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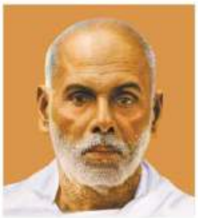

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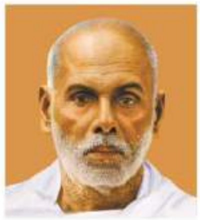

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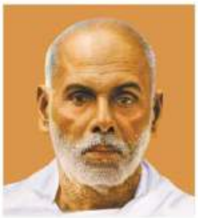

DEPARTMENT OF CIVIL ENGINEERING

ARTIFICIAL ISLAND

A SEMINAR REPORT

Submitted by

SILNA M

(SNC19CE020)

To

The APJ Abdul Kalam Technological University

In partial fulfillment of the requirements for the award of the

Degree of

Bachelor of Technology

In

Civil Engineering

DEPARTMENT OF CIVIL ENGINEERING

SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY, [illegible]

NOVEMBER 2022

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CERTIFICATE

This is to certify that this seminar report entitled **"ARTIFICIAL ISLAND"** submitted by **SILNA. M (SNC19CE020)** to the APJ Abdul Kalam Technological University in partial fulfilment of the requirements for the award of the Degree of Master of Technology in Civil Engineering is a bonafide record of seminar work carried out by them under our guidance and supervision.

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DECLARATION

I undersigned hereby declare that the seminar report "Artificial Island", submitted for partial fulfilment of the requirements for the award of degree of Bachelor of Technology of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by me under supervision of Ms. Pooja, Assistant Professor, Department of Civil Engineering. This submission represents my ideas in my own words and where ideas or words of others have been included; I have adequately and accurately cited and referenced the original sources. I also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

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I would like to express my heart-felt gratitude to my parents without whom I would not have been privileged to achieve and fulfill my dreams.

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ABSTRACT

Due to rise in sea level and rapid growth in population, it is expected that there will be an area shortage in the coastal areas in upcoming years. Many countries had solved their land shortage issues by either reclaiming lands or creating new islands. Changing scenarios and needs have shaped the today's requirement of the creating of artificial islands. If we look at the practices in historic times, early artificial islands included factors of security and culture as main factors (such as the Tenochtitlan, Mexico and Nan Madol). Later comes era of sea trades in which the construction of harbors to provide an isolated site for sea trade route [Dejima]. In 17 th century, Portugal and Spain built islands for defense purposes. In modern times, artificial islands have usually been formed by land reclamation, because of shortage of area for particular development or growing needs of the country to provide new habitat or recreational activities. More recently, they have been built to ease overcrowding in urban areas, accommodate airports, and promote tourism. Also, there are proposals been made to build new islands to mitigate coastal erosion or generate electric power from renewable energy sources. Such projects could bring new opportunities and activities to an area which had lesser scope for further development or area shortage which is likely to be seen in future. The design of such a project poses many problems particularly in respect of its impact on the environment. It is necessary to examine its aspects. This paper will be about how the objectives of the making of new islands or land reclamation had changed from past to the modern times, pros and cons and also, how it will be in the future when there will expected to have new issues or objectives to create the new land.

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ABBREVATION

SCS	South China Sea
APEC	Asia Pacific Economic Cooperation

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CHAPTER 1
INTRODUCTION

1.1 GENERAL

An artificial island or man-made island is an island that has been constructed by people rather than formed by natural means. Artificial islands may vary in size from small islets reclaimed solely to support a single pillar of a building or structure, to those that support entire communities and cities. Early artificial islands included floating structures in still waters, or wooden or megalithic structures erected in shallow waters (e.g. crannógs and Nan Madol discussed below). In modern times artificial islands are usually formed by land reclamation, but some are formed by the incidental isolation of an existing piece of land during canal construction (e.g. Donauinsel, Ko Kret, and much of Door County), or flooding of valleys resulting in the tops of former knolls getting isolated by water (e.g. Barro Colorado Island). One of the world's largest artificial islands, René-Levasseur Island, was formed by the flooding of two adjacent reservoirs.

1.2 HISTORY

Despite a popular image of modernity, artificial islands actually have a long history in many parts of the world, dating back to the reclaimed islands of Ancient Egyptian civilization, the Stilt crannogs of prehistoric Wales, Scotland and Ireland, the ceremonial centers of Nan Madol in Micronesia and the still extant floating islands of Lake Titicaca.The city of Tenochtitlan, the Aztec predecessor of Mexico City that was home to 500,000 people when the Spaniards arrived, stood on a small natural island in Lake Texcoco that was surrounded by countless artificial chinamitl islands. The people of Langa Langa Lagoon and Lau Lagoon in Malaita, Solomon Islands built about 60 artificial islands on the reef including Funaafou, Sulufou and Adaege.[2][3] The people of Lau Lagoon build islands on the reef as these provided protection against attack from the people who lived in the centre of Malaita.[4][5] These islands were formed literally one rock at a time. A family would take their canoe out to the reef which protects the lagoon and then dive for rocks, bring them to the surface and then return to the selected site and drop the rocks into the water. Living on the reef was also healthier as the mosquitoes, which infested the coastal swamps, were not found on the reef islands. The Lau people continue to live on the reef islands. Many artificial islands have been built in urban harbors to provide either a site deliberately isolated from the city or just spare real estate otherwise unobtainable in a crowded metropolis. An example of the first case is Dejima (or Deshima), created in the bay of Nagasaki in Japan's Edo period as a contained center for European merchants. During the isolationist era, Dutch people were generally banned from Nagasaki and Japanese from Dejima. Similarly, Ellis Island, in Upper New York Bay beside New York City , a former tiny islet greatly expanded by land reclamation, served as an isolated immigration center for the United States in the late 19th and early 20th century, preventing an escape to the city of those refused entry for disease or other perceived flaws, who might otherwise be tempted toward illegal immigration. One of the most well-known artificial islands is the Île Notre-Dame in Montreal , built for Expo 67.The Venetian Islands in Miami Beach, Florida, in Biscayne Bay added valuable new real estate during the Florida land boom of the 1920s. When the bubble that the developers were riding burst, the bay was left scarred with the remnants of their failed project. A boom town development company was building a sea wall for an island that was to be called Isola di Lolando but could not stay in business after the 1926 Miami Hurricane and the Great Depression, dooming the island-building project. The concrete pilings from the project still stand as another development boom roared around them, 80 years later.

1.3 METHODS OF CREATION

Expanding existing islets

Construction on existing reefs

Amalgamating several natural islets into a bigger island.

Construction on sea bed

Land reclamation

Oil platform

1.4 REASONS FOR CONSTRUCTION

The following are the major reasons to justify the creation of artificial islands:

1. Urban development (special structures)
2. Industry
3. Waste handling
4. Infrastructure (ports and airports)
5. Extended runways
6. Recreation
7. Mining of natural resources
8. Tidal or wind energy generation

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1.5 PREVIOUS USAGE

Artificial islands have been used since the seventeenth century for coastal defence and as extensions of the land base.

Artificial islands are being used as oil exploration and production platforms.

Artificial islands are being used to provide a platform for coal mine ventilation shaft access, positively contributes to the safety, effective ventilation and reserves of a coal mine.

Technology of artificial island construction is available to construct islands in water depths of 70m.

Artificial island become a focus for sea life, enhancing the marine environment.

1.6 DESIGN CONSIDERATIONS

Water depth

Wave height range climate

Ice conditions

Tidal range

Foundation conditions and Earthquake risks

Source of materials

Shipping lanes

Existing pipelines and cables

Legal aspects

Environmental considerations

Fisheries considerations

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1.7 LOAD IMPOSED IN DESIGN

Permanent loads

Variable loads

Environmental loads

1.7.1 PERMANENT LOADS

The weight in air of the structure and super structures calculated from nominal values of dimensions and mean values of densities.

Equipment which cannot be removed

Hydrostatic external pressure and buoyancy in calm sea conditions calculated for mean sea level.

Ballast including ballast water pressure

Permanent earth pressure.

1.7.2 VARIABLE LOADS

Weight of equipments , materials and stores which may be removed after the phase considered

Variations in internal and external pressure from water , oil , gas , etc. caused by normal operating of the structure.

Loads due to fendering and mooring of vessels , helicopter landing , cranes or drilling operations .

1.7.3 ENVIRONMENTAL LOADS

Wind

Weather loads due to heating and cooling.

Sea loads like wave loads , tidal loads , currents etc.

Earthquake and tsunami loads.

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CHAPTER 2

CONSTRUCTION OF ISLAND

2.1 Steps in construction of artificial island

- Dredging
- Soil bed preparation
- Concreting

2.1.1 Dredging :

Removal of top loose layer of water bed to make channels docks or to deepen waterways .

Its type and method depends upon

- depth of dredging
- Depth of water
- Soil type and its density, hardness, strength and grain size.

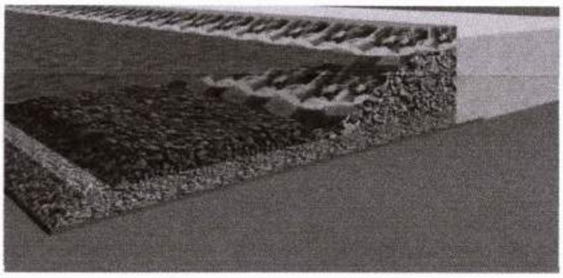

Fig 2.1: dredging

2.1.2 Soil bed preparation:

Sand is dumped into a dread site from trailer to make a strong and hard bed on water strata.

Once water become shallow it is transported to required places using a stationary dredger.

Fig 2.2: Preparation of soil bed

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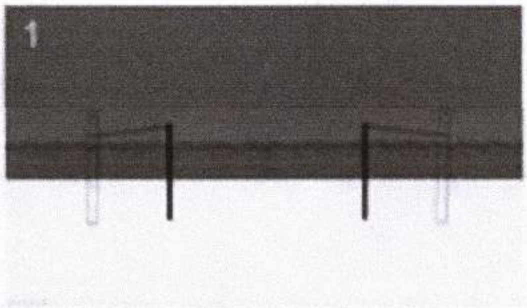
2.1.3 CONCRETING

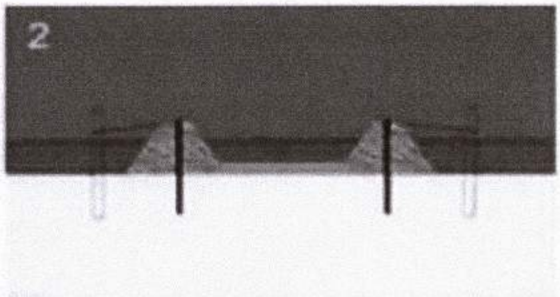
Temporary tube piles driven into the sea bed.

Temporary sheet piles and tie rods driven into the sea bed to support boundary rocks.(see figure 1)



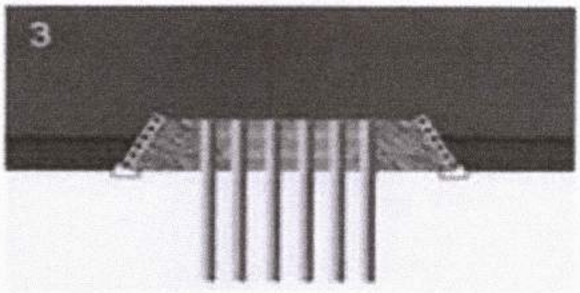
Permanent boundary rock is constructed like bunds and it deposited either side of sheet piles.

Hydraulic fill layers deposited between bunds to displace sea water and form island.(see figure 2)

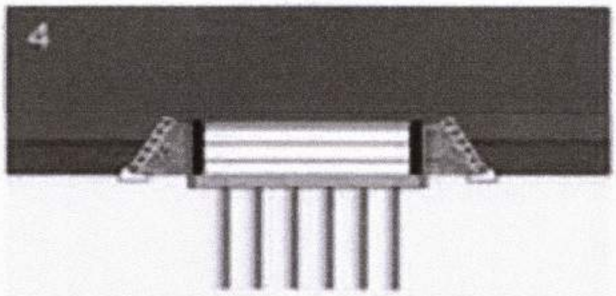


Permanent concrete units are placed around island to protect it from the waves.

2m diameter 43m deep piles driven through island into the below of the sea bed to stabilize structure.(see figure 3)



- Island interior excavated and temporary sheet piles or coffer dam inserted.
- 2m thick concrete plug slab laid at base of island.
- Reinforced concrete retaining wall built.
- Basement floors created.(see figure 4)



2.2 PROTECTION OF ARTIFICIAL ISLAND

2.2.1 Breakwater: A structure which breaks the force of the waves, it is constructed close to the island and acts as a protection against strong currents and winds.

- The breakwater is constructed using multiple layers of sand, a water permeable sheet, small rocks,and layers of armour rocks.
- The breakwater should be constructed of rock rather than concrete to encourage the creation of an artificial reef.
- Two openings in the breakwater were created in order to prevent the water inside from stagnating.

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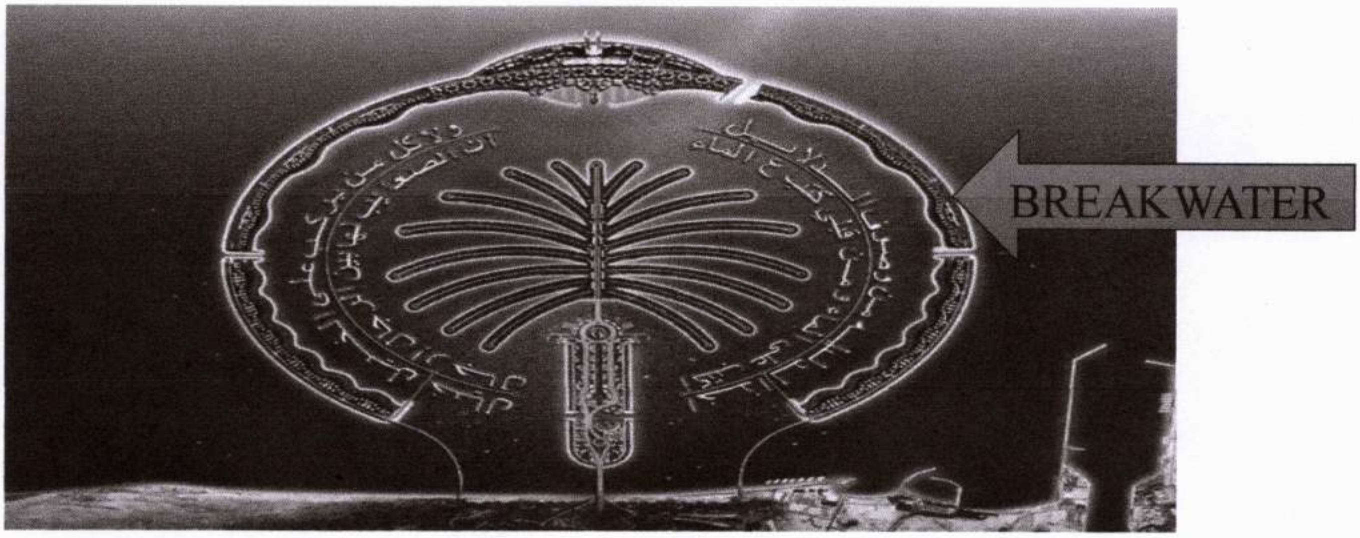

Fig 2.3: PALM JUMERIAH, DUBAI

2.2.2. VIBRO COMPACTION:

- During an earthquake, water saturated soils can lose their strength and transform into a liquid-like state. This process of liquefaction could cause the reclaimed islands to settle or sink.
- Thus special provisions need to be made to prepare the sand base under the structure so that it does not compact. This is done using vibro-compaction.
- Vibro compaction is a process by which sand particles are caused to float, and then they are rearranged into a denser state. A vibration probe penetrates the soil and moves down via a combination of vibration, and jets of water and/or air.

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FAMOUS ARTIFICIAL ISLANDS

Fig 2.4 THE WORLD-DUBAI

Fig 2.5 PALM ISLANDS-DUBAI

Fig 2.6 KANSAI AIRPORT, JAPAN

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2.3 PROBLEMS AND CHALLENGES

1. Excessive cost involved in construction.
2. Slow construction process due to limited availability of dredgers.
3. Environmental impact due to removal and placement of sand. Though it can be prevented through shallow cuts.
4. Settlement of the island in deep waters, as in the case of Kansai airport, Japan.
5. Excessive exposure to winds, tidal forces, earthquake and tsunami loads. Thus special provisions are required.

2.4 ADVANTAGES

- Any shape, a ny size & anywhere.
- Land reclamation will definitely increase land area for a certain country.
- More lands, more buildings and better infrastructure can be built.
- Can reclaimed lot of lands from flooding.
- Can be used for mass tourism as Palm Islands, Dubai.

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CHAPTER 3

CASE STUDY

Introduction

An artificial island is "an island that has been constructed by humans rather than formed through natural processes."1 The traces of artificial islands date back to the ancient Egyptian Civilisation. In modern times, it was China that constructed the first artificial island in August 1995.2 In the present scenario, there are innumerable reasons why artificial islands are being constructed, ranging from residential, industrial, commercial to strategic purposes. Residential purpose includes building housing colonies and other living amenities on the islands. Industrial purpose includes extraction of natural gas, coal, oil and minerals from the sea bed and also constructing processing and manufacturing industries on the islands. Commercial purpose includes keeping control of commercial sea trade routes and straits, tourism and recreational activities or building commercial infrastructures like shopping malls, seaport or airports in the middle of the sea. Finally, the strategic purpose involves setting up potential defence infrastructures and regulating activities on the man-made island with an aim to keep watch on the neighbours and have control over a particular region.3 Some of the leading countries in the construction of artificial islands are China, Japan, the United States of America and the United Arab Emirates to name a few. Island-building is a highly expensive process, however, in the future there is more scope for further construction of artificial islands as a result of increasing urban congestion along with better technology making it easy for humans to construct islands. Some of the famous artificial islands are Palm Jumeirah islands of Dubai, Danube Islands of Austria, Amwaj Islands of Bahrain, Flevoland of Netherlands, etc.4 Unlike the natural islands, artificial islands are constructed in a variety of shapes and sizes using highly sophisticated machinery, technology and engineering skills. Artificial islands are erected through either of the different methods like land reclamation, constructing or extending over the already existing islands, rock or even coral reef, or through linking islets by filling the in-between areas using different construction material. There are various dimensions of constructing artificial islands. Following are a few important dimensions among them.

Economic Dimension

One of the principal dimensions of an artificial island is economic dimension which primarily corresponds to commercial and industrial purposes. Mostly, artificial islands are constructed for exploring and extracting resources such as oil, coal, petroleum, minerals and even fishery products. For instance, Upper Zakum Islands of Abu Dhabi was constructed for the purpose of extracting oil and petroleum from the sea bed.6 China too has constructed various small artificial islands in the South China Sea (SCS). There are multiple economic reasons why China is constructing islands such as the seabed SCS which is a giant offshore oil field with a large chunk of global fish catch and region of the busiest trade routes.7 Another economic dimension attributed to artificial islands is in the tourism sector. Countries construct artificial islands for tourist-attraction like the Balboa Island of California, Palm Jumeirah of Dubai and Pearl Island of Doha to name a few. The other economic purpose includes construction of seaports and airports. When seaports are constructed on islands it becomeseasy for larger cargo ships to move in and out of the harbour, like Willington Island in Kochi, India.

Important Artificial Islands

Upper Zakum Oil Field, Abu Dhabi

Upper Zakum was an island constructed under the UZ750 project, purely for economic and commercial purposes. The construction of the artificial island has complemented the oil production for Abu Dhabi. It is located 84 km west of Abu Dhabi and is owned by Zakum Development Company on behalf of Abu Dhabi's National Company (66%) and Exxon Mobil (28%) and Japan Oil Development Company (12%). This is a US$ 3.7 billion project constructed on a manmade island. The Upper Zakum island was built for oil extraction purposes and is estimated to have oil worth 50 billion barrels. Upper Zakum oil field is the second largest offshore oilfield and fourth-largest oil field in the world. Once the UZ750 project gets completed in 2024, the production will rise to 100,000 BPD. It is also one of the first offshore fields in the world that is operated remotely using highly advanced technology. This man-made island is also projected to include a residential area for 2150 people along with recreational areas, a mosque and an operations and drilling office.

Kansai International Airport Island, Japan

Kansai International Airport constructed in the Kansai region of Japan is an architectural marvel by Italian architect Renzo Piano. It is located 24 miles southwest of Osaka station and on the north is the Rokko mountain and Ikoma, Kongo mountains to the east and Izumi mountain to the south. One of the primary reasons for the construction of Kansai airport on an artificial island was to avoid noise pollution that would affect the mainland. The Airport also has amenities including a shopping area, children's playroom and an automated intra-airport transportation facility. Since it is an offshore airport, it can function 24 hours without violating the noise pollution policy.

Forest City Project, Malaysia

Forest City is an artificial island that is being constructed by Malaysia in the Iskandar Malaysia Special Economic Zone in Johor. The primary reason for the construction of this is to reduce the rising congestion in the small island nation. The project is constructed for multiple purposes: residential, leisure, commercial and industrial. It consists of four islands that are being constructed opposite Singapore in the Johor strait covering an area of 30 sq km. The prime location of the Forest City allows all the Asia Pacific Economic Cooperation (APEC) countries including India and China to reach the location within just 6 to 8 hours.

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CHAPTER 4

CONCLUSION

Building an artificial island would seem like an overly ambitious dream to most, but for one of the wealthiest countries in the world, it was one of several ambitious projects that have come to make the country one of the top luxury and tourist destinations in the world.The construction of an artificial island was a feat of engineering, but did not come without its challenges.Knowing the challenges of building an artificial island can be helpful in figuring out more efficient and effective construction methods. Knowing the post construction impacts will give rise to future designs and methods that help reduce these types of impacts.With these ideals in mind, ambitious projects like the Palm Jumeirah can continue to grow and evolve, producing even greater feats of engineering.

Artificial island construction is a modern-day phenomenon that is on a rising scale due to multiple factors including population growth, strategic importance, economic gain, geopolitical advantage along with other factors. This paper has attempted to analyse how artificial island construction would play a role in determining the relation of a nation with other nations and how it would help a country to grow on its own. China's artificial island construction in the SCS is a primary reason for its strained relationship with neighbours. The nine-dash line is the boundary basis on which China is constructing artificial islands which intrudes the economic boundary of her neighbours. On the other hand, the artificial island construction by Abu Dhabi and Malaysia is for their betterment and economic growth. The pace of island construction in modern times could lead to island building race in the near future, which can become a key factor in determining tomorrow's international relations and also in reducing the quality of marine life and oceans, thus altering the geographical character of the region.

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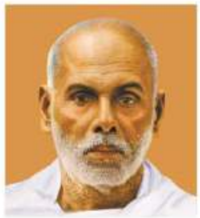

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMINAR REPORT

MEDICAL DIAGNOSTIC SYSTEMS USING ARTIFICIAL INTELLIGENCE (AI) ALGORITHMS : PRINCIPLES AND PERSPECTIVES

Seminar report submitted in partial fulfillment of the Requirements for the Award of the Degree of

BACHELOR OF TECHNOLOGY

in

COMPUTER SCIENCE AND ENGINEERING

By

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Under the Guidance of

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AFFILIATED TO A P J ABDUL KALAM TECHNOLOGICAL UNIVERSITY, KERALA

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CERTIFICATE

This is to certify that the seminar report entitled **MEDICAL DIAGNOSTIC SYSTEM USING ARTIFICIAL INTELLIGENCE (AI) ALGORITHMS: PRINCIPLES AND PERSPECTIVES** submitted by **FATHIMATHU SAHALA BEEVI (SNC19CS013)**, in the partial fulfillment for the award of the Degree of Bachelor of Technology in Computer Science and Engineering to **A P J ABDUL KALAM TECHNOLOGICAL UNIVERSITY, KERALA**, is a record of bonafied work carried out under my guidance and supervision.

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DECLARATION

I, **FATHIMATHU SAHALA BEEVI (SNC19CS013)** hereby declare that the dissertation entitled, submitted for the **MEDICAL DIAGNOSTIC SYSTEM USING ARTIFICIAL INTELLIGENCE (AI) ALGORITHMS: PRINCIPLES AND PERSPECTIVES** B.Tech Degree is my original work and the dissertation has not formed the basis for the award of any degree, associate ship, fellowship or any other similar titles.

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Thanking you,

FATHIMATHU SAHALA BEEVI

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LIST OF SHORT FORMS

Abbreviation	Elaboration
ANN	Artificial Neural Network
CNN	Convolution Neural Network
kNN	k- Nearest Neighbor
SVM	Support Vector Machine
CNS	Central Neural System

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ABSTRACT

Disease diagnosis is the identification of an health issue, disease, disorder, or other condition that a person may have. Disease diagnoses could be sometimes very easy tasks, while others may be a bit trickier. There are large data sets available; however, there is a limitation of tools that can accurately determine the patterns and make predictions. The traditional methods which are used to diagnose a disease are manual and error-prone. Usage of Artificial Intelligence (AI) predictive techniques enables auto diagnosis and reduces detection errors compared to exclusive human expertise. In this paper, we have reviewed the current literature for the last 10 years, from January 2009 to December 2019. The study considered eight most frequently used databases, in which a total of 105 articles were found. A detailed analysis of those articles was conducted in order to classify most used AI techniques for medical diagnostic systems. We further discuss various diseases along with corresponding techniques of AI, including Fuzzy Logic, Machine Learning, and Deep Learning. This research paper aims to reveal some important insights into current and previous different AI techniques in the medical field used in today's medical research, particularly in heart disease prediction, brain disease, prostate, liver disease, and kidney disease. Finally, the paper also provides some avenues for future research on AI-based diagnostics systems based on a set of open problems and challenges.

CHAPTER 1
INTRODUCTION

In the field of healthcare, the study of disease diagnosis plays a vital role.Any cause or circumstances that lead to pain, illness, dysfunction, or eventually,human being's death is called a disease. Diseases may affect a person physically and mentally, and it considerably manipulates the living style of the affected person. The causal study of disease is called the pathological process. A disease is made by signs or symptoms that are interpreted by clinical experts. Diagnosis has been defined as the method of identifying a disease from its signs and symptoms to conclude its pathology. Diagnosis can also be defined as the method of figuring out which disease is based on an individual's symptoms and signs .The data gathered from medical history physical examination of the individual having medical pathology constitutes the knowledge required for diagnosis. Often, at least one diagnostic procedure, such as medical tests, is done during this procedure.

To form an honest diagnosis, a medical doctor will perform a process that involves several steps, allowing them to collect the maximum amount of information as possible . Diagnosis of diseases is the most challenging process at the same time, a very pivotal phenomenon for a medical care professional as before reaching the conclusion. The diagnostic process could be very tiresome and complex. To minimize the uncertainty in medical diagnosis health, the care experts collect empirical data to ascertain a patient's disease. The patient's correct treatment may be adjourned or missed with serious health issues due to making fault in the diagnosis process. Unfortunately, all doctors don't have expert knowledge in each domain of the medical field. Hence, there was a need of automatic diagnostic system that provides benefits from both human knowledge and accuracy of the machine . A suitable decision support system is needed to achieve accurate results from the diagnosis process with reduced costs. Classification of diseases depending upon various parameters is a complex task for human experts but AI would help to detect and handle such kinds of cases. Currently, various AI techniques have been used in the field of medicine to accurately diagnosis sicknesses. AI is an integral part of computer science by which computers become more intelligent. The vital need for any intelligent system is learning. There are various techniques in AI that are based on Learning like deep learning, machine learning, etc. Some specific AI methods that are significant in the medical field named as *a Rule-based intelligent system*, provides a set of if-then rules in healthcare, which act as a decision support system. Gradually, intelligent systems are being replaced in the medical field by AI-based automatic techniques where human intervention is very less .

The neural network or artificial neural network (ANN) is a large collection of neural units designed based on biological neurons connected in the brain. It is a simulation of the human brain and works exactly like it. Each neural unit is linked with many other neurons approximately similar to the bipartite graph. These kinds of systems learn and are trained automatically. Finding the possibilities and predictions regarding health issues is a tedious task for doctors and surgical experts. In some cases, ANN provides decisions regarding healthcare at rapid speed wherein the systems can collect data, understand it, and detect pieces that will play a vital role in prediction . Deep learning, a subset of machine learning and also based on algorithms, is used in the medical field to assist specialists for the examination of any illness. Thus, resulting in better medical decisions. Deep learning provide benefits in different fields such as drug discovery, medical imaging, Genome, detecting Alzheimer's disease . In this paper, we primarily focus on the three main branches of AI: Fuzzy logic, Machine learning, Deep Learning. The major trend in healthcare using deep learning is to detect breast cancer. In a recent study conducted by a cancer institute, it is clear that the accuracy of Automatic breast cancer is equal/high than a human radiologist. Moreover, AI trained itself continuously and have greater chances to produce more accurate results than before. Another significant application of AI is the Internet of Medical Things that helps to collect healthcare data using IOT Devices.

AI-based software detects the disease even before its occurrence by sensing its symptoms. Neural networks can be trained to detect lung cancer, breast cancer, Stroke in less time than a trained radiologist. Various AI algorithms help doctors to analyze medical images such as MRIs, x-rays, and CT scans and diagnose specific diseases by just spotting signs. Detection of disease and providing correct treatment is always a tricky and complex process since some diseases have very similar signs. Using medical expert systems, doctors can diagnose patients more accurately and prescribe the most suitable treatment. Using AI tools, doctors can not only detect the disease but can also classify the types of different fatal diseases. Modern AI algorithms already help doctors in arranging a comprehensive approach to disease management. Moreover, they are often used to improve surgical robots that execute highly complex operations. The contributions of the this paper is three folds

- We first describe the existing elements that affect the initial outbreak of disease detection.
- We latter discuss how AI techniques have been altered for initial disease diagnosis
- We provide a thorough analysis through a systematic review for medical diagnostic systems. We make use of the well know PRISMA approach.
- We then provide a summary for all the selected articles; the diseases which were targeted,the AI techniques which were used, the articles' research goals along with Their findings. We also present a thorough discussion of the reviewed articles followed by future research directions. The rest of this paper is organized as follows. We present the related works on AI applied methods for medical diagnostic systems. Whereas Section 3 discusses fuzzy logic-based medical diagnosis, Section 3.2 and Section 3.3 present diagnostic systems using machine learning and deep learning algorithms, respectively.

Artificial intelligence (AI) algorithms have been increasingly used in the field of healthcare, particularly in medical diagnostics. Medical diagnostic systems using AI algorithms have the potential to revolutionize the way healthcare is delivered, by improving the accuracy, speed, and efficiency of diagnoses. These systems use machine learning techniques to recognize patterns in medical data, and use that knowledge to make accurate diagnoses.The development and implementation of medical diagnostic systems using AI algorithms raise important questions and considerations, including the technical challenges involved, the potential impact on the healthcare system, and the ethical considerations related to data privacy and bias. In this paper, we explore the principles and perspectives of medical diagnostic systems using AI algorithms, with a focus on the benefits, challenges, and ethical considerations.

We begin with a review of the existing literature on medical diagnostic systems using AI algorithms, including their development, implementation, and effectiveness. We then discuss the principles behind the use of AI algorithms in medical diagnosis, including machine learning techniques, data collection, and pattern recognition. Next, we explore the perspectives on the use of medical diagnostic systems using AI algorithms, including the benefits, challenges, and ethical considerations.We also consider the technical challenges and requirements for developing and deploying medical diagnostic systems using AI algorithms, including the need for large datasets, computational power, and expertise in machine learning and data science. Additionally, we discuss the potential impact of medical diagnostic systems using AI algorithms on the healthcare system, including their potential to improve patient outcomes, reduce medical errors, and increase efficiency.

Finally, we provide recommendations for future research and development in the field of medical diagnostic systems using AI algorithms, including addressing ethical concerns, improving data quality and quantity, and exploring new techniques and technologies. Overall, this paper aims to provide insights into the principles and perspectives of medical diagnostic systems using AI algorithms, and to offer recommendations for further research and development in this field.

CHAPTER 2
LITERATURE SURVEY

2.1 Author: Nguyen Hoang Phuong , Vladik Kreinovich

Title: Fuzzy logic and its applications in medicine

Fuzzy set theory and fuzzy logic are a highly suitable and applicable basis for developing knowledge-based systems in medicine for tasks such as the interpretation of sets of medical findings, syndrome differentiation in Eastern medicine, diagnosis of diseases in Western medicine, mixed diagnosis of integrated Western and Eastern medicine, the optimal selection of medical treatments integrating Western and Eastern medicine, and for real-time monitoring of patient data. This was verified by trials with the following systems that were developed by our group in Vietnam: a fuzzy Expert System for Syndromes Differentiation in Oriental Traditional Medicine, an Expert System for Lung Diseases using fuzzy logic, Case Based Reasoning for Medical Diagnosis using fuzzy set theory, a diagnostic system combining disease diagnosis of Western Medicine with syndrome differentiation of Oriental Traditional Medicine, a fuzzy system for classification of Western and Eastern medicaments and finally, a fuzzy system for diagnosis and treatment of integrated Western and Eastern Medicine.

We have to spend more time and work on this study to achieve our objective, that is to formalize medical entities as fuzzy sets, and formalize reasoning in a rule-based system in medicine. We have tried to distinguish the notion of 'fuzzy logic' in both a broad and narrow sense. In this paper, we use 'fuzzy logic' in a broad sense to formalize approximate reasoning in a medical diagnostic system. We have applied this formalism to build a fuzzy Expert System for Syndromes Differentiation in Oriental Traditional Medicine, an Expert System for diagnosis of Western medicine such as for diagnosis of Lung Diseases using fuzzy logic, then a diagnostic system combining disease diagnosis of Western Medicine with syndrome differentiation of Oriental Traditional Medicine. We have shown the performance of the diagnostic system for Lung diseases as an example. Our further work is to apply the Soft Computing techniques such as fuzzy logic, neural network, genetic algorithms, learning and expert systems in order to develop intelligent systems in diagnosis and therapy of integrated Western and Eastern medicine.

Advantages:

- Dealing with Uncertainty: Fuzzy logic is useful for handling uncertainty in medical diagnosis and decision-making processes. It can help in providing a more accurate diagnosis by considering all available evidence.
- Improved Accuracy: Fuzzy logic can help in improving the accuracy of medical diagnoses by providing a more nuanced understanding of the relationship between medical data and diagnoses.
- Easy to Understand: Fuzzy logic is easy to understand and interpret, even for non-experts. This makes it a useful tool for medical professionals who may not have a background in complex mathematical models.
- Applicable to a Wide Range of Medical Data: Fuzzy logic can be applied to a wide range of medical data, including images, text, and numerical data.

Disadvantages:

- Complexity: Fuzzy logic models can be complex and difficult to interpret, especially for non-experts. This can make it difficult to implement in medical settings where time and resources are limited.
- Lack of Standardization: There is no standardized approach to using fuzzy logic in medicine, which can lead to inconsistencies in how it is applied across different medical fields and institutions.
- Limited Availability of Data: Fuzzy logic requires large amounts of data to work effectively, which can be a limitation in medical settings where data availability is limited.
- Computational Resources: Fuzzy logic models require significant computational resources to implement, which can be a limitation in medical settings where resources are limited.

2.2 Author: Saira Charan, Muhammad Jaleed Khan, Khurram Khurshid

Title: Breast Cancer Detection in Mammograms using Convolutional Neural Network

Breast cancer is among world's second most occur-ring cancer in all types of cancer. Most common cancer among women worldwide is breast cancer. There is always need of advancement when it comes to medical imaging. Early detection of cancer followed by the proper treatment can reduce the risk of deaths. Machine learning can help medical professionals to diagnose the disease with more accuracy. Where deep learning or neural networks is one of the techniques which can be used for the classification of normal and abnormal breast detection. CNN can be used for this detection. Mammograms-MIAS dataset is used for this purpose, having 322 mammograms in which almost 189 images are of normal and 133 are of abnormal breasts. Promising experimental results have been obtained which depict the efficacy of deep learning for breast cancer detection in mammogram images and further encourage the use of deep learning based modern feature extraction and classification methods in various medical imaging applications especially in breast cancer detection.It is an ongoing research and further developments are being made by optimizing the CNN architecture and also employing pre-trained networks which will hopefully lead to higher accuracy measures.

Proper segmentation is mandatory for efficient feature extraction and classification.This study implemented the Convolution neural networks on mammograms for detection of normal and abnormal mammograms. This deep learning technique is used on mammograms MIAS dataset by extracting features from sub-divided abnormal classes to the normal class. Different filter sizes and preprocessing techniques were used on the original data to remove noise factors which can lower the accuracy of the overall network. It was also noted that proper segmentation is mandatory for efficient feature extraction and classification. Masking and segmentation based on morphological operations significantly improved the classification results.

Advantages:

- The study focuses on an important and relevant topic in healthcare, which is the early detection of breast cancer.
- The use of CNNs for mammogram classification has shown promising results in previous studies, and this paper builds on that existing knowledge.

- The methodology used is clearly described and follows best practices in machine learning, including the use of cross-validation and hyperparameter tuning.
- The study reports high accuracy and specificity rates, which are important metrics in breast cancer detection.

Limitations:

- The study is based on a retrospective analysis of mammograms, which may not accurately represent the population at large and may introduce bias.
- The dataset used for training and evaluation may not be representative of all types of mammograms or breast cancer cases.
- The study does not compare the performance of the proposed CNN-based approach to other existing methods or models for breast cancer detection.
- The paper does not provide insights into the interpretability of the CNN model or the features learned by the model, which may be important for clinical decision-making.

This paper focuses on the application of CNNs for breast cancer detection in mammograms. The aim is to develop a system that can accurately classify mammogram images as either benign or malignant. The system takes advantage of the ability of CNNs to automatically learn and extract features from images without requiring manual feature engineering.The paper discusses the methodology used to train and evaluate the CNN model, including the pre-processing of mammogram images, the selection of hyperparameters, and the evaluation metrics used. The results of the study demonstrate the effectiveness of the proposed CNN-based approach in breast cancer detection, achieving high accuracy and specificity rates.

Overall, the study highlights the potential of CNNs in improving the accuracy and efficiency of breast cancer detection in mammograms, which can lead to earlier diagnosis and improved patient outcomes.

2.3 Author: David Moher1, Larissa Shamseer, Mike Clarke , Davina Ghersi, Alessandro Liberati, Mark Petticrew

Title: Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement.

Systematic reviews should build on a protocol that describes the rationale, hypothesis, and planned methods of the review; few reviews report whether a protocol exists. Detailed, well-described protocols can facilitate the understanding and appraisal of the review methods, as well as the detection of modifications to methods and selective reporting in completed reviews. We describe the development of a reporting guideline, the Preferred Reporting Items for Systematic reviews and Meta-Analyses for Protocols 2015 (PRISMA-P 2015). PRISMA-P consists of a 17-item checklist intended to facilitate the preparation and reporting of a robust protocol for the systematic review. Funders and those commissioning reviews might consider mandating the use of the checklist to facilitate the submission of relevant protocol information in funding applications. Similarly, peer reviewers and editors can use the guidance to gauge the completeness and transparency of a systematic review protocol submitted for publication in a journal or other medium.

The current system of implementing reporting guidelines is not optimal. At present, their primary mechanism of uptake is through endorsement by journals at their discretion, if at all. In journals that do endorse guidelines, language describing their support is often vague, leaving authors unclear on what they are supposed to do with a given reporting guideline during the submission process. Furthermore, policies around how journal editors and peer reviewers should ensure and/or enforce adherence to reporting checklists are even less clear, if they exist at all. Other barriers to implementation may include a lack of awareness of the guideline and perceived burden of using a reporting guideline checklist during the editorial process. Some well-known checklists, such as PRISMA, include a column to the right of the main checklists in which users report the page number on which a specific item is reported. This was initially intended to help authors ensure each checklist item is addressed and to aid peer reviewers in locating reported text for each item within a document. However, this system is not optimal. One major problem is that peer reviewers still have to search within a considerable body of text to locate the exact text describing a checklist item. When multiple items are listed separately but reported together or vice versa, this problem is compounded, because exactly which content pertains to each item may remain unclear. The lack of implementation and adherence to reporting guidelines is systemic; additional authorities encountered early in the research process should promote a clearer message about author adherence to reporting standards if improvements in reporting are to be made. In targeting protocols of systematic reviews, PRISMA-P has a unique opportunity to not only affect the way in which protocols are reported but to also impact the way in which reviews are eventually conducted, perhaps allowing for a more seamless transition into a completely reported systematic review.

There is no standard definition for a systematic review and meta-analysis protocol, and we note that some terminology contained within these definitions may carry different meanings for different readers (i.e., 'systematic search'). The terms 'systematic review', 'meta-analysis,' and 'protocol' are defined . The former two terms are in accordance with the definitions reported in the PRISMA Statement and are in line with those used by the Agency for Healthcare Research and Quality's Evidence-based Practice Center (EPC) program, The Cochrane Collaboration , and the 2011 guidance from the Institute of Medicine. The definition provided is a culmination of the terminology used by the Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) 2013 initiative , the PROSPERO register, and the IOM Standards

2.4 Author: N.Nandha Gopal,Dr.M.Kanan

Title: Diagnose Brain Tumor Through MRI Using Image Processing Clustering Algorithms Such As Fuzzy C Means Along With Intelligent Optimization Techniques

Magnetic Resonance Imaging (MRI) is one of the best technologies currently being used for diagnosing brain tumor. Brain tumor is diagnosed at advanced stages with the help of the MRI image. Segmentation is an important process to extract suspicious region from complex medical images. Automatic detection of brain tumor through MRI can provide the valuable outlook and accuracy of earlier brain tumor detection. In this paper an intelligent system is designed to diagnose brain tumor through MRI using image processing clustering algorithms such as Fuzzy C Means along with intelligent optimization tools, such as Genetic Algorithm (GA), and Particle Swarm Optimization (PSO). The detection of tumor is performed in two phases: Preprocessing and Enhancement in the first phase and segmentation and classification in the second phase.

A Review of the significant result obtained in the course of the work and scope for future research are highlighted in this chapter. The primary objective of this thesis is to develop more accurate, efficient for detection of brain tumor. A novel approaches to segmentation using image processing clustering algorithm such as Fuzzy C Means and optimization tools such as GA and PS0 were proposed. In Preprocessing and enhancement the proposed method has been used to remove the film artifacts using tracking algorithm. In the enhancement stage for remove high frequency components, the Median is used to enhance the image and the performance of the system was investigated.

Segmentation was done by Fuzzy C Means along with metaheuristic algorithms such as GA and PSO. The population based optimization Genetic algorithm is investigated in that the pixel intensity values were considered as population strings, reproduction was applied to those strings to generate parent strings using fitness values. Crossover and mutation operator were used to generate the new population. The optimum value was considered to select the initial cluster point to find the adaptive value (the out put of the FCM) for tumor detection. In that 3×3, 5×5, 7×7, 9×9, 11×11 windows are analyzed the GA with Fuzzy C Means of 3×3 window is chosen based on the high contrast than 5×5, 7×7, 9×9, and 11×11.

In the PSO the optimum value was considered to select the initial cluster point to find the adaptive value (the out put of the FCM) for tumor detection.In that 3×3, 5×5, 7×7, 9×9, 11×11 windows are analyzed the PSO with FCM of 3×3 window is chosen based on the high contrast than 5×5, 7×7, 9×9, and 11×11. In performance of the MRI image in terms of weight vector, execution time and tumor pixels detected using the PSO with Fuzzy C Means.

PSO which is computationally very efficient optimization technique is proposed for brain tumor image segmentation. The proposed method is relatively simple, reliable, and efficient. The efficiency was compared with GA. PSO provides better performance comparing with GA. PSO with FCM algorithm has been used to find out the optimum value. It can be concluded that the proposed approach has lower tumor value and lesser execution time. There is a decrease beyond 80% in both the values when compared to any other existing approach.

The average classification error of GA is 0.078%. The average accuracy GA is 89.6%. PSO gives best classification accuracy and average error rate. The Average classification error of PSO is 0.059% and the accuracy is 92.8% and tumor detection is 98.87%.

The average classification error is reduced when the number of sample is increased. The results have provided substantial evidence that for brain tumor segmentation of PSO algorithm performed well.

2.5 Author: Swapna G, Vinayakumar R., Soman K.P.

Title: Diabetes detection using deep learning algorithms .

Diabetes is a metabolic disease affecting a multitude of people worldwide. Its incidence rates are increasing alarmingly every year. If untreated, diabetes-related complications in many vital organs of the body may turn fatal. Early detection of diabetes is very important for timely treatment which can stop the disease progressing to such complications. RR-interval signals known as heart rate variability (HRV) signals (derived from electrocardiogram (ECG) signals) can be effectively used for the non-invasive detection of diabetes. This research paper presents a methodology for classification of diabetic and normal HRV signals using deep learning architectures. We employ long short-term memory (LSTM), convolutional neural network (CNN) and its combinations for extracting complex temporal dynamic features of the input HRV data. These features are passed into support vector machine (SVM) for classification. We have obtained the performance improvement of 0.03% and 0.06% in CNN and CNN-LSTM architecture respectively compared to our earlier work without using SVM. The classification system proposed can help the clinicians to diagnose diabetes using ECG signals with a very high accuracy of 95.7%.

Considerable part of human population is under the grip of diabetes which is incurable. If not managed well, diabetes can lead to health hazards. Hence, early detection of diabetes is extremely crucial. Nerve damages caused by diabetes, affect the working of the heart. In the proposed work, HRV data is analysed to diagnose diabetes using deep learning techniques. The maximum accuracy value of 95.7% was obtained for CNN 5-LSTM with SVM network. This is the highest value published for the automated diabetes detection with HRV as input data. Our non-invasive, flexible and reproducible system can serve as a reliable tool to clinicians to detect diabetes. Further improvement in accuracy can be obtained using a very large sized input dataset. The potential of deep learning is so tremendous that it can take a big stride in future to the so far challengingly difficult area of anomaly prediction from the anomaly detection if sufficiently large sized input data is available for research. The anomaly prediction can be tried from the input data which may not have anomaly by extracting dynamic characteristics from the input data. The predicted information can serve as a warning signal for the patient as well as the doctor to take sufficient control and precautionary measures.

2.6 Author: Ruo-Ping Han,Tony Cheng

Title: Disease prediction with different types of neural network classifiers.

Disease prediction has long been regarded as a critical topic. Artificial intelligence and machine learning techniques have already been developed to solve this type of medical care problem. Recently, neural network ensembles have been successfully utilized in a variety of applications including to assist in medical diagnosis. Neural network ensembles can significantly improve the generalization ability of learning systems through training a finite number of neural networks and then combining their results. However, the performance of multiple classifiers in disease prediction is not fully understood. The major purpose of this study is to investigate the performance of different classifiers, including individual classifiers involved in an ensemble classifier and solo classifiers. In addition, we use various evaluation criteria to examine the performance of these classifiers with real-life datasets. Finally, we also use statistical testing to evaluate the significance of the difference in performance among the three classifiers. The statistical testing results indicate that an ensemble classifier performs better than an individual classifier within an ensemble. However, the solo classifier does not perform worse than the ensemble classifier built with the same size training dataset.

The main contributions of this study are as follows: First, we compare the performance of the single neural network classifier and multiple neural network classifiers with the four authentic datasets for the purpose of disease prediction. Also, we vary the parameter, k, from 3 to 5 for understanding the change of their prediction accuracy performances. Secondly, we use statistical tests to investigate the significance of the difference in performance among these classifiers. Theoretically, multiple neural network classifiers should be better than a single neural network classifier. The statistical test results show that the EC (Ensemble Classifier belongs to the multiple neural network classifiers) performs better than the IC (Individual Classifier belongs to the single neural network classifier), involved in an ensemble classifier. However, the EC does not always perform better than the SC (Solo Classifier belongs to the single neural network classifier). Third, the result of the cost-effect analysis show that the EC and SC are in a tie based on the four datasets. There are two issues with the statistical test results which need to be discussed where multiple neural network classifiers outperform single neural network classifiers. First, the EC is significantly better than the IC with a mean difference of 0.0119 ($p = 0.005$), and the EC is better than the IC regardless of the type of disease in the dataset. Second, the

Experimental results show that the EC does not always outperform the SC in the criteria, Accuracy, Precision, TPR, TNR, and F1-score, respectively. Therefore, an SC which is a type of single classifier, built with a bigger size of training dataset will show improved performance and may perform better than the EC with multiple neural network classifiers. In the reality of medical-care case, we suggest that the index, recall, is the first priority to be considered; the reason is if a disease in a patient is true positive but he/she is no further cured, this will suffer an irreparable damage. In theory, a classifier can be treated as a better one if its precision rate is higher than others. We expect that this better classifier can predict all possible true positives as the new data are arriving. Hence, we should pay more attentions to the two metrics than others in the circumstance of this study. F1 is a harmonic metric between recall and precision; therefore, we suggest that it can be treated as a trade-off evaluation criterion to investigate the performance of classifiers.

Finally, the costeffect consideration is a critical factor in hospitals; therefore, the cost-effect index can be another better evaluation criterion during the predicting process. Effective disease prediction furnishes useful instruments for disease identification and healthcare services. Different types of neural network classifiers can not only help doctors to effortlessly understand the health status of their patients, but advise health warnings for patients themselves.

The medical resource will be considerably saved to be advantageous for hospitals or governments in finance. The payment of national health insurance, such as Obamacare, can be effectively handled as well. Researchers or practitioners can employ the EC or the SC in the diagnosis of various diseases with their own datasets so that the external validity of the EC or the SC can be strengthened. The better condition of the SC is for some datasets of which size is of volume; therefore, they can use the bigger size of training dataset to generate a classification model. However, an overfitting problem might be existing if the proportion of training dataset is overhigh; hence, researchers or practitioners should be contemplating further. On the other hand, the better opportunity to adopt the EC is that the size of dataset is not relatively plenty. Therefore, the EC can be used with a group-decision idea to be voting for the final outcome. With respect to the application of the IC, if the type of datasets is not too complicated and liner, researchers or practitioners might use the IC for saving the computing time. However, the external validity of the IC has to be considered in advance.

Advantages:

- The study investigates the performance of different types of neural network classifiers in disease prediction, which is an important and challenging problem in healthcare.
- The methodology used is clearly described and follows best practices in machine learning, including the use of cross-validation and feature selection techniques.
- The study evaluates the performance of the classifiers on a large and diverse dataset, which enhances the generalizability of the results.
- The results demonstrate the potential of neural network classifiers for disease prediction, with high accuracy rates reported for some of the models.

Limitations:

- The study does not compare the performance of the neural network classifiers to other existing methods or models for disease prediction, which limits the ability to assess the novelty or superiority of the proposed approach.
- The study focuses on a specific type of medical data, which may not be representative of all types of medical diseases or patient populations.
- The paper does not provide insights into the interpretability of the neural network models or the features learned by the models, which may be important for clinical decision-making.
- The study does not address potential ethical or legal implications of using machine learning models for disease prediction in healthcare.

2.7 Author: Philipp Nesteruk , Igor Kotenko

Title: Creation of a Fuzzy Knowledge Base for Adaptive Security Systems.

To design next generation adaptive security systems the powerful intelligent components should be developed. The paper describes the fuzzy knowledge base specifying relationships between threats and protection mechanisms by Mathworks MATLAB Fuzzy Logic Toolbox. The goal is to increase the effectiveness of the system reactions by minimization of neural network weights. We demonstrate a technique for creation of a fuzzy knowledge base to improve the system protection via rules monitoring and correction. The main contribution of the paper consists in proposing the technique for development of a fuzzy knowledge base inference system in the MathWorks MATLAB which can be used for adaptive security systems. This inference system is based on Mamdani and Sugeno models of fuzzy inference.

In the paper we suggested the technique that provides step by step creation of fuzzy knowledge base applicable for adaptive security systems. This knowledge base specifies relationships of threats and protection mechanisms in production rules that make possible to form flexible security policy via adequate setting and adjustment of protection mechanism or its parameters. We considered a very simple example of relationships between threats and protection mechanisms. More complex rules are used now to model a fuzzy decision support subsystem realizing policy based selection of protection mechanisms. These solutions are planned for implementation in a decision support component of the security information and event management system. An important core component of adaptive security system (for example, intrusion detection systems) is a knowledge base that is necessary to store and manipulate security rules. It is supposed that security administrators initially set expert estimates for different security rules in a knowledge base.

Advantages:

- Fuzzy logic can provide a more flexible and adaptable framework for security systems by allowing for imprecise and uncertain data to be used in decision-making.
- Fuzzy logic can handle complex and dynamic security threats that traditional rule-based systems may struggle with.
- Fuzzy clustering techniques can be used to identify patterns in security data and adapt the fuzzy knowledge base accordingly.

- Fuzzy logic-based systems can improve the performance of security systems by providing more accurate and efficient decision-making.

Disadvantages:

- Designing and implementing fuzzy logic-based security systems can be challenging and time-consuming, as it requires expert knowledge and skills.
- Evaluating the performance of fuzzy logic-based systems can be difficult since it is based on imprecise and uncertain data.
- There may be a lack of understanding and acceptance of fuzzy logic-based systems among security professionals, which could hinder their adoption and implementation.
- Fuzzy logic-based systems may be vulnerable to cyber-attacks, and their performance may be affected by the quality and reliability of the data used in decision-making.

The paper proposes the creation of a fuzzy knowledge base that can be used in adaptive security systems to evaluate the security risk level of a given situation and make decisions accordingly. The fuzzy knowledge base consists of a set of fuzzy rules and membership functions that can be used to model the relationships between various security parameters and the security risk level. The author also discusses the use of fuzzy clustering techniques for identifying patterns in security data and adapting the fuzzy knowledge base accordingly.

2.8 Author: Riccardo Miotto, Fei Wang.

Title: Deep learning for healthcare: review, opportunities and challenges.

Gaining knowledge and actionable insights from complex, high-dimensional and heterogeneous biomedical data remains a key challenge in transforming health care. Various types of data have been emerging in modern biomedical research, including electronic health records, imaging, -omics, sensor data and text, which are complex, heterogeneous, poorly annotated and generally unstructured. Traditional data mining and statistical learning approaches typically need to first perform feature engineering to obtain effective and more robust features from those data, and then build prediction or clustering models on top of them. There are lots of challenges on both steps in a scenario of complicated data and lacking of sufficient domain knowledge. The latest advances in deep learning technologies provide new effective paradigms to obtain end-toend learning models from complex data. In this article, we review the recent literature on applying deep learning technologies to advance the health care domain. Based on the analyzed work, we suggest that deep learning approaches could be the vehicle for translating big biomedical data into improved human health. However, we also note limitations and needs for improved methods development and applications, especially in terms of ease-of-understanding for domain experts and citizen scientists.

We discuss such challenges and suggest developing holistic and meaningful interpretable architectures to bridge deep learning models and human interpretability.The use of deep learning for medicine is recent and not thoroughly explored. In the review some of the main recent literature related to applications of deep models to clinical imaging, EHRs, genomics and wearable device data. All the papers mentioned in this literature review, in particular highlighting the type of networks and the medical data considered. To the best of our knowledge, there are no studies using deep learning to combine neither all these data sources, nor a part of them in a joint representation for medical analysis and prediction. A few preliminary studies evaluated the combined use of EHRs and genomics without applying deep learning though; for this reason, they were not considered relevant to this review. The deep architectures applied to the health care domain have been mostly based on convolutional neural networks (CNNs), recurrent neural networks (RNNs), Restricted Boltzmann Machines (RBMs) and Autoencoders (AEs) provides the main ideas.

Advantages:

- The paper provides a comprehensive review of the opportunities and challenges of using deep learning in healthcare, which can serve as a valuable resource for researchers and practitioners in the field.
- The study highlights the potential of deep learning to improve the accuracy and efficiency of various healthcare tasks, such as medical imaging analysis, electronic health record analysis, and drug discovery.
- The authors discuss the ethical and legal considerations associated with using deep learning in healthcare, which is an important aspect that needs to be carefully addressed for the responsible development and deployment of these technologies.
- The paper provides a critical analysis of the limitations and challenges of deep learning in healthcare, such as the need for large and diverse datasets, the interpretability of the models, and the potential for bias and discrimination.
- The study includes examples of successful applications of deep learning in healthcare, which can inspire further research and development in the field.

Disadvantages:

- The study does not provide a detailed methodology or empirical evaluation of the performance of deep learning models in healthcare tasks, which limits the ability to assess the effectiveness of these models.
- The review may not be comprehensive and may not cover all aspects of deep learning in healthcare, as the authors may have focused on specific areas or applications.
- The paper may not be accessible to readers without a strong technical background in deep learning, as the language and concepts used may be difficult to understand for non-experts.

2.9 Author: Guojun Zhang

Title: A Modified SVM Classifier Based on RS in Medical Disease Prediction

Too many unimportant attributes are ended up specifying in medical disease sample data sets if we are not sure which attribute to include for disease prediction, which could spoil the classification and increase many unwanted calculations of the medical disease prediction. Thus how to preprocess these medical data and enhance the prediction performance is worth a problem to research. In the paper, a modified SVM classifier based on RS is proposed in medical disease prediction. RS not only provides new scientific logic and research method for information and cognitive science, but also develops effective preprocessing techniques for intelligent information process. It can find out these relevant features influencing the medical disease. And then, using them as the input vectors of SVM, the medical disease prediction model is conducted, which make great use of the advantages of RS in eliminating redundant information and take full advantage of SVM to train and test the data.

Experiment results explain the validity and feasibility of our proposed algorithm.SVM is a promising method of machine learning based on the theory of VC dimension and the principle of structural risk minimum, which is characteristic of good generalization performance. The whole theory can be simply described as follows: searching an optimal hyper-plane satisfies the request of classification, and then use a certain algorithm to make the margin of the separation beside the optimal hyperplane maximum while ensuring the accuracy of correct classification. Based on statistical learning theory, the margin scale reflects the generalization capability to a great extent. The bigger the margin scale takes, the better the generalization capability of SVMs will have.

RS is an effective tool to decrease data dimension in dealing with vagueness and uncertainty information; SVM is a promising method of machine learning based on the structural risk minimization principle, which is characteristic of good generalization performance. In the paper, RS, as an anterior preprocessor of SVM, can find out these relevant features influencing the medical disease. And then, using these relevant features as the input vectors of SVM, a modified SVM classifier based on RS is conducted in medical disease prediction. By comparing with other machine learning algorithms, we conclude that the training rapidity and accuracy of our proposed model are both evidently modified in medical disease prediction. The question of how to rapidly get all reducts demands further research in the future.

Advantages:

- The study focuses on an important and relevant topic in healthcare, which is the prediction of medical diseases.
- The use of a modified support vector machine (SVM) classifier based on rough sets (RS) is a novel approach that may improve the accuracy and efficiency of disease prediction.
- The methodology used is clearly described and follows best practices in machine learning, including the use of cross-validation and feature selection techniques.
- The study reports high accuracy rates for disease prediction using the proposed modified SVM classifier.

Limitations:

- The study is based on a retrospective analysis of medical data, which may not accurately represent the population at large and may introduce bias.
- The dataset used for training and evaluation may not be representative of all types of medical diseases or patient populations.
- The study does not compare the performance of the proposed modified SVM classifier to other existing methods or models for medical disease prediction.
- The paper does not provide insights into the interpretability of the modified SVM classifier or the features learned by the model, which may be important for clinical decision-making.

The proposed modified SVM classifier combines the strengths of both SVM and RS to achieve high accuracy in disease prediction.The methodology used in the study is clearly described, including the preprocessing of medical data, the feature selection process, and the training and evaluation of the modified SVM classifier. The study uses cross-validation to evaluate the performance of the classifier and reports high accuracy rates for disease prediction using the proposed approach.

Overall, the paper presents a novel and promising approach to medical disease prediction using a modified SVM classifier based on RS. The methodology used is rigorous and the results are promising, which suggests that this approach may be useful in clinical practice for improving the accuracy and efficiency of disease prediction.

2.10 Author: Deepti Sisodiaa, Dilip Singh Sisodi

Title: Prediction of Diabetes using Classification Algorithms.

Diabetes is considered as one of the deadliest and chronic diseases which causes an increase in blood sugar. Many complications occur if diabetes remains untreated and unidentified. The tedious identifying process results in visiting of a patient to a diagnostic center and consulting doctor. But the rise in machine learning approaches solves this critical problem. The motive of this study is to design a model which can prognosticate the likelihood of diabetes in patients with maximum accuracy. Therefore three machine learning classification algorithms namely Decision Tree, SVM and Naive Bayes are used in this experiment to detect diabetes at an early stage. Experiments are performed on Pima Indians Diabetes Database (PIDD) which is sourced from UCI machine learning repository. The performances of all the three algorithms are evaluated on various measures like Precision, Accuracy, F-Measure, and Recall. Accuracy is measured over correctly and incorrectly classified instances. Results obtained show NNaive Bayes outperforms with the highest accuracy of 76.30% comparatively other algorithms.

These results are verified using Receiver Operating Characteristic (ROC) curves in a proper and systematic manner.One of the important real-world medical problems is the detection of diabetes at its early stage. In this study, systematic efforts are made in designing a system which results in the prediction of disease like diabetes. During this work, three machine learning classification algorithms are studied and evaluated on various measures. Experiments are performed on Pima Indians Diabetes Database. Experimental results determine the adequacy of the designed system with an achieved accuracy of 76.30 % using the Naive Bayes classification algorithm. In future, the designed system with the used machine learning classification algorithms can be used to predict or diagnose other diseases. The work can be extended and improved for the automation of diabetes analysis including some other machine learning algorithms.

Advantages:

- The study presents an application of classification algorithms for predicting diabetes, which can have significant practical implications for healthcare providers and patients.
- The authors compare the performance of different classification algorithms, which can help identify the most effective approach for predicting diabetes.

- The study uses a large and diverse dataset for training and testing the models, which enhances the generalizability of the findings.
- The paper provides a clear methodology for the data preprocessing, feature selection, and model evaluation, which enhances the transparency and reproducibility of the study.
- The results of the study demonstrate the potential of machine learning approaches for predicting diabetes, which can motivate further research and development in the field.

Disadvantages:

- The study may be limited by the quality and completeness of the dataset, as there may be missing or erroneous data that could affect the accuracy of the models.
- The paper does not discuss the interpretability of the models, which is an important consideration in medical diagnosis and treatment.
- The authors do not address the ethical and legal implications of using machine learning algorithms for predicting diabetes, such as the potential for bias and discrimination.
- The study does not compare the performance of the classification algorithms with existing clinical methods for diabetes diagnosis, which could provide a more meaningful assessment of the usefulness of the models.

The authors compare the performance of different classification algorithms using a large and diverse dataset and provide a clear methodology for data preprocessing, feature selection, and model evaluation. The study demonstrates the potential of machine learning approaches for predicting diabetes and can motivate further research and development in the field. However, the study may be limited by the quality and completeness of the dataset, and the authors do not address the interpretability, ethical, and legal implications of using machine learning algorithms for diabetes prediction. Nevertheless, the study can provide valuable insights for healthcare providers and researchers interested in applying machine learning approaches for predicting diabetes.

CHAPTER-3
ABOUT THE TOPIC

3.1 FUZZY LOGIC AND DISEASE DIAGNOSIS

In this section we first summarize the current related work which are based on fuzzy logic. We later describe the fuzzy logic process for disease diagnosis.

3.1.A. EXISTING WORKS USING FUZZY METHODS

Fuzzy logic provides dynamic methods that deal with difficult problems. Fuzzy logic is assumed to be a solid tool for decision-making systems, such as expert systems or Pattern classification systems. Fuzzy logic plays a vital role in the medical evaluation as it provides an exact examination report. These sorts of frameworks provide an instant and straightforward strategy for clinical assessment. They are also useful where an expert or clinical specialist is absent. These frameworks give an outcome depending on the knowledgebase incorporated within or from specialists or experts in the field. Various clinical diagnoses systems created depend on the fuzzy set model and applied in the medical field. The word fuzzy refers to things that are ambiguous. Sometimes we face a circumstance when we are uncertain about whether the state is valid or invalid, wherein fuzzy logic provides reasoning for such conditions as depicted in Fig. 2. It is a rule-based method. Fuzzy Rule-Based System (FRBS) is a frequently used technique in healthcare that drives from Fuzzy Inference Systems (FIS). FRBS applies IF-THEN rules for information portrayal . Besides this, clustering and classifying techniques are also used in the medical domain. Also, FIS and FDSS are determined as the most common techniques in the area of medicine. The main feature of fuzzy logic is that it can alleviate the inaccuracies and uncertainties of any situation. There is no logic for the absolute valid and absolute invalid value, but partially true and partially false intermediate value exists in a fuzzy logic system. Let's take the following example to show how fuzzy logic works. In the past few years, Fuzzy logic is consistently gaining popularity in diagnosing disease based on different parameters. For instance, coronary illness is a sort of malady caused due to a damage or blockage of veins in the heart, thus influencing less oxygen supply to heart organs. Common heart diseases are heart failure, artery blockage, heart attack, stroke, etc. Fuzzy logic is continually developing to distinguish heart patients all through the world with the assistance of growing new AI techniques. Lots of articles have been published to detect coronary disease by utilizing Fuzzy logic. Sari and Gupta discussed coronary disease detection using a neuron-fuzzy integrated system and their results reached a similar level of doctor's opinion in case of high/low cardiac risk. Junior et al presented a cardiovascular arrhythmia grouping framework utilizing fuzzy classifiers to recognize the particular point of the electroencephalogram utilizing network fuzzy Rules. In their system, the total time of ECG signal processing is reduced by a sequence of samples, without any essential loss. The ECG signals are imposed into the framework that implements cleaning, and afterward utilizes a clustering algorithm ''Gustafson–Kassel fuzzy'' for the signal classification and correlation. Their study suggested that common heart diseases like myocardial infarct, arterial coronaria and angina diseases can easily be detected by their system.

According to the obtained results, their method provided better disease diagnosis for Pulse Pressure Variation compared to other reported systems. Ebola Virus Disease is a fatal infectious disease also known as the ''Ebola hemorrhagic fever''. Hence, a secure method of diagnosis has been investigated. Oluwagbemi et al described that Ebola fuzzy informatics system was designed to diagnose EVD. They utilized fuzzy logic as its inference engine along with a collection of rules. A knowledgebase was created to help provide a diagnosis of the Ebola Virus Disease (EVD). The method used as a fuzzy inference method was Root Sum Square. According to the performance of their system, we can say that their system is a valuable addition to fight against Ebola. BRAIN DISEASE or disorder is a condition where a person loses the capability of reasoning, loss of memory; change personality, mild seizures, and twitching are common symptoms. The brain is the central control of the body. When brain problems occur, the results can be devastating. Brain diseases such as stroke, brain tumours, Alzheimer's disease can cause problems like vision loss, weakness, and paralysis, etc .

Early detection of these problems is very necessary for a doctor as well as a patient in order for the treatment to be started. Gopal and Karnan proposed a system for diagnosing Brain Tumor. A system designed to diagnose brain tumors using MRI images by the use of the Fuzzy C Means clustering algorithm. The tools used along with Fuzzy C means algorithms are Genetic Algorithm and Particle Swarm Optimization. The suspicious block is fragmented by the use of two algorithms GA and PSO. Computer-aided System is then utilized for verification and correlation of brain tumor in the diagnosis algorithm. Fuzzy C Means helped to determine the adaptive threshold for brain tumor fragmentation. The results of previous techniques were compared with existing outcomes. Their results indicated that it improves the overall performances of the fragmentation and can find the optimal solution. Another representation was given by Chen et al to introduce a productive brain problem detection system by the use of fuzzy k-closest neighbour or SVM for Parkinson's disease diagnosis. A comparative analysis was performed between SVM and FKNN. The experimental outcome showed that the FKNN technique worked better over the SVM classifier. The accuracy obtained by the FKNN was 96.07 which is more than the SVM method. Different diseases such as neuro diseases, cancer, diabetes, heart diseases, thyroid disorder, asthma disease were also diagnosed by using various ANN mechanisms. The neuro-fuzzy model has been proposed by Patra and Thakur for the proper diagnosis of adult Asthma disease. The dataset was collected from various hospitals. Three learning algorithms were used: ANN with Self Organizing Maps (SOM), ANN with Learning Vector Quantization (LVQ) and ANN with Backpropagation Algorithm along with NF tool to produce accurate results. Fuzzy inference was then used to classified data to diagnosis a disease. Fuzzy logic is also capable to detect dangerous diseases like cancer, especially BREAST CANCER. Breast cancer is a sort of sickness caused by bumps found in the breast that frames the cells. Cancer appears when cells start to grow out of control. Miranda and Felipe inter-operated on the Fuzzy Omega algorithm, an automated tool to detect breast lesions. The user availed elements like contour, size, and density and the system suggested the BI-RADS classification. Their method achieved an accuracy of 76.6 % for nodules and 83.34% for calcifications. Another approach was given by Nilashi for early diagnosis to tackle the disease. The authors designed an information-based architecture for the classification of breast cancer disease using Clustering, and classification approaches. They used Expectation-Maximization for clustering the data. Fuzzy rules extracted from Classification and Regression Trees were used for the classification of breast cancer disease.

Their method can be used as a decision support system for disease diagnosis. The liver ailment is also a sort of hepatic sickness that makes the liver stop its working partially or completely. Most of the factors of liver ailment are due to an alcoholic or hereditary nature. The most well-known kind of liver illness is fatty liver. In order to diagnose, a liver disease, Satarkar S.L. and Ali M.S worked to form an expert system that cooperated with fuzzy logic. According to the authors, the portrayal was provided by the Mamdani approach to recognize the risk factors. Their system could be used to make predictions of cirrhosis and avoid the need for liver biopsy. DIABETES is a kind of sickness which is caused by the increase of blood glucose levels in the body. Apart from that, this disease decreases insulin level in body cells and cause type 1, type 2, or gestational diabetes. An excessive amount of sugar level in the body prompts different issues like harming the kidney and nerves. Kalpana and kumar focused on developing a model to analyze diabetes malady using a fuzzy determination mechanism. To decide whether a person has the possibility of diabetic or not, the author used the fuzzy determination system to asses rules with the fuzzy operator in their study and portray knowledge with descriptions. Lukmanto proposed an intelligence system by using a fuzzy hierarchical model that can perform initial diagnosis against diabetes. The proposed model was implemented on 311 relevant data and acquired an accuracy of 87.46 % as equivalent to a medical doctor's statement. Another proposal was given by Rajeswari et al on diabetic diagnosis using an associative classification method based on fuzzy logic to tackle the problem of the boundary value confusion while partitioning risks. Tooth Decay, Periodontal Disease, Gingivitis, Dental Plaque, etc are diseases that occur in teeth, and are commonly termed as DENTAL DISEASES. Allahverdi and Akcan analyzed based on periodontal dental disease around 164 fuzzy rules taken with some inputs. The prime goal of their study was to decrease the time taken for early recognition of dental disease. Son et al designed a system called Dental Diagnosis System to find out dental problems which depend on the hybrid technique of fragmentation, classification and decision making.

They investigated that the accuracy of DDS in dental problem detection is 92 % approximately that is higher than any other systems like fuzzy inference system (89%), fuzzy k-nearest neighbor (80%), prim spanning tree (58%) and Kruskal spanning tree (58%). Bacterial diseases like Cholera arises after swallowing polluted or infected water. This kind of disease can prompt drying out, diarrhea and can also become the reason for death, if not handle at the perfect time. Uduak and Mfon proposed a system based on Mamdani fuzzy approach. Centriod method was used as a deffuzifier and performed better in MATLAB simulation. Another representation was given by Okpor M.D, they classified their investigation on cholera using fuzzy classification. The results were satisfactory for tackling cholera as compared to previous applications.

3.1.B MEDICAL DIAGNOSIS PROCESS USING FUZZY LOGIC

Fuzzy logic has the ability to portray information and outcomes in the form of semantic articulation. It tends to be valuable since most diagnosis processes have been performed based on the probability of medical findings. The power of human thinking and decision-making ability develop a clinical proof-based theory to make the process of diagnosis better. Due to the demonstrated viability of applying fuzzy methods in the field of healthcare to display uncertainty, it has been used in the finding procedure with various applications as per the kind of illness and targets of the researchers [45]. The main rule of this framework in medical science has two major elements in which symptoms are used as input and the disease as output. Generally, the Fuzzy logic process to disease diagnosis as described in Fig 3 is made by the following steps:

• **Fuzzifier:** The Fuzzification process is done by a Fuzzifier. It is a process of changing a crisp input value to the fuzzy set. Hence Fuzzifier is used as a mapping from observing input to fuzzy value.

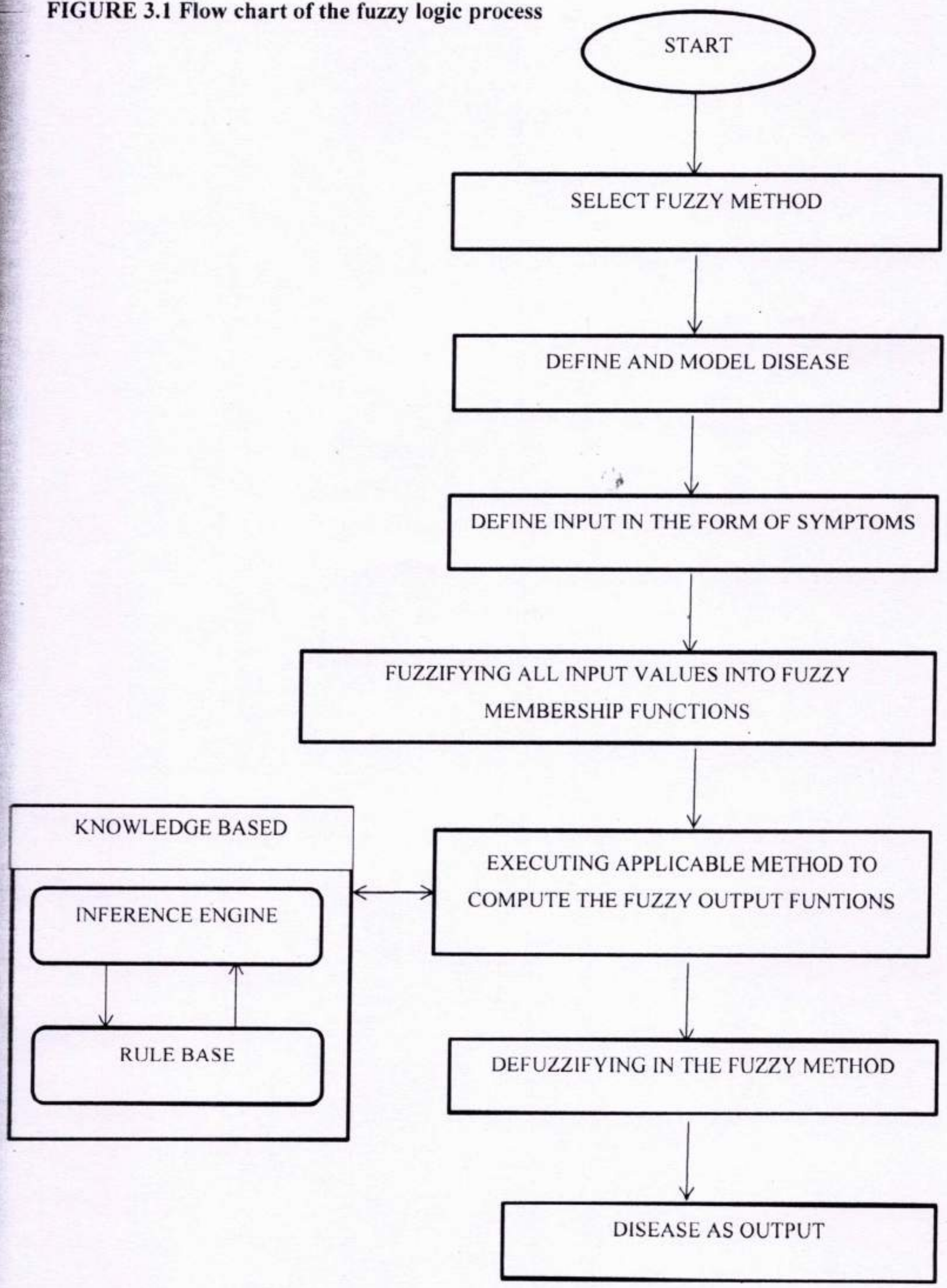
• **Inference engine:** After completing the fuzzification process, fuzzy value processed by the inference engine using a set of rules act as a collection of rules to the knowledge base.

• **Knowledgebase:** This is the main component of the fuzzy logic system. The overall fuzzy system depends on the knowledge base. Basically, it consists of rules, structured and unstructured data also named the database.

• **Defuzzifier:** The process of converting the output from the inference engine into crisp logic. Fuzzy value is an input to the defuzzification that maps fuzzy value to crisp value.

Fuzzy Logic is taken into account among the techniques for AI, where intelligent behavior is achieved by creating fuzzy classes of some parameters. The rules and criteria are understandable by humans. These rules and the fuzzy classes are defined by a domain expert mostly. Therefore, a great deal of human intervention is required in fuzzy logic. The actual processing of data basically provides a presentation of the information in fuzzy logic. One of such representations can be done using machine learning in the medical field even in a much better way than fuzzy logic. The statistical model used for estimation is not capable to produce good performance results. Statistical models fail to detect missing values, large data values and hold categorical data. All the above-mentioned reasons can be achieved through machine learning (ML). ML plays an essential role in numerous applications such as natural language processing, information mining, image detection, and disease detection. In all the above-mentioned domains, ML provides appropriate solutions as per the problem. Thus, ML also facilitates advanced diagnosis systems and treatment options in healthcare. In the following section, we describe how ML was used for disease diagnostic systems.

FIGURE 3.1 Flow chart of the fuzzy logic process



3.2. MACHINE LEARNING AND DISEASE DIAGNOSIS

In this section we first present the current related work which are based on machine learning. We then describe the ML process for disease diagnosis

3.2.A EXISTING WORKS USING FUZZY ML

Machine learning is a field that comes within the broader area of AI in which by training, a machine learns itself and perform tasks. In machine learning, there are algorithms for supervised learning (under the control and ''guidance'' of a human expert) in which we are initially aware about both input and results, as well as unsupervised learning (requiring very little human intervention or domain expert's service) where we are not aware of what will be the results. A machine is trained to learn a concept by giving examples and creating pattern models that are supposed to differentiate between two or more objects. In the medical field, machine learning assist the experts to handle large and complicated medical data and also helps to investigate the results. The output of this process can be used for further research. Therefore, when machine learning is applied in healthcare, it increases the trust level of patients in medical science in order to predict a disease by implementing machine learning algorithms. Sometimes, illness is not early detected by human experts, in such types of cases machine learning can be used to detect early stages of the disease before its occurrence or it becomes dangerous to someone. In this way, it can help to prevent future problems as ''Prevention is better than cure''.

