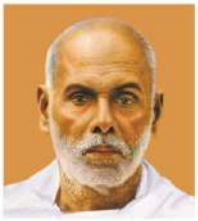
Sree Narayana Guru College of Engineering & Technology

CHALAKKODE P.O., KOROM, PAYYANUR, KANNUR-670 307

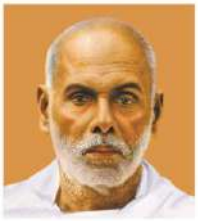


STUDENT'S SEMINARS

Est. 2003

Sree Narayana Guru College of Engineering & Technology

CHALAKKODE P.O., KOROM, PAYYANUR, KANNUR-670 307



DEPARTMENT OF CIVIL ENGINEERING

SREE NARAYA GURU COLLEGE OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING
SEVENTHTH SEMESTER (2022-23)

ROLL NUM	REGISTER NUMBER	NAME OF STUDENT	SEMINAR TOPICS	Guides name	CO Mapping	PO Mapping
1	SNC19CE001	AADITHYA KRISHNAN.C	GIS	Dr.Susan Abrham	1,2,3,4,5	1,4,6,7,8,9,10,11,12, PSO1, PSO2
2	SNC19CE002	ABHIRAMY RAJ	Environmental Impact On Rail Construction	Ms. B.Mary Sonia George	1,2,3,4,5	1,4,6,7,8,9,10,11,12, PSO1, PSO2
3	SNC19CE003	AKASH.P.V	Road Power Generation	Ms. Shilpa Valsakumar	1,2,3,4,5	1,4,6,7,8,9,10,11,12, PSO1, PSO2
4	SNC19CE004	ANANDHU ASHOK K P	Fukushima Power plant accident impact	Ms. Saritha Sasindran	1,2,3,4,5	1,4,6,7,8,9,10,11,12, PSO1, PSO2
5	SNC19CE005	ANANJANA.C	Innovative methods in low cost housing	Mr. Premanand	1,2,3,4,5	1,4,6,7,8,9,10,11,12, PSO1, PSO2
6	SNC19CE006	ANJALI MP	Automated Highway System	Mr.Shibin	1,2,3,4,5	1,4,6,7,8,9,10,11,12, PSO1, PSO2
7	SNC19CE007	ANJANA.C	Ancient Indian heritage temple architecture	Ms.Shamya Sukumaran	1,2,3,4,5	1,4,6,7,8,9,10,11,12, PSO1, PSO2
8	SNC19CE008	ASHAYA RAMESH	Innovative methods in Irrigation	Ms.Revathi P	1,2,3,4,5	1,4,6,7,8,9,10,11,12, PSO1, PSO2
9	SNC19CE009	ASWITHA GANGADHARAN	Under water windmill	Dr.Susan Abrham	1,2,3,4,5	1,4,6,7,8,9,10,11,12, PSO1, PSO2
10	SNC19CE010	ATHIRA ARUN K	Sponge City	Ms. B.Mary Sonia George	1,2,3,4,5	1,4,6,7,8,9,10,11,12, PSO1, PSO2

HOD

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

11	SNC19CE011	AYSHATH SAIFA	Flood Resistant building and Cities	Ms. Shilpa Valsakumar	1,2,3,4,5	1,4,6,7,8,9,10,11,12, PSO1, PSO2
12	SNC19CE012	KRISHNA PRASAD S L	Generation of energy from solid Waste	Ms. Saritha Sasindran	1,2,3,4,5	1,4,6,7,8,9,10,11,12, PSO1, PSO2
13	SNC19CE013	MUHAMMED HANNAN	Vertical City	Mr. Premanand	1,2,3,4,5	1,4,6,7,8,9,10,11,12, PSO1, PSO2
14	SNC19CE014	MUHAMMED RUFAID M	Current Situation and Analysis of parking problem	Mr.Shibin	1,2,3,4,5	1,4,6,7,8,9,10,11,12, PSO1, PSO2
15	SNC19CE015	NIKHIL SAI.K	U boot Technology in Construction	Ms.Shamya Sukumaran	1,2,3,4,5	1,4,6,7,8,9,10,11,12, PSO1, PSO2
16	SNC19CE016	PRANAV.A.K	Advanced earthquake resistance Technology	Ms.Revathi P	1,2,3,4,5	1,4,6,7,8,9,10,11,12, PSO1, PSO2
17	SNC19CE017	PRAYAG PRABHAKARAN	Eco efficient earth construction	Ms. B.Mary Sonia George	1,2,3,4,5	1,4,6,7,8,9,10,11,12, PSO1, PSO2
18	SNC19CE018	SACHIN SURENDRAN.M	Rubber Bridge	Mr. Premanand	1,2,3,4,5	1,4,6,7,8,9,10,11,12, PSO1, PSO2
19	SNC19CE019	SHAMSHAD.P.V	GFRG Panels	Ms.Revathi P	1,2,3,4,5	1,4,6,7,8,9,10,11,12, PSO1, PSO2
20	SNC19CE020	SILNA.M	Artificial Island	Mr. Premanand	1,2,3,4,5	1,4,6,7,8,9,10,11,12, PSO1, PSO2
21	LSNC19CE021	SREEHARI K K	Nano Concrte	Ms.Revathi P	1,2,3,4,5	1,4,6,7,8,9,10,11,12, PSO1, PSO2

