart illness using Machine learning techniques.. An effective machine learning approach generated from a different examination of many machine learning techniques in an Open Source Public Access Data Analysis Platform, WEKA, should be employed for the accurate identification of heart disease.

Keywords: data mining, machine learning techniques, WEKA, Data Analysis.

INTRODUCTION

"Data mining is the non-trivial retrieval of implicit, heretofore unknown, and possibly important data information."[1]. Data Mining is also called "knowledge Discovery Database ". Data mining is used to analyze big amounts of databases and new information.

According to a Survey by World Health Organization, Cardiovascular Diseases are the leading cause of the global death ratio. conclude ratio of CVDs 17.9 According to all statistics, millions of people died in 2019, accounting for 32% of all worldwide fatalities.85% of these deaths are caused by an attack or a stroke, and more CVD deaths occur than the total of their components.in nations with low and medium incomes, corresponding to WHO inspect. And that's why it's important to detect the cardiovascular illness as soon as possible so that counseling and drug treatment can begin[12].

A real-time patient detection method capable of sensing several genuine data such as core temperature, pulse rate, humidity, and heartbeat was constructed and demonstrated using Arduino to check the cardiovascular disease patient 24 hours by his/her caretaker/doctor. The created system is capable of transmitting gathered information to a central server that receives upgrades every 10 seconds As a result, if emergency treatment is required, practitioners may utilize the application to view the person's actual sensor information and begin streaming live video. Another important aspect of the present approach is that whenever any real factor of a person exceeds the threshold, the indicated doctor is notified. is immediately contacted using GSM technology.

CARDIOVASCULAR DISEASE

Cardiovascular disease is a general term for conditions affecting the heart or blood vessels. They include many cardiovascular diseases[12]

1. **coronary heart disease**: Coronary heart disease damages the blood arteries that feed the heart muscle.
    - ❖ Causes :
        - ➢ Insulin deficiency or diabetes
        - ➢ Blood pressure is high
        - ➢ Inadequate physical activity
        - ➢ Tobacco usage or smoking
    - ❖ Prevention :
        - ➢ Give up smoking.
        - ➢ Control hypertension, cholesterol, and glucose.
        - ➢ Workout often.
        - ➢ Stress may be reduced and managed.
        - ➢ Keep your weight under control.
2. **cerebrovascular disease**: affects blood vessels feeding the brain.
    - ❖ Causes :
        - ➢ Diabetes
        - ➢ elevated cholesterol levels
        - ➢ excessive blood pressure
        - ➢ obesity and sedentary behavior
        - ➢ Continue to smoke
    - ❖ Prevention :
        - ➢ Give up smoking.
        - ➢ eating a well-balanced diet that promotes vascular health, such as the DASH diet.
        - ➢ Workout often.
        - ➢ Stress may be reduced and managed.
        - ➢ Keep your weight under control.
3. **Peripheral arterial disease**:affects the blood vessels that feed the arms and legs.
    - ❖ Causes :
        - ➢ Inflammation of the blood vessels
        - ➢ Arm or leg injury
        - ➢ Muscle or ligament changes
        - ➢ Radiation exposure
    - ❖ Prevention :
        - ➢ You should not smoke.
        - ➢ Maintain blood sugar control.
        - ➢ Consume foods low in saturated fat.
        - ➢ Get frequent exercise, but consult with your doctor about the type and amount that is best for you.
        - ➢ Keep a healthy weight.
        - ➢ Control your blood pressure and cholesterol.

4. **Rheumatic heart disease**: This form of illness is caused by streptococcus bacteria and destroys the heart muscle and heart valves.
    - ❖ Causes :
        - ➢ Infection-causing microorganisms are normally targeted by the body's immune system.
    - ❖ Prevention :
        - ➢ proper antibiotic course
5. **congenital heart disease**: Birth abnormalities that interfere with the proper development and operation of the heart caused by congenital defects in the cardiac structure are referred to as congenital heart disease.
    - ❖ Causes :
        - ➢ Lack of regular exercise
        - ➢ High lipoprotein
        - ➢ High blood pressure
    - ❖ Prevention :
        - ➢ Get excellent maternity care.
        - ➢ Take a multivitamin containing folic acid.
        - ➢ Don't cigarette or drink.
        - ➢ Manage chronic health disorders and avoid dangerous chemicals.
6. **Deep vein thrombosis and pulmonary embolism**: these conditions includeThrombosis in the knees that can be fatal displace and travel to the lungs and coronary arteries.Thrombosis in the knees that can be fatal
7. displace and travel to the lungs and coronary arteries
    - ❖ Causes :
        - ➢ Fat extracted from a shattered long bone's marrow
        - ➢ A cancer fragment
        - ➢ Bubbles of air
    - ❖ Prevention :
        - ➢ Thinners of the blood (anticoagulants).
        - ➢ Elevate your legs.
        - ➢ Physical exercise.
        - ➢ Stockings with compression
        - ➢ Compression through pneumatic means.

LITERATURE REVIEW

According to our survey, a lot of the risk factors used to diagnose cardiovascular diseases, such as poor eating habits,smoking, physical inactivity, and daily rooting, in addition to cigarette and alcohol use, all are risk factors for cardiovascular disease.[1]

This document provides thorough Facts, Common Types, and Treatments for Coronary Heart Disease as well as Risk Factors WEKA (Waikato Environment for Knowledge Analysis) is the Data Mining tool utilized, and it is an excellent Data Mining Tool for Bioinformatics Fields[6].The classifying data mining methods are used in [2] to analyze the efficiency of an algorithm. WEKA, naive bayes and Apriori are the algorithms employed. As an outcome, the classification matrix is applied to determine performance reliability.

Ongoing monitoring of intensive care cardiac patients is available in hospitals, although patients are generally released from the hospital without direct observation. These patients require continuous supervision of their health status for at least a week to decrease the possibility of unexpected sequelae. As a result, another goal of this study is

indeed the actual creation and execution of a concept of a constant real-time heart health monitoring system utilizing Arduino-based sensors that can be commercially produced and affixed to the body of the sufferer Sensor data may be sent to the service and stored in the main server using the Wi-Fi module[11].

Sensor data on the server could be updated every 10 seconds, and physicians using cellphones could access it. can use this software from any location to see their patients' current health status. If any of the heartbeat, temperature, or humidity sensors exceed the threshold value, Physicians will immediately get an alarm message on both the software and his phone. Furthermore, relatives and caregivers may monitor the person's actual information via the app, and if the individual remains in the ICU, the Arduino's siren will alert them even if the system failed. When a client need medical guidance or medication. in another part of the world, he or she may simply launch the application and begin live video streaming[11].

Data mining techniques are used to create an Innovative Heart Disease Predictor System (IHDPS).Naive Bayes, Neural Networks, and Decision Trees were suggested by Sellappan Palaniappan et al. [3]. Each strategy has its own unique ability to provide proper outcomes. Hidden patterns and their relationships are employed to develop this system. It is web-based, easy to use, and extendable[1].

As a device for prediction and diagnosis, the computer-aided automated diagnostic system can assist the clinician. This study examines several heart disease categorization systems. According to the findings, big data plays a significant influence in heart disease categorization. A neural net with teaching is useful for illness prediction in the early stages, and the system's performance can be improved by using preprocessed and standardized datasets[7].