The popularity of machine learning in different areas has tended it towards machine learning algorithms that produce correct outcome as compared to traditional models with little processing of raw data. Machine learning algorithms like Decision trees,Support vector machine, Multilayer perception, Bayes classifiers, K-Nearest Neighbour, Ensemble classifier techniques, etc are used to determine various ailments. Using machine learning algorithms can lead to rapid disease prediction with high accuracy. The learning process begins with observations or information, such as examples, direct experience or instruction. In particular, the algorithms look for data patterns and makes better decisions. The key goal is to allow the machines to learn automatically without human interference and adjust the response accordingly. The intended contribution of AI in the field of medical science is to develop programs that can help a medical expert in practicing expert and more accurate diagnosis. The forecast for diseases plays an important role in machine learning. Various types of diseases can be predicted using ML techniques. Here, we examine how machine learning techniques are used to predict various disease types. We focused on the prediction of some chronic diseases like kidney disease, diabetes, heart disease, and breast cancer, lung disorders, etc.

KIDNEY DISEASE is a common word for diverse disorders affecting the kidney's structure and working. The definition of chronic kidney disease is centered on kidney damage or reduced kidney function for three months or more. Kidney failure is among the most serious outcomes of chronic renal disease, with complications of decreased kidney function being the primary reason. Sinha and Sinha proposed a decision support framework to diagnose kidney disease. They compared the performance of two classier, SVM, KNN. The comparison was based on accuracy, precision and execution time of both algorithms. From the investigation they observed that KNN works better than SVM. In another study, Charleonnan et al classified his analysis on performing a comparative analysis based on four ML techniques KNN, SVM, logistic regression (LR), and decision tree classifiers to detect diagnosis kidney disease. In order to pick the best technique, they compared their performance with each other. It was observed that the SVM method is best than the rest of others and gives a maximum accuracy of 98.3 %. BREAST CANCER which is a chronic disease for females, is the most common cancer disease and a leading cause of death. In recent years, machine learning was used a helpful tool in the detection of breast cancer. Zheng et al focused on developing a model to diagnose breast cancer based on the extracted tumor features. To extract useful information and diagnose the tumor, the K-means algorithm was used to identify the hidden designs of benign and malignant tumors.

Afterward, SVM was utilized to get the classifier to differentiate the incoming tumors. Their system improves accuracy up to 97% approximately. In another study, Asri et al classified their analysis on breast cancer using different methods of machine learning. The authors have done comparatively performance based analysis between ML methods such as SVM, k Nearest Neighbors, Decision Tree using the Breast cancer dataset. The prime objective was to evaluate the accuracy in classifying data relating to each algorithm in terms of correctness, precision, sensitivity. Results produced by those algorithms showed that SVM provided the highest accuracy. Soreness of one or more joints, the reason for pain and stiffness that can become worsen with age is referred as ARTHRITIS. Various sorts of arthritis exist such as osteoarthritis and rheumatoid arthritis. Each type has a different way of treatment. ARTHRITIS reduces the quality of life of a person. Hence, early detection of arthritis is necessary which can be achieved using ML . Neeraj et al presented a system to classify patients with arthritis dataset which was taken from Koch. Their system classified the data with features such as identity, gender, age and treatment with an algorithm CART to find out true or false rates. DIABETES is a chronic disease that appears when the pancreas is not able to make insulin. To predict diabetes disease, Nahla and Bradely worked on diagnosis by classifying based on a blood test to diagnose diabetic disease using SVM classification. SVM prediction accuracy of 94%, the sensitivity of 93%, and specificity of 94% were achieved. Kandhasamy and Balamurali compared machine learning classifiers Random Forest, K-Nearest Neighbors, J48 Decision Tree and SVM to classify patients who have symptoms of diabetes. These techniques have been tested with data taken from the UCI data repository. The results of the algorithms have been tested with noisy data and dataset set without noisy data and compared in terms of specificity, sensitivity and accuracy.

Their investigation concluded that the decision tree J48 classifier got higher efficiency than the other three classifiers. PARKINSON'S DISEASE is a disorder responsible for the dysfunction of nervous system progress and its movement. Gradually symptoms arise may be some time starting from tremor in just one hand. Sriram et al. proposed a system in which the tools used for experimentation analysis included classification and evaluation using Orange along with weka tools. UCI Machine learning repository provided Voice dataset for Parkinson's disease. Classification algorithm such as Random Forest showed good accuracy (90.26) compared to all remaining algorithms like KNN, SVM (88.9%) and Random Forest(90.26). Naïve Bayes has shown the least accuracy (69.23). In 2014 Salvatore supervised a machine learning algorithm which was used to diagnose patients with Parkinson's disease and Progressive Supranuclear Palsy. They took 28 MRI image records of both PD and PSP patients based on feature extraction technique and SVM was used as a classifier. The algorithm was able to differentiate PD patients from PSP patients at an individual level. Respiratory systemnose, throat, and lungs affected by a viral infection is known as Influenza. Pineda et al investigated seven different classifier of ML for detection of influenza and compared their results within built influenza Bayesian classifier. Their study demonstrated that ML had the power to provide a diagnosis of irresistible sicknesses. Concerning the occurrence of cancer in liver cells, Sandeep et al proposed a model for Lung images which can be classified into normal or dangerous categories. According to the authors, by following this mechanism results could be achieved with high accuracy. Through the use of electronic records, ML can predict various diseases.

3.2.B MEDICAL DIAGNOSIS PROCESS USING ML

Machine learning has granted computer systems new abilities that we could have never thought of. Machine learning is a field of AI that gives machines to power to learn itself by examples [62] In order to analyze how to different models perform in ML without using human judgment. The working of ML are explained step by step as follow [63] as shown in Fig.3.2.

1) **Data Collection:** The very first step is to collect data. It is a very critical step as quality and quantity affect the overall performance of the system. Basically it is a process of gathering data on targeted variables.

2) **Data Preparation:** After the collection of data, the second step is data preprocessing. It is a process to change raw data to useful data, on which a decision could be made. This process is also called data cleaning.

3) **Choose a Model:** To represent preprocessed data into a model, one chooses an appropriate algorithm according to the task.

4) **Train the Model:** ML use supervised learning to train a model to increase the accuracy of decision making or doing predictions.

5) **Evaluate the Model:** To evaluate the model, a number parameters is needed. The parameters are driven from the defined objectives. Also, one needs to capture the performance of the model with the previous one.

6) **Parameter Tuning:** This step may include: numbering of training steps, performance, outcome, learning rate, initialization values, and distribution, etc.

7) **Make Predictions:** To evaluate the developed model with the real world, it is indispensable to predict some outcome on the test dataset. If that outcome will match with domain expert or opinions nearer to it, then that model can be used for further predictions.

The basic steps of for disease detection using ML is described as follows :

1) Collect test data with patient details.

2) The feature extraction process picks attributes which are useful for disease prediction.

3) Afterward, the selection of attributes, then select and process the dataset.

4) Various classifications methods as mentioned in the diagram can be applied to preprocess dataset to evaluate the accuracy of prediction of disease

5) The performance of different classifiers compared with each other in order to select the best classifier with the highest accuracy.

In Machine learning, all the features extracted by a domain specialist to minimize the complications of data and to develop patterns in such a way that would easily visible to ML algorithms. However, deep learning based technique can extract features manually without human intervention, the only condition is to make precise decisions in which the testing data would be accurate. This technique eliminates the requirement of a domain expert for feature extraction. In the following section, we describe how deep learning has been used for disease diagnostic system.

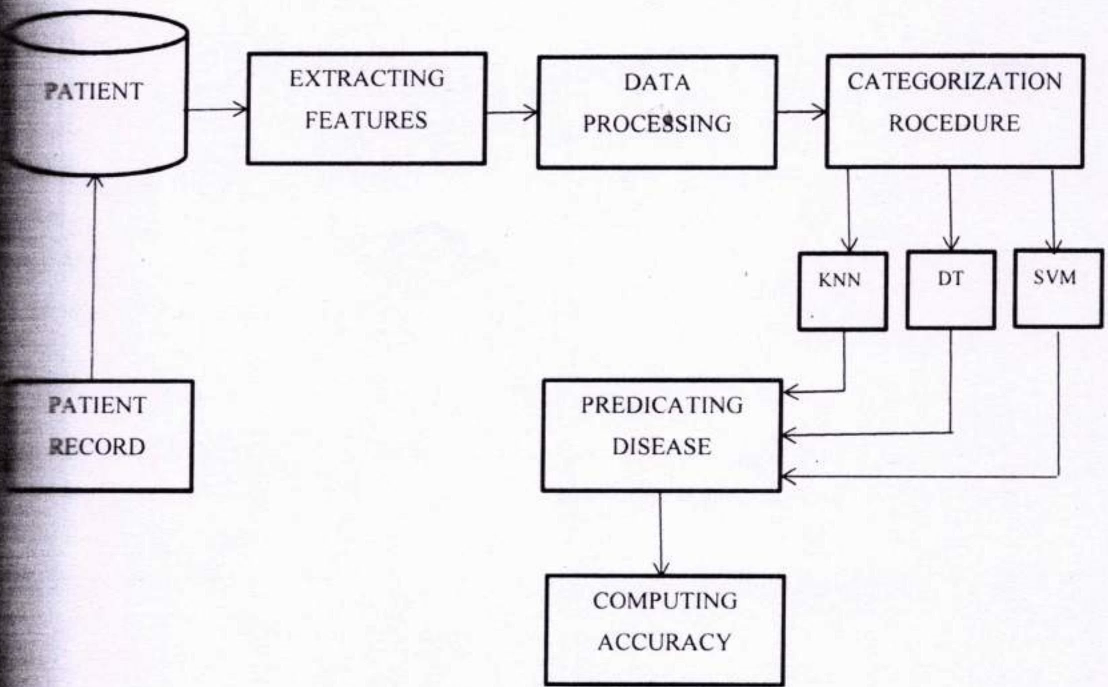


FIGURE 3.2 Machine Learning System

3.3 DEEP LEARNING AND DISEASE DIAGNOSIS

In this section we first present the current related work which are based on deep learning. We further describe how deep learning is used for disease diagnosis processes.

3.3.A EXISTING WORKS USING DEEP LEARNING

An artificial intelligence technique that mimics the workings of the human brain and creating patterns for decision making is known as Deep Learning. While machine learning methods required to break down a problem statement into different parts first and then their outcome to be integrated at the final stage; the Deep Learning method's objective is to solve the issue end to end. In medical science, deep learning achieves better results than traditional machine learning models. Deep learning has got great interest in each field and especially in medical image analysis. The term deep learning refers to utilize of deep neural network models. The main component of the neural network is the simulation of the human brain in the form of neurons. It works on the scenario in which different signals use as input, join them suing weights and pass those joined signals to produce output.

The ANNs (artificial neural networks) and deep learning can be differentiated by the variations in a number of hidden layers and their inter-connectivity and the efficiency to yield a suitable result of the inputs. The ANNs are generally constituted of three different layers and are instructed to retrieve well-structured information that could be suitably utilized only to perform the specialized task. On the other hand, in Deep learning, physical and clinical examination of the patient are determined through the nature of the diseases. Though there are many tools and techniques that are available for diagnosis of diseases, a certain degree of inaccuracy and uncertainty still persists in the diagnosis process. It is quite evident from various analytics survey that using machine learning techniques has its own limitations. In addition to that, the present system of diagnosis only considers attributes to determine diseases. The conventional way of selecting attributes which is used for disease prediction some time yield erroneous result. In contrary to machine learning, deep learning is capable to select the most relevant attributes out of the database which in turn leads to the prediction of diseases with a great degree of precision. A considerable number of diagnosis systems using deep learning can be found in the literature. Skin diseases may affect human skin and mostly seem to be an external disease as it originates and affects the layers of the skin. But sometimes it gives very important clues to diagnose underlying causes of internal diseases. There is a variety of skin disease that can be acne, skin cancer, rashes, etc. Early detection of skin disease is important as a preventive measure of future skin problems. Liao proposed a system to classify different skin diseases using deep convolutional neural networks. Using 2300 skin disease images taken from Dermnet and OLE dataset, the proposed system was able to train the CNN model and assess its results. Their system could achieve Top-1 accuracy of 73.1%. Another classification was given by Shoieb et al to diagnose skin cancer. Their model detected the infected part of skin and CNN which is used for feature extraction. Their model used SVM as a classifier and utilize CNN to train the model suing skin image data. Their results represented significant improvement and accuracy compared to previous ones in skin diagnosis. Chronic disease such as breast cancer when detected using deep learning get higher accuracy compared to other techniques. Zaher and Eldeib proposed a system CAD approach for the diagnosis of breast cancer that has been modeled using a deep belief network. In their technique, the unsupervised path followed by back propagation supervised path with "Liebenberg Marquardt's learning function" and weights were initialized using the deep network path.

Their function was tested on Breast Cancer Data and provided a correctness in results up to 99% greater than previous approaches. Charan et al. used CNN for breast cancer diagnosis. A total 322 mammograms records extracted for testing in which 189 were used and showed negative results and 133 were of abnormal breast records. Their results showed the effectiveness of deep learning for breast cancer diagnosis for mammogram images. Diabetes is a metabolic illness influencing people groups around the world. Its frequency rates are expanding alarmingly and consistently. Goutham et al. proposed a model for the classified diabetic and normal Heart rate signals with help of deep learning system. They utilized CNN for extracting features and HRV data was used use as input. Classification of features was done by SVM. Their proposed system is predicted to help medical doctors to diagnose diabetes using ECG signals with very high accuracy. Another representation was given by Sisodia and Sisodia on the early detection of diabetics. The main aim of their research was to develop a system that can predict the possibility of diabetics with maximum correctness. Hence three ML algorithms SVM, Naive Bayes, and Decision Tree were used to diagnose diabetes at an early stage. The Pima Indians Diabetes Database was used to perform experiments. The performances of these algorithms were assessed on various measures like Accuracy, Precision, F-Measure. Their results indicated that Naive

Bayes performed better with the highest accuracy of 0.76 compared to previous models. Heart disease classification was done by Rubin et al and their study identified variabilities heart sounds using an automatic cardiac auscultation system. Their algorithm collected the time-frequency rate of heart sounds and classified with the help of a deep convolutional neural network. The motive of their research was to determine normal and abnormal heart sounds. The authors achieved high specificity score out of all entries. Miao and Miao developed an enhanced deep neural network (DNN) to diagnose heart disease. The designed deep neural network model was based on a deeper multilayer perceptron framework. Their model classified the data based on the training set. To investigate the performance of this model, 303 test data were taken from patient with coronary disease.

Their model achieved accuracy of 83%, sensitivity of 93% approximately. For Liver cancer, Sun et al developed three deep learning algorithms implemented using Convolutional Neural Network, Deep Belief Networks and Stacked Denoising Autoencoder to diagnosis lung cancer diagnosis. They compared the performance of all three algorithms on 28 image features of the lungs dataset. SVM was used for classification. CNN, DBNs, and SDAE provided accuracies of 0.7976, 0.8119, and 0.7929, respectively. COVID-19 (Coronavirus) disease is an infectious virus. It spreads when an infected person coughs, sneezes, and his generated droplets are transmitted to other persons. Most people who get infected by COVID-19 experience high temperature, cough, difficulty in breathing. COVID-19 has killed millions of people across the world. Due to the increasing number of cases and limited test kits, it becomes difficult to detect the presence of COVID-19. Here at this point, the need for other alternatives such as X-ray has been arisen. When researchers use X-RAYS with AI techniques it becomes easy to detect COVID-19. Recently, a deep-learning-assisted model comes with four phases: data augmentation, preprocessing, stage-I, and stage-II deep network model designing. The model has been implemented on 1215 X-RAY images. Initially, in stage1 model differentiates induced pneumonia, bacteria-induced pneumonia, and normal/healthy people with 93.01% accuracy. After that images detected with viral-induced pneumonia are sent to stage2 for detection of COVID-19 that has gained 97.22% accuracy.

Overall, results of this model are accurate, reliable, and fast. Most often COVID-19 disease makes doctors confused with lungs infection in this condition and diagnosis become a difficult task here. For this, quick diagnosis is required that can be possible with different deep models.

We came across a novel Convolutional CapsNet using chest X-ray images. The model provides accurate results with the binary classification of 97.24% and multi-class classification of 84.22%. In the study, a Pre-trained deep neural network was used to diagnose COVID-19 on chest CT images. Brain Hemorrhage refers to bleeding within the brain, it can happen due to a brain tumor, clot, or hypertension. Whenever a Hemorrhage occurs, oxygen cannot be able to reach the brain cells and eventually brain cells die rapidly. A novel convolutional neural network based on ResNet to diagnose and predict the type of brain hemorrhage is also developed. 752,803 DICOM files have been collected to conduct this study. The model obtained an accuracy of 93.3%.

3.3.B MEDICAL DIAGNOSIS USING DEEP LEARNING

As mentioned earlier, the conventional automated diagnostic method used a machine-learning algorithm in that clinical expert manually fetched features in diagnosis reports. But sometimes it became difficult to extract features from large dataset.Hence, those methods suffered with accuracy and efficiency as depicted in Fig. 5. Absence of important information is a considerable obstacle for deep learning models. Presently, medical research use electronic health records, but there is no predictable technique to evaluate the EHRs, which implies that accuracy of diagnostic process using automated system could be limited. If the system fail to collect accurate data, the model will not able to diagnose a disease precisely, which makes it complicated to show accurate prediction. To tackle this kind of problem, the authors in developed effective deep learning model for early & correct detection of various diseases. In conventional approach, a Deep CNN model is used to detect diseases. Then the neural system utilizes approaches to data expansion. Each layer inside CNN filters the raw data in the image to get a specific pattern. The few initial layers find the large feature set like diagonal lines and the next few layers are used to get better details, organize them into complicated features. The most final layer works as an ordinary neural network and the network becomes fully connected.Then it put together highly specific features like various symptoms of the disease and as a result, perform the prediction of the disease. The authors in rectified the approach in order to solve the issue of lacking information or missing values. Afterward, a deep learning model trained by the processed data have proved their efficiency as shown in Fig 3.3

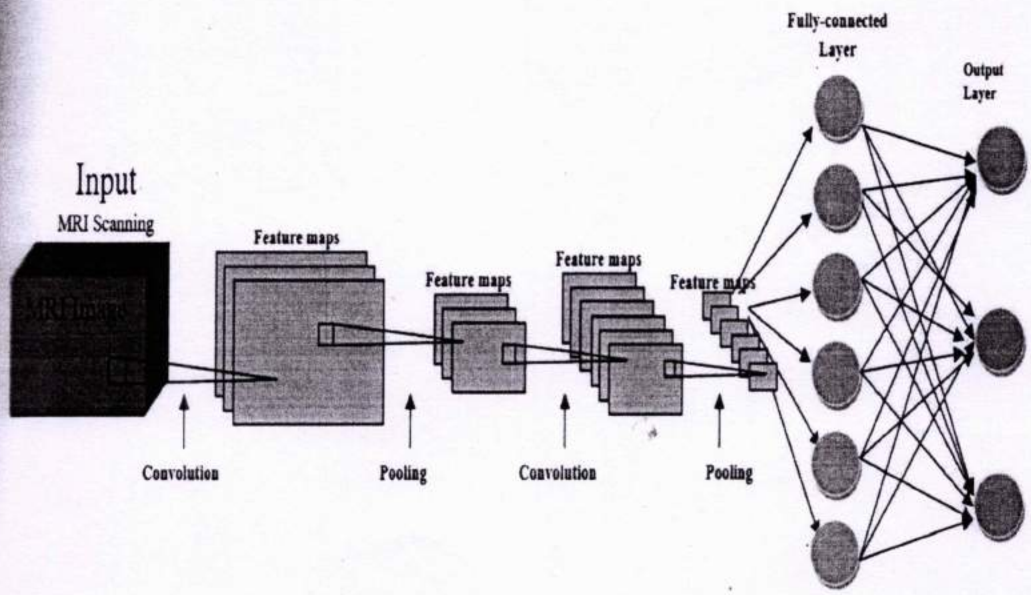


FIGURE 3.3 DEEP PROCESS TO DIAGNOSIS A DISEASE

CHAPTER-4
METHODOLOGY

PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) method was used for a systematic review. This method was invented by Moher et al. In this method, a survey is carried out on basis of a predefined question by the virtue of which data from the studies that are included in the survey, are collected and subsequently analyzed systematically and evaluated critically. Meta-analysis is a statistical, formal, quantitative study design technique used for systematic evaluation and integrating the results of the included studies or previous study to derive the conclusion. Both systematic review and meta-analyses are an integral part of research to summarize evidence relevant to the efficacy and safety of medical care interventions precision and certainty. In a systematic review method, the least collection of elements is based upon evidence and meta-analyses that summarize and analyze scientific reliable literature by utilizing a structure method based on predetermined queries that can be used by various researchers. Different findings and ideas which are published in the conventional papers by different researchers can be investigated with a correct and comprehensive analysis in a systematic review method. With the help of the PRISMA method, an investigator can perform systematic reviews and meta-analyses with a degree of accuracy that can lead research in a well-structured manner.

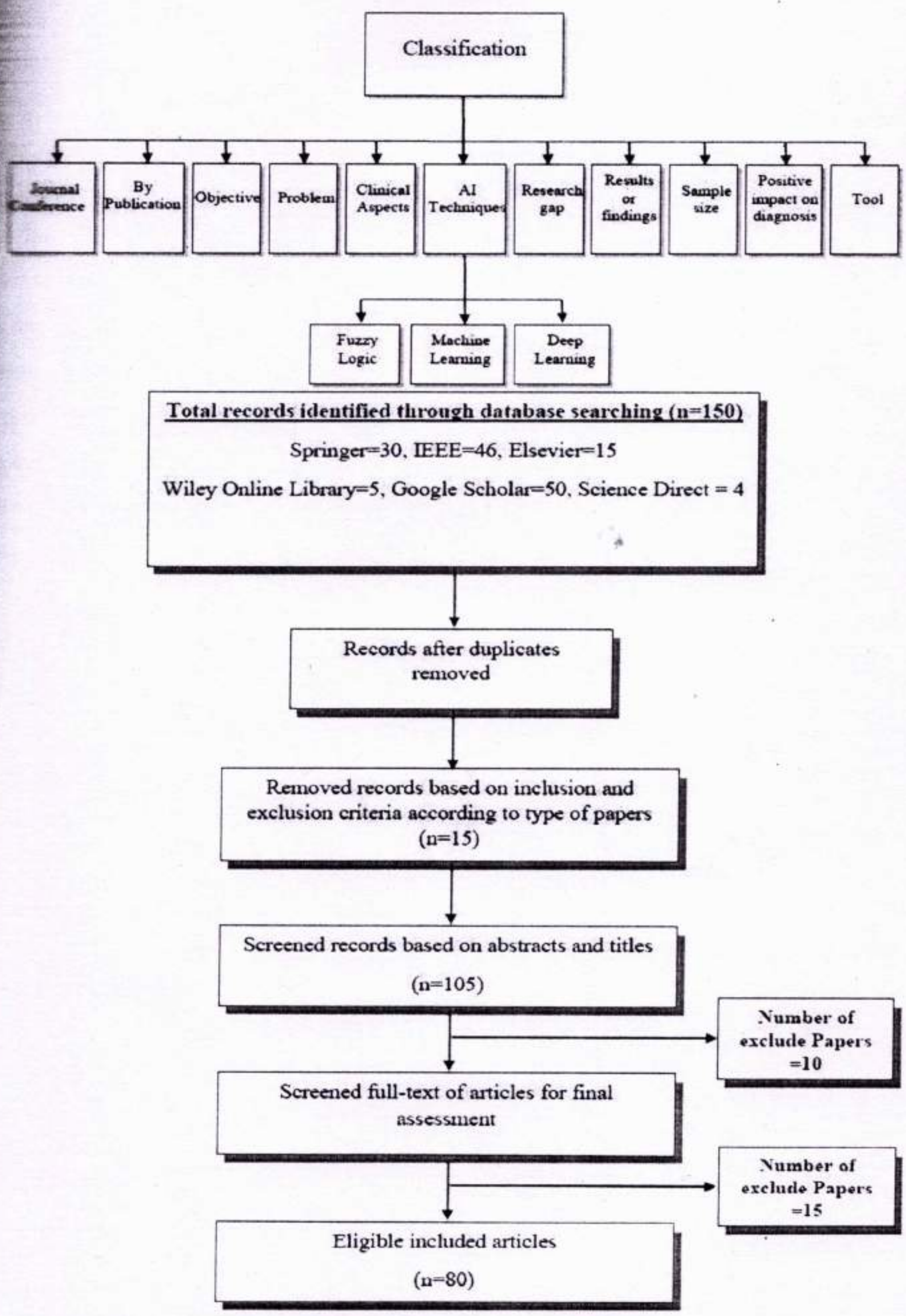


FIGURE 4: PRISMA METHOD FOR REVIEW

CHAPTER-5
EXPECTED RESULTS

In the last stage, we reviewed all the papers which consisted of 95 articles in order to complete the final study and achieve the desired result. The articles which were extracted for the research were vetted meticulously to find out the answer to the crucial questions as per the requirement of the research. A form was formulated for the extraction of data that make the necessary classification, inspection, and incorporation of the included articles in the light of the present criteria. The data extraction form which was formulated helped to a great extend to accomplish the desire results and draw a suitable conclusion. The criteria which were incorporated included the reference of the author, its year of publication, whether it belongs to a journal or conference proceeding, the definition of the diseases; its types and complications, objectives, loophole in the research, methods used fuzzy logic, machine learning, and deep learning methods, results, finding and positive impact on diagnosis process. Fig.4 indicates a chart related to classification. After reviewing all collected papers, 80 academic research papers from 30 international scientific journals and 10 conferences proceeding which were published from the year 2009 to 2019 were taken into account in this systematic research. We thoroughly reviewed all selected article and finally retained those articles which applied fuzzy logic, machine learning, and deep learning for diagnosis of a disease. Notwithstanding, though adopting the PRISMA method and selecting articles accordingly is a time-consuming process, still this method is a most suitable method for carrying out research as it is a structured method for which we have to include only those articles in the study which were explicit to the subject of the systematic review.

- A review of the existing literature on medical diagnostic systems using AI algorithms, including their development, implementation, and effectiveness.
- An overview of the principles behind the use of AI algorithms in medical diagnosis, including machine learning techniques, data collection, and pattern recognition.
- An exploration of the perspectives on the use of medical diagnostic systems using AI algorithms, including the benefits, challenges, and ethical considerations.

- A discussion of the technical challenges and requirements for developing and deploying medical diagnostic systems using AI algorithms, including the need for large datasets, computational power, and expertise in machine learning and data science.
- A consideration of the potential impact of medical diagnostic systems using AI algorithms on the healthcare system, including their potential to improve patient outcomes, reduce medical errors, and increase efficiency.
- Recommendations for future research and development in the field of medical diagnostic systems using AI algorithms, including addressing ethical concerns, improving data quality and quantity, and exploring new techniques and technologies.

Overall, the expected results of this paper are likely to provide insights into the principles and perspectives of medical diagnostic systems using AI algorithms, and to offer recommendations for further research and development in this field.

CHAPTER-6
CONCLUSION AND FUTURE SCOPE

CONCLUSION

Recent advancements in AI techniques lead to successful applications of AI in healthcare. Even it has become a hot topic of discussion whether AI expert systems will eventually replace human doctors. Still, we consider the fact the AI expert system can assist the human doctor to make a better decision or even replace human judgment in some cases. Different AI techniques can help to find out relevant information from a large amount of clinical data. Also, AI methods are trained in such a way that can have the ability of self-learning, error-correcting, and they produce results with high accuracy. This survey is about the use of three AI approaches in disease diagnosis. In this review, we assess the impact of the AI methods and their constancy on disease diagnosis to minimize the errors in misdiagnosis, with the PRISMA method. To accomplish the primary goal, we developed a search scheme. In this prospect, different scientific journals including Google Scholar, IEEE, Science Direct, Web of Science, Wiley Online Library, and Elsevier were chosen to fetch the published scientific papers from the years 2009 to 2019. All the retrieved papers are distributed based on authors, published years, various AI tools, the fuzzy methods, machine learning methods and deep learning methods various kinds of diseases, results and lastly the influence of AI methods that are applied in disease detection. The results have shown that the frequency of paper publishing in the medical field has rapidly enhanced.

Another aim of this study was to investigate which AI method was most effective for disease diagnosis according to most of the researchers. Based on our study we concluded that applied methods of AI in healthcare provide beneficial results by improved diagnosis process and to detect the disease in early stages which follows to pick the suitable treatment plan. The other key concept to keep in mind is that we investigated three AI techniques (Fuzzy logic, machine learning, and deep learning) that are widely used in healthcare and we produce our results using these three methods. Also, the effect of every AI technique based on the frequency of influence recorded by papers was analyzed. Major medical areas that we have reviewed were related to cardiology, neurology, cancer, kidney disease, diabetics, cholera, and dental disease respectively using AI diagnostic criteria. Besides this, we also discovered that the papers differed significantly depending on the type of disease. In this study we observe that AI is not limited to identify any specific disease, we can utilize various AI techniques to detect any kind of disease or to improve the diagnosis process for all diseases. Therefore we can say that this survey will be helpful in future research. Moreover, in this research paper, we observe that over 91% of AI methods reported a positive impact on disease diagnosis. The efficiency to detect disease by AI cannot be ignored. Another significant finding in this review is that most of the researchers use tools like MATLAB, Python, Java, C# for designing AI architecture. This research also has some limitations. PRISMA method analyzed the articles published only in a specific decade in terms of healthcare using AI techniques. Although some selected articles published in 2020 were considered in this survey, the main review focus was on the articles published from 2009 to 2019. For future studies, we project to consider the diagnosis in a broader sense to indicate the applicability of AI methods in Alzheimer's disease and Parkinson's Disease Diagnosis. Moreover, the roles of AI techniques for the diagnostics systems using sensors-based computing frameworks will also be investigated. An in-depth assessment of the economic impact of AI in health care is also a part of our future works.

FUTURE SCOPE

As evident from the progress and discussion presented in this paper, AI algorithms are potential to provide a significant contribution to medical diagnostic systems. Nonetheless, in order to obtain the maximum potential of AI for mining novel insights from the associated medical data, AI-based diagnostic systems must address some major issues as follows.

1. EXPLAINABLE DIAGNOSIS

AI models are often criticized because of its internal unclear decision-making process. In this regard, explainable AI deals with the implementation of clarity and reasoning of the behaviors of statistical black-box AI learning methods, particularly deep learning. As such, in addition to uncovering the pattern recognition problems, AI systems should come with causal models of the world supporting explanation and understanding. This is even more important when we seek for the applications of AI in medical diagnostics. Researchers argue that it is essential to look at even beyond explainable AI. Causability will eventually results in explainable diagnosis covering measurements for the quality of explanations.

2. QUALITY OF TRAINING

The performances of machine learning and deep learning algorithms largely depend on the availability of high-quality training models to achieve the required diagnostic capability. Moreover, the problem of data scarcity is very central since data are at the key of AI-based medical applications. There exist some efforts to create additional annotated information by utilizing alternative methods, such as information augmentation and picture synthesis. However, it is not fully clear whether they are suitable for AI-based medical diagnostics.

3. CLINICAL TRANSLATION

The development in AI research used in medical diagnostics is indeed rapid, and their possible adoption has been shown by systems including the detection of various cancer metastasis, brain recognition, and diagnosing diseases in retinal pictures. Nevertheless, the adoption of AI-based system in clinical settings will undergo various transformations and phases and many methods still to come. As mentioned before, present studies focus mainly on optimizing the performance of complex machine learning models, while disregarding their explainability. As a result, physicians struggle to intepret these models, and feel it is hard to trust them. Therefore, reliable and trustworthy communications between medical experts and AI model experts is also highly important to transform the AI-based diagnostic potentials into clinical practice.

4. MEDIAL DATA CHARACTERISTICS

Since the medical data is the ultimate basis of mining knowledge required for disease diagnosis, the information should be of high quality. Moreover, the volume of medical data is usually very high, the data sources are diverse, and the data is often coming from real-time sensors. Therefore, preserving the data quality is a challenging task. With more and more mobile sources used for medical data, with complex applications that need remote access to healthcare data, having it stored on the cloud seems a more viable option. Although various solutions have been introduced to solve issues with cloud storage, none of them can handle all aspects of medical data characteristics precisely, because of the additional need to maintain the compliances with medical data security policies.

5. STANDARDIZATION AND INTEROPERABILITY

In the diagnosis context, there are many ways that vendors can manufacture a diverse range of diagnostic products while integrating a set of AI algorithms selected from many possible methods. However, they may not follow standard rules and regulations for compatible interfaces and associated protocols across diverse computing frameworks. This prompts interoperability issues. To address system diversity, immediate efforts are required to set the technical standards for AI-based medicine and diagnosis. In this regard, various technical and medical organizations including the AI group run by the international organization for standardization, world health professions alliance, and world health organization can work together.

6. SECURE DIAGNOSIS

AI methods in general and deep learning techniques in particular are vastly application-specific where a model trained for diagnosing one disease might not be able to work well for another diagnosis. The algorithms usually need to be retrained with respective medical data to be utilized for other diseases; otherwise, false diagnosis will be unavoidable. Also, improper selections of hyper parameters, by even slight change, can invoke large change in model's performance resulting in bad diagnosis. For example, whereas supervised learning is considered stable due to fixed data sets, reinforcement learning is not stable at all. On that, more insights are required for AI algorithms to be optimized for particular disease diagnosis. Another important aspect of secure diagnosis is that the diagnostic systems must be protected from wrongdoers. The attackers exploit the features of the AI algorithms to break the system. For example, an adversary can play with the training parameters and mislead the diagnostic system to learn the opposite of what it is supposed to do. It is, therefore, very vital to deeply investigate the characteristics of AI algorithms, reexamine the respective roles in diagnostic systems, and address the respective challenges.

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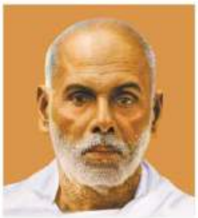

DEPARTMENT OF ELECTRONICS AND COMMUNICATIONS ENGINEERING

SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that the Seminar entitled **"AUTOMATIC DETECTION OF MIND WANDERING FROM VIDEO IN THE LAB AND CLASSROOM"** is a bonafide record of the work done by **KEERTHANA CV** of seventh semester **Electronics and Communication Engineering** towards the partial fulfilment for the award of the degree of Bachelor of Technology by Kerala Technological University.

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Above all it is the grace and blessing of God the Almighty, which make this endeavour success.

ABSTRACT

We report two studies that used facial features to automatically detect mind wandering, a ubiquitous phenomenon whereby attention drifts from the current task·to unrelated thoughts.

In a laboratory study, university students (N = 152) read a scientific text, whereas in a classroom study high school students (N = 135) learned biology from an intelligent tutoring system. Mind wandering was measured using validated self-report methods.

In the lab, we recorded face videos and analysed these at six levels of granularity: (1) upper- body movement; (2) head pose; (3) facial textures; (4) facial action units (AUs); (5) co- occurring AUs; and (6) temporal dynamics of AU. Due to privacy constraints, videos were not recorded in the classroom.

Instead, we extracted head pose, AUs, and AU co-occurrences in real-time. Machine learning models, consisting of support vector machines (SVM) and deep neural networks, achieved F1 scores of .478 and .414 (25.4% and 20.9% above-chance improvements, both with SVMs) for detecting mind wandering in the lab and classroom, respectively. The lab- based detectors achieved 8.4% improvement over the previous state-of-the-art; no comparison is available for classroom detectors.

We discuss how the detectors can integrate into intelligent interfaces to increase engagement and learning by responding to wandering minds.

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CHAPTER 1
INTRODUCTION

A time when realized our attention had drifted away from thinking about what where trying to do towards something completely unrelated. The goal is to develop automated methods to detect mind wandering to support a variety of applications aimed at improving task performance. Most of us can recall a time when we realized our attention had drifted away from thinking about what we were trying to do towards something completely unrelated. For example, we might be reading a book or news article and suddenly realize that we have no idea what we were reading. Or we might find ourselves attending a lecture but have no recollection of what the speaker just said. Such lapses in attention, known as mind wandering , are ubiquitous experiences. For example, one large-scale study that used experience sampling to track mind wandering of 5,000 people in 86 countries found that it occurred 46.9% of the time during day-to-day life. Mind wandering is not merely incidental; recent meta-analyses have confirmed that it is negatively related to performance across a variety of tasks . Here, our goal is to develop automated methods to detect mind wandering to support a variety of applications aimed at improving task performance.

1.1 PROPOSED STUDY

The explore video-based detection of mind wandering as a step towards intelligent technologies that sense and respond to user's mental states. Focus on mind wandering detection during learning with technology , due its high incidence and negative consequences in this contexts. There is considerable potential for intelligent learning environments to improve engagement and learning by automatically detecting and adapting the learning environment when minds wander.

Fig 1. 1Examples of facial expressions for positive(lef tcolumn)and negative mind wandering(righ tcolumn)

CHAPTER 2

CASES

2.1 STUDY1 SELF CAUGHT MIND WANDERING DETECTION DURING READING IN THE LAB

2.1.1 FLOWCHART

Data collection

Extracting videoclips

Feature extraction

Fig 2.1 Flow chart

2.1.2 DATA COLLECTION

Collect the students data in lab. Participant where conscious about Key to report whenever the zoning out happened .Participants where instructed to distinguish between two types of zone outs.

1. Task related thoughts

2. Task unrelated thoughts

Participants (152 university students) read the introductory chapter of Soap Bubbles: Their Colors and the Forces that Mould Them by C.V. Boys . The text is about the physical behaviors of soap bubbles, how surface tension enables bubble formation, and how chemical composition affects bubble formation. We used this text because it is likely to be unfamiliar to most participants but is written to be understandable without prior knowl edge of the topic. he text was presented on 57 screens (called pages) with about 114 words per page. Participants used the right arrow key to advance to the next page. Videos of particpants 'faces were recorded with a Logitech C270 webcam ($20 USD5) at 12.5 frames per second. Of the 152 participants, 10 were removed due to video recording errors and three were removed because they did not sign a data release agreement, leaving 139 participants in the dataset.

Participants used predesignated key store port whenever they caught themselves zoning out a colloquial term for mind wandering. These served as "ground-truth" la- bels for supervised machine learning .Zoning out was defined as: At some points during reading, you may realize that you have no idea what you just read. Not only were you not thinking about what you are actually reading, you were thinking about something else altogether. This is called "zoning out". Participants were further instructed to distinguish between two types of zone outs – task-related interferences vs. task-unrelated thoughts – as part of a larger study. However, both these types of zone outs were grouped because they are related, and multiclass detection was infeasible given the data set size.

We used the self-caught method here vs. the probe- caught method (Study 2) because we were interested in tracking mind wandering without task disruptions and were focused on mind wandering with meta-awareness (people are consciously aware that they are mind wandering).

It is important to emphasize a few points about this method to track mind wandering. First, heme thodrelieson self-reports because in wandering is an inherently internal phenomenon, which requires conscious awareness for reporting. At this time, there are no reliable neuro physiological or behavioral markers that can accurately substitute for the self-report methodology. Second, self-reports of mind wandering have been objectively linked to a host of theoretically-grounded behavioral and physiological signals . providing convergent validity for this approach. Self-reports also consistently correlate with objective outcome measures, which provides evidence for their predictive validity. Finally, our reliance on self-reports to measure mind wandering is consistent with the state of the art in the psycho-logical and neuro science literatures.

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2.1.3 EXTRACTING VIDEO CLIPS

Video clips where extracted in10 sec window, leading up to each mind wandering reports. Extracted videos are classified up to positive and negative. There were a total of 2,577mind wandering reports across 7,923 pages of text (about one report every 3 pages). On average, each participant provided 18.5reports (SD=13.5)As shown in Fig.2, the number of reports was quite variable across participants, which makes person-independent mind wandering detection quite challenging. Participants reported mind wandering an average of 16seconds into the page. Accordingly, we extracted video clips in 10s windows leading up to each mind wandering report; these corresponded to positive instances of mind wandering. We used 10s as a compromise between having longer, potentially more informative clips, while maximizing the number of clips that could be extracted. Of the 2,577 clips, 1,339 clips over lapped across pages and were discarded because of the concern that the action of leaning forward and looking at the keyboard to find the page-turn key might have influenced facial feature tracking. We also added a 4s buffer before the mind wandering report to ensure that clips did not capture the movements associated with the self-report keypress.

We chose a 4s buffer length based on a pilot study where four raters made judgments on whether the keypress was visible in 540 randomly-selected video clips with buffer lengths ranging from 0-6s. Raters were instructed to report "if there is apparent hand or eye movement at the end of the clip as participants look and reach for the MW key." Two raters initially coded 250clips with 0s-4s buffers.They reported apparenth and movements in73%of clips with a 0s buffer.(eye movements in 93%), down to 4% hand movements and 5% eye movements for 4s clips. We increased the buffer lengths to 5s and 6s, and obtained ratings from the same raters and two new raters, finding no further de- crease in apparent hand or eye movements with longer buffers. Thus, we proceeded with a 4s buffer length. A further 207clips were removed because the face could not be automatically detected for at least 1 second of the clip, which was our minimum threshold for usable data. A real-time application of our methods could also discard such clips, so removing them does not harm validity. In total, there were thus 1,031 usable mind wandering clips of which 64% were task-unrelated mind wandering reports. These served as positive instances for the classifiers. Negative instances were extracted from periods of time between mind wandering reports(seeFig.3).We divided each video into 14s instances (10s window of data + 4s off- set to avoid including page turn movements) and removed any instances that coincided with page turn events. We also removed any negative mind wandering instances that fell within a 30s period before each mind wandering re- port, because the participant might have been mind wandering but had not yet realized or report edit. The duration of mind wandering is an open question, but is hypothesized to not exceed 20s ; the 30s buffer was taken out of an abundance of caution. We randomly selected 2,406 negative mind wandering instances from there maining instances to obtain a 30% mind wandering rate, which is consistent with previous research on the incidence of mind wandering during learning, especially during reading(see meta-analysis). The dataset comprised a total of 3,437 instances (1,031 positive mind wandering).

2.1.4 FEATUREEXTRACTION

There are two level of features extraction upper body movement features and head pose features .

2.1.4.1 Upper body movement features :

Silhouetting method is used feature extraction Each video frame is compared to continously updated background image frame weighted average of previous four frames. We used a validated motion silhouetting method [63], where each video frame is compared to a continuously updated background image formed by the weighted average of the previous four frames. Gross body movement was estimated as the pro- portion of pixels that changed compared to the back- ground motion silhouette .This movement estimation method also serves as an accurate proxy for pressure-sensitive posture sensors [63]. We extracted the following statistical features from the body movement time series in each 10s clip: mean, median, standard deviation, minimum, maximum, and range.

Fig2.2 Upper body movement

2.1.4.2 Head pose features:

specifically extracted head yaw (looking to the side) pitch (looking up or down) , and roll(tilting to the side).We utilized head pose features as a proxy for gaze direction, motivated by the link between eye gaze and mind wandering, summarizing each with mean, median, standard deviation, mini- mum, maximum, and range across the 10s clips yielding18 head pose features in total.

fig2.3 Headposefeatures

2.2 STUDY 2 PROBE CAUGHT MIND WANDERING DETECTION WITH AN INTELLIGENT TUTORING SYSTEM IN THE CLASSROOM

2.2.1 FLOW CHART

Guru tutor

↓

Data collection

↓

Automatic Mindwandering Detection

Fig 2.4 flow chart

2.2.2 GURU TUTOR

Is an intelligent tutoring system .Designed to teach some specific topics .It engages students in one on one collaborative conservation in natural language. Guru utilizes an animated pedagogical agent that references a multimedia workspace. Tutor uses synthesized speech and gestures. Students communicated by typing here response.

2.2.3 DATA COLLECTION

A probe caught method is used. The thought probe occurred pseudo randomly every 90-120 sec. The probe automatically paused the tutoring session. The tutor was speaking at the time the probe was to be triggered, the probe was delayed until the tutor finished speaking.

Fig2.5Classroom layout

2.2.4 AUTOMATIC MINDWANDERING DETECTION

2.2.4.1 Real–time feature extraction:

Due to privacy considerations, videos of students could not be recorded for later feature extraction and analysis .Due to privacy considerations, videos of students could not be recorded for later feature extraction and analysis. Therefore, features were extracted in real-time. We could not extract features with emotient SDK, as we did in the lab study, due to licensing constraints. Instead, we extracted AUs and head pose with Open Face. The feature extraction frame rate was variable because of external computational resource demands (e.g., system processes) and varying demands of the feature extraction process itself (e.g., when face tracking is lost the entire image must be searched to rediscover the face–a computationally expensive process). For this reason, frame rate was also relatively low (mean = 4.6 frames per second) compared to the lab study (exactly 12.5framespersecond). Additionally, temporal filter features could not be extracted from AU estimates because of the variable timing and sparsity of frames. Body motion and LBP features were also not extracted since they add additional computational complexity. Thus, we extracted head pose and AU features real-time, and calculated AU co-occurrence features (JSD features) offline.

2.2.4.2 Instance extraction :

Extract 2888 instances each 10sec long , from the 125 students. We discarded 502 instances because they contained fewer than 5 frames of data (ap-proximately 1s), leaving 2,386 instances (25.9% positive mind wanderinginstances,62.5% of which were uninte national).

2.2.4.3 Supervised Classification: As in the lab study, we trained SVM and DNN classifiers for the individual channels (Basic AUs, Co-occurring AUs, and Head Pose only) using the exact same cross-validation, feature selection, instance weighting, and hyper parameter tuning procedures from Study1.Weals of trained similar feature-level fusion, decision-level fusion (CART).

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CHAPTER 3

ADVANTAGES, DISADVANTAGES

This technology offer good performance.

3.1 ADVANTAGES

- Avoid depression and stress
- Mitigate anxiety

3.2 DISADVANTAGES

- Negatively impact reading comprehension
- Impair the ability to with hold automatised responses
- Disrupt performance on tests of working memory and intelligence

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CHAPTER 4

CONCLUSION

Automatic mind wandering detection is a challenging problem,especially given the prototypical mind wandering facial expressions. Upper body movement is detected, facial feature is detected. The mind wandering detection approach reported here represent the first automatic face-based mind wandering detection in a laboratory and in a classroom. The results we presented indicate that mind wandering can be detected at levels above chance though far from perfectly. Additionally, the features that could be extracted in the classroom environment were limited by the processing power of the computers available. While this is a realistic constraint that must be dealt with, future work with in- creased processing power for real-time feature extraction will be necessary for determining performance.

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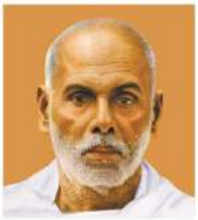

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CERTIFICATE

*This is to certify that the report entitled **"FUZZY LOGIC CONTROL FOR SOLAR PV FED MODULAR MULTILEVEL INVERTER TOWARDS MARINE WATER PUMPING APPLICATIONS"** is a bonafide record of the seminar presented by **Mr. VAISHNAV T V** (Roll No .SNC19EE003), in partial fulfillment of the requirements for the award of Degree of Bachelor of Technology in Electrical & Electronics Engineering of the APJ ABDUL KALAM TECHNOLOGICAL University.*

15/12/2022

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Vaishnav T V

15th December 2022

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ABSTRACT

This presents the design and implementation of Modular Multilevel Inverter (MMI) to control the Induction Motor (IM) drive using intelligent techniques towards marine water pumping applications. The proposed inverter is of eleven levels and has the ability to control the speed of an IM drive which is fed from solar photovoltaics. It is estimated that the energy consumed by pumping schemes in an onboard ship is nearly 50% of the total energy. Considering this fact, this paper investigates and validates the proposed control design with reduced complexity intended for marine water pumping system employing an induction motor (IM) drive and MMI. The analysis of inverter is carried out with Proportional-Integral (PI) and Fuzzy Logic (FL) based controllers for improving the performance. A comparative analysis has been made with respect to better robustness in terms of peak overshoot, settling time of the controller and Total Harmonic Distortion (THD) of the inverter. Simulations are undertaken in MATLAB/Simulink and the detailed experimental implementation is conducted with Field Programmable Gate Array (FPGA). The results thus obtained are utilized to analyze the controller performance, improved inverter output voltage, reliable induction motor speed control and power quality improvement by reduction of harmonics. The novelty of the proposed control scheme is the design and integration of MMI, IM drive and intelligent controller exclusively for marine water pumping applications.

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CHAPTER 1 **INTRODUCTION**

In general modular multilevel inverters are use for marine water pumping applications. These systems are normally fed by conventional energy sources like diesel etc. According to International Convention for the Prevention of Pollution from Ships Organization (MARPOL), marine shipping diesel engines emit 2.8% of Carbon Di Oxide,15% of Nitrogen Oxides,13% of Sulphur Oxides which are the most significant gases involved to pollute the atmosphere.

1.1 INTRODUCTION

In the proposed system the Modular Multilevel Inverter is fed by Solar Photovoltaic source promoting the use of renewable energy sources.In order to reduce the complexity of the system Fuzzy Logic Control is used making it more reliable and user friendly. Fuzzy Logic Control seeks to deal with complexity by creating heuristics of problems. It provides a way of dealing with imprecision and non linearity in complex control situations.

CHAPTER 2 **PROPOSED SYSTEM**

In the proposed system Fuzzy Logic Control is used for Solar PV Fed Modular Multilevel Inverter towards Marine Water Pumping Applications.

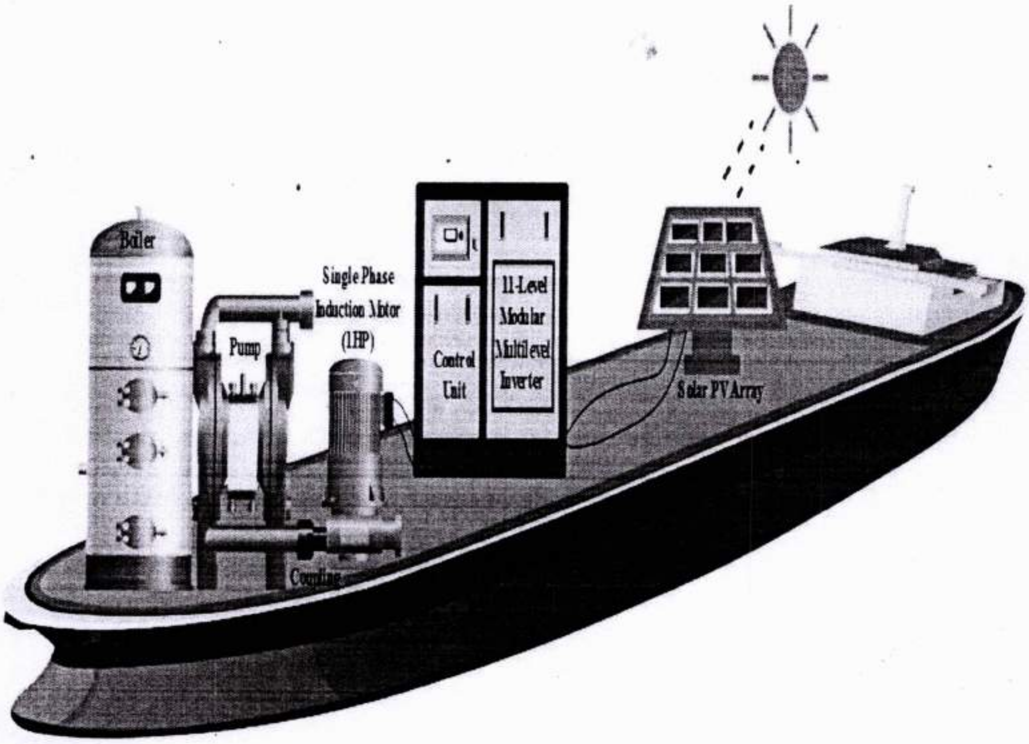

FIGURE 1. Schematic diagram of the Proposed 11-Level Inverter

CHAPTER 3 **DESCRIPTION OF PROPOSED SYSTEM**

3.1 SYSTEM CONFIGURATION AND OPERATION No table of figures entries found.

The PV array with a maximum power capacity of 150W at Standard Test Conditions (STC) (1000W/m², 25°C) is considered in accordance with the rating of IM drive coupled water pump. The operating power capacity of the PV array is selected such that it can run the motor pump system with aid of modular multilevel inverter [11], [12].

A. PV ARRAY DESIGN

A 10W solar PV module is made up of 36 cells (36 cells x 0.588 V = 21.6 V_{oc}) connected in series. The specifications are: Maximum power (P_{max}) = 10W_p, V_{oc} = 21.6V and I_{sc} = 0.659 A. The maximum voltage and current of a module is

V_{mp} = 17V and I_{mp} = 0.588A ($P_{max} = V_{mp} \times I_{mp} = 17 \times$
$0.588 = 9.96$W).

A 20W solar module with 72 cells associated in series is utilized as an input source. The specifications are: Maximum power (P_{max}) = 20W_p, V_{oc} = 21.5V and I_{sc} = 1.24 A. The maximum voltage and current ratings of a module at V_{mp} =
17.5V and I_{mp} =1.143A ($P_{max} = V_{mp} \times I_{mp} = 17 \times 1.14 =$
19.38W).

The two different ratings of 10W and 20W cited above are connected in series and parallel to achieve the maximum power capacity of 150 W (5 × 10 = 50W, 5 × 20 = 100W) at STC.

The current equation of solar cell given in equation (1) has four indefinite constraints (I_L, I_0, R_s and α) that has to be dogged before attaining the V-I characteristics of the PV cell.

$$I = I_L - I_D = I_L - I_0 e^{\left(\frac{V + iR_s}{\alpha}\right)} - 1$$

3.1.1 DC-DC CONVERTER DESIGN

An intermediate DC-DC converter in the solar photovoltaic conversion system is set to operate at maximum power for providing symmetric input to MMI. Equation (8) shows the relationship between input voltage and output voltage of DC-DC boost up converter with respect to duty cycle.

$$V_{out} = \frac{V_{in}}{1 - D} \tag{8}$$

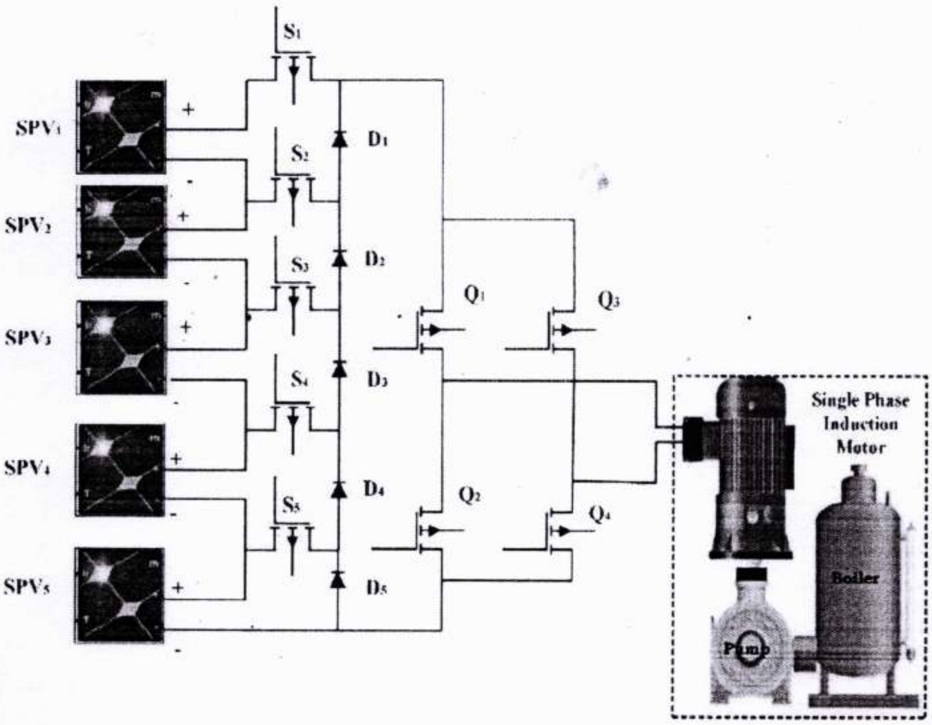

FIGURE 2. Proposed Multilevel Inverter.

3.1.2 DESIGN OF AN INDUCTOR (L)

The following steps given from Equations (9)-(10) illustrate the design of an Inductor required for the system.

$$L_1 = \frac{V_{in} * (V_{out} - V_{in})}{1I_L * f_s * V_{out}} \quad (9)$$

$$1I_L = (2o/o - 4o/o) * I_{out(max)} * \frac{V_{out}}{V_{in}} \quad (10)$$

$$\Delta I_L = (0.03) * 5 * \frac{24}{12} = 0.3$$

$$L_{b1} = \frac{12 * (24 - 12)}{0.3 * 3 \times 10^3 * 24} = 0.65$$

3.1.3 DESIGN OF CAPACITOR

The following steps given from Equations (11)-(12) illustrate the design of a Capacitor required for the system.

$$C_1 = \frac{I_{(out)} * D}{f_s * 1V_{out}} \quad (11)$$

$$1V_L = (2o/o - 4o/o) * V_{out(max)} * \frac{I_{out}}{I_{in}} \quad (12)$$

$$\Delta V_L = (0.03) * 24 * \frac{5}{10} = 0.36$$

$$D = \frac{V_{out}}{V_{in} + V_{out}} = \frac{12}{36} = 0.67$$

$V_{out(max)}$ is the maximum voltage delivered by the PV module under STC

3.1.4 MULTILEVEL INVERTER DESIGN

The voltage separator at the input end is composed of five numbers of series connected solar PV modules denoted with SPV_1, SPV_2, SPV_3, SPV_4, and SPV_5 as shown in Figure 2. The input voltage thus separated is then transmitted to the route comprises of semiconductor devices (both controlled and uncontrolled in nature) denoted as S_1, S_2, S_3, S_4, S_5, D_1, D_2, D_3, D_4, and D_5 and finally leads to a H-bridge (Q_1, Q_2, Q_3, and Q_4). Equations (13) and (14) point outs that the symmetrical modular multilevel topology significantly increases the number of output voltage levels [15].

$$N_{level} = 2S + 1 \qquad (13)$$

$$N_{IGBT} = S + 4 \qquad (14)$$

3.1.4.1 WATER PUMP DESIGN

The water pumping system comprises of IM drive along with centrifugal pump which is used for marine applications. Pump affinity law is considered as a reference for the design of centrifugal pump. In accordance to it, the load torque is directly proportional to the speed square as given in (15).

$$T_L = K_p \times \omega_{r2}$$

$$K_p = \frac{9.94}{(2 \times \pi \times 24)^2} = 0.00043712 \mathrm{Nm/(rad/\ sec)^2}$$

3.2 CONTROL TOPOLOGY FOR MMI

The structure of the solar PV fed IM drive for marine water pumping system employing an MMI is shown in Figure 3. The proposed topology is to control the MMI using the PI and FL based controllers. The switching schemes of an inverter are governed by PWM with aid of intelligent control techniquestooperatemultilevelinverterandcontrolthespeed of an induction motor.

The v/f control scheme is employed by varying the voltage, frequency along with the reference in Alternate Phase Opposition Disposition (APOD) under the category of multicarrier PWM methods. The five different triangular carrier waveforms (each out phase of 180^0) are compared with the one sinusoidal reference waveform to generate the required PWM pulses as shown in Figure 4.

The logic control and rule based techniques for both the controllers intend to generate the modulating signal which is then compared with the carrier to generate the dynamic pulses required for the inverter switches [16], [17]. The performance of IM with PI and Fuzzy controllers at constant and variable loads in open loop and closed loop operation are analyzed.

The following sections describe the design and imple-
mentation of PI and FL based controllers in improving the performance of an IM drive operating along with MMI.

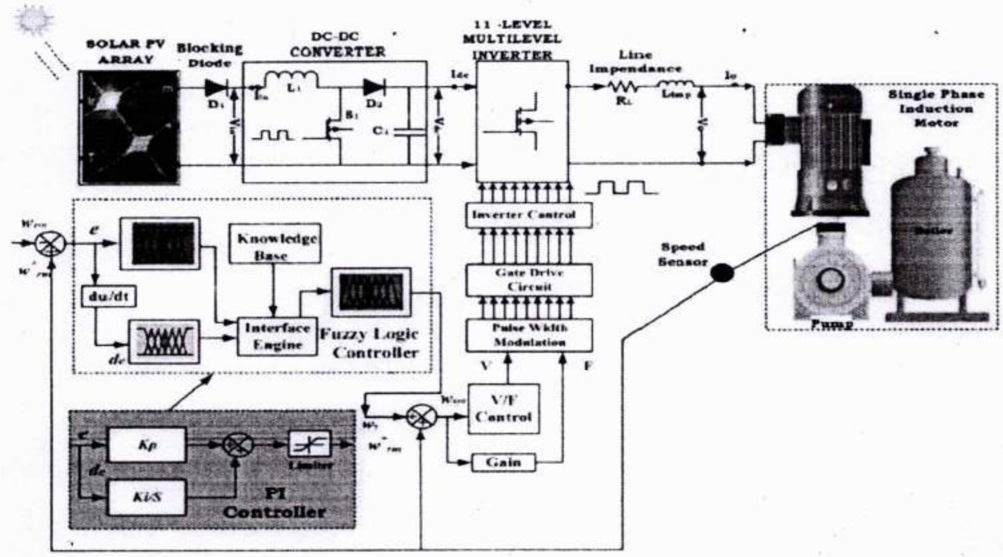

FIGURE 3. Control Topology

3.2.1 PI CONTROLLER BASED SPEED CONTROL

The PI based controller is generally implemented with any of the three different methods such as trial and error, evolutionary techniques based searching, Cohen Coon, Lambda tuning and Ziegler Nichols. In comparison of various methods for PI controller tuning, trial and error method is nominated due to its several benefits in detecting the gain parameters and better performance in motor drive applications.

Typically, the comparator compares the actual (ω_{rm}) and reference ($\omega_{rm}*$) speed and the error ($\omega_{e(n)}$) thus obtained is used for tuning the parameters K_p and K_i. The error equation

($\omega_{e(n)}$).is given by,

$$\omega_{e(n)} = \omega_{rm} - \omega_{rm}*$$

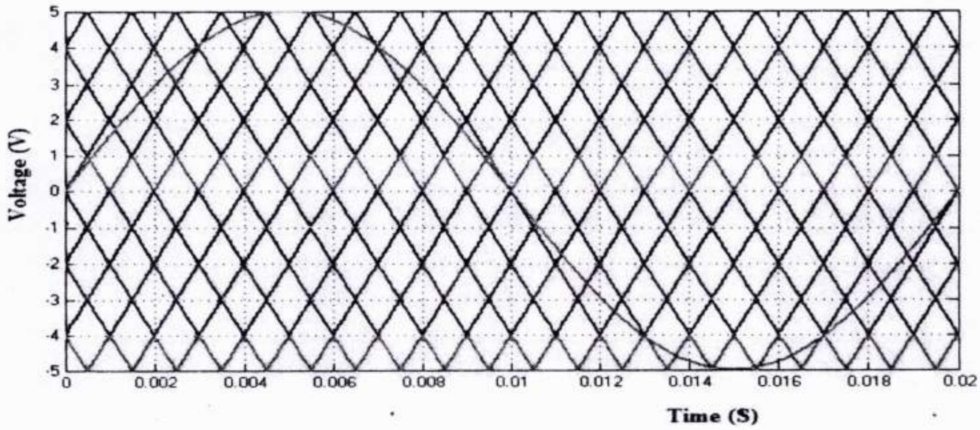

FIGURE 4. APOD Control Signal

$$1\omega_{e(n)} = \omega * e_{-\omega_{re(n-1)}}$$

The trial and error method mainly focused on two essential parameters in calculating the proportional and integral gain for motor drive applications. The numerical value of K_p and K_i attained from trial error method are 50 and 2, respectively. The objective of the PI controller is to minimize the error to enhance the driving performance.

The. objective of the closed loop PI controller has the superior performance while controlling the speed of an induction motor at constant torque. The proposed inverter (S_1, S_2, S_3, S_4, and S_5) and (Q_1, Q_2, Q_3, and Q_4) switches are controlled bythev/fmethod.TheswitchesS$_1$ toS$_5$ controlsandoperates the inverter while the other switches Q_1 to Q_4 convert the polarity changes of the inverter. The output of the inverter with constant v/f is fed into IM drive.

The open and closed control operation with PI controller has some limitations such as the rotor speed is slightly modified which is less than synchronous speed, stator current exceedstheratedcurrentandslipspeedcannotbemaintained. These drawbacks of a PI controller mainly occur with fluctuating operative conditions. This limitation of the PI controller is overcome by FLC.

3.2.2 FUZZY LOGIC CONTROLLER

Fuzzy logic controller is a most efficient tool which is used to enhance the electrical apparatus through its fastness to evaluate the speed controller incorporating human thinking and rule based protocols. Generally, three methods are available for the control of induction motors namely, (1) voltage/ frequency method, (2) flux control Method and (3) Vector control method. In comparison with the speed control methods, closed loop v/f control method is characterized as best due to its simplicity and good accuracy.

The proposed FL controller is intended to solve the two important main tasks: (1) estimating induction motor speed and (2) reducing error in speed using the rules based system and also deteriorating the harmonics.

The FL controller is designed with two inputs and one output. The error and change in error speed are considered as input and the modulating signal is taken as the output. FL controller mainly follows the four necessary steps; such as:

(1) Analog fuzzifier converts input into fuzzy variables
(2) Stores fuzzy rules
(3) Inference and associated rules
(4) Defuzzifier converts the fuzzy variables into actual target

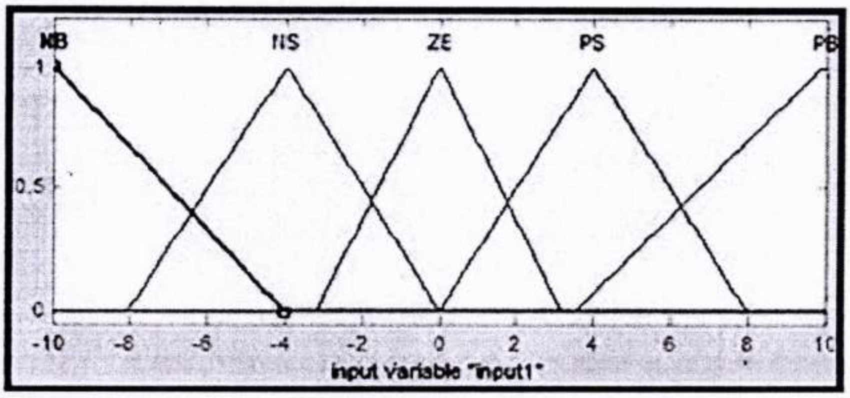

FIGURE 5. Allocation of Range for Subsets

TABLE 1. Fuzzy Rules.

e/cè	NB	NS	ZE	PS	PB
NB	ZE	NS	NB	NB	NB
NS	ZE	NS	NB	NS	NB
ZE	PB	PS	ZE	NS	NB
PS	PB	PS	PS	ZE	NS
PB	PB	PB	PB	PS	ZE

The input to the fuzzy operator has two or more relationship values from fuzzifier input variables. The output is a single truth value. If input 1 is declared to indicate the error means it while the input 2 indicates the changing error. The linguistic variables contain eight fuzzy subsets in which five subsets are used which are described as follows:

(1) Negative error speed Big (NB)
(2) Negative error speed Small (NS)
(3) Positive error speed Small (PS)
(4) Positive error speed Big (PB) and
(5) Zero error speed (ZE)

If suppose the output is NS, it values up to 0.3416 such that the entire rule based membership functions work along with it. The output of the NB is 0.1, PB is 1, PS is 0.66 and ZE is 0.5 as illustrated in Figure 5. The input linguistic values range are NB =-1600, -10, -4, NS =-8.06, -3.96, 0.02646, ZE =-3.2, 0, 3.2, PS = 0, 4, 8 and PB = 3.52, 9.92,1550. Table 1 shows the rule matrix based the logic to control the speed.

The 11 level MMI has 9 semiconductor switches (S_1-S_5) switches which are connected in parallel to (Q_1-Q_4) H bridge switches. The bipolar triangular and sine wave is compared to generate the PWM based upon the fuzzy rules. The pulses for S_1 –S_5 are inverter control pulses and Q_1 to Q_4 are level control pulses.

FLC structure is fully designed by switching pattern of the inverter using switching pulse generator as shown in Figure 6. The input fuzzification membership is designed (IN_1-IN_6)

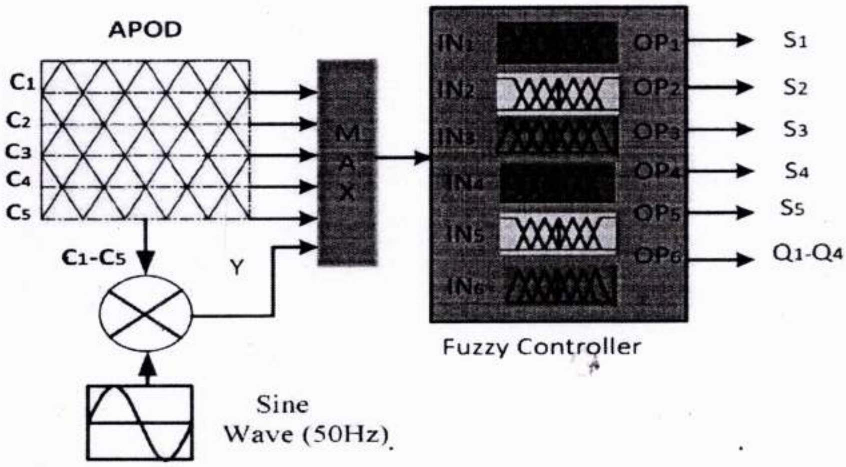

FIGURE 6. FL Controller Switching Pulse Generation Structure.

with switching magnitude range of (−1, 0, 1). Positive range from 0 to 1 represents the first quarter cycle (0°-90°) and second quarter cycle (90°-180°) respectively. Similarly, the negative range from −1 to 0 represents the third quarter cycle (180°-270°) and fourth quarter cycle (270°-360°). Later, in defuzzification, six membership functions are developed based on fuzzy rules to obtain the desired output.

The paper illustrates the design and development of two controllers for water pumping application. The voltage and frequency are used to control the inverter. The speed of induction motor is controlled by v/f method.

CHAPTER 4 SIMULATION AND ITS ANALYSIS

The simulation model is developed in MATLAB/Simulink 2013 to perform the performance comparison between PI and FL based controllers. The analysis for harmonics reduction under open and closed loop operation is also undertaken.

4.1 SPEED TRACKING PERFORMANCE AND HARMONICS ANALYSIS OF INVERTER

The IM drive connected with the pump is desired to reach the speed from 0 to 1000 rpm. To reach the desired speed, the parameters such as overshoot, undershoot and steady-state error are higher in PI when compared to FLC. Both controllers are examined at the reference speed of 1000 rpm.

It is noted that FLC based IM drive system reaches the desired speed with the minimum time period.

The simulation result with PI controller is shown in Figure 7 point outs the motor starting at 0s and the motor speed is settled nearly 2 sec with the set speed of 1000 rpm. Using the FL controller, motor starts at 0s and settles at 0.5sec as shown in Figure 8.

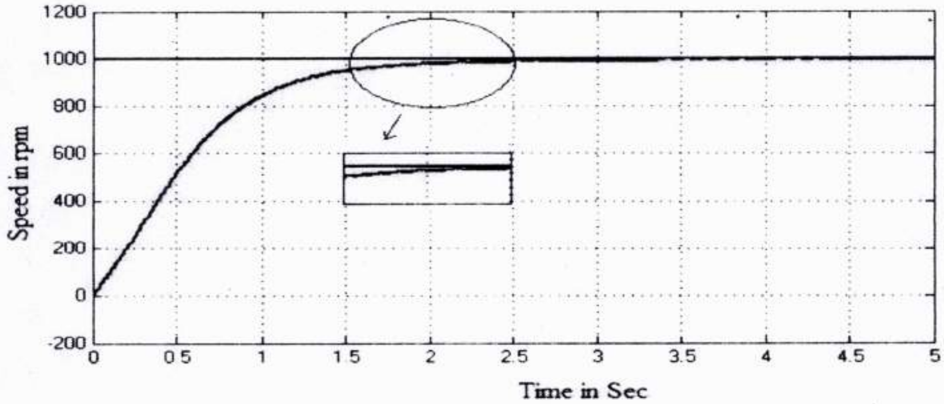

FIGURE 7. Speed Response of PI Controller at 1000 rpm.

The simulation result with PI controller is shown in Figure 7 point outs the motor starting at 0s and the motor speed is settled nearly 2 sec with the set speed of 1000 rpm. Using the FL controller, motor starts at 0s and settles at 0.5sec as shown in Figure 8.

The results are compared with respect to optimal gains, and faster setting time. By analyzing the power quality, the Total Harmonic Distortion (THD) with PI controller is 10.44% and with FL controller is 5.67% as shown in Figures 9 and 10 respectively. The FLC for motor fed MMI provides a good

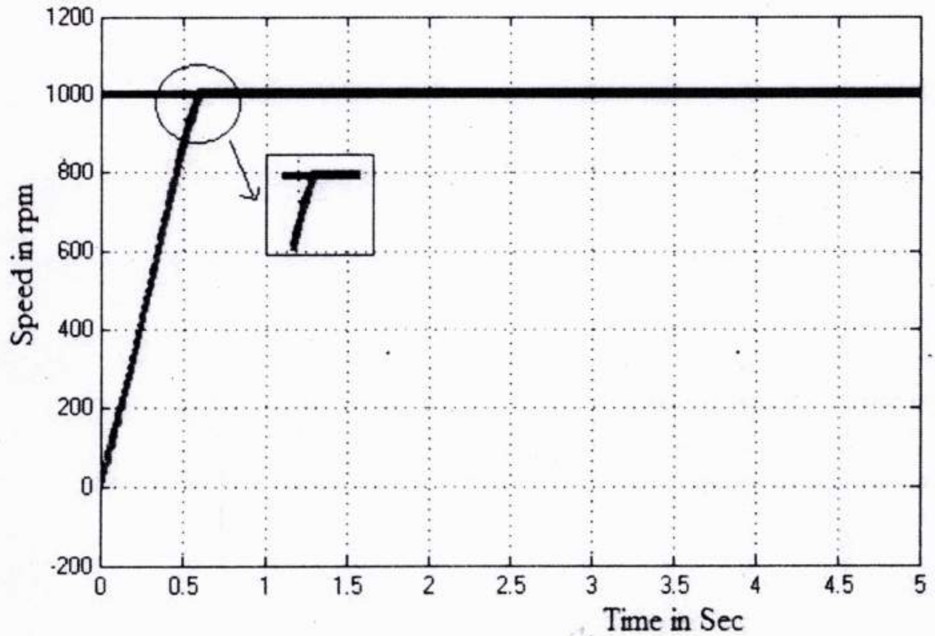

FIGURE 8. Speed Response of FLC at 1000 rpm.

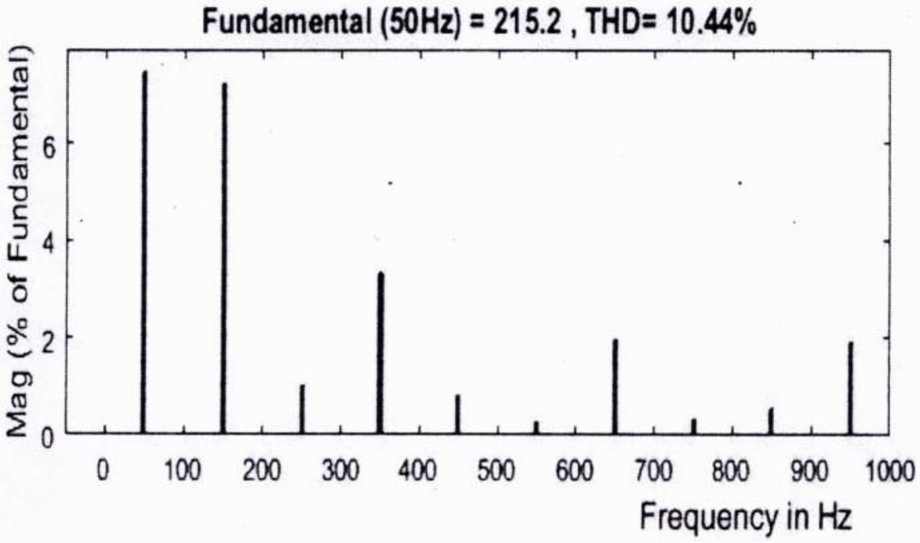

FIGURE 9. Harmonic analysis with PI Controller.

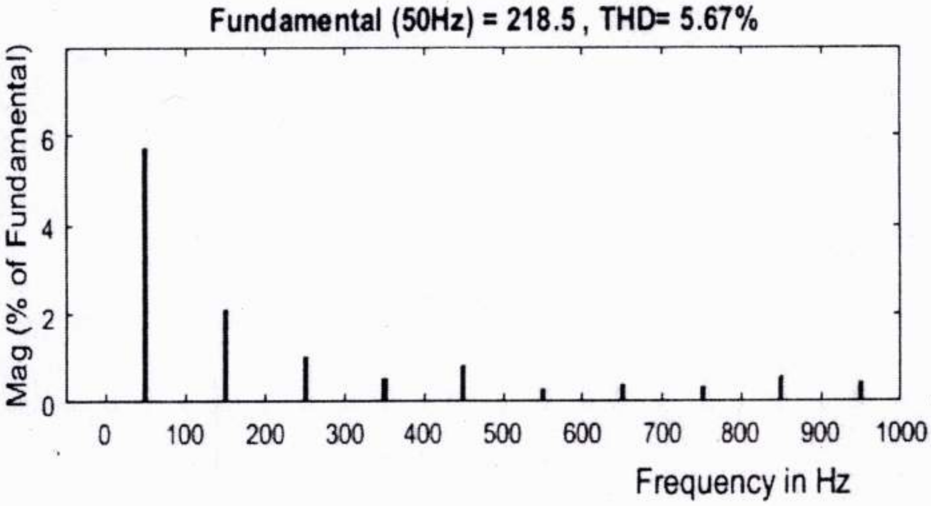

FIGURE 10. Harmonic Analysis with FL controller.

response under the tracking of speed reference and also lower THD. The output voltage of inverter an 11 level inverter is shown in Figure 11. The proposed IM drive is integrated with the water pump system for the marine application.