HOD

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY, PAYYANNUR
KANNUR

ARTIFICIAL ISLAND

A SEMINAR REPORT

Submitted by

SILNA M
(SNC19CE020)

To

The APJ Abdul Kalam Technological University

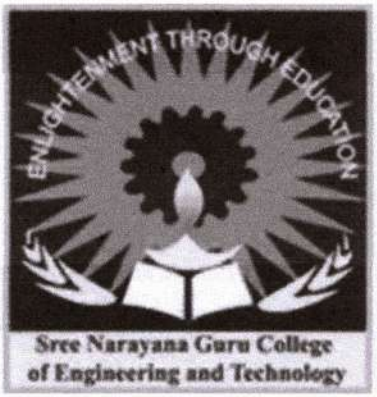
In partial fulfillment of the requirements for the award of the

Degree of

Bachelor of Technology

In

Civil Engineering



DEPARTMENT OF CIVIL ENGINEERING
SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY,

NOVEMBER 2022

HOD

Dr. LEENA A. V
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

DEPARTMENT OF CIVIL ENGINEERING

SREE NARAYANA GURU COLLEGE OF ENGINEERING AND TECHNOLOGY-PAYYANUR

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.

Seminar Guide

Ms. POOJA
Assistant Professor
Department of Civil Engineering
Sree Narayana Guru College of Engineering and Technology

Seminar Co-Ordinator

Mrs. MARY SONIA GEORGE
HOD, Assistant Professor
Department of Civil Engineering
Sree Narayana Guru College of Engineering and Technology

Head of Department

Mrs. MARY SONIA GEORGE
Assistant professor
Department of Civil Engineering

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

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.

Payyannur

07/01/20203 SILNA M

HOD

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

ACKNOWLEDGEMENT

It is with great enthusiasm and learning spirit that I bring out this Seminar report. I also feel that it is the right opportunity to acknowledge for the support and guidance from all those who helped me during the course of completion of my Seminar.

I am extremely grateful to the Principal **Dr. LEENA. A.V**, Sree Narayana Guru College of Engineering and technology-Payyanur, for providing the necessary facilities for the completion of the report.

I am pleased to show my heartiest gratitude to HOD and Guide **Mrs. MARY SONIA GEORGE** for her valuable suggestions and guidance. I also thank all my friends for their valuable support and co-operation.

I express my sincere thanks and gratitude to Assistant Professor **Mrs. MARY SONIA GEORGE** seminar coordinator for her gracious help in pointing me to the right direction.

I convey my sincere thanks to all the teaching, non-teaching staff and lab assistants for their support in completing the seminar.

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.

SILNA M

HOD

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

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.

HOD

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

TABLE OF CONTENTS

HOD

Dr. LEENA A. V
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

LIST OF FIGURES

HOD

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

ABBREVATION

SCS	South China Sea
APEC	Asia Pacific Economic Cooperation

HOD

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

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

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

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.

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.

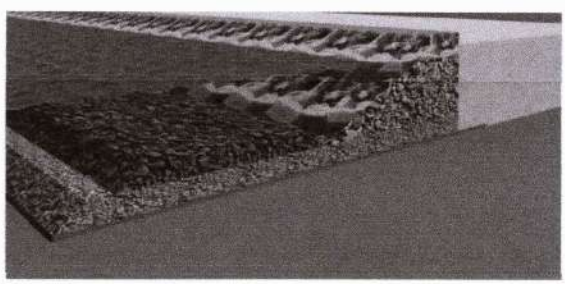


Fig 2.1: dredging

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.