This study scrivener the main identification and hindrance of heart-related unhealthiness utilizing several classification approaches applied using the R analytical tool. The reliability of Naïve Bayes classifier is superior to another for the prediction of heart-related harmfulness at the process used to produce time periods of time. According to studies, the accuracy of foreseeing cardiac unhealthiness differs from one another, and the accuracy of foreseeing also depends on the platform. In the instance of Naive Bayes classification algorithm by employing R data analytics tool for having a stroke or heart ailment with attribute filtration, the efficiency and area under curve are sovereign[5].

This study tackles the problem of predicting heart disease based on various input qualities. Heart disease has become a worldwide epidemic. It can't be easily anticipated because it is a challenging process that needs experience and advanced understanding. Data mining recovers hidden information that is critical in decision making.decision-makingThis research conducted an experiment utilizing several data mining approaches to discover a much more probability of a specific for predicting heart disease. By each data mining method in this research, two sets of information (collected and UCI standard) are employed independently[10].

The overarching goal of their research is to better anticipate the existence of cardiac disease. To produce more precise findings, two additional input variables, obesity and smoking, are employed in this work. Decision trees, Naive Bayes, and Neural Networks were used as information mining classification approaches. According to the data, Neural Network models produce more accurate results than Decision Trees and Naive Bayes[1].

We conclude that a database with appropriate samples and precise data is required to create an accurate cardiovascular disease prediction model. The dataset must be standardized appropriately since this is the most important step in preparing the dataset for usage by the machine learning algorithm and producing effective results. When creating a prediction model, an appropriate algorithm must also be employed. We can see that Artificial Neural Networks (ANN) and Decision Tree fared well in certain forecasting models for heart disease (DT)[9].

There are several data mining approaches that may be utilized to identify and prevent heart disease in patients. Three classification function algorithms in data mining are examined in this research for predicting heart disease.The algorithms are function-based Logistic, Multilayer Perceptron, and Sequential Minimal Optimization. According to the experimental data, this logistic segmentation function approach is the best classifier for heart disease detection since it has the highest accuracy and the lowest error rate[2].

PROPOSED METHOD

Based on our survey results, we've decided to apply machine learning to discover the illness in our review paper. In this study ,WEKA is a data mining platform that uses a huge dataset to detect the presence or predict the likelihood of having cardiac disease.

Then, utilizing an Arduino-based microcontroller system, a continuous cardiac monitoring system design was presented.

The suggested system's step-by-step design methodologies, as well as the overall system's workflow, are discussed below[11]:

➢ Documentation and evaluation of diverse heart disease datasets for teaching various machine learning techniques.

➢ A comparison of the precision and recall of several data mining algorithms in detecting cardiac disease.

➢ Choosing the appropriate algorithm based on model performance attributes to create a cloud-based artificial automated diagnostic software platform.

➢ Storing expert and health history in a cloud-based server after identification of patients and physicians individually through the application.

➢ A full-fledged design procedure of an Android platform with applicable criteria is presented in the Research and Results section.

➢ On the system interface, the patient may manually enter all heart disease characteristics, as well as sensor data such as heartbeat, by pressing a specified button. As a result, They can anticipate whether or not they have cardiovascular disease.

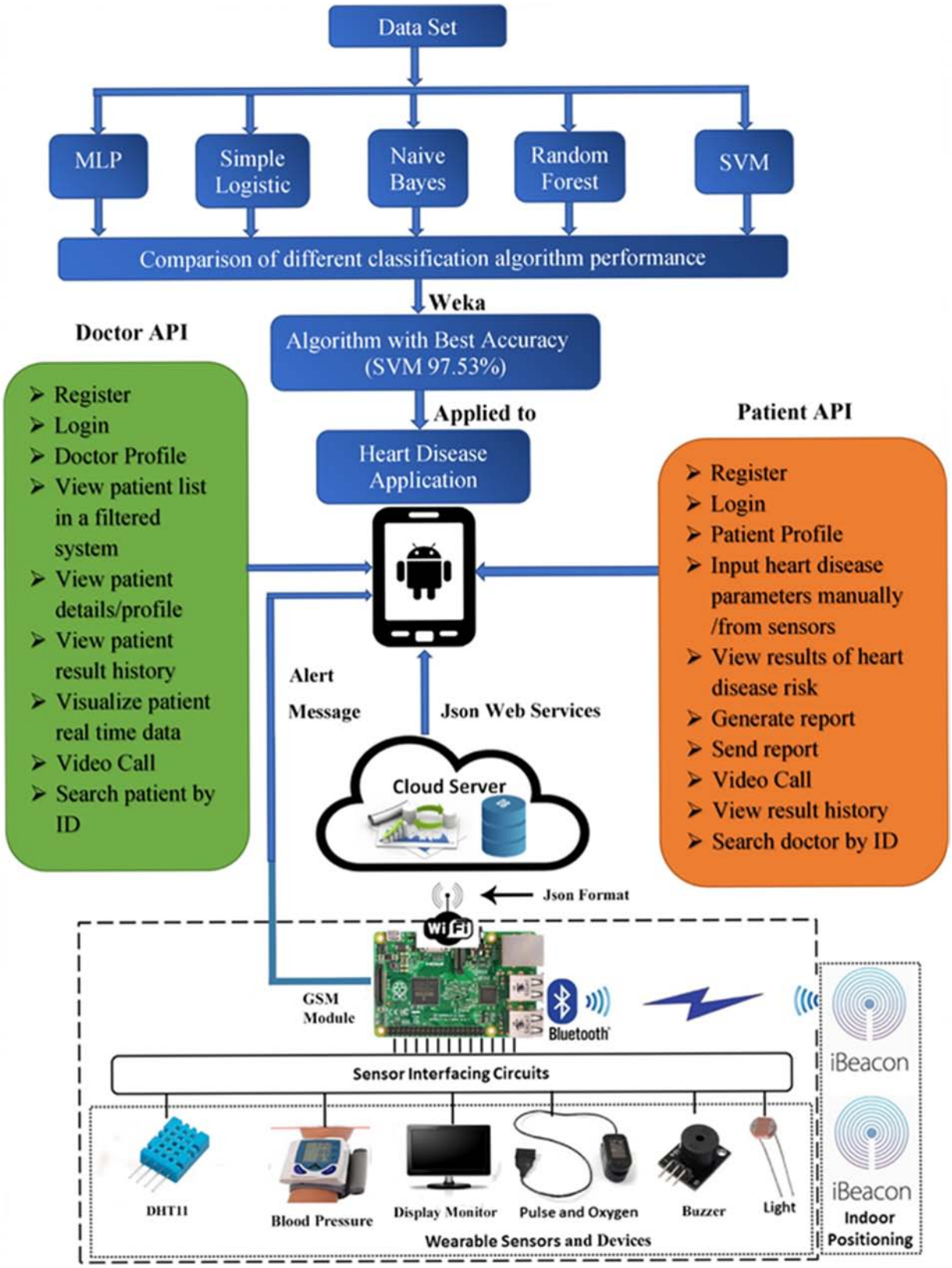
➢ Following that, the person may forward the report to any specialist who is a member of the programme. the programme by putting the surgeon's ID into the search box. Furthermore, if a serious emergency arises, he or she can initiate a live video contact with the doctor.

➢To collect essential patient physiology data and recognize the patient's urgent state, a primary bluetooth smart health surveillance system is built using Arduino and temperature, humidity, and pulse sensors.