4.2 EXPERIMENTAL ANALYSIS

The experimental setup consists of the solar PV array connected with the modular multilevel inverter with rated power. The 150W solar PV module specifications are given in Table 2. The entire hardware setup is shown in figure 12 along with the entire components involved and its associated output voltage waveform of improved power quality.

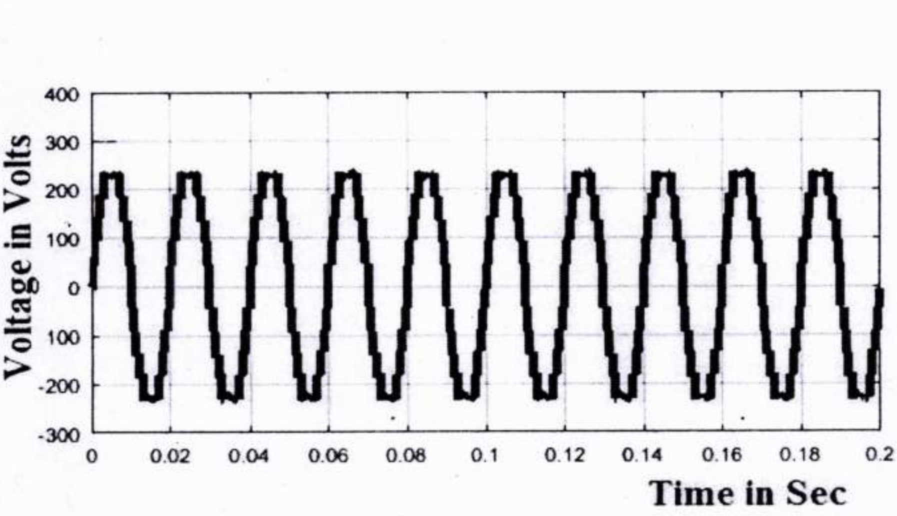

FIGURE 11. Output Voltage Waveform of a 11-Level Inverter

TABLE 2. Hardware Specifications for Solar PV

Module specification	$10W_p$	$20W_p$
Maximum Power (P_{max})	10W	20W
Solar PV Open circuit Voltage (V_{oc})	21.6V	21.5A
Solar PV short circuit current (I_{sc})	0.659A	1.24V
Solar PV voltage at MPP (V_{mp})	17V	17.5V
Solar PV current at MPP (I_{mp})	0.588A	1.143A
Maximum reverse current	1A	1A

The proposed inverter has been evaluated by practical implementation in real time control using FPGA Spartan - 6 controllers considering the motor of 1.1 kW rating. The IM is fed by MMI using nine MOSFETs switch with gate drive board as shown in Figure 12.

The motor currents are measured using the speed sensor and feedback is sent to the controllers which produces the PWM pulse to operate inverter. The performances of PI and FL controllers are tested and the results are compared for both simulation and experimental setup. The results ensured that the FL controller shows the fast settling time compared with PI controller. The two controllers are tested for the speed variations from 0-1000 rpm. The PI controller shows the settling time at 0.2 sec while FL controller settles at 0.09 sec as exposed in Figure 13.

The induction motor coupled with the pump is used for marine application of seawater pumping to ship usage and clean the water every day at an average of around 50 liters used for various purposes. The main work of the pump is to suck the water from the sea. This process can be done by both open and closed loop system [22]–[30]. The developed system also reduces the THD as illustrated in Figures 14 and 15. The corresponding inverter output voltage is depicted in Figures 16.
The VHDL coding for synthesized devices of SPARTAN3E500 FPGA at 50MHz is performing a major role in Xilinx project navigator [23].

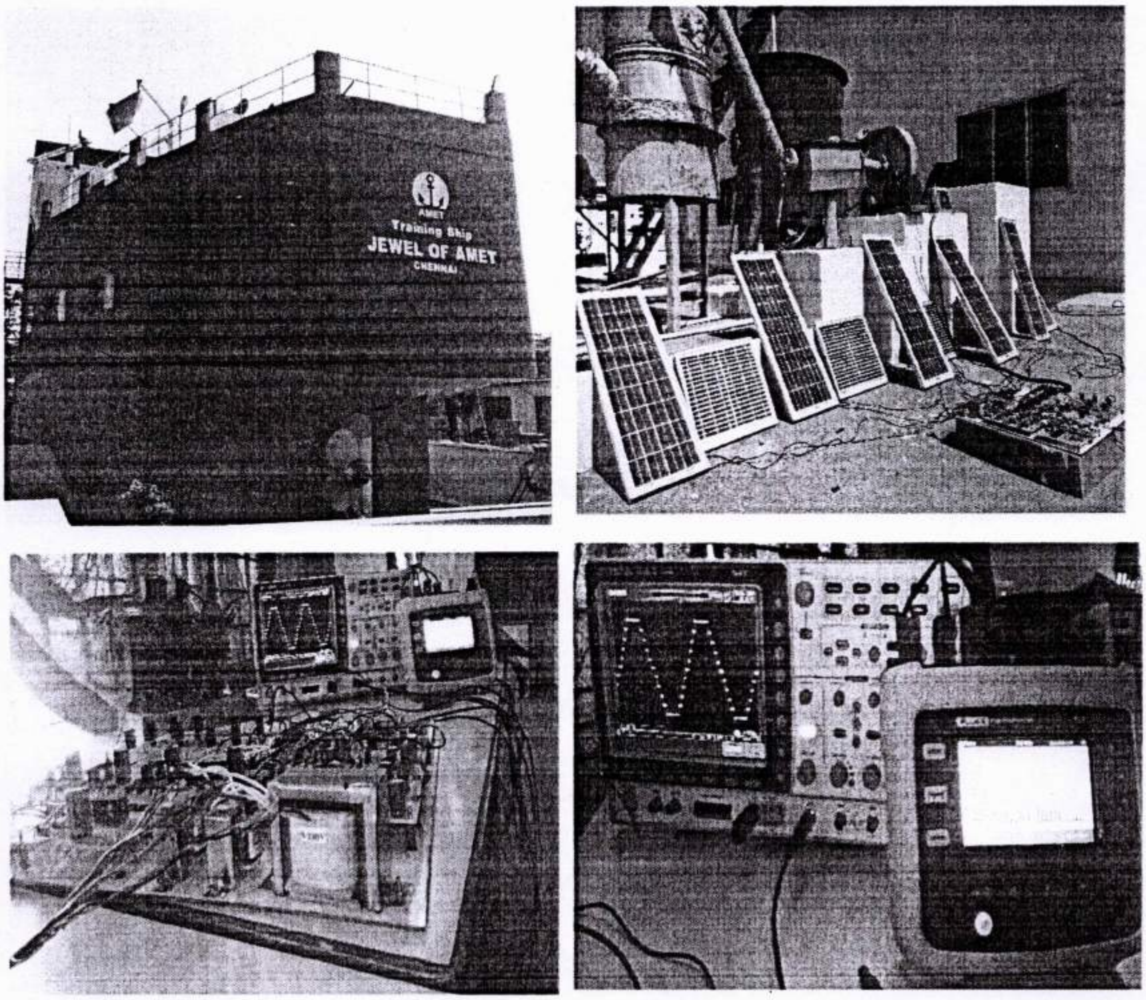

FIGURE 12. Experimental Setup.

The FPGA is mainly focused on three important parameters, such as: (1) to reduce the size of the program area of the controller (2) to increase the speed of the controller and (3) to reduce the power dissipation.

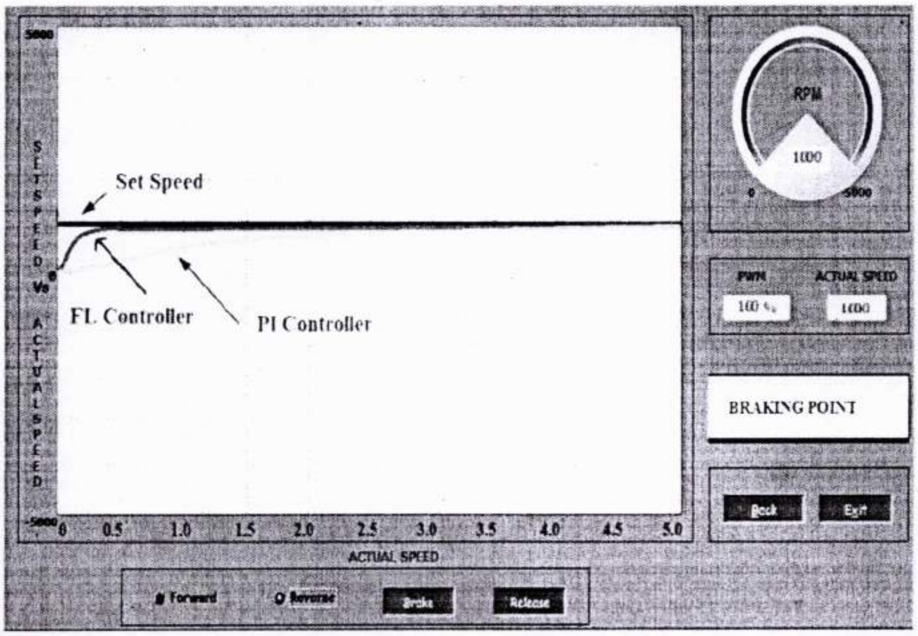

FIGURE 13. Speed Response with PI-FL based Controllers

The hardware description design and functionality tool of Modelsim6.3f is used as shown in Figure 17. A 17.50Hz clock divider. 2.4 kHz frequency is used to generate the PWM pulses for the switches Q_1 - Q_4 and Q_2 - Q_3.

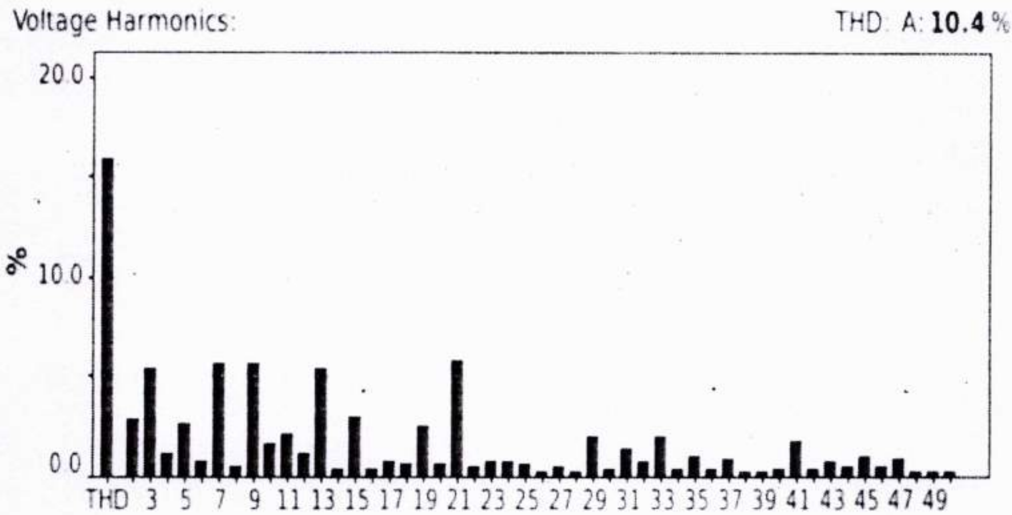

FIGURE 14. Harmonic Analysis with PI Controller.

The five different triangular carriers (C_1-C_5) are compared with the sinusoidal wave at 50Hz fundamental frequency to generate the PWM pulses for S_1 to S_5 based on the switching pattern.

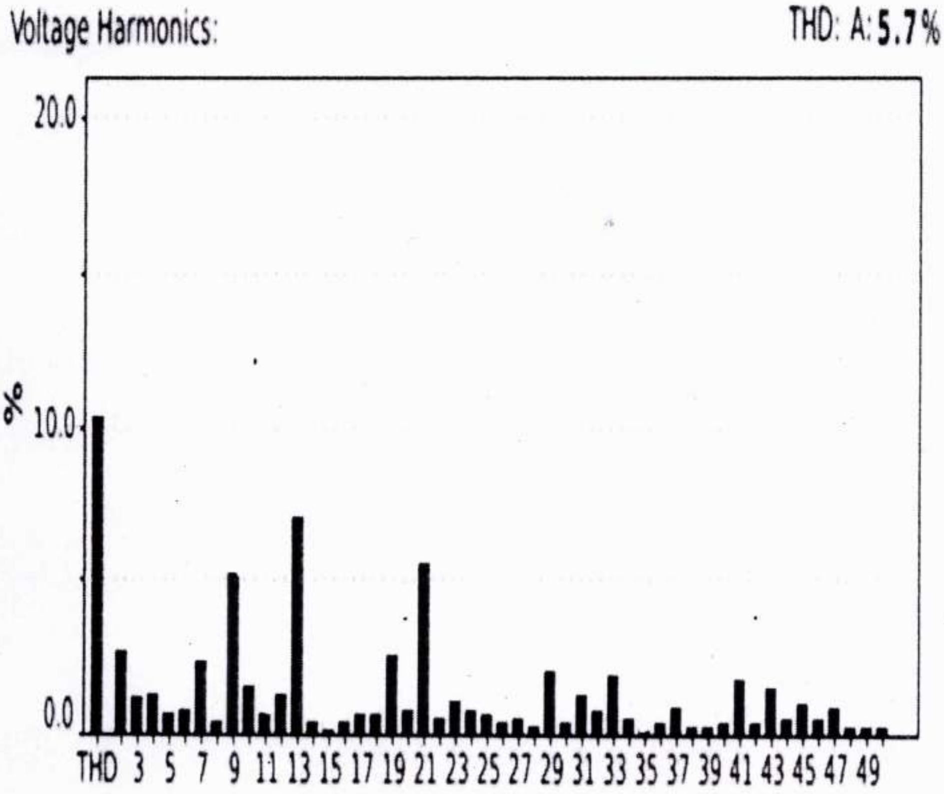

FIGURE 15. Harmonic Analysis with Fuzzy Controller.

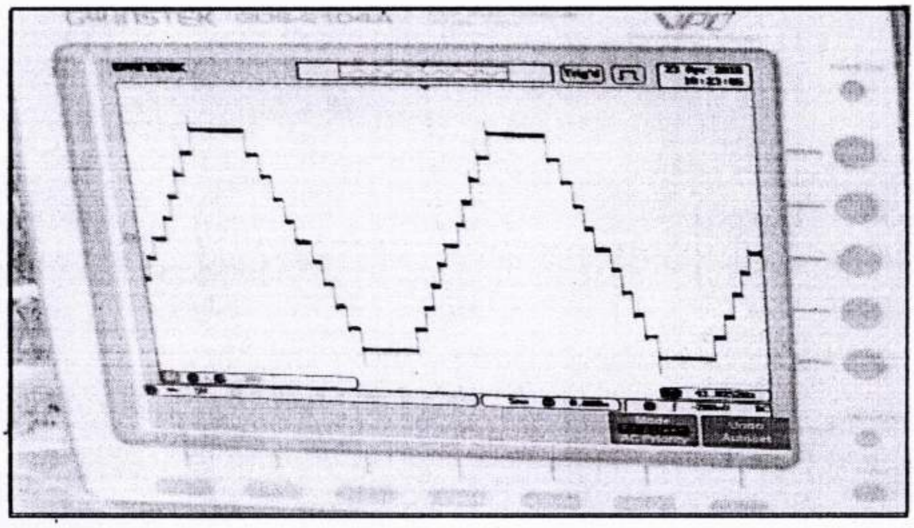

FIGURE 16. Output Voltage Waveform of MMI.

The main impact of the proposed control scheme is to reduce the steady-state error of the induction motor speed control and deteriorate harmonics at the output voltage of modular multilevel inverter.

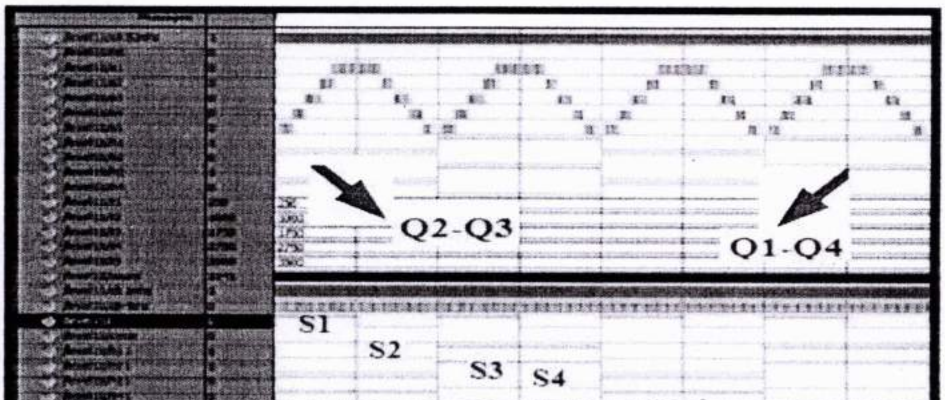

FIGURE 17. Model sim 6.3f based Switching Pulse for Inverter Switches.

CHAPTER 5 ADVANTAGES AND DISADVANTAGES

5.1 ADVANTAGES

It is a robust system where no precise inputs are required. These systems are able to accommodate several types of inputs including vague, distorted or imprecise data. The computational "thinking" of fuzzy resembles human thinking. Its structure is simple and justifiable. It does not require any strong information sources.

5.2 DISADVANTAGES

The rotor speed is slightly modified which is less than synchronous speed. Stator current exceeds the rated current and slip speed cannot be maintained. These drawbacks of a'PI controller mainly occur with fluctuating operative conditions. This limitation of the PI controller is overcome by FLC. They use rotation instead of suction to move water, and therefore have almost no suction power.

Reverse impeller rotation, vibration, pump seizure and leakage are also the disadvantage of centrifugal pumps. Centrifugal pumps develops a phenomenon called "cavitation". Cavitation is caused by insufficient water supply to the pump and resulting low pressure.

CHAPTER 6 FUTURE SCOPE

The Fuzzy logic is used in various fields such as automotive systems, domestic goods, environment control, etc. Some of the common applications are: It is used in the aerospace field for altitude control of spacecraft and satellite. This controls the speed and traffic in the automotive systems.

The Fuzzy Logic can be used in a variety of industries, including domestic goods, automotive systems, environment control, etc. Some of them are: It is used to control the altitude of aircraft, satellites, and spaceships Multilevel inverter is like an inverter and it is used for industrial applications as alternative in high power and medium voltage situations. The multilevel inverters produce common mode voltage and it reducing the stress of the motor and the motor will not get damage. As India is gradually increasing the use of solar and wind energy, the CEA stated that renewable energy generation might increase from 18% to 44% by 2029-30 in the country. In the future, India aims to portray a "green" environment with rooftop solar systems in all Indian households. t can harness up to 10-15% more power in comparison to a conventional layout on ground. Without power cut: Project can be very useful and can provide electricity without any power cut problem. Solar technology: Solar trees may build awareness and interest in solar technology and also provide shade and meeting places Photovoltaics (PV) and concentrating solar power are likely to continue to grow rapidly—the National Renewable Energy Laboratory (NREL) projects solar energy could provide 45% of the electricity in the United States by 2050 if the energy system is fully decarbonized—and technology costs are projected.

CHAPTER 7 CONCLUSIONS

The relevance of the proposed work is to provide high quality of input power to the inverter drive pertaining to marine water pumping applications. A solar PV fed MMI for speed control of induction motor drive has been examined at steady state and dynamic behaviors to investigate its suitability for water pumping system intended for the marine applications. The solar PV array is connected with the proposed inverter when is then fed to an induction motor. The motor speed is sensed and feedback is given to the controller for generating optimal PWM pulses for the inverter switches. The motor is started gradually and the speed is increased to achieve reference speed with aid of PI and FL based controllers.

Ref.No	Number of Sources	Number of Switches	Number of Level
18	3n+1	5n+6	6n+3
19	2n+2	4n+6	4n+3
20	4n+2	4n+6	8n+5
21	4n	12n	16n+1
Proposed	**n**	**n+4**	**2n+1**

TABLE 3. Comparative Analysis.

The performance of PI and FL controllers for a feasible operation is verified and results are compared in both simulation and experiment. The results ensure that the FL based controller provides fast settling time and reduced harmonics when compared with the PI controller. The main impact of the proposed control scheme is to reduce the steady-state error of the induction motor speed control and deteriorate harmonics at the output voltage of modular multilevel inverter.

On considering the number of components required for the proposed MMI, the Table 3 illustrates the comparative analysis on the number of semiconductor switches required for the design of MMI along with those inverters available in the literature.

The source, converter, load, controller and grid are the major components of a DC microgrid. A microgrid is normally referred as a stand alone autonomous system to generate power by the community and for the community regions. In the proposed system, the entire component cited for DC microgrid is present and performs its function effectively. The appropriate estimation of power generated and power used is the future scope.

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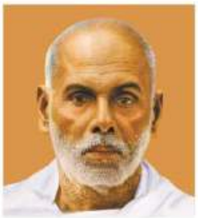

DEPARTMENT OF MECHANICAL ENGINEERING

"CAMLESS ENGINES"

SEMINAR REPORT

Report submitted in partial fulfillment of the Requirements for the Award of the Degree of

BACHELOR OF TECHNOLOGY

in

MECHANICAL ENGINEERING

Submitted By

ATHUL B : SNC19ME007

Under the guidance of

Mr. PRIYESH PADMANABHAN

DEPARTMENT OF MECHANICAL ENGINEERING

SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY

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CERTIFICATE

This is to certify that the Seminar report entitled **CAMLESS ENGINE** submitted by ATHUL B : SNC19ME007, in the partial fulfillment for the award of the Degree of Bachelor of Technology in Mechanical Engineering to **A P J ABDUL KALAM TECHNOLOGICAL UNIVERSITY**, KERALA, is a record of bonafied work carriedout under my guidance and supervision.

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ABSTRACT

IC Engines or an internal combustion engine which converts the heat energy in to the mechanical energy. The cam has been an main part of the Internal combustion engines. Motor engineers introduced "Camless engine" for better fuel economy, increased power, and less pollution. The article looks at the working of the electrohydraulic camless engine uses neither cams, nor springs, which reduces the height and weight of engine. The valves were opens and closes using hydraulic force. The potential energy of compressed fluid is converted in to kinetic energy of the valve during the valve opening. During the closing, the energy of the valve motion is returned to the fluid. Recuperation of kinetic energy is the key to the low energy consumption. The system offers a continuously variable and independent control of all parameters of the valve motion. This will allow the optimization of valve events for each conditions without compromises.

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CHAPTER 1

INTRODUCTION

The cam has been an important part of the internal combustion engines. Most piston type IC engines use mechanically driven camshafts for valve operations. Cams connected to camshaft which is operated by crankshaft. Cam push open valves at proper time and guide their closure. These mechanical valvetrains generally have fixed values of valve lift, time, duration. Engineers could not vary timing, lift and duration of valve opening infinitely. Fixed valve events compromises the engine power and fuel efficiency. Considering this compromise automobile companies developed numerous camshaft based variable valve mechanisms. But its effects were limited. In camless valve train, there is no camshaft or connecting mechanisms and the valve motion is controlled directly by valve actuators. An electro hydraulic camless valve train controls the opening and closure of the valves. The engines in today's vehicle, whether they burn gasoline or diesel fuel, rely on a system of valves to admit air and fuel in to the cylinder and let exhaust gases escape after the combustion. Rotating shaft and egg shapes cams are the brains of the system. They open and closes the valves through the arrangement of pushrods, rocker arms, springs.

CHAPTER 2
LITERATURE REVIEW

Gagandeep Singh Mavi, Dinesh Kumar [1]. Have done research on the topic "A Review Study on Working of Electrohydraulic Camless Engine". An experimental engine with an electrohydraulic camless valvetrain, capable of total valve motion control, was built at Ford Research Laboratory. The system uses neither cams, nor springs, which reduces the engine height and weight. Hydraulic force both opens and closes the valves

Zltina Dimitrova, Massinissa tari, Patrick Lanusse, Francois Aioun, Xaviour Moreau[2], have done research on the topic "improvement and control of a camless engine Valve train "and they shows an inventive utilization of an electromagnetic actuator for future camless engine valve train.

Zibani, R.marumo, J.chuma, I.Ngebani and K.Tsamaase [3], have studied on the title "Venturing Valve Actuator for a camless IC Engine" here they show it offers many advantages over poppet valve system, cylinder valve collaborations

CHAPTER 3
CAMLESS VALVETRAIN

3.1 OVERVIEW

The sensors, electronic control unit, and actuator are three crucial parts that the camless engine uses to do away with the cam, camshaft, and other linked systems. Five sensors are primarily utilised in relation to valve functioning. One each for an exhaust gas sensor, a valve position sensor, a current sensor, an engine speed sensor, and an engine load sensor. The electronic control unit will receive signals from the sensors. The microprocessor of the electronic control unit is outfitted with a software algorithm. Based on this algorithm, the microprocessor sends signals to the solid-state circuitry, which in turn controls the actuator to operate as needed. Electro hydraulic camless systems were initially developed as research instruments that could quickly simulate a broad range of cam profiles. For example, systems that precisely modulate the position of a hydraulic actuator to achieve a specific engine valve lift versus time characteristic can simulate the output of various camshafts. The issue of energy usage is frequently insignificant in these systems. The method discussed here was designed to be used in commercial engines. Therefore, it was crucial to reduce the amount of hydraulic energy used.

3.2 HYDRAULIC PENDULUM

Engine valve timing, lift, and velocity are continually changing under the direction of the electrohydraulic camless valvetrain (ECV). It doesn't utilise springs or cams. It takes use of the elastic properties of a compressed hydraulic fluid , which work as a liquid spring to accelerate and decelerate each engine valve as it opens and closes. This is how the hydraulic pendulum works. The hydraulic pendulum converts potential energy into kinetic energy, then back into potential energy with little energy loss, much like a mechanical pendulum does.

The fluid's potential energy is transformed into the valve's kinetic energy during acceleration. The energy of the valve action is transferred back into the fluid during deceleration. This occurs both when the valve opens and closes. Recovery of kinetic energy is the key to the low energy consumption of this system. A 16-valve 2.0 L engine is predicted to have an average hydraulic energy consumption of 125 W (50 mbar MEP) at light load, 1500 rpm, and an energy conversion efficiency of 80%.

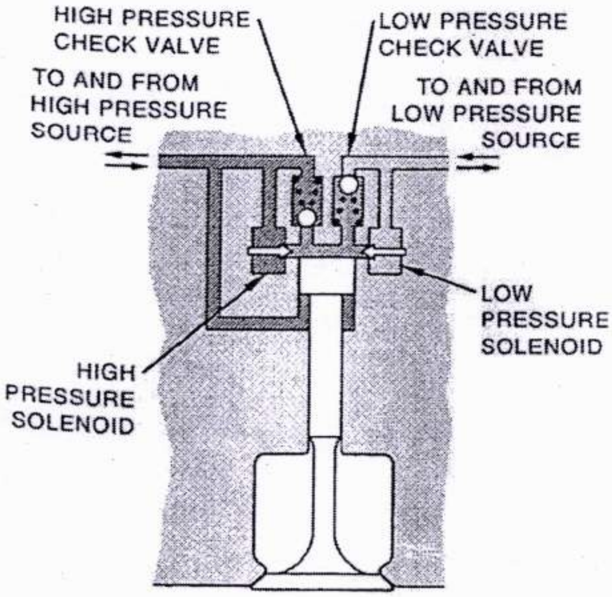

Fig 3.1 Hydraulic Pendulum

The idea of a hydraulic pendulum is shown in Figure 3.1. Both high- and low-pressure reservoirs are included in the system. The engine valve's top is secured with a tiny double-acting piston that rides in a sleeve. Either a high- or low-pressure source can be linked to the space above the piston. The area underneath the piston is always in contact with the high-pressure source. There is a substantial difference in size between the pressure areas above and below the piston.

A high-pressure solenoid valve that is open during engine valve acceleration and closed during engine valve deceleration controls the engine valve opening. A low-pressure solenoid valve's opening and shutting regulates the valve closure. Check valves for high and low pressures are also part of the system.

The high-pressure solenoid valve is open during valve opening, which accelerates the engine valve downward due to the net pressure force acting on the double-acting piston. The piston accelerates as the solenoid valve shuts, forcing the fluid from the lower volume back into the high-pressure reservoir as the pressure above the piston decreases. During deceleration, low-pressure fluid that passes through the low-pressure check valve fills the space above the piston. The check valve shuts when the engine valve stops moving downward, locking it in the open state.

In theory, the valve closing procedure is comparable to the valve opening process. The engine valve accelerates upward when the low-pressure solenoid valve opens, the pressure above the piston decreases to the level in the low pressure reservoir, and the net pressure force acting on the piston. As the piston slows down, fluid from the volume above it is forced through the high-pressure check valve and back into the high-pressure reservoir as the solenoid valve shuts, increasing the pressure above it.

The hydraulic pendulum is a mechanism without springs. The hydraulic pendulum system's hypothetical graphs of acceleration, velocity, and valve lift vs time are shown in Figure 3.2. The absence of springs allows the valve to move continuously accelerating and decelerating. Compared to systems that employ springs, this enables the needed valve motion to be performed with a significantly less net driving force. The benefit is further enhanced by the fact that the engine valve is the sole moving mechanical mass in the springless system. The opening and closing accelerations and decelerations must be identical in order to reduce the hydraulic pendulum's constant driving force (symmetric pendulum).

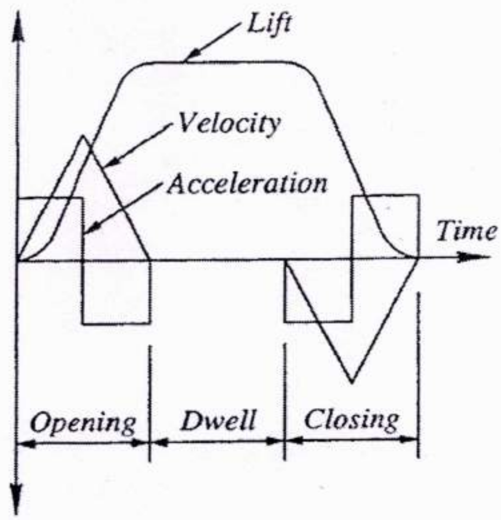

Fig 3.2 Dynamic characteristics of hydraulic pendulum.

Maintaining a precise connection between the forces operating on the valve and the valve shape is necessary to produce a symmetric hydraulic pendulum. A formula that just takes into consideration hydraulic and inertial forces can accurately describe these conditions:

$PL/PH = 1 - 2\,AS/AP$

where

PL - low pressure,

PH - high pressure,

AS - valve stem area,

AP - valve piston area,

CHAPTER 4
VALVE OPENING AND CLOSING

A more detailed step-by-step illustration of the valve opening and closing process is given in Figure 4.1 . It is a six-step diagram, and in each step an analogy to a mechanical pendulum is shown.

Step 1 involves opening the opening (high-pressure) solenoid valve, which allows high-pressure fluid to enter the space above the piston of the valve. The pressure above and below the piston equalise, but the constant net hydraulic force is directed downward due to the difference in the pressure regions. The valve is opened, and it moves faster in the opening direction. The second solenoid valve, together with the two check valves, are still shut.

In Step 2 the opening solenoid valve closes and the pressure above the piston drops, but the engine valve continues its downward movement due to its momentum. The alow-pressure check valve opens and the volume above the piston is filled with the low-pressure fluid. The downward motion of the piston pumps the high-pressure fluid from the volume below the piston back into the high-pressure rail. This recovers some of the energy that was previously spent to accelerate the valve.

The balance between the high and low pressures is chosen so that the net pressure force is upward-directed and that the valve decelerates until it runs out of kinetic energy and comes to a stop. The fluid above the piston is now trapped when the opening check valve shuts. The piston cannot go backward as a result, and the engine valve is kept firmly in the open position by hydraulic forces on both sides of the piston. Step 3, the open dwell position, serves as an illustration of this condition.

As long as is necessary, the engine valve stays in the open dwell position. The commencement of the valve shutting is seen in Step 4. In order to link the volume above the piston with the low-pressure rail, the closing (low-pressure) solenoid valve opens. The engine valve accelerates in the direction of closure as a result of the upward-pointing net pressure force, forcing fluid from the higher volume back into the low-pressure reservoir. During acceleration, the other solenoid valve and both check valves are shut.

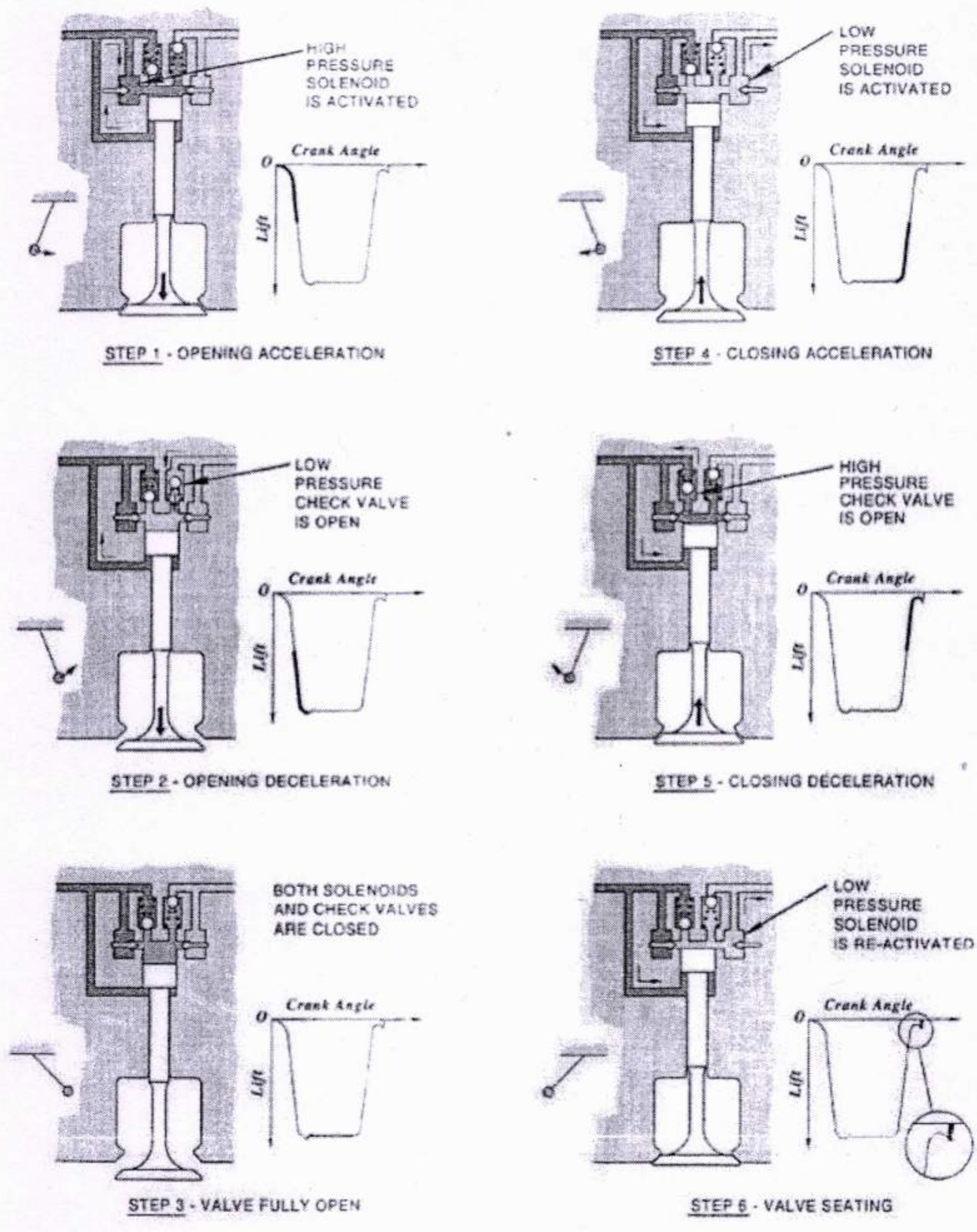

Fig 4.1 Valve opening and closing

The upper volume is cut off from the low-pressure rail in Step 5 when the closing solenoid valve closes, but the engine valve keeps moving higher because of its momentum. The high-pressure check valve that links this volume with the high-pressure reservoir is opened by increasing pressure in the higher volume. Fluid from the volume above the piston of the valve is pumped into the high-pressure reservoir as it moves higher, and fluid from the same reservoir is pumped into the space below the piston as it moves downward. The net flow of the fluid is into the high-pressure reservoir because the volume change below the piston is just a small portion of the volume change above the piston. Energy recovery occurs once more, just as it did during the valve opening. Thus, each valve action in this system involves two energy recovery processes.

The check valve closes when the valve runs out of kinetic energy and ceases to move. The valve should always seat on its seat when this happens. However, doing this is challenging. The closing solenoid valve can be momentarily opened again after the valve has completely stopped only a few thousandths of a millimeter before it reaches the valve seat. Once more, a connection is made between the higher volume and the low-pressure reservoir, and the high pressure in the lower volume forces the valve all the way shut. The valve seating is illustrated in step 6. The closing solenoid valve is then turned off once more. The pressure above the piston of the valve is equal to the pressure in the low-pressure reservoir throughout the remainder of the cycle, and the high pressure beneath the piston maintains the engine valve securely closed.

CHAPTER 5
VALVE MOTION CONTROL

The time of the engine valve opening and shutting can be changed by adjusting the timing of both solenoids' activation. Naturally, this affects the duration of the valve event as well. By adjusting the solenoid voltage pulse's duration, valve lift may be managed. By adjusting the high pressure, the valve's acceleration, velocity, and travel time may be adjusted. The valve may be turned off while the engine is running by simply turning off the solenoids that regulate it. Deactivation may persist for a certain number of cycles or may just last for one cycle.It's not necessary to increase the number of solenoid valves to match an increase in the number of valves in each cylinder. A single valve can be controlled by the same pair of solenoid valves that control another valve, as well as numerous parallel valves. In a four-valve engine, two synchronously running intake valves are operated by a pair of solenoid valves, while the two exhaust valves are operated by a different set.

5.1 UNEQUAL LIFT MODIFIER

A pair of intake or a pair of exhaust valves in a four-valve engine are controlled by an actuator set made up of two solenoid valves and two check valves. A single control chamber that serves both check valves and solenoids is attached to both valves (Figure 5.1). There are a total of eight control chambers and eight pairs of valves in a four-cylinder engine. For each pair, a component known as the lift modifier connects the volumes below the hydraulic pistons to the high pressure reservoir.When the modulator is in its neutral position, the valves' motion is unaffected, and when the solenoid valves are activated, both engine valves move simultaneously.

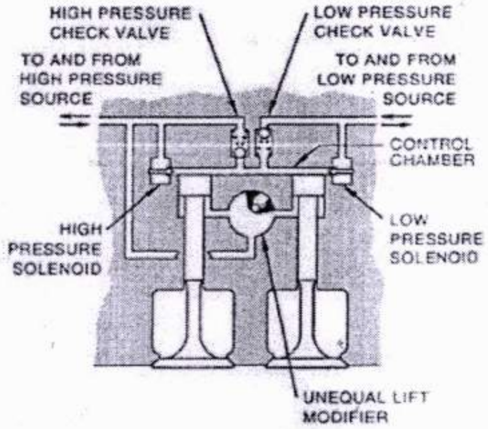

Fig 5.1 Unequal Lift Modifier

It is frequently beneficial to have uneven lift of the two intake valves, or even to keep one of the two valves closed while the other opens, to improve the ability to change the intake air velocity in the engine cylinder. It could occasionally also be used to paired exhaust valves. The opening of one of the paired valves is then restricted using the lift modifier.

In Figure 5.2, the modifier is conceptually represented as a rotatable rod with its axis of rotation parallel to the drawing's plane. Between the two intake valves, the rod is inserted in the cylinder head. A communication chamber formed by a cutout in the rod connects to the areas below the hydraulic pistons of both intake valves.

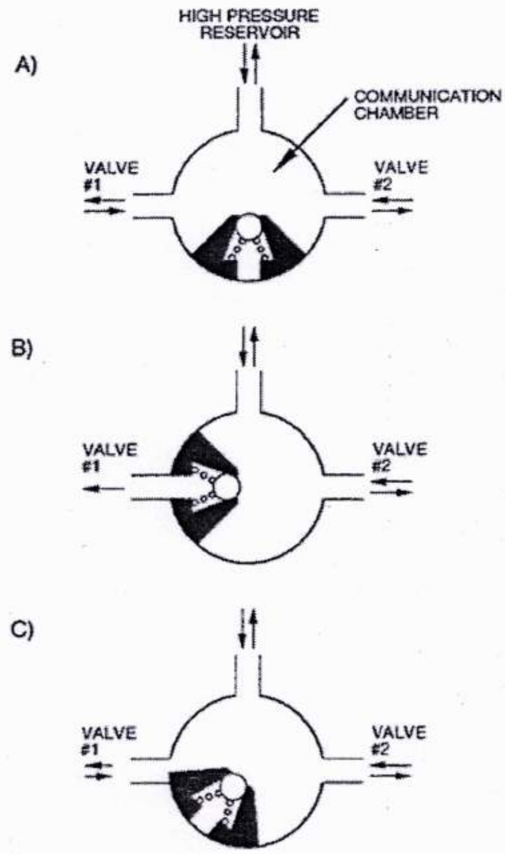

Fig 5.2 Unequal lift control.

The high pressure reservoir is constantly linked to the communication chamber. In example A, both valves work together as the modifier is in the neutral position. The modifier rod is seen in example B rotating 90 degrees in a clockwise direction. The valve No. 1 cannot move in the direction of opening because the oil escape from the volume below the hydraulic piston is blocked. However, a one-way valve attached to the modulator rod allows oil to enter the space beneath the hydraulic piston. This ensures that if deactivation occurs, valve No. 1 will close and stay closed while valve No. 2 continues to function normally. The valve No. 2 is switched off if the modulator rod is twisted 90 degrees anticlockwise (from the position depicted in example A), yet the valve No. 1 would continue to function normally.In example C, the lift of one valve is less than the lift of the other. The rod is rotated at a lesser angle such that the flow of oil from valve No. 1 into the communication chamber is greatly reduced but not totally prevented. As a result, the valve number one's action is slowed down and its lift is lower than the valve number two's. The degree of oil throttling may be changed by adjusting the modulator rod's angular position, which changes the lift of valve No. 1.

CHAPTER 6
TESTING AND DEVELOPMENT

Camless valvetrain development is a long process that involves designing, testing, analysing, and redesigning various parts and subsystems. The system's capacity to work dependably and repeatedly at a variety of speeds, valve lifts, and event durations was tested in the laboratory first using a single-valve test installation. Figure 18 shows a 9 mm valve lift for a certain crank angle duration and 1500, 4000, and 8000 engine rpm that was produced in a test fixture. The high pressure was chosen to ensure that the valves would move sufficiently quickly at the highest engine speed. The lift profile has a trapezoidal shape with progressively steeper slopes as the speed is decreased.

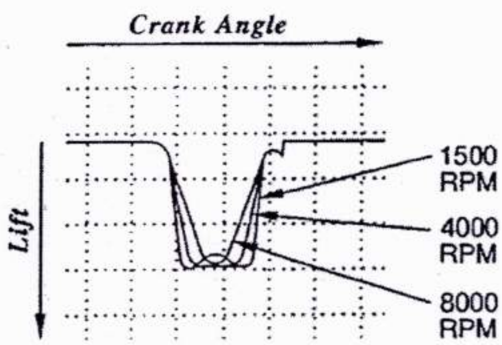

Fig 6.1 Lift traces of engine valve

The primary goal of testing and creating a system with two parallel intake or exhaust valves was to provide independent lift controls for each individual valve. The solenoid voltage-pulse duration determines the nominal lift of both valves since the two valves are controlled by the same pair of solenoids. The lift modifier's action is overlaid over the solenoid action, allowing one of the paired valves to independently and constantly vary its lift while the other valve maintains its computer-controlled lift. The traces of two hydraulically coupled valves with a 4 mm maximum lift are shown in Figure 6.2. The valves are operated in the near synchronous mode (bottom), or with a small reduction of one of the lifts (middle), or with a nearly deactivated lift (top).

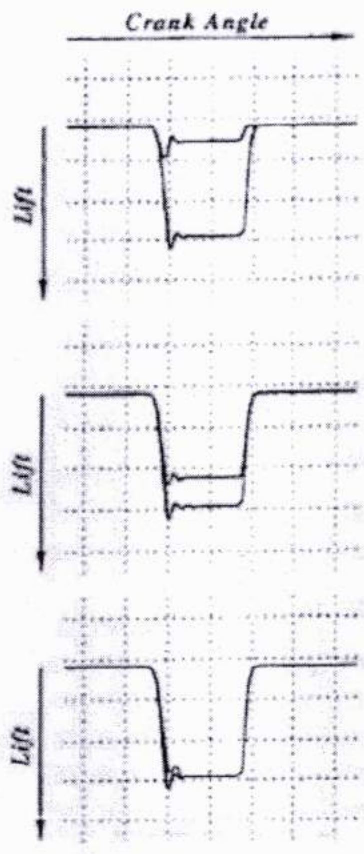

Fig 6.2 Traces of unequal set lifts

Obtaining a quiet engine valve seating required a significant amount of effort. The hydraulic pendulum that was previously mentioned could only produce silent sitting when the lift control was high and the cycle-to-cycle lift fluctuation was minimal. A slight departure from a precisely calibrated low-noise operation, however, led to a loud operation. A hydraulic snubbing motion was developed as a workable fix. The snubbing occurs in the final 0.2 to 0.4 mm of closure and lessens sensitivity to seating control settings while interfering with hydraulic energy recovery as little as possible (Figure 6.3). This maintains the valve seating velocity at or below 0.1 m/s.

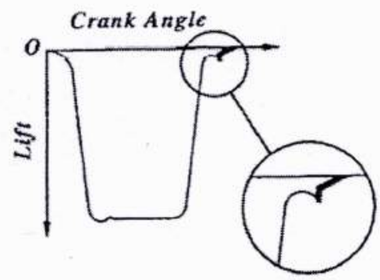

Fig 6.3 Quite seating control

Figure 6.4 shows part-load pressure-volume diagrams obtained with conventional and late intake valve closing. At 1500 rpm and 4 bar IMEP the engine ran essentially unthrottled.

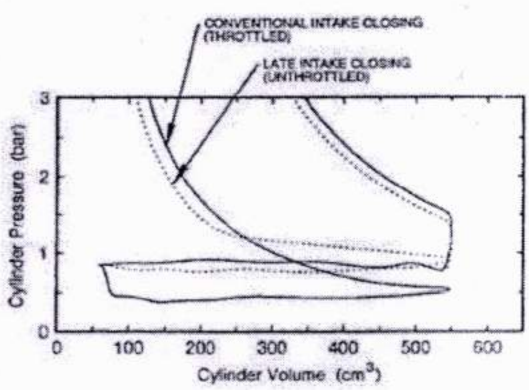

Fig 6.4 Pressure Volume diagram

The near future will see a number of system upgrades. To accommodate greater hydraulic pressures, the cylinder head construction will be strengthened. This will make it possible to reduce the impact of the fluid's air content on the bulk modulus. To avoid increasing the hydraulic energy consumption, the pressures in the high- and low-pressure reservoirs will be raised by an equal amount. The hydraulic pendulum's performance will be adjusted, and the control chamber volume will be reduced, to improve the hydraulic energy efficiency. Additionally, solenoid and driver circuit optimization is intended.

CHAPTER 7

ADVANTAGES AND DISADVANTAGES

7.1 ADVANTAGES

- Enables the development of higher torque throughout the entire rev range which in turn improves fuel economy
- Cylinder Deactivation can be achieved during the idling phase
- Better fuel economy- 7 to 10 % increase
- Higher torque & power- 10 to 15 % increase
- Lower exhaust emissions- EGR system is eliminated since EGR effect occurs on its own & thus reduces NO_x emissions
- Reduces friction losses
- Reduction in size & weight

7.2 DISADVANTAGES

- High Cost
- Increased power consumption
- Air gap between the solenoids may demand a higher magnitude of current during certain periods
- The control strategy for valve seating velocity needs to be modified

CHAPTER 8
CONCLUSION

1. For a camless engine, an electro hydraulic camless valve train was created. Initial testing demonstrated that it can effectively manage the valve timing, lift, velocity, and event length in a four-valve multi-cylinder engine, as well as carry out selectively variable deactivation.

2. The system uses the hydraulic pendulum concept, which helps to reduce the amount of hydraulic energy used.

3. The electro hydraulic valve train is integral with the cylinder head, which lowers the head height and improves the engine packaging.

4. Reviewing the advantages of a camless engine reveals significant enhancements in performance, fuel efficiency, and emissions over and beyond what is possible with engines having camshaft-based valve systems.

5. The creation of a camless engine with an electro hydraulic valve train, as described in this article, is just the beginning of full engine optimization. For this system's outstanding versatility to be fully utilised, more study and improvement are required.

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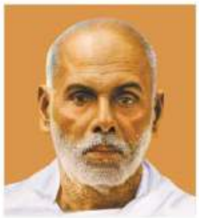

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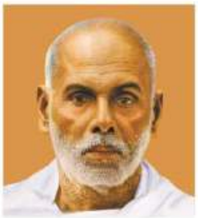

DEPARTMENT OF CIVIL ENGINEERING

IDENTIFICATION AND ANALYSIS OF ACCIDENT BLACK SPOT USING GIS

A PROJECT REPORT

Submitted by

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ANJALI MP (SNC19CE006)

To

The APJ Abdul Kalam Technological University In partial fulfillment of the requirements for the award of the degree
of
Bachelor of Technology

Department of Civil Engineering

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CERTIFICATE

This is to certify that the report entitled **IDENTIFICATION AND ANALYSIS OF ACCIDENT BLACK SPOT USING GIS** submitted by **Aadithya Krishnan C,** and **Anjali MP** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology in Civil Engineering is a bonafide record of the project work carried out by them under my guidance and supervision . This report in any form has not been submitted to any other University or Institute for any purpose.

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DECLARATION

I undersigned hereby declare that the seminar report (**IDENTIFICATION AND ANALYSIS OF ACCIDENT BLACK SPOT USING GIS**) submitted for partial fulfillment of the requirements for the award of degree of Bachelor of Technology of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by me under supervision of Dr. Susan Abraham. This submission represents ideas in my own words and where ideas or words of others have been included, I have adequately and accurately cited and referenced the original sources. I also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

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ABSTRACT

In some countries where the economies are weak, it becomes crucial for those concerned with developmental policies to adopt approaches which will ensure that all available land is used to develop the country. In those fields to facilitate a conducive environment for economic development. Road traffic accidents have been recognized as one of those adverse elements which contribute to the suffocation of economic growth in the developing countries, due to the high cost related to them, hence causing social and economic concern. Hence traffic safety is an important key and integral role in sustainable transportation development areas. Now days, the main adverse impact of modern road transportation systems are injuries and deaths in road accidents. The success of traffic safety and highway improvement programs hinges on the analysis of accurate and reliable traffic accident data. This study discuses the present state of traffic accident information on State Highway 64 from Pilathara to Pappinisseri in the sub district of Kannur in the district Kannur .

The present study aims to find the major accident black spots in Pappinisseri KSTP road (Chungam to Pilathara) and to identify various traffic parameters and road factors causing Accidents.

To identify the nearest facilities like hospitals ,Police Stations , Fire Stations etc. and to find the shortest distance between the facilities and accident spots.

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LIST OF TABLES

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CHAPTER 1

INTRODUCTION

1.1 General

It is well said that every turn of wheel is the revolution ahead in terms of development, but looking on other side we can say that road traffic accidents are a threat to mobility. Injuries from Road traffic accidents are a global public health concern. Amongst all traffic accident, road traffic accident bears largest number of human life and tends to be most serious problem world over. Road accidents are largely predictable and preventable; provided rational analysis and countermeasures. As per the World Bank report on Road traffic injury prevention, worldwide the number of people killed in road traffic crashes each year is estimated at almost 1.2 million. Total number of deaths worldwide and injuries is forecast to rise by some 65% between 2000 and 2020, and in developing countries deaths are expected to increase by as much as 80%. The analysis of road accident data 2018 reveals that about 1374 accidents and 400 deaths take place every day on Indian roads which further translates into 57 accidents and loss of 17 lives on an average every hour in our country.

Kerala is also facing serious threat in road traffic accidents. In response, the Kerala government is trying to cut the fatality by half through a new road safety policy that focuses on first response at the 'golden hour' (the first hour after the accident). The state wants to reduce the fatal accident by nearly 50% by 2023. The government will ensure zero black spot policy for reduction in the road accidents . To achieve this goal identification of black spots is the first step. Here we can use GIS by which we can not only identify accident black spots but can also make query about geographical distribution of road accidents and the types, time of day, vehicles involved, etc. GIS can easily synchronize and map the data with spatial relation. Further it can be used as decision making tool. This project is a step forward in the procedure of identification and analysis of black spots using GIS . The other method for identification of the most vulnerable segments is the method of Prioritization by carrying out road inventory survey. An accident black spot is a hazardous or high risk location where a number of accidents repeatedly occur . The identification analysis and treatment of black spots is widely regarded as one of the most effective approach to prevent road accidents.

1.2 Geographic Information System (GIS)

A Geographic Information System (GIS) is a computer system that analyses and displays geographically referenced information. It uses data that is attached to a unique location. Geographic Information System (GIS) is an effective tool to represent the black spot graphically .

GIS integrates hardware, software , and data for capturing , managing , analysing , and display all forms of geographically referenced information.

Accident prone locations can be identified by using GIS by analysing spatial characteristics about identified location , and also able to figure out the underlying factors causing accidents. In developed countries GIS has widely used for analysing the accident prone location or accident black spots . GIS analysis is performed using ArcGIS software .

1.3 ArcGIS10

Esri's ArcGIS is a geographic information system (GIS) for working with maps and geographic information. It is used for: creating and using maps; compiling geographic data; analysing mapped information; sharing and discovering geographic information; using maps and geographic information in a range of applications; and managing geographic information in a database. The system provides an infrastructure for making maps and geographic information available throughout an organization, across a community, and openly on the Web.

CHAPTER 2

LITERATURE REVIEW

2.1 General

Journals and Research papers are followed and studies for understanding the idea of using GIS.

i. DeepthiJayan K. et al. (2010) have identified high rate accident location or safety deficient areas within Kannur ArcGIS software to analyze spatial data and identified accident patterns. These results are then sent to 'expert' systems for providing suitable recommendations

ii. Liyamol Isen, Shibu A(2013) has identified the most vulnerable stretches in the two districts Alappuzha and Ernakulam of the state Kerala. They have used Weighted Severity Index (WSI) method to rank the accidents, from which top six and ten spots were selected as black spots in Alappuzha and Ernakulam respectively. These black spots were then analyzed using prioritization method in ArcGIS. Two stretches were identified as the most vulnerable accident locations and suitable remedial measures were provided for these locations.

iii. Pavan R Vyas et al. (2014) has described the prioritization methodology to be used in GIS and how the various accident causing factors like width of road, number of lanes in each direction, drainage condition, surface type, presence of median, ribbon development, etc. are involved, ranking of these parameters according to how they are contributing towards accidents. From the results, suitable countermeasures are provided and the importance of GIS in identification of hazardous locations has been emphasized.

iv. Urban Road Safety Audit (URSA) – toolkit (2013) developed by Transport research and Injury prevention program of IIT New Delhi and civil engineering department of IIT New Delhi is safety program examination for urban roads. It aimed to address problems relating to urban road safety and minimize the numbers and severity of accidents v.

Modelling and Simulation in Transportation Engineering 2014 two-lane highway traffic safety conditions is of practical importance and has attracted significant research attention within the last decade. Many cost-effective and proactive solutions such as low-cost treatments and roadway safety monitoring programs have been developed to enhance traffic safety performance under prevailing conditions.

vi.

Prioritization of Accident Black Spots using GIS - The study includes visiting these accident prone sites, collecting required data for GIS analysis and cross-checking the data with Bangalore traffic police records. Selected sites for present study include East end circle, Kudlu gate junction, Anepalya road, Khodays circle, Binny mills circle and Gubbalala gate. Two data points were taken for each black spot. Road maps of selected sited were collected and fed into software. The analysis was carries out and Anepalya road was found out to be the prime accident prone location. The results were cross checked with respective traffic police station records to verify the validity of the model.

CHAPTER 3

3.1 DATA COLLECTION

3.1.1 Scope and objectives

i. Identify location which have both high risk of crash losses and justifiable opportunity for reducing the risk.
ii. To implement a methodology for the identification and prioritization of hazardous road Location.
iii. To find and represent the major road accident black spot in Pappinisseri Pilathara KSTP road.
iv. Road network analysis.
v. show the shortest path between facilities like Hospitals. Police station , Fire station etc, and the black spot.
vi. To identify various traffic parameters and factors causing accidents and suggestions of possible improvement.

3.1.2 Study Area

Pappinissseri - Pazhayangadi - Pilathara KSTP Road(SH64) stretches for a length of 21kms in Sub-district Kannur of the district Kannur . The road starts from Pilathara , passes through Pazhayangadi, and Kannapuram and ends at Papppinisseri on NH 66 .

Features

i. The entire stretch is two line state highway.
ii. Road surface is Asphalt.
iii. No divider at this stretch/Highway.
iv. Speed limit mentioned at some sections only.
v. No toll booths.

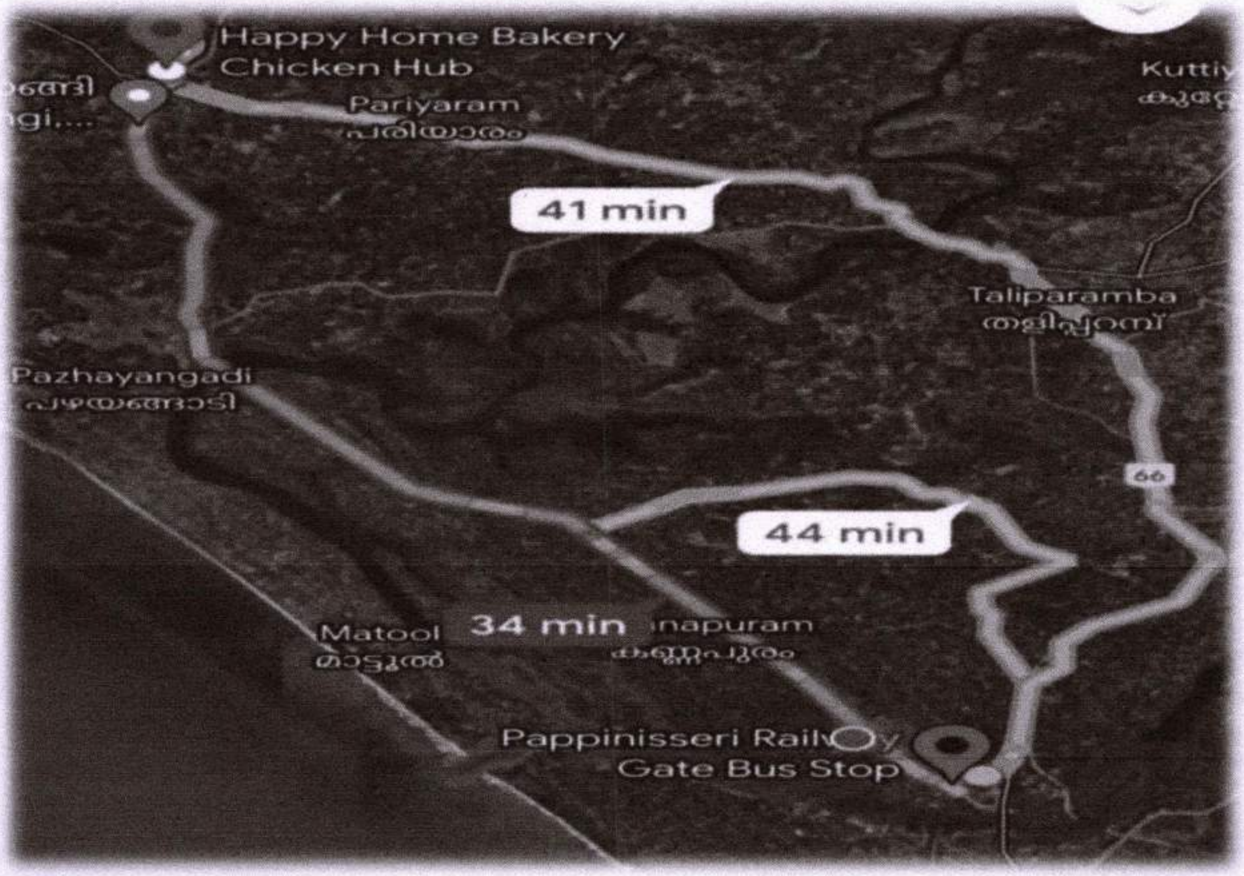

Fig 3.1: IDENTIFIED ROAD STRETCH Source : [Google Maps]

3.1.3 Site investigation

A visit to the site was conducted

Detailed information and characteristics of road were collected namely

i. Road sections.
ii. Road junction.
iii. Surface and road conditions.
iv. Available traffic volume and obstruction.
v. Sign board at road.
vi. Speed cameras at intervals.
vii. Observation cameras at 2km intervals.

fig 3.2: pilathara road

fig 3.3: pappinisseri road

3.1.4 Climate

- The climate of the region is tropical humid , with temperature ranging from 23-31 o Celsius.
- The hottest month are April-May and the coldest November-January .
- The Annual rainfall of 2500mm-3600mm(mainly concentrated from June to October

3.1.5 Primary data

Accident data of the selected area is collected from Kannur City and Rural Police Station. The data collection involves the collection of accident data of the area for five years (2018 , 2019,2020 2021,2022) from Kannur City Police station and Kannur Rural police station.

The accident data was collected from Kannur City Police station and Kannur Rural police station for the following years

To find the shortest path, the datas of near by facilities like Hospitals ,police station , fire stations near the road stretch are collected.

3.1.6 Secondary data

In this accidental data includes physical survey detailed such as road inventory data which include

i. Name of the road- Pilathara Pappinisseri road

ii. Length of the road- 21 Km

iii. Type of the road - State Highway

iv. Width of the road - 7meter

3.2 IDENTIFICATION

The identification of accident prone areas can be made either by reactive or proactive methods.

i. Reactive method develops according to statistical data of the traffic amount, number and type of accidents. The accuracy of reactive method relies on a great extent to the accuracy of data collection and storage. This method can identify black spots.
ii. Proactive method is based on physical properties and operational conditions. In fact, safety of operation in a route can be evaluated by means of key factors and the way of operationsand hence the safety indicator can be identified. These methods require a lot of time, precision and also making use of safety experts.

The result of these methods is a prioritized list of accident prone areas or black spots. In this study black spots or accident prone areas were identified by reactive approach that included collecting accident record data from Kannur city & Rural police station.

3.3 GEOGRAPHIC APPROACH

The approach to any geographical problem and its solution is divided into following five phases:

3.3.1 Ask

Approaching a problem geographically involves framing the question from a location-based perspective. What is the problem you are trying to solve or analyze, and where is it located?

3.3.2 Acquire

After clearly defining the problem, it is necessary to determine the data needed to complete your analysis and ascertain where that data can be found or generated

3.3.3 Examine

You will not know for certain whether the data you have acquired is appropriate for your study until you thoroughly examine it.

3.3.4 Analyse

The data is processed and analysed based on the method of examination or analysis one chooses, which is dependent on the results one hopes to achieve.

3.3.5 Act

The results and presentation of the analysis are important parts of The Geographic Approach. The results can be shared through reports, maps, tables, and charts and delivered in printed form or digitally over a network or on the Web. You need to decide on the best means for presenting your analysis. You can compare the results from different analyses and see which method presents the information most accurately.

3.4 METHODOLOGY

The model described in this paper requires a map of the desired road network digitized in a suitable form and certain specified road attributes to carry out prioritization The analysis then ranks black spots on the given road network. While carrying out the analysis the model incorporates only the road related factors such as road geometries, which lead to accidents. The factors considered are as follows:

i. Road width
ii. Number of lanes in each direction
iii. Approximate number of vehicles per day
iv. Drainage facilities
v. Surface condition of the pavement
vi. Frequent vehicle type
vii. Presence of shoulders, edge obstructions and median barriers

3.5 PROCEDURE

In order to model using mentioned road related factors and achieve the desired result, a step by step procedure as given below is adopted.

i. Scanning of the map containing the desired road network and feeding this image to Arc View for digitizing.
ii. Digitizing the road network with due considerations for separation of every link and assigning ID number to every link.
iii. Specifying the attributes for every road link using the questionnaire provided.
iv. Exporting the road attribute table generated in database format so that it can be imported by Arc view.
v. Joining the road attribute table to the digitized road map and prioritizing the road network for accident occurrence using total weights assigned to every link.
vi. Black spots on a given road network are ranked by result obtained from prioritization.

3.6 ROAD ANALYSIS

Table 3.1 : road data analysis

Sl.No	PARTICULARS	PILATHARA PAPPINISSERI ROAD
1	Starting Chainage	Km 0+000(Pilathara)
2	Ending Chainage	Km 20+900(Pappinisseri)
3	Length	20.90km
4	Classification	Major District Road
5	Proposed RoW	Min – 13m & Max – 20m
6	Proposed carriage way width	Built-up & rural areas : 10m ROB Location : 7.5 m CW with 3.5 service roads
7	Junction Improvements	Major junctions – 3 Nos Minor junctions – 77 Nos
8	Pavement Composition Details	Existing CW : Overlaid with 40mm BC+ PCC Widening : 40 BC + 75 DBM + 250 WMM+200 GSB
9	Drains (both sides)	20194 m
10	Passenger Shelter	37 Nos.
11	Crash Barrier	3260 m
12	Pedestrian guard rail	5365 m
13	Parking space(Taxi , Auto , etc.)	Existing : 9 Nos. New : 3Nos.
14	Oxbow Land	4 Nos.

Table 3.1 : road data analysis

Sl.No	PARTICULARS	PILATHARA PAPPINISSERI ROAD
16	Noise Barrier	94 m at educational building areas
17	Protection measures	Stone Pitching 240m (including both side) Turfing length -- 480 m (including both side)
15	Bridge / Culvert	Total – 43 Nos. Major Bridge - 1Nos. Minor Bridge - 2 Nos. ROB – 2 Nos. Culverts – 38 Nos.

3.7 ROAD CHARACTERISTICS

3.7.1 Speed boards

i. Pilathara -70
ii. Mundoor- 50
iii. Ambalam road – 60
iv. Aduthila – 60
v. Pazhayangadi – 50
vi. Thavam – 70
vii. Punnacherry – 60
viii. Vellierangal - 30
ix. Kovvapuram – 40
x. Pallichal – 50

xi. Thara – 30

xii. Kannapuram – 40

xiii. Yogashala – 70

xiv. Irnavu – 40

xv. Kottpalam – 60

xvi. Karikkankulam – 60

xvii. Hajiroad – 40

3.7.2 Junctions

i. Cheruthayam ambalam road- traffig light (warning signal only)

ii. Pazhayangadi – Madayi roundaboat

iii. Pazhayangadi – matool junction

iv. Kovvaporam junction – traffic lights (Warning signal only)

v. Irnavu junction – traffic light (warning signal only)

3.7.3 Speed cameras

i. Pilathara

ii. Hanuman ambalam road

iii. Punnachery

iv. Yogashala

v. Kaila palli

3.7.4 Observation camera

i. Mundoor - 1

ii. Adutila - 1

iii. Pazhayangadi -7

iv. Punnachery – 1

v. Cherukunnu thara -1

vi. Kannapuram bank – 1

vii. Yogashala – 1

viii. Irnavu – 1

ix. Karikkankulam – 1

x. Highschool -1

xi. Hajiroad – 1

xii. Chungam - 1

3.8 TRAFFIC VOLUME

Table 3.2 : traffic volume at morning and evening peak hours

DIRECTION	TIME	NO.OF VEHICLES
IRNAVU – CHUNGAM	8:30-9:30 AM	927
CHUNGAM - IRNAVU	8:30-9:30 AM	694 Sum= 1627
IRNAVU – CHUNGAM	4-5 PM	836
CHUNGAM - IRNAVU	4-5 PM	1148 Sum= 1984
CHERUKUNNU - IRNAVU	8:30-9:30 AM	697
IRNAVU - CHERUKUNNU	8:30-9:30 AM	1313 Sum= 2010
CHERUKUNNU - IRNAVU	4-5 PM	1873
IRNAVU - CHERUKUNNU	4-5 PM	1427 Sum = 3300
ADUTILA -CHERUKUNNU	8:30-9:30 AM	755
CHERUKUNNU-ADUTILA	8:30-9:30 AM	1251 Sum =2006
ADUTILA -CHERUKUNNU	4-5 PM	1891
CHERUKUNNU-ADUTILA	4-5PM	1527 Sum=3418
PILATHARA- ADUTILA	8:30-9:30 AM	757
ADUTILA-PILATHARA	8:30-9:30 AM	1252 Sum=2009
PILATHARA- ADUTILA	4-5 PM	1893

ADUTILA-PILATHARA	4-5 PM	1556 Sum =3449

3.8.1 Average traffic volume

Table 3.3: Average daily traffic volume

ROAD SECTION	MORNING PEAK HOUR	EVENING PEAK HOUR	PEAK AVERAGE FLOW	AVERAGE DAILY TRAFFIC (ADT)
CHUNGAM - IRNAVU	1627	1984	1805.5	21494.04762
IRNAVU - CHERUKUNNU	2010	3300	2655	31607.14286
CHERUKUNNU - ADUTILA	2006	3418	2712	32285.71429
ADUTILA PILATHARA	2001	3449	2729	32488.09524

Peak avg. flow = (Morning peak hour + Evening peak hour) / 2

ADT = (Peak avg. flow * 100) /8.4

3.9 PRIORITIZATION

Prioritization involves assigning suitable weights to different factors so as to achieve a desired result. In this model, the various factors, which tend to influence the occurrence of accidents on roads, are assigned weights on a scale of 0-10 in such a manner that the factors which tend to increase the probability of the accidents have lower weights. In order to prioritize roads for occurrence of accidents, the various factors considered and the weights assigned to them are given in following table:

Table 3.4 : Factors effecting weightages

SL/NO	FACTORS	POSSIBLE VARIATION	WEIGHTAGES ASSIGNED
1	No of Lanes in each side direction	1	4
		2	6
		3	8
		4	10
2	Road width	Less than 6m	4
		6.1-7.5m	6
		7.6-10.5m	8
		15m above	10
3	No vehicles per day	20000	2
		20001-25000	4
		25001-30000	6
		30001-35000	8

		35000 above	10
4	Drainage facilities provided	Good Satisfactory Poor No drainage	10 7 4 1
5	Surface condition	Concrete WBM Other Bituminous Surface Painted Earth road	10 8 6 4 2
6	Frequent Vehicle Type	Bus/Truck Car/3wheeler Bycycle Carts	2 4 6 8 10
7	Presence of shoulders	Yes No	10 4
8	Presence of edge obstruction	Yes No	4 10
9	Provision of median barriers to Channelize the traffic	Yes No	10 4

3.10 WEIGHTAGE ANALYSIS

- The final weight assigned to each road link is obtained by adding all the individual weights and normalizing the value using maximum weight (in this case 90) that can be assigned.
- Total Weightage = $\sum$ Individual Weightage x100 / 90
- According to above table respective weights are given for specific values of factors and total weights are calculated for all the points as shown in the table below.

Table 3.5: weightage calculation

FACTORS	CHINGAM-IRNAVU SECTION	IRNAVU-CHERUKUNNU SECTION	CHERUKUNNU-ADUTILA SECTION	ADUTILA PILATHARA SECTION
No Lanes in each side sirection	4	4	4	4
Width of the road	4	4	4	4
No vehicles per day	4	8	8	8
Drainage facilities provided	7	1	7	10
Surface condition	8	8	8	8
Frequent Vehicle Type	4	4	4	4
Presence of shoulders	10	10	10	10
Presence of edge obstruction	10	10	10	10
Presence of median barriers	4	4	4	4
To Channelize the traffic sum	55	53	59	62

Total sum	61.11	58.89	65.56	68.89

Thus road link with high final weight are less prone to accident than the road link with low final weight. The classification of roads for occurrence of accident based on final weights are done using the following classification scheme:

Table 3.6: Prioritization scheme

FINAL WEIGHT	ACCIDENT PRONE LEVEL
>70	Very low
60-70	Low
50-60	Medium
0-50	High

The road characteristics as well as traffic parameters of each spot is specified as attributes and linked with each spot in the digitized road map. The various spots were then prioritized for accident occurrences using total weights assigned to every attribute, as a result of which the black spots were ranked on the basis of vulnerability

Table 3.7: Final weightage and accident prone level of each spot

SECTION	WEIGHTAGE	ACCIDENT PRONE LEVEL
CHUNGAM -IRNAVU	61.11	LOW
IRNAVU - CHERUKUNNU	58.89	MEDIUM
CHERUKUNNU-ADUTILA	65.56	LOW
ADUTILA-PILATHARA	68.89	LOW

CHAPTER4

REDULT AND DISCUSSION

4.1 RANKING OF ACCIDENT BLACK SPOT

Table 4.1: accident ranking in each section (source police accident data)

SECTION	KILLED(K)	GRIEVOUS INJURIES (GI)	MINIOR INJURIES (MI)	WEIGHTED SEVERITY INDEX (WSI) WSI=41*K+4*GI+MI
CHUNGAM- IRNAV	9	48	17	578
IRNAV- CHERUKUNNU	25	61	63	1332
CHERUKUNNU-ADUTHILA	21	77	64	1233
ADUTHILA-PILATHARA	11	29	14	581

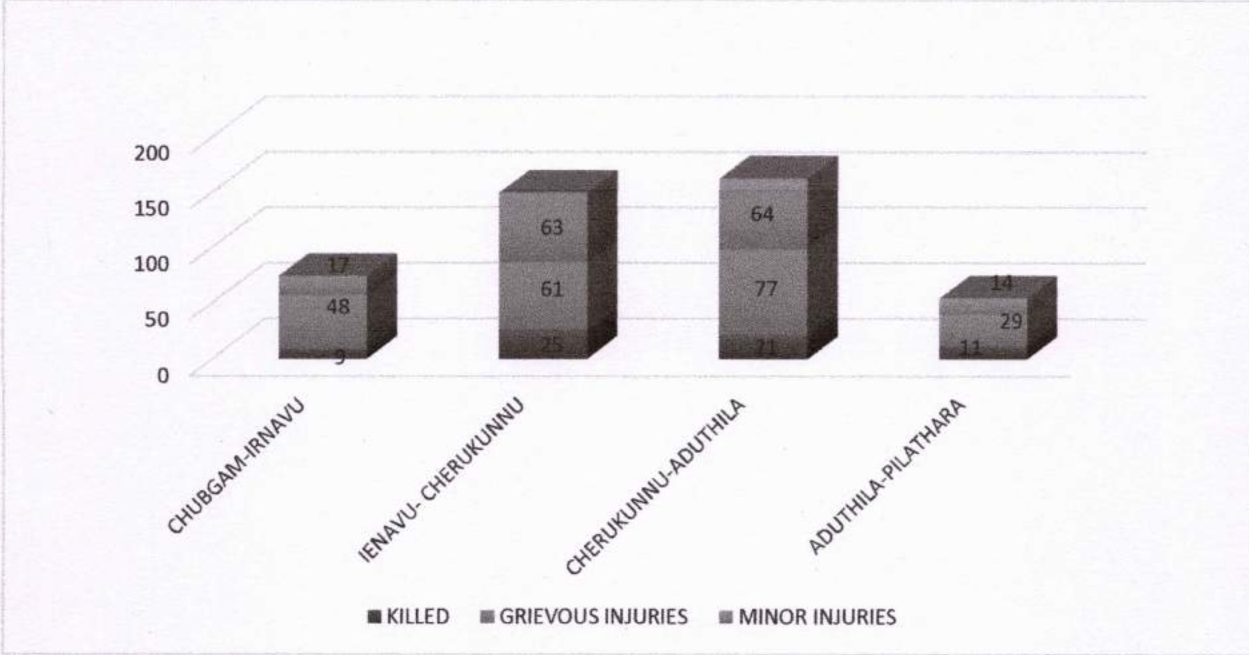

Fig 4.1: graphical representation of accident data

From the given table 4.1 and fig4.1 it is clear that Irnav-Chungam section has maximum weightage severity index I,e 1332 , and Accident prone level of that section is medium according to table 3.8 ,which according to the concept of prioritization in this report the most accident prone point. So the maximum accident prone point in Pappinisseri-Pilathara road is Irnavu – Cherukunnu section.