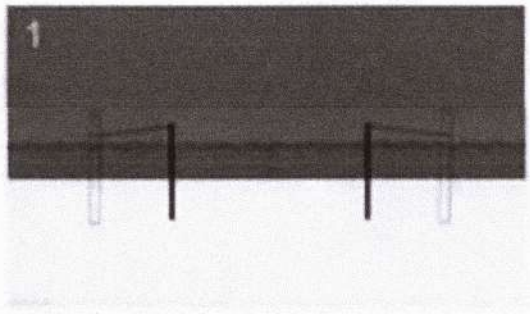
Once water become shallow it is transported to required places using a stationary dredger.

Fig 2.2: Preparation of soil bed

2.1.3 CONCRETING

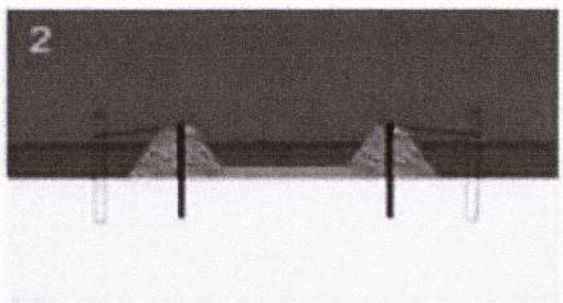
Temporary tube piles driven into the sea bed.

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



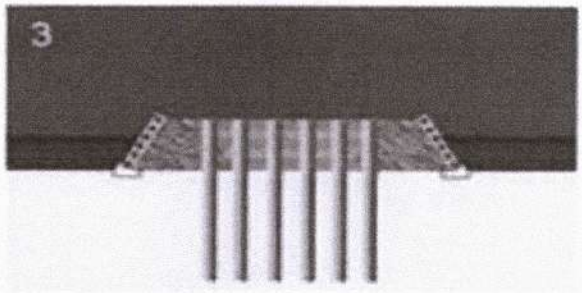
Permanent boundary rock is constructed like bunds and it deposited either side of sheet piles.

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

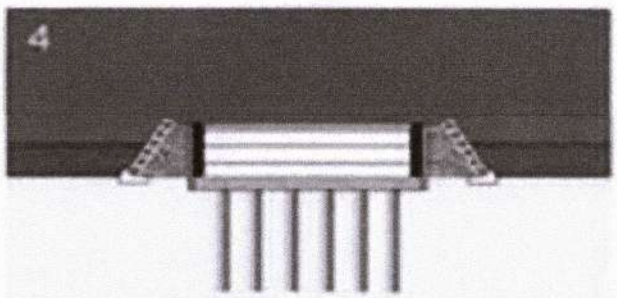


Permanent concrete units are placed around island to protect it from the waves.

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.

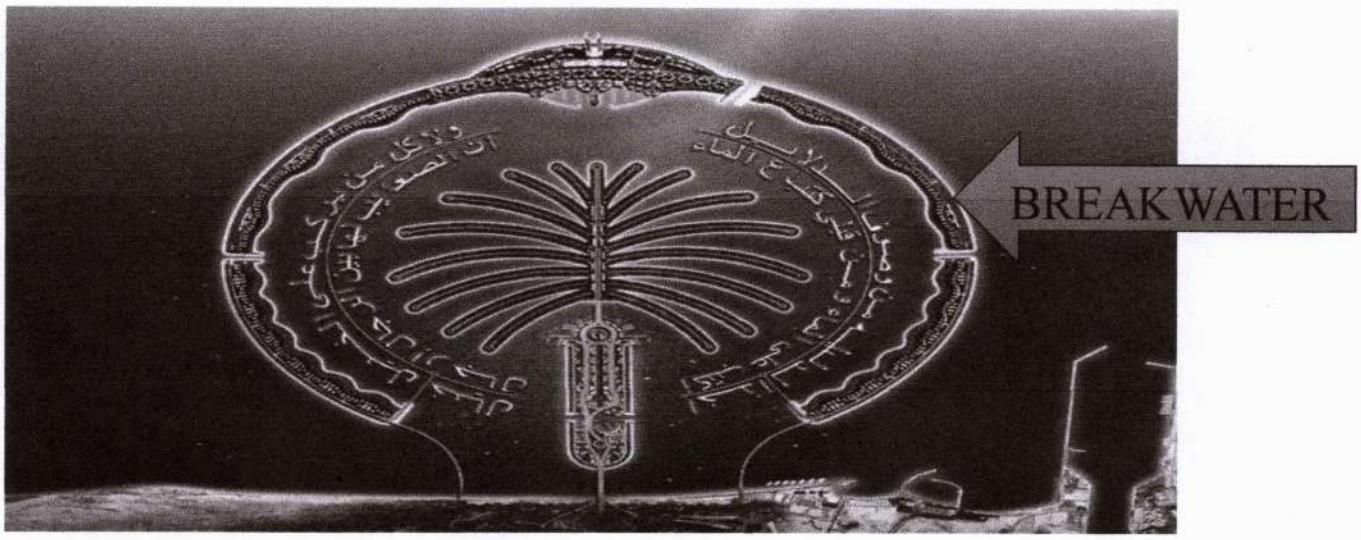


Fig 2.3: PALM JUMERIAH, DUBAI

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.