➢All detector real statistics are automatically recorded and modified on the public cloud database after a certain time (every 10 seconds), and if any undesired sensor value is detected, the recommended specialist from any location around the world is contacted through mobile Message using the Gsm network.

In the event of Hospitalized patients, an alerting system with a siren is in place to promptly warn the guardian or nurses.

➢ Once getting a warning notification with the current information from his device's sensors, the doctor will enter into the programme to verify the patient's past physiological parameters and consult a suitable prescription through live video streaming.


Data Set
MLP
Simple Logistic
Naive Bayes
Random Forest
SVM
Comparison of different classification algorithm performance
Weka
Algorithm with Best Accuracy (SVM 97.53%)
Applied to
Heart Disease Application
Doctor API
Register
Login
Doctor Profile
View patient list in a filtered system
View patient details/profile
View patient result history
Visualize patient real time data
Video Call
Search patient by ID
Patient API
Register
Login
Patient Profile
Input heart disease parameters manually /from sensors
View results of heart disease risk
Generate report
Send report
Video Call
View result history
Search doctor by ID
Alert Message
Json Web Services
Cloud Server
Json Format
Wi Fi
GSM Module
Bluetooth
Sensor Interfacing Circuits
DHT11
Blood Pressure
Display Monitor
Pulse and Oxygen
Buzzer
Light
Wearable Sensors and Devices
iBeacon
iBeacon
Indoor Positioning

Appropriate 1. A summary of the planned cardiovascular disease diagnosis and client monitoring system[11]

CONCLUSION

This is a survey, and we have studied all of the papers, and We have concluded that the machine learning approach and data mining in the Weka method are the best for the prediction of cardiac diseases.

Electronic medical records for patients typically include useful, irrelevant, and duplicate information. Because of this inefficient amount of features, doctors encounter a problem in predicting and diagnosing cardiac ailments swiftly and effectively. Various research studies the importance of feature selection strategies in selecting the ideal collection of characteristics to be utilized in predicting and diagnosing heart disease using various methodologies and generalization abilities.

here, We use machine learning techniques and WEKA to tackle all of the difficulties associated with the diagnosis of heart diseases.

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Stress Analysis of Nozzle to Head Junction with Stress Indices

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Abstract

The design of a pressure vessel is usually made with external attachments and required openings. The most common external attachment is the nozzles with their junctions. Under different loading conditions the stress concentration will occur at the junction area. In addition, due to discontinuity of the geometry and difficulties during welding and defects detected there, the junction region will become the weakest point and the failure source of the whole structure. In Reactor, stresses are produced at nozzle to shell and nozzle to head attachment. Evaluating the state of stress at the junction of a nozzle to a bottom head is most important. In this paper as per WRC 107 stresses at the eight points of nozzle to head junction is calculated and also PV-CodeCalc is employed to calculate stresses of various components at attachment of reactor as per ASME. It contains curves for hollow and solid circular attachment; it determines local stresses at the eight points (Four upper and Four lower points) in the spherical and cylinder shell. This resultant data determines whether design is safe or not for given design parameters.

Keywords*:* WRC 107, PV-CodeCalc, Primary Stress, General Primary Membrane Stress (P_m), Local Primary Membrane Stress (P_l) Primary Bending Stress (P_b) ,Secondary Stress (Q) , Peak Stress (F).

1. Introduction

Finding local stresses in spherical and cylindrical shells due to external loading in WRC. So the design of nozzle junction based on ASME pressure vessel design code is very necessary for external loading on the nozzle. Welding Research Council Bulletin No 107 has been one of the most widely used bulletins for finding local stresses in spherical and cylindrical shells due to external loading in WRC. The method published in WRC 107 is based on theoretical work of Prof. Bijlaard, the formulations for calculation of the combined stress intensity. The original bulletin was published in August 1965. In the March 1979 revision of bulletin WRC 107, there are some additional revisions and clarification. Generally nozzle attachment the relatively high stresses occur which direct subjected to various forms of external loading on the nozzle. It contains curves for hollow and solid circular attachment; it determines local stresses at the eight points (Four upper and four lower points) in the spherical and cylinder shell in Fig. 5.1 Existing available methods, which are frequently used, the methods published in WRC 107. For nozzle to cylinder/head intersections the following assumptions were made by Prof. Bijlaard:

- The external load is applied directly to the cylindrical/head surface.
- The nozzle-cylinder/head intersection is in a plane.
- The circular loaded surface is replaced by an equivalent square loaded area.

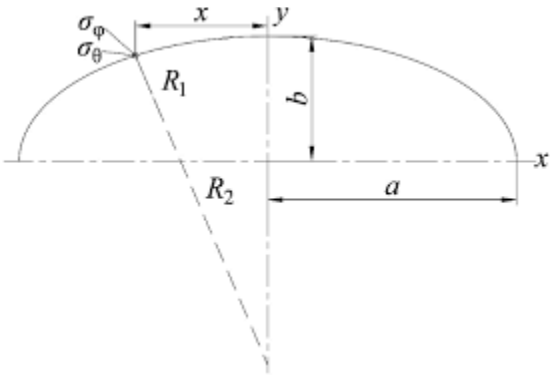


Figure 1.Stresses at spherical Head

1.1 Stress Resulting from Arbitrary Loading:

In the general case, all applied loads and moments must be resolved (at attachment shell interface) in the three principal direction; i.e. they must be resolved into components P; V_L; V_C; M_L; M_C& M. If one then proceeds in the manner previously outlined, embrane, bending & shear stresses can be evaluated at eight distinct points in the shell at its juncture with the attachment. These eight points are shown in figure 5.1. The numerous stress components can be readily accounted for using maximum Shear Stress Intensity. Also, it is to be noted that evaluation of stresses resulting from internal pressure has been omitted.

1.2 Limitations on Application:

The foregoing procedure is applicable to relatively small attachments on large spherical shells. Where relatively large attachments are considered or when situations are encountered that deviate considerably from idealized cases presented herein. Under certain conditions, it is possible that stresses will be higher at points removed from the attachments to shell juncture than they are at the juncture itself (as assumed in the foregoing procedure).Approaches vary widely, however the following approach can produce an effective introduction.

2. Methodology

Porter and Martens have presented methodology to calculate stresses and acceptance criteria for loads on nozzle to shell junctions on pressure vessels. First stage of present work finds stresses at nozzle to head junction by WRC 107 with and With stress indices. In the general case, all applied loads & moments must be resolved (at attachment shell interface) in the three principal direction; i.e. they must be resolved into components P, V,VC, ML, MC and M ,membrane, bending and shear stresses can be evaluated at eight distinct points in the shell at its juncture with the attachment. These eight points are shown in Figure 1. All the nozzle loads and moments are considered to be acting at the same time, on conservative front. Nozzles external are shown in Figure 2.