4.2 ROAD NETWORK ANALYSIS

- Network analysis in GIS rests firmly on the theoretical foundation of the mathematical sub disciplines of graph theory and topology. The most common and familiar implementations of network models are those used to represent the networks with which much of the population interacts every day: transportation and communications networks
- Routing is the act of selecting a course of travel, and it is arguably the most fundamental logistical operation in network analysis

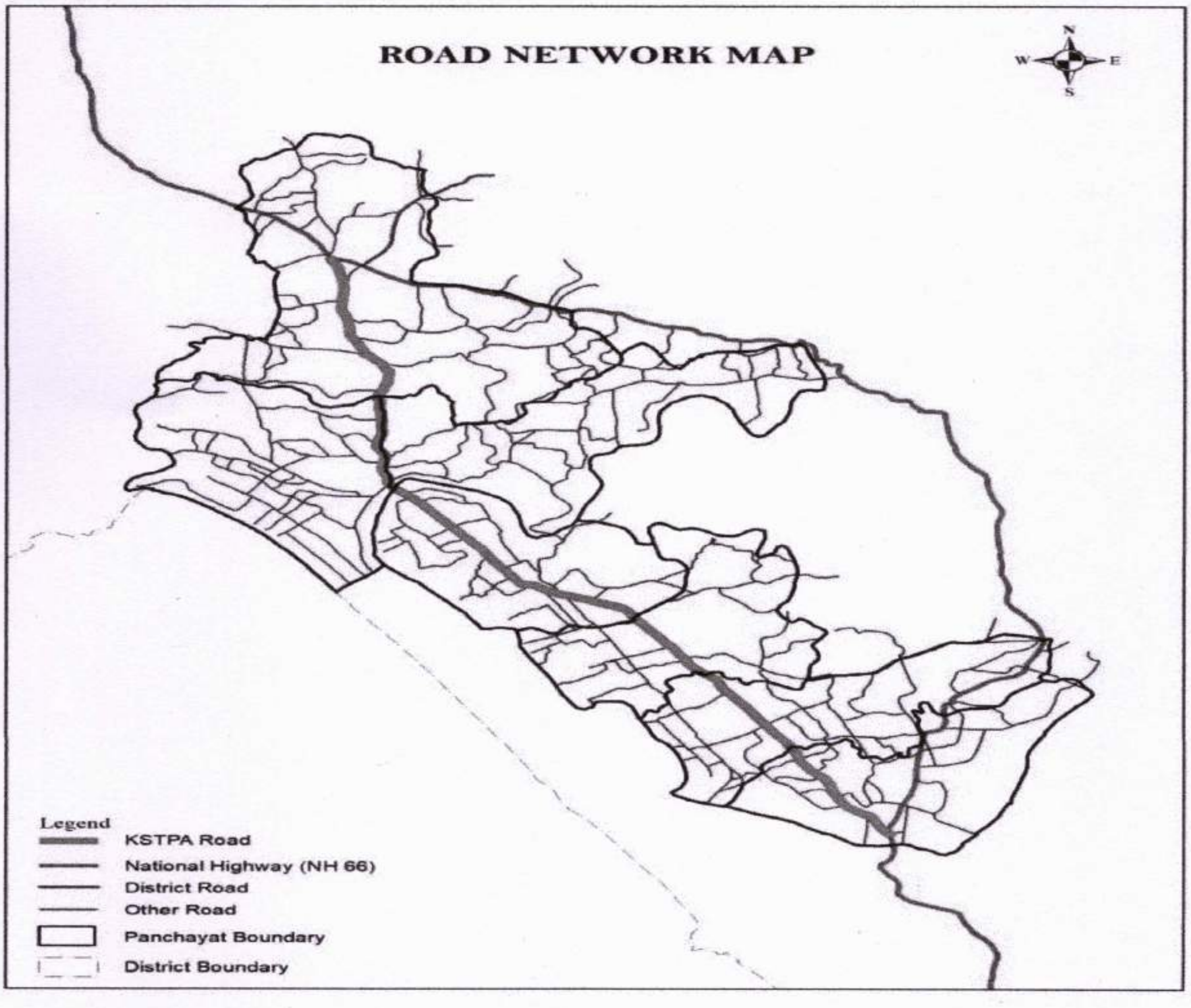

Fig4.2 :Road network map

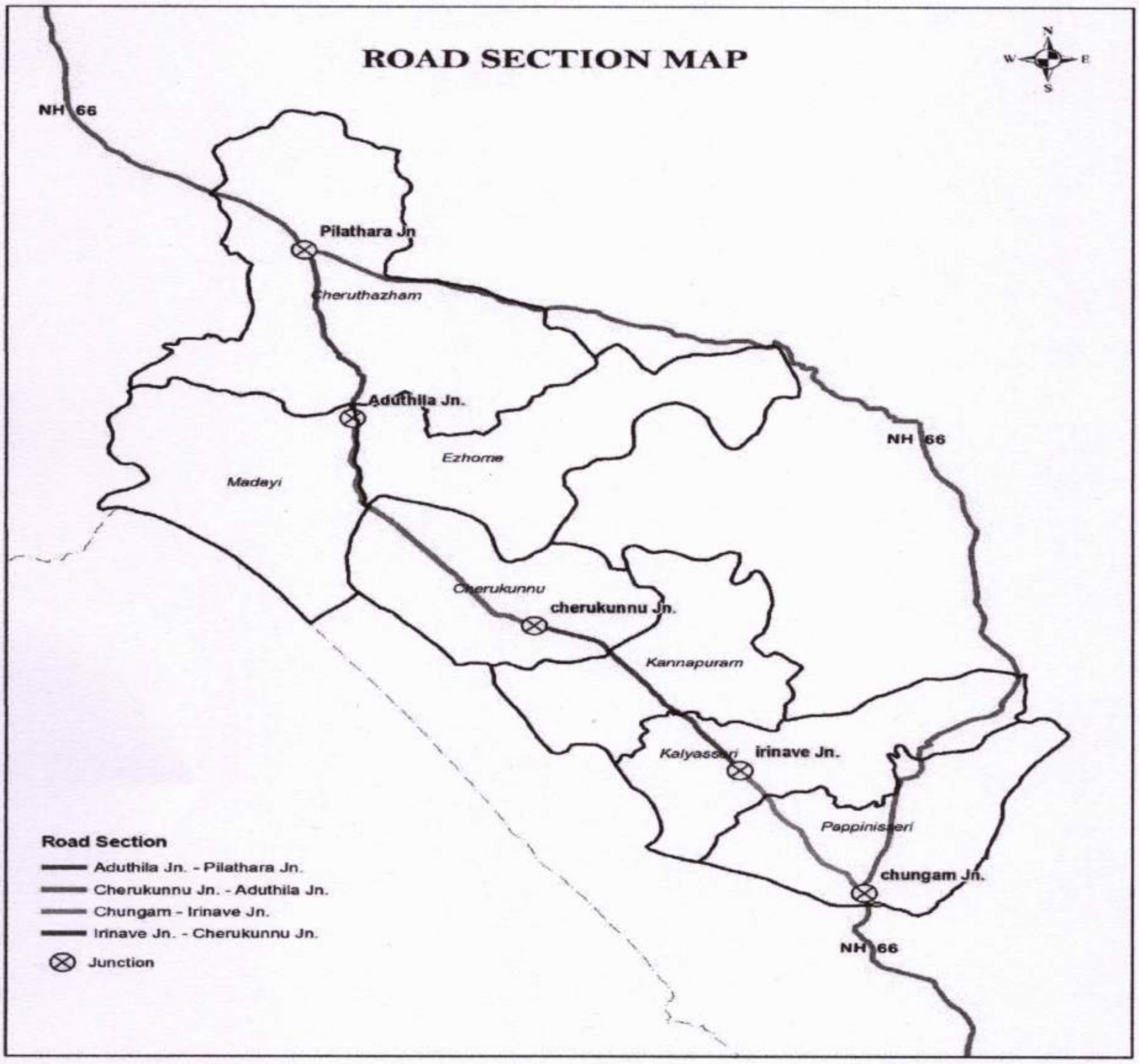

Fig 4.3: Road section map

How to find the shortest route using network analysis in ArcGIS

1. Create a network dataset for the road section. Import the image to ArcMap10 .
2. Right click on road shape file. Click "new network dataset" . Select "name" . Click "next". Click "finish".
3. Right click on the tool bar and click on Network Analyst and enable it.
4. Click on network analyst and select new route. New route is enabled
5. Table of contents is also shown ,it consist of layers (stops , point barrier, routes ect.
6. Click on "Create network location" tool . Select the point from where we need to finding the distance and click the end point.
6. Select "solve" tool from "Network Analyst" tool bar Select "Direction" tool from "Network Analyst" test bar to find the direction of road .
7. To calculate the distance , right click on routes and open attribute table.
8. There is also Select/move location tool to change the selected point .

By importing network dataset and the collected data into ArcGIS10 we can obtain a digitalized view of the road stretch and the surrounding areas and facilities around it . So when an accident occur at this stretch then by selecting the required facilities(Hospital ,Police station, Fire station) we can obtain the shortest path and its navigation to reach there or when a accident happens police vehicle or ambulance or firefighters can know the location and the shortest and fastest way to reach the Accident spot.

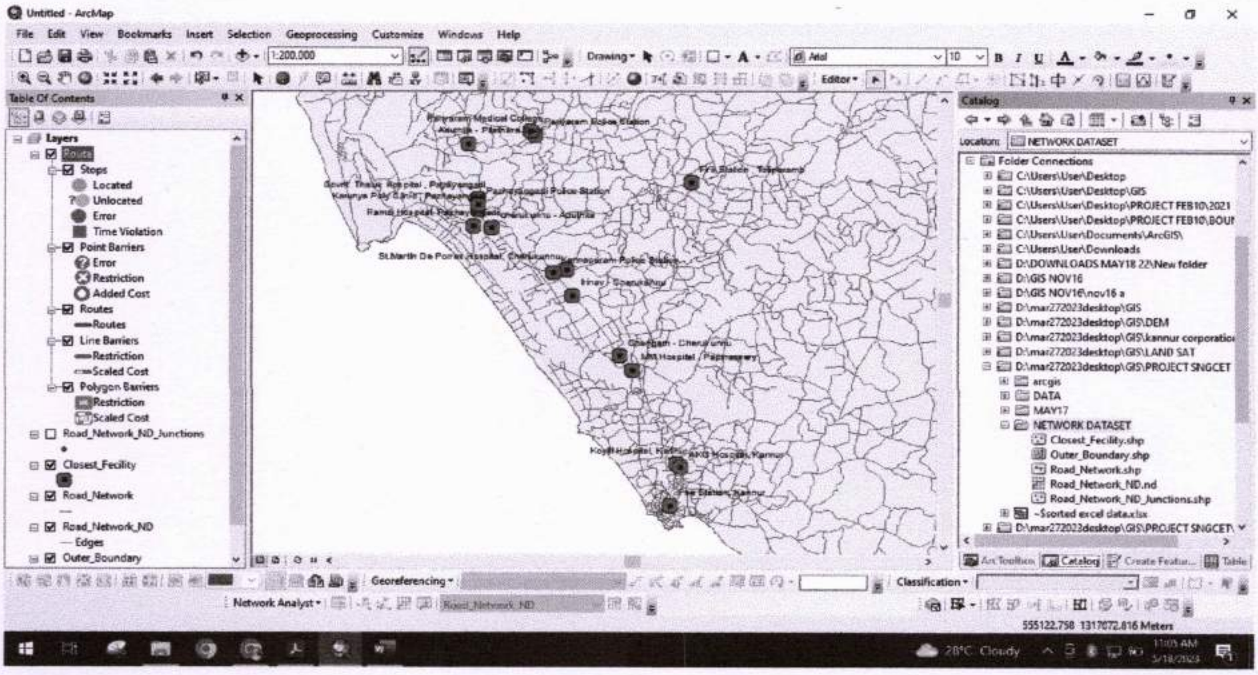

Fig4.4: accident blackspot and near by facilities(Hospitals, clenics , police station , fire station)

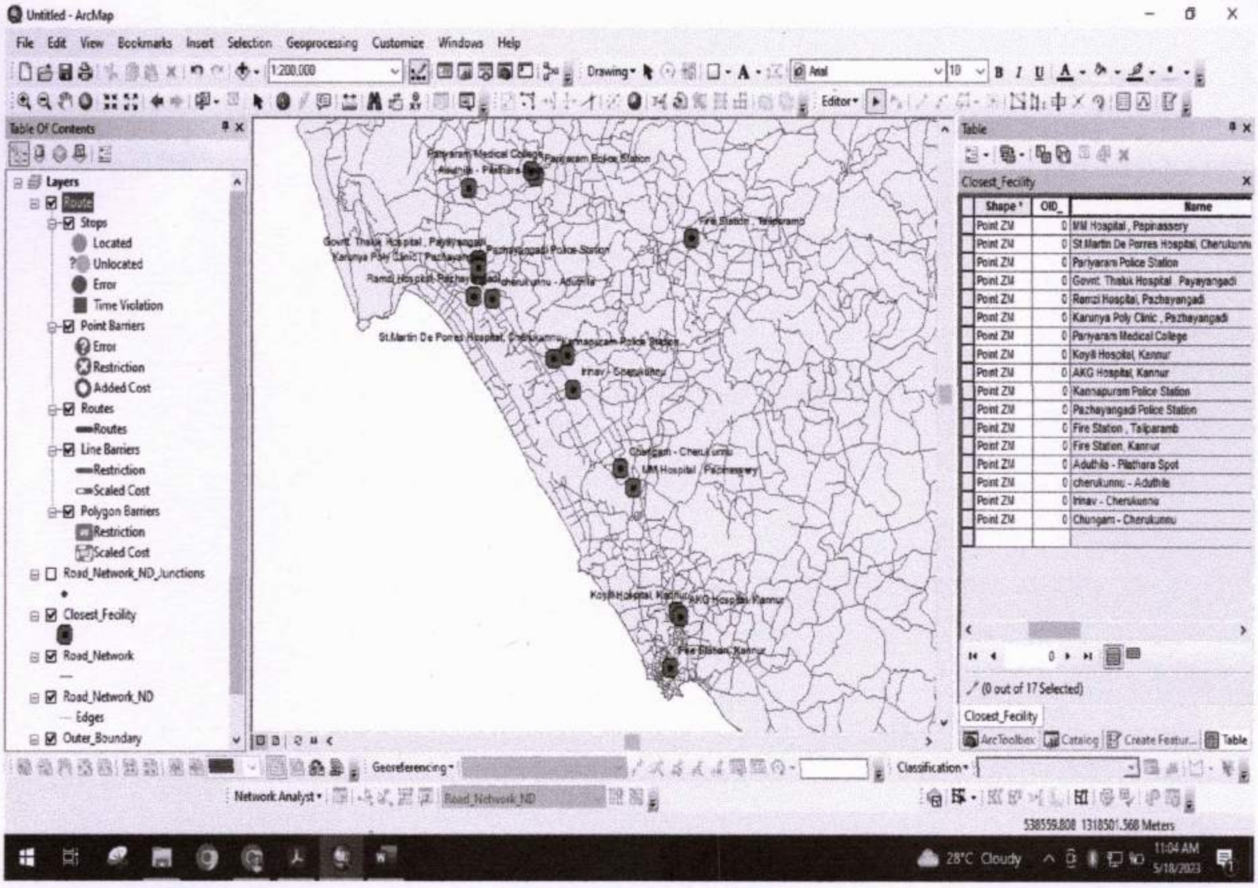

Fig4.5: accident blackspot and near by facilities (Hospitals , police station , fire station)

After inserting the road network data and enabling network analyst , to find the shortest path we can select an unknown location and the destination in the road using Create network location tool . In fig4.6 it shows the shortest location between black spot in irnav cherukunnu road to Kannur fire station , and by selecting route from Table of contents ,it automatically shows the starting point ,turns ,directions ,distance and destination point, by using latitudes and longitudes of the location .

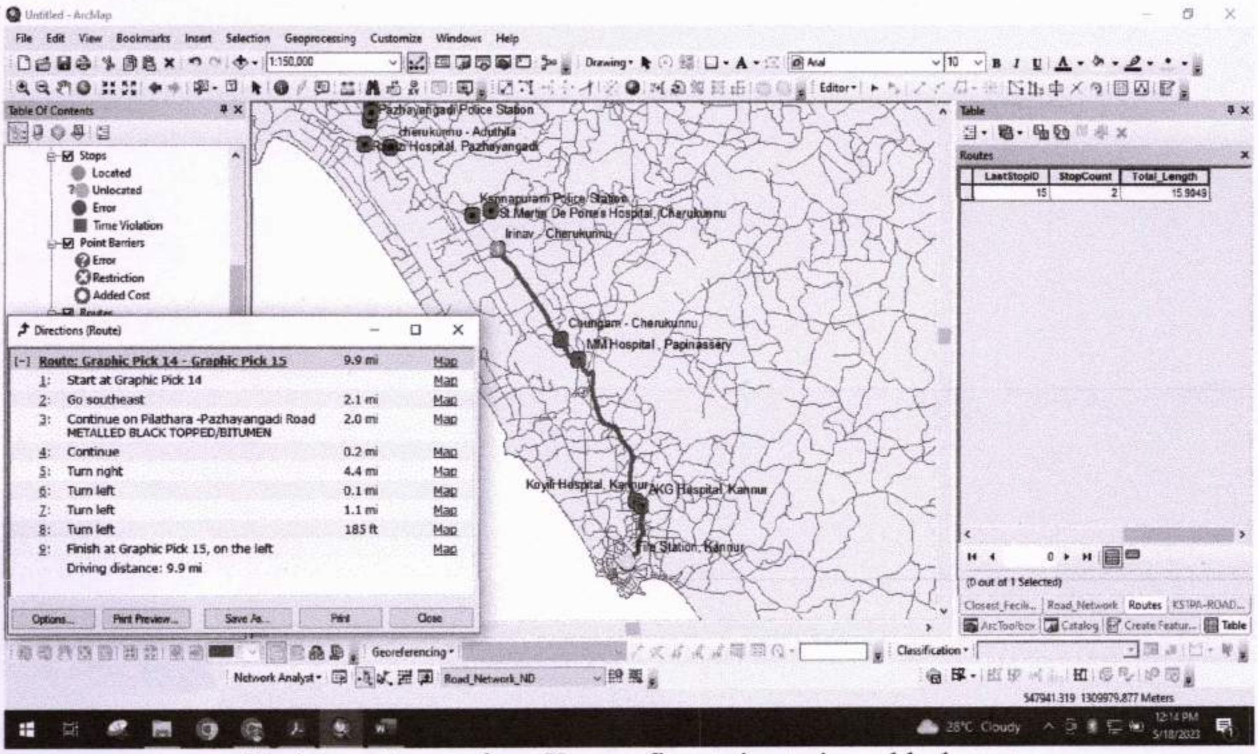

Fig4.6: route map from Kannur fire ststion to irnav black spot

Same in fig 4.7 and 4.8, using create network location tool select the origin points and the destination point from the network map and select solve tool from the tool bar , then the shortest distance between the points are shown with navigations like turns , distance ,etc.

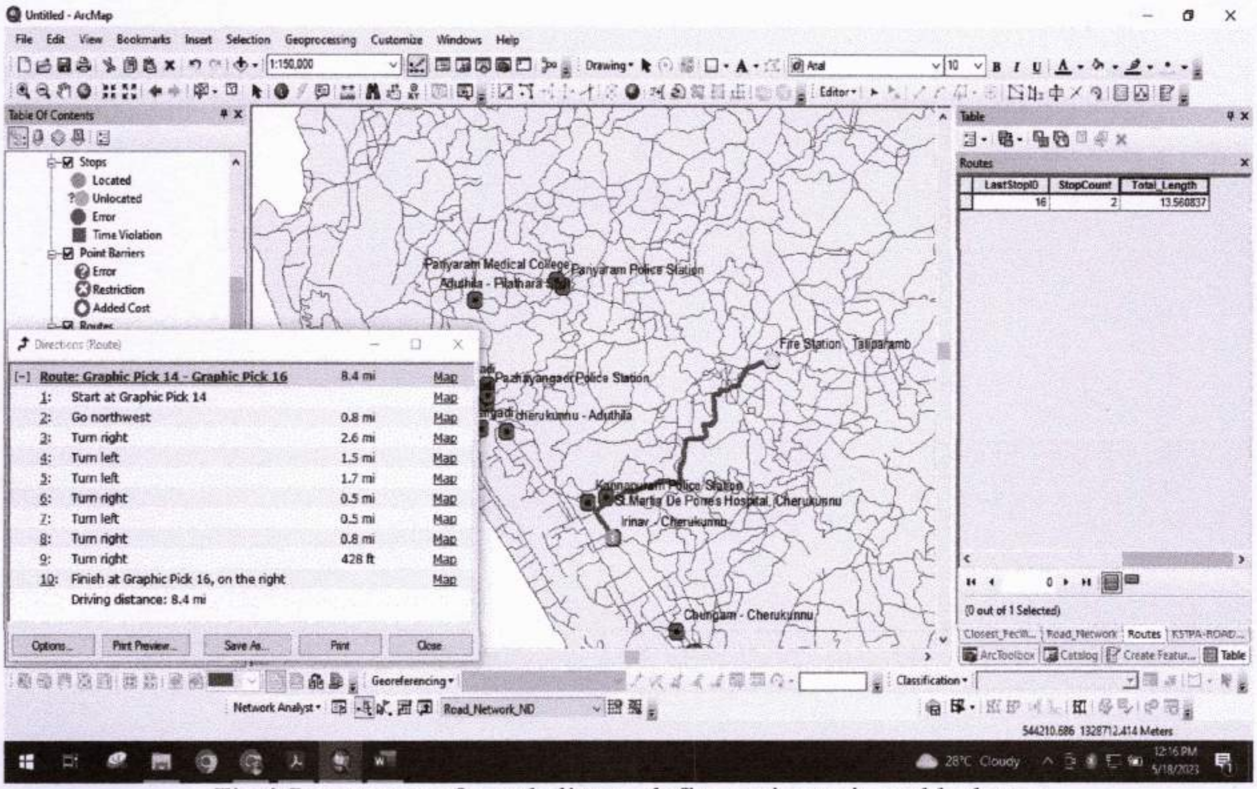

Fig 4.7: route map from thaliparamb fire station to irnav black spot

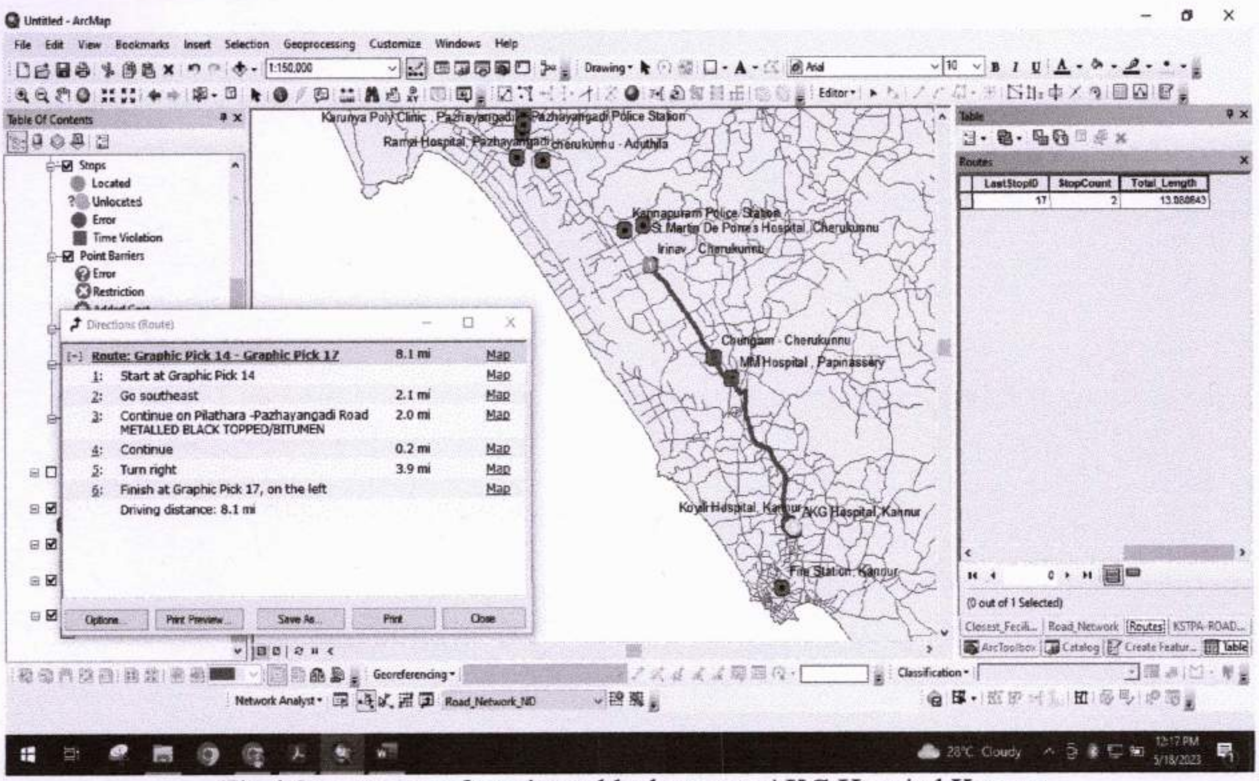

Fig 4.8: route map from irnav black spot to AKG Hospital Kannur

The fig 4.9 and 4.10 the shortest distance between two points by using create network location tool select the origin points and the destination point from the network map and select solve tool from the tool bar , then the shortest distance between the points are shown with navigations like turns , distance ,etc.

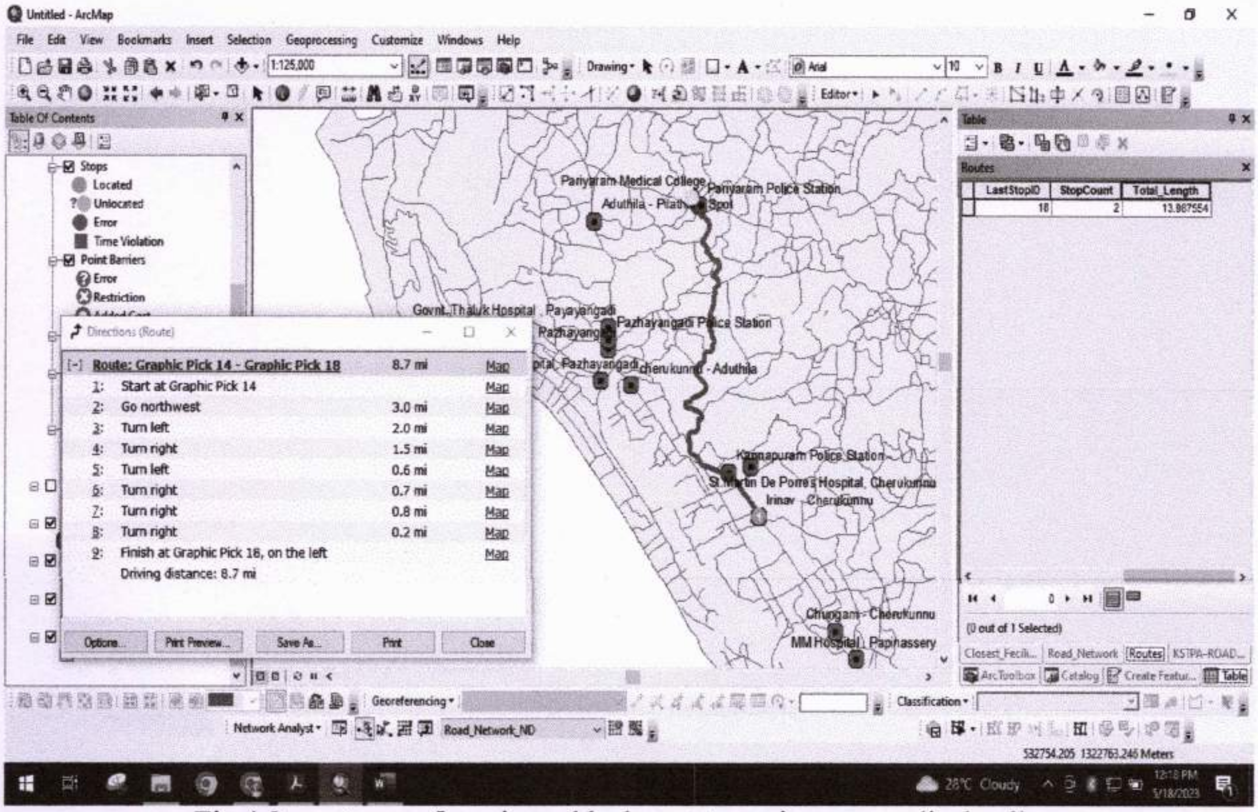

Fig 4.9: route map from irnav black spot to pariyaram medical college

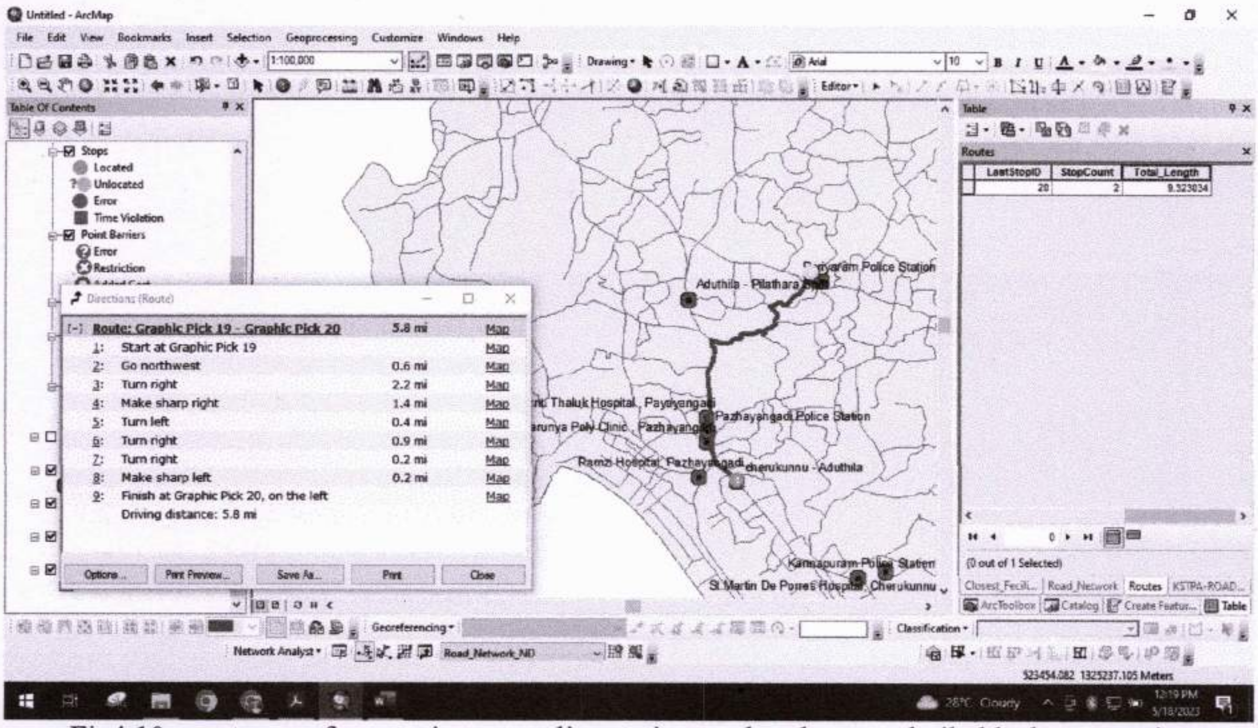

Fig4.10 : route map form pariyaram police station to cherukunnu adutila blackspot section

The fig 4.11 and 4.12 the shortest distance between two points by using create network location tool select the origin points and the destination point from the network map and select solve tool from the tool bar , then the shortest distance between the points are shown with navigations like turns , distance ,etc.

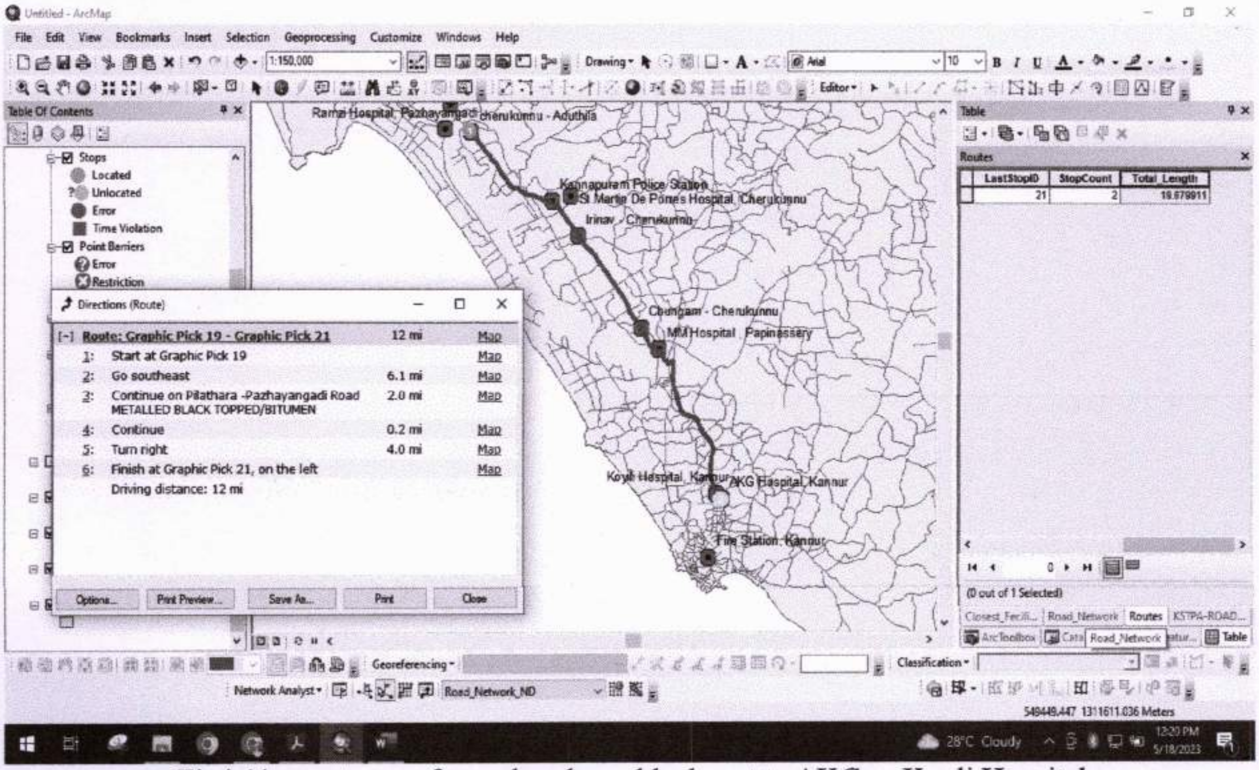

Fig4.11 : route map from cherukunu blackspot to AKG or Koyli Hospital

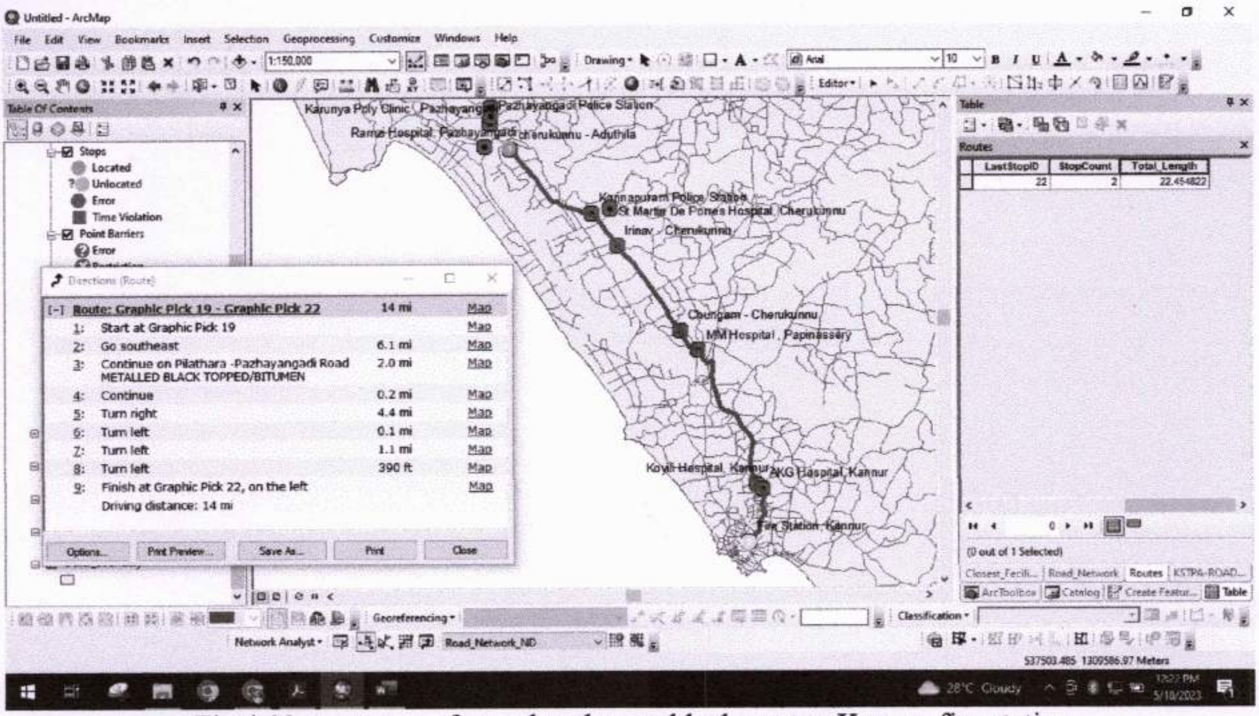

Fig 4.12: route map from cherukunnu black spot to Kannur fire station

The figure 4.13 shows the shortest distance between cherukunnu blackspot to thaliparamb fire station
Along with its routes by selecting origin point and destination point using network analysis tool and select solve.

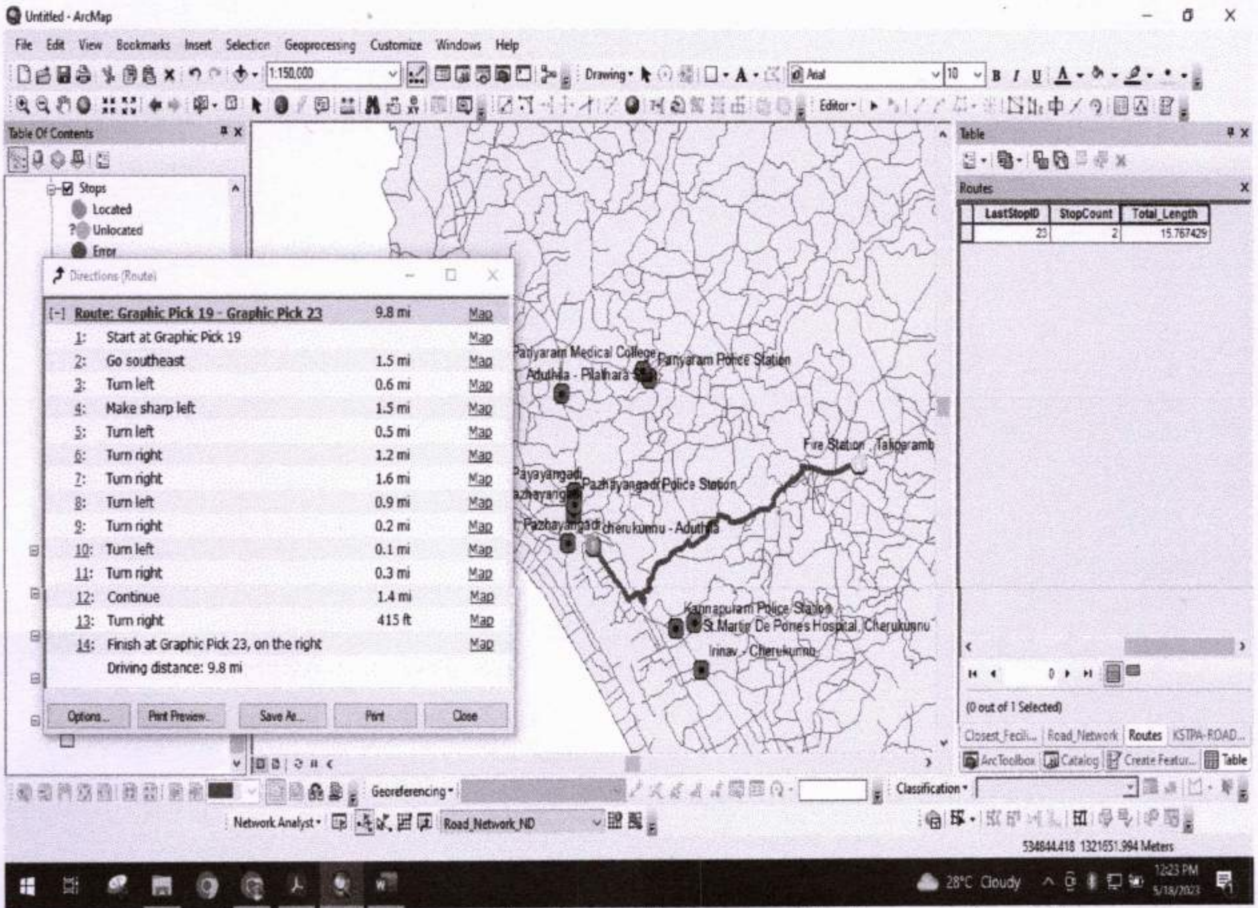

Fig 4.13: route map from cherukunnu blackspot to Thaliparamb fire station

The fig 4.14 shows the shortest distance between adutila clack spot and pariyaram medical collage A
along with its routes by selecting origin point and destination point using network analysis tool and select solve.

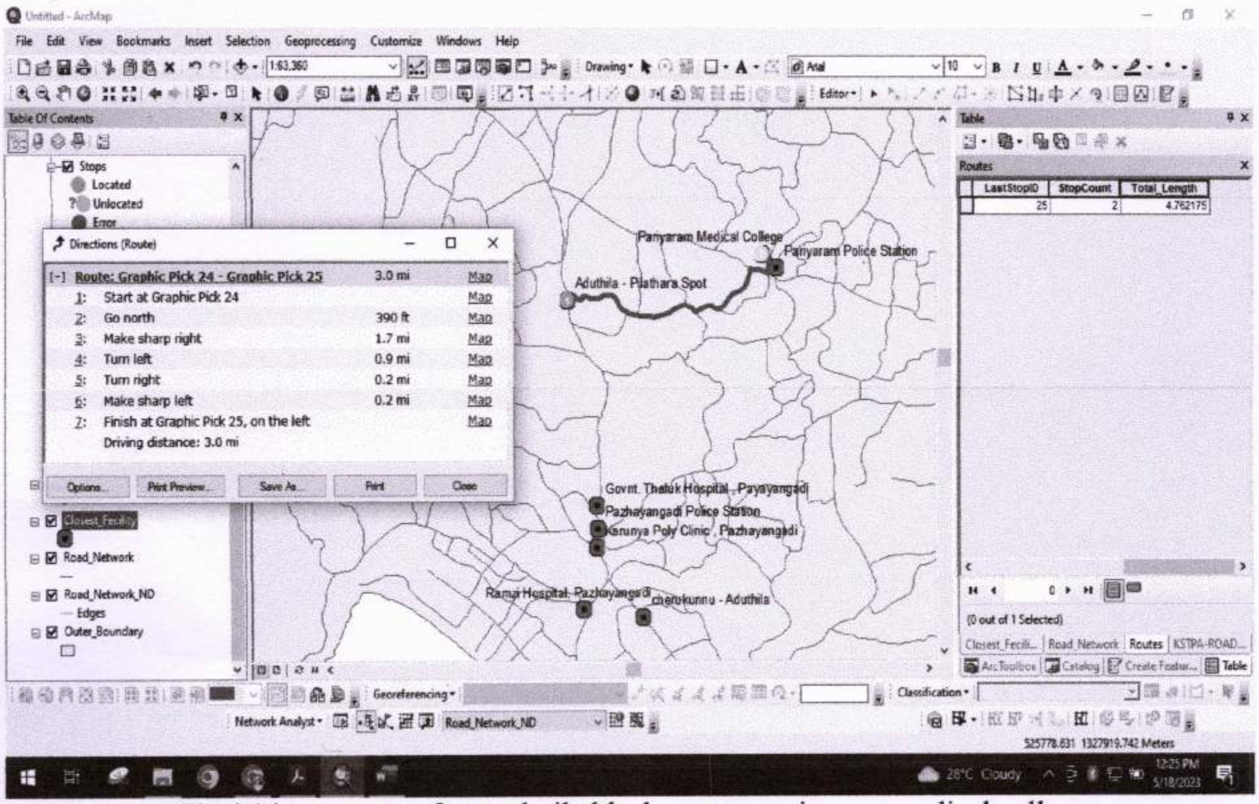

Fig 4.14: route map from adutila black spot to pariyaram medical college

4.3 BUFFER ZONES

As our facilities are within 10 km around the road we can find the shortest path using buffer zones

4.3.1 Buffer Zone in GIS

A buffer in GIS is a reclassification based on distance: classification of within/without a given proximity. Buffering involves measuring the distance outward in all directions from an object. Buffering can be done on all three types of vector data: point, line, area.

4.3.2 Generation of Buffer Zones

A Buffer zone was created for a distance of 6km around each black spot located in each section. Near by hospitals , police stations , fire stations are available in this buffer zone .

- The idea of using buffer zones instead of road network analysis to find the nearest distance between origin point and destination point is because our select road stretch is comparatively small region and all the facilities are around within 10 to 20km so it will be better to use buffer zoning than road network analysis.
- The shortest path in buffer zone is calculated in same way as road network analysis ,by selecting origin point and destination point using network location tool and selecting solve tool from tool bar ,automatically the best shortest route is generated by the software.

The fig4.15 and 4.16 shows the buffer zones of 6km radius around each blackspot and nearest facilities around the road stretch .

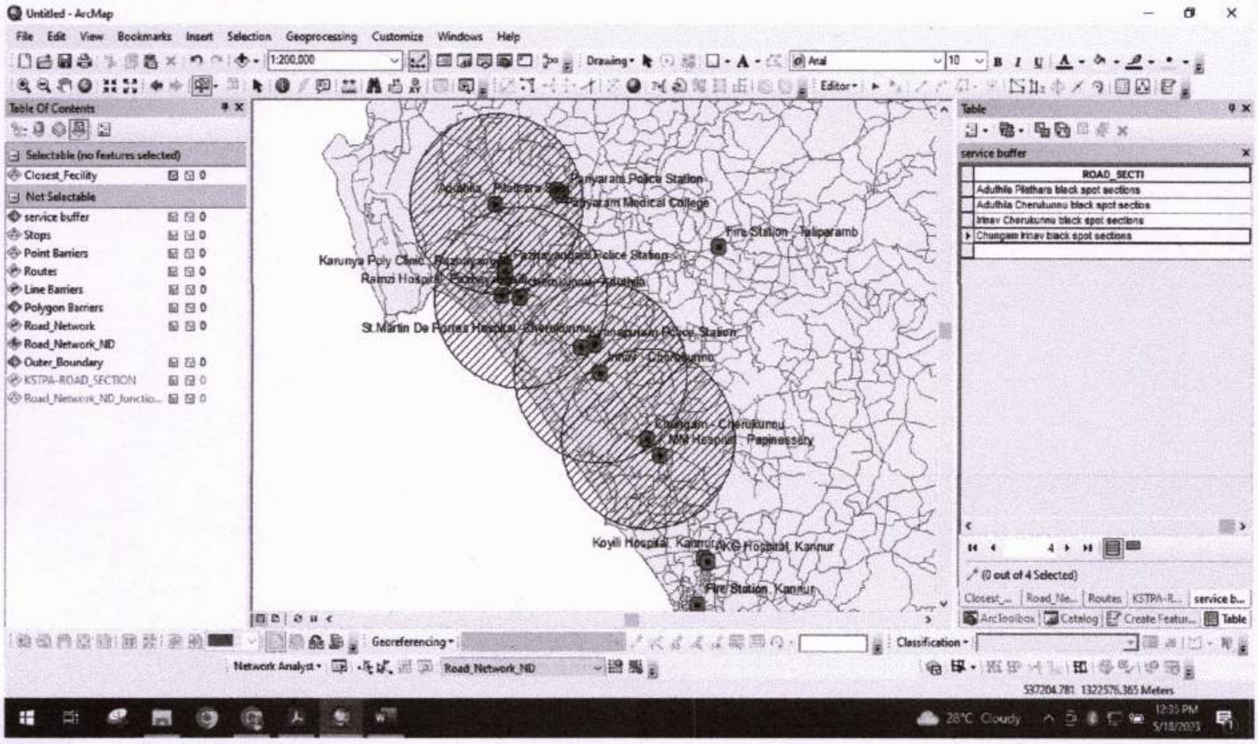

Fig4.15: buffer zones mapped around each blackspots

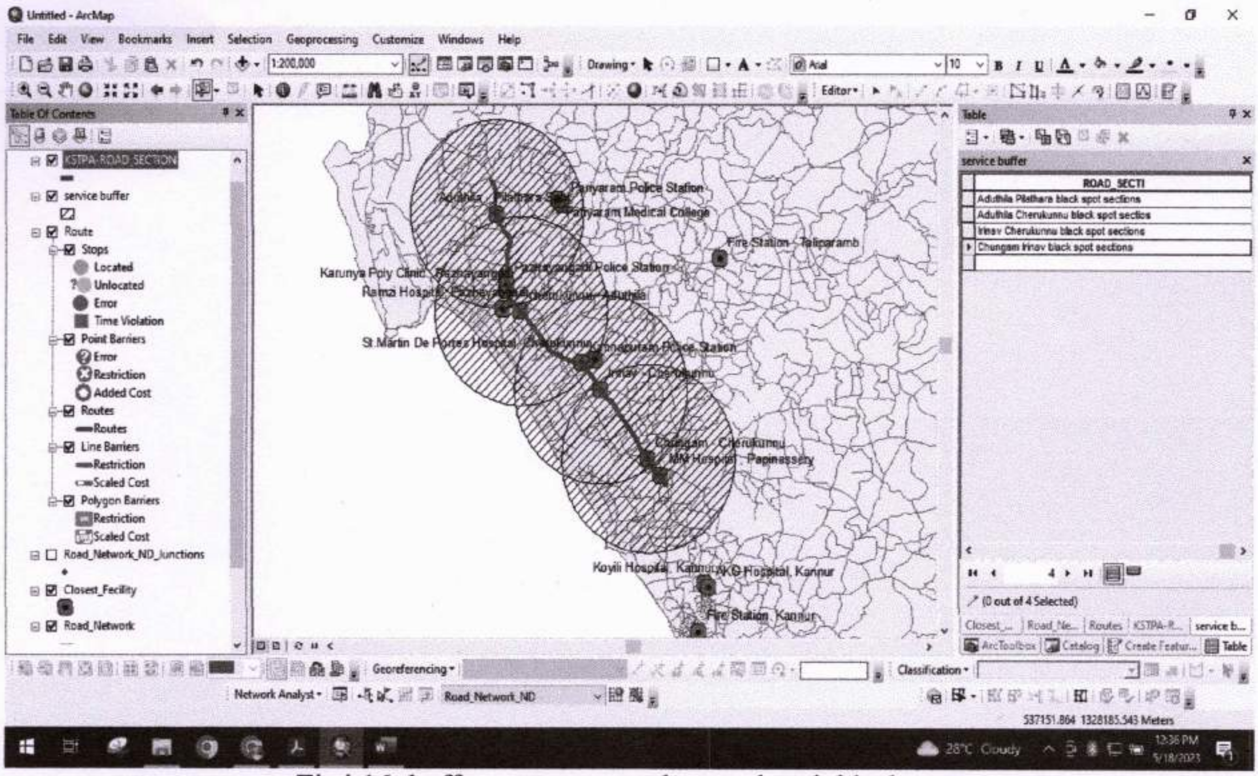

Fig4.16: buffer zones mapped around each blackspots

The figure 14.17 and 14.18 shows the buffer zones around chungam and irnav black spot and facilities provided inside the zone

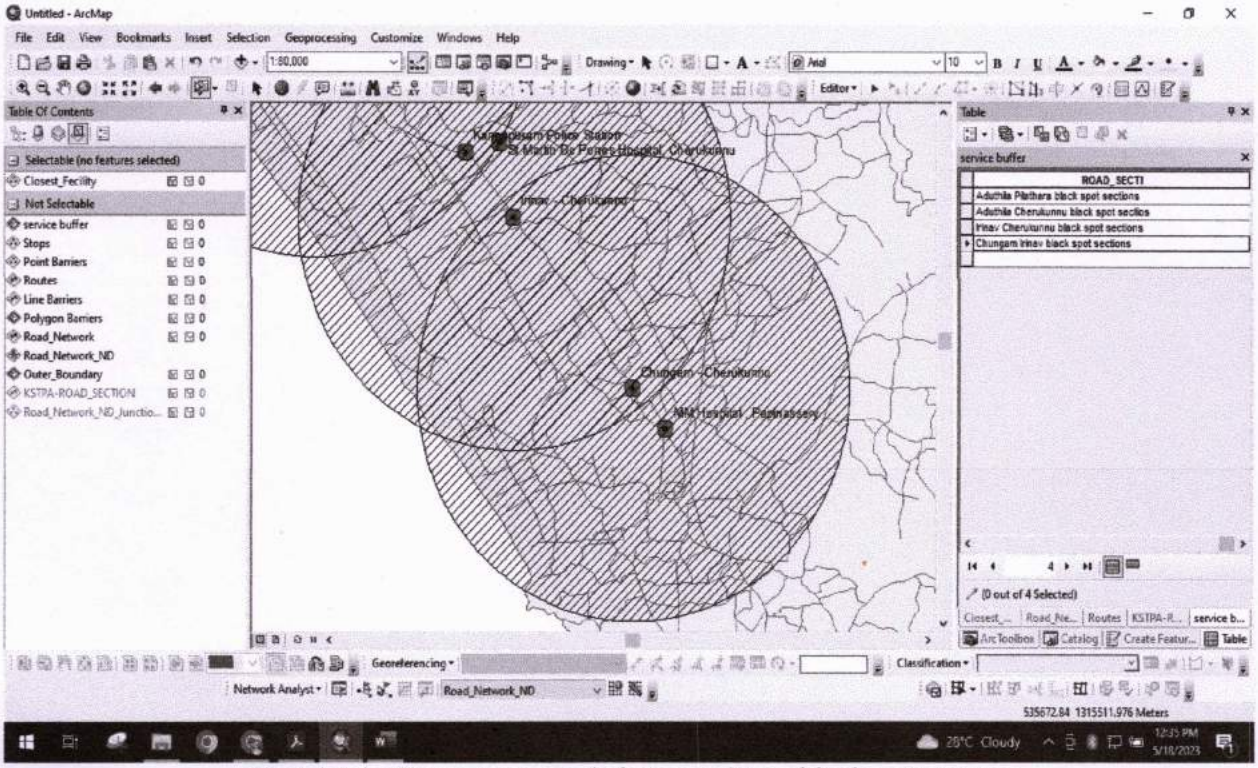

Fig4.17: buffer zone around chungam irnav blackspot section

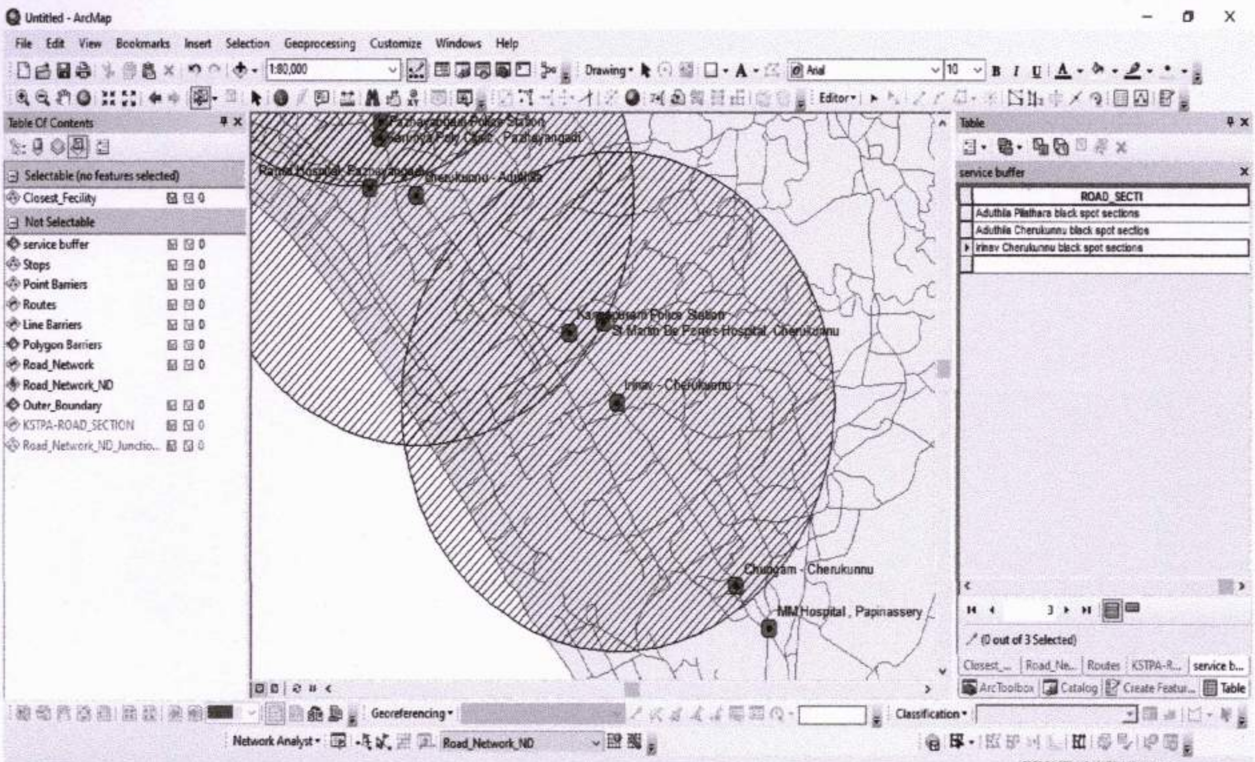

Fig4.18: buffer zone around irnav cherukunnu black spot section

The fig 14.19 and 14.20 shows the buffer zones generated around cherukunnu adutila black spot and adutila pilathara black spot and the facilities inside the zone.

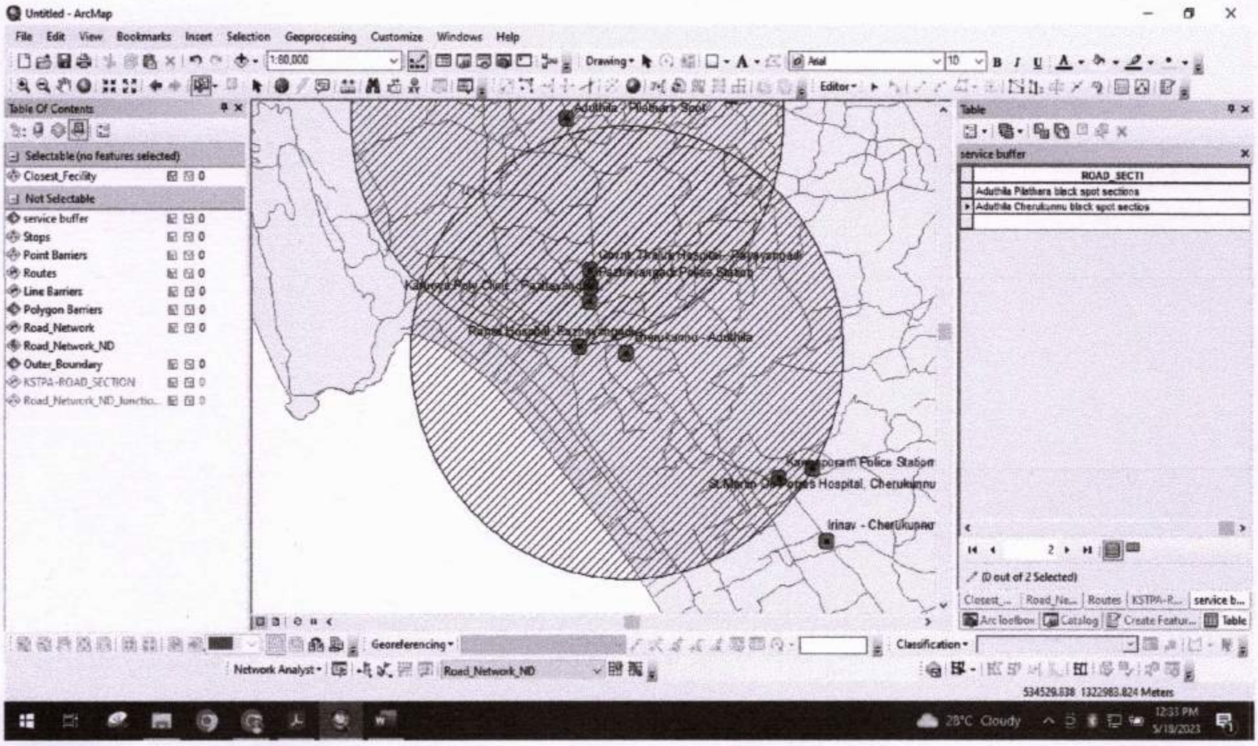

Fig4.19: buffer zone around adutila cherukunnu black spot section

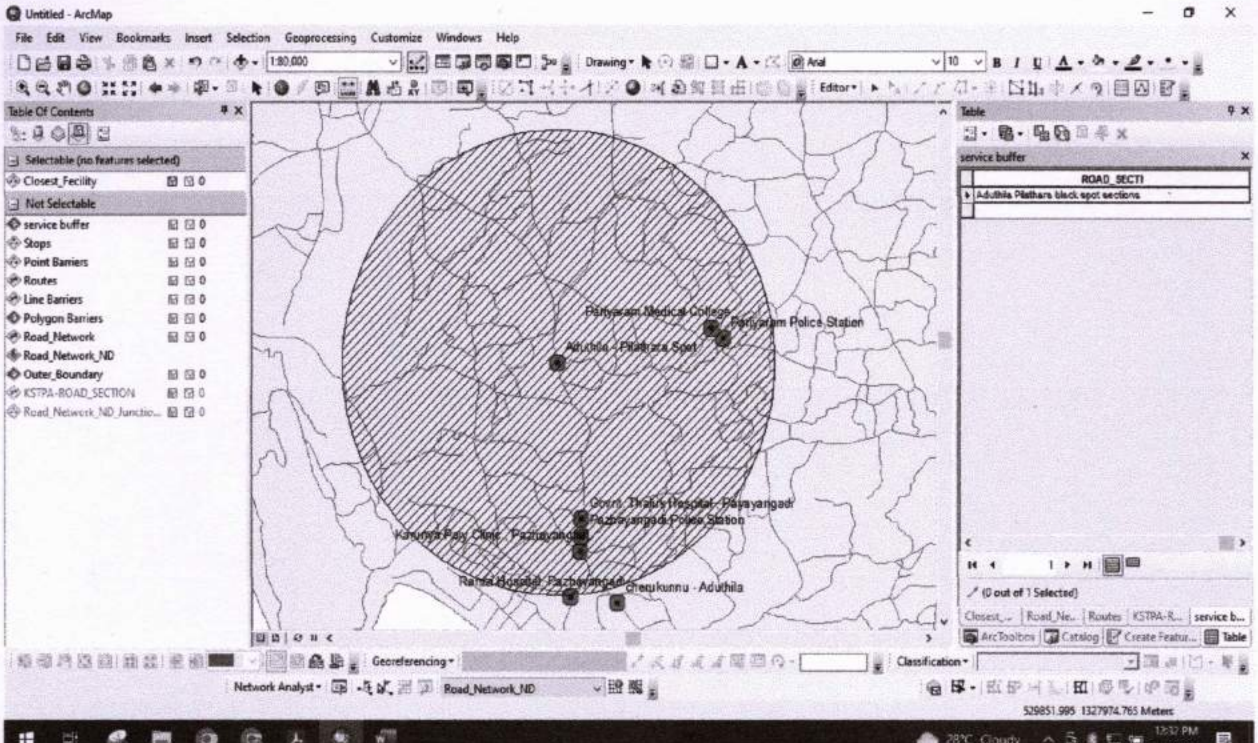

Fig4.20: buffer zone around adutila pilathara blackspot section

CHAPTER 5

CONCLUSION

5.1 General

i. The study was an attempt to identify the most vulnerable accident black spots in the study stretch from Pilathara to Chungam on SH64.

ii. The required road characteristics and traffic parameters of the spots were obtained.

iii. For each parameter thus collected, weightage within the range of 0-10 was assigned such that least weightage was given to the factor that contributes least to the occurrence of accidents.

iv. All the spots were then again prioritized in GIS using the prioritization scheme

v. By creating road network map and assigning the datas of near by hospitals ,police stations and fire station .

vi. When a accident occurs we can locate the near by facilities and shortest path to reach these facilities form the accident spot.

vii. The distance and map navigation are also provided

5.2 RECOMMENDATIONS

From detailed observations and analysis of each spot it was found that there is scope for improvements at each spot. Some suggestions for the possible improvements of the spots are made here ;

i. Removal of unnecessary edge obstructions like electric posts, hand rails, bushes.

ii. Provide sign boards indicating staggered T intersection.

iii. Provide sufficient paved shoulders and raised pavement reflectors

iv. Provide street lights at each intervals wherever required.

v. Provide warning signals at accident prone areas.

vi. Provide dividers

vii. Provide Rumble strips at long roads.

viii. Proper data collection methods need to be conveyed to the personnel doing the ground work. This will result in improved accuracy of the accident dataset.

ix. The limitations we faced was there was no exact location(latitude and longitudinal points) of the place of accident in the police data.

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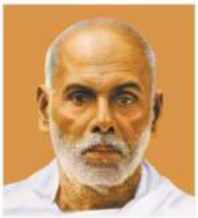

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

PROJECT REPORT

on the title

"EARLY DETECTION OF ALZHEIMER'S DISEASE USING MACHINE LEARNING AND DEEP LEARNING"

Report submitted in partial fulfillment of the Requirements for the Award of the Degree of

BACHELOR OF TECHNOLOGY

in

COMPUTER SCIENCE AND ENGINEERING

By

MISHAB C.P. – SNC19CS020

PALLAVI SWAROOP KUMAR – SNC19CS025

SIDHARTH K. – SNC19CS030

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Under the guidance of

Prof. SUNDER V

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY

AFFILIATED TO A P J ABDUL KALAM TECHNOLOGICAL UNIVERSITY,

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2022-2023

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that the Project report entitled **Early Detection of Alzheimer's Disease using Machine Learning and Deep Learning** submitted by **Ms. Pallavi Swaroop Kumar (SNC19CS025)**, in the partial fulfillment for the award of the Degree of Bachelor of Technology in Computer Science and Engineering to **A P J ABDUL KALAM TECHNOLOGICAL UNIVERSITY**, KERALA, is a record of bonafide work carried out under my guidance and supervision.

21/6/2023

Guide:

Prof. SUNDER V

21/6/2023

Head of the department:

Prof. SUNDER V

Dr. LEENA A. V.
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KANNUR

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THANKING YOU,

Pallavi Swaroop Kumar

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PROJECT OBJECTIVE

The primary objective of this project is to develop a comprehensive system for the detection and prediction of Alzheimer's disease (AD) using a combination of deep learning and machine learning techniques. The specific objectives of the project are as follows:

Design and implement a deep learning-based algorithm for feature extraction from magnetic resonance imaging (MRI) scans: The project aims to utilize convolutional neural networks (CNNs) for the extraction of meaningful features from MRI scans. By leveraging the power of deep learning, the system can automatically learn relevant patterns and structures in the images, improving the accuracy of AD detection.

Develop a machine learning-based classification model using Random Forest: In addition to CNN-based feature extraction, the project incorporates Random Forest classifiers for the classification stage. Random Forest is known for its ability to handle high-dimensional data and feature interactions, making it suitable for the classification of AD cases based on the extracted features.

Build an intuitive web-based admin module: The project involves the development of an admin module as a web application using the Flask framework. The admin module provides healthcare professionals with a user-friendly interface to upload MRI scans, process them using the deep learning and machine learning models, and obtain accurate AD detection results. The module should facilitate easy data management, model training, and result visualization.

Develop a user module as an Android application: The project includes the development of a user module as an Android application. The user module aims to provide individuals with access to relevant information about AD, educational resources, and updates on AD research. It should serve as a platform for raising awareness about the disease and promoting early detection.

Utilize a comprehensive and diverse dataset for training and evaluation: The project requires the compilation of a representative dataset of MRI scans from individuals with and without AD. The dataset should encompass a wide range of demographics, ensuring the reliability and generalizability of the developed system. The dataset will be used for training the deep learning and machine learning models, as well as evaluating their performance.

Evaluate the performance of the developed system: The project involves thorough performance evaluation of the system, including the accuracy, precision, recall, and F1-score of AD detection.

Comparative analysis between the CNN-based deep learning model and the Random Forest classifier will be conducted to determine the effectiveness of each approach. The evaluation will also consider the system's computational efficiency and user-friendliness.

Provide a robust and scalable system architecture: The project aims to design and implement a system architecture that is scalable, allowing for future enhancements and expansion. The architecture should be capable of handling large volumes of data, accommodating potential updates to the deep learning and machine learning models, and integrating with other healthcare systems or databases.

By achieving these objectives, the project aims to contribute to the early detection and prediction of AD, ultimately improving patient care and management of the disease. The developed system has the potential to assist healthcare professionals in accurate AD diagnosis, provide individuals with valuable information and resources, and promote awareness about the disease in the wider community.

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PROJECT OUTCOME

The project outcome demonstrates the effectiveness of the deep learning-based feature extraction using CNNs and the machine learning-based classification using Random Forest for AD detection and prediction. The accuracy comparison of different algorithms provides valuable insights into their performance for AD detection. The results contribute to the field's knowledge and have practical implications in assisting medical professionals in early AD diagnosis.

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LIST OF FIGURES

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LIST OF ABBREAVATION

SYMBOL	DESCRIPTION
ML	MACHINE LEARNING
SVM	SUPPORT VECTOR MACHINE
ANN	ARTIFICIAL NEURAL NETWORK
AD	ALZHEIMER'S DISEASE
MRI	MAGNETIC RESONANCE IMAGING
CNN	CONVULATION NEURAL NETWORK

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ABSTRACT

Alzheimer disease (AD) is a neurological disorder. For the AD, there is no specific treatment. Early detection of Alzheimer's disease can help patients receive the correct care. Many studies employ statistical and machine learning techniques to diagnose AD. The human-level performance of Deep Learning algorithms has been effectively shown in different disciplines. In the proposed methodology, the MRI data is used to identify the AD and Deep Learning technique is used to classify the present disease. The classification of Alzheimer's disease using deep learning methods has shown promising results, and successful application in clinical settings requires a combination of high accuracy, short processing time, and generalizability to various populations. In this study, we developed a system of Alzheimer's disease detection using Convolutional Neural Network (CNN) architecture using magnetic resonance imaging (MRI) scans images which are trained using Kaggle dataset. The models in this study are trained on the same dataset in order to analyse their performances. The Convolutional Neural Network (CNN) architecture gives the highest accuracy where training accuracy is 86.34% and validation accuracy is 86.45% on the test data that detects AD accurately.

CHAPTER 1

INTRODUCTION

Alzheimer's disease (AD) is a progressive and degenerative brain disorder that affects memory, thinking, and behavior. It is the most common cause of dementia in older adults and can severely impair a person's ability to carry out daily activities. Symptoms of Alzheimer's disease usually develop gradually and worsen over time, becoming severe enough to interfere with daily functioning. The exact cause of Alzheimer's disease is not known, but it is believed to be related to a combination of genetic, environmental, and lifestyle factors. There is no known cure for Alzheimer's disease, but there are treatments that can help manage the symptoms and improve quality of life. Alzheimer's disease (ad) is the leading cause of dementia and poses a significant social and economic challenge. It is responsible for more than half of all cases of dementia. Over 50 million individuals currently suffer from dementia worldwide with a projected increase to 152 million by 2050. The early signs of the disease include forgetting recent events or conversations.

As the disease progresses, a person with Alzheimer's disease will develop severely memory impairment and lose the ability to carry out everyday tasks. Medications may temporarily improve or slow the progression of symptoms. These treatments can sometimes help people with Alzheimer's disease maximize function and maintain independence for a time. Different programs and services can help support people with Alzheimer's disease and their caregivers. In advanced stages of the disease, complications from severe loss of brain function — such as dehydration, malnutrition, or infection — result in death. No cure for the ad has been discovered, but there is an intense effort to develop new clinical interventions that may slow or halt the disease. Such interventions are aimed at the early stages of the disease prior to extensive cell damage when it is thought treatment is more likely to be effective.

SYMPTOMS:

Memory loss is the key symptom of Alzheimer's disease. Early signs include difficulty remembering recent events or conversations. As the disease progresses, memory impairments worsen and other symptoms develop. At first, a person with Alzheimer's disease may be aware of having difficulty remembering things and organizing thoughts. A family member or friend may be more likely to notice how the symptoms worsen. Brain changes associated with Alzheimer's disease led to growing trouble with:

MEMORY

Everyone has occasional memory lapses, but the memory loss associated with Alzheimer's disease persists and worsens, affecting the ability to function at work or at home.

People with Alzheimer's may:

- Repeat statements and questions over and over
- Forget conversations, appointments or events, and not remember them later
- Routinely misplace possessions, often putting them in illogical locations
- Get lost in familiar places
- Eventually forget the names of family members and everyday objects
- Have trouble finding the right words to identify objects, express thoughts or take part in conversations

THINKING AND REASONING

Alzheimer's disease causes difficulty concentrating and thinking, especially about abstract concepts such as numbers. Multitasking is especially difficult, and it may be challenging to manage finances, balance check books, and pay bills on time.

Eventually, a person with Alzheimer's may be unable to recognize and deal with numbers.

MAKING JUDGMENTS AND DECISIONS

Alzheimer's causes a decline in the ability to make reasonable decisions and judgments in everyday situations. For example, a person may make poor or uncharacteristic choices in social interactions or wear clothes that are inappropriate for the weather. It may be more difficult to respond effectively to everyday problems, such as food burning on the stove or unexpected driving situations.

PLANNING AND PERFORMING FAMILIAR TASKS

Once-routine activities that require sequential steps, such as planning and cooking a meal or playing a favourite game, become a struggle as the disease progresses. Eventually, people with advanced Alzheimer's often forget how to perform basic tasks such as dressing and bathing.

CHANGES IN PERSONALITY AND BEHAVIOR

Brain changes that occur in Alzheimer's disease can affect moods and behaviors. Problems may include the following:

- Depression
- Apathy
- Social withdrawal
- Mood swings
- Distrust in others
- Irritability and aggressiveness
- Changes in sleeping habits
- Wandering
- Loss of inhibitions
- Delusions, such as believing something has been stolen

PRESERVED SKILLS

Many important skills are preserved for longer periods even while symptoms worsen. Preserved skills may include reading or listening to books, telling stories and reminiscing, singing, listening to music, dancing, drawing, or doing crafts. These skills may be preserved longer because they are controlled by parts of the brain affected later in the course of the disease.

CAUSES:

The exact causes of Alzheimer's disease aren't fully understood. But at a basic level, brain proteins fail to function normally, which disrupts the work of brain cells (neurons) and triggers a series of toxic events. Neurons are damaged, lose connections to each other and eventually die. Scientists believe that for most people, Alzheimer's disease is caused by a combination of genetic, lifestyle and environmental factors that affect the brain over time. Less than 1% of the time, Alzheimer's is caused by specific genetic changes that virtually guarantee a person will develop the disease. These rare occurrences usually result in disease onset in middle age. The damage most often starts in the region of the brain that controls memory, but the process begins years before the first symptoms. The loss of neurons spreads in a somewhat predictable pattern to other regions of the brains. By the late stage of the disease, the brain has shrunk significantly.

Researchers trying to understand the cause of Alzheimer's disease are focused on the role of two proteins:

- **Plaques.**

Beta-amyloid is a fragment of a larger protein. When these fragments cluster together, they appear to have a toxic effect on neurons and to disrupt cell-to-cell communication. These clusters form larger deposits called amyloid plaques, which also include other cellular debris.

- **Tangles.**

Tau proteins play a part in a neuron's internal support and transport system to carry nutrients and other essential materials. In Alzheimer's disease, tau proteins change shape and organize themselves into structures called neurofibrillary tangles. The tangles disrupt the transport system and are toxic to cells.

RISK FACTORS:

- Age
- Family history and genetics
- Down syndrome
- Sex
- Mild cognitive impairment
- Head trauma
- Air pollution
- Excessive alcohol consumption
- Poor sleep patterns
- Lack of exercise
- High blood pressure and cholesterol
- Poorly controlled type 2 diabetes
- Lifelong learning and social engagement

model while the generalization ability of the ensemble model was maximized to successfully capture AD-related brain variations early in the disease process; it can also provide new insights into understanding the complex heterogeneity of whole-brain MRI changes in AD. Further research is needed to examine the clinical implication of the finding, capability of the advocated CNN-EL approach to help understand and evaluate an individual subject's disease status, symptom burden and progress, and the generalizability of the advocated CNN-EL approach to locate the most discriminable brain regions in the detection of other brain disorders such as schizophrenia, autism, and severe depression, in a data-driven way.

2.2 LITERATURE REVIEWS

2.2.1 EARLY DETECTION OF ALZHEIMER'S DISEASE USING VARIOUS MACHINE LEARNING TECHNIQUES: A COMPARATIVE STUDY

Alzheimer's disease (AD) is an incurable, progressive neurodegenerative disease, which leads to the loss of memory. Various psychological tests are used by doctors to diagnose patients, albeit, there is no well-defined procedure to detect AD in its early stage. This paper comprises of exhaustive analysis and accuracy of various machine learning techniques on a combination of different biomarkers associated with the disease. Since no prior research has suggested the use of a Voting Classifier Algorithm for early detection of AD, the present study attempts to crystallize the intrusion of the averaging factor through Soft Voting Classifier, which influences the accuracy of the output in away, that it removes the possibility of inaccuracies in the result by averaging the probable outcomes of the classifiers in the previous stage, giving the best possible result and making it more precise. A performance gain of 86% is obtained using Soft Voting classifier, wherein 437 cases are analyzed in our dataset, eliminating all the ineffective entries. Alzheimer's disease (AD) is a neurological disorder prominently caused by old age, which results in gradual memory loss. This matter requires attention, for AD is growing at an alarming rate and in no time it will swamp the world with every next person suffering from his baneful disease, will it not be paid attention to, both in terms of its early detection and its cure? Alzheimer's disease was named after Dr. Alois Alzheimer. The symptoms include memory loss, The trouble with familiar tasks, difficulties with problem-solving, changes in mood, language problems, and unpredictable behavior, which changes according to the stage of the disease. The synapses in the neurons are responsible for the neurotransmissions responsible for the transmission of signals in the brain, which makes the communication between neurons happen. During the business of communicating information, in addition to releasing neurotransmitters, neurons also release a small peptide called Amyloid beta.

While the molecular causes of Alzheimer's are still debatable, most scientists believe that the origin of dementia is an accumulation of Amyloid beta between synapses forming Amyloid plaques. Apart from that, a protein called tau is known to form tangles in the areas of the brain crucial for memory, and then, gradually causing inflammation and cellular damage leading to the destruction of cells and neurons, which in turn results in memory loss. Some scientists believe that the only cure for Alzheimer's disease is to keep the Amyloid Beta plaques from reaching the threshold. Thus, early detection of AD becomes imperative as it may increase the chances of proactive treatments in the future. Yet, only a tiny fraction of patients is formally diagnosed or treated. Memory loss is considered an inevitable part of aging, rather than a sign of a degenerative disease. There is no available cure for the illness, just medicines to control the symptoms. These medications do not cure Alzheimer's Disease but keep the symptoms in check so the patient can lead a healthy life for some years, not to mention the fact that AD is fatal.

For the detection of Alzheimer's disease, primal methods such as documentation of neurological deterioration are used. To detect the disease, various psychological tests such as Monumental State Examination (MMSE) and Clinical Dementia Rating (CDR) are assessed by neurologists, albeit no concrete test is available for early detection of the disease. For a definitive diagnosis, invasive tests such as post-mortem neuropathological brain tissue tests can be done, but no non-invasive methods are available. Apart from that, imaging tests like resonance imaging (MRI), positron emission tomography (PET), cerebrospinal liquid (CSF) can also be used for superior determination, but they are costly, and not all people can afford it. In this context, it is worthwhile to consider that leaning towards Machine Learning for developing better diagnostic tools is of paramount importance at present.

After scrutinizing the available options, five machine learning algorithms are finalized. From primal algorithms such as support vector machine to developed soft voting classifier, this paper has listed the techniques and the accuracy is achieved by applying them on the dataset

- Support vector machine

  A support vector machine (SVM) also known as support vector network (svn) is a machine learning algorithm that analyzes data for classification and regression analysis. SVM is a supervised learning method that looks at data and sorts it into one of two categories. An SVM outputs a map of the sorted data with the margins between the two as far apart as possible. SVMs are used in text categorization, image classification, handwriting recognition, and in the sciences.

- Voting classifier

A Voting Classifier is a machine learning model that trains on an ensemble of numerous models and predicts an output (class) based on the highest probability of chosen class as the output. It simply aggregates the findings of each classifier passed into Voting Classifier and predicts the output class based on the highest majority of voting. The idea is instead of creating separate dedicated models and finding the accuracy for each of them, we create a single model which trains by these models and predicts output based on their combined majority of voting for each output class. Classified as the following:

  - Hard voting classifier

    In hard voting, the predicted output class is a class with the highest majority of votes i.e., the class which had the highest probability of being predicted by each of the classifiers. Suppose three classifiers predicted the *output class (A, A, B)*, so here the majority predicted *A* as output. Hence *A* will be the final prediction.

  - Soft voting classifier

    In soft voting, the output class is the prediction based on the average of probability given to that class. The class with the highest probability is given the most priority.

- Decision tree algorithm

Decision Tree is a Supervised learning technique that can be used for both classification and Regression problems, but mostly it is preferred for solving Classification problems. It is a tree-structured classifier, where internal nodes represent the features of a dataset, branches represent the decision rules and each leaf node represents the outcome. In a Decision tree, there are two nodes, which are the Decision Node and Leaf Node. Decision nodes are used to make any decision and have multiple branches,

CHAPTER 2

SYSTEM ANALYSIS

2.1 EXISTING SYSTEM

Early detection is critical for effective management of Alzheimer's disease (AD) and screening for mild cognitive impairment (MCI) is common practice. Among several deep-learning techniques that have been applied to assessing structural brain changes on magnetic resonance imaging (MRI), convolutional neural network (CNN) has gained popularity due to its superb efficiency in automated feature learning with the use of a variety of multilayer perceptrons. Meanwhile, ensemble learning (EL) has shown to be beneficial in the robustness of learning-system performance via integrating multiple models. Here, we proposed a classifier ensemble developed by combining CNN and EL, i.e., the CNN-EL approach, to identify subjects with MCI or AD using MRI: i.e., classification between (1) AD and healthy cognition (HC), (2) MCIc (MCI patients who will convert to AD) and HC, and (3) MCIc and MCInc (MCI patients who will not convert to AD). For each binary classification task, a large number of CNN models were trained applying a set of sagittal, coronal, or transverse MRI slices; these CNN models were then integrated into a single ensemble. Performance of the ensemble was evaluated using stratified fivefold cross-validation method for 10 times. The number of the intersection points determined by the most discriminable slices separating two classes in a binary classification task among the sagittal, coronal, and transverse slice sets, transformed into the standard Montreal Neurological Institute (MNI) space, acted as an indicator to assess the ability of a brain region in which the points were located to classify AD. Thus, the brain regions with most intersection points were considered as those mostly contributing to the early diagnosis of AD. The result revealed an accuracy rate of 0.84 ± 0.05, 0.79 ± 0.04, and 0.62 ± 0.06, respectively, for classifying AD vs. HC, MCIc vs. HC, and MCIc vs. MCInc, comparable to previous reports and a 3D deep learning approach (3D-SENet) based on a more state-of-the-art and popular Squeeze-and-Excitation Networks model using channel attention mechanism. Notably, the intersection points accurately located the medial temporal lobe and several other structures of the limbic system, i.e., brain regions known to be struck early in AD. More interestingly, the classifiers disclosed multiple patterned MRI changes in the brain in AD and MCIc, involving these key regions. These results suggest that as a data-driven method, the combined CNN and EL approach can locate the most discriminable brain regions indicated by the trained ensemble whereas Leaf nodes are the output of those decisions and do not contain any further branches. The decisions or the test are performed on the basis of features of the given dataset.

- XGBoost algorithm

XGBoost is an implementation of Gradient Boosted decision trees. XGBoost models majorly dominate in many Kaggle Competitions. In this algorithm, decision trees are created in sequential form. Weights play an important role in XGBoost. Weights are assigned to all the independent variables which are then fed into the decision tree which predicts results. The weight of variables predicted wrong by the tree is increased and these variables are then fed to the second decision tree. These individual classifiers/predictors then ensemble to give a strong and more precise model. It can work on regression, classification, ranking, and user-defined prediction problems.

- Random Forest Classifier

Every decision tree has high variance, but when we combine all of them together in parallel then the resultant variance is low as each decision tree gets perfectly trained on that particular sample data and hence the output doesn't depend on one decision tree but multiple decision trees. In the case of a classification problem, the final output is taken by using the majority voting classifier. In the case of a regression problem, the final output is the mean of all the outputs. This part is Aggregation. The basic idea behind this is to combine multiple decision trees in determining the final output rather than relying on individual decision trees. Random Forest has multiple decision trees as base learning models. We randomly perform row sampling and feature sampling from the dataset forming sample datasets for every model. This part is called Bootstrap.

From the experiment above, it is affirmative regarding the significance of biomarkers in the detection of Alzheimer's disease. Monumental State Examination, Clinical Dementia Rating, Normalized Whole Brain Volume can be used exclusively for the detection of Alzheimer's disease. The decision trees algorithm produced results with a mere accuracy of 79%, whereas the XG Boost algorithm achieved an accuracy of 80%. The algorithms, such as Support Vector Machine and Rain forest classifier, could only achieve an accuracy of 81%. No prior research has been done on the Voting Classifier, which worked well for the selected biomarkers in terms of accuracy when compared to other algorithms tested. Both the hard voting classifiers and soft voting classifiers are applied on our dataset and achieved an accuracy of 84% and 86%, respectively. Soft Voting Classifier is best suited for our set of biomarkers when compared with other algorithms used. The weight associated with multiple classifiers in the soft voting system, increases the precision, thus increasing the accuracy. Th is paper has concluded that the Soft voting classifier, when applied on bio-markers such as many mental state examination, clinical dementia rating, normalized whole brain volume produces the highest accurate results.

2.2.2 BLOOD VESSEL FEATURE DESCRIPTION FOR DETECTION OF ALZHEIMERS DISEASE

Alzheimer's disease (AD) is the commonest form of dementia, affecting over 800,000 people in the UK and with no efficient treatment. Diagnosis is difficult, as many neurodegenerative conditions present with a similar picture. Amyloid beta (A_) is a normal product of metabolism, cleaved from an amyloid precursor protein (APP). Young brains are equipped with different mechanisms to break down and eliminate A_, but with aging and on the background of different genotypes the elimination of A_ fails, leading to its accumulation and to AD. The accumulation of A_ in the walls of blood vessels of the brain reflect a failure of its elimination along the walls of blood vessels. In recent years, researchers have tried to detect AD in the human brain using image processing techniques. Most of them have used MRI and CT scans to detect the abnormalities in the human brain including texture and shape abnormalities. For example, Li detected the shape changes of corpus callosum in AD. In addition, Free borough evaluated a texture feature vector to discriminate the AD with the normal brain, while Fischl introduced a new method to measure the thickness of the human cerebral cortex by considering the white and the grey matter. However, although the methods using computer vision have been demonstrated some detection capability, little attention has been given to detecting the abnormalities of specific components in the brain that are affected by amyloid beta, such as blood vessels. The concept of the early onset detection of AD has yet to receive much research attention. Naturally, any approach that can detect AD at the onset or early in its progression could be invaluable in medical planning. Blood vessels have previously been analysed in diagnosis of diabetes, hypertension and atherosclerosis supporting their potential use for diagnosing Alzheimer's disease. The importance of blood vessels towards diagnosing the disease has suggested the need for detection of the abnormalities of the blood vessels using computer vision. This is made difficult by the limited observations and understanding of blood vessels patterns. Natural pattern such as a sea fans, river deltas and trees show structural similarity that have yet to be understood by human and computer vision. The detection of a blood vessel's pattern can use many features such as density and tortuosity which can be appropriate to define the blood vessels for Alzheimer's disease detection. To our knowledge, there has been no prior analysis of branching structure, especially in the analysis of blood vessels and in the diagnosis of Alzheimer's disease. In this study, we describe the branching structure of blood vessels by their density, by a new invariant measure of branching structure, and by their tortuosity. Our aim is to detect the signs of AD at early stage by focusing on the objects that have been most affected by this disease in early onset detection as the high density of blood vessels in Alzheimer's disease could show early sign of the disease and the inspiration of detection diabetes and other's disease by their tortuosity [8, 10] A particular focus of this paper is the analysis of blood vessel analysis of blood vessel shape for the detection of Alzheimer's disease. This confirms that the branching structure is consistent with the presence of Alzheimer's disease and confirms the influence of the branching structure on shape and on disease detection. The first task was to determine which of the Fourier descriptors was most appropriate here. The correct classification rates for the detection of Alzheimer's disease where the horizontal axis is the value of k used within the k-NN rule. Subjects with AD and recognised as such, together with subjects without AD and recognised as such, are both considered to be correct classifications. A subject without AD but recognised as a subject with AD, and vice versa, is marked as an incorrect classification. The correct classification rate is shown for the Complex and the Elliptic Fourier Descriptors of vessels that have a single branching point and the comparison is between the three groups (AD, age-matched control and young). The correct classification rate is the proportion of subjects correctly classified as having Alzheimer's disease or not averaged across the three groups. As can been the Complex FDs offer greater discrimination capability, and the trend of performance of both descriptors is very similar. Correct classification rate for two different FD. We also investigated use of feature selection using Sequential Forward Floating Search (SFFS) to find which coefficients contribute the most for correct classification. It interesting that the results show the earlier coefficients are major contributors to correct classification, emphasizing the importance of overall shape. The distribution of the first and second most important descriptors is similar for the complex FDs and the EFDs, and the most important descriptions are different for vessels with branching structure, and vessels without branching structure, as expected. Accordingly, Complex Fourier descriptors are chosen to perform the description as they show a better classification rate than Elliptic Fourier descriptors. To investigate the effect of branching structure we then separated is 84.4% with use of a SVM. Since those results were not successful, a deep learning-based technique (Convolutional Neural Network) was proposed as the second experiment. The proposed Convolutional Neural Network (CNN) model was being tested using different image segmentation methods and different datasets. Finally, the best image segmentation method obtained a high accuracy around 96% (sensitivity - 96%, specificity - 98%). And the CNN model remains unbiased to the dataset. Results of those experiments suggest an important role for early diagnosis of Alzheimer's disease using image processing and deep learning techniques. Alzheimer's Disease (AD) is a neurodegenerative disease and the most common type of dementia worldwide. The current prevalence of AD is about 2% at the age of 65 and 35% or higher at the age of 85. As life expectancy increases, the number of people suffering from AD grows rapidly. In 2006, the estimated number of people with AD was 26.6 million. This number is expected to be over 100 million by 2050. Therefore, besides causing a major psychological burden on patients and families. AD is also expected to place large socioeconomic consequences in our societies as well. Alzheimer's disease is usually diagnosed based upon the person's medical history, behavioural patterns and the medical history of relatives. The National Institute of Neuro- logical and Communicative Disorders and Stroke (NINCDS) and the Alzheimer's Disease and Related Disorders Association (ADRDA, now known as the Alzheimer's Association) has established the most commonly used NINCDS-ADRDA Alzheimer's Criteria for diagnosis in 1984. These criteria require that the presence of cognitive impairment and a suspected dementia syndrome, be confirmed by neuro psychological testing for a clinical diagnosis of possible or probable AD. However, diagnosing Alzheimer's requires a careful medical evaluation. Moreover, neuropsychological tests such as the mini-mental state examination (MMSE) are widely used to evaluate the cognitive impairments needed for the diagnosis of the disease. The main disadvantages of the MMSE are, difficulty in identifying mild cognitive impairment and difficulty in recording changes in cases of severe dementia. Alzheimer's disease is considered as the loss of neurons and synapses in the cerebral cortex and in certain subcortical regions. This loss of neurons and synapses from the disease leads to clearly visible differences in brain tissues. The hippocampal atrophy, ventricle enlargement and cortex shrinkage are sensitive features of Alzheimer's disease. Therefore, doctors perform brain scans, such as Computed Tomography (CT), Magnetic Resonance Imaging (MRI), or Positron Emission Tomography (PET), to rule out the other possible causes for the symptom. Since this is time consuming and less accuracy making the diagnosis of Alzheimer's Disease is often difficult, particularly in the early stages. Moreover, the diagnosing accuracy mainly depend on the experience of the radiologists. During the recent years, there have been many studies on the automatic diagnosis of Alzheimer's disease using different methods. Several pattern classifiers have tried for the discrimination of subjects using different neuroimaging data. Different feature extraction methods and classification methods have been used in those recent studies. The main objective of this study is to overcome the problem of pre-detecting Alzheimer's disease. In general, SVM has a lower generalization error than the other classifiers hence SVM has been commonly used to solve pattern classification problems. We first used the SVM-based criteria to select the most discriminative features, and then applied the SVM-based classifier to diagnose healthy controls and AD patients using MRI brain images. In that study, they have achieved an accuracy of 90.0%, a sensitivity of 91.8% and a specificity of 87.8%. Nir et al. used the fibertract modelling method to extract image features and applied SVM to differentiate AD from NC and achieved an accuracy of 86.2%, a sensitivity of 88.0%, and a specificity of 89.2%. According to the recent studies SVM has given the best classification accuracy among the other classifiers. Bayes classifiers are a family of simple probabilistic classifiers based on Bayes' theorem. It proposed the multifold Bayesian Kernelization method, which can differentiate AD from NC with a high accuracy, but achieved poor results in diagnosing MCI subjects and non-MCI-subjects. Planetal combined the feature selection with classification using a Bayes classifier for the discrimination between AD and NC on MRI data and reported an accuracy of up to 92%. It applied the multivariate methods, to feature extraction, and then employed the Bayesian framework to classify AD with NC using PET and Single-photon emission computed tomography (SPECT) images. ANNs have been used to solve a wide variety of tasks that are hard to solve using ordinary rule-based programming. It showed that a higher sensitivity and a higher accuracy can be derived using ANN than the traditional discriminant function analysis used in dementia classification using MRI. Moreover, it employed the artificial neural network technology to build an automaton to assist neurologists during the differential diagnosis of AD and Vascular Dementia (VD). The focus of most of these studies has been relied upon the detection of AD using neuroimaging data. However, any Alzheimer's Disease pre-detection method has not been established yet. Recognizing symptoms early (Pre-detection) is crucial, as disease modifying drugs will be most effective if administered early in the course of disease before any irreversible brain damage occurs. At present, there is no any curative treatment for Alzheimer's disease. The objective of the disease modifying drugs is rather to slow down the progression of the disease, address the behavioural problems and to improve the quality of life. In order to slow down the progression, early diagnosis of the Alzheimer's disease is important. Also, having an early diagnosis helps people with Alzheimer's and their families in different ways such as planning for the future, to be concerned on financial and legal matters and making living arrangements. Bianchini M and Scarselli F have studied on the complexity between shallow neural networks and deep neural networks in 2014. According to their comparison, deep neural networks perform well than the shallow nets. Also, they have emphasized that the deep networks can perform well in classification problems with few resources. Moreover, Schindler A, Lidy T and Rauber A compare Shallow versus Deep Neural Network Architectures for Automatic Music Genre Classification. In their comparison, they have indicated that the deep neural networks outperform over shallow neural networks in each dataset that they have used. Convolutional Neural Networks (CNNs) are a category of deep neural networks that have proven very effective in areas such as image recognition and classification. Also, it is a type of feed-forward artificial neural network which learn image features by its own in the convolutional layer. In 2016 Bojarski M, Testa D and et al studied on "End to End Learning for Self-Driving Cars". In that study, they have trained a CNN to map raw pixels from a single front facing camera directly to steering commands. Finally, they concluded that without any explicit labelling, CNN had the capacity to learn meaningful road features. Krizhevsky A, Sutskever I and Hinton G trained a deep convolutional neural network to classify ImageNet dataset. They have selected only 1.2 million images from the ImageNet dataset which belongs to 100 classes for their study with the use of Graphics Processing Unit (GPU). Finally, they won the top- 5 test error rate of 15.3% in ImageNet Large Scale Visual Recognition (ILSVR) Challenge in 2012. He studied on real time object detection in 2015. They proposed a CNN to classify ImageNet dataset and Microsoft COCO object detection dataset. They achieved the first place in both ILSVR 2015 and Microsoft COCO 2015 competitions. They got the lowest error rate for large scale image classification among the other classification methods., images were sharpened using the unsharp masking filter and edges were detected using the Canny edge detection algorithm. Here the edges were detected since the volume of the ventricles, hippocampal and cortex are considered as features. Moreover, images were segmented using the Region of Interest (ROI) method.

A. Experiment 1: Accuracy testing using SVM

During the recent years, there were many studies on the automatic diagnosis of AD using different methods and different data sets. However, the comparison made between those studies and their results are not practicable since they have used different data sets, different diagnosing methods and different features of the brain. Therefore, in this study, the most recent and the common detection methods were tested as the first experiment. This study mainly depends on our main assumption (if there is a successful detection method it would definitely generate successful results at the pre-detection). The Support Vector Machines (SVMs) have been used extensively for the detection studies. An SVM with a Radial Basis Function (RBF) kernel were implemented to verify the recent diagnosing methods since it provides the best classification results when there is small number of features and large amount of data. For this experiment, only two classes were used (AD and Healthy - NL) since SVM is binary classifier which doesn't perform well in multiclass classifications.

B. Experiment 2: Application of CNN

It is apparent that the previously utilized SVM method is not ideal to detect symptoms of mild to moderate AD cases (Pre-detection stage) from the results obtained from the initial experiment. CNN has the best results when compared to any other image classification method. Therefore, a CNN was implemented to classify brain images. The proposed CNN architecture consists of two convolutional layers, one pooling layer and a fully connected layer. That CNN model was implemented using Theano1 and Keras2 python deep learning libraries and it was used for each sub experiment. Two sub experiments were initiated to select the best segmentation method and to evaluate the robustness of the model. Pre-processed images were further processed in order to achieve the best result. All the images which were to be input to the CNN model were resized into 160 x 160 dimension because different sizes may reduce the accuracy of the classification. Then reformatted images were stored in a matrix in a flattened format. Because the flatten format will merge all the layers of the image into a single layer. After flattering, all the images have the same appearance, but the difference is that image contents are in a single layer. The data were labelled with the corresponding class (0 - AD, 1 - MCI, 2 - NL). Afterward, the data set was shuffled. Then the data set has been divided(split) into training set and testing set with a ratio of 80/20 (80%for training and 20% for testing). The Batch size, the number of classes and the number of epochs were defined as 32, 3 and 20 respectively. Batch size defines the number of samples that are going to be propagated through the network. This model takes 32 samples (first 32 images) from the training set and train the network then it takes next 32 samples and train again. An epoch is one forward pass and one backward pass of all the training samples. Here the number of epochs is 20 because a number of epochs should be defined by doing lots of experiments on the same network. The number of epochs shouldn't be either very small or very large. If the number of epochs is small or large, then the network led to overfitting by itself. Therefore, the number of epochs is defined as 20, and it can be changed with future improvements. Moreover, a number of convolutional filters, the size of the convolutional kernel and the size of the pooling area were declared as 32, 3 and

2 respectively. A number of convolutional kernels define the number of different kernels that model used to learn the features. And the convolutional kernel is 3 x 3 matrix since the size is defined as 3. After and each convolutional operation an additional activation function was used to increase the non-linearity of the network. In here Rectified Linear Unit (ReLU) functions was used as the activation function. It applied pixel by pixel and it replaces all the negative pixels by zero and adds non-linearity to the network.

2.2.5 FULLY AUTOMATIC BRAIN SEGMENTATION FOR ALZHEIMER'S DISEASE DETECTION FROM MAGNETIC RESONANCE IMAGES

This paper proposes a new automatic method to segment the whole brain in magnetic resonance (MR) image series and calculate its volume for detecting Alzheimer's disease (AD). The underlying MR images were obtained from the Alzheimer's Disease Neuroimaging Initiative (ADNI) database. The whole brain T1-weighted MRI was performed at 1.5 T in 100 subjects. The proposed automatic segmentation method is based on the mathematical morphology of image and our proposed technique called the "brain template" to limit the boundary around the brain. The results show that the volumes of AD patients, mild cognitive impairment (MCI) patients, and normal persons are 828±49mm^3, 922±30 mm^3, and 1056±102 mm^3 respectively. We also performed the three-class classification problem on the data set using the Bayes classifier and four-fold cross validation. The classification rate of 87% is achieved on the test sets. Nowadays, the numbers of dementia and Alzheimer patients are on the rise. Most countries in the world face an enormous number of these patients. Dementia is a brain disorder that seriously affects a person's ability. It is usually defined as an acquired condition involving multiple cognitive impairments that are sufficient to interfere with activities of daily living. Memory impairment is one of the most common deficiencies. The other domains such as language, logic is often involved. The most important cause of dementia is an age-related incidence, thinking, and language. Alzheimer's disease (AD) is a condition which the brain slowly shrinks and dies. Nerve cells in the brain also stop working, and brain signals that are essential for life do not function properly. AD starts with mild memory loss. People with AD gradually lose judgment, thinking, and reasoning. As such, the investigators within the ADNI contributed to the design and implementation of ADNI and/or provided data but did not participate in analysis or writing in this report. Personality and behavior change for the worse. The person may become anxious, excited, and delusional. AD is a slow disease, starting with mild memory loss and ending with severe brain damage. The course of the disease is unique vary in each person. However, age is the most important known factor for AD. There have been several attempts to solve the problem of automatic brain segmentation from MR images. However, only a handful of them were fully automatic. Examples of fully automatic segmentation methods are in where the active contour model (snakes) was applied and in where the Bayesian approach was applied. However, none of them could completely solve the brain segmentation in MR images. The problem is still challenging. Some methods are of semi-automatic approach. Users were required to draw a region of interest (ROI) prior to the automatic segmentation step. The experts who provided the ROI's had to make sure that the ROI approximately cover the whole brain acquired in the coronal plane. It was mentioned in the work that the method could not work on MR images acquired in the sagittal plane. Moreover, most of the previously proposed fully automatic segmentation methods in brain MR images were focused on hippocampus and amygdala regions in the coronal plane. Therefore, in this research, we propose a new brain segmentation method for MR images. The volume of the whole brain is estimated from the stack of segmented brain images. The estimated volume is used to predict whether the subject is of AD, mild cognitive impairment (MCI) or normal class. In this work, we propose a new fully automatic brain segmentation to detect the Alzheimer's disease from the magnetic resonance images. Using 100 subjects of T1- weighted MR images in the sagittal plane, we found that the proposed method works really well. The derived brain volumes of Alzheimer's disease, mild cognitive impairment, and normal subjects are grouped quit well with typical possible overlaps. The classification performance of 87% on the test sets of the four-fold cross validation is achieved using the Bayes classifier. This demonstrates that the proposed segmentation method provides another promising alternative Alzheimer's disease detection. In the future work, we will create a new segmentation method for the other parts inside the brain.

2.2.6 LONGITUDINAL MONITORING AND DETECTION OF ALZHEIMER'S TYPE DEMENTIA FROM SPONTANEOUS SPEECH DATA

A method for detection of Alzheimer's type de- mentia though analysis of vocalisation features that can be easily extracted from spontaneous speech is presented. Unlike existing approaches, this method does not rely on transcriptions of the patient's speech. Tests of the proposed method on a data set of spontaneous speech recordings of Alzheimer's patients (n=214) and elderly controls (n=184) show that accuracy of 68% can be achieved with a Bayesian classifier operating on features extracted through simple algorithms for voice activity detection and speech rate tracking. Automatic monitoring of physical and cognitive well- being has become a focus of great research interest as well as practical relevance in the area of elderly care. Emerging applications aimed at promoting healthy ageing and improving care have built on advances in sensor technology and machine learning, which provide opportunities for collection and analysis of vast quantities of personal behavioural data. Due to its high prevalence, and the burden it places on carers and society, Alzheimer's type dementia (ATD) has been the focus of numerous efforts in this area. A promising research direction is the automatic categorisation of patients with ATD based on cognitive markers. This type of categorisation has long been part of diagnostic procedures and of the overall study of the natural history of ATD. Methods of diagnostic assessment of ATD based on cognitive markers include the mini mental state examination (MMSE) and a range of other neuropsychological tests. However, a need for improved methods for earlier detection of ATD symptoms has been identified by dementia researchers, and there is growing recognition that technologies that enable finer- grained personal monitoring in daily life might play an important role in the development of such methods. Recently, there have been attempts to use machine learning for identification of ATD through analysis of the patient's speech. Language dysfunction is characteristic of ATD, and it is believed that first semantics, then syntax and finally phonology are affected as the disease progresses. Consequently, machine learning approaches have often employed lexical and sometimes syntactic structure as categorisation features. While these new methods have achieved some success, with accuracy rates up to 81%, they often rely on the availability of speech transcripts. However, automatic speech recognition (ASR) for spontaneous speech produced in daily life remains a very challenging problem. We present an alternative approach based on patterns of vocalisations and other paralinguistic speech features which does not depend on ASR. If successful, this approach may help pave the way for fine-grained, longitudinal monitoring of speech in daily life for the purposes of identifying cognitive changes that may be characteristic of ATD. We stipulate as a basic requirement that the input data for the proposed method must consist of features that can be either readily entered by the user or easily acquired in natural interactive settings with acceptable accuracy. Therefore, we assume a scenario where the user enters personal information (e.g., age, gender) and the subsequent monitoring consists of tracking of low-level paralinguistic features and functionals of the user's spontaneous speech, such as the timing and duration of vocalisations and pauses speaking rate, and voice quality measures. In this paper we focus on vocalisation events and speech rate. These features are easily extracted through basic signal processing and are reasonably robust.

2.2.3. ALZHEIMER'S DISEASE EARLY DETECTION USING CONVOLUTIONAL NEURAL NETWORKS

Alzheimer's disease is the extremely popular cause of dementia that causes memory loss. People who have Alzheimer's disease suffer from a disorder in neurodegenerative which leads to loss in many brain functions. Nowadays researchers prove that early diagnosis of the disease is the most crucial aspect to enhance the care of patients' lives and enhance treatment. Traditional approaches for diagnosis of Alzheimer's disease (AD) suffers from long time with lack both efficiency and the time it takes for learning and training. Lately, deep-learning-based approaches have been considered for the classification of neuroimaging data correlated to AD. In this paper, we study the use of the Convolutional Neural Networks (CNN) in AD early detection, VGG-16 trained on our datasets is used to make feature extractions for the classification process. Experimental work explains the effectiveness of the proposed approach. Alzheimer's disease (AD) is a neurodegenerative disorder that reasons interactive problems, memory, and feeling, and that ultimately is fatal. AD is also an irreversible, gradual brain disorder, characterized by a loss of memory without a validated disease that modifies treatment. So, they have made much trial to develop early detection process, particularly at pre-symptomatic stages, to prevent the evolution of the disease. AD is a popular disease especially among older people. AD is the greatest popular type of dementia. Based on the latest reports, there are over 52.8 million population is living with dementia, 48 million diagnosed with Alzheimer's. People that suffer from dementia are expected that their percentage will increase in the coming years with 52 million in 2030 and 152 million in 2050. Mild cognitive impairment (MCI) is a progression formal from Cognitively Normal (CN) to dementia, which has a 12% conversion rate to AD. Several neuroimaging methods, like positron emission tomography (PET) and magnetic resonance imaging (MRI), are used for research (AD). In the AD grouping, MRI is more popular where it provides a satisfactory resolution of the brain's soft tissues. In the last period, MRI-based computer vision techniques for AD-classification have been implemented. All methods aid in making decisions, whether an image is an AD or not. Most of these methods used traditional computer vision techniques in the AD classification process. Recently, deep learning expanded countless devotion in almost every field of computer vision and image processing. Among the deep learning methods, the most constant technique was the convolution neural network. In recent years, CNNs are recognized for learning about the generic features of neuroimaging for the classification of AD. There are two classification levels; a binary classification in which the technique specifies the CN vs. AD and a multiclassification

2.2.7 PREDICTING ALZHEIMER'S DISEASE USING DRIVING SIMULATOR DATA

Early detection of Alzheimer's Disease (AD) is critical in creating better outcomes for patients. Performance in complex tasks such as vehicular driving may be a sensitive tool for early detection of AD and serve as a good indicator of functional status. In this study, we investigate the classification of AD patients and controls using driving simulator data. Our results show that machine learning algorithms, especially random forest classifier, can accurately discriminate AD patients and controls (AUC = 0.96, Sensitivity = 87%, and Specificity = 93%). The model-identified most important features include Pothole Avoidance, Road Signs Recalled, Inattention Measurements, Reaction Time, and Detection Times, among others, all of which closely align with previous studies about cognitive functions that are affected by AD. In this study, we investigate driving simulator data obtained from AD patients and controls to determine whether subjects can be successfully stratified into their corresponding cohorts. Specifically, we develop machine learning models to examine a large array of driving data and classify the patients into two groups (AD/control) and provide various performance metrics. More importantly, we identify key variables that help differentiate AD patients and controls and provide insights. Data Description Driving data were collected on patients age 65 and up with early Alzheimer's Disease (AD) and age-matched control subjects via a mid-range driving simulator located at the University of Virginia. Participants were recruited from a database of diagnosed patients at a memory disorders clinic based on clinical judgement and standard of care. In addition, AD participants met core clinical criteria for probable AD based on the recommendations from the NIA and Alzheimer's Association work groups and MMSE > 20. The control participants were individuals without active neurological, psychiatric, or ophthalmologic illnesses except for the need to wear corrective lenses. All subjects had to have a valid license, and either be actively driving or have ceased driving within less than one year of testing and must have also been fluent in English. Once recruited, a battery of neuropsychological tests was performed, and if they met criteria based upon the results of these tests, subjects who continued to meet inclusion criteria underwent the off-road driving simulator evaluation. A total of 35 subjects (18 AD and 17 Control) participated in the study. In order to assess driver competence, 125 operational driving variables assessing participant visual, motor, cognitive, and executive function abilities were collected. These variables included both time-based and score-based measurements. Driving simulator results were available for 30 of the 35 participants in this study. The five without simulator results had demographic data available but friendly interface, allowing healthcare professionals and end-users to conveniently access the system's capabilities. The system's architecture ensures data security, privacy, and efficient processing. Through the integration of the admin module website and the user module Android application, the proposed system aims to improve early diagnosis, intervention, and patient care in the context of Alzheimer's disease.

which classifies the disease in which level (CN, AD, MCI, LMCI). AD is a progressive brain disease and the most common case of late-life dementia. AD contributes to the death of nerve cells and tissue degradation in the brain, thereby significantly decreasing brain size over time and affecting most of its functions. So, we introduce the approach of the Deep Learning algorithm using CNN in detecting AD accurately. We presented a view of related work and discussed the use of CNN in this problem and experimental work conducted. In this work, we used the VGG16 pretrained learning transfer network and used it as a feature extractor. We also computed a performance metric to evaluate our model. The best accuracy we obtained from the algorithm when we split data into 20% testing data and 80% training data at this accuracy of training 97.49% and testing 95.31%. Our results showed the effectiveness of the presented approach, in detecting AD to good accuracy. In the future, we plan to extend our template by considering more optimization techniques to improve the accuracy of the algorithm. We consider further applying our proposed model with different datasets to verify the effectiveness of the model and also to consider combining other approaches.

2.2.4 APPLYING CONVOLUTIONAL NEURAL NETWORKS FOR PRE-DETECTION OF ALZHEIMER'S DISEASE FROM STRUCTURAL MRI DATA

During the recent years, there have been many studies implemented on the automatic diagnosis of Alzheimer's Disease (AD) using different methods. The focus of most of these studies has relied upon the detection of AD from neuro-imaging data. However, recognizing symptoms early as much as possible (Pre-detection) is crucial as disease modifying drugs will be most effective if administered early in the course of disease, before the occurrence of irreversible brain damages. Therefore, there is a high importance of utilizing automated techniques for the purpose of pre-detection of AD symptoms from such data. We report an experimental approach to evaluate the best pre-detection method of AD. Our study consists of two main experiments. Those two experiments were implemented using the Alzheimer's Disease Neuroimaging Initiative (ADNI) dataset. Prior to our first experiment we have stated an assumption which is, if there is a successful AD detection method that will be successful in AD pre-detection also. Different studies have used different data sets and different diagnosing methods. Therefore, we have verified the existing and the most successful detection method which is Support Vector Machine (SVMs) as the first experiment. According to the results obtained from the initial experiment (detection study) the sensitivity is 95.3%, the specificity is 71.4% and the accuracy the data into vessels with and without branching points for the three groups (AD, age-matched control and young). The correct classification rate is then the proportion of subjects correctly classified as having Alzheimer's disease or not averaged across the three groups. Clearly in this result the correct classification rate for the vessels with branching points show considerably higher performance than those without branching points. This suggests that the branching structure can be used to differentiate subjects with AD from those without AD as suspected by the effect of Alzheimer's disease on the drainage of Amyloid beta.

We then combined the vessels of young and age-matched control subjects as a single class of normal subjects and compared this with the vessels from subjects with AD to clarify the result. Again, this shows that branching structure aids recognition capability. The increase in recognition suggests that there is similarity in structure between the vessels of young and age-matched control subjects, further confirming the capability to use vessel shape description for the detection of AD. Studies suggest that the drainage of the protein A_ is consistent with presence of Alzheimer's disease and this suggests that image-based analysis of blood vessel structure might indicate the presence of Alzheimer's disease. Here we have deployed the standard measures of density and tortuosity for this analysis and have developed a new technique which is suited to analysis of the small branching structures to be found in these images. The images were derived from brain tissue of subjects in controlled conditions. We have performed the boundary analysis of vessels using Fourier Descriptors as the most discriminative feature in the recognition analysis. These two measures (branching structure and FDs) are formulated to have requisite invariant properties for this analysis. We have shown that it is possible by these measures to discriminate between subjects with Alzheimer's disease and those without AD. In general, our initial result shows that the branching structure appears to be a major contributor to discriminate AD from a normal brain. This is reflected in the description by complex FDs, especially of the vessels with branching points. Branching structure is also discriminative as well as other features (density and tortuosity). The tortuosity has shown some contribution even though as per feature, it shows slightly lower performance compared with others and motivates the need for a better way to analyse tortuosity. The study so far has concentrated on features rather than classification and that and fusion could be more sophisticated though the approaches here suffice to demonstrate basic performance.

were not used in this analysis. The 30 participants that were used were equally split between AD and Control. In this study, we demonstrated that machine learning algorithms, particularly random forest, could effectively classify subjects into their respective groups based upon characteristics of driving. By applying these algorithms, we can predict who is at risk of AD based upon performance on a driving simulator. These results underscore the utility of driving as a sensitive measure of cognitive function and support the need for further exploration of virtual reality driving as a diagnostic test in AD. Machine learning can play a critical role in determining which variables should be targeted as markers of impaired cognition in future research

2.2.8 DETECTING ALZHEIMER DISEASE ON FDG PET IMAGES USING A SIMILARITY INDEX BASED ON MUTUAL INFORMATION

Mutual information is an image similarity metric often used for the robust registration of multimodality images. The aim of this study is to investigate the use of a simple to implement similarity computation method based on a mutual information index for the automated detection of Alzheimer's disease from FDG PET studies. 102 healthy and 95 Alzheimer's disease FDG PET patient images from the online Alzheimer's disease Neuroimaging Initiative (ADNI) database were used to develop and test the system. Images were pre-processed for enabling comparison. An index was computed for each new image based on its degree of similarity to images belonging to AD patients versus healthy control patients. Classification was made based on the value of this index. The leave-one-out method was used for performance evaluation. Performance was evaluated using Receiver Operating Characteristic (ROC) curves. The diagnostic reliability given by the area under the curve (AUC) was determined as 0.857±0.0261. The results suggest that a mutual information-based image similarity method can potentially be useful as a second opinion computer aided diagnostic (CAD) system providing verification to visual and black box approaches. The system does not need training with new data and does not require the computation of image feature. The leading cause of dementia is known to be the Alzheimer's disease (AD). AD is now responsible for a growing number of deaths. Improved healthcare and education was found to stabilize the prevalence of dementia. With Positron Emission Tomography (PET), it is possible to monitor metabolic and molecular processes in vivo. PET is therefore very effective for observing changes in cerebral glucose metabolism and inflammatory processes. It is also possible to monitor neurotransmitter systems as well as changes in amyloid deposits that are characteristics of AD. Quantitative imaging of amyloid deposits and the associated biomarker has the potential of being used in the management of the disease but does not have sufficient specificity for diagnosis. Since at present it is not possible to cure Alzheimer's disease, early diagnosis becomes crucial for slowing down its progression. Lately, quantitative methods have been developed in order to assist clinicians during the diagnostic process. These systems help in reducing the variance between readings and increase accuracy. Computer aided diagnosis (CAD) is an important area in medicine and aims to increase both efficiency and diagnostic reliability but faces important challenges. Two of those challenges have been reported as developing sound segmentation methods and developing better feature extraction /selection approaches. Another challenge has been reported as the development of standardized performance assessment. A number of computer aided diagnosis (CAD) schemes have been experimented for detecting AD from PET scans. Some early work uses comparison of regional quantitative values by using statistical analysis while many used classifiers trained with features. In a database of 18F- Fluorodeoxyglucose (FDG) PET images was used for statistical comparison. A study conducted by James C Patterson II demonstrates the evaluation of AD with the statistical parametric mapping (SPM) software. In a principal component analysis (PCA) was used to compute eigenbrains. Then, support vector machines were used for classifying images. In artificial neural networks (ANN) were used for the automated detection of AD. In this, a method is described that makes use of 18F-FDG and Pittsburg Compound B (PiB) PET to perform analysis using association rules. Inthe Mann-Withney-Wilcoxon U-Test was used. Gaussian Mixture models were used in here. In, brain images were first segmented into 116 regions of interest (ROI) using an atlas. Then features computed from these ROI's were ranked and used for classification. Also deep learning methods were experimented. A support vector machine-based algorithm was presented here. Most of the above-described methods and similar other works cited in the literature are based on complex regional computational analysis and/or feature extraction. They may not provide an explanation of the results or may be very prone to errors by the operator. This study hypothesizes that AD can be diagnosed from FDG PET studies by the use of a simple mutual information (MI) image similarity metric often used in image registration. In this method, no features need to be extracted. MI and its versions have been previously shown to be robust with respect to varying levels of noise degradations. Furthermore, the image database does not have to be fixed and can be updated continuously without the need of retraining. The aim is to devise a system that can be used as a second opinion provider in addition to visual assessments or complex black box type CAD systems. The database from the Alzheimer's Disease Neuroimaging Initiative (ADNI) project was used for the project. In the following, in the methods section, a description of data is presented. Then the classification method based on image similarity is presented. The results are then presented. Finally, the results are discussed and conclusions are drawn in the context of recent work in the literature.

2.3 PROPOSED SYSTEM

The proposed system is designed to enable the detection and prediction of Alzheimer's disease using deep learning and machine learning techniques. The system aims to provide accurate and timely results based on the analysis of MRI scans. It consists of two modules: the admin module, developed as a website using Flask, and the user module, implemented as an Android application using Java and XML.

Admin Module:

The admin module serves as the primary interface for healthcare professionals and system administrators. It is designed as a web application using the Flask framework. The admin module provides functionalities such as data uploading, model training, and result generation. Healthcare professionals can securely upload MRI scans from patients and initiate the detection process. The system preprocesses the scans and utilizes a pre-trained convolutional neural network (CNN) model to extract relevant features. The extracted features are then passed through a random forest classifier for classification. The admin module also enables the visualization and analysis of the detection results, allowing healthcare professionals to make informed decisions based on the predictions.

User Module:

The user module is developed as an Android application to provide a convenient and accessible interface for end-users. It allows individuals to input their personal information and upload their MRI scans for Alzheimer's disease detection. The user module securely transmits the uploaded data to the backend system for processing. The system performs feature extraction using the pre-trained CNN model and applies the random forest classifier to predict the presence of Alzheimer's disease. The results are then displayed to the user through the application interface. The user module also includes features such as user authentication, data privacy, and seamless integration with the backend system.

Overall, the proposed system combines the power of deep learning and machine learning algorithms to accurately detect and predict Alzheimer's disease from MRI scans. It offers a user-

CHAPTER 3

SYSTEM SPECIFICATION

HARDWARE REQUIREMENTS:

The hardware requirement for developing and implementing the proposed system are given below:

- Processor : Intel Core i3 and above
- Primary Memory : 4GB RAM and above
- Storage : 320 GB hard disk and above
- Display : VGA Color Monitor
- Key Board and Mouse : Windows compatible

SOFTWARE SPECIFICATION

The software requirement used to develop the system are:

- Front End : HTML, CSS, JS
- Back End : MySQL
- Language : Python
- Ide Used : PyCharm, Android Studio

CHAPTER 4

SOFTWARE DESCRIPTION

WAMPSERVER

WampServer works like a local server in your system that is generally used by PHP developers to test their websites. WampServer acts as a virtual server on your computer because the server is not connected to the internet. It's interface is so simple that anyone without web-tech knowledge can easily set up a web application. WAMP is sometimes used as an abbreviated name for the software stack Windows, Apache, MySQL, PHP. It is derived from LAMP which stands for Linux, Apache, MySQL, and PHP. As the name implies, while LAMP is used on Linux servers, WAMP is used on Windows servers. Because WordPress isn't usually installed on Windows Servers, WAMP has become popular among developers as a method of installing WordPress on their personal computers.

SQLYOG

SQLYog is the most complete and easy to use MySQL GUI. It lets you apply schema and data changes visually while moving from test to production. It streamlines data transfer/migration from any ODBC compliant data source to MySQL. In short, it is a powerful means to manage your MySQL databases.

PYTHON

Python is an interpreted, object-oriented, high-level programming language with dynamic semantics. Python's simple, easy to learn syntax emphasizes readability and therefore reduces the cost of program maintenance. The Python interpreter and the extensive standard library are available in source or binary form without charge for all major platforms, and can be freely distributed. Python is a widely used high-level programming language for general-purpose programming, created by Guido van Rossum and first released in 1991. An interpreted language, Python has a design philosophy that emphasizes code readability (notably using whitespace indentation to delimit code blocks rather than curly brackets or keywords), and a syntax that allows programmers to express concepts in fewer lines of code than might be used in languages such as C++ or Java. The language provides constructs intended to enable writing clear programs on both a small and large scale. Python features a dynamic type system and automatic memory management and supports multiple programming paradigms, including object-oriented, imperative, functional programming, and procedural styles. It has a large and comprehensive standard library. Python interpreters are available for many operating systems, allowing Python code to run on a wide variety of systems. CPython, the reference implementation of Python, is open-source software and has a community-based development model, as do nearly all of its variant implementations. CPython is managed by the non-profit Python Software Foundation.Python is a multi-paradigm programming language: object-oriented programming and structured programming are fully supported, and many language features support functional programming and aspect-oriented programming (including by metaprogramming and metaobjects (magic methods)). Many other paradigms are supported via extensions, including design by contract and logic programming. Python uses dynamic typing and a mix of reference counting and a cycle-detecting garbage collector for memory management. An important feature of Python is dynamic name resolution (late binding), which binds method and variable names during program execution. The design of Python offers some support for functional programming in the tradition. the language has filter(), map(), and reduce() functions; list comprehensions, dictionaries, and sets; and generator expressions. The standard library has two modules (itertools and functools) that implement functional tools borrowed from Haskell and Standard ML.

PYCHARM

PyCharm is a dedicated Python Integrated Development Environment (IDE) providing a wide range of essential tools for Python developers, tightly integrated to create a convenient environment for productive Python, web, and data and data science development. it provides code analysis, a graphical debugger, an integrated unit tester, integration with version control systems, and supports web development with Django. PyCharm is developed by the Czech company JetBrains.

CHAPTER 5

PROJECT DESCRIPTION

Alzheimer disease (AD) is a neurological disorder. For the AD, there is no specific treatment. Early detection of Alzheimer's disease can help patients receive the correct care. Many studies employ statistical and machine learning techniques to diagnose AD. In the proposed methodology, the MRI data is used to identify the AD and Machine Learning technique is used to classify the present disease. In this study, we developed a system of Alzheimer's disease detection using Random Forest algorithm using magnetic resonance imaging (MRI) scans images which are trained using Kaggle dataset.

5.1 MODULE DESCRIPTION

The proposed system divided into 2 modules.

Admin

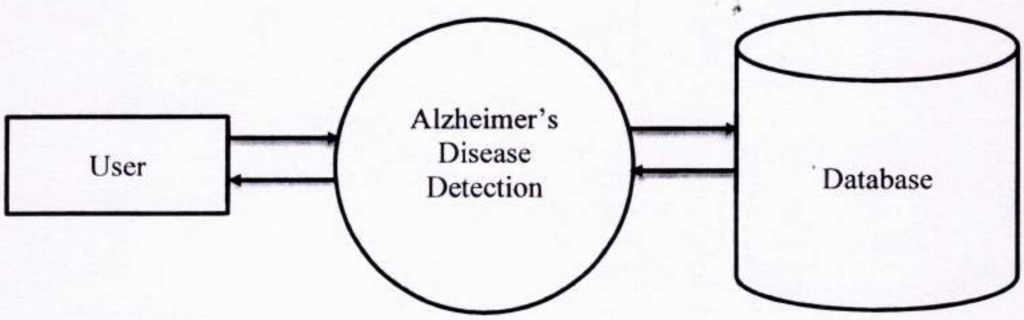
a. Login
b. Change password
c. View users details
d. Important notes managements
e. View patient list

User

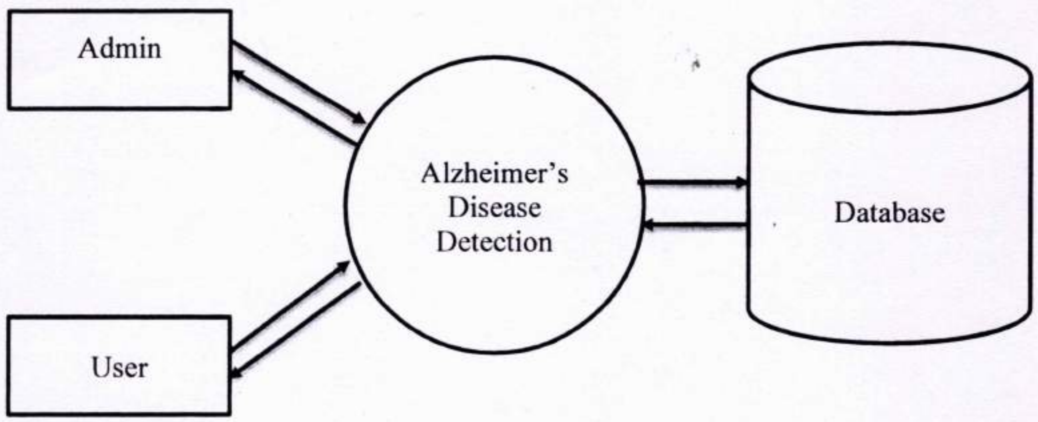
a. Register
b. Login
c. Important date management
d. Known person management
e. Predict disease and view result
f. View important note

5.2 DATA FLOW DIAGRAM

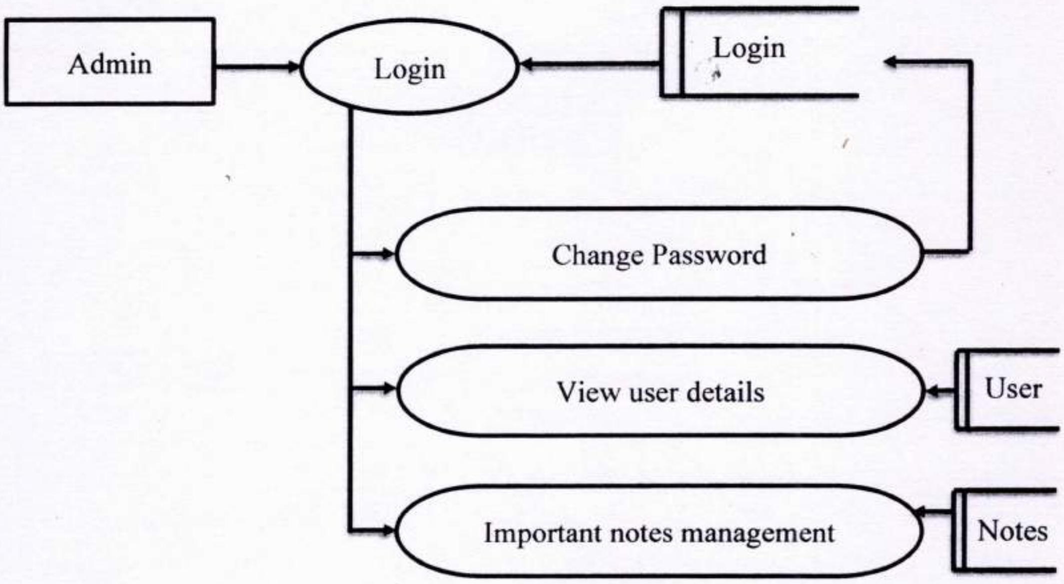
Level 0



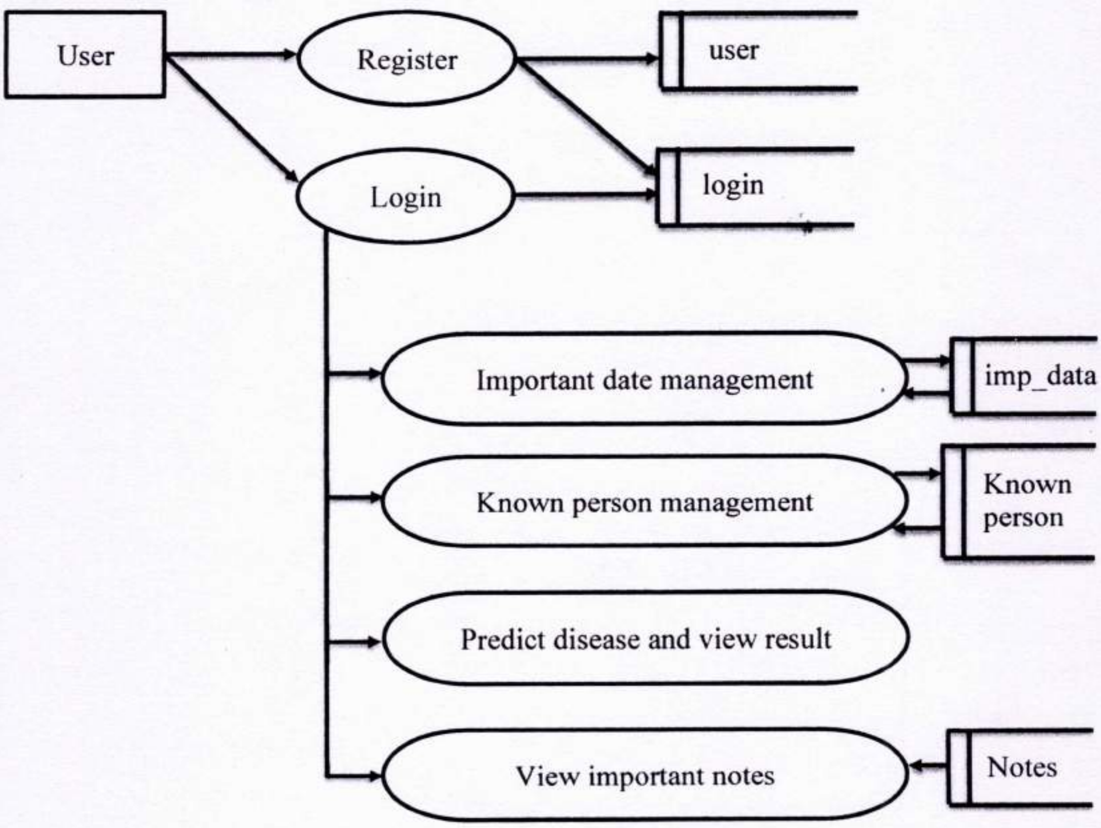
Level 1



Level 1.1


Admin
Login
Login
Change Password
View user details
User
Important notes management
Notes

Level 1.2


User
Register
Login
user
login
Important date management
imp_data
Known person management
Known person
Predict disease and view result
View important notes
Notes

CHAPTER 6

CODING DETAILS

PROGRAMMING LANGUAGES AND FRAMEWORKS

Java:

Java is utilized as the backend programming language for the User Module in the Android application. It enables the implementation of the core logic, data processing, and communication with the server or database.

XML:

XML (eXtensible Markup Language) is employed for designing the frontend user interface of the User Module. It allows the specification of structured data and provides a flexible means of defining user interface elements, layouts, and interactive components in the Android application.

Flask:

Flask, a lightweight web framework in Python, is used for developing the Admin Module's website. It facilitates the creation of a responsive and user-friendly interface for administrators to manage the system.

MySQL:

The MySQL relational database management system is utilized for storing and managing data in the system. Both the User Module and the Admin Module interact with the MySQL database for storing user profiles, medical records, and other relevant information.

ALGORITHMS AND TECHNIQUES:

Convolutional Neural Networks (CNNs):

Convolutional Neural Networks (CNNs) are utilized specifically for feature extraction in the Alzheimer's detection system. CNNs have proven to be highly effective in automatically learning and extracting relevant features from MRI scans.

Random Forest:

For the classification stage, the Random Forest algorithm is employed in the Alzheimer's detection system. Random Forest is a powerful machine learning technique known for its ability to handle high-dimensional data and feature interactions. In this context, Random Forest takes the features extracted by the CNNs as input and constructs a multitude of decision trees. The predictions of these individual decision trees are combined to make accurate classifications.

CHAPTER 9

SYSTEM TESTING

System testing of Alzheimer's disease detection using deep learning typically involves several steps to evaluate the performance and accuracy of the developed system. Here is an overview of the process:

Data Collection:

Gather a dataset of brain images or other relevant data from individuals with and without Alzheimer's disease. This dataset should be representative and diverse, including different age groups, genders, and disease stages.

Data Preprocessing:

Preprocess the collected data to ensure its quality and suitability for training the deep learning model. This step may involve image normalization, noise reduction, image registration, or other techniques specific to the data type.

Model Development:

Design and train a deep learning model capable of detecting Alzheimer's disease using the preprocessed data. Common approaches include convolutional neural networks (CNNs) or recurrent neural networks (RNNs), depending on the type of data used.

Training and Validation:

Split the dataset into training and validation sets. Train the model on the training set, adjusting hyperparameters and monitoring performance on the validation set. This step involves optimizing the model to achieve the best accuracy and generalization.

Test Set Preparation:

Reserve a separate test set that was not used during model development. This set should remain untouched until the final evaluation to ensure unbiased testing.

Performance Metrics:

Calculate relevant performance metrics such as accuracy, precision, recall, F1-score, or area under the receiver operating characteristic curve (AUC-ROC) to quantify the system's performance in detecting Alzheimer's disease.

Comparison and Baselines:

Compare the performance of the developed system to existing methods or baselines to assess its effectiveness and superiority.

Error Analysis:

Analyze the errors made by the system to identify patterns or common misclassifications. This analysis can provide insights into areas for improvement or further investigation.

Validation Testing:

Perform further validation and external testing of the refined system to ensure its reliability and generalization across different datasets or populations.

CHAPTER 8

SYSTEM IMPLEMENTAION

DEVELOPMENT PROCESS

The development process followed an iterative approach, combining elements of Agile methodologies. It involved multiple phases, including requirement gathering, data collection, model development and user interface design. Regular meetings were conducted with the project team to review progress, address challenges, and incorporate feedback.

DATA COLLECTION AND PREPROCESSING

A dataset of MRI scans was collected from reputable medical institutions, comprising images of individuals with and without Alzheimer's disease. The dataset consisted of 5117 MRI scans, divided into training and testing sets. It consists of MRI scans of patients with different stages such as mild demented, moderate demented and non-demented.

MODEL ARCHITECTURE

The deep learning model employed a Convolutional Neural Network (CNN) architecture specifically designed for Alzheimer's detection. The model consisted of multiple convolutional layers, followed by pooling layers for feature extraction. Fully connected layers were utilized for classification.

USER INTERFACE

The user interface was developed using the Flask web framework. It provided a user-friendly interface that allowed healthcare professionals to upload MRI scans for Alzheimer's detection. The interface facilitated seamless interaction with the system, enabling users to submit scans, view the detection results, and view the relevant reports.

INTEGRATION OF COMPONENTS

The deep learning model was seamlessly integrated with the user interface. When a user uploaded an MRI scan, the system processed the image using the trained model. The detection results were then displayed to the user, indicating the likelihood of Alzheimer's disease.

DATABASE MANAGEMENT

A MySQL database was employed for efficient management of user information and detection results. The database stored user profiles, including personal information and uploaded MRI scans. It also maintained a record of all detection results.

CHAPTER 7

CONCLUSION AND FUTURE WORK

In conclusion, the developed Alzheimer's detection system has demonstrated significant potential in accurately detecting the disease from MRI scans. The utilization of CNNs for feature extraction has enabled the system to automatically learn and extract relevant features from the input images, thereby facilitating the classification process. Moreover, the integration of Random Forest as a classification algorithm has further enhanced the system's performance. By combining the diverse set of decision trees generated by Random Forest, the system achieves robust and reliable classification of MRI scans. The ensemble nature of Random Forest helps mitigate overfitting and improves the generalization capability of the model, ensuring accurate detection across different datasets.

This project can be improvised by working on the dataset expansion, integration of additional diagnostic features and User- interface enhancements. The implementation of the Alzheimer's detection system holds significant promise in the field of healthcare. It provides a non-invasive, reliable, and scalable solution for early detection and diagnosis of Alzheimer's disease. By identifying the disease at an early stage, healthcare professionals can initiate timely interventions and personalized treatment plans, leading to improved patient outcomes and enhanced quality of life.

CHAPTER 10

APPENDICES

web.py

```
import random
import smtplib
from email.mime.text import MIMEText

import demjson
from flask import Flask, render_template, request, redirect, session, url_for,jsonify
import datetime

from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score
from sklearn.model_selection import train_test_split
from sklearn.naive_bayes import GaussianNB
from sklearn.svm import LinearSVC

from Dbconnection import Db

app = Flask(_name_)

app.secret_key="alzh"

@app.route('/')
def hello_world():
  return render_template("index.html")

@app.route('/',methods=['get','post'])
def login():
  if request.method=="POST":
    n=request.form['textfield']
    p=request.form['textfield2']
    obj=Db()
    result=obj.selectOne("select * from login where username='"+n+"' and password='"+p+"'")
    if result:
      c=obj.selectOne("select count(login_id) as v from login where usertype='caretaker'")
      u=obj.selectOne("select count(login_id) as v from login where usertype='user'")
      session['c']=c['v']
      session['u']=u['v']
      session['lid']=result['login_id']
```

```
        session['lin']="1"
        k=datetime.datetime.now().strftime("%B %d %Y")
        session['mnth']=k
        typ=result['usertype']
        if typ=='admin':
            return redirect('/adminhome')
        else:
            return '''<script>alert("invalid user");window.location="/"</script>'''
    else:
        return  '''<script>alert("invalid user");window.location="/"</script>'''
  else:
    return render_template("index.html")

@app.route('/logout')
def logout():
  session['lin']="0"
  return redirect('/')

@app.route('/adminhome')
def adminhome():
  if session['lin']=="1":
    obj=Db()
    c = obj.selectOne("select count(noteid) as v from notes")
    u = obj.selectOne("select count(login_id) as v from login where usertype='user'")
    session['c'] = c['v']
    session['u'] = u['v']
    return render_template('ADMIN/index.html')
  return redirect('/')


@app.route('/change_pass',methods=['get','post'])
def change_pass():
  if session['lin']=="1":
    if request.method == "POST":
      old = request.form['textfield']
      new = request.form['textfield2']
      con = request.form['textfield3']
      db = Db()
      res = db.selectOne("select * from Login where Password='" + old + "' and usertype='admin'")
      if res is not None:
        if new == con:
          db.update("update Login set Password='" + con + "' where usertype='admin'")
          return '<script>alert("Changed Password");window.location="/"</script>'
        else:
          return '<script>alert("Password miss
```

```
match");window.location="/change_password"</script>'
        else:
            return '<script>alert("Password incorrect");window.location="/change_password"</script>'

    return render_template('ADMIN/change_password.html')
  return redirect('/')


@app.route('/users',methods=['get','post'])
def users():
  if session['lin']=="1":
    if request.method == 'POST':
      s=request.form['s']
      obj = Db()
      a1 = obj.select("select * from user where User_name like '%"+s+"%'")
      return render_template('ADMIN/users.html', data=a1)
    obj=Db()
    a1 = obj.select("select * from user")
    return render_template('ADMIN/users.html',data=a1)
  return redirect('/')


@app.route('/note_add')
def note_add():
  if session['lin']=="1":
    session['head'] = "Add Tips"
    return render_template("admin/Tips-add.html")
  else:
    return redirect('/')

@app.route('/Tips_addpost',methods=['post'])
def Tips_addpost():
  if session['lin']=="1":
    tips=request.form['Tips']
    db=Db()
    q1 = db.selectOne("select * from `notes` where note='"+tips+"'")
    if q1 is None:
      q=db.insert("INSERT INTO `notes`(`note`,`date`)VALUES('"+tips+"',curdate())")
      c = db.selectOne("select count(noteid) as v from notes")
      session['c'] = c['v']
      return "<script>alert('Insert sucessfully');window.location='/Tips_view#service'</script>"
    else:
      return "<script>alert('Already Inserted ');window.location='/Tips_view#service'</script>"

  else:
```

```
        return redirect('/')

@app.route('/Tips_view')
def Tips_view():
    if session['lin']=="1":
        db = Db()
        session['head'] = "View Tips"
        q = db.select("select * from `notes`")
        return render_template("admin/Tips-view.html",data=q)
    else:
        return redirect('/')

@app.route('/deletetips/<i>')
def deletetips(i):
    if session['lin']=="1":
        db = Db()
        q = db.delete("delete from `notes`where noteid='"+i+"'")
        return "<script>alert('Deleted successfully ');window.location='/Tips_view#service'</script>"
    else:
        return redirect('/')


@app.route('/patient')
def patient():
    if session['lin']=="1":
        obj=Db()
        a1 = obj.select("select * from user,result where uid=User_id order by date desc")
        return render_template('ADMIN/patient.html',data=a1)
    return redirect('/')
```

SCREENSHOTS

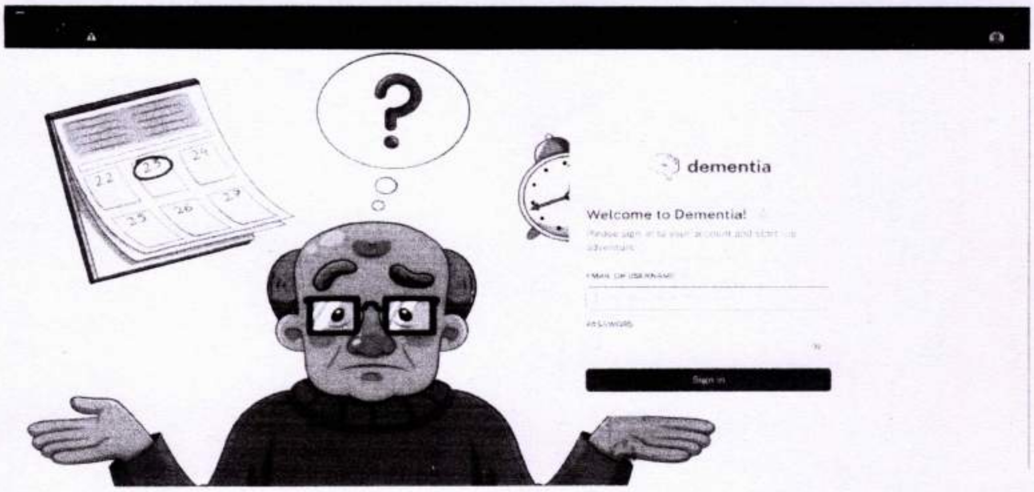


Fig. 1: Main web page

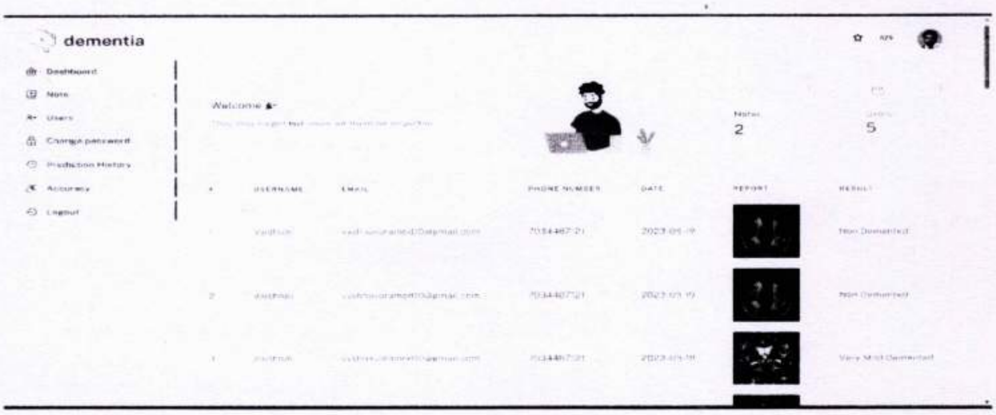


Fig. 2: Admin view

[redacted]

Fig. 3: User login

[redacted]

Fig. 4: Registered user information

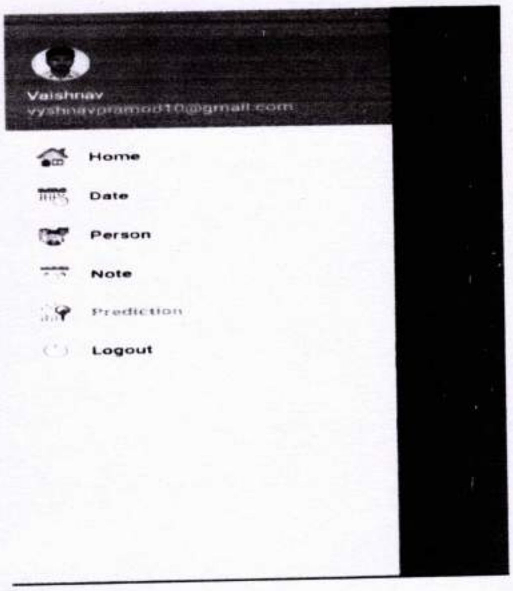


Fig. 5: User Control Options

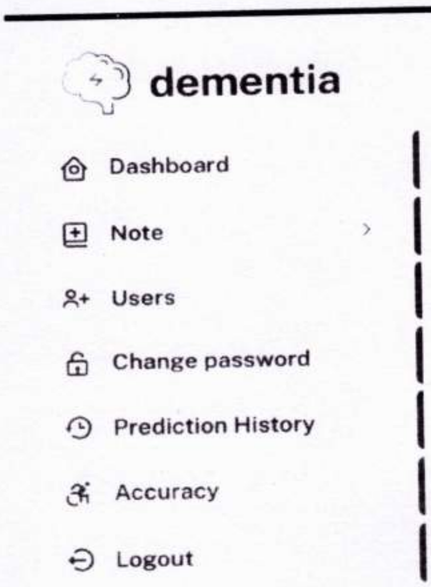


Fig. 6: Admin Control Options

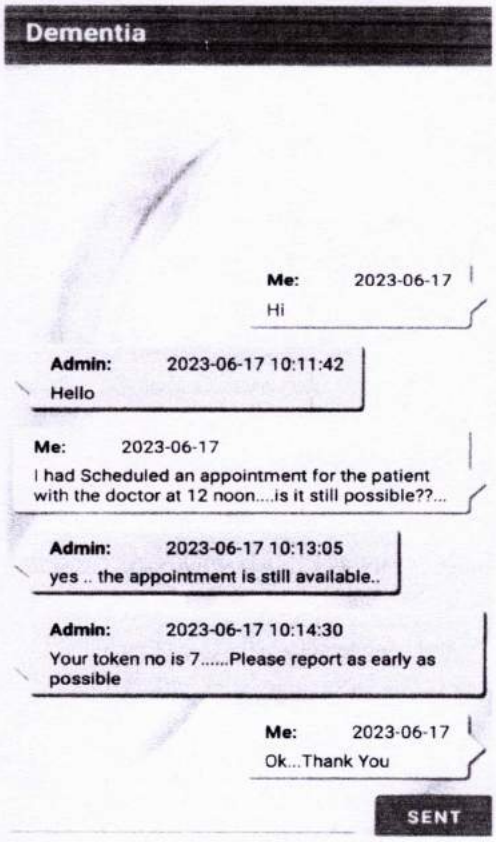


Fig. 7: Chat box

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1. Dr.Abhishek Gireesh Babu, MBBS, MGM Hospital and Medical College, Kamothe, Navi Mumbai, Maharashtra
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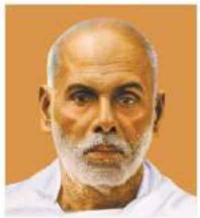

DEPARTMENT OF ELECTRONICS AND COMMUNICATIONS ENGINEERING

SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY

(Affiliated to APJ Abdul Kalam Technological University and approved by AICTE New Delhi)

Sree Narayana Guru College of Engineering and Technology

PROJECT PHASE II

REPORT ON

AUTOMATIC FISH AND PLANT CULTIVATION

Submitted in partial fulfilment of the requirement for the awardof

the degree of Bachelor of Technology

Presented by

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KEERTHANA C V(SNC19EC003)

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

A P J ABDUL KALAM TECHNOLOGICAL UNIVERSITY

2022-2023

Dr. LEENA A. V.
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(Affiliated to APJ Abdul Kalam Technological University and approved by AICTE New Delhi)

Sree Narayana Guru College of Engineering and Technology

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that the Project entitled **"AUTOMATIC FISH AND PLANT CULTIVATION"** is a Bonafide record of the work done by **ARJUN ASHOK K, JITHIN SASIDHARAN N V,KEERTHANA CV,MARIYAMBI ,SANISHMA SACHITHANAND** of Eighth Semester **Electronics and Communication Engineering** towards the partial fulfilment for the award of the degree of **Bachelor of Technology** by KTU Technological University.

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Above all, I also owe my gratitude to God almighty for showering abundant blessing upon me. Above all it is the grace and blessing of God the Almighty, which make this endeavor a success

HoD ECE

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ABSTRACT

Fish and plant cultivation has been separately done till date. Our project conveys the idea of combining fish and plant cultivation under same roof. By using the technique ,we could save both time and space. This technique also promotes sustainable organic waste management. Our project, automatic fish and plant cultivation focuses on growing fishes and plants under the same roof. On the ground part of the apparatus we fix aquarium and lettuce plant production on top of it. So that we could take the impure water from the aquarium and purify it by giving it into plant production part .thus the impure water can be purified by the process of leeching. Leeching is the process of sweeping down of water through soil thus water getting purified. The water after leeching can be reused into aquarium once again so that there is no wastage of water. Aquaponics is a food production method that combines the traditional hydroponics with aquaculture in a symbiotic relationship that facilitates a sustainable system with necessary input as all the water and nutrients within are re-circulated in order to grow terrestrial plants and aquatic life. This technique of agriculture can possibly replace other traditional methods if brought in use effectually. And when traditional Aquaponics meets the technology, remarkable outcomes could become visible. The IoT based Aquaponics Monitoring system features to monitor pH value, temperature and humidity level, water level using the specific sensors has been done and then after perceiving those values from the sensors. A new technology, Internet of Things has been introduced that bridges the gap between the physical world and the digital world and that starts with things. To connect the sensors with the internet, the database server and application server can be managed so as to display the information regarding the sensors. In order to introduce technology to the traditional aquaponics system.

HoD ECE

EENA A. V.

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HoD ECE

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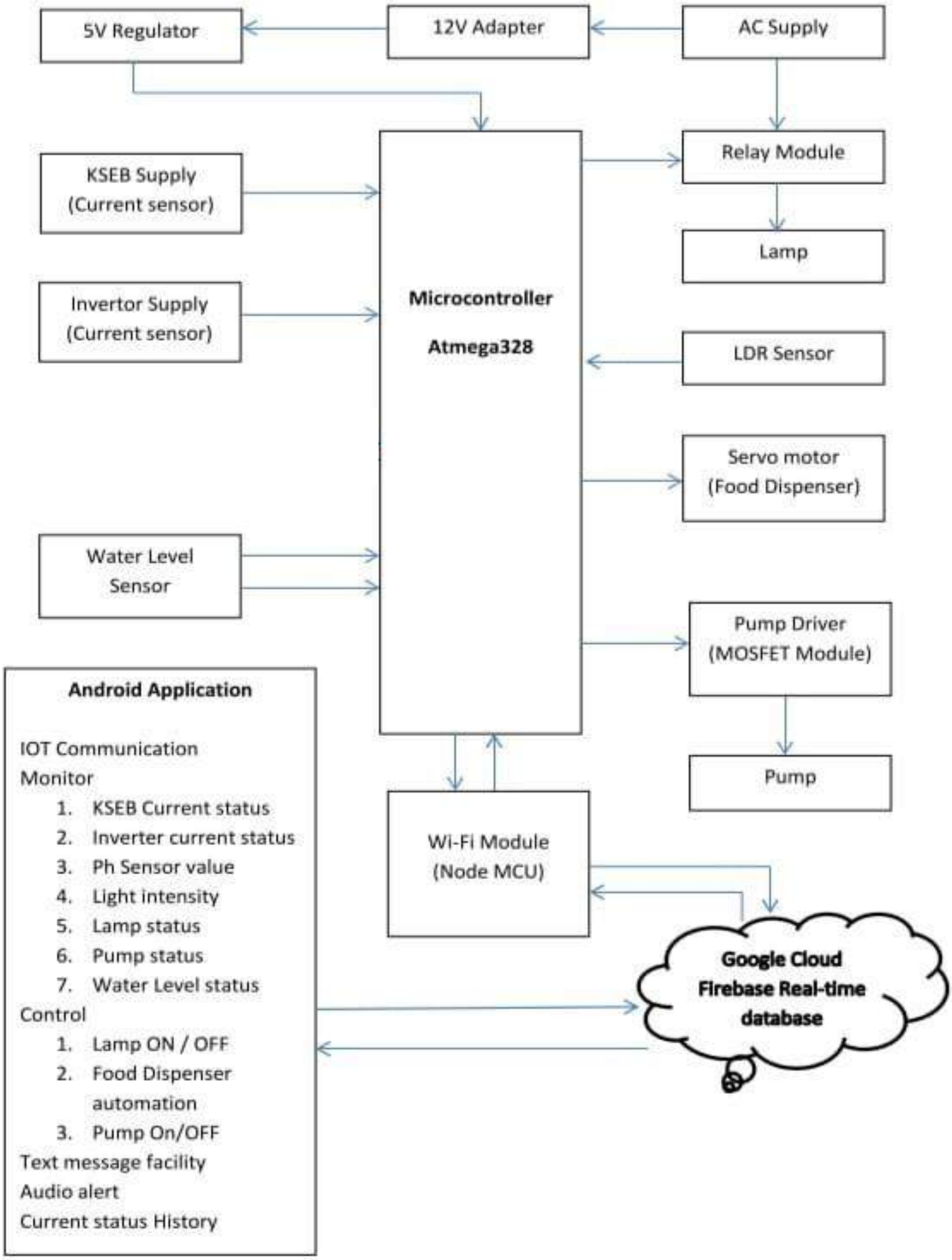
CHAPTER 1

INTRODUCTION

Research in aquaculture is an input to increase stabilized production. In last decade various scientists have made sustained efforts that resulted in development of modern production technologies that have revolutionized farm production. The main aim of the project is to remote monitoring of the fish farming system by using the various sensors to reduce the risks. In this processes we use sensors like pH value, current sensors and level sensors. By using these sensors all the work is automated and it will also be easy to monitor the fish farming remotely from other location. Fish farming have been used for more than three decades. Research in aquaculture is an input to increase and stabilize production. Fish farming refers to farming variety of marine species such as shellfish, sport fish, bait fish, ornamental fish, crustaceans, mollusks, algae, sea vegetables, and fish eggs to breed, rear and harvest in different water environments such as ponds, rivers, lakes, and ocean. Fish are cold-blooded animals, regulating their body temperature directly by the water environment. Changes in water temperature affect the amount of dissolved oxygen in the water and fish oxygen consumption. A chilling injury will cause the fish to rush into, paralysis with a loss of balance, leading to death. The reason may be the respiratory center, or osmotic regulation is affected at high temperatures, we cannot control such things. But we can provide air follow through the water to increase the oxygen level in the water. If the amount of dissolved oxygen in water is reduced to below a certain limit fish growth will be hindered. When the amount of dissolved oxygen becomes lower than the fish survival conditions the fish will die. And if the follow of air is stopped the fish will die. In general fish farming the acidity and alkaline of the water should be maintained between 6 to 8. Too acidic or alkaline will cause adverse effects, acid erosion of the gill tissue, tissue coagulation necrosis, increased mucus secretion, abdominal congestion and inflammation. If the PH value is less than 4.5, the fish will die.

CHAPTER 2

BLOCK DIGRAM



CHAPTER 3

BLOCK EXPLANATION

INTRODUCTION TO ATMEGA328

Atmega328 is a single-chip microcontroller created by Atmel in the mega AVR family(later Microchip Technology acquired Atmel in 2016).It has a modified Harvard architecture 8- bit RISC processor core.ATmega328 is basically an Advanced Virtual RISC (AVR) micro- controller. It supports the data up to eight (8) bits. ATmega328 has 32KB internal built-in memory. This micro-controller has a lot of other characteristics.

ATmega328 has 1KB Electrically Erasable Programmable Read Only Memory (EEPROM). This property shows if the electric supply supplied to the micro-controller is removed, even then it can store the data and can provide results after providing it with the electric supply. Moreover, ATmega328 has 2KB Static Random Access Memory (SRAM).