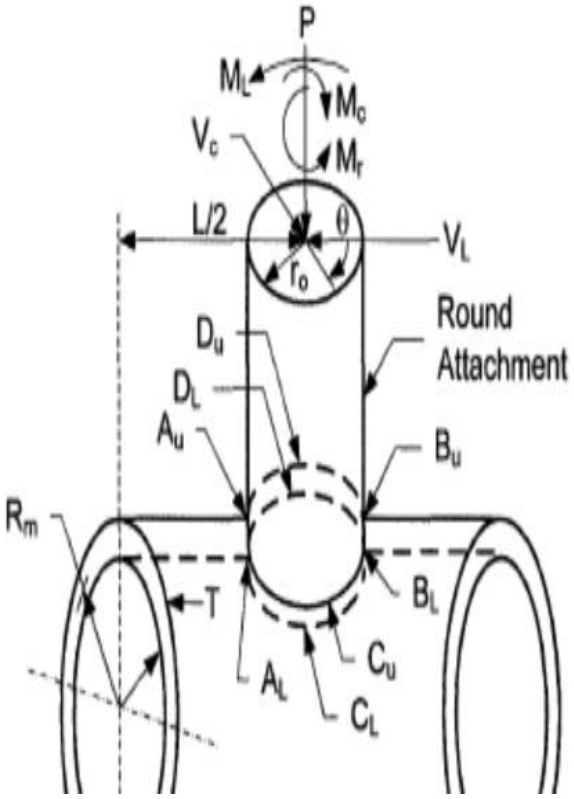
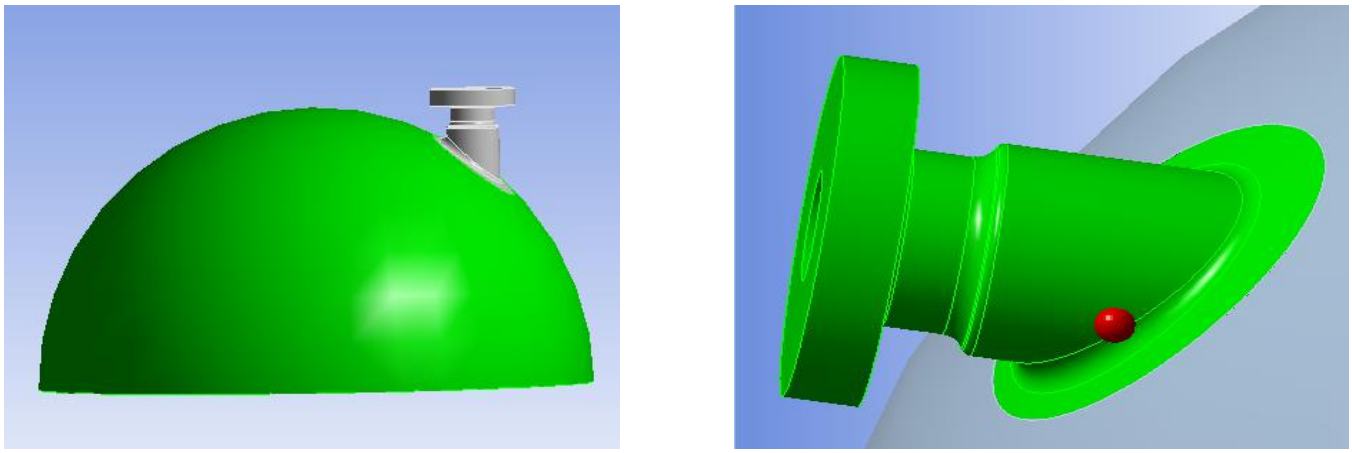


Figure2. Nozzle Loads
[Ref:WRC bulletin series 107 and 537,April 2001]

3. Nozzle Junction Model

The nozzle to shell junction model is as shown in Fig. 3 (a) and (b). It includes spherical dishend with hill side nozzle and the angle is attached with it. All dimensions are as per the Table 2. The nozzle and shell junction having 19 mm inside radius at a location of intersection is as shown in Fig. 3 (a) and (b).



(a) **(b)**

Figure 6.1 Nozzle to shell junction model

Material of construction Shell: SA 516 GR.60
Nozzle: SA 105
Material properties: The physical properties used for various materials are listed below as per the material specification. The following temperature dependent properties
of materials as given in **ASME Section II, part D.**
Elastic Modulus (E) = $2 * 10^5$ MPa
Shell, Dished Head, and Nozzle
Poison's ratio (μ) = 0.29
Density (ρ) = 7850 kg/m^3

4. Stress Analysis of Nozzle to Head Junction with Stress indices

As per ASME section VIII division II part 5 ANNEX 5.D. Stress indices may be used to determine peak stresses around a nozzle opening. The term stresses index, is defined as the numerical ratio of the stress components σ_t, σ_n and σ_r under consideration to the computed membrane hoop stress in the unreinforced vessel material; however, the material which increases the thickness of a vessel wall locally at the nozzle shall not be included in the calculation of the stress components.

4.1 Design Data:

Table 1 gives the design data used for the analysis. Table 2 gives data pertaining to geometry of the pressure vessel. Nozzle external loads applied at top of the nozzle neck and are as given is Table 3.
Material of Shell is SA- 516 GR 60 and that of Nozzle is SA -105.

Table 1. Design Data

Design code	ASME Section VIII DIV. I& II
Internal pressure(MAWP)	1.610 Kgf/mm^2
Design Temperature	70° C
Corrosion allowance	0

Table 2. Geometry Inputs

ID of shell	1878 mm
OD of shell	1944 mm
Thickness of shell	66 mm
ID of nozzle	101.6 mm
OD of nozzle hub	193.6 mm
OD of nozzle neck	161.9 mm
Internal pressure	15.69 MPa

Table 3. Nozzle loads

Nozzle Loads	At Top Of the Nozzle Neck
Radial Load(P)	-2447.5 Kgf
Longitudinal Shear (VL)	2447.5 Kgf
Circumferential Shear (VC)	2447.5 Kgf
Longitudinal moment (ML)	734 Kg-m
Circumferential moment (MC)	734 Kg-m
Torsional moment	734 Kg-m

4.2 Geometric Parameters:

U=0.38, L=1.6, p =1.43
Design internal Pressure= 1.610 Kgf/mm^2
Fillet Radius between Nozzle and Vessel= 19mm
Dimensionless Loads for Spherical Shells at Attachment Junction According to L and p select the below value from Curves in WRC 107.

$N_{(x)}$ T/p =0.09051 .....(1)
$M_{(x)}$/p =0.09102 .....(2)
$N_{(x)}$ T (√R_mT)/M_C =0.20579 .....(3)
$M_{(x)}$ p (√R_mT)/M_C =0.26158 .....(4)
$N_{(x)}$ T (√R_mT)/M_L =0.20588 .....(5)
$M_{(x)}$ (√R_mT)/M_L =0.26158 .....(6)
$N_{(y)}$ T/p =0.18466 .....(7)
$M_{(y)}$/p =0.05234 .....(8)
$N_{(y)}$ T (√R_mT)/M_C =0.08640 .....(9)
$M_{(y)}$ (√R_mT)/M_C =0.19675 .....(10)
$N_{(y)}$ T (√R_mT)/M_L =0.08640 .....(11)
$M_{(y)}$ R_mT/M_L =0.19675. .....(12)

As per WRC 107 Appendix B Stress Concentration factors for stresses due to external loads, K_n = 1; K_b= 1.