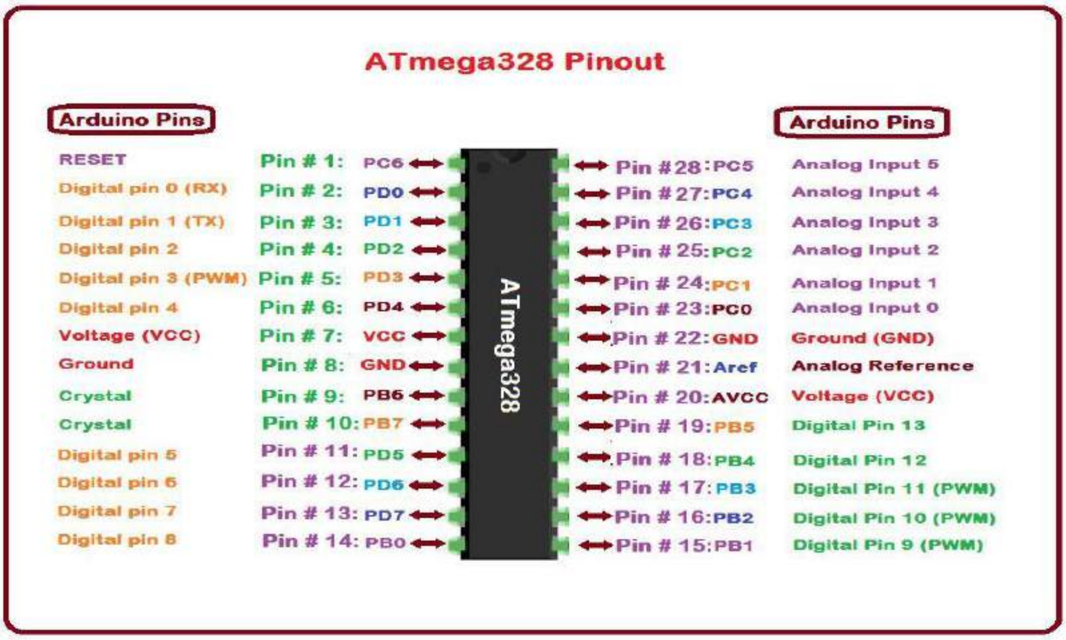


Fig 1 AT mega 328

ATmega328 has several different features which make it the most popular device in today's market. These features consist of advanced RISC architecture, good performance, low power consumption, real timer counter having separate oscillator, 6 PWM pins, programmable Serial USART, programming lock for software security, throughput up to 20 MIPS etc. ATmega-328 is mostly used in Arduino.

ATmega328 is an eight (8) bit Microcontroller. It can handle the data sized of up to eight (8)bits. It is an AVR based micro-controller. Its built-in internal memory is around 32KB. It operates ranging from 3.3V to 5V. It has an ability to store the data even when the electrical supply is removedfrom its biasing terminals. Its excellent features include the cost efficiency, low power dissipation, programming lock for security purposes, and real timer counter with separate oscillator. It's normallyused in Embedded Systems applications.

ATmega328 Pins

- ATmega-328 is an AVR Microcontroller having twenty eight (28) pins in total.
- All of the pins in chronological order are listed in the table shown in the figure given below.

ATmega328 Pins			
Pin Number	Pin Name	Pin Number	Pin Name
1	PC6	15	PB1
2	PD0	16	PB2
3	PD1	17	PB3
4	PD2	18	PB4
5	PD3	19	PB5
6	PD4	20	AVCC
7	Vcc	21	AREF
8	GND	22	GND
9	PB6	23	PC0
10	PB7	24	PC1
11	PD5	25	PC2
12	PD6	26	PC3
13	PD7	27	PC4
14	PB0	28	PC5

ATmega328 Pins Description

- Functions associated with the pins must be known in order to use the device appropriately.
- ATmega328 pins are divided into different ports which are given in detail below.

VCC is a digital voltage supply.

AVCC is a supply voltage pin for analog to digital converter.

GND denotes Ground and it has a 0V.

Port A consists of the pins from **PA0** to **PA7.** These pins serve as analog input to analog to digital converters. If analog to digital converter is not used, **port A** acts as an eight (8) bit bidirectional input/output port.

Port B consists of the pins from **PB0** to **PB7.** This port is an 8 bit bidirectional port having an internal pull-up resistor.

Port C consists of the pins from **PC0** to **PC7.** The output buffers of **port C** has symmetrical drive characteristics with source capability as well high sink.

Port D consists of the pins from **PD0** to **PD7.** It is also an 8 bit input/output port having an internal pull-up resistor.

- All of the AVR ports are shown in the figure given below

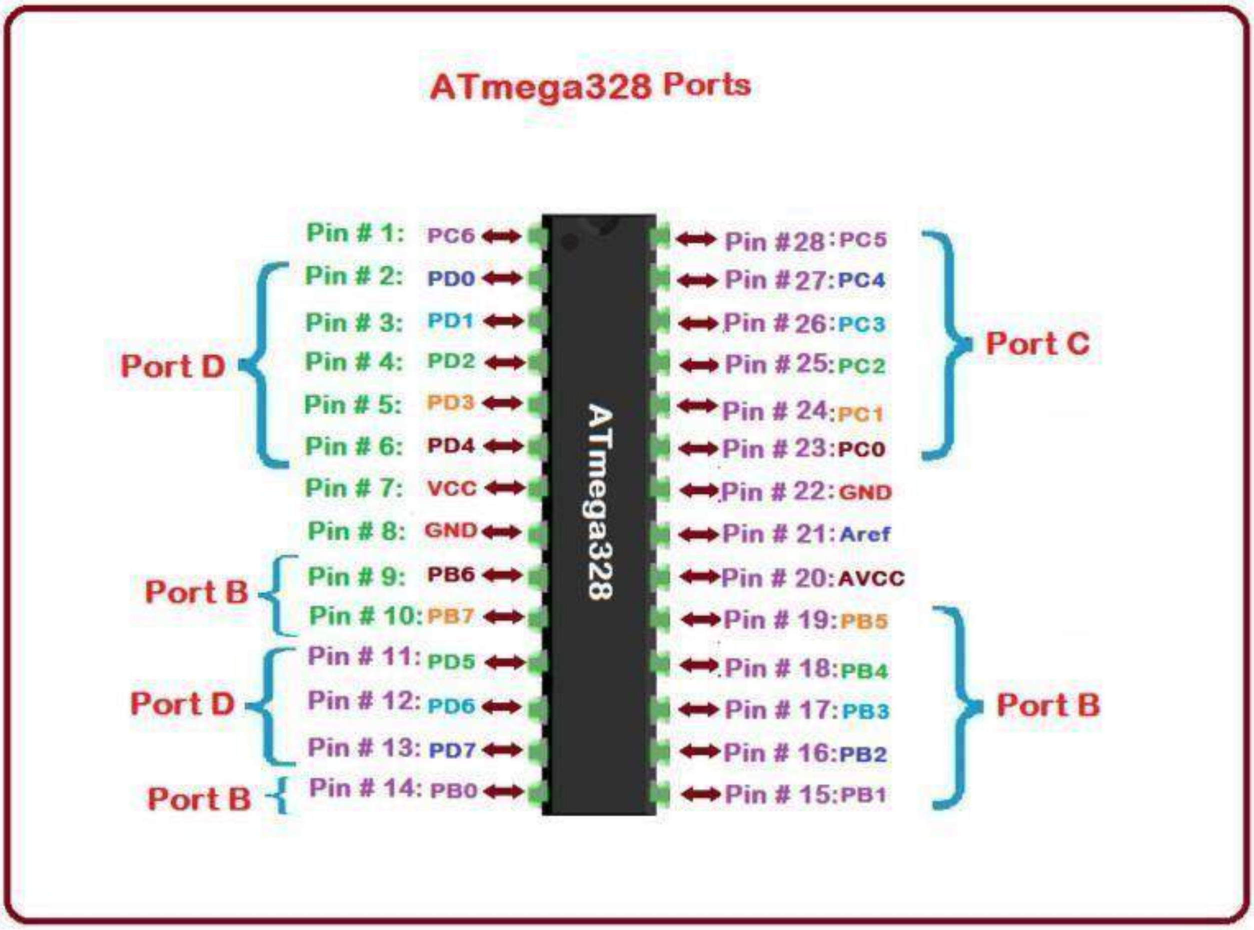


Fig 2 ATmega 328 port

AREF is an analog reference pin for analog to digital converter.

- So this was the brief of all the pins in ATmega328 AVR micro-controller.

ATmega328 Memory

- ATmega328 has three types of memories e.g. EEPROM, SRAM etc.
- The capacity of each memory is explained in detail below.

Flash Memory has 32KB capacity. It has an address of 15 bits. It is a Programmable Read Only Memory (ROM). It is nonvolatile memory.

SRAM stands for Static Random Access Memory. It is a volatile memory i.e. data will be removed after removing the power supply.

EEPROM stands for Electrically Erasable Programmable Read Only Memory. It has a long term data.

- AVR memory spaces are shown in the figure given below.

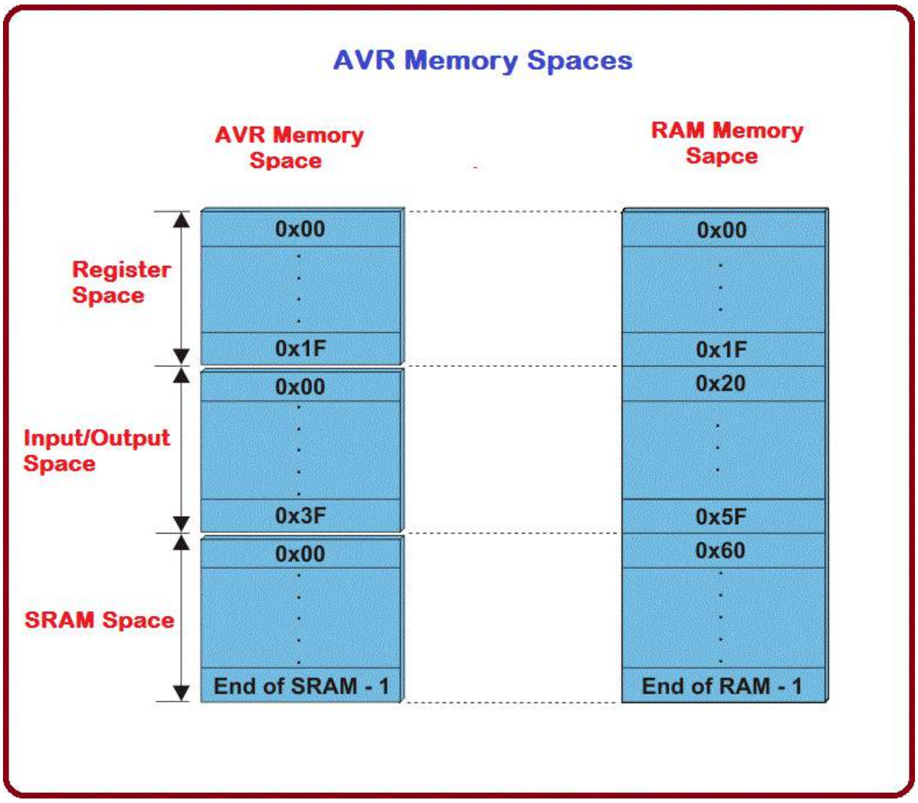


Fig 3 AVR memory

Atmega328 Architecture

- Architecture of a device presents each information about the particular device.
- ATmega-328 architecture is shown in the figure given below.

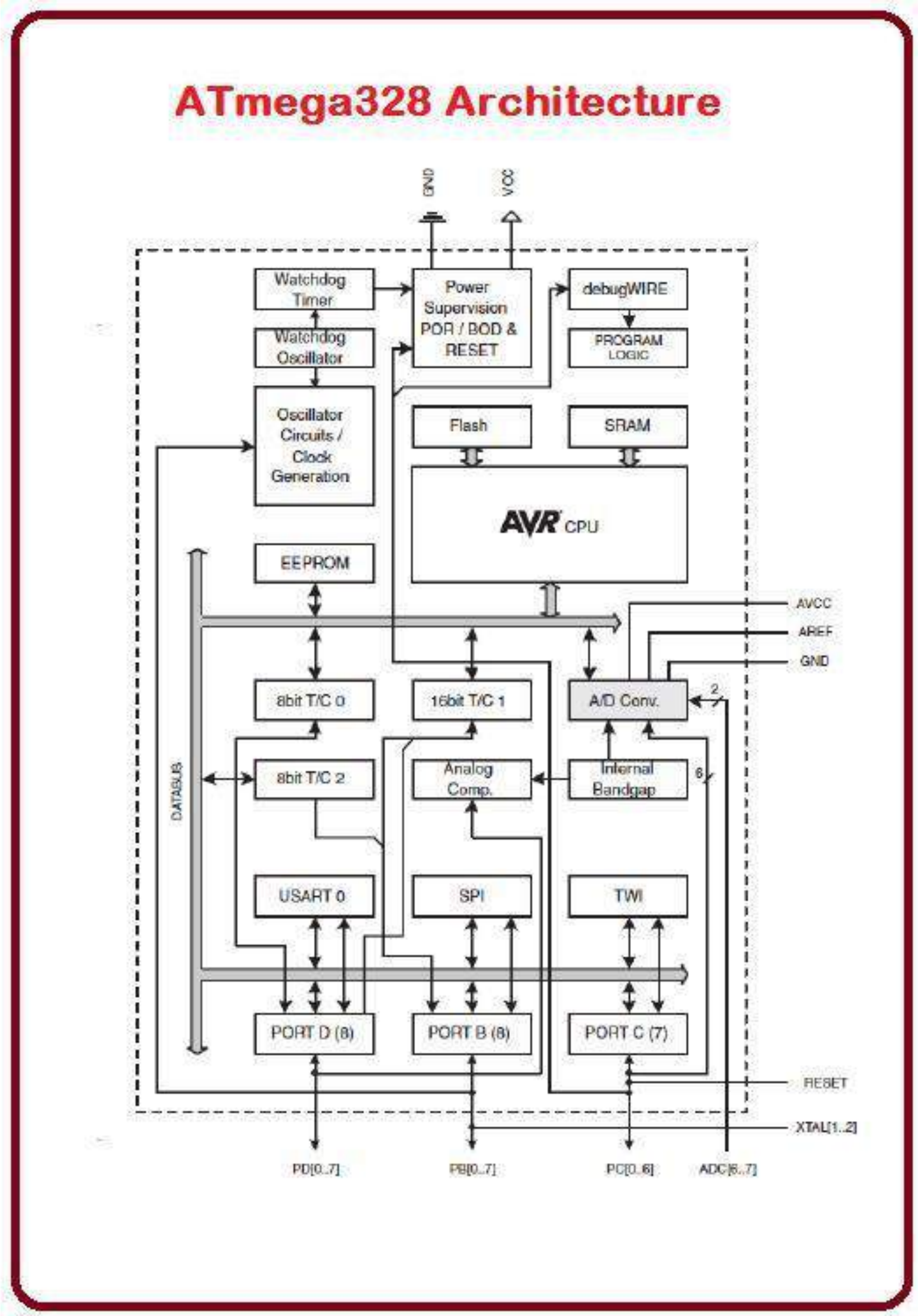


Fig 4 ATmega328 architecture

ATmega328 and Arduino

- ATmega328 is the most micro-controller that is used while designing.
- ATmega328 is the most important part of Arduino.
- The program is uploaded on the AVR micro-controller attached on Arduino.
- AVR attached on Arduino is shown in the figure given below.

Fig 5 ATmega328 & Arduino

POWER SUPPLY

Power is the backbone of any electronic system and the power supply is what feeds the system. Choosing the right supply can be the critical difference between a device working at optimum levels and one that may deliver inconsistent results. The power supply unit is the part of the hardware that is used to convert the power provided from the outlet into usable power to many parts inside an electrical device. Every energy supply must drive its load, which is connected to it. Depending on its design, a power supply unit may obtain energy from various types of energy sources, like electrical energy transmission systems, electromechanical systems such as generators and alternators, solar power converters, energy storage devices such as a battery and fuel cells, or other power supply.

There are two types of power supplies existed, AC and DC power supply. Based on the electrical device's electric specifications it may use AC power or DC power.

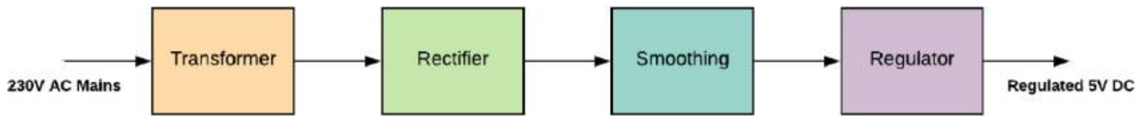
What is a Power Supply?

The power supply can be defined as it is an electrical device used to give electrical supply to electrical loads. The main function of this device is to change the electrical current from a source to the accurate voltage, frequency and current to supply the load. Sometimes, these power supplies can be named to as electric power converters. Some types of supplies are separate pieces of loads, whereas others are fabricated into the appliances that they control.

Power Supply Block Diagram

The Power supply circuit is used in various electrical & electronic devices. The power supply circuits are classified into different types based on the power they utilize for providing for circuits or devices. For instance, the microcontroller based circuits are generally the 5V DC regulated power supply (RPS) circuits, which can be designed with the help of different method for changing the power from 230V AC to 5V DC.

The power supply block diagram, and the step by step conversion of 230V AC to 12V DC is discussed below.



- A step-down transformer converts the 230V AC into12v.
- The bridge rectifier is used to change AC to DC
- A capacitor is used to filter the AC ripples and gives to the voltage regulator.
- Finally voltage regulator regulates the voltage to 5V

.

Input Transformer

The input transformer is used to convert the incoming line voltage down to the required level of the power supply. It also isolates the output circuit from the line supply. Here we are using a step-down transformer.

Rectifier

The rectifier used to convert the incoming signal from an AC format into raw DC. For rectification purpose we use a diode, a diode is a device that allows current to pass only in one direction i.e. when the anode of the diode is positive with respect to the cathode also called as forward biased condition & blocks current in the reversed biased condition.

Filter Capacitor

The pulsated DC from the rectifier is fed to the smoothing capacitor. It will remove the unwanted ripples in the pulsated DC.

Voltage Regulator

A Voltage regulator is a device which converts varying input voltage into a constant regulated output voltage.

AC-DC CONVERSION BASICS

A power supply takes the AC from the wall outlet, converts it to unregulated DC, and reduces the voltage using an input power transformer, typically stepping it down to the voltage required by the load. For safety reasons, the transformer also separates the output power supply from the mains input.

Once the voltage has been rectified, there is still fluctuation in the waveform—the time between the peaks—that needs to be removed. The rectified AC voltage is then filtered or "smoothed" with a capacitor.

The capacitor is typically quite large and creates a reservoir of energy that is applied to the load when the rectified voltage drops. The incoming energy is stored in the capacitor on the rising edge and expended when the voltage falls. This significantly reduces the amount of voltage droop and smoothes out the voltage. Increasing the storage capacity of the capacitor generally produces a higher quality power supply.

Once the voltage conversion is complete, there is still some variation in output, called ripple. In a regulated power supply, the voltage is then passed through a regulator to create a fixed DC output with less ripple.

5V Power Supply Using 7805

Circuit diagram of 5V power supply is given below.

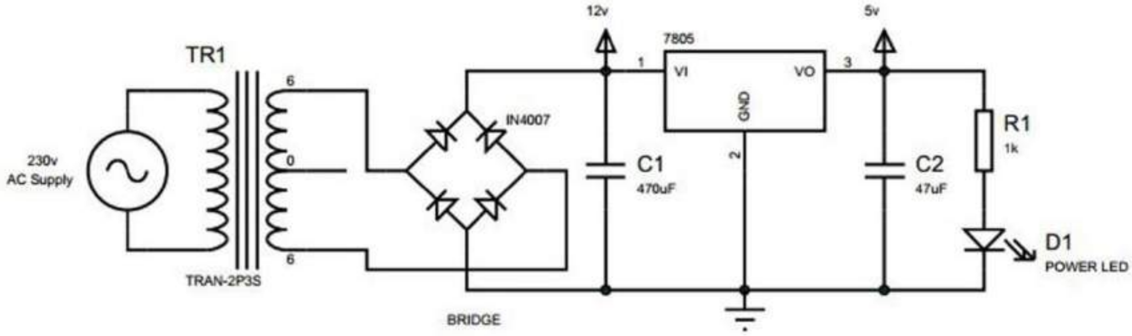


Fig 6 5V power supply

Components Used

- 6-0-6 Step Down Transformer
- 4 x 1N4007 Diode (Bridge Rectifier)
- 470uF Electrolytic Capacitor
- 7805 Voltage Regulator
- 47uF Electrolytic Capacitor
- 1k Resistor
- 3mm Red Led (Power Indication)

Step Down Transformer

A Transformer is a static apparatus, with no moving parts, which transforms electrical power from one circuit to another with changes in voltage and current and no change in frequency. There are two types of transformers classified by their function: Step up Transformer and Step down Transformer.

Principle of Working of Transformers

An electrical transformer works on the principle of Mutual Induction, which states that a uniform change in current in a coil will induce an E.M.F in the other coil which is inductively coupled to the first coil.

In its basic form, a transformer consists of two coils with high mutual inductance that are electrically separated but have common magnetic circuit. The following image shows the basic construction of a Transformer.

Relation between Voltage and Turns

Let N_P be the number of turns of the coil in the Primary Winding and N_S be the number of turns of the coil in the Secondary Winding. If the alternating voltage at the primary side of the transformer is V_P and the alternating voltage at the secondary side of the transformer is V_S, then the relation between the voltages at primary and secondary and number of turns of the coil in primary and secondary is given as follows.

$$V_P/V_S = N_P/N_S$$

Step Down Transformer

A Step down Transformer is a type of transformer, which converts a high voltage at the primary side to a low voltage at the secondary side.

If we speak in terms of the coil windings, the primary winding of a Step down Transformer has more turns than the secondary winding. The following image shows a typical step down transformer.

Bridge Rectifier

Before going to bridge rectifier, we need to know what actually a rectifier is and what is the need for a rectifier? So first let's take a look at the evolution of rectifiers.

Evolution of Rectifiers

Rectifiers are mainly classified into three types: Half-wave rectifier, Center tapped full-wave rectifier and Bridge rectifier. All these three rectifiers have a common aim that is to convert Alternating Current (AC) into Direct Current (DC). Not all these three rectifiers efficiently convert the Alternating Current (AC) into Direct Current (DC), only the center tapped full-wave rectifier and bridge rectifier efficiently convert the Alternating Current (AC) into Direct Current (DC).
The rectifier efficiency of a bridge rectifier is almost equal to the center tapped full wave rectifier. The only advantage of bridge rectifier over center tapped full wave rectifier is the reduction in cost. In bridge rectifier, instead of using the center-tapped transformer, four diodes are used.

Bridge Rectifier Construction

The bridge rectifier is made up of four diodes namely D_1, D_2, D_3, D_4 and load resistor R_L. Thefour diodes are connected in a closed loop (Bridge) configuration to efficiently convert the Alternating Current (AC) into Direct Current (DC). The main advantage of this bridge circuit configuration is that we do not require an expensive center tapped transformer, thereby reducing its cost and size.

The input AC signal is applied across two terminals A and B and the output DC signal is obtained across the load resistor R_L which is connected between the terminals C and D. The four diodes D_1, D_2, D_3, and D4 are arranged in series with only two diodes allowing electric current during each half cycle. For example, diodes D_1 and D_3 are considered as one pair which allows electric current during the positive half cycle whereas diodes D_2 and D_4 are considered as another pair which allows electric current during the negative half cycle of the input AC signal.

How Bridge Rectifier works?

When input AC signal is applied across the bridge rectifier, during the positive half cycle diodes D_1 and D_3 are forward biased and allows electric current while the diodes D_2 and $D_4$are reverse biased and blocks electric current. On the other hand, during the negative half cycle diodes D_2 and D_4 are forward biased and allow electric current while diodes D_1 and $D_3$are reverse biased and blocks electric current.

During the positive half cycle, the terminal A becomes positive while the terminal B becomes negative. This causes the diodes D_1 and D_3 forward biased and at the same time, it causes the diodes D_2 and D_4 reverse biased. The current flow direction during the positive half cycle is shown in the figure A (I.e. A to D to C to B).

During the negative half cycle, the terminal B becomes positive while the terminal A becomes negative. This causes the diodes D_2 and D_4 forward biased and at the same time, it causes the diodes D_1 and D_3 reverse biased. The current flow direction during negative half cycle is shown in the figure B (I.e. B to D to C to A).

From the above two figures (A and B), we can observe that the direction of current flow across load resistor R_L is same during the positive half cycle and negative half cycle. Therefore, the polarity of the output DC signal is same for both positive and negative half cycles. The output DC signal polarity may be either completely positive or negative. In our case, it is completely positive. If the direction of diodes is reversed then we get a complete negative DC voltage.

Thus, a bridge rectifier allows electric current during both positive and negative half cycles of the input AC signal. The output waveforms of the bridge rectifier is shown in the below figure.

Advantages of Bridge Rectifiers

The advantages of bridge rectifier are listed below.

Low ripples in the output DC signal

The DC output signal of the bridge rectifier is smoother than the half wave rectifier. In other words, the bridge rectifier has fewer ripples as compared to the half wave rectifier. However, the ripple factor of the bridge rectifier is same as the center tapped full wave rectifier.

High rectifier efficiency

The rectifier efficiency of the bridge rectifier is very high as compared to the half wave rectifier. However, the rectifier efficiency of bridge rectifier and center tapped full wave rectifier is same.

Low power loss

In half wave rectifier only one half cycle of the input AC signal is allowed and the remaining half cycle of the input AC signal is blocked. As a result, nearly half of the applied input power is wasted.

However, in the bridge rectifier, the electric current is allowed during both positive and negative half cycles of the input AC signal. So the output DC power is almost equal to the input AC power

7805 Voltage Regulator

It is a positive voltage regulator used for providing constant output voltage overa wide range of input voltage. Voltage regulation is referred as the measure of voltagechange between input and output. The IC 7805 does the same thing. It provides constant output voltage when a range of different voltage is applied at the input terminal. This component comes with three terminals called input, ground, and output.This is called positive voltage regulator because it generates positive voltage with respect to the ground terminal. Transistors and voltage regulator IC like 7805 work in a similar way with the intention of providing voltage regulation.

7805 is an IC used for voltage regulation and comes in TO-220 version. This component belongs to 78xx series where xx defines the output voltage it generates. Voltage fluctuation is a common practice during the execution of many electronic projects. This component overcomes and prevents this voltage fluctuation by providing a constant output voltage at the output terminal.

The best part is that it doesn’t require any additional components to set output voltage. It is a compact IC that comes with a built-in protection circuit that avoids the circuits from too much heating, making it suitable for circuits drawing high current. The input voltage range applied to the input terminals of this IC varies from 7 V to 18 V (in some cases 7 to 35 V), resulting in the generation of constant output voltage around 5 V.

You can see, there is a huge difference between input voltage and the output voltage that gets regulated. This difference is discharged as heat. The surge of heat generation can damage the device and affect the overall project performance. There are two ways to overcome this heat generation i.e. you can use a heat sink that is widely used for heat dissipation OR you can limit the input current 2 to 3 V above the regulated voltage at the output terminal. For example, you'll get 5 Vat the output terminal, so itis suitable to limit input voltage within 7 or 8 V.

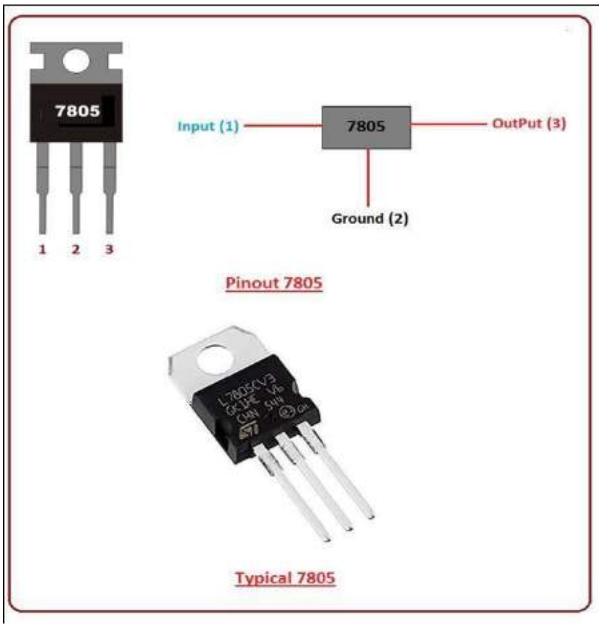


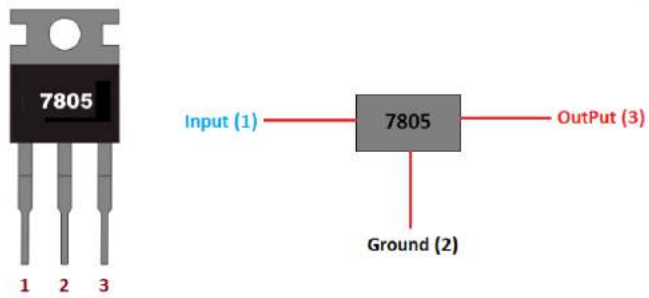
Fig 7 7805 voltage regulator

Heat sink comes in different sizes based on the amount of heat that is required to disperse. Itis advised to calculate the size of heat sink before you put your voltage regulator in operation. With the addition of heat sink, this IC can control output current at around 1.0 A.

This voltage regulator is an ideal choice for the applications where safe area compensation, thermal shutdown, and current limiting are required. This device is designed with the purpose of getting constant output voltage; however, it can be coupled with external components with the intention of generating desired voltage and current. This IC comes with an accurate circuit which generates constant voltage so no capacitors are required to produce smooth output, however, it is advised to place 10µF capacitors in the input and output terminal to remain in the safer side.

Pinout of 7805

Following figure shows the pinout of this voltage regulator.



Pin No.	Name	Function
1	Input	Input Voltage (5 to 18 V)
2	Ground	Ground
3	Output	Output Regulated Voltage (4.8 to 5.2 V)

7805 Pinout

Fig 8 pinout of 7805

- Pin 1 shows the input voltage applied to this regulator which ranges between 7 to 18 V.
- Pin 2 shows the ground terminal. Voltage regulator generates positive voltage with respect to the ground terminal.
- Pin 3 shows the output terminal where regulated voltage is obtained. Regulated voltage shows the tolerance between 1.5 % to 2 %.
- This regulator has a capacity of controlling output current around 1 A.
- It shows a voltage dropout around 2 V. It is advised to provide minimum 7 V at the input terminal in order to obtain exact 5 V at the output terminal.

Introduction to NodeMCU

The NodeMCU (**N**ode **M**icro **C**ontroller **U**nit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Exspress if Systems, contains the crucial elements of a computer: CPU, RAM, networking (Wi-Fi), and even a modern operating system and SDK. That makes it an excellentchoice for the Internet of Things (IoT) projects of all kinds.

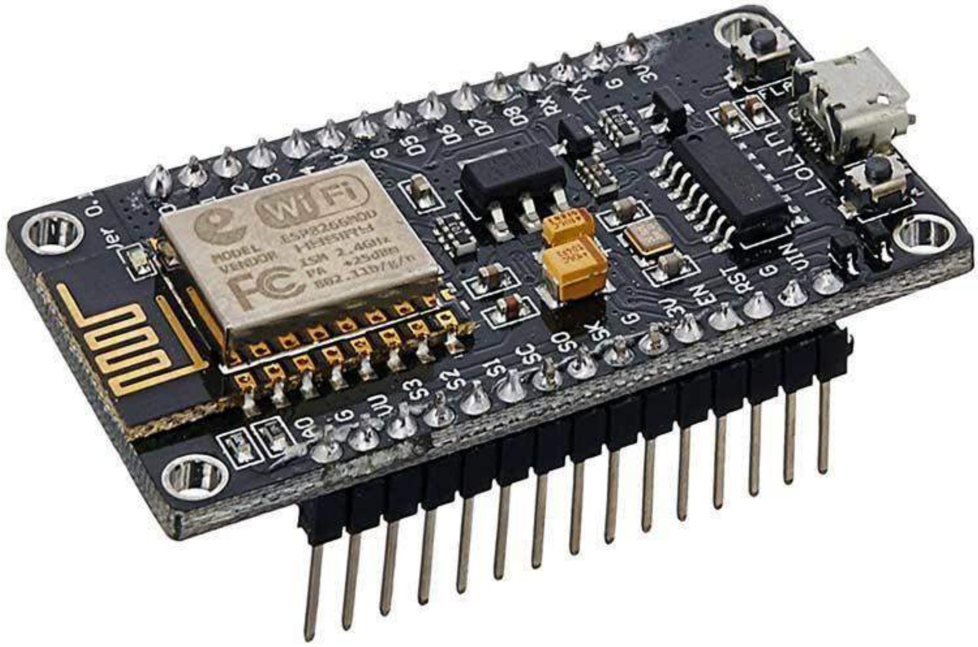


Fig 9 Node MCU

Since NodeMCU is an open-source platform, its hardware design is open for edit/modify/build. NodeMCU Dev Kit/board consists of ESP8266 Wi-Fi enabled chip. The **ESP8266** is a low-cost Wi-Fi chip developed by Espressif Systems with TCP/IP protocol.

Hardware Specification:

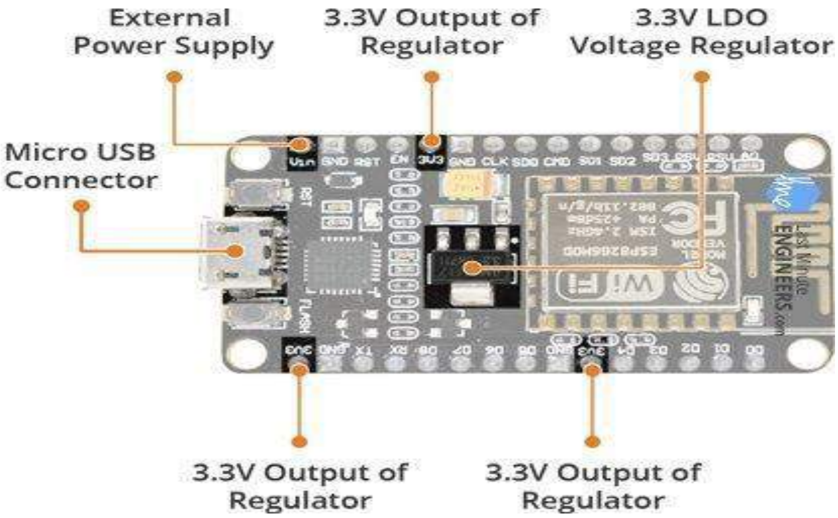
The development board equips the ESP-12E module containing ESP8266 chip having **Tensilica Xtensa 32-bit LX106 RISC microprocessor** which operates at **80 to 160 MHz** adjustable clock frequency and supports **RTOS**.

There's also **128 KB RAM and 4MB of Flash memory** (for program and data storage) just enough to cope with the large strings that make up web pages, JSON/XML data, and everything we throw at IoT devices nowadays.

The ESP8266 Integrates **802.11b/g/n HT40 Wi-Fi transceiver**, so it can not only connect to a Wi-Fi network and interact with the Internet, but it can also set up a network of its own, allowing other devices to connect directly to it. This makes the ESP8266 NodeMCU even more versatile.

Power Requirements:

As the operating voltage range of ESP8266 is **3V to 3.6V**, the board comes with a LDO voltage regulator to keep the voltage steady at 3.3V. It can reliably supply up to 600mA, which should be more than enough when ESP8266 pulls as much as **80mA during RFtransmissions**. The output of the regulator is also broken out to one of the sides of the board and labelled as 3V3. This pin can be used to supply power to external components.

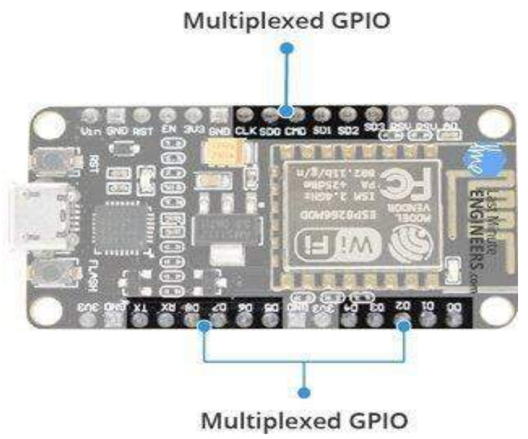


Power to the ESP8266 NodeMCU is supplied via the **on-board MicroB USB connector**. Alternatively, if you have a regulated 5V voltage source, the **VIN pin** can be used to directly supply the ESP8266 and its peripherals.

Peripherals and I/O:

The ESP8266 NodeMCU has total **17 GPIO pins** broken out to the pin headers on both sides of the development board. These pins can be assigned to all sorts of peripheral duties, including:

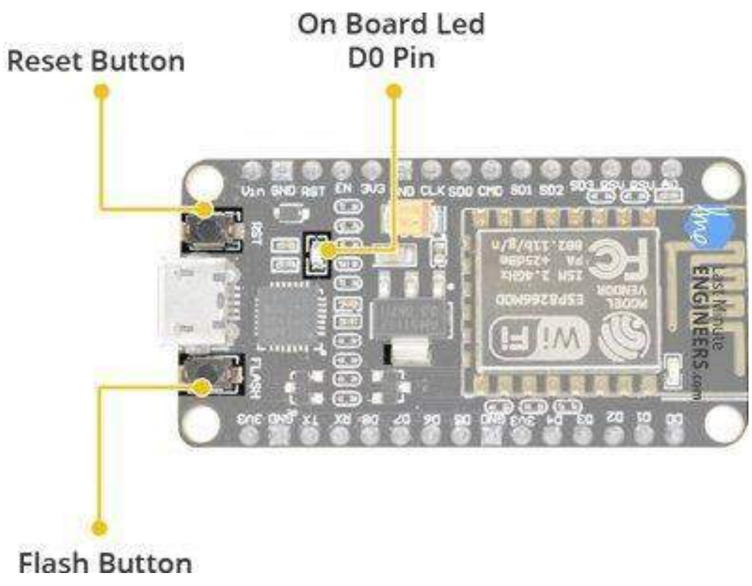
- **ADC** channel - A 10-bit ADC channel.
- **UART** interface - UART interface is used to load code serially.
- **PWM** outputs - PWM pins for dimming LEDs or controlling motors.
- **SPI, I2C** interface - SPI and I2C interface to hook up all sorts of sensors and peripherals.



Thanks to the ESP8266's **pin multiplexing feature** (Multiple peripherals multiplexed on a single GPIO pin). Meaning a single GPIO pin can act as PWM/UART/SPI.

On-board Switches and LED Indicator:

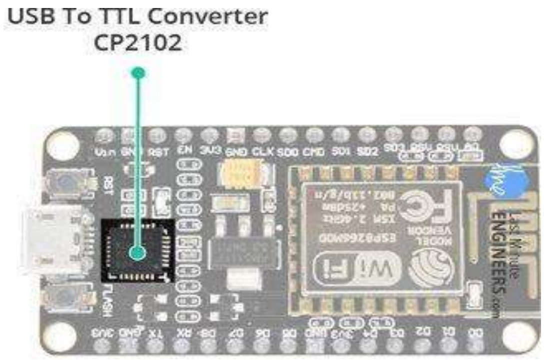
The ESP8266 NodeMCU features two buttons. One marked as **RST** located on the top left corner is the Reset button, used of course to reset the ESP8266 chip. The other **FLASH** button on the bottom left corner is the download button used while upgrading firmware.



The board also has a **LED indicator** which is user programmable and is connected to the D0 pin of the board.

Serial Communication:

The board includes CP2102 USB-to-UART Bridge Controller from Silicon Labs, which converts USB signal to serial and allows your computer to program and communicate with the ESP8266 chip.



ESP8266 NodeMCU PINOUT:

The ESP8266 NodeMCU has total 30 pins that interface it to the outside world. The connections are as follows:

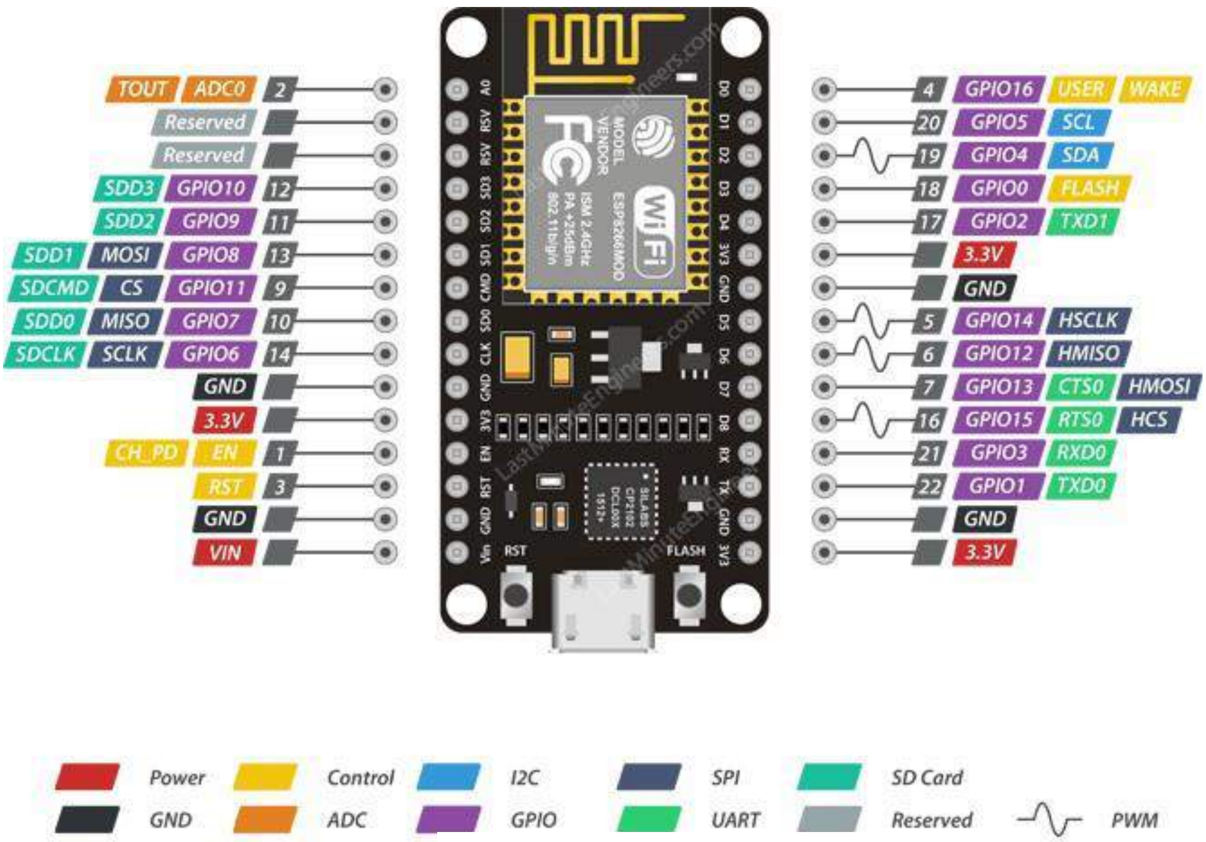


Fig 9 Node mcu

Power Pins:

There are four power pins. one VIN pin & three 3.3V pins. The VIN pin can be used to directly supply the ESP8266 and its peripherals, if you have a regulated 5V voltage source. The3.3V pins are the output of an on-board voltage regulator. These pins can be used to supply power toexternal components.

GND:

GND is a ground pin of ESP8266 NodeMCU development board.

I2C Pins:

These pins used to hook up all sorts of I2C sensors and peripherals in your projects. Both I2C Master and I2C Slave are supported. I2C interface functionality can be realized programmatically, and the clock frequency is 100 kHz at a maximum.
It should be noted that I2C clock frequency should be higher than the slowest clock frequency of the slave device.

GPIO Pins:

ESP8266 NodeMCU has 17 GPIO pins which can be assigned to various functions such as I2C, I2S, UART, PWM, IR Remote Control, LED Light and Button programmatically. Each digital enabled GPIO can be configured to internal pull-up or pull-down, or set to high impedance. When configured as an input, it can also be set to edge-trigger or level-trigger to generate CPU interrupts.

ADC Channel:

The NodeMCU is embedded with a 10-bit precision SAR ADC. The two functions can be implemented using ADC viz. Testing power supply voltage of VDD3P3 pin and testing input voltage of TOUT pin. However, they cannot be implemented at the same time.

UART Pins:

ESP8266 NodeMCU has 2 UART interfaces, i.e. UART0 and UART1, which provide asynchronous communication (RS232 and RS485), and can communicate at up to 4.5 Mbps. UART0 (TXD0, RXD0, RST0 & CTS0 pins) can be used for communication. It supports fluid control. However, UART1 (TXD1 pin) features only data transmit signal so; it is usually used for printing log.

SPI Pins:

ESP8266 features two SPIs (SPI and HSPI) in slave and master modes. These SPIs also support the following general-purpose SPI features:

- 4 timing modes of the SPI format transfer.
- Up to 80 MHz and the divided clocks of 80 MHz .
- Up to 64-Byte FIFO

SDIO Pins:

ESP8266 features Secure Digital Input/output Interface (SDIO) which is used to directly interface SD cards. 4-bit 25 MHz SDIO v1.1 and 4-bit 50 MHz SDIO v2.0 are supported.

PWM Pins:

The board has 4 channels of Pulse Width Modulation (PWM). The PWM output can be implemented programmatically and used for driving digital motors and LEDs. PWM frequency range is adjustable from 1000 μs to 10000 μs, i.e., between 100 Hz and 1 kHz.

Control Pins:

These are pins used to control ESP8266. These pins include Chip Enable pin (EN), Reset pin (RST) and WAKE pin.

- EN pin – The ESP8266 chip is enabled when EN pin is pulled HIGH. When pulled LOW the chip works at minimum power.
- RST pin – RST pin is used to reset the ESP8266 chip.
- WAKE pin – Wake pin is used to wake the chip from deep-sleep.

Introduction to DC Pumb:

What is a DC Water Pump? A DC water pump is an electric pump with low voltage. They are quiet and use little power. They are used for many applications, including automotive, household, and water wells. Various DC water pumps are available in the market, including the DC Fountain Pump VP30, a five-volt mini water pump perfect for a solar fountain. You can also find DC Submersible Pumps VP30A and VP40A for aquariums, tabletop crafts, and even fish tanks.

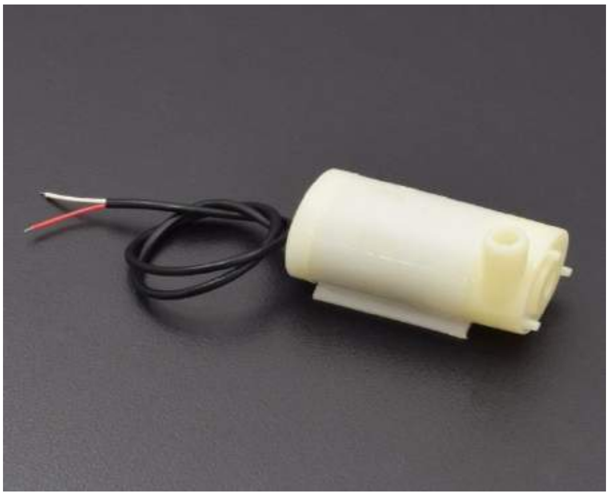


Fig 10 DC pumb

When selecting a small water pump, it's important to check its power consumption. Most pumps draw up to 9.5 amps, so it's important to choose one that matches your power needs. Check that the motor is corrosion-resistant and can withstand multiple freeze-thaw cycles. In addition, the housing should be intact and have no cracks. Finally, choose a pump that comes with a warranty. If a mini water pump fails after just a few years, it may be good to look for a brand that offers a warranty. After-sales support can also help you replace any parts if needed.

DC Water Pump Used For:

DC water pumps are small pumps powered by a battery, dc power supply, or solar panel. Their primary use is to circulate, pressurize, and emulsify liquids. They are particularly useful in environments where water is in short supply. Listed below are some other uses for DC submersible pump. This article will explain the most common applications for DC water pumps.

When purchasing a small water pump, paying attention to its maximum head is important. The max head refers to the maximum water flow rate that the pump can handle. This figure must be higher than the maximum pumping height specified on the label. Often, there is a margin of about five to ten percent between the maximum and normal flow rates. Mini water pumps have a higher maximum flow rate than other pumps, which means you should choose a pump accordingly. Another important point to remember when purchasing a DC water pump is the power supply. Micro DC pumps are designed to work with low voltage supplies, so they cannot overheat. They can used safely even in locations where the power supply is unstable. Micro DC pumps are also available in a wide range of sizes and types. It's important to understand the differences between these two types andhow each differs from one another.

A DC pump is more efficient and versatile than its AC counterpart. It has a higher life span and can runcompletely off the electricity of the power line. Some advanced designs have brushless motors and magnetically coupled drives. They also have no fans or shaft leakage. There are two main types of DCpumps – the PV and B12 models. The PV models are solar direct. B12 models are design to connect toa 12-volt battery. Both will work, though the PV model will run slightly slower, and the B12 model will need a power source.

DC Pump Working:

Here's the ultimate guide if you're considering buying a DC water pump for your RV. First, consider the size of your RV. A 12 volt DC water pump will run on its built-in 12-volt power system. A large commercial pump requires a 230-volt power supply, while a 12-volt model requires only a 120-volt power source. Both options will require a mini water pump.

To get the proper flow, you'll need to ensure the pump can handle the required amount of water. Make sure the pipe is made of drinking water grade PVC. A pump designed for 24 Volts may have a 3/4-inch outlet. For 12 Volts, you'll need a pump compatible with the smaller pipe size. The difference in size will affect how much water a pump will be able to draw from the tank.

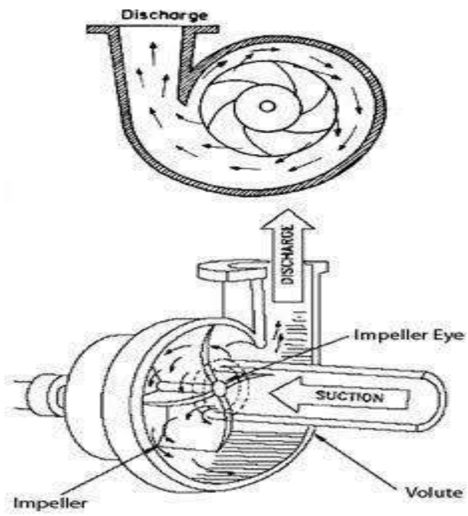


Fig 11 working of DC pumb

Fortunately, there are many reasons to consider a DC water pump. One major advantage of a **DC submersible pump** is its flexibility of installation. If you have an existing power source, you can easily install a DC submersible pump anywhere. Manufacturers can even install them without needing a dedicated electrical grid. This will increase the flexibility of installation. You can even put one in your RV's water tank! So if you have an RV, now's the perfect time to get one!

INTRODUCTION TO LDR:

LIGHT DEPENDENT RESITOR

Light dependent resistors, LDRs or photo resistors are often used in circuits where it is necessary to detect the presence or the level of light. They can be described by a variety of names from light dependent resistor, LDR, photo resistor, or even photo cell, photocell or photoconductor.

A photo resistor or light dependent resistor is a component that is sensitive to light. When light falls upon it then the resistance changes. Values of the resistance of the LDR may change over many orders of magnitude the value of the resistance falling as the level of light increases. It is not uncommon for the values of resistance of an LDR or photo resistor to be several mega ohms in darkness and then to fall to a few hundred ohms in bright light. With such a wide variation in resistance, LDRs are easy to use and there are many LDR circuits available. The sensitivity of light dependent resistors or photo resistors also varies with the wavelength of the incident light. LDRs are made from semiconductor materials to enable them to have their light sensitive properties. Many materials can be used, but one popular material for these photo resistors is cadmium sulphide, CdS.

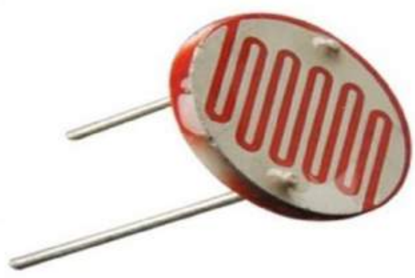
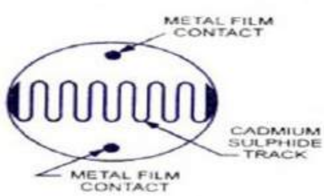


Fig 12 LDR sensor

LDR STRUTURE AND WORKING

The basic structure of an LDR is shown below.



The snake like track shown below is the Cadmium Sulphide (CdS) film which also passes through the sides. On the top and bottom are metal films which are connected to the terminal leads. It is designed in such a way as to provide maximum possible contact area with the two metal films. The structure is housed in a clear plastic or resin case, to provide free access to external light. As explained above, the main component for the construction of LDR is cadmium sulphide (CdS), which is used as the photoconductor and contains no or very few electrons when not illuminated. In the absence of light it is designed to have a high resistance in the range of mega ohms. As soon as light falls on the sensor, the electrons are liberated and the conductivity of the material increases. When the light intensity exceeds a certain frequency, the photons absorbed by the semiconductor give band electrons the energy required to jump into the conduction band. This causes the free electrons or holes to conduct electricity and thus dropping the resistance dramatically (< 1 Kilo ohm).

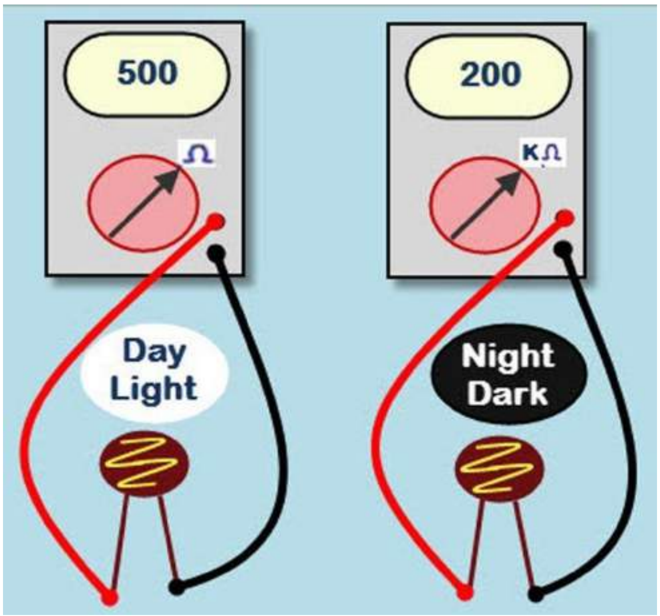


Fig 13Variation of LDR Resistance with Variation in Light Intensity

If a constant “V’ is applied to the LDR, the intensity of the light increased and current increases. The figure below shows the curve between resistance Vs illumination curve for a particular light dependent resistor.

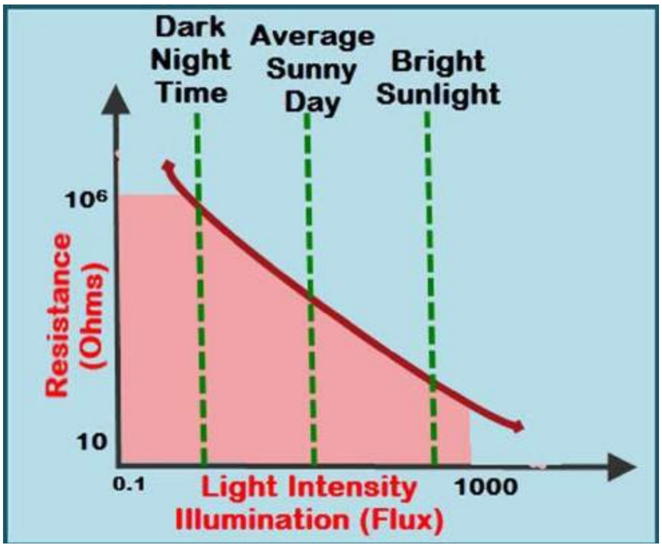


Fig 14 Light Intensity vs LDR Resistances

Types of light Dependent Resistors

Light dependent resistors are classified based on the materials used.

Intrinsic Photo Resistors

These resistors are pure semiconductor devices like silicon or germanium. When the light falls on the LDR, then the electrons get excited from the valence band to the conduction band and number of charge carriers increases.

Extrinsic Photo Resistors

These devices are doped with impurities and these impurities create a new energy bands above the valence band. These bands are filled with electrons. Hence this decrease the band gap and small amount of energy is required in moving them. These resistors are mainly used for long wavelengths.

INTRODUCTION TO RELAY MODULE:

Relay is one kind of electro-mechanical component that functions as a switch. The relay coil is energized by DC so that contact switches can be opened or closed. A single channel 5V relay module generally includes a coil, and two contacts like normally open (NO) and normally closed (NC). This article discusses an overview of the 5V relay module & its working but before going to discuss what is relay module is, first we have to know what is relay and its pin configuration.

What is a 5V Relay?

A 5v relay is an automatic switch that is commonly used in an automatic control circuit and to control a high-current using a low-current signal. The input voltage of the relay signal ranges from 0 to 5V.

5V Relay Pin Configuration:

The pin configuration of the 5V relay is shown below. This relay includes 5-pins where each pin and its functionality are shown below.

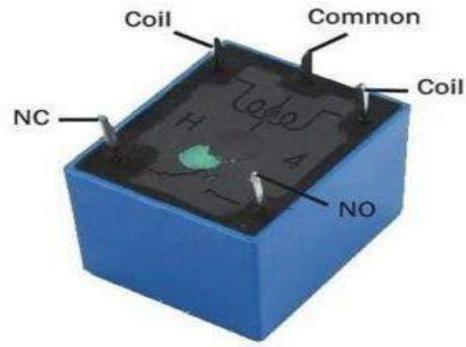


Fig 15 5V Relay

- **Pin1 (End 1):** It is used to activate the relay; usually this pin one end is connected to 5Volts whereas another end is connected to the ground.
- **Pin2 (End 2):** This pin is used to activate the Relay.
- **Pin3 (Common (COM)):** This pin is connected to the main terminal of the Load to make it active.
- **Pin4 (Normally Closed (NC)):** This second terminal of the load is connected to either NC/ NO pins. If this pin is connected to the load then it will be ON before the switch.
- **Pin5 (Normally Open (NO)):** If the second terminal of the load is allied to the NO pin, then the load will be turned off before the switch.

Features:

The **features of the 5V relay** include the following.

- Normal Voltage is 5V DC
- Normal Current is 70mA
- AC load current Max is 10A at 250VAC or 125V AC
- DC load current Max is 10A at 30V DC or 28V DC
- It includes 5-pins & designed with plastic material
- Operating time is 10msec
- Release time is 5msec
- Maximum switching is 300 operating per minute

5V Relay Module:

The relay module with a single channel board is used to manage high voltage, current loads like solenoid valves, motor, AC load & lamps. This module is mainly designed to interface through different microcontrollers like PIC, Arduino, etc.

5V Relay Module Pin Configuration:

The pin configuration of the 5V relay module is shown below. This module includes 6-pins where each pin and its functionality are discussed below.

Fig 16 Relay Module Pin Diagram

- **Normally Open (NO):** This pin is normally open unless we provide a signal to the relay modules signal pin. So, the common contact pin smashes its link through the NC pin to make a connection through the NO pin
- **Common Contact:** This pin is used to connect through the load that we desire to switch by using the module.
- **Normally Closed (NC):** This NC pin is connected through the COM pin to form a closed circuit. However, this NC connection will break once the relay is switched through providing an active high/low signal toward the signal pin from a microcontroller.
- **Signal Pin:** The signal pin is mainly used for controlling the relay. This pin works in two cases like active low otherwise active high. So, in active low case, the relay activates once we provide an active low signal toward the signal pin, whereas, in an active high case, the relay will trigger once we provide a high signal toward the signal pin.

However, these modules generally work on an active high signal which will strengthen the relay coil to make contact with the common terminal with the normally open terminal.

- **5V VCC:** This pin needs 5V DC to work. So 5V DC power supply is provided to this pin.
- **Ground:** This pin connects the GND terminal of the power supply

LAMP:

The light bulb is one of the wonders of the modern world. Found nearly everywhere on the planet, light bulbs are so common and widespread that it's easy to forget how dependent we are on them. The light bulb is an electric light source that's technically called a lamp. This term is, of course, also more commonly used by consumers to mean a portable type of lighting such as a table lamp or a desk lamp.

The **most common type of "lamp" or bulb** is the incandescent light bulb. These types of light bulbs are the oldest and simplest form of bulb technology, dating back to Thomas Edison's experiments with filament types back in 1879.

Fig 17 lamp

How Incandescent Bulbs Work?

An incandescent bulb works on **the principle of incandescence**, a general term **meaning light produced by heat**. In an incandescent type of bulb, an electric current is passed through a thin metal filament, heating the filament until it glows and produces light.

So, how do incandescent light bulbs work? Incandescent bulbs typically use a tungsten filament because of tungsten's high melting point. A tungsten filament inside a light bulb can reach temperatures as high as 4,500 degrees Fahrenheit. A glass enclosure, the glass "bulb", prevents oxygen in the air from reaching the hot filament. Without this glass covering and the vacuum it helps create, the filament would overheat and oxidize in a matter or moments.

After the electricity has made its way through the tungsten filament, it goes down another wire and out of the bulb via the metal portion at the side of the socket. It goes into the lamp or fixture and out a neutral wire.

This is an elegantly simple system and it works quite well at producing light. It's perfect for a wide range of applications, cheap and easy to manufacture, and is compatible with either AC or DC current

.

INTRODUCTION TO WATER LEVEL SENSOR

The Water level sensor is used to measure the water content (moisture) . In the presence of water, the module output is at high level; else the output is at low level.

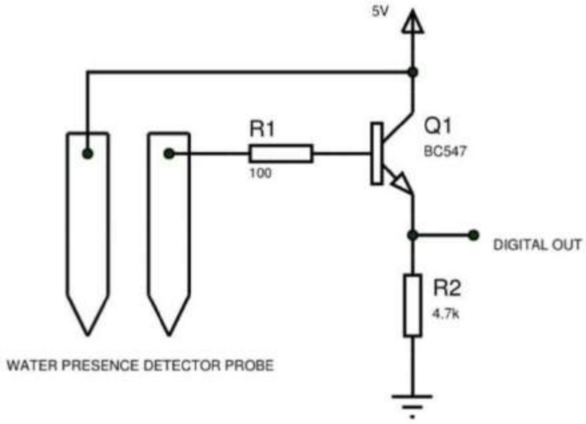


Fig 18 water level sensor

We have used an NPN transistor to detect water presence. . This water presence detector circuit can be used in many applications like Automatic plant irrigation system, Greenhouse projects etc.

Working Explanation:

This Water presence Detector Circuit is very simple. Here we have used a water presence detector probe to sense the water presence and an NPN transistor to get digital output. Working on this circuit is straightforward and clearly understandable. Here we have connected one wire of probe directly to 5V and another probe to the base of the transistor Q1 and 100 ohm resistor is used for the sensitivity of the circuit. Now when there is no water presence then probes does not allow 5V to the base of transistor Q1 so the digital output will be LOW. Now, whenever both probes will come in contact with water then both the probe gets shorted, because water is good conductor of electric current. And when probes get shorted then the base of the transistor gets 5V.

As we know when we apply some voltage to the base of an **NPN Transistor** it gets turn on and allow current to pass through the collector to emitter. And as soon as transistor turns on and digital output will be HIGH.

INTRODUCTION TO SERVO MOTOR

A servo motor is a type of motor that can rotate with great precision. Normally this type of motor consists of a control circuit that provides feedback on the current position of the motor shaft, this feedback allows the servo motors to rotate with great precision. If you want to rotate an object at some specific angles or distance, then you use a servo motor. It is just made up of a simple motor which runs through a servo mechanism. If motor is powered by a DC power supply then it is called DC servo motor, and if it is AC-powered motor then it is called AC servo motor. For this tutorial, we will be discussing only about the DC servo motor working. Apart from these major classifications, there are many other types of servo motors based on the type of gear arrangement and operating characteristics. A servo motor usually comes with a gear arrangement that allows us to get a very high torque servo motor in small and lightweight packages. Due to these features, they are being used in many applications like toy car, RC helicopters and planes, Robotics, etc.

Servo motors are rated in kg/cm (kilogram per centimeter) most hobby servo motors are rated at 3kg/cmor 6kg/cm or 12kg/cm. This kg/cm tells you how much weight your servo motor can lift at a particular distance. For example: A 6kg/cm Servo motor should be able to lift 6kg if the load is suspended 1cm away from the motors shaft, the greater the distance the lesser the weight carrying capacity. The position of a servo motor is Servo Motor Working Mechanism

It consists of three parts:

1. Controlled device
2. Output sensor
3. Feedback system

It is a closed-loop system where it uses a positive feedback system to control motion and the final position of the shaft. Here the device is controlled by a feedback signal generated by comparing output signal and reference input signal.

Here reference input signal is compared to the reference output signal and the third signal is produced by the feedback system. And this third signal acts as an input signal to the control the device. This signal is present as long as the feedback signal is generated or there is a difference between the reference input signal and reference output signal. So the main task of servomechanism is to maintain the output of a system at the desired value at presence of noises.

Servo Motor Working Principle

A servo consists of a Motor (DC or AC), a potentiometer, gear assembly, and a controlling circuit. First of all, we use gear assembly to reduce RPM and to increase torque of the motor. Say at initial position of servo motor shaft, the position of the potentiometer knob is such that there is no electrical signal generated at the output port of the potentiometer. Now an electrical signal is given to another input terminal of the error detector amplifier. Now the difference between these two signals, one comes from the potentiometer and another comes from other sources, will be processed in a feedback mechanism and output will be provided in terms of error signal. This error signal acts as the input for motor and motor starts rotating. Now motor shaft is connected with the potentiometer and as the motor rotates so the potentiometer and it will generate a signal. So as the potentiometer’s angular position changes, its output feedback signal changes. After sometime the position of potentiometer reaches at a position that the output of potentiometer is same as external signal provided. At this condition, there will be no output signal from the amplifier to the motor input as there is no difference between external applied signal and the signal generated at potentiometer, and in this situation motor stops rotating.

Interfacing Servo Motors with Microcontrollers:

Interfacing hobby Servo motors like s90 servo motor with MCU is very easy. Servos have three wires coming out of them. Out of which two will be used for Supply (positive and negative) and one will be used for the signal that is to be sent from the MCU. An MG995 Metal Gear Servo Motor which is most commonly used for RC cars humanoid bots etc. The picture of MG995 is shown below:

Fig 19 servo motor

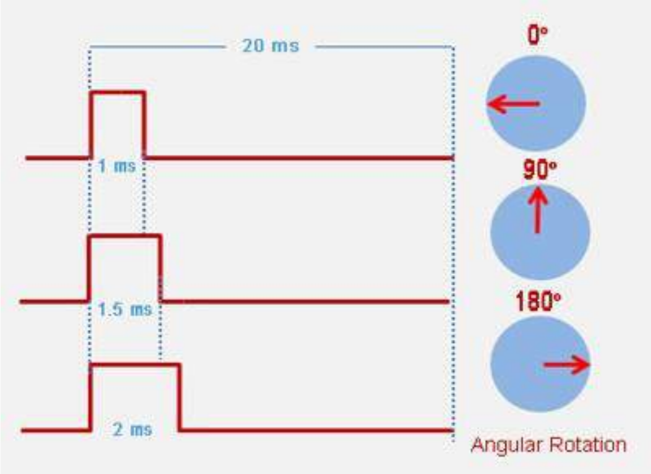
The color coding of your servo motor might differ hence check for your respective datasheet.All servo motors work directly with your +5V supply rails but we have to be careful on the amount of current the motor would consume if you are planning to use more than two servo motors a proper servo shield should be designed.

Controlling Servo Motor:

All motors have three wires coming out of them. Out of which two will be used for Supply (positive and negative) and one will be used for the signal that is to be sent from the MCU.

Servo motor is controlled by PWM (Pulse with Modulation) which is provided by the control wires. There is a minimum pulse, a maximum pulse and a repetition rate. Servo motor can turn 90 degree from either direction form its neutral position. The servo motor expects to see a pulse every 20 milliseconds (ms) and the length of the pulse will determine how far the motor turns. For example, a 1.5ms pulse will make the motor turn to the 90° position, such as if pulse is shorter than 1.5ms shaft moves to 0° and if it is longer than 1.5ms than it will turn the servo to 180°.Servo motor works on PWM (Pulse width modulation) principle, means its angle of rotation is controlled by the duration of applied pulse to its Control PIN. Basically servo motor is made up of DCmotor which is controlled by a variable resistor (potentiometer) and some gears. High speed force of DC motor is converted into torque by Gears. We know that WORK= FORCE X DISTANCE, in DC motor Force is less and distance (speed) is high and in Servo, force is High and distance is less The potentiometer is connected to the output shaft of the Servo, to calculate the angle and stop the DC motoron the required angle.

Servo motor can be rotated from 0 to 180 degrees, but it can go up to 210 degrees, depending on the manufacturing. This degree of rotation can be controlled by applying the **Electrical Pulse** of proper width, to its Control pin. Servo checks the pulse in every 20 milliseconds. The pulse of 1 m s (1 millisecond) width can rotate the servo to 0 degrees, 1.5ms can rotate to 90 degrees (neutral position) and 2 m s pulse can rotate it to 180 degree. All servo motors work directly with your +5V supply rails but we have to be careful about the amount of current the motor would consume if you are planning to use more than two servo motors a proper servo shield should be designed.

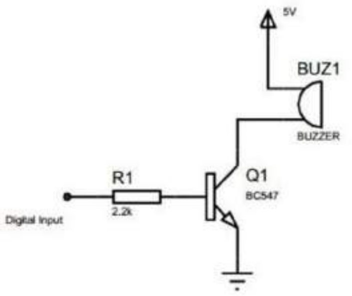


BUZZER:

A buzzer is an audio signaling device which may be mechanical, electrical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke. A buzzer takes some sort of input and emits a sound in response to it. They may use various means to produce the sound; everything from metal clappers to electromechanical devices.

A buzzer needs to have some way of taking in energy and converting it to acoustic energy. Many buzzers are part of a larger circuit and take their power directly from the device's power source. In other cases, however, the buzzer may be battery powered so that it will go off in the event of a mains outage. Some devices that provide emergency power have buzzers on them so that the user knows that they are running on backup power and not on mains power.

Circuit diagram of Buzzer is given below;



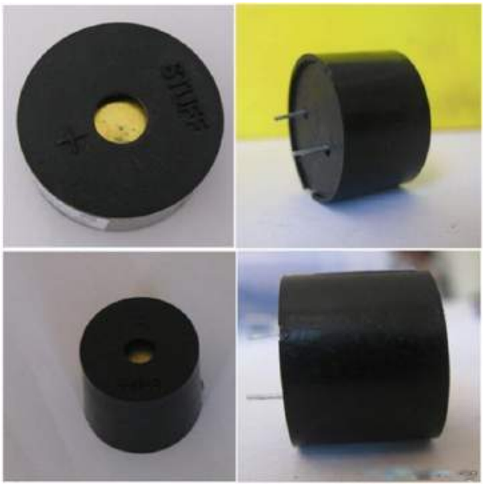


Figure 20 buzzer

LED (LIGHT EMITTING DIODE):

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices, and are increasingly used for lighting. Introduced as a practical electronic component in 1962,[2] early LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet and infrared wavelengths, with very high brightness. When a light-emitting diode is forward biased (switched on), electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence and the color of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor. An LED is usually small in area (less than 1 mm2), and integrated optical components are used to shape its radiation pattern and assist in reflection.[3] LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved robustness, smaller size, faster switching, and greater durability and reliability. LEDs powerful enough for room lighting are relatively expensive and require more precise current and heat management than compact fluorescent lamp sources of comparable output.

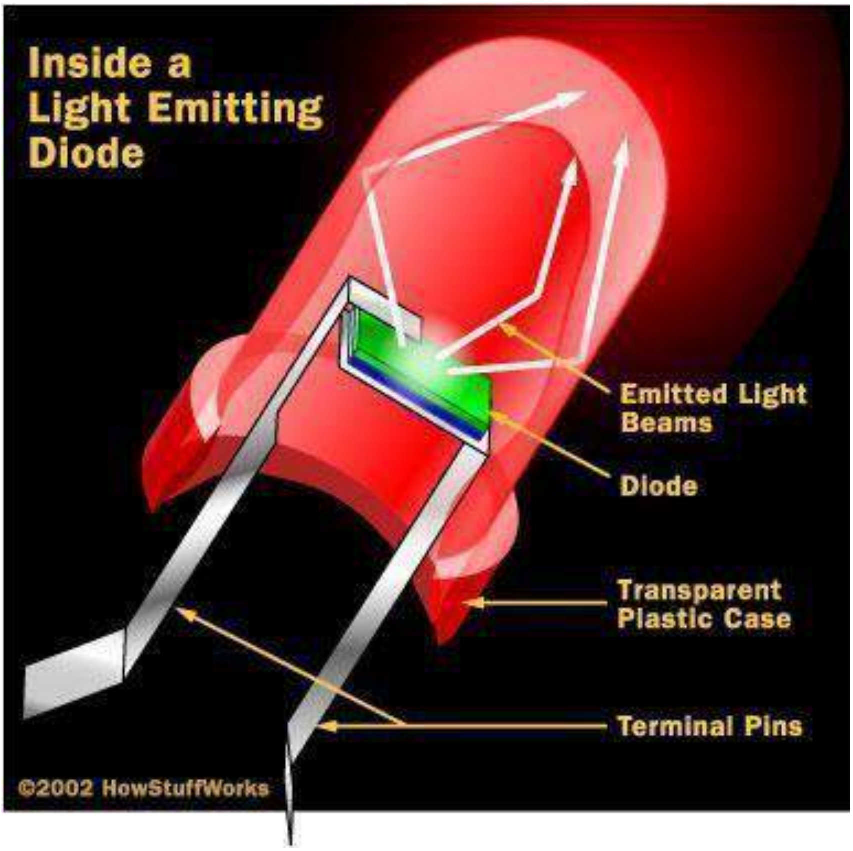


Fig 20 LED

INTRODUCTION TO IoT:

The ‘Thing’ in IoT can be any device with any kind of built-in-sensors with the ability to collect and transfer data over a network without manual intervention. The embedded technology in the object helps them to interact with internal states and the external environment, which in turn helps in decisions making process.

In a nutshell, IoT is a concept that connects all the devices to the internet and let them communicate with each other over the internet. IoT is a giant network of connected devices – all of which gather and share data about how they are used and the environments in which they are operated .By doing so, each of your devices will be learning from the experience of other devices, as humans do. IoT is trying to expand the interdependence in human- i.e. *interact*, *contribute* and c*ollaborate* to things. I know this sounds a bit complicated, let’s understand this with an example.

A room temperature sensor gathers the data and sends it across the network, which is then used by multiple device sensors to adjust their temperatures accordingly. For example, refrigerator’s sensor can gather the data regarding the outside temperature and accordingly adjust the refrigerator’s temperature. Similarly, your air conditioners can also adjust its temperature accordingly. This is how devices can interact, contribute & collaborate.

Benefits of IoT

Since IoT allows devices to be controlled remotely across the internet, thus it created opportunities to directly connect & integrate the physical world to the computer-based systems using sensors and internet. The interconnection of these multiple embedded devices will be resulting in automation in nearly all fields and also enabling advanced applications. This is resulting in improved accuracy, efficiency and economic benefit with reduced human intervention. It encompasses technologies such as smart grids, smart homes, intelligent transportation and smart cities. The major benefits of IoT are:

- **Improved Customer Engagement** – IoT improves customer experience by automating the action. For e.g. any issue in the car will be automatically detected by the sensors. The driver, as well as the manufacturer, will be notified about it. Till the time driver reaches the service station, the manufacturer will make sure that the faulty part is available at the service station.
- **Technical Optimization** – IoT has helped a lot in improving technologies and making them better. The manufacturer can collect data from different car sensors and analyze them to improve their design and make them much more efficient.
- **Reduced Waste** – Our current insights are superficial, but IoT provides real-time information leading to effective decision making & management of resources. For example, if a manufacturer finds fault in multiple engines, he can track the manufacturing plant of those engines and can rectify the issue with manufacturing belt.

Nowadays, we are surrounded by lots of IoT enabled devices which are continuously emitting data and communicating through multiple devices.

Components used in IoT

There are four main components used in IoT:

1. **Low power embedded systems**

   Less battery consumption, high performance is the inverse factors play a significant role during the design of electronic systems.
2. **Cloud Computing**

   Data collected through IoT devices is massive and this data has to be stored on a reliable storage server. This is where cloud computing comes into play. The data is processed and learned, giving more room for us to discover where things like electrical faults/errors are within the system.
3. **Availability of Big Data**

   We know that IoT relies heavily on sensors, especially real-time. As these electronic devices spread throughout every field, their usage is going to trigger a massive flux of big data.
4. **Network Connection**

   In order to communicate, internet connectivity is a must where each physical object is represented by an IP address. However, there are only a limited number of addresses available according to the IP naming. Due to the growing number of devices, this naming system will not be feasible anymore. Therefore, researchers are looking for another alternative naming system to represent each physical object.

Applications of IoT

Energy Applications: The energy rates have raised to a great instinct. Individuals and organizations, both are searching ways to reduce and control the consumption. IoT provides a way to not only monitor the energy usage at the appliance-level but also at the house-level, grid level or could be at the distribution level. Smart Meters & Smart Grid are used to monitor energy consumption. It also detects threats to the system performance and stability, which protect appliances from downtime and damages.

Healthcare Application: Smart watches and fitness devices have changed the frequency of health monitoring. People can monitor their own health at regular intervals. Not only this, now if a patient is coming to the hospital by ambulance, by the time he or she reaches the hospital his health report is diagnosed by doctors and the hospital quickly starts the treatment. The data gathered from multiple healthcare applications are now collected and used to analyze different disease and find its cure.

Education: IoT provides education aids which helps in fulfilling the gaps in the education industry. It not only improves the quality of education but also optimizes the cost and improves the management by taking into consideration students response and performance.

Government: Governments are trying to build smart cities using IoT solutions. IoT enhances armed force systems and services. It provides better security across the borders through inexpensive & high-performance devices. IoT helps government agencies to monitor data in real-time and improve their services like healthcare, transportation, education etc.

Air and Water Pollution: Through various sensors, we can detect the pollution in the air and water by frequent sampling. This helps in preventing substantial contamination and related disasters. IoT allows operations to minimize the human intervention in farming analysis and monitoring. Systems automatically detect changes in crops, soil, environment, and more.

Transportation: IoT has changed the transportation sector. Now, we have self-driving cars with sensors, traffic lights that can sense the traffic and switch automatically, parking assistance, giving us the location of free parking space etc. Also, various sensors in your vehicle indicate you about the current status of your vehicle, so that you don’t face any issues while travelling.

Marketing your product: Using IoT, organizations can better analyze & respond to customer preferences by delivering relevant content and solutions. It helps in improving business strategies .

CHAPTER 4

CIRCUIT DIAGRAM

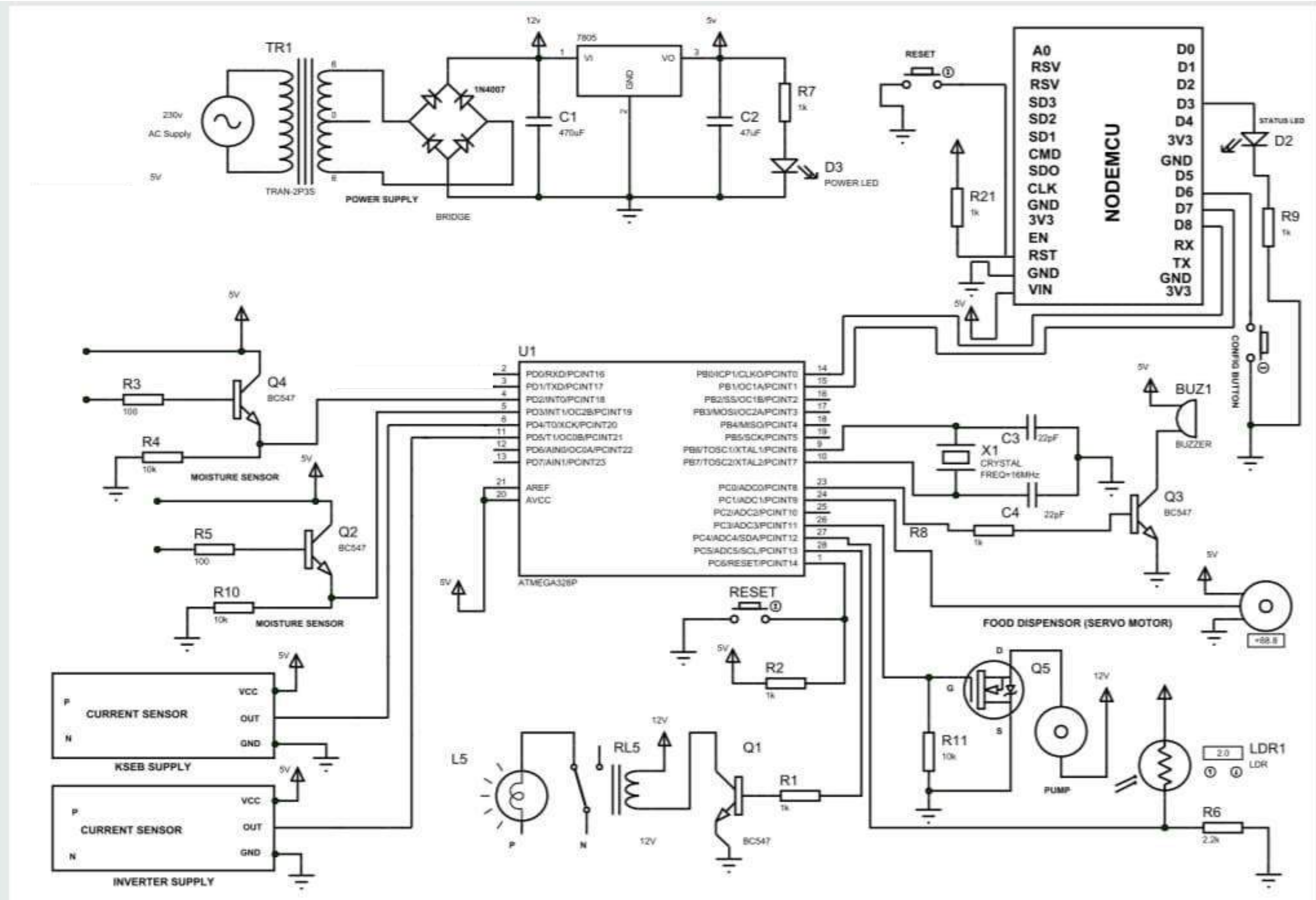


Fig 21 circuit diagram

CHAPTER 5

WORKING

The prototype is designed for fish farmers, the system is connected with different sensors such as current sensor, LDR,Water level sensors. These sensors are connected to microcontroller ATMega328. And send the sensor data to Node MCU controller which have built in Wi-Fi module , so it can share the sensor data to firebase real-time database. From the firebase the android application can collect the data and show it to users. Similarly user can control the feeder servo by clicking the open feeder button in android application and by setting the clock timer in application. There is a lamp installed in the system that will turn on when the LDR sensor value is less than 200 and will turn off otherwise.

The android application will alert the user when the KSEB current status is OFF as well as Inverter current is low. Also the history of current status will also show in application that will be great help for famers to turn on generator accordingly to maintain the air flow pump to keeps on to maintaindissolved oxygen in the fish tank.

CHAPTER 6

SOFTWARE SECTION

INTRODUCTION TO ARDUINO IDE

Here we are discussing about Introduction **to Arduino IDE** where IDE stands for Integrated Development Environment – official software introduced by Arduino.cc, that is mainly used for writing, compiling and uploading the code in the Arduino Device. Almost all Arduino modules are compatible with this software that is an open source and is readily available to install and start compiling the code on the go.

Introduction

Arduino IDE is open source software that is mainly used for writing and compiling the code into the Arduino Module. It is official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process. It is easily available for operating systems like MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the code in the environment. A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro and many more. Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code.

The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board. The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module. This environment supports both C and C++ languages.

The IDE environment is mainly distributed into three sections

1. Menu Bar
2. Text Editor
3. Output Panel

As you download and open the IDE software, it will appear like an image below.

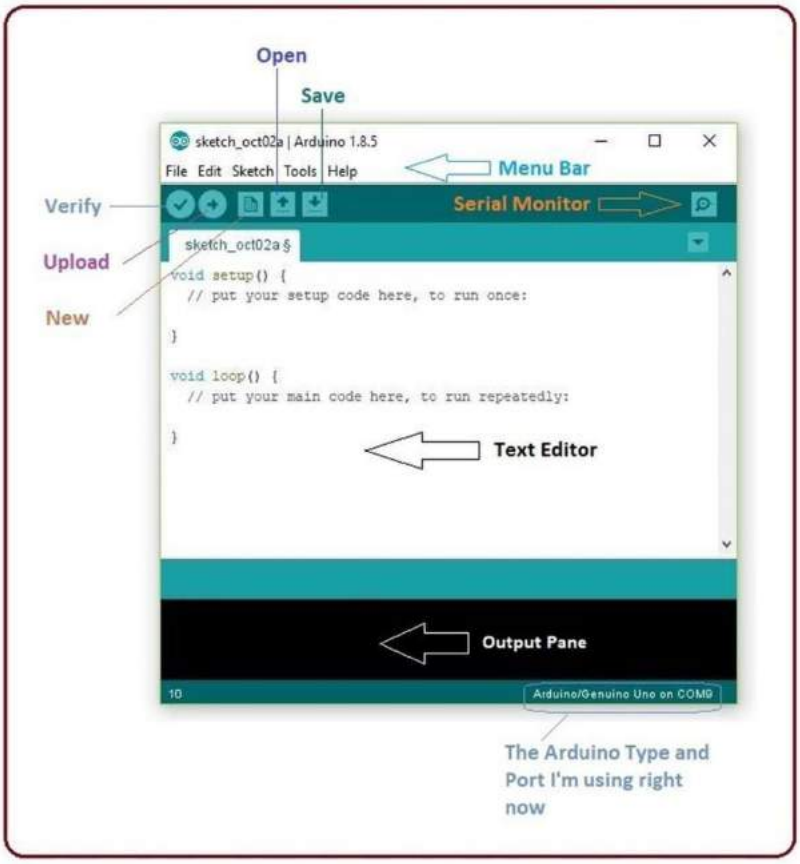
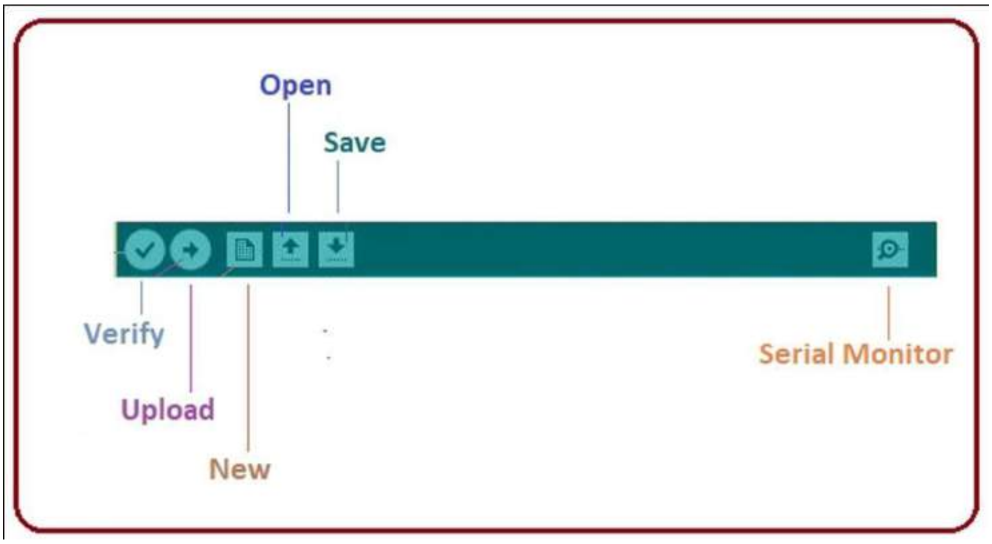


Fig 23 IDE software

The **Six Buttons** appearing under the Menu tab are connected with the running program as follow.



- The check mark appearing in the circular button is used to verify the code. Click this once you have written your code.
- The arrow key will upload and transfer the required code to the Arduino board.
- The dotted paper is used for creating a new file.
- The upward arrow is reserved for opening an existing Arduino project.

- The downward arrow is used to save the current running code.
- The button appearing on the top right corner is a **Serial Monitor** – A separate pop-up window that acts as an independent terminal and plays a vital role for sending and receiving the Serial Data. You can also go to the Tools panel and select Serial Monitor, or pressing Ctrl+Shift+M all at once will open it instantly. The Serial Monitor will actually help to debug the written Sketches where you can get a hold of how your program is operating. Your Arduino Module should be connected to your computer by USB cable in order to activate the Serial Monitor.
- You need to select the baud rate of the Arduino Board you are using right now. For my Arduino Uno Baud Rate is 9600, as you write the following code and click the Serial Monitor, the output will show as the image below.

MIT APP INVENTOR

App Inventor for Android is an open-source web application originally provided by Google, and now maintained by the Massachusetts Institute of Technology (MIT).
It allows newcomers to computer programming to create software applications for the Android operating system (OS). It uses a graphical interface, very similar to Scratch and the Star Logo TNG user interface, which allows users to drag-and-drop visual objects to create an application that can run on Android devices. In creating App Inventor, Google drew upon significant prior research in educational computing, as well as work done within Google on online development environments.

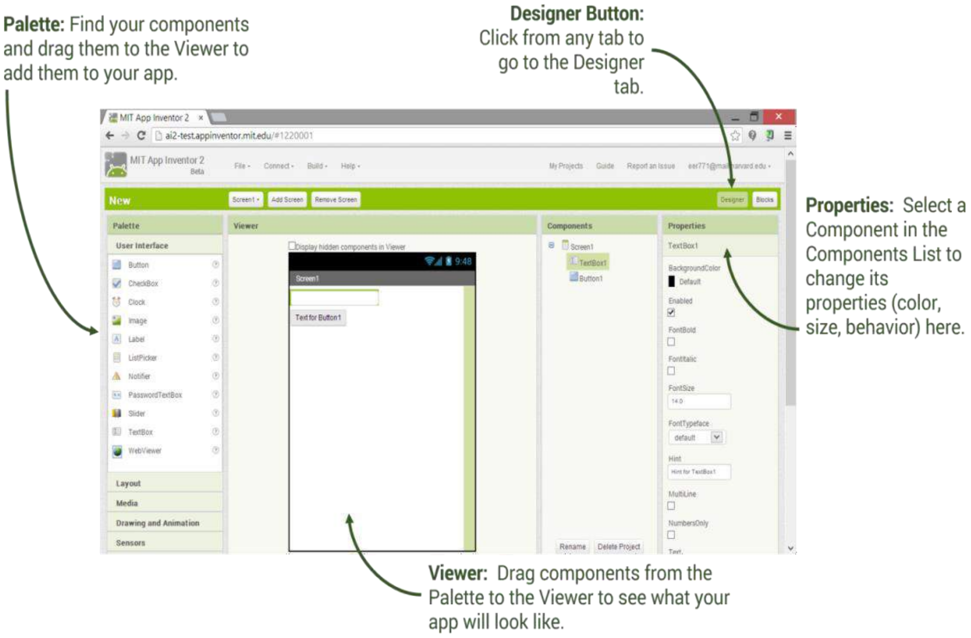
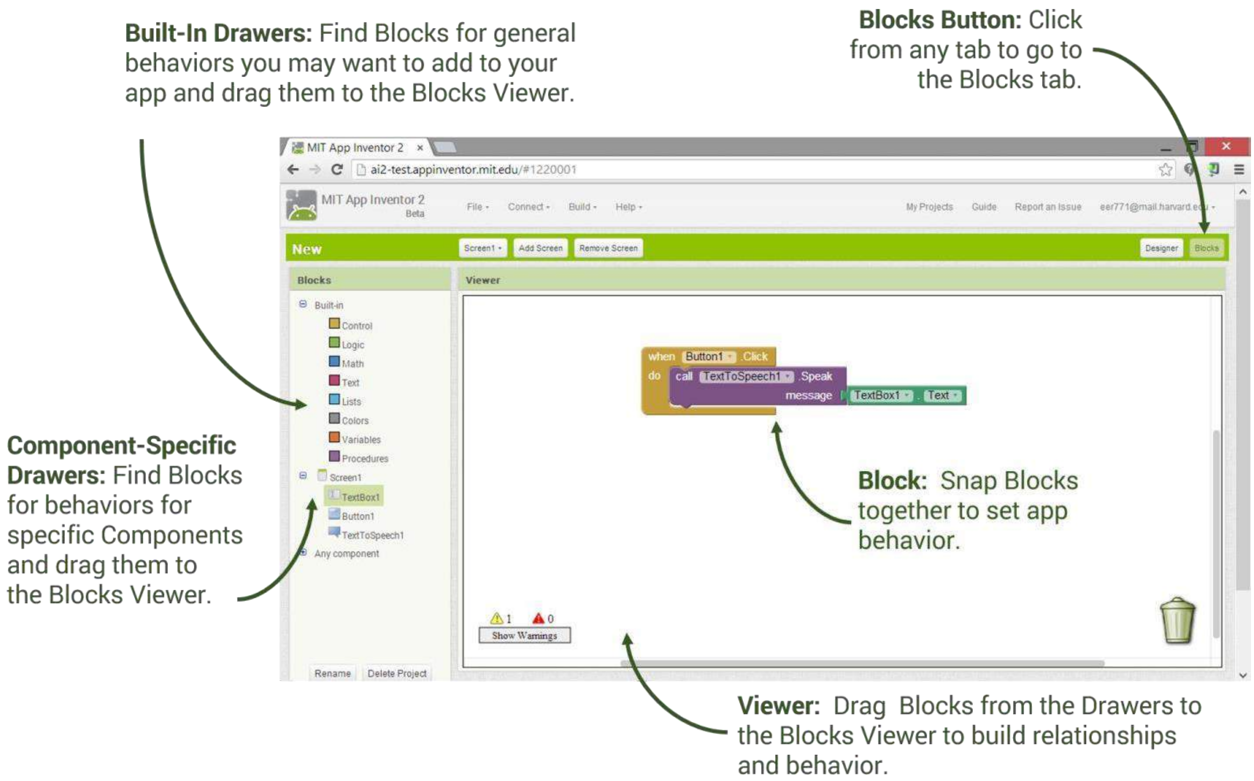


Fig 23 MIT app inventor



MIT App Inventor is basically for creating Android Apps in your browser where you design how the app will look and function. Like fitting together puzzle pieces, you set how your app will behave to different events by simply signing in with your Gmail Account, so that the App Inventor server can store your work and help you keep track of projects.

It basically consists of two parts

1. App Inventor Designer
2. App Inventor Block Editor

In **App Inventor Designer** you select the components for your app while in **App Inventor Block Editor** you assemble program blocks that specify how the components should behave visually, fitting pieces together like pieces of a puzzle. After completing the above phases you may run your app directly in your Android phone by connecting it to your computer or may run it on Android Emulator if you don't have an Android phone. Moreover you may even download your app (.apk file) and install and run it on your Android device directly.The figure below shows an overview of how **MIT App Inventor** works!

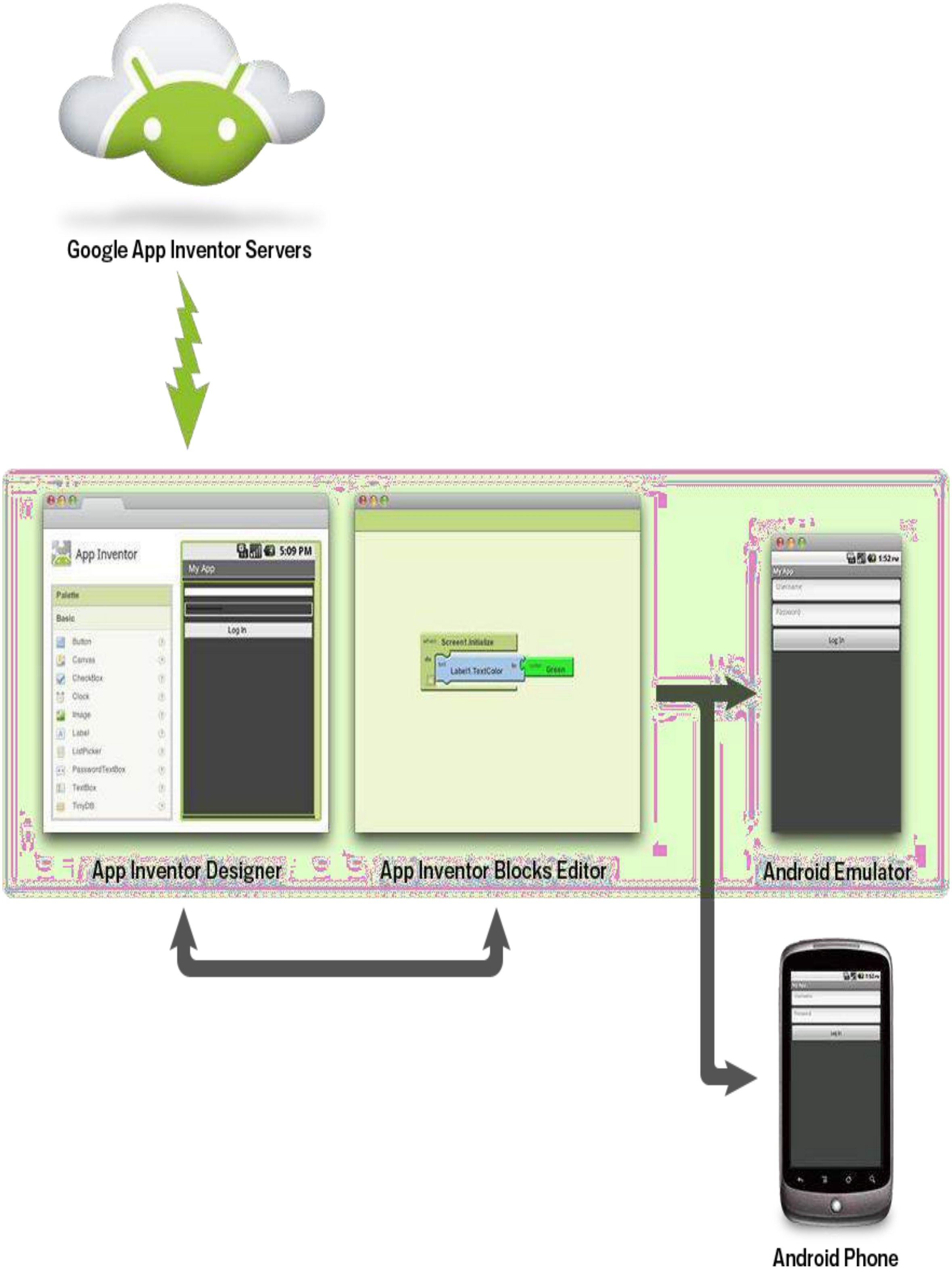
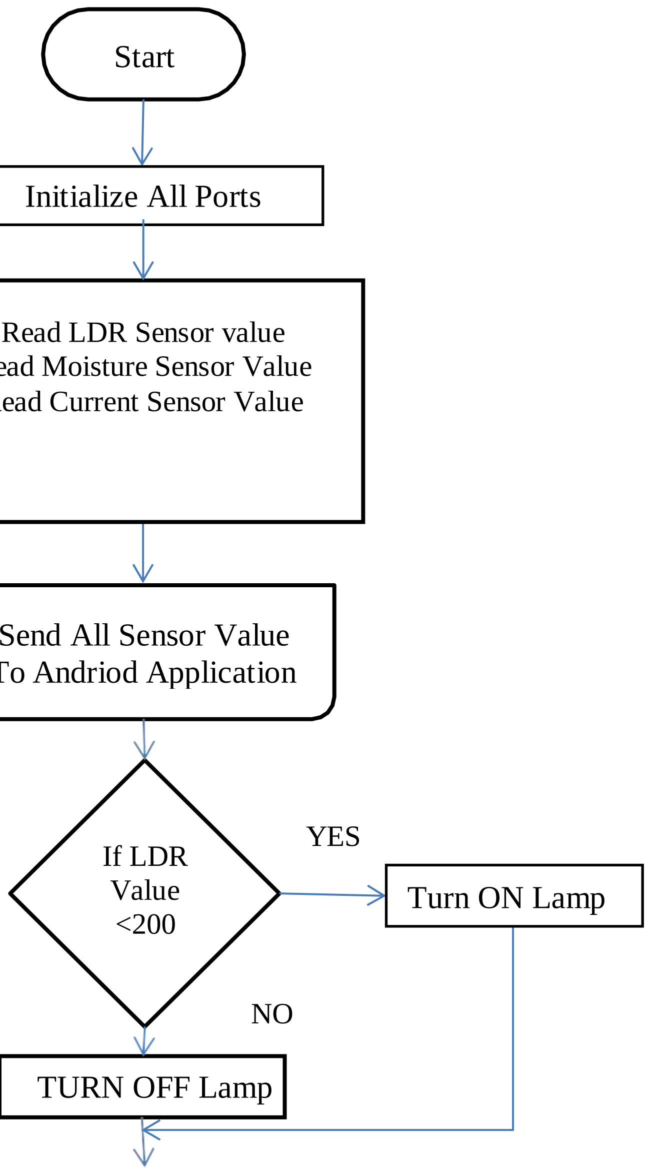


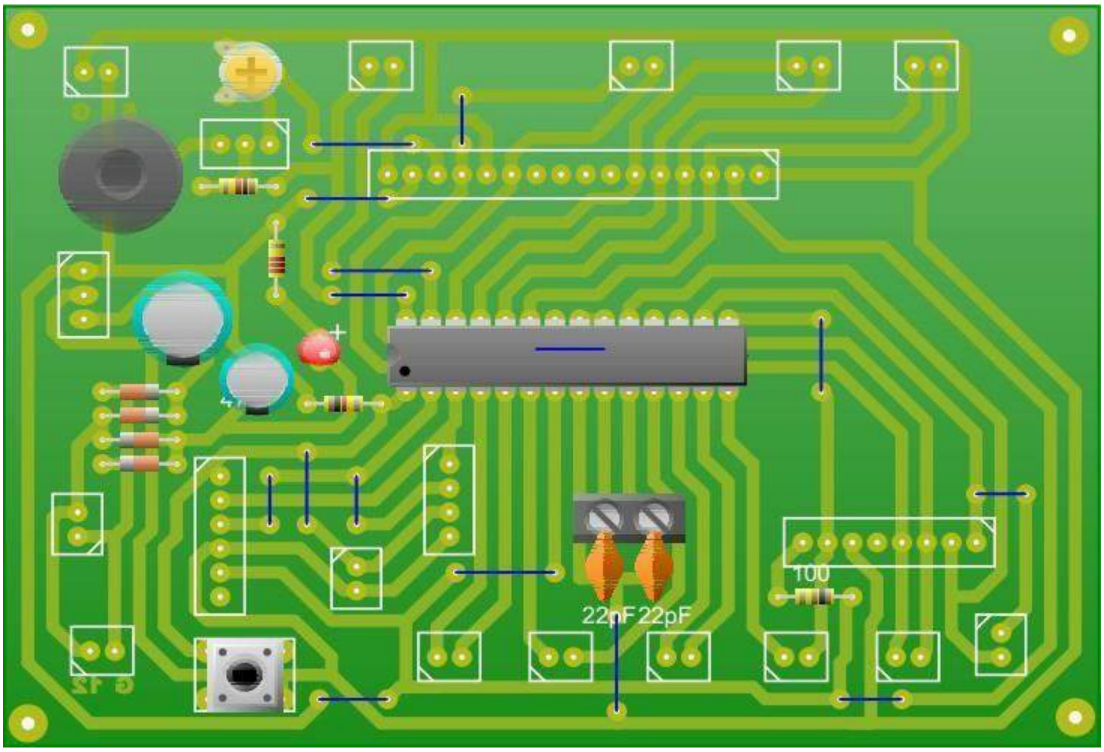
Fig 24 working of MIT app inventor

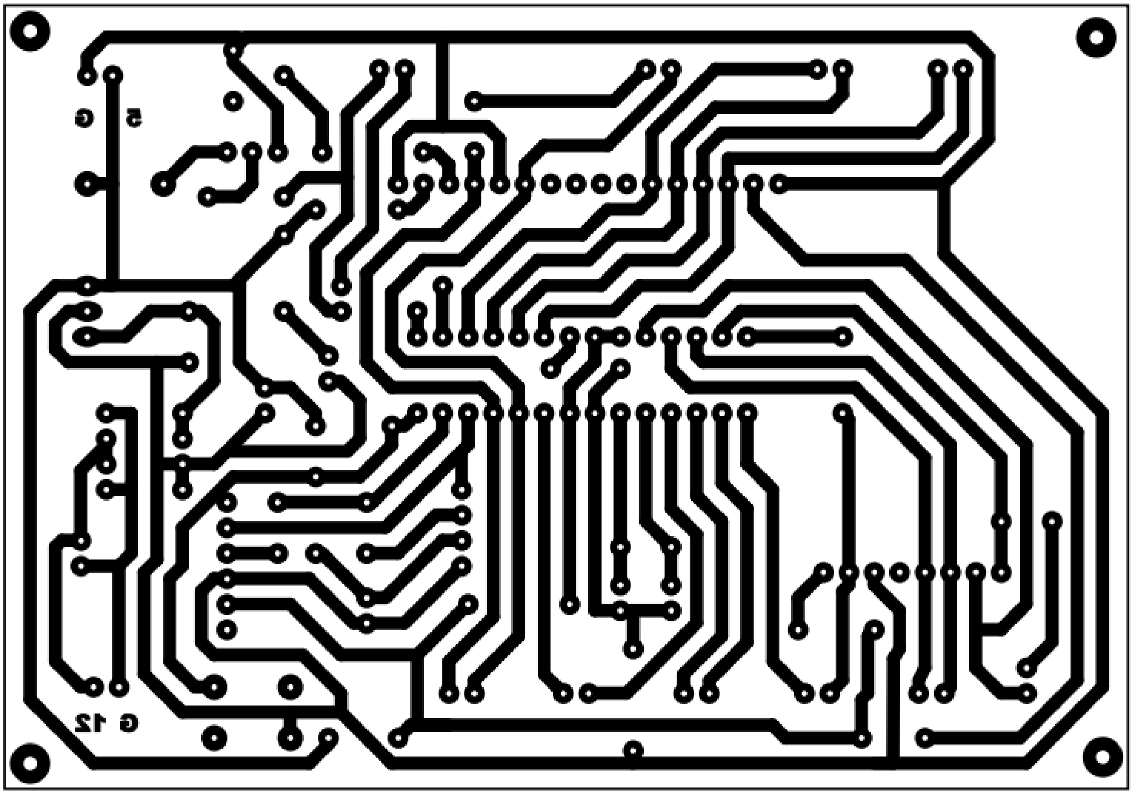
FLOW DIAGRAM



CHAPTER 7

PCB DESIGN & FABRICATION





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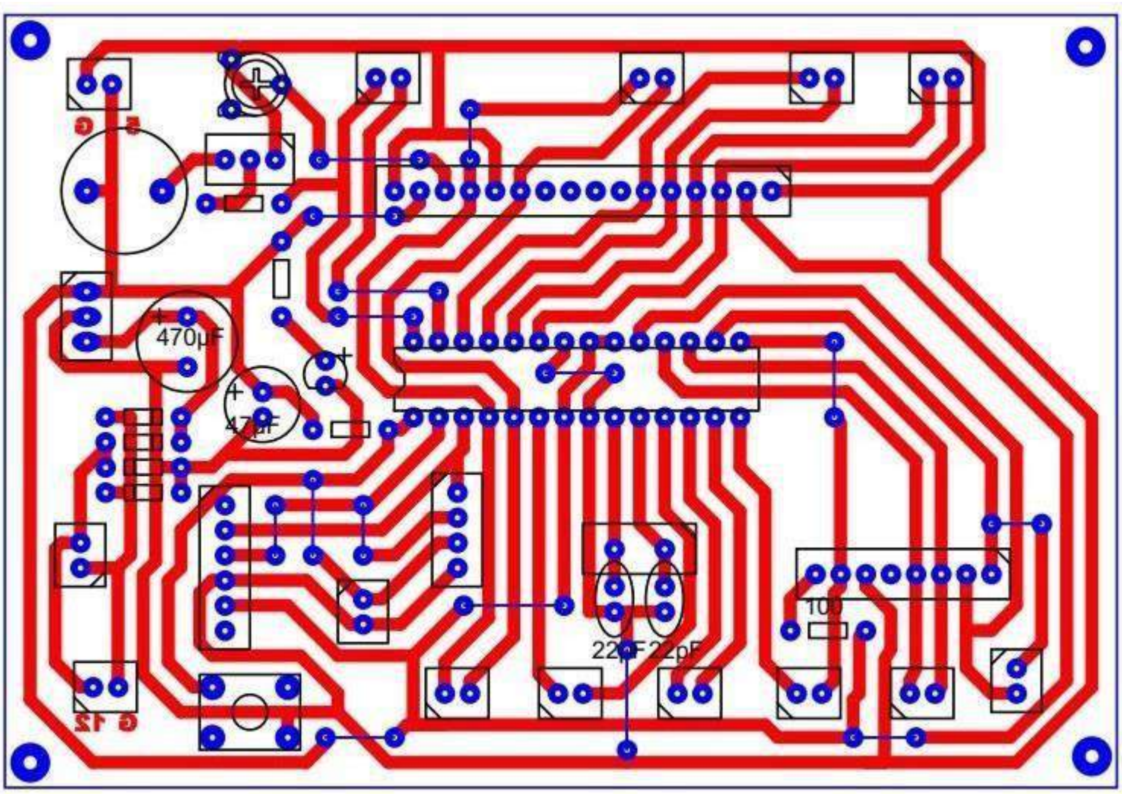

Fig 25 PCB design

Design of printed circuit board (PCB) can be considered as the last step in electronic circuit design as well as the first step in production. It plays important role in the performance and reliability of electronic circuits, the productivity of the PCB's its assembling, and its service ability depends on design. All these factors get reflected in a piece of electronic equipment. It is clear that task of PCB design is not very simple or always straight forward. The schematic is follower by layout generation. Layout design is the stage where engineering capacity combined with creativity is the governing inputs.

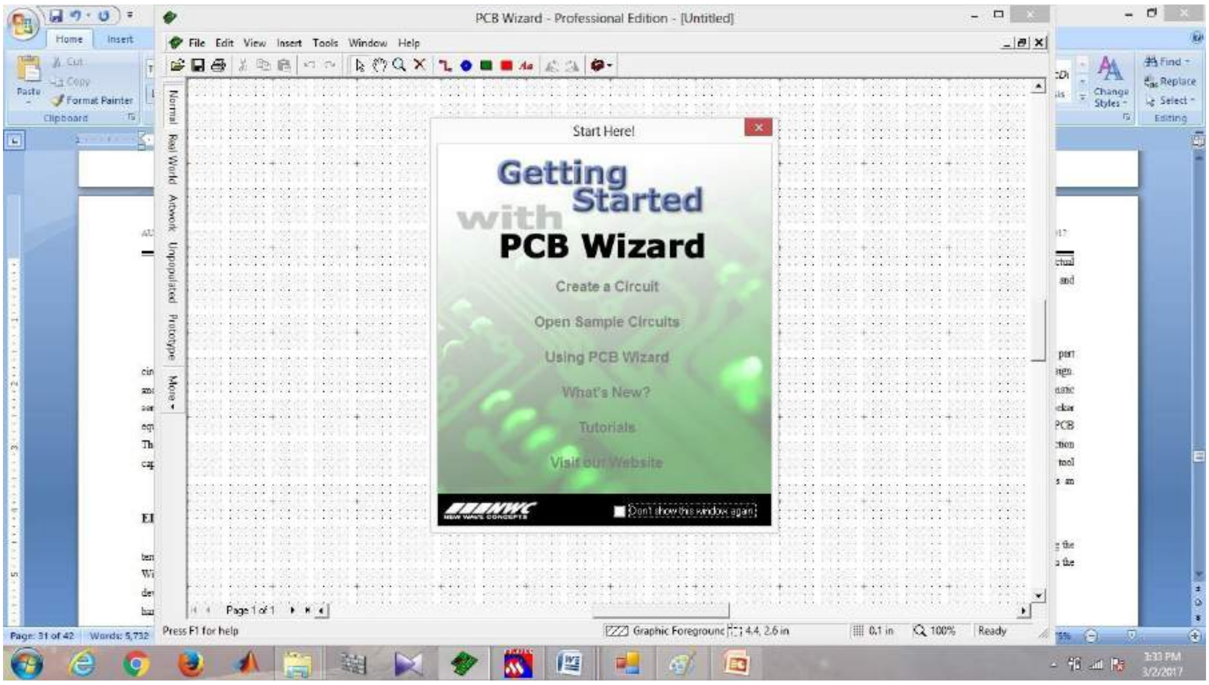

Fig 25 PCB Wizard Software to design the PCB LAYOUT.

ELECTRONIC DESIGN AUTOMATION TOOLS

Most product testing is being done is done with the help of computer programs. The term Electronic Design Automation (EDA) is being used to describe the use of these tools. With the help of advanced powerful computing systems and interactive software tools and development of electronic circuits has undergone automation. Thus the software and hardware tools, which enables this automation includes PCB designing, IC design, circuit simulation etc. These tools help us in such a way that we can draw the circuit; test the functioning of the circuit in response to test inputs in simulation software. After successfully simulation we can get the PCB art work done by replacing the routing software. The design automation tool used here is ORCAD.

- **PCB DESIGN PROCEDURES**

  The PCB designing procedure consists of following steps:

DRAWING THE CIRCUIT SCHEMATIC

Drawing of circuit is done through ORCAD CAPTURE. It includes many libraries with thousands of component symbols. We can select the required symbol from the library and place it in the schematic page. After placing the component symbols, we can complete the interconnection using wire or bus control. The next step is to assign part reference. Each component has to be assigned footprint or PCB pattern name. The footprint gives the actual size physical representation of components on the PCB artwork. The component symbol and foot symbol should correspond inall respects.

DESIGN RULE CHECK AND NET LIST CREATION

After the circuit schematic is completed with all required information such as part reference and footprints, the design rule check can be used for checking errors in the design. It will check for duplicate symbols, overlapped lines and dangling lines. After the schematic design file passes the DRC check, it is processed by a program called an electric rule checker (ERC) that checks for writing errors. The final operation to be done before starting PCB artwork is the net list creation. A net list creation of the components and interconnection along with other information such as foot prints, track width etc. A net list software or tool can take the circuit schematic as input and generate net list. The net list can be used as an information source for the remaining stages.

CREATING THE PCB ARTWORK

In automatic design, the net list obtained from the previous stage is used for getting the required foot print and interconnections. The software used for the PCB artwork design in the ORCAD LAYOUT.

- **PCB FABRICATION**

You need to generate a positive (copper black) UV translucent art work film. You will never get a good board without good art work, so it is important to get the best possible quality at this stage. The most important thing is to get a clear sharp image with a very solid opaque black. Art work is done using ORCAD software. It is absolutely essential that your PCB software prints holes in the middle of pads, which will act as center marks when drilling. It is virtually impossible to accurately hand-drill boards without these holes. If you are looking to buy PCB software at any cost level and

- **ETCHING**

Ferric chloride etchant is a messy stuff, but easily available and cheaper than most alternatives. It attacks any metal including stainless steel. So when setting up a PCB etching area, use a plastic or ceramic sink, with plastic fitting and screws wherever possible, and seal any metal screws with silicon. Copper water pipes may be splashed or dripped-on, so sleeve or cover them in plastic; heat-shrink sleeve is great if you are installing new pipes. Fume extraction is not normally required, although a cover over the tank or tray when not in use is a good idea. You should always use the hex hydrate type of ferric chloride, which shouldbe dissolved in warm water until saturation. Adding a teaspoon of table salt helps to make the etchant clearer for easier inspection. Avoid anhydrous ferric chloride. It creates a lot of heat when dissolved. So always add the powder very slowly to water; do not add water to the powder, and use gloves and safety glasses.

Copper clad laminate

- **DRILLING**

Drilling of PCB

If you have fiber glass (FR4) board, you must use tungsten carbide drill bits. Fiberglass eats normal high-speed steel (HSS) bits very rapidly, although HSS drills are alright for older larger sizes (> 2mm). Carbide drill bits are available as straight-shank or thick-shank. In straight shank, the hole bit is the diameter of the hole, and in thick shank, a standard size (typically about 3.5 mm) shank tapers down to the hole size. The straight-shank drills are usually preferred because they break less easily and are usually cheaper. The longer thin section provides more flexibility. Small drills for PCB use usually come with either a set of collets of various sizes or a three-jaw chuck. Sometimes the 3-jaw chuck is an optional extra and is worth getting for the time it saves on changing collets. For accuracy, however, 3-jaw chucks are not brilliant, and small drill sizes below 1 mm quickly formed grooves in the jaws, preventing good grip. Below 1 mm, you should use collets, and buy a few extra of the smallest ones; keeping one collect per drill size as using a larger drill in a collect will open it out and it no longer grips smaller drills well. You need a good strong light on the board when drilling, to ensure accuracy. A dichroic halogen lamp, under run at 9V to reduce brightness, can be mounted on a microphone gooseneck for easy positioning. It can be useful to raise the working surface above 15 cm above the normal desk height for more comfortable viewing. Dust extraction is nice, but not essential and occasional blow does the trick! A foot pedal control to switch the drill 'off' and 'on' is very convenient, especially when frequently changing bits. Avoid hole sizes less than 0.8 mm unless you really need them. When making two identical boards, drill them both together to save time. To do this, carefully drill a 0.8 mm hole in the pad near each corner of each of the two boards, getting the center as accurately as possible. For larger boards, drill a hole near the center of each side as well. Lay the boards on the top of each other and insert a 0.8 mm track pin in two opposite corners, using the pins as pegs to line the PCBs up. Squeeze or hammer the pins into boards, and then into the remaining holes.

The metals involved are not the only things to consider in a solder. Flux is vital to a good Solder joint. Flux is an aggressive chemical that removes oxide and impurities from the parts to be soldered. The chemical reactions at the point(s) of connection must take place for themetal to fuse. RMA type flux (Rosin Mildly Active) is the least corrosive of the readily available materials, and provides an adequate oxide. In electronics, a 60/40 fixed core solder isused. This consists of 60%lead and 40% tin, with flux cores added to the length of solder. There are certain safety measures which you should keep in mind when soldering. The tin materialused in soldering contains dangerous substances like lead (40-60% of typical soldering tins are lead and lead is poisonous). Also, the various fumes from the soldering flux can be dangerous.While it is true that lead does not vaporize at the temperature at which soldering is typically done.When soldering, keep the room well ventilated and use a small fan or fume trap. A proper fume trap of a fan will keep the most pollution away from your face. Professional electronic workshopsuse expensive fume extraction systems to protect their workers. Those fume extraction deviceshave a special filter which filters out the dangerous fumes. If you can connect a duct to the output from the trap to the outside, that would be great. Always wash hands prior to smoking, eating, drinking or going to the bathroom.

CHAPTER 8

ADVANTAGES

- Current sensor helps to know the current status whether the KSEB supply or Invertor supplyis present or not.
- LDR sensor relay combination helps to turn ON/OFF the Lamp according to Light intensity status.
- Water level sensor helps to maintain the water level.
- Fish feeder helps to feed the fish based on set time and manual time.
- The IOT application helps to monitor all the system status through users mobile phone.
- Less dependence on labor as opposed to absenteeism and inefficiency.
- Uniform growth in the tank: With the correct distribution of the feed in the tanks, using dispersers integrated into the feeding system, more homogeneous batch of fish or shrimp are achieved.
- The farmed fish provides high quality protein for human consumption.
- Fish farming can be integrated into the existing farm to create additional income and improve its water management. The farmers can select the fish species with desired characteristics to raise

.

DISADVANTAGES

- The main disadvantage of this system is that it will be use-less when the current-connection to the system break.
- Disadvantages Of Using pH Meters,You will need to clean it regularly to avoid possible contamination of samples. As most pH meters contain a probe with a glass tip, these are extremely fragile so can be easily broken or damaged if exposed to corrosive substances.
- Memory limitations. Less powerful. Processing power is weaker than the microcontroller. node MCU.
- Lacks performance compared to higher bit microcontrollers. ATMEGA 328.
- To Operate DC Motor,

  1. You need a separate DC Power Supply to operate. The modern world is moving towards AC motors.

2. If there is only AC Source Available then a converter is required and will cost converter cost.
3. Losses will occur in AC to DC converters

Extra Motor Safety and Precautions are Required as the DC Voltage peak value won't go to Zero like AC Voltage. i.e one accidental touch leads to death.

- Uninterrupted power supply required.

- Due to the continuous usage temperature occurs and causes damage to the components.

CHAPTER 9

APPLICATIONS

1. High density Fish farming regions.
2. High tech Aquarium.
3. Automatic Fish Feeders Are Reliable.
4. Better Fishing Spots.
5. Increase Your Stocks.
6. Stronger Food Chain.
7. Fish Feed is Affordable.

CHAPTER 10

CONCLUSIONS

The IOT enabled Fish automation system is designed and developed successfully. There are lot of challenges we faced such as Pump controlling, Microcontroller and Node MCU serial communication, Node MCU Firebase communication , Firebase to android application communication etc. Finally we obtained a successful result and the system works very well.

PROGRAM

```
#include <ESP8266HTTPClient.h>
#include <ESP8266WiFi.h>
#include <DNSServer.h>
#include <ESP8266WebServer.h>
#include <WiFiClientSecureBearSSL.h>

#include <WiFiManager.h>
WiFiManager wifiManager;

#include <ArduinoJson.h>
DynamicJsonDocument doc(1024);

#include <SoftwareSerial.h>
SoftwareSerial mySerial(D5, D2);

//String bUrl = "https://fish-automation-55h6koaz7a-uc.a.run.app";
String bUrl = "https://fish-automation-pinarayi-55h6koaz7a-uc.a.run.app";
String baseUrl = bUrl;
int httpCode = 0;

HTTPClient https;

int configPin = D4;
int connectionLed = D3;
bool initialConfig = false;

unsigned long previousMillis = 0;
unsigned long dataPreviousMillis = 0;
long interval = 1000;

String payload = "", nodeMCU_data = "";

//int lamp = D0;
//int current_sensor1 = D1; //inverter
//int current_sensor2 = D5; //kseb

//int current_status1 = 0, current_status2 = 0;

//String ph_value_string, ldr_value_string, temp_value_string;
String data, controlData;
//String pH, lightIntensity, temperature, lamp_status_data, kseb_status, inverter_status;

//float ph_data = 0, ldr_data = 0, temp_data = 0;

void setup()
{
  pinMode(configPin,INPUT_PULLUP);
  pinMode(connectionLed,OUTPUT);
```

```
  Serial.begin(115200);
  mySerial.begin(9600);

  if (WiFi.SSID()=="")
  {
    initialConfig = true;
  }
  else
  {
    WiFi.begin(WiFi.SSID(),WiFi.psk());
  }
}

void loop()
{

  unsigned long currentMillis = millis();

  if (currentMillis - previousMillis >= interval)
  {
    previousMillis = currentMillis;
    digitalWrite(connectionLed, !digitalRead(connectionLed));
  }

/////////////////////////////////////////////////////////////////////

  if(WiFi.status() == WL_CONNECTED)
  {
    std::unique_ptr<BearSSL::WiFiClientSecure> client(new BearSSL::WiFiClientSecure);
    client->setInsecure();

    interval = 1000;

    if (currentMillis - dataPreviousMillis >= 3000)
    {
      dataPreviousMillis = currentMillis;
      mySerial.print("S");
      Serial.println("data sent");
    }

    https.begin(*client, baseUrl + "/control");
    httpCode = https.GET();
    if (httpCode > 0)
    {
      payload = https.getString();
      https.end();
      deserializeJson(doc, payload);
      JsonObject obj = doc.as<JsonObject>();
      String feederControl = obj[String("feeder")];
      String lampControl = obj[String("lamp")];
      String pumpControl = obj[String("pump")];
      if (feederControl == "1")
```

```
{
  mySerial.print("O");
  Serial.println("feeder opened");
  https.begin(*client, baseUrl + "/control");
  https.addHeader("Content-Type", "application/json");
  controlData = "0";
  data = "{\"feeder\":\"" + controlData + "\"}";
  httpCode = https.POST(data);
  https.end();
}
if (lampControl == "1")
{
  mySerial.print("A");
  //lamp_status_data = "1";
  https.begin(*client, baseUrl + "/control");
  https.addHeader("Content-Type", "application/json");
  controlData = "2";
  data = "{\"lamp\":\"" + controlData + "\"}";
  httpCode = https.POST(data);
  https.end();
}
else if(lampControl == "0")
{
  mySerial.print("a");
  //lamp_status_data = "0";
  https.begin(*client, baseUrl + "/control");
  https.addHeader("Content-Type", "application/json");
  controlData = "2";
  data = "{\"lamp\":\"" + controlData + "\"}";
  httpCode = https.POST(data);
  https.end();
}
if (pumpControl == "1")
{
  mySerial.print("P");
  //lamp_status_data = "1";
  https.begin(*client, baseUrl + "/control");
  https.addHeader("Content-Type", "application/json");
  controlData = "2";
  data = "{\"pump\":\"" + controlData + "\"}";
  httpCode = https.POST(data);
  https.end();
}
else if(pumpControl == "0")
{
  mySerial.print("p");
  //lamp_status_data = "0";
  https.begin(*client, baseUrl + "/control");
  https.addHeader("Content-Type", "application/json");
  controlData = "2";
  data = "{\"pump\":\"" + controlData + "\"}";
  httpCode = https.POST(data);
```

```
        https.end();
      }
    }

    if (mySerial.available() > 0)
    {
      delay(100);
      nodeMCU_data = mySerial.readString();
      Serial.println(nodeMCU_data);
      https.begin(*client, baseUrl + "/data");
      https.addHeader("Content-Type", "application/json");
      data = "{\"hardwareData\":\"" + nodeMCU_data + "\"}";
      httpCode = https.POST(data);
      https.end();
    }
  }
  else
  {
    interval = 50;
    Serial.println("not connected");
  }
  if ((digitalRead(configPin) == LOW) || (initialConfig))
  {
    digitalWrite(connectionLed,HIGH);
    wifiManager.startConfigPortal("ThinkFoTech","admin123");
    digitalWrite(connectionLed,LOW);
    initialConfig = false;
    ESP.reset();
  }
}
```

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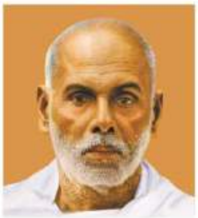

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

[redacted]

PROJECT REPORT

ON

STREET LIGHT MONITORING AND ACCIDENT DETECTION USING IoT

Submitted in partial fulfillment for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

ELECTRICAL AND ELECTRONICS ENGINEERING

BY

VAISHNAV T V (SNC19EE003), VISHAL K (SNC19EE004),

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CERTIFICATE

This is to certify that the report entitled **"STREET LIGHT MONITORING AND ACCIDENT DETECTION USING IoT"** is a bonafide record of the project submitted by **VAISHNAV.T.V (SNC19EE003)** and **VISHAL.K (SNC19EE004)** in partial fulfillment of the requirements for the award of Degree of Bachelor of Technology in Electrical and Electronics Engineering of the APJ ABDUL KALAM TECHNOLOGICAL University.

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Place: Payyanur

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ABSTRACT

Automatic Street Light Control System is a simple yet powerful concept, which uses transistor as a switch. By using this system manual works are 100% removed. It automatically switches ON lights when the sunlight goes below the visible region of our eyes. This is done by a sensor called Light Dependant Resistor (LDR) which senses the light actually like our eyes. It automatically switches OFF lights whenever the sunlight comes, visible to our eyes. In this project, no need of manual operation like ON time and OFF time setting. An efficient vehicle tracking system is designed and implemented for tracking the movement of any equipped vehicle from any location at any time. The proposed system made good use of a popular technology that combines a Smartphone application with Node MCU. This will be easy to make and inexpensive compared to others. This project will help the accident detection and rescue operations quick and effective with the help of proper emergency communication systems.

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ABBREVIATIONS

IoT	Internet of Things
LDR	Light Dependent Resistor
IR	Infra Red
GPS	Global Positioning System
MCU	Micro-Controller Unit
LED	Light Emitting Diode
AC	Alternating Current
DC	Direct Current
GND	Ground
VCC	Voltage Common Collector
UART	Universal Asynchronous Reciever-Transmitter
PWM	Pulse Width Modulator
ADC	Analog to Digital Converter
GPIO	General Purpose Input/Output

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Chapter 1
INTRODUCTION

Roads play an important role in our transportation system. Global status report of 2015 says that the total numbers of deaths caused due to road accidents are 1.25 million a year. Among this India faces the highest number of accidents and accident fatalities in the world. The major fatalities caused in the accidents were to the lack of a proper system for accident detection and rescue facilities. The proposed **"Street Light Monitoring and Accident Detection using IoT"** monitors the accident prone areas and provide proper communication with the authorities about the threat and hazards as well as provides energy saving automated street light. Street lights with automatic switching capability which reduces the need of human interference thereby providing sufficient light on roads when needed. It increases the working efficiency of street lights.

Chapter 2

LITERATURE SURVEY

"IoT-Based Smart Street Light Monitoring System with Kalman Filter Estimation"Edgardo Ricardo B. Sajonia;Lovely Mae Dagsa 2021 6th International Conference on Development in Renewable Energy Technology (ICDRET)

Integrating an intelligent control and management system on solar streetlights has an advanced impact in improving its system efficiency. The study developed a system for collecting, analyzing, and monitoring information on streetlight infrastructure in remote areas using IOT-based technology utilizing a Kalman filter estimation method. A solar street light controller is integrated into the conventional intelligent streetlight PV system using a plurality of Gravity I2C digital wattmeter, and LILYGO TTGO T-Call V1.5 that includes a real-time collection and logging of data. The study utilized open-source software such as PHP framework and MySQL database to display the battery and solar panel status online. The Kalman filter algorithm with modified initialization was used to estimate the bus voltage and load current. Data acquisition is in a one-minute interval based on the IEC61724 standard.

"Design of intelligent light control system based on NB-IoT" Xiaoling Zeng;Jianping Zhang 2022 International Conference on Wearables, Sports and Lifestyle Management (WSLM)

At this stage, the level of urbanization in China is constantly improving, and the construction of "smart city" is gradually included in the ranks of national urban planning. As an important part of smart cities, intelligent street light are welcoming unprecedented development opportunities. The traditional street light control system generally adopts the methods of centralized line control, human inspection, and computer-side web monitoring. Aim at the lag of traditional street lamp management, and lack of real-time monitoring and remote control, this thesis designs a set of intelligent street light monitoring system based on NB-IoT (Narrow Band-Internet of Things). The system realizes the real-time control of street lighting system, environmental monitoring, spray cooling and dust suppression, etc. Cloud technology is used to calibrate the geographic location information and working status information of each street lamp.

"Vehicle Accident Detection and Prevention using IoT and Deep Learning"

Lakshmy S;Renjith Gopan;Meenakshi M L;Adithya V;Mariya R Elizabeth 2022 IEEE International Conference on Signal Processing, Informatics, Communication and Energy Systems (SPICES)

Road accidents have become an issue of major concern to the people. This paper presents an accident prevention mechanism developed through alcohol detection using an MQ3 alcohol sensor followed by automatic engine locking. The detection part uses an SW-420 vibration sensor to detect any sort of abnormal vibrations that may occur from a collision. This is accompanied by supervised deep learning CNN algorithms. The accident scene image is captured using a front camera built in the vehicle to be used by the deep learning model for accident prediction. Accident detection is followed by communication to the nearest emergency center using GPS and GSM modules

"A Study on Cloud and IoT based Accident Detection & Prevention Systems"

Shaik Areef;T Yuvanth Sai;V. Sri Harsha;Gubbala Satya Sai Deepak;Amarendra K;Pachipala Yellamma

2023 International Conference on Sustainable Computing and Data Communication Systems (ICSCDS)

The world's population has recently surpassed 7 billion, and accidents are also growing day by day due to poor driving habits, excessive speed, and carelessness. In India, there were more than five lakhs traffic accidents in 2015, and 1.5 lakh fatalities were reported. By 2022, this number is anticipated to rise by 50% The deaths of the victims are increasing because of not getting emergency help at the hospital at the right time and not reaching the emergency vehicle at the right time to the accident spot. So, requires an urgent need to develop an IOT-based Accident detection model, which will help in reducing deaths. This study reviews the existing accident detection models and strategies to ascertain the best strategy to prevent traffic accidents and provide the best solution for locating the accident site and sending the information about the accidents as an alert message to the nearby hospital. This study mainly discusses about the accident detection and prevention system developed by using IOT.

"Smart Energy Efficient Home Automation System Using IoT"

Satyendra K. Vishwakarma;Prashant Upadhyaya;Babita Kumari;Arun Kumar Mishra

2019 4th International Conference on Internet of Things: Smart Innovation and Usages (IoT-SIU)

Advancement in IoT based application has become the state-of-the art technology among the researcher due to the availability of Internet everywhere. To make the application more user friendly, web based and android based technologies have gained their importance in this cutting edge technology. In this paper, smart energy efficient home automation system is proposed that can access and control the home equipments from every corner of the world. For this system, Internet connectivity module is attached to the main supply unit of the home system which can be accessed through the Internet. For wireless connectivity, the static IP address is used. Home automation is based on multimodal application that can be operated using voice recognition command of the user using the Google Assistant or through a web based application. Thus, main objective of this work is to make our home automation system more secure and intelligent.

Chapter 3

OBJECTIVES

The main objective of the system is to provide various protections, controls and monitoring of various road conditions by the control room and implement an energy saving and efficient street lighting system. The system also aim to implement an better and efficient for the response to accidents that occur in remote areas like forest roads and express way journeys. In the system the above goals are achieved through proper programming of Node MCU microcontroller and android system that is installed in the vehicle module. The node MCU send warning signals and accident alarms to the designated locations like hospitals or rescue centres in the case of a collision or other types if accidents. The proposed syatem Saves energy by increasing the intensity of the lights only when the system detects the movement of an object. The system increases the intensity of the streetlight ahead of the movement of an object and decreases the intensity of trailing lights simultaneously. The proposed system is easy to setup and implement and it doesn't require extra maintenance compared to the already traditional existing system which is already in us

Chapter 4

PROPOSED METHODOLOGY

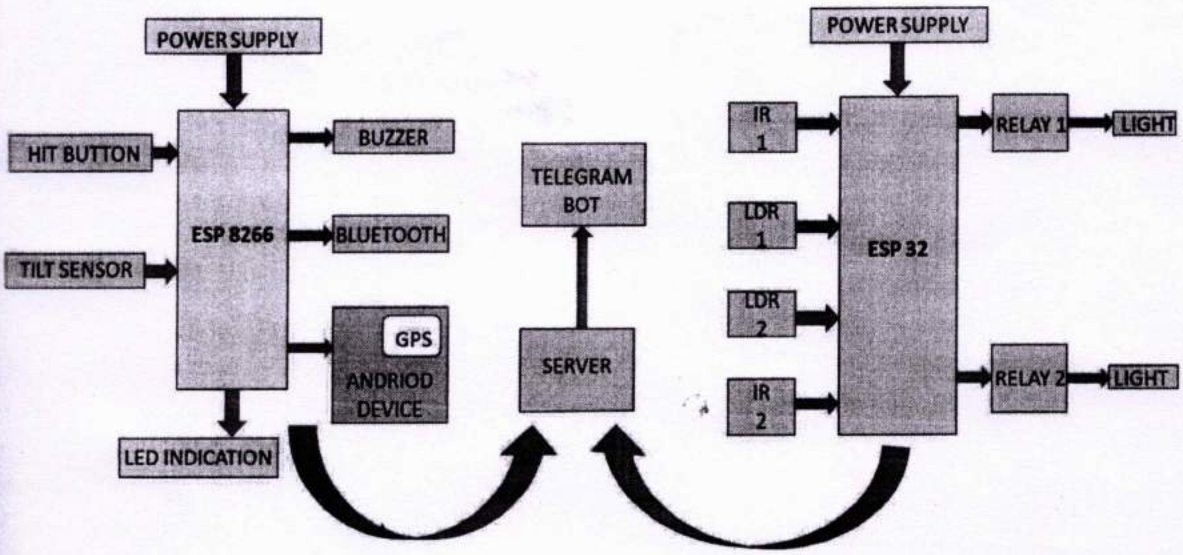

Fig.4.1 Block diagram

The block of fig.4.1 shows the hardware part of the model which consists of power supply, two microcontrollers, two IR sensors, two LDR sensors, tilt sensor, hit button, power supply, buzzer, Bluetooth module, android device, relays, LEDs, server and a telegram bot. The system consists of two sections- street light section and accident detection section. The street light section uses ESP32 Microcontroller. It consists of two LDR sensors and two IR sensors places on two streetlight poles respectively. It also consist of two relays which are connected to the two streetlights respectively. When the LDR detects the presence of light, the Streetlight automatically turns OFF and when the LRD do not detect light, the streetlight is turned ON with help of signals generated by the microcontroller. IR sensors placed on two streetlight poles respectively detects the passage vehicles. When the first IR detects a vehicles, it initiates a count by the microcontroller. This count stops when the second IR detects the vehicle. If the first IR is detected and the second IR do not detect any vehicle within the time of count, an alert signal is sent to the control room to observe the road.

The second section of the block diagram in the accident detection side which consist of hit button, tilt sensor, buzzer, Bluetooth module and android device. When an accident occurs, the tilt sensor and hit button are activated. When these two components gets activated at same time, a message is passed to the control room that an accident is detected through the server. The android device fetches the location of the collision spot and sends the location to the assigned contact number.

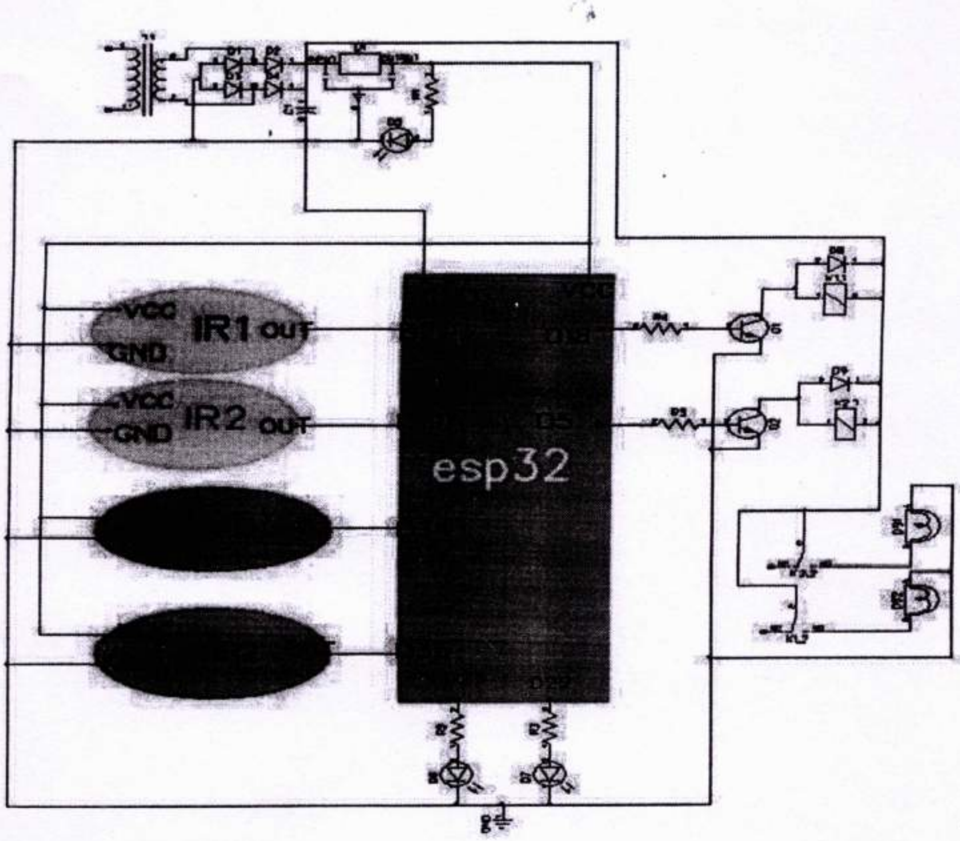

Fig.4.2 Circuit Diagram of Street light

The power supply circuit converts the 230V AC into 5V DC which is the power required for the operation of Node MCU. 5V DC is connected to the Vcc of the Node MCU. Hence the microcontroller gets the requires operating power. The IR Sensors are connected to the D21 and D19 pins of the Node MCU respectively. The ground terminal is properly grounded and the 5V DC supply is given to the Vcc pin of sensors. The two LDR sensors are connected to the D34 and D35 pins of the Node MCU. Power supply is given and ground is also provided for the LDRs. Pins D22 and D23 are LED indications. D18 and D5 pins are connected to the street lights through two transistors and relays respectively. Transistor acts as a switch. When the LDR sensors are LOW there is no presence of sunlight. Hence the Microcontroller send a signal for the transistor to open which creates a magnetic field in relay causing the deflection inside the relay completing the circuit of streetlight. Thus the street lights are turned ON.

When the LDR1 senses an element, the Node MCU starts a count. The count stops when the LDR2 is also sensed. If the LDR2 doesn't sense any object before the count stops, the microcontroller sends a message to the telegram bot.

The ESP32 development board has 25 GPIO pins that can be assigned different functions by programming the appropriate registers. There are several kinds of GPIOs: digital-only, analog-enabled, capacitive-touch-enabled, etc. Analog-enabled GPIOs and Capacitive-touch-enabled GPIOs can be configured as digital GPIOs. Most of these digital GPIOs can be configured with internal pull-up or pull-down, or set to high impedance.

Pins GPIO34, GPIO35, GPIO36(VP) and GPIO39(VN) cannot be configured as outputs. They can be used as digital or analog inputs, or for other purposes. They also lack internal pull-up and pull-down resistors, unlike the other GPIO pins. All GPIOs can be configured as interrupts.

ESP32 is one such microcontroller that can be used to start learning IOT and making IOT circuits. It is therefore important to learn about its pins layout and also what is the purpose of each pin and how it can be used. In this article, first, the layout of pins available in ESP32 Wroom 30-pin microcontroller is specified. Then the different types of pins that are available in ESP32 are described. ESP32 is used for a variety of applications including the use of wifi, transmitters, and receiver devices, Serial Peripheral Interfaces, analog and digital devices, and lots of sensors.

[redacted]

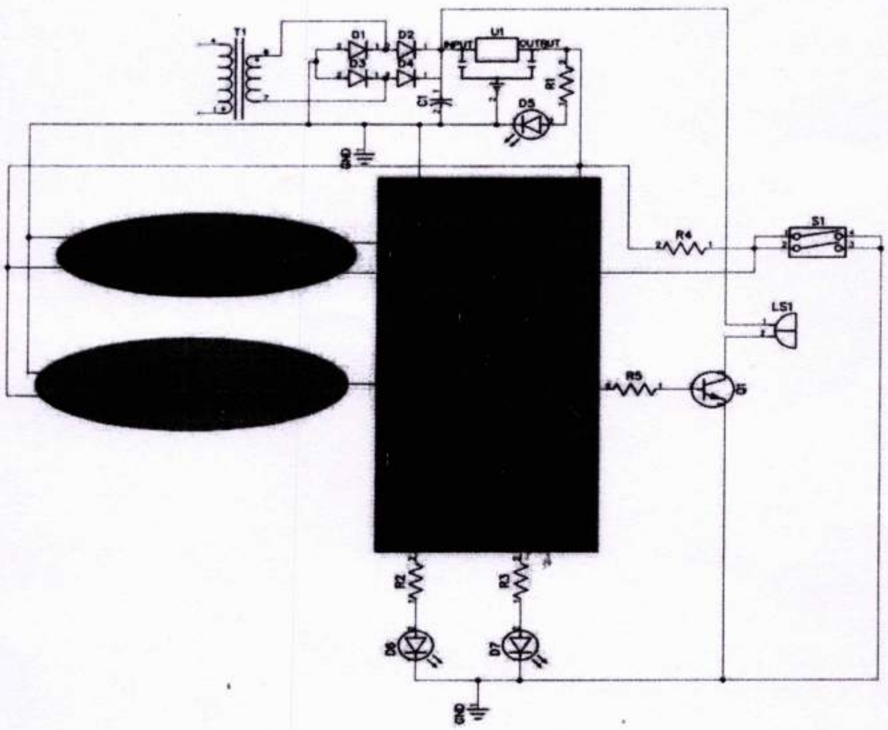

Fig.4.3. Circuit Diagram of Accident Detection

The GND pin of the ESP8266 is connected to the ground and the vcc is connected to the power supply. At a digital pin is connected to Hc-05 bluetooth module and tilt sensor. when hit button is pressed and tilt sensor is tilted high pulse is sent to ESP32 and the buzzer pin is high. When ESP32 has sensed accident it send an alert message to control room and with the help of an android app it send the location and an sms message to the number which is been uploaded from the android APP.2 led light are built in the board to understand the sensing and working of ESP32.

Buzzer is connected to the mcu through a thyristor and a resistor.when there is a power supply from mcu to the base of thyristor the collector and emmiter gets contaced and buzzer will get the power supply properly

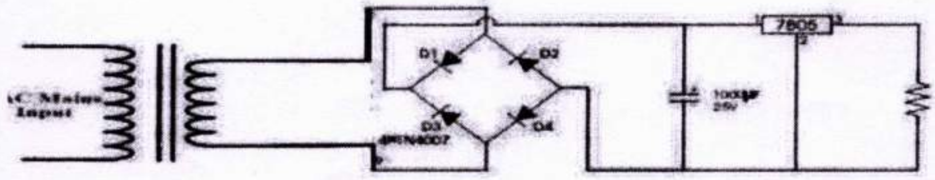

Fig .4.4. Circuit Diagram Power Supply

The power supply section contains a step-down transformer for stepping down the AC 230V into 12V and is rectified using bridge rectifier and filtered using capacitor filtering method and given to PIC as itssource voltage, 5V DC. Power supply is a device or system that supplies electrical or other types of energy to an output load or group of loads. A simple AC powered linear power supply usually uses a transformer to convert the voltage from the wall outlet (mains) to a different, usually a lower voltage. If it is used to produce DC a rectifier circuit is employed either as a single chip, an array of diodes sometimes called a diode bridge or Bridge Rectifier, both for full wave rectification or a single diode yielding a half wave (pulsating) output. More elaborate configurations rectify the AC voltage at first to pulsating DC. Then a capacitor smooth out part of the pulses giving a type of DC voltage. The smaller pulses remaining are known as ripple. Because of a full wave rectification they occur at twice the mains frequency. Finally depending on the requirements of the load, a linear regulator may be used to reduce the ripple sometimes also allowing for adjustment of the output to thedesired but lower voltage.

Chapter 5

HARDWARE COMPONENTS

- **ESP8266**

The ESP8266 chip incorporates on a standard circuit board. The board has a built-in USB port
that is already fixed with wired up in the chip. The hardware reset button, Wi-Fi antenna, LED lights, and standard-sized GPIO (General Purpose Input Output) pins that can plug into a bread board. It has Processor called L106 32bit RISC microprocessor core based on the Ten silica Xtensa Diamond Standard 106Micro running at 80 MHz and has a memory of 32 Kbit instruction RAM ,32 Kbit instruction cache RAM, 80 Kbit user data RAM&16 Kbytes system data RAM. It has inbuilt Wi-Fi modules of (IEEE 802.11 b/g/n) Wi-Fi technology. The ESP8266 is the name of a micro controller designed by Expressive Systems. The ESP8266 itself is one of the self-contained Wi-Fi networking solutions that also offering as a bridge from presented micro controller to Wi-Fi and is also capable of organization self-contained applications. Node MCU is a low-cost open source IoT platform. It initially included firmware which runs on the ESP8266 Wi-Fi SoC from expressive Systems, and hardware which was based on the ESP-12 module. Later, support for the ESP32 32-bit MCU was added. ESP8266 is a wifi SOC (system on a chip) produced by expressive. It is a highly integrated chip designed to provide full internet connectivity in a small package.

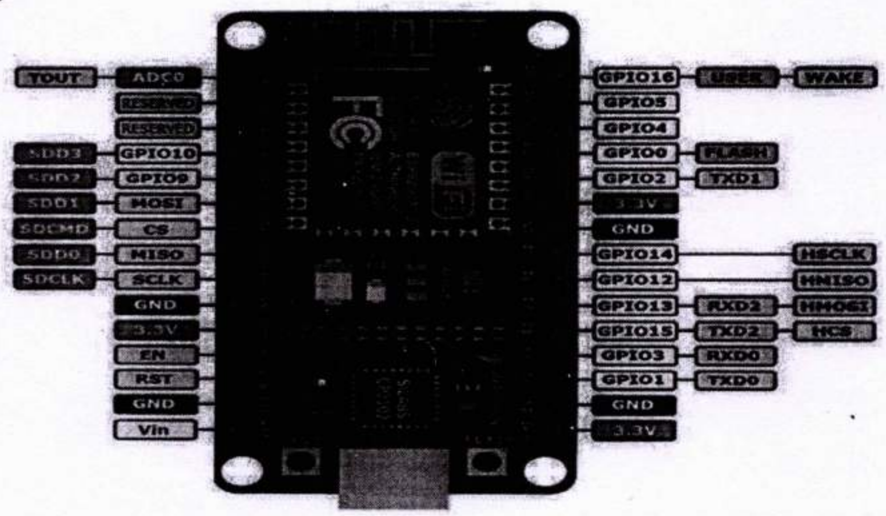

Fig.5.1 ESP8266 pin diagram

- ESP32 is a series of low-cost, low-power system on a chip Power Pins There are four power pins. VIN pin and three 3.3V pins.
- VIN can be used to directly supply the NodeMCU/ESP8266 and its peripherals. Power delivered on VIN is regulated through the onboard regulator on the NodeMCU module – you can also supply 5V regulated to the VIN pin
- 3.3V pins are the output of the onboard voltage regulator and can be used to supply power to external components.

- [redacted] are the ground pins of NodeMCU/ESP8266

- [redacted] NodeMCU/ESP8266 has 17 GPIO pins which can be assigned to functions such as I2C, I2S, UART, PWM, IR Remote Control, LED Light and Button programmatically. Each digital enabled GPIO can be configured to internal pull-up or pull-down, or set to high impedance. When configured as an input, it can also be set to edge-trigger or level-trigger to generate CPU interrupts.

- [redacted] the NodeMCU is embedded with a 10-bit precision SAR ADC. The two functions can be implemented using ADC. Testing power supply voltage of VDD3P3 pin and testing input voltage of TOUT pin. However, they cannot be implemented at the same time.

- UART Pins NodeMCU/ESP8266 has 2 UART interfaces (UART0 and UART1) which provide asynchronous communication (RS232 and RS485), and can communicate at up to 4.5 Mbps. UART0 (TXD0, RXD0, RST0 & CTS0 pins) can be used for communication. However, UART1 (TXD1 pin) features only data transmit signal so, it is usually used for printing log.

- PWM Pins The board has 4 channels of Pulse Width Modulation (PWM). The PWM output can be implemented programmatically and used for driving digital motors and LEDs. PWM frequency range is adjustable from 1000 μs to 10000 μs (100 Hz and 1 kHz).

- EN: The ESP8266 chip is enabled when EN pin is pulled HIGH. When pulled LOW the chip works at minimum power.

- **ESP32**

SP32 is a series of low-cost, low-power system on a chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth. The ESP32 series employs either a Tensilica Xtensa LX6 microprocessor in both dual-core and single-core variations, Xtensa LX7 dual-core microprocessor or a single-core RISC-V microprocessor and includes built-in antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power-management modules. ESP32 is created and developed by Espressif Systems, a Shanghai-based Chinese company, and is manufactured by TSMC using their 40 nm process.[2] It is a successor to the ESP8266 Microcontroller

Fig 5.2 ESP32

- **IR SENSOR**

It An infrared (IR) sensor is an electronic device that measures and detects infrared radiation in its surrounding environment. Infrared radiation was accidentally discovered by an astronomer named William Herchel in 1800. While measuring the temperature of each color of light (separated by a prism), he noticed that the temperature just beyond the red light was highest. IR is invisible to the human eye, as its wavelength is longer than that of visible light (though it is still on the same electromagnetic spectrum). Anything that emits heat (everything that has a temperature above around five degrees Kelvin) gives off infrared radiation. There are two types of infrared sensors: active and passive. Active infrared sensors both emit and detect infrared radiation. Active IR sensors have two parts: a light emitting diode (LED) and a receiver. When an object comes close to the sensor, the infrared light from the LED reflects off of the object and is detected by the receiver. Active IR sensors act as proximity sensors, and they are commonly used in obstacle detection systems (such as in robots).

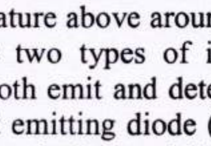

Fig.5.3 IR Sensor

- **LDR SENSOR**

A photo resistor (also known as a photocell, or light-dependent resistor, LDR, or photo-conductive cell) is a passive component that decreases resistance with respect to receiving luminosity (light) on the component's sensitive surface. The resistance of a photo resistor decreases with increase in incident light intensity; in other words, it exhibits photoconductivity. A photo resistor can be applied in light-sensitive detector circuits and light-activated and dark-activated switching circuits acting as a resistance semiconductor. In the dark, a photo resistor can have a resistance as high as several mega ohms (MΩ), while in the light, a photo resistor can have a resistance as low as a few hundred ohms. If incident light on a photo resistor exceeds a certain frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electrons (and their hole partners) conduct electricity, thereby lowering resistance. The resistance range and sensitivity of a photo resistor can substantially differ among dissimilar devices. Moreover, unique photo resistors may react substantially differently to photons within certain wavelength bands.

A photoelectric device can be either intrinsic or extrinsic. An intrinsic semiconductor has its own charge carriers and is not an efficient semiconductor (such as silicon is). In intrinsic devices, most of the available electrons are in the valence band, and hence the photon must have enough energy to excite the electron across the entire band gap. Extrinsic devices have impurities, also called do pants, added whose ground state energy is closer to the conduction band; since the electrons do not have as far to jump, lower energy photons (that is, longer wavelengths and lower frequencies) are sufficient to trigger the device. If a sample of silicon has some of its atoms replaced by phosphorus atoms (impurities), there will be extra electrons available for conduction. This is an example of an extrinsic semiconductor.

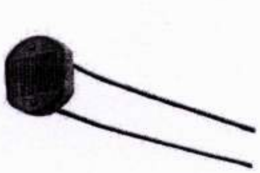

Fig 5.4 LDR Sensor

- **BC547 TRANSISTOR**

It The BC547 NPN bipolar junction transistor is top pick for low-power applications, such as illuminating LEDs, amplifying sensor signals, and inciting action in miniscule relays and motors. Its accessibility, affordability, and effortless integration into a plethora of circuit designs have secured its position as a staple in the electronics industry.

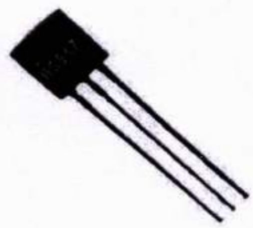

Fig.5.5 BC547

- **VOLTAGE REGULATOR**

Voltage regulator 7805 IC is one of the most widely used voltage regulator IC in different electrical and electronic circuits. It takes an unregulated voltage of 7 V to 35 V and produces a fixed regulated output voltage of 5 V DC

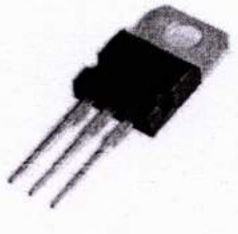

Fig.5.6. 7805 VOLTAGE REGULATOR

- **12V RELAY**

Relay is an electromagnetic device which is used to isolate two circuits electrically and connect them magnetically. They are very useful devices and allow one circuit to switch another one while they are completely separate. They are often used to interface an electronic circuit (working at a low voltage) to an electrical circuit which works at very high voltage. For example, a relay can make a 5V DC battery circuit to switch a 230V AC mains circuit. Thus, a small sensor circuit can drive, say, a fan or an electric bulb.

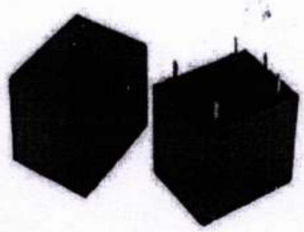

Fig.5.7 12V RELAY

- **470mF CAPACITOR**

Electrolytic capacitors are a type of capacitor widely used in electronic circuits due to their high capacitance values and relatively small size. They are commonly used for surge suppressing, transient voltages, and filtering out noise at the ~1KHz or less.