Table 4. Stresses at Attachment Junction With Stress Indices
[Ref:WRC bulletin series 107, 2001]

Types of stress and load Location	Au	Al	Bu	Bl	Cu	Cl	Du	Dl
Rad. Memb. P	0	0	0	0	0	0	0	0
Rad. Bend. P	0	0	0	0	0	0	0	0
Rad. Memb. Mc	0	0	0	0	0	0	0	0
Rad. Bend. Mc	0	0	0	0	-1	1	1	-1
Rad. Memb. ML	0	0	0	0	0	0	0	00
Rad. Bend.	-1	1	1	-1	0	0	0	0
Total Rad. Stress P	-0.8	0.7	1.5	-1.2	-0.8	0.7	1.5	-1.2
Tang. Memb P	0	0	0	0	0	0	0	0
Tang. Bend. ML	0	0	0	0	0	0	0	0
Tang. Memb. Mc	0	0	0	0	0	0	0	0

Tang Bend. Mc	0	0	0	0	0	0	0	0
Tang Memb. ML	0	0	0	0	0	0	0	0
Tang Bend. ML	0	0	0	0	0	0	0	0
Total Tang. Stress	-0.6	0.7	1.1	-0.8	-0.6	0.7	1.1	-0.8
Sheare Vc	0	0	0	0	0	0	0	0
Shear VL	0	0	0	0	0	0	0	0
Shear MT	0	0	0	0	0	0	0	0
Total Shear	0.3	0.3	0.1	0.1	0.1	0.1	0.3	0.3
Stress Intensity	1.03	0.96	1.55	1.18	0.84	0.72	1.71	1.34

4.3 WRC 107 Stress Summations:

Porter and Martens have presented methodology to calculate stresses and acceptance criteria for loads on nozzle to shell junctions on pressure vessels. First stage of present work finds stresses at nozzle to head junction by WRC 107 with and With stress indices. In the general case, all applied loads & moments must be resolved (at attachment shell interface) in the three principal direction; i.e. they must be resolved into components P, V,VC, ML, MC and M ,membrane, bending and shear stresses can be evaluated at eight distinct points in the shell at its juncture with the attachment. These eight points are shown in Figure 1. All the nozzle loads and moments are considered to be acting at the same time, on conservative front. Nozzles external are shown in Figure 2.

Table 5. Stresses at Eight Points at Nozzle Junction

Type of Stress Int. Location	Au	Al	Bu	Bl	Cu	Cl	Du	Dl
Rad.Pm (SUS)	23	23	23	23	23	-2	23	-2
Rad.Pl(SUS)	0	0	0	0	0	0	0	0
Rad.Q(SUS)	0	0	1	-1	0	0	1	-1

Long.Pm(SUS)	23	-2	23	-2	23	23	23	23
Long.Pl(SUS)	0	0	0	0	0	0	0	0
Long. Q(SUS)	0	0	0	0	0	0	0	0
Shear Pm(SUS)	0	0	0	0	0	0	0	0
Shear Pl(SUS)	0	0	0	0	0	0	0	0
Shear Q(SUS)	0	0	0	0	0	0	0	0
Pm(SUS)	23.7	26.1	23.7	26.1	23.7	26.1	23.7	26.1
Pm+Pl(SUS)	23.8	25.6	24	26.1	23.8	26.2	24	26.1
Pm+Pl+Q (Total)	23.4	26.1	25.3	25.7	23.2	26.1	25.4	26.4

5. Result and Discussion

Table 6. Results Summary

Type of stress Int.	Max Stress Induced	Allowable Stress	Result
Pm(SUS)	26.08	12.02	Failed
Pm+Pl(SUS)	26.21	18.03	Failed
Pm+Pl+Q(Total)	26.45	36.07	Passed

The stress evaluation is performed by WRC 107 & PV-CodeCalc software. WRC 107 results are validated with PV-CodeCalc results. General primary membrane equivalent Stress (P) General primary membrane equivalent Stress plus Local primary membrane equivalent Stress (Pm+ Pl) and General primary membrane equivalent Stress plus Local primary membrane equivalent stress plus secondary stress (P
L+P+Q) are meeting the requirements of Part 5 of ASME Section VIII, Div 2, Ed' 2007, ADD 2008. It is also shown that head and nozzle are adequate as the stress intensity are within allowable limits. The results obtained by WRC 107 and PVCodeCalc calculation With stress indices are shown in Table 6.

6. Conclusion

The above mentioned detailed Calculation is carried out to determine the requirement of the reinforcement pad for the given loading condition as per ASME Section VIII, Div. I. This calculation steps simplifies the stresses at the eight points of nozzle to head junction and it also determines local stresses at the eight points (Four upper and Four lower points) in the spherical and cylinder shell. This resultant data determines whether design is safe or not for given design parameters. The calculation result suggests that there is no need for providing a reinforcement pad.

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Design Methodology to Generate Radio Frequency Signals for Electronic Countermeasure Devices for Unintended Wireless Signals Reception

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Abstract. Radio Frequency (RF) signal generation has been characterized on different operating frequencies in numerous wireless communication applications. This paper presents design methodology of generating RF signals used in standard digital cell-phone frequency bands. The proposed RF signal generation methods depend on key characteristics such as operating frequency range, transmitter power, dc supply requirements, RF signal coverage area, design complexity and cost. System parameters of Global System for Mobile Communication (GSM-900), Digital Cellular System (DCS-1800) and Personal Communications Service (PCS-1900) are considered. For GSM-900, a simple and low cost design has been proposed for analyzing wireless transmissions up to 5 meters operating range. A slightly complex design is evolved for a higher range of operation (up to 20 meters) in the uplink and downlink frequency bands of 890–915 MHz and 935-960 MHz, respectively. For DCS-1800 and PCS-1900, the circuit design requirements are presented to achieve radio coverage up to 10 meters for efficient RF signal generation in 1800 MHz and 1900 MHz bands, respectively. The proposed design methodologies can be extended to 4G/5G cell phone transmissions operating in different frequency bands.

Keywords – *DCS-1800, Digital cellular standards, GSM-900, PCS-1900, RF signal generation.*

INTRODUCTION

The basic principle to block unintended wireless transmissions is to generate and transmit the high-power RF signal in the specified RF band within the desired radio coverage area. This prohibits unnecessary reception of RF signals by intended devices in certain operating area. This also serves the purpose of denying the possible access to a particular wireless transmission from safety angle or for monitoring purpose.

Now-a-days, everyone is using cell phones as an essential tool for variety of commercial and non-commercial applications. It is quite obvious that continuous use of cell phones in some situations may be unwarranted such as the ringing sound may cause annoyance or disruption in regular tasks. For an instance, designated places such as seminar halls, conference rooms, law courts, central library, lecture classrooms, examination halls, and religious places may need this type of arrangement. In such situation, a wireless device can be installed in near vicinity so as to inhibit the incoming or outgoing calls from cell phones in its operating region. These types of wireless devices can be simply termed as electronic countermeasure devices. In case the area is served by any wireless communication networks, say, similar to cellular phone systems, then the wireless device is known as wireless transmission inhibitors. Security, of course, is another major issue for using such RF signal generating wireless devices for restricting the use of unauthorized cell phones or any other similar wireless communication devices. [1].

A cell phone functions by establishing two-way wireless link with its nearest cellular tower, also known as base transceiver station (BTS). An RF signal electronic countermeasure device generates and transmits pure sinusoidal signal with adequate power exactly on the assigned RF band as the cell phone, thereby causing strong interference in

the RF signals between the BTS and the cell phone. This is similar to denial-of-service (DoS) type attack in computer networks. [2]. The wireless signal generating device denies access of the allocated RF band to cell phone users which happens to be within its radio range. With these types of wireless devices, the situation appears to be somewhat similar to out-of-range or out-of network service. Mostly cell phones are designed to use different allocated cellular bands for communications with cell phone towers.

This paper is organized in sections. Section II is devoted to some related literature. In Section III, design of a generalized RF signal countermeasure device is given in the form of a basic functional block schematic diagram. Specific circuit design of GSM-900 RF signal countermeasure device is presented in Section IV. In Section V and VI, similar circuit designs for DCS-1800 and PCS-1900 are described. Section VII concludes the discussions.

RELATED LITERATURE

Cell phone wireless transmission countermeasure RF devices can either function by interfering cell phone to base station frequency band or vice versa [3]. Now, various regions of the world are using different GSM standards for mobile cellular communications. [4]. GSM-900 has certain advantages over DCS-1800 including high coverage range and high output power with lesser propagation path losses [5]. DCS-1800 has an advantage of small cell radius making it an ideal capacity solution [6]. PCS-1900 standard is also used worldwide. [7]. Most of the network components are same as that used in GSM-900 and DCS-1800. It has the RF bandwidth in between these two standards. As such these types of RF devices for a particular GSM standard is to be operated on the specific frequency, so one device suited for one application cannot work with other. [8]. This paper has proposed the design requirements for all these three different cellular standards.

DESIGN OF A RF SIGNAL GENERATOR

The design and analysis of RF circuits can be quite complex because RF devices often behave in ways that are difficult to predict. Figure 1 shows the block diagram for a generalized RF signal generating device, depicting three major components: Power Supply, IF Section and RF Section.

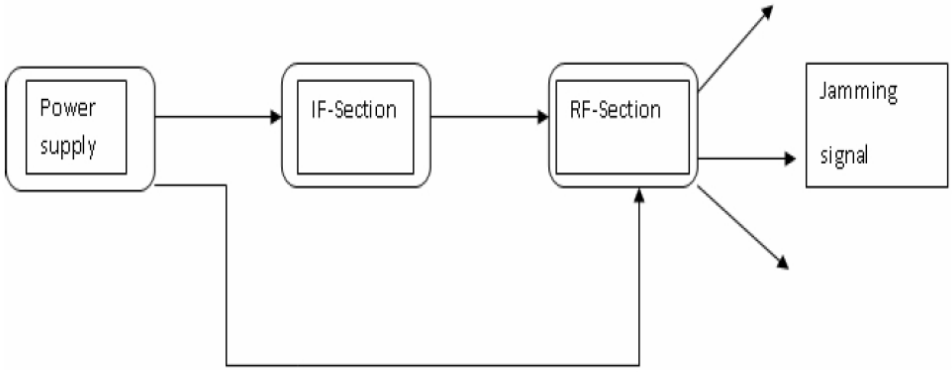

FIGURE 1. Simplified Block Diagram of a RF Signal Generating Device or Countermeasure Device

The IF section basically comprises of a triangular waveform signal generator circuit, a noise signal generator circuit and a clamper circuit. This provides the required sweep signal so as to generate the desired minimum to maximum frequency signals [6-7]. The RF Section is based on voltage-controlled oscillator (VCO) which generates whole range of frequencies with the tuning signal generated in IF section.

The output frequency band to be generated is decided solely by VCO characteristics. RF amplifier and an antenna are attached at the output of the VCO in order to increase the output power of the RF signal generated by the VCO. Now, depending upon design of the RF section and IF section, different types of RF signal countermeasure devices can be designed for different cell phone standards and different operating frequency bands. These are described in the following sections.

RF SIGNAL GENERATION IN GSM-900 BAND

The GSM-900 standard is a global cellular standard in the 900-MHz band for digitized voice transmissions. [9]. The allocated RF band is divided in two sub bands, having 25 MHz each in the uplink and downlink. Two design circuits have been presented for GSM-900 RF signal countermeasure device with different output RF power levels and operating range [10].

Low Range GSM-900 Cell Phone RF Signal Countermeasure Device Using IC555

A low cost design provides a nominal range of up to 5 meters which is suitable for commercial applications. The following circuit using IC555 in astable mode with high frequency output by deciding the values of R1, R2 and C is good enough to be used as a 'Noisy Transmitter' for cell phones, as depicted in Fig. 2.

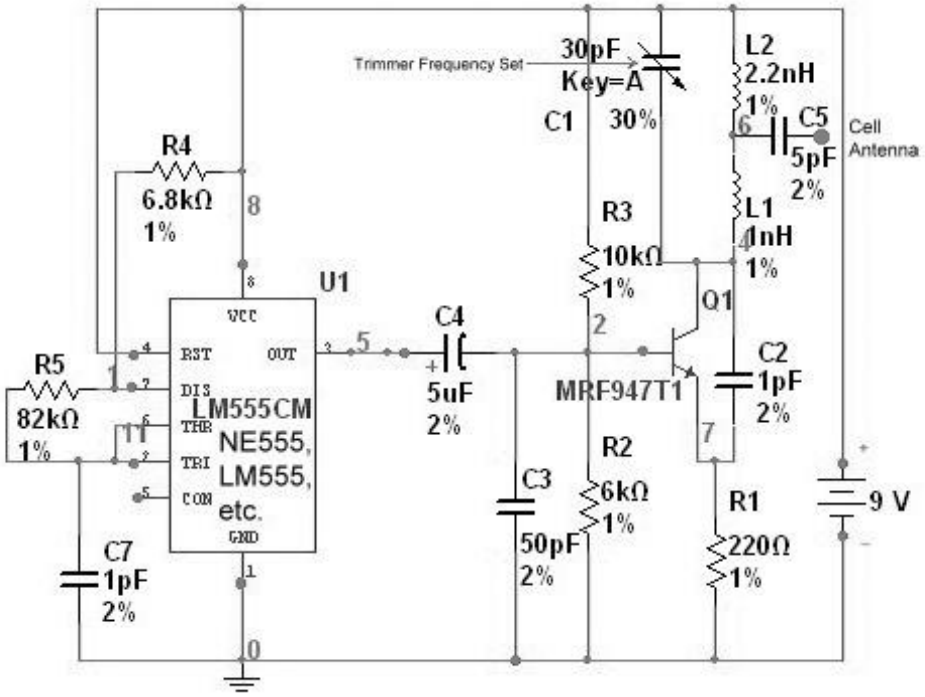

FIGURE 2. Schematic for Low Range GSM-900 RF Signal Generating Device using IC555

The IC 555 timer with a coupling capacitor C4 modulates oscillator designed around MRF transistor. With proper setting of C1, 900 MHz signal is obtained at its output. By changing value of the variable capacitor C1, the output frequency is varied from 800 MHz to 2000 MHz. As shown, two moulded inductors L1 and L2 are used. The values of L1, L2, C1 and C2 are properly set as per the required frequency range. A cell phone antenna is connected to C5. It is observed that the output is quite good but the current drawn is slightly on higher side. Therefore, a new +9V battery is connected for operation for about an hour.

Medium to High Range GSM-900 RF Signal Generating Device using VCO55BE

Low range GSM-900 RF signal countermeasure design could not be used for security applications for which a larger range of up to 20-30 meters is a minimum requirement [11-12]. So, the circuit schematic, as shown in Fig. 3, has been implemented with design specifications having 20 meters range and output power of +34 dBm.