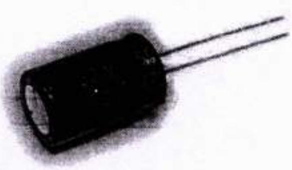

Fig.5.8. 470mF Capacitor

- **5V BUZZER**

  Piezo Buzzer 5V (Wire type) is a loud continues type Piezo Buzzer. It has two wires for connection and can work on 3 to 7 V DC. Just connect with power supply and it will give loud sound. The piezo buzzer produces sound based on reverse of the piezoelectric effect.

Fig.5.9. 5V Buzzer

- **470 ohm RESISTOR**

  A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses.

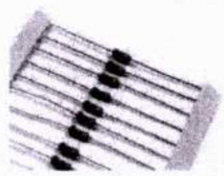

Fig.5.10. 470 ohm RESISTOR

- **LIGHT EMITTING DIODES (LED)**

  A Light-Emitting Diode (LED) Is A Semiconductor Light Source That Emits Light When Current Flows Through It. Electrons In The Semiconductor Recombine With Electron Holes, Releasing Energy In The Form Of Photons. This Effect Is Called Electroluminescence. The Colour Of The Light (Corresponding To The Energy Of The Photons) Is Determined By The Energy Required For Electrons To Cross The Band Gap Of The Semiconductor. White Light Is Obtained By Using Multiple Semiconductors Or A Layer Of Light-Emitting Phosphor On The Semiconductor Device.

  LEDs are made in different packages for different applications. A single or a few LED junctions may be packed in one miniature device for use as an indicator or pilot lamp. An LED array may include controlling circuits within the same package, which may range from a simple resistor, blinking or color changing control, or an addressable controller for RGB devices. Higher-powered white-emitting devices will be mounted on heat sinks and will be used for illumination. Alphanumeric displays in dot matrix or bar formats are widely available. Special packages permit connection of LEDs to optical fibers for high-speed data communication links.

  The light from LEDs can be modulated very quickly so they are used extensively in optical fiber and free space optics communications. This includes remote controls, such as for television sets, where infrared LEDs are often used. Opto-isolators use an LED combined with a photodiode or phototransistor to provide a signal path with electrical isolation between two circuits. This is especially useful in medical equipment where the signals from a low-voltage sensor circuit (usually battery-powered) in contact with a living organism must be electrically isolated from any possible electrical failure in a recording or monitoring device operating at potentially dangerous voltages. An optoisolator also lets information be transferred between circuits that do not share a common ground potential.

Fig.5.11. LED

Chapter 6

SOFTWARE USED

1.DIPTRACE SOFTWARE

Fig.6.1.Diptrace Software

Diptrace Is EDA/CAD Software For Creating Schematic Diagrams And Printed Circuit Boards. The Developers Provide Multi-Lingual Interface And Tutorials (Currently Available In English And 21 Other Languages). Diptrace Has 4 Modules: Schematic Capture Editor, PCB Layout Editor With Built-In Shape-Based Auto-Router And 3D Preview& Export, Component Editor, And Pattern Editor.

Diptrace Is An Advanced PCB Design Software Application That Consists Of 4 Modules PCB Layout With Efficient Auto-Router And Auto-Placer, Schematic Capture, Component And Pattern Editors That Allow You To Design Your Own Component Libraries. Diptrace Has A Powerful Automatic Router, Superior To Many Routers Included In Other PCB Layout Packages. It Can Route A Single Layer And Multilayer Circuit Boards, And There Is An Option To Auto Route A Single Layer Board With Jumper Wires, If Required. Diptrace Also Provides You With External Auto Router Support. Smart Manual Routing Tools Allow Users To Finalize The Design And To Get The Results They Want In A Blink Of An Eye. There Are Number Of Verification Features, That Allows You To Control Accuracy Of Your Project. Diptrace Modules Allow You To Exchange Schematics, Layouts And Libraries With Other EDA And CAD Packages. Output Formats Are DXF, Gerber, Drill And G-Code. Standard Libraries Contain More Than 98,000 Components.

Basic Features

- Simple UI
- Multi-Sheet And Hierarchical Schematics
- High-Speed Shape-Based Auto router
- Smart Manual Routing Tools
- Differential Pairs
- Wide Import / Export Capabilities

- Advanced Verifications With Real-Time DRC
- Real-Time 3D PCB Preview & STEP Export

ODB++ And Gerber Manufacturing Outputs

3. ARDUINO SOFTWARE

Fig.6.2. Arduino Software

Arduino (/ɑːrˈdwiːnoʊ/) is an open-source hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices. Its hardware products are licensed under a CC BY-SA license, while the software is licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially from the official website or through authorized distributors. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards ('shields') or breadboards (for prototyping) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs. The microcontrollers can be programmed using the C and C++ programming languages(Embedded C), using a standard API which is also known as the Arduino Programming Language, inspired by the Processing language and used with a modified version of the Processing IDE. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) and a command line tool developed in Go.

The Arduino project began in 2005 as a tool for students at the Interaction Design Institute Ivrea, Italy, aiming to provide a low-cost and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors.

The name *Arduino* comes from a bar in Ivrea, Italy, where some of the project's founders used to meet. The bar was named after Arduin of Ivrea, who was the margrave of the March of Ivrea and King of Italy from 1002 to 1014.

3.ANDROID

Fig.6.3. Android

Android Is An Operating System Based On With A Java Programming Interface. It Provides Tools, E.G. A Compiler, Debugger And A Device Emulator As Well As Its OwnJava Virtual Machine (Dalvik Virtual Machine - DVM). Android Is Created By The OpenHandset Alliance Which Is Led ByGoogle. Android Uses A Special Virtual Machine, E.G. The Dalvik Virtual Machine. DalvikUses Special Byte Code. Therefore You Cannot Run Standard Java Byte Code On Android. Android Provides A Tool "Dx" Which Allows To Convert Java Class Files Into "Dex" (Dalvik Executable) Files. Android Applications Are Packed Into An .Apk (Android Package) File By The Program "Aapt" (Android Asset Packaging Tool) To Simplify Development Google Provides The Android Development Tools (ADT) For Eclipse. The ADT Performs Automatically The Conversion From Class To Dex Files And Creates The Apk During Deployment. Android Supports 2-D And 3-D Graphics Using The Opengl Libraries And Supports data storage in a SQLite database. Every Android applications runs in its own process and under its own userid which is generated automatically by the Android system during deployment. Therefore the application is isolated from other running applications and a misbehaving application cannot easily harm other Android applications.

Chapter 7

PROGRAM

STREET LIGHT

```
#include <WiFi.h>
#include <HTTPClient.h>
const char* ssid     = "Redmi";
const char* password = "spiderman";
const char* serverName = "http://192.168.43.101:5000/test";
unsigned long lastTime = 0;
unsigned long timerDelay = 1000;

int  stat_led=23;
int data_led=22;
int ir1=21;
int ir2=19;
int ldr1=34;
int ldr2=35;
int relay1=18;
int relay2=5;
int count=0;
bool flag=0,flag1=0,flag2=0,flag3=0,flag5=0;

void setup_wifi()
{
 WiFi.begin(ssid, password);
 while (WiFi.status() != WL_CONNECTED)
 {
  delay(500);
  Serial.println("CONNECTING.....");
 }
 Serial.println("CONNECTED");
}

void sendData(String val)
{
 if ((millis() - lastTime) > timerDelay)
 {
  if (WiFi.status() == WL_CONNECTED)
  {

   WiFiClient client;
   HTTPClient http;
   http.begin(client, serverName);
```

```
    http.addHeader("Content-Type", "application/x-www-form-urlencoded");
    String httpRequestData = String(val);
    int httpResponseCode = http.POST(httpRequestData);
    Serial.println(httpResponseCode);
    if (httpResponseCode > 0)
    {
     String res = http.getString();
     Serial.println(res);
    }
    http.end();
   }
   else
   {
    Serial.println("WiFi Disconnected");
   }
   lastTime = millis();
  }
}

void setup()
{
 Serial.begin(9600);
 setup_wifi();
 pinMode(stat_led,OUTPUT);
 pinMode(data_led,OUTPUT);
 pinMode(ir1,INPUT);
 pinMode(ir2,INPUT);
 pinMode(ldr1,INPUT);
 pinMode(ldr2,INPUT);
 pinMode(relay1,OUTPUT);
 pinMode(relay2,OUTPUT);
}
void loop()
{
 if (digitalRead (ldr1)==1)
 {
  digitalWrite(relay1,HIGH);
 }
 else
 {
  digitalWrite(relay1,LOW);
 }
  if (digitalRead (ldr2)==1)
 {
  digitalWrite(relay2,HIGH);
 }
  else
 {
```

```
  digitalWrite(relay2,LOW);
 }
 //////////////////////////////////////////////////////////////
 int ir1_val=digitalRead(ir1);
 int ir2_val=digitalRead(ir2);
 if(ir1_val==0)
 {
  flag1=1;
 }
 if(ir1_val==1 && flag1==1)
 {
  flag1=0;
  flag3=1;
 }
 if(ir2_val==0 && flag1==0)
 {
  flag2=1;
 }
 if(ir2_val==1 && flag2==1)
 {
  flag2=0;
  flag3=0;
  count=0;
  digitalWrite(data_led,LOW);
 }
 if(flag3==1)
 {
  count++;
  digitalWrite(data_led,HIGH);
  Serial.println(count);
 }
 if(count==4000)
 {
  digitalWrite(stat_led,HIGH);
  flag3=0;
  digitalWrite(data_led,LOW);
  sendData("X");
  count=0;
  delay(1000);
  digitalWrite(stat_led,LOW);
 }
}
```

ACCIDENT DETECTION

```
#include<ESP8266WiFi.h>
#include<ESP8266HTTPClient.h>
#include<HttpClient.h>
#include<WiFiClient.h>

WiFiClient wificlient;
HTTPClient http;

const char* ssid="Redmi";
const char* password="spiderman";
unsigned long int last_post=0;
int post_interval=1000;
int count=0;

int stat_led = 16;
int data_led = 5;
int buzzer = 4;
int tilt = 14;
int button = 12;
bool flag1 = 0, flag2 = 0, flag3 = 0;


void setup_wifi()
{
  WiFi.begin(ssid,password);
while(WiFi.status()!=
WL_CONNECTED)
  {
    delay(1000);
    Serial.println("CONNECTING....");
  }
  Serial.println("CONNECTED");
}
void send_data(String A)
{

if(WiFi.status()==WL_CONNECTED&
&(millis()-last_post)>=post_interval)
  {

http.begin(wificlient,"http://192.168.43.1
01:5000/test");
    http.addHeader("Content-
Type","application/x-www-form-
urlencoded");
```

```
String data=A;
    int httpcode=http.POST(data);
    String payload=http.getString();
    Serial.println(httpcode);
    last_post=millis();
    if(httpcode>0)
    {
      String res=http.getString();
      Serial.println(res);
    }
    http.end();
  }
}
void setup()
{
  Serial.begin(9600);
  setup_wifi();
  pinMode(stat_led, OUTPUT);
  pinMode(data_led, OUTPUT);
  pinMode(buzzer, OUTPUT);
  pinMode(tilt, INPUT);
  pinMode(button, INPUT);
}

void loop() {
  count++;
  Serial.println(count);
  if(count>100)
  {
    digitalWrite(stat_led,HIGH);
  }
   if(count>200)
  {
    digitalWrite(stat_led,LOW);
    count=0;
  }
  int b_val = digitalRead(button);
  int t_val = digitalRead(tilt);
  if(t_val==0)
  {
    flag2=1;
  }
  if(t_val==1)
  {
    flag2=0;
  }
  if(b_val==0)
  {
    flag1=1;
  }
  if(b_val==1 && flag1==1 && flag2==1)
  {
    flag1=0;
    Serial.write('A');
    send_data("Y");
    digitalWrite(data_led,HIGH);
    digitalWrite(buzzer,HIGH);
    delay(1500);
    digitalWrite(data_led,LOW);
    digitalWrite(buzzer,LOW);
  }
}
```

Chapter 8

PCB LAYOUT OF THE CIRCUIT

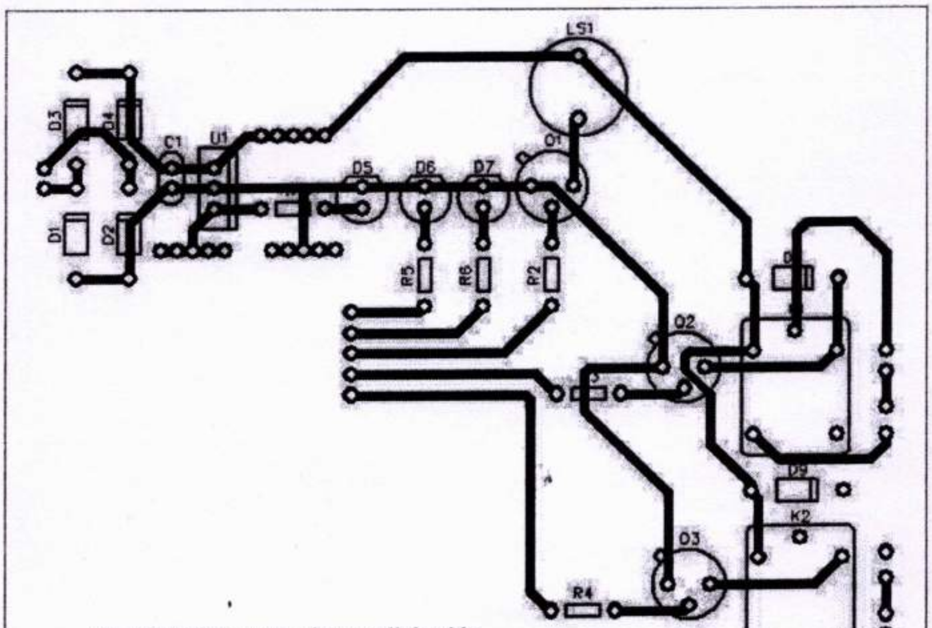

Fig.8.2.PCB Layout of street light side

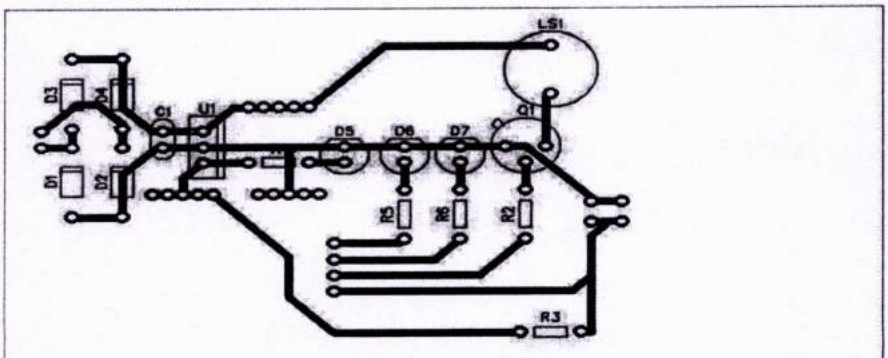

Fig.8.1. PCB Layout of accident detection

Design of printed circuit board (PCB) can be considered as the last step in electronic circuit design as well as the first step in production. It plays important role in the performance and reliability of electronic circuits, the productivity of the PCB's its assembling, and its service ability depends on design. All these factors get reflected in a piece of electronic equipment. It is clear that task of PCB design is not very simple or always straight forward. The schematic is follower by layout generation. Layout design is the stage where engineering capacity combined with creativity is the governing inputs.

- Firstly, we verify the circuit using bread board.
- Then, draw the circuit using 'Diptrace'. All the components are provided there itself.
- Print the circuit on a cloth piece. The printed place will be transparent.
- After printing, keep it on copper clad, place paint on top of the circuit and gently pull the paint onto the circuit using a wiper. This process is called screening.
- Then place the circuit in ferric chloride solution. Let it sit for few minutes so that copper reacts with the solution and the copper in the masked area will remain as no reaction takes place on that area.
- Perform soldering and drilling and soldering on the necessary areas.
- Place the components as per the circuit diagram.

Chapter 9

FUTURE SCOPE

The proposed system deals with the detection of the accidents. But this can be extended by providing medication to the victims at the accident spot. By increasing the technology we can also avoid accidents by providing alerts systems that can stop the vehicle to overcome the accidents. Artificial Intelligence cameras can be included in future for the real time monitoring of accident prone areas in real time with the help of AI Technology. Navigant Research estimates that by 2023, there will be 116 million LED street lights in use, one for each HPS fixture. These smart lights will help cities reduce electricity costs, lower CO_2 emissions, and improve maintenance.

Chapter 10

CHALLENGES

This system cannot implemented in areas with heavy traffic as well as in areas with pocket roads. Sensing of objects other than vehicles will increase the complexity of the system. Proper maintenance in remote areas is a great challenge faced by the system. Areas with low network coverage will create difficulties in passing the information in specific required time.

Chapter 11

ADVANTAGES

The proposed system requires minimum human interference in the operation of street lights. By this method energy saving can be done effectively. The system helps to detects the occurance of accident in real time and initiates proper communication. It also analyses the chance of occurance of accidents. Rescue operations can be initiated within specific limited time.

Chapter 12

CONCLUSIONS

The "Street light monitoring and accident detection using IoT" is a cost effective, practical, eco-friendly and the safest way to save energy. This project helps to provide proper treatment for accident casualities and can reduce the deaths caused by accidents in remote areas. The system has much relevant in India where approximately 1.5 lakh people die of accidents every year.

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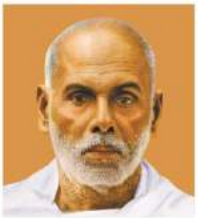

DEPARTMENT OF MECHANICAL ENGINEERING

HILL HOLD ASSIST ON MANUAL TRANSMISSION VEHICLES

PROJECT REPORT

submitted by

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to

The APJ Abdul Kalam Technological University

in partial fulfilment of the requirements for the award of the Degree

of

Bachelor of Technology

In

Mechanical Engineering

Department of Mechanical Engineering

Sree Narayana Guru College of Engineering and Technology,

Payyanur

JUNE 2023

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DECLARATION

We undersigned hereby declare that the project report **"HILL HOLD ASSIST ON MANUAL TRANSMISSION VEHICLES"**, submitted for partial fulfilment of the requirements for the award of degree of Batchelor of Technology of the APJ Abdul Kalam Technological University, Kerala is a Bonafede work done by us under supervision of **Dr. SUDHIN CHANDRAN**, Assistant Professor, Department of ME. This submission represents our ideas in our own words and where ideas or words of others have been included, We have adequately and accurately cited and referenced the original sources. We also declare that we have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in our submission. We understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

Place: Payyanur

Date: 03/04/2023

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CERTIFICATE

This is to certify that the project report entitled "**HILL HOLD ASSIST ON MANUAL TRANSMISSION VEHICLES**" submitted by '**ADARSH P K (SNC19ME001), ATHUL B (SNC19ME007), MOHAMMED AAFIL ISMAYIL M K (SNC19ME011)**'to the APJ Abdul Kalam Technological University in partial fulfilment of the requirements for the award of the Degree of Bachelor of Technology is a Bona fide record of the project work carried out by him/her under my/our guidance and supervision. This report in any form has been submitted to any other University or Institute for any purpose.

Supervisor

Project Coordinator

HEAD OF THE DEPT

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ACKNOWLEDGEMENT

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Thanking you

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ABSTRACT

Road transport safety is an important issue in the land transport sector all over the world due to the increment in the usage of automobiles in few decades. It is highly likely that ineffective braking is to blame for a number of car accidents that result in catastrophic injuries. Between 20 and 30 percent of all work-related deaths and major injuries each year are caused by reversing vehicles. This is a scientifically proven fact. The paper presents "HILL HOLD ASSIST ON MANUAL TRANSMISSION VEHICLES" for both light and heavy vehicles. This paper outlines system requirements to successfully develop and deploy a less complicated, safe and secure mechanism for the uncontrolled reverse motion of the vehicle on hilly terrains.

This mechanism consists of a vehicle and ratchet & pawl connected to the rear drive shaft of the vehicle and an electromagnet which will control the movement of the pawl while engaging or disengaging the mechanism. The engaging mechanism will represent the reverse motion is undesirable or to be restricted and disengaging mechanism when the reverse motion is desirable. Technically, this mechanism encounters the issue free motion of the shafts of the gearbox as the vehicle tries to roll downhill when the clutch is pressed (disengaged) for the moments in which driver shifts his foot from the brake pedal to accelerator pedal to accelerate the engine. Such mechanisms restrict one or the other shaft(s) of the gearbox to rotate opposite under the influence of wheels, thereby restricting vehicle to roll back in opposite direction. In this work the mechanism has been developed to stop the vehicle from rolling backwards when the vehicle is moving in the hill roads.

KEYWORDS : *Ratchet, Pawl, Electromagnet*

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LIST OF FIGURES

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CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

India accounts for 4,80,652 road accidents in the year 2018 which is third highest count compared to the other countries in the world and records the death count of 1,50,785 which is the highest compared to all other countries. The maximum casualties due to road accident occurs in developing countries. In a recent analysis of fatal accident statistics showed that reversing activities were involved in 12% of all the fatal transport accidents. Insurance claims data and research by the University of Huddersfield reveal that approximately 25% of all reported collisions arise from vehicles reversing. Many of these occur at the workplace and in parking lots. In scenarios where other individuals are involved, serious damage can occur to the vehicle or the individual. Although too many do not regard reversing as a significant hazard, a significant portion of commercial vehicle accident claims involves reversing vehicles. Research has shown that almost 60% of all commercial vehicle accident claims involve reversing and HGVs lead the way with 19% of these claims, vans 15% and company cars 10%. According to research in Ireland, reversing activities were involved in 11% of all fatal workplace transport accidents. Reversing incidents that do not result in injury can result in costly damage to vehicles, plant, equipment, and premises.

A typical problem that is encountered, in four wheeled vehicles with manual transmission, is when the drivers find themselves stopped on a positive gradient and want to move uphill, the vehicle begins to roll in the backward direction when the brake pedal is released. For this, in vehicles with a manual transmission, the hand brake is typically used when starting on an incline. This procedure is awkward at times because the vehicle immediately moves backward once the foot on the brake pedal is lifted. When performing this procedure, the driver will normally position one foot on the clutch pedal to disengage the transmission and the other foot on the brake pedal to hold the vehicle stationary on the incline. When it is time to continue up the incline, the hand brake is engaged and the foot on the brake pedal is moved to the accelerator pedal to increase the engine speed at the same time the clutch pedal begins to return to its rest position. The hand brake is then released as the accelerator pedal is pressed. It is important to carefully coordinate the release of the hand brake while depressing the accelerator pedal and letting up the clutch pedal in order to prevent the vehicle from rolling backwards or stalling the engine. Many drivers consider this to be a very difficult manoeuvre and therefore choose to ride the clutch in an upward incline; i.e., the throttle is opened slightly over idle speed and the clutch pedal is engaged so that the clutch slips just enough to hold the vehicle stationary. This driving technique results in heavy wear on the clutch disc and when used often, results in substantial shortening of the life of the clutch disc. Heavy vehicle moving slowly due to overloading or stopping due to traffic in uphill will make the steering uncontrollable and similarly the vehicle going downhill in overloading condition is also another reason for heavy vehicle accident in hill roads. In hill roads driving heavy vehicle is a challenging task for drivers. Mainly when the vehicle is parked or moving slowly in gradient road. Various safety control system like traction control, antilock braking system, electronic stability control system and hill assistance system is available in the market. In the inclination state, the most important issue to the drivers is to stop their car on inclination and to go in a forward direction. While holding up in the action, the car needs to move forward continuously, this situation is problematic, for the drivers to make their car not to roll back on the inclination. So the system must be developed to keep the vehicle from moving back and it should not stop the vehicle from forward motion may be overcome. This limit can be proficient by using ratchet and pawl instrument. The ratchet and pawl should be arranged and should be fit in the rear drive shaft.

Ratchet and pawl mechanism is used in many applications effectively where the one side power transmission is required for example in (i) Giant wheel- It is the large wheel used in the amusement parks to rotate along the horizontal axis to rotate in one direction while carrying the number of passengers. (ii) Clocks- where the hands rotate in clockwise directions only. (iii) Baffle gates- in the entrances of many buildings which rotate about vertical axis in one direction. In the hill station, the most common problem to the drivers is to park their cars in the slope and to start up the car. While waiting in the traffic, the cars have to move on step by step very slowly this situation is a difficult one for the drivers to make their car not to roll back in the slope. So the mechanism has to be developed to stop the vehicle from rolling back and it should not stop the vehicle in accelerating forwards. This function can be achieved by using the ratchet and pawl mechanism. These mechanisms give a solution for the general issue of descending or rolling back of the vehicle, while starting motion uphill in forward or reverse direction in various ways. The issue is encountered by employing the devices like freewheel, roller clutch or ratchet-pawl mechanism in different-different manners and locations within the gearbox. The issue is discussed here considering uphill motion in forward direction. Uphill motion in the reverse direction also has the similar issue. The land transport sector encompasses the commercial use of many different vehicles including lorry, light vans, taxis, buses, cars construction and agricultural machinery, emergency service vehicles, motorcycles, mopeds and bicycles. Road transport safety is an important issue in the land transport sector. Driving mistakes made by heavy goods vehicle drivers may be more serious because of the weight, size, shape, maneuvering abilities, braking abilities, etc., of the vehicle.

The main types of transport accidents are Vehicle crashes People being struck or run over by moving vehicles (e.g. during REVERSING or coupling). People falling from vehicles People struck by objects falling from vehicles, or vehicles overturning. The analysis of European Statistics on Accidents at Work (ESAW) data reveals that 29% of fatal accidents at work are due to loss of control of means of transport or handling equipment. Thus, improper handling and loss of control over vehicles may cause a severe threat to both the driver and the pedestrians. Unexpected reverse motion of vehicles in gradients and mountain roads is one of that problem which may cause disastrous accidents. Even though a modern vehicle has modern equipment's like parking assistance system, hand brake, etc., drivers aproscenia will cause serious damages. For conventional trucks in India, moving uphill is often a very risky proposition, particularly with a full payload. The vehicle risks rolling back if the driver lets go the clutch with not enough power on the gas. In high-end commercial vehicles though, technologies like the Electronic Braking Systems (EBS) helps pull away the vehicle from a standstill on steep gradients with no risk of rolling back. As a common practice in the country, the parking brake is usually engaged, when loading or unloading a vehicle or on inclines to avoid roll back. This is never a full-proof option, and requires adequate driving skills to ensure operation. That was the challenge that the engineering team at KBI took up, that of developing a technically suitable and commercially viable system for the Indian market that predominantly runs on vehicles with manual transmissions. When the vehicle is stationary and inclined, the releasing of brakes activates the flow control means, which releases the air from the rear brake actuator at a slow rate. That enables the vehicle to remain stationary even after the brakes are released. The slow release of air provides the time needed for the driver to feel and accelerate the vehicle, either to drive up the hill or reverse it. The present invention in a preferred embodiment provides systems and methods for preventing a vehicle from reverse movement on a slope In the inclination state, the most important issue to the drivers is to stop their car on inclination and to go in a forward direction. While holding up in the action, the car needs to move forward continuously, this situation is problematic, for the drivers to make their car not to roll back on the inclination. So the system must be developed to keep the vehicle from moving back and it should not stop the vehicle from forward motion may be overcome. This limit can be proficient by using ratchet and pawl instrument. The ratchet and pawl should be arranged and should be fit in the rear drive shaft.

The system comprising of

a) A manual transmission vehicle.

b) A ratchet and pawl device connected to at least one wheel of the vehicle.

c) A connecting or fastening component which connects the ratchet and pawl device such that the wheel shall rotate only if the ratchet and pawl device rotates.

d) Electromagnets which will control the movement of the pawl while engaging or disengaging the mechanism Where in the system may be engaged using an engaging mechanism when reverse motion is undesirable or to be restricted, and may be disengaged when the reverse motion is desirable and is to be. Same as for the front ward motion is undesirable or restricted.

(e) Electromagnet is connected with battery and limit switches for controlling pawl engagement

CHAPTER 2

LITERATURE REVIEW

A. Arunkumar, T. Muthumani et.al has Studied to stop the vehicle from rolling backwards when the vehicle is moving in the hill roads. Ratchet and Pawl mechanism has been identified to arrest the motion to the front axle. Anti-Roll Back mechanism has been fabricated and tested on the front axle assembly. The mechanism works well. In this work, Ratchet and Pawl mechanism is identified to arrest the backward motion to the car. The ratchet is placed in the front drive shaft and the Pawl is fitted with the frame. When the vehicle is moved in the hill road, the lever has to make the pawl to touch the ratchet

Mohamed Krid, Faiz Benamar et.al has studied integrated approach of an active anti-roll system has been presented. An innovative kinematics which can be easily added on existent off-road chassis is proposed. A model predictive controller based on minimization of load transfer and energy consumption is designed. Simulation results show that this system improves the performance and the stability of the robot when cornering. An important advantage of the proposed solution is its easy integration as new part, without any transformation of the original chassis. This system can be controlled independently and is demonstrated to have no effect on the dynamics of path controller. A new rover based on an existent commercial chassis is currently under construction to equip it with electric actuators, sensors, and the active anti-roll system detailed in this paper. The next steps will focus on the experimental validation of this promising new system. Another challenge for increasing offroad performance, would be the design and development of innovative systems for preventing tip-over instability along both roll and pitch axes.

J. A. Kennedy & L. L. Howell et.al has studied a ratchet and pawl ring mechanism that has advantages for mechanical safety mechanisms, particularly when the design envelops is too small to allow for traditional mechanical components. The mechanism constraints are outlined and the mechanism and its modeling are defined. A series of three scaled prototypes and their testing are described.

William K. Messer smith & Keith H. Fulmer et.al has studied booster connected to a control circuit provides a system for the continued braking of a vehicle when the vehicle is situated on an incline and the brake pedal is released by the operator. Continued brake application is accomplished by utilizing a control circuit responsive to vehicular attitude, clutch pedal position, and vehicular direction. The control circuit is connected to the combination of a check valve and two-way solenoid valve connected to a movable wall brake booster. The combination valve is connected to a flexible hose disposed interiorly of the booster, and the other end of the flexible hose connected to the input opening of a three-way poppet valve located at the central hub of the booster. When the control circuit senses that the vehicle is on an incline, the clutch pedal depressed, the ignition "on", and the vehicle not backing up, it actuates the two-way solenoid of valve which continues to supply a first fluid pressure to the front booster chamber while closing to prevent the supply of the first fluid pressure to the rear booster chamber, via the flexible hose and poppet valve.

Cook George et.al invented relates to an anti-creep and hill holder brake system and more particularly to a brake system which prevents the creeping or rolling of automobiles equipped with either automatic fluid transmissions or friction clutches. Presently known types of anti-creep or anti-roll systems incorporate a circuit having a number of switches with one switch being operated by the ignition key, another by the accelerator pedal and another by the movement of the vehicle. Because of the slow actuation provided for these switches, present systems do not operate satisfactorily since the systems do not respond properly to the actions of the driver and interfere with the actions of the driver.

William Kent-Improved Release Mechanism for a Hill Holder Device. The invention provides a wheel braking torque sensor disposed within a wheel brake so that when the vehicle is accelerated and effects corresponding wheel braking torque changes within the brake, the change in torque is sensed and provides an input to either a solenoid connected with the mechanical brake control device or to the control circuit connected to the braking assistance servo-motor in order to effect operatively a release of the brakes from the applied position to a released position and permit movement of the vehicle. It provides an improved release mechanism for mechanical brake control device in a vehicle having a brake pedal and a clutch pedal, the brake pedal being movable from a rest position to an applied position during braking, the clutch pedal being movable from a rest position to an applied position when the associated clutch assembly is disengaged, the mechanical brake control device being operatively connected with the brake pedal for actuation thereby and so including means for opposing movement of the brake pedal away from the applied position in order to retain the brake pedal in said applied position, and a release mechanism operatively coupled with said brake control device for effecting operation of the brake control device and a subsequent release of the brake pedal from the applied position, wherein the release mechanism comprises braking torque sensor means for sensing a change in braking wheel torque when the vehicle begins movement and effects a change in the braking torque, and actuation means coupled to the brake control device and responsive to said sensor means in order to effect release of the brake pedal from the applied position.

V. D. Kolate , R. R. Kurup , A. M. Latake. In this work, Ratchet and Pawl mechanism is identified to arrest the backward motion to the car. The ratchet is placed in the rear drive shaft and the Pawl is fitted with the frame. When the vehicle is moved in the hill road, the lever has to make the pawl to touch the ratchet. If the vehicle tends to move backward direction, the pawl would stop the ratchet to move Counter Clock-wise direction with respect to front wheel. As the vehicle is in neutral position, the pawl engaged the ratchet and the vehicle did not move in backward direction. So the hand brakes need not to be applied. When the vehicle is in moving condition, the engagement between the ratchet and pawl is detached.

Vehicle transmission hill holder Alvin H. Berger used a one-way clutch when engaged it prevents rolling of the vehicle. A device operable in a transmission for substantially preventing vehicular rollback on an incline includes a shaft, a gear, a one-way clutch, and a pawl member. The gear is selectively connected for common rotation with the shaft. The gear is rotatable in a first rotary direction and a second rotary direction. The one-way clutch has an inner race and an outer race, where the inner race is connected to the gear and the outer race has an outer surface having a plurality of engaging teeth. The pawl member has a first end and a second end, where the first end is pivotal mounted to a transmission housing. The second end of the pawl has a first angled portion configured to release and engage at least one of the pluralities of engaging teeth of the outer race as the outer race rotates in the second rotary direction.

Design and Fabrication of Rack and Pinion Jack S.S. Dheeban Kumar, A.V. Antony Ajith, P. Clifford Rayen, T. Ignatius Daniel In this research, a novel design for a lifting jack driven by a quick-return crank mechanism and gear drive has been designed and fabricated. The jack's screw rod is fixed to the spear gear its combined more gears in one rod. The manual source power keys are interface with handle rod. Ratchet and pawl mechanism using here lock the reverse direction during the lifting process. The jack's screw rod is fixed to the spear gear its combined more gears in one rod. The manual source power keys are interface with handle rod. Using this equipment, we can easily access the lifting of load in various purpose of our need. By alternating the power transmission with higher torque, the jack can lift heavy load easily

Design and Fabrication of Self-Locking Wheel Mechanism for Manual Transmission 4 Wheeled Automobiles Subjected to Positive Gradients Benssin K.B, Blesson Abraham, Cyriac James, Jerrin Mathew,Visant P.V The project aims at making a simple and reliable hill hold mechanism coupled to idle shaft of a manual transmission vehicle that will allow a driver of the vehicle to begin movement from a stop on an incline while preventing the vehicle from rolling.If the vehicle approaches a positive gradient, the gyro sensor send signal to the relay to energize the solenoid which engages the ratchet and pawl mechanism. The driver only needs to throttle the vehicle instead of adjusting clutch, handbrake and throttle simultaneously.

Locking Reverse Wheel Using Anti Roll Back Mechanism Rajeshkanna. S, Pradeep. S, Venkatraman. K. S, Venkateshperumal. R, Surya Vignesh. N This Paper consists of locking the reverse wheel such that it constraint the reverse motion of the vehicle with the help of ratchet and pawl mechanism. The movement of the pawls will be controlled with the help of the linear actuators. A push button will be provided on gear of the vehicle which will be operated by the driver on choice. In this work the mechanism has been developed to stop the vehicle from rolling backwards when the vehicle is moving in the hill roads. Ratchet and Pawl mechanism has been identified to arrest the motion to the rear axle. In this project, they made a simple and economical solution to the above mentioned problem. We used Ratchet and Pawl mechanism as our major capital and fabricated equipment which can be attached to any automobile that it prevents unwanted reverse motion when it is at rest or in motion.

Hill Assist Control System Mr. Shinde Ajay R., Mr. Kharat Amol B, Mr. Chakor Manik N Mr. Patil Sangram S, Prof. A.V.Kanade In this project work the design and construction of a model of automatic braking system for vehicles in hill stations is to be developed. The mechanism has been developed to stop the vehicle from rolling back ward when the vehicle is moving in the hill roads. This construction made of two phases in a first deigns of ratchet and pawl mechanism, frame, shaft, etc. is done and in second sensor selection and interference is done. Ratchet and pawl mechanism has been fabricated and assembled with sensor interface is tested. The proposed mechanism is to lock reverse break using ratchet gear. By reverse locking the differential is disengaged from the axle. Thus the power is directly transmitted to the axle and hence to the wheels.

Automatic Reverse Wheel Locking Mechanism Yashwant Bhesota, Sumit Paroliya, Kumar Rajul Patel, Madhvi Sharma This mechanism consists of a vehicle and ratchet & pawl connected to the rear drive shaft of the vehicle and an actuator along with the help of an inclination sensor which will control the movement of the pawl while engaging or disengaging the mechanism. The engaging mechanism will represent the reverse motion is undesirable or to be restricted and disengaging mechanism when the reverse motion is desirable.

Design of an Automatic Hill Start Assistance System, Arun Pranesh M , R. Rohith Renish, Niruban Projoth The project aims to design and develop an automatic hill start assistance system to prevent the roll back of the vehicle while attempting to move a vehicle during hilly driving conditions. This could improve the safety and drivability of vehicles plying on hills specifically while driving in off roads and also on low-traction surfaces. The proposed system consists of an internal ratchet pawl design with an engagement system that is actuated by a solenoid. This has been designed to be the fundamental part of the rear axle of the vehicle. This is to prevent or possibly eliminate the backward motion of the vehicle when the driver releases the brake to move in forward direction.

Dhanya et.al. (2012)VHDL created the auto-braking mechanism to maintain a set distance. A clever pre-collision smart security system is provided. Using a sensor, this module can measure the distance between your car and the one in front of it, and if the driver doesn't slow down, it will apply the brakes automatically. Your car's speed and the distance between it and the next closest vehicle are shown by the system. The system ran well.

Eung Soo Kim et.al. (2009) In order to reduce car crashes in the back, it is important to judge the need for emergency evacuation as soon as possible and start assistance naturally. On the other hand, we obtained a mathematical model of driver sensitivity of proximity to the vehicle following the condition and a proven model of successful driver slowing down to define speed-reduction patterns and braking time for a professional driver. In this study, an automatic brake system will be proposed to avoid collisions based on the profile of the brake profile and the brakes of the professional driver's brakes for smooth, environmentally friendly brake assistance. It will be shown that the proposed control method can produce a smooth profile in a variety of contexts.

Design and Development of Automatic Braking System, Pranav Patil, Himanshu Sharma, Karan Shende, Prithvijit Parmar ,V.M. Chavan, The aim is to design and develop a control system based on intelligent electronically controlled circuit called "AUTOMATIC BRAKING ON SLOPE REGION". In the hill station, the most common problem to the driver is to park their cars in the slope and to start up the car. While waiting in the traffic, the cars have to move on step by step very slowly; this situation is a difficult one for the drivers to make their car not to roll back in the slope. So the mechanism has to be developed to stop the vehicle from rolling back and it should not stop the vehicle in accelerating forwards. This function can be achieved by using the ratchet and pawl mechanism. The ratchet and pawl has to be designed and has to be fit in the rear drive shaft in case of the rear drive vehicles. In this work the instrument has been made to keep the vehicle from moving backward when the vehicle is moving on the slant roads. Ratchet and pawl part has been recognized to catch the development to the rear rotating axle. Antagonistic to Roll Back part has been produced in this mechanism.

Emergency Braking System for Hill Station Vehicle, R. Vijaykumar, A. Anantharaj, S. GokulaKannan, N. YuvaBharathi, In this project we are introducing the automatic brake for hill station vehicles. The main reason to fabricate the automatic brake is to avoid the reverse movement of vehicle during the vehicle is in off condition this project is to avoid the accident due to reverse movement of the vehicle in hill stations. The project contains simple mechanical arrangement. This project consists of following parts sprocket, reveres braking, linkage joint, linkage support and motor. In this project we are introducing the automatic brake for hill station vehicles. The main reason for fabricate the automatic brake is to avoid the reverse movement of vehicle during the vehicle is off condition due to the reverse movement the vehicle get accident for impacting to other vehicle so this project is highly avoid the accident due to this reverse movement on the vehicle. The project contains simple mechanical arrangement and operation is simple

CHAPTER 3
OBJECTIVE & PROBLEM DEFINITION

3.1 OBJECTIVE

- The major goal of our idea is to use simple and inexpensive measures to prevent these types of accidents and unexpected reverse movement.
- To prevent the uncontrolled reverse motion of an automobile under slopes and hilly roads.
- To protect drivers and pedestrians from catastrophic accidents caused by loss of control and incorrect equipment management.
- To ensure safety of the driver and vehicle on inclined terrains.
- To increase the life of brakes and to reduce the fuel consumption.

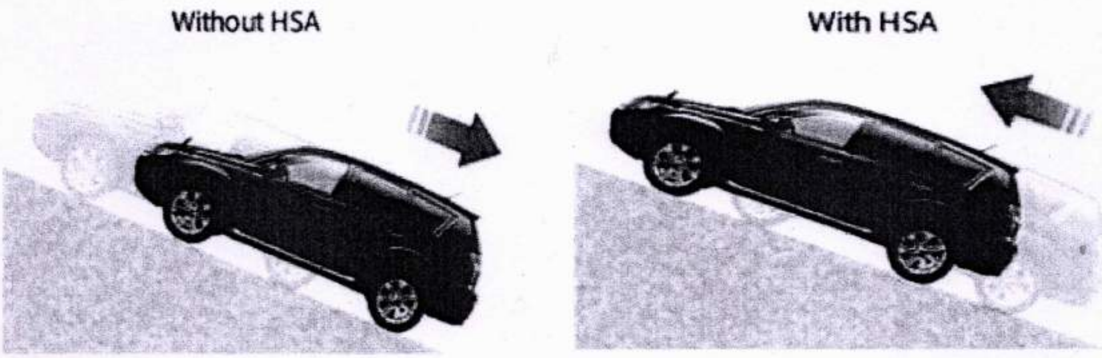


Fig:1.1: Vehicle with & without has

3.2 PROBLEM DEFINITION

- The most common problem in the hilly terrains is to park the vehicles in the slope and to start up.
- When stuck in traffic on mountain roads, cars had to proceed very slowly and cautiously, which made it challenging for drivers to keep their vehicles from reversing and increasing the risk of accidents.
- This problem may occur due to driver's carelessness or improper handling of the vehicle equipment.

- The issue with brakes is that they lock all four wheels of the car, making it impossible for it to go forward or backward.
- So as to avoid such cases we designed a simple and economical equipment which will give a solution to the above mentioned problems.

CHAPTER 4

MATERIALS REQUIRED

1. Ratchet
2. Pawl
3. Electromagnet
4. Limit Switch
5. Battery
6. Connecting Wires
7. Square Metal pipes

4.1 RATCHET AND PAWL

A ratchet consists of a gear or a rack that contains teeth aligned at a particular angle. The gear or the rack helps the ratchet to move smoothly. The ratchets are also known as ratchet wheels. Pawls are thin metallic strips that are positioned in close proximity to the gear or rack. Pawls' primary function is to limit the motion of a ratchet. The pawl rises and slides between the angled teeth of the gear or rack when the ratchet is rotated. When the ratchet stops turning, the pawl comes to rest between the teeth, making a clicking sound. The pawl and teeth tend to collide and oppose the action when the ratchet is rotated or pushed in the other direction. Some ratchets contain a locking mechanism that prevents the fastener and socket from falling out of place. For the purpose of locking and unlocking, a push-button is utilized. The lock disengages and the fastener is released when the button is pressed. The pawl, which engages the ratchet teeth, is a beam member pivoted at one end, other end being shaped to fit the ratchet tooth flank. Hardened steel is used for making these ratchet and pawl.

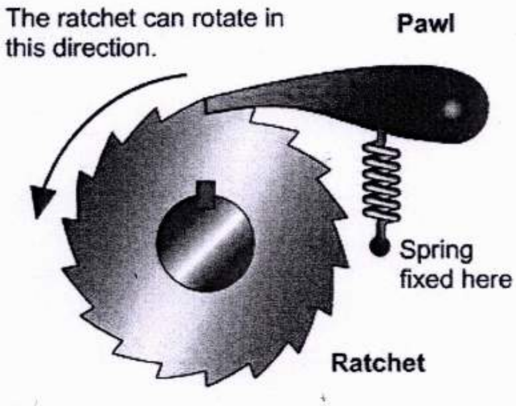


Fig:4.1: Ratchet & pawl mechanism

4.2 ELECTROMAGNET

An electromagnet is a device that consists of a magnetic core surrounded by a coil through which an electric current is carried to magnetise the core. Electromagnets are used whenever controlled magnets are needed, such as in devices that allow the magnetic flux to be adjusted, reversed, or switched on and off. A current flowing through the wire produces a magnetic field that is focused in the coil's centre hole. When the current is switched off, the magnetic field vanishes. The wire turns are frequently coiled around a magnetic core consisting of a ferromagnetic or ferrimagnetic material, such as iron; the magnetic core concentrates the magnetic flux, resulting in a stronger magnet. The major benefit of an electromagnet over a permanent magnet is the ability to quickly change the magnetic field by regulating the amount of electric current in the winding. In contrast to a permanent magnet, which requires no power, an electromagnet requires a constant source of electricity to sustain the magnetic field. Electromagnets are widely used as components of other electrical devices, such as motors, generators, electromechanical solenoids, relays, loudspeakers, hard disks, MRI machines, scientific instruments, and magnetic separation equipment. In industrial, electromagnets are used to pick up and move heavy iron items such as scrap iron and steel. In our mechanism electromagnets are used to hold and release the pawl for engage with ratchet.

Fig:4.2: Electromagnet

4.3 LIMIT SWITCH

A limit switch is a switch that is activated by the motion of a machine part or the presence of an item. A limit switch can be used to operate equipment as part of a control system, as a safety interlock, or to count things passing through a point. Limit switches are utilised in a wide range of applications and situations due to their robustness, simplicity of installation, and dependability. They can determine an object's presence, passage, location, and end of transit. They were initially used to determine an object's limit of travel, thus the term "limit switch." The operation of a limit switch is similar to that of a sensor in determining the presence or absence of an object. This switch can be mechanically activated by interacting with other substances. When the object makes contact with the switch's actuator, it ultimately advances to the actuator's border whenever the location of the contact changes. The majority of these switches are mechanical in operation and have heavy-duty contacts capable of switching large current. A limit switch can be activated by several types of mechanisms: magnetic, mechanical and optical. In general, there are Two Types of Limit switches

- Mechanical – These switches are controlled by a physical movement (typically using a lever). This often makes them suitable for delicate equipment because they don't require any power to operate. However, they can be more prone to wear and tear than electronic versions.
- Electronic – Electronic limit switches are powered by batteries or mains electricity and use sensors to detect when an object crosses a certain point.

Magnetic limit switches are activated by magnets located near them. Mechanical limit switches are activated by physical contact with a lever or other object that moves when the actuator comes into close proximity with it. Optical limit switches use light-emitting diodes (LEDs) and photoelectric cells to detect when an object has come within a certain distance of them. Here we are using a mechanical type limit switch. And it will control ON/OFF of electromagnet.

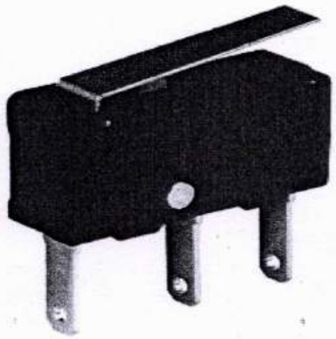


Fig:4.3: Limit switch

4.4 BATTERY

In this project we are using AMARON battery of 12v and 5 Ah. It is a lead acid battery and mainly used for bikes like discover, pulser, passion pro, glamour etc. The cell used in it is galvanic cell. The battery is a VRLA (Valve Regulated Lead Acid) type. Here we are using battery to store electrical energy and supply power to electromagnet.

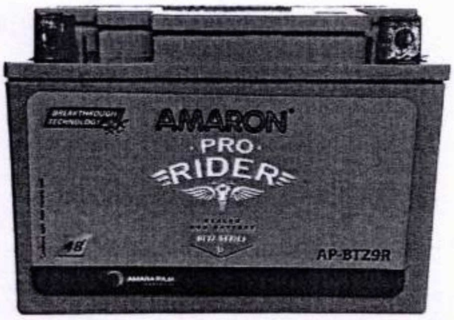


Fig:4.4: Battery

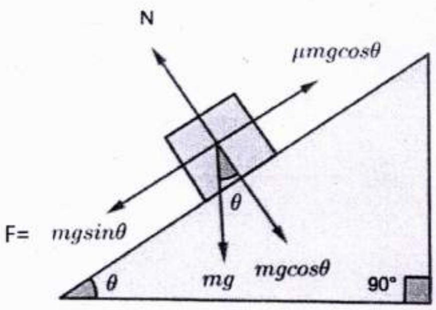
CHAPTER 5

DESIGN AND ANALYSIS

5.1 RATCHET AND PAWL DESIGN CALCULATION

Torque to be arrested is,

$\mu mg \cos\theta = P.$



$$P = \frac{W[\sin[\alpha - \phi]]}{\cos\phi} \quad \text{———————— (1)}$$

$$\mu = 0 \cdot 7$$

$$\phi = \tan^{-1}(0.7) = 34.9°$$

$W = mg = 1000 \times 9.81$ ———————— (2)

= 9810 N (Weight of the car)

$$P = \frac{9810[\sin[45 - 34 \cdot 9]]}{\cos 34.9}$$

= 2033.78 N

Then torque, $M_t = F \times r$ ———————— (3)

= 2033.78× 0.31

= 630.447 Nm

So Torque to be arrested, $M_t = 630.447 \times 10^3$Nmm

Since both ratchet and pawl are made of hardened steel material, the design stress of them is considered as, $[\sigma_b]$=50 N / mm^2

Calculation of Ratchet dimensions

Number of teeth, Z=16

(i) Module(m)= $2 \times \sqrt[3]{\frac{M_t}{Z \times \psi \times [\sigma_b]}}$ ———————— (4)

Assuming $\psi = b/m = 2.5$

$$m = 2 \times \sqrt[3]{\frac{630.447}{16 \times 25 \times 50}} = 13.6\text{mm} \approx 14\text{mm}$$

(ii) Outer Diameter of ratchet,

$D = mz = 14 \times 16 = 224$mm ———————— (5)

(iii) Face width of teeth,

$b = \psi \times m = 2.5 \times 14 = 35$mm ———————— (6)

Checking for edge pressure (i.e ,) unit pressure, p = P/b

where P = Peripheral force

$P = \frac{2 \times M_t}{D} = \frac{2 \times 630.447 \times 10^3}{224} = 5628.99$ ———————— (7)

therefore p = 5628.99/35 = 160.82 N / mm

Since this pressure is far less than the max pressure(i.e.,300N/mm), our design is safe

(iv)Tooth thickness, a = m = 14mm

(v) Tooth height, $h = 0.75 \times m = 10.5$mm ———————— (8)

(vi) Circular pitch, $Pc = \pi \times m = 43.98$mm ———————— (9)

Pawl dimensions:

(vii) The diameter of pawl-pin is given by

$d = 2 \cdot 71 \times \sqrt[3]{\frac{P}{2 \times \sigma_b}\left(\frac{b}{2} + a_1\right)}$ ———————— (10)

Assuming , $[\sigma_b]$=50 N/mm^2 (Design bending stress for pawl material)

$a_1 = 10$mm (Clearance between ratchet and frame)

$$d = 2 \cdot 71 \times \sqrt[3]{\frac{5628 \cdot 99}{2 \times 50}\left(\frac{35}{2} + 10\right)} = 31.34\text{mm}$$

(viii) Length of pawl , L:

Using the formula,

$tan\,\phi > \mu + \frac{\mu_1 d}{2L cos^2 \phi}$ ———————— (11)

Assuming ϕ = Ratchet tooth angle = 15°

μ = Coefficient of friction between ratchet tooth and pawl= 0.1

μ_1 = Coefficient of friction between pawl and pin = 0.1

$$tan\,15 > 0.1 + \frac{0.1\times30}{2Lcos^2 15}$$

$$0.268 > 0.1 + \frac{1.661}{L}$$

$$L > 9\cdot88$$

This length is so small comparing to ratchet diameter and hence using another empirical relation, L can be found out as

$$L = 2\times\pi\times m = 88\text{mm} \qquad \text{———————— (12)}$$

Checking the induced bending strength, The pawl is subjected to a total stress

$$\sigma = \frac{P}{bx} + \frac{6P\cdot e}{bx^2} \qquad \text{———————— (13)}$$

Assuming x = 35mm (pawl thickness at bend),

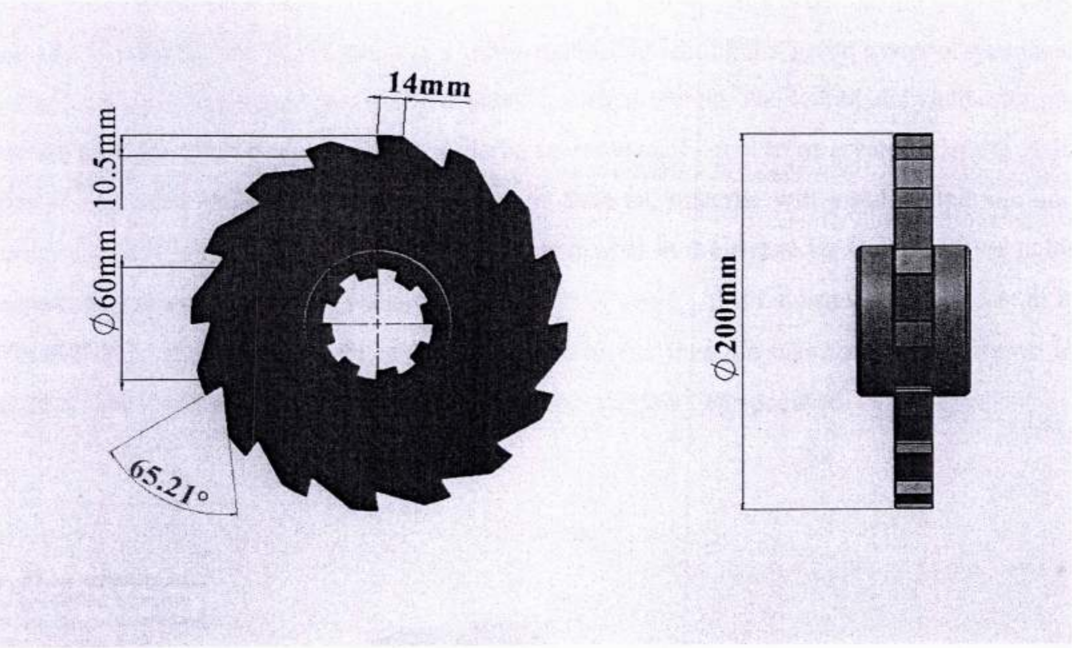
e = 1.5d = 46.5mm (pawl axis eccentricity)

$$\sigma = \frac{5628.99}{35\times35} + \frac{6\times5628.99\times46.5}{35\times35^2} = 41.21\text{N}/mm^2$$

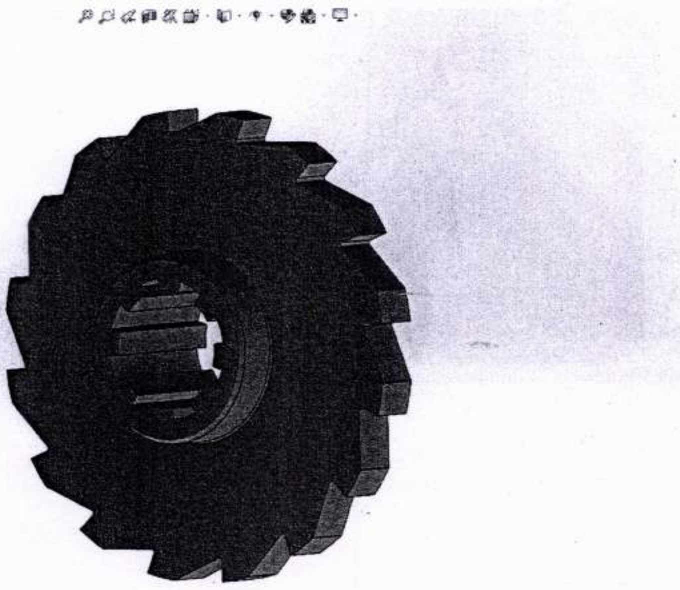
since $\sigma < [\sigma_b]$, our design is safe

(DESIGN BASED ON PSG DATA BOOK Page No.7.85)

5.2 DESIGNED RATCHET USING SOLIDWORKS



(a)



(b)

Fig:5.2: Designed Ratchet

5.3 LOAD ANALYSIS ON SOLIDWORKS

Designed Ratchet wheel undergoes a load test by applying 127 N force on each teeth. Color-coded plot on the right side shows the maximum and minimum stresses on the model using von Mises criteria. Von Mises stress is a value used to determine if a given material will yield or fracture. It is mostly used for ductile materials, such as metals. The von Mises yield criterion states that if the von Mises stress of a material under load is equal to or greater than the yield limit of the same material under simple tension then the material will yield. Maximum and minimum stress experienced under the load is indicated in the figure by Red and Blue color respectively. Maximum stress value is 3949420.75 N / m^2. Yield strength of the material is 4700000 N / m^2. Yield strength of the material is higher than the maximum stress shown in the plot. That indicates the part does not yield under the load we specified.

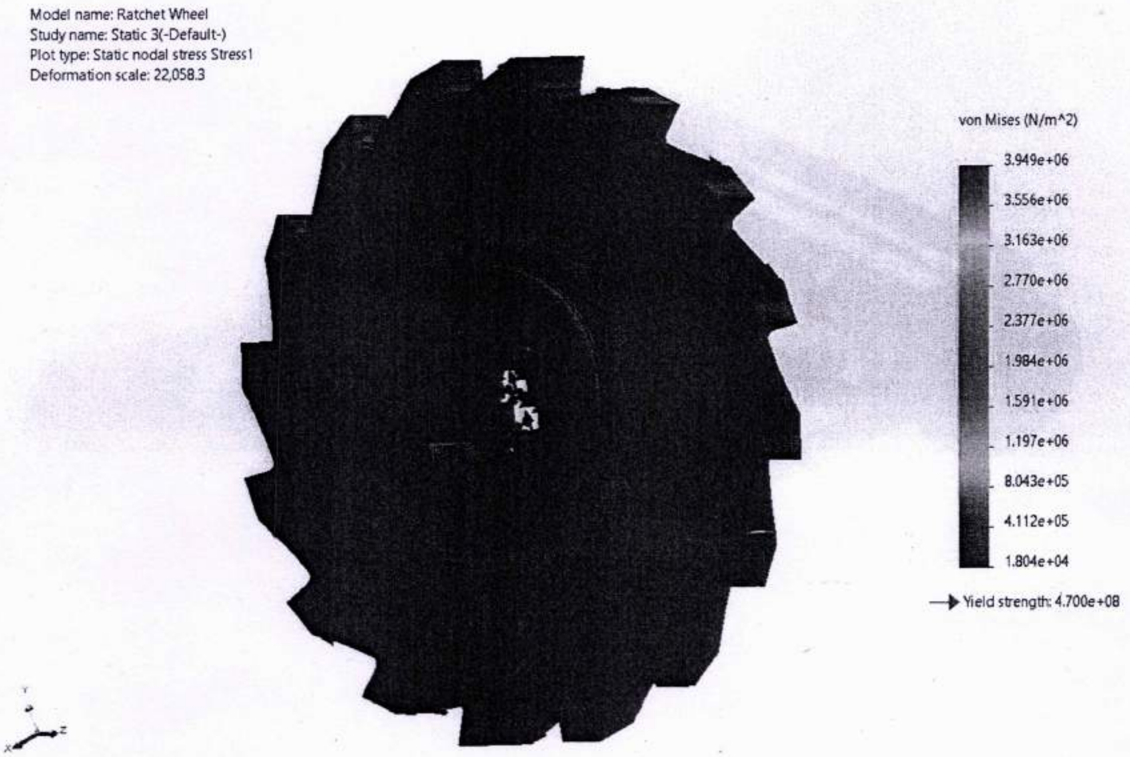


Fig:5.3: Load analysis on solidworks

CHAPTER 6

CONSTRUCTION AND WORKING

6.1 CONSTRUCTION

- Square metal pipes are welded to the required shape of the frame.
- The wheels are attached to the both ends of front and rear drive shaft
- Ratchet wheels are coupled with rear drive shaft, Corresponding pawls placed above the ratchet mounted on the frame.
- Two electromagnets are placed above the pawl.
- Electromagnets are connected with battery, it will hold pawl when it is magnetised.
- Limit switch is placed under the gear lever and connected with electromagnets.

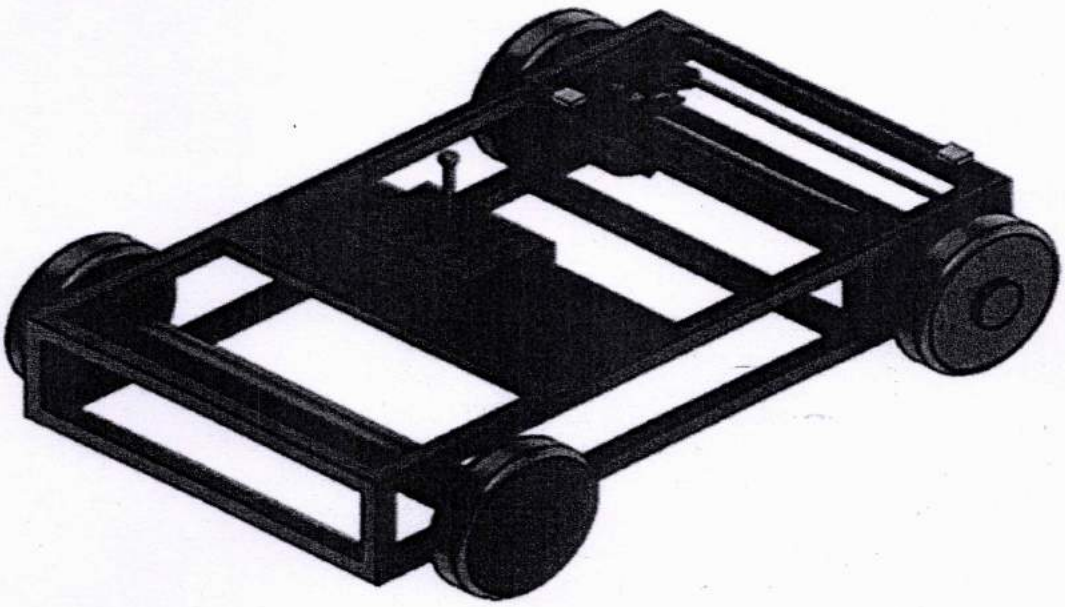


Fig:6.1: Designed model using Fusion 360

6.2 WORKING

When the vehicle is stationary in an inclined surface, it is impossible to operate 3 foot pedals by 2 foot to start the vehicle from rest to forward motion with ease. To solve this problem, we make use of a ratchet wheels which are attached to the rear drive shafts. The ratchet wheel is engaged with the help of pawl which is controlled by the electromagnets and limit switches.

To prevent undesired backward and forward motions, two ratchet wheels are connected in opposing directions. Engagement of pawls with ratchet wheel is controlled by electromagnet which is connected with battery and limit switch. Limit switches are placed under the gear lever, whenever the lever contacts with the limit switch electromagnets will loose the connection and pawl will engage with the ratchet wheel. In normal running condition the electric supply will be given to the electromagnet so that it will be magnetized and attract pawl. So shaft will be rotate freely without any restrictions. Whenever the vehicle stops on the slope, we change gear to 1^{st} then the gear lever comes in contact with limit switch, the connection between the battery and the electromagnet breaks, and the electromagnet loses its magnetism. So pawl will fall and engage with ratchet then the backward motion will be restricted. Unwanted frontward motion can be restricted by same mechanism, whenever the gear changes to reverse corresponding electromagnet will loose the connection and pawl will engage with ratchet to restrict the frontward motion.

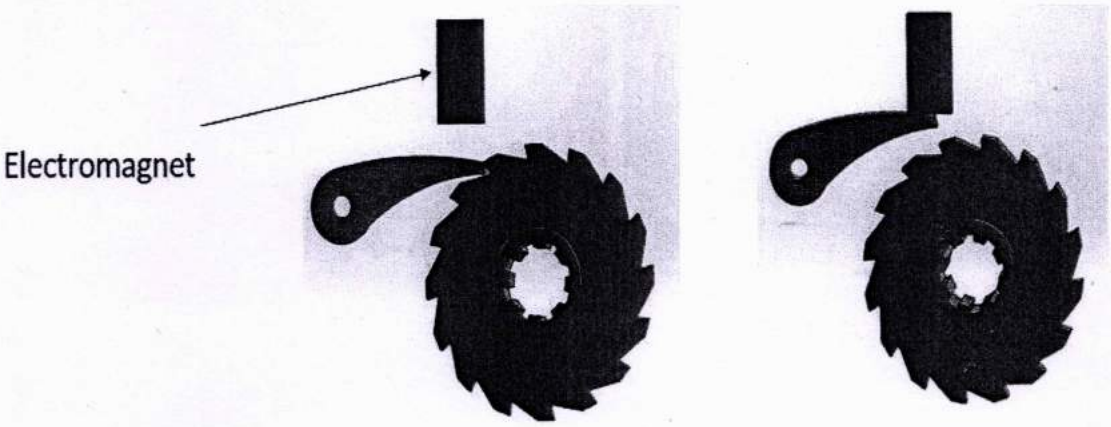


Fig:6.2: Working of Ratchet & Pawl Mechanism

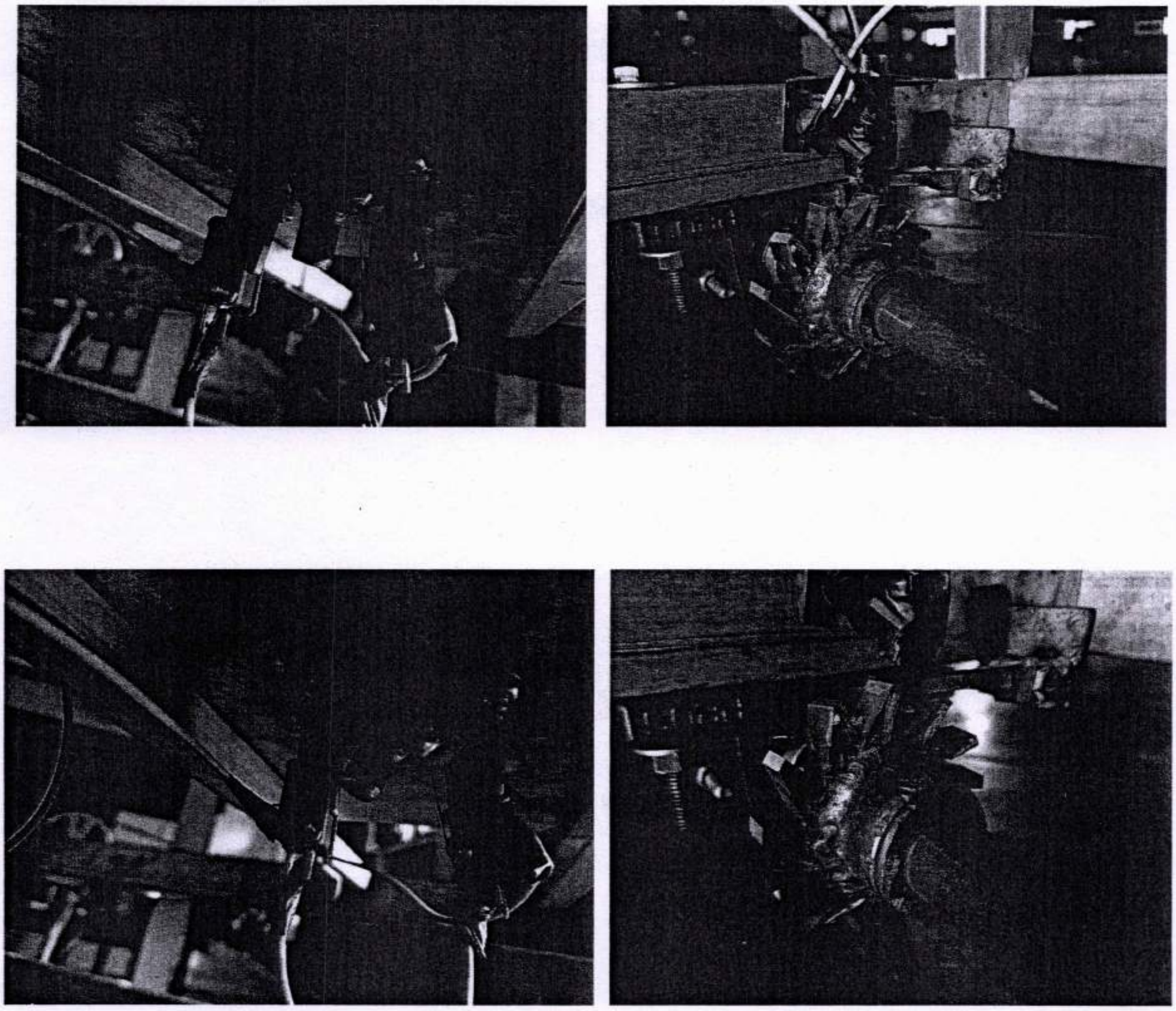


Fig:6.3: Workshop images

Fig:6.4:Final prototype view

CHAPTER 7
RESULT

Each portion of the system is functioning properly, and the whole system has been completed. Whenever the gear changes to first or reverse, electromagnet looses its magnetism and pawl will attract with ratchet wheel. Limit switches and electromagnets are working well.

7.1 ADVANTAGES AND DISADVANTAGES

7.1.1 Advantages

- Mechanism will increase the braking life of the vehicle.
- The cost of the project is not much more that's why we can use comfortably in four wheelers.
- The installment and mounting is easy and also it can be added to any existing vehicles.
- There is no any need of the major changes in the vehicle design so it is easy and to designer.
- Also vehicle will not moves backward or frontward in the off condition because both ratchet and pawl will be engaged and don't even want to engage the handbrake.

7.1.2 Disadvantages

- This mechanism of ratchet and a single pawl to restrict the one directional motion is difficult to implement on a heavy vehicle as it may causes safety problems.
- Correct engagement of pawl and ratchet teeth is difficult.

CHAPTER 8
CONCLUSION AND FUTURE SCOPE

8.1 CONCLUSION

- Thus the mechanism can stop the vehicle from rolling back in hill roads. This would be more helpful for the driver to drive their car comfortably in hilly roads and he can take off the car in the uphill without rolling back the car.
- Indian roads have a mixed pattern of traffic, with all modes of transportation coexisting in bumper-to-bumper traffic. A roll back of a vehicle could mean serious injuries, sometimes fatal, to fellow occupants on roads.
- The Hill hold system developed here is a solution that reduces this risk significantly

8.2 FUTURE SCOPE

To overcome the disadvantage we just designed a new mechanism which can be safely added to the heavy vehicles which will be more safe and effective. And it consist of a mechanical dog which have only linear motion and used to engage ratchet housing, pawls with equal number of ratchet teeth, electromagnets & limit switches.

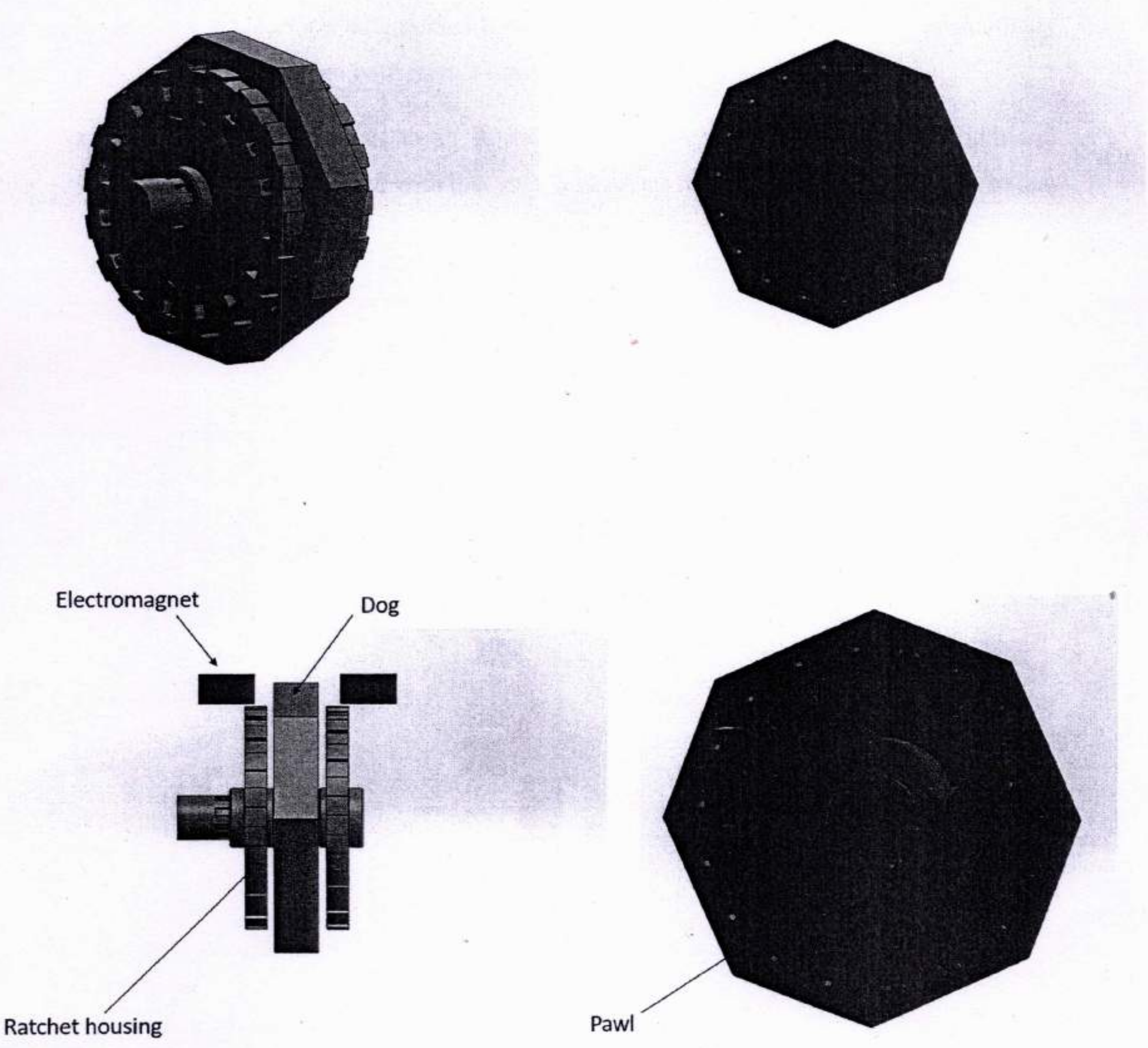


Fig:8.2: Design of Ratchet housing, pawl ,dog

8.2.1 Working

- This mechanism consist of two Ratchet and housing with pawls in it, a mechanical dog in between the ratchet housing which locks it.
- This mechanism can be attached to the propeller shaft itself
- Electromagnets will be placed on the frame near the dog on both sides, it will be connected with battery and limit switches which is placed under the gear lever.
- In normal condition both ratchet housing will be rotated and dog will be in stationary condition in between both ratchet housings as shown in Fig (1).
- When the gear changes to 1^{st} it will comes in contact with the limit switch and electromagnet connected with that switch becomes magnetized, dog will moves to that side and locks the ratchet housing as shown in Fig (2).
- When the gear shifts to reverse, it makes contact with the limit switch, and the electromagnet linked to that switch becomes magnetized , causing the dog to move to that side and lock the ratchet housing as shown in Fig (3).

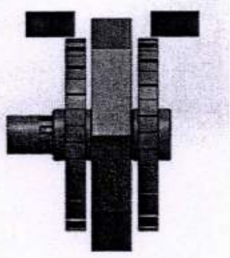


Fig (1)

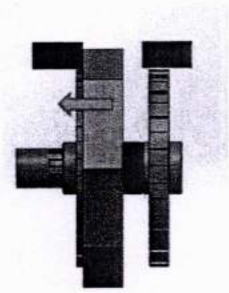


Fig (2)

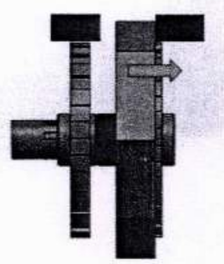


Fig (3)

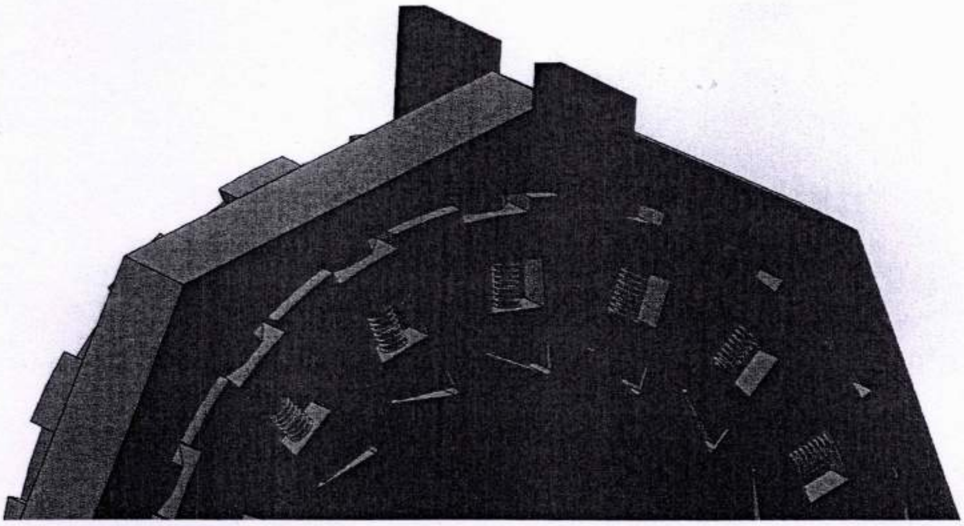


Fig:8.3: Dog locking ratchet housing

- When dog locks with ratchet housing, the rotation of housing will be restricted and then ratchet will start rotating with shaft to the permitted direction
- Then the roll back can be avoided

CHAPTER 8
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