It mainly comprises of Triangular Wave Generator using IC NE555 Timer, Noise Generator using IC LM386 Audio Amplifier, Mixer IC LM741 (Operational Amplifier as Summer), Voltage Controlled Oscillator IC CVCO55CL, RF Power Amplifier IC PF08109B, and Monopole Antenna with frequency range 850 MHz - 1 GHz.

IC NE555 Timer has been used in Astable mode so as to generate a triangular wave signal for sweeping the VCO in the desired frequency range. The VCO output is simply an unmodulated sweeping RF carrier signal. Therefore, the triangular waveform is mixed with noise signal (similar to FM modulated carrier signal with noise as modulating signal).

A zener diode is used to generate wide band noise-type signal due to avalanche effect in reverse-bias condition. This noise signal is then passed through two amplifier stages comprising of NPN transistor operating in common-emitter configuration, followed by audio amplifier IC LM386. The mixer stage here is simply a summer amplifier. So, the triangular wave and noise signal will be added using IC LM741 prior to applying at the input of VCO. RF power amplifiers used for amplification of RF signals generally possess nonlinear characteristics which may produce intermodulation interference beyond the required bandwidth of the channel.

It offers an input impedance of 50 Ω and VSWR specification having less than 2.

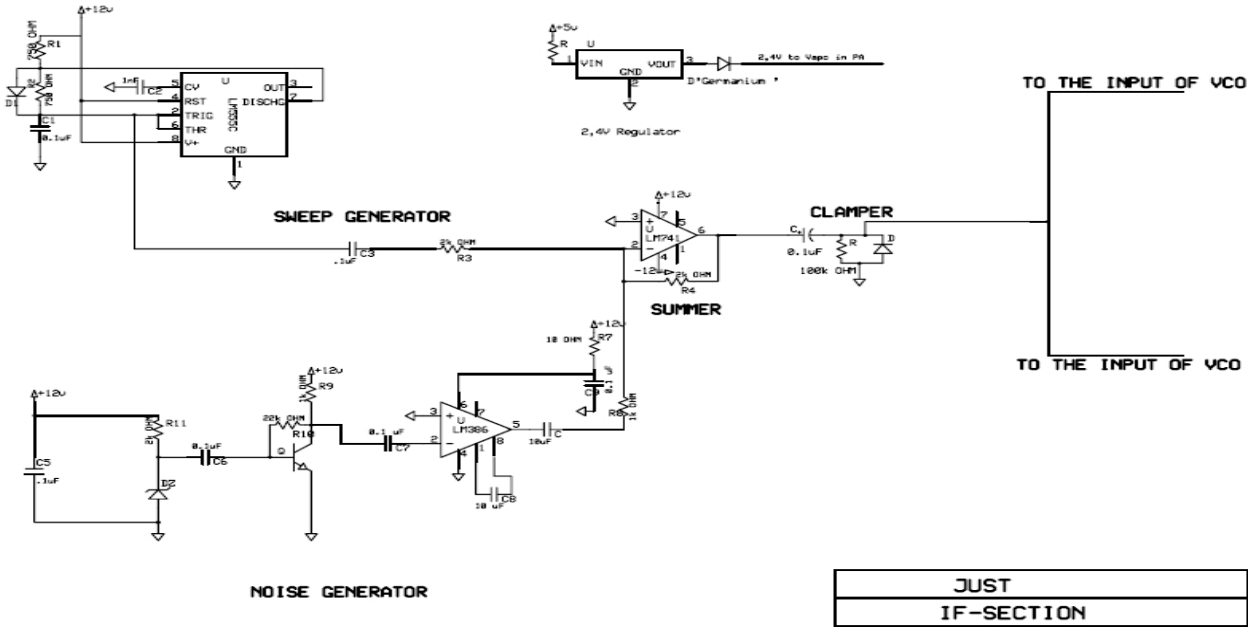

FIGURE 3. Circuit Schematic of IF Section

Figure 4 illustrates the schematic of RF Amplifier stage. The VCO generates the required RF signal that serves as RF signal generating circuit to be used as counter measuring device for the cell phone. The VCO output signal has frequency that varies in the same proportion as the amplitude of the input signal.

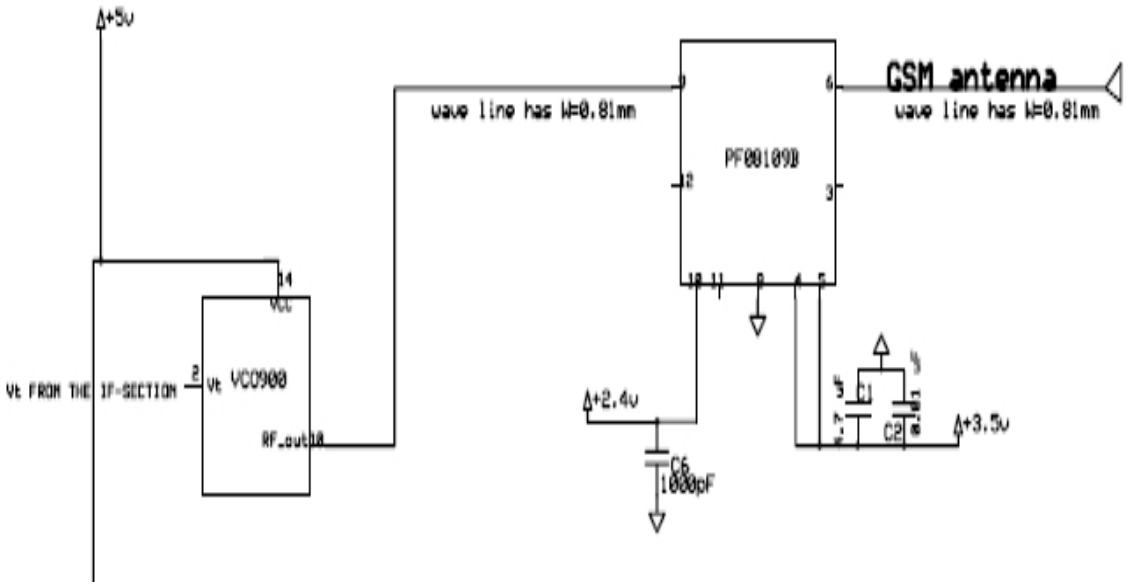

FIGURE 4. Schematic Diagram of RF Amplifier Section

Obviously, for DC input voltage the output signal has fixed pre-designed frequency [14]. In case the input signal is of typical triangular waveform signal, then the output signal will have a specified frequency range. A design of cell phone transmission analyzer device is proposed here around IC CVCO55CL. It is observed that the RF power output is maximum +8 dBm over the frequency range of 925 - 970 MHz. The gain of IC PF08109B is about 35 dB. As per the datasheet, it is designed to operate in GSM-900 as well as in DCS-1800 dual band. Finally, a monopole antenna has been used with input impedance of 50 ohms and VSWR < 2, within the frequency range of 850 MHz – 1 GHz.

Table I summarizes the major characteristics of low-range and high-range GSM-900 countermeasure devices for generating RF signals [15].

TABLE I. GSM-900 Countermeasure Device – Major Characteristics

Characteristics	Low Range	High Range
Operating Frequency Band	925-970 MHz	925-970 MHz
Operating Range	Up to 5 meters	Up to 20-30 meters
Output Power	+5 dBm	+34 dBm
Type of VCO	MRF transistor oscillator	CVCO55CL
RF Power Amplifier type	Not Used	PF08109B
Antenna type	Cell Antenna with frequency range 850 MHz-1 GHz	Monopole Antenna with frequency range 850 MHz-1 GHz
Design Complexity	Very Simple	Complex
Cost	Low	High
Application Areas	Commercial	Security and Defense

RF SIGNAL GENERATION IN DCS-1800 BAND

In DCS-1800 digital mobile phone standards, the RF spectrum in the 1800 MHz band has been allocated with RF carrier channel bandwidth of 75 MHz each for uplink and downlink (3 times that for GSM-900). The RF signal

generating and countermeasure device circuit has been implemented with following components and devices for range of operation up to 10 meters and output RF power up to +34 dBm for 1800 MHz band of operation:

a) Triangular Wave Generator: NE555 Timer
b) Noise Generation : LM386 Audio Amplifier
c) Mixer: LM741 Operational Amplifier as Summer
d) VCO IC CVCO55BE
e) PF08109B RF Power Amplifier:
f) Monopole antenna with frequency range of 1700 - 1900 MHz having 50Ω impedance and VSWR < 2.

IF Stage and RF Stage is common for DCS-1800 and GSM-900 except that VCO used for the DCS-1800 falls in the frequency range of 1785-1900 MHz. As shown in Fig. 5, VCO used here is CVCO55BE for DCS-1800.

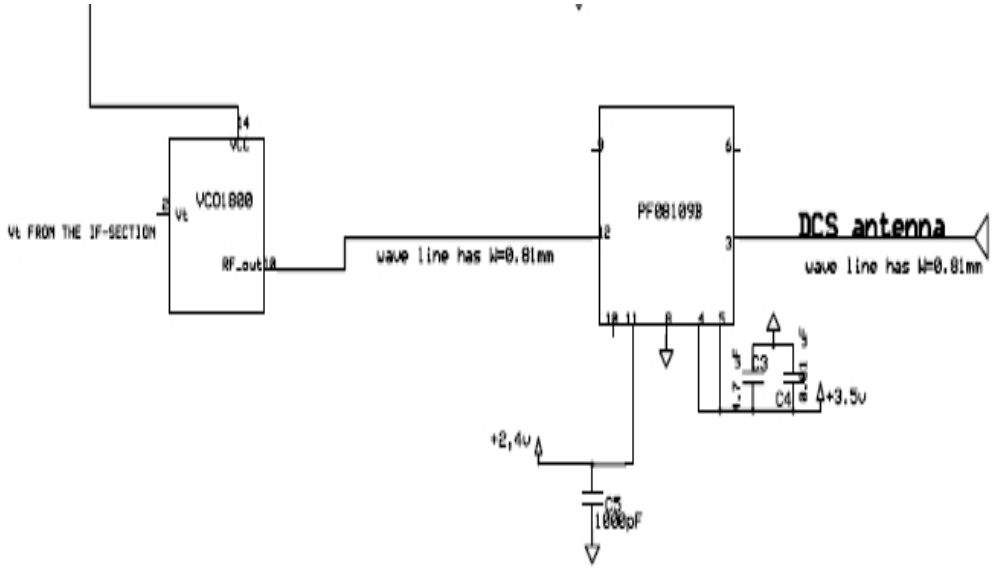

FIGURE 5. Schematic of RF Amplifier Section

The RF output power from the VCO is +5 dBm maximum which is amplified by an amplifier IC PF08109B with a suitable gain to increase it to +34 dBm. Monopole antenna is used having omni-directional radiation pattern in the frequency band of 1700 - 1900 MHz with input impedance of 50 Ω and VSWR < 2.

RF SIGNAL GENERATION IN PCS-1900 BAND

PCS-1900 standard is specified in 1900 MHz spectrum with RF bandwidth of 60 MHz. The design of PCS-1900 RF signal generating and countermeasure device has the identical components as used for GSM-900 or DCS-1800 RF signal generating and countermeasure devices. Design requirements for PCS-1900 RF signal countermeasure circuit include microcontroller IC8051 that generates a clock up to 25 MHz given as an input to the integrator. Instead of microcontroller, IC555 could also be used to generate a square wave. A simplified functional block schematic diagram for design of PCS-1900 RF signal generating and countermeasure device is shown in Fig. 6.

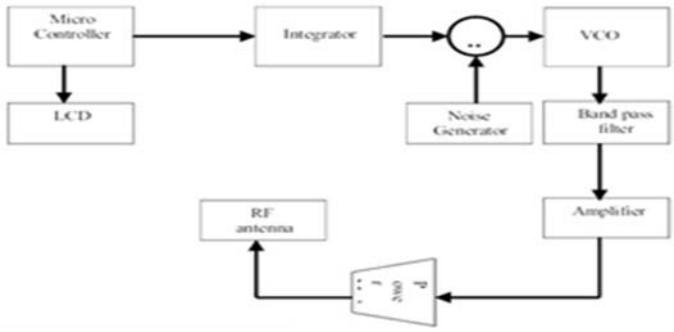

FIGURE 6. PCS-1900 RF Signal Generating and Countermeasure Device Block Diagram

IC LM358 can be used as an integrator which provides triangular or ramp waveform at its output for constant voltage applied at its input. High speed JFET TL072 and dual operational amplifiers can be used. Power amplifier IC LM386 has been used in low power transmission analyzer applications. IC AG603-86 (low-cost SMD) can provide higher dynamic range as buffer amplifier. RF signal output is then transmitted using a monopole antenna with input impedance 50Ω and VSWR less than 2.

Table II provides a comparative analysis of the major characteristics of DCS-1800 and PCS-1900 RF signal generating and countermeasure devices [16-18].

TABLE II. DCS-1800/PCS-1900 Countermeasure Device Characteristics

Characteristics	**DCS-1800**	**PCS-1900**
Operating Frequency Band	1785-1900 MHz	1910-1990 MHz
Operating Range	Up to 10 meters	Up to 10 meters
Output Power	+34 dBm	+30 dBm
Type of VCO	CVCO55BE	M3500-1324S/T
RF Power Amplifier type	PF08109B	AG603-86
Antenna type	Monopole Antenna with frequency range 1700-1900 MHz	Monopole Antenna with frequency range 1910-1990 MHz
Design Complexity	Complex	Very Complex
Cost	High	High
Application Areas	Security and Defense	Security and Defense

DISCUSSIONS AND CONCLUSION

Various designs to generate RF signals for use in electronic countermeasure devices for different operating frequencies for cellular communication applications have been proposed. A comparative analysis has been presented based on these design and analysis of circuits. Design criteria of RF signal generation and transmission as countermeasure devices have been specifically deliberated for GSM-900, DCS-1800 and PCS-1900 cellular standards mainly at the functional schematic levels. The circuit diagrams are suggested which can be implemented and amended as per the specific requirement. For GSM-900 countermeasure device, a simplified low-cost design has been proposed for low range (up to 5 meters) as well as for a higher range (up to 20 meters) of operation. For DCS-1800 and PCS-1900 countermeasure devices, the circuit design requirements have been presented up to a typical range of 10 meters. These outcomes can be further used to develop similar devices for other applications.

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