FAMOUS ARTIFICIAL ISLANDS

Fig 2.4 THE WORLD-DUBAI

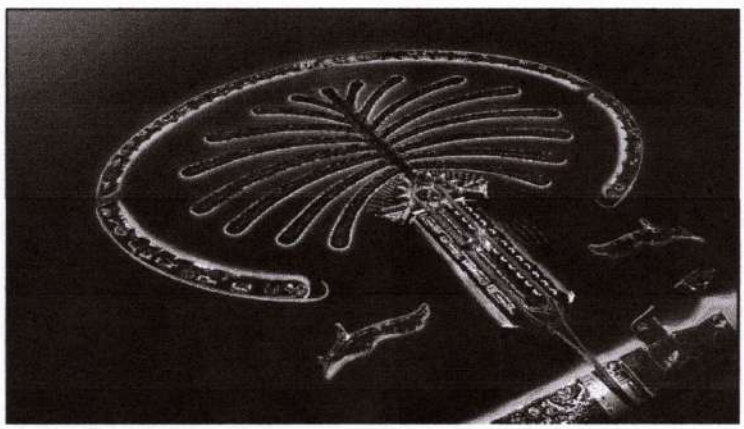


Fig 2.5 PALM ISLANDS-DUBAI

Fig 2.6 KANSAI AIRPORT, JAPAN

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.

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.

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.

REFERANCES

- Ben C. Gerwick-john wiley and sons,Construction of offshore structures
- Centre for civil engineering research and codes-A.A.Balkema/Rotterdam/Brookefield, Artificial sand fills in water
- Case study:Burj Al Arab, Dubai
- Terry Austin,Man made land features: The palm Jumeriah and Dubai's Artificial islands
- Thomas Telford limited,FIP recommendations for the design and construction of concrete sea structures
- De Huawere, Nathalie, ed. 2017. "Marine Gazetteer Placedetails." Marine Regions, January 18, 2017.
- Duong, Huy. 2015. "Massive Island-Building and International Law." Asia Maritime Transparency Initiative, June 15, 2015.
- Forest City Malaysia. 2019. "Forest City Malaysia Completes New Homes, Introduces Connected Smart City Experience." PR Newswire: news distribution, targeting and monitoring, July 11, 2019. https://www. prnewswire.com/news-releases/forest-city-malaysia-completes-new-homes-introduces connectedsmart-city-experience-300883306.html.
- Nicol, Will. 2017. "Everything You Need to Know about China's Artificial Islands." Digital Trends, May 3, 2017.
- "Middle East – Projects." Upper Zakum Oil Field Project, United Arab Emirates. Petrofac. Accessed July 2020.
- Panda, Ankit. 2020. "Are China's South China Sea Artificial Islands Militarily Significant and Useful?" The Diplomat, January 15, 2020.
- "South China Sea." Lowy Institute. Accessed July 2020.
- Stephenson, Phil. 2019. "The Launch of the Stephenson Ocean Security Project." Center for Strategic and International Studies, January 10, 2019.
- Valera, Stephanie. 2013. "12 Amazing Artificial Islands of the World (PHOTOS)," The Weather Channel, August 28, 2013.
- "Willingdon Island - a Man-Made Island in Kochi, Ernakulam." Kerala Tourism (Department of Tourism, Kerala). Accessed July 2020.
- Zhen, Liu. 2016. "What's China's 'Nine-Dash Line' and Why Has it Created so Much Tension in the South China Sea?" South China Morning Post, July 12, 2016.

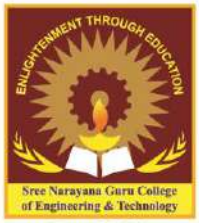
https://www.scmp.com/news/china/ diplomacy-defence/article/1988596/whats-chinas-nine-dash-line-and-why-has-it-created-so.

- https://www.marineregions.org/gazetteer.php?p=details
- https://amti.csis.org/massive-island-building-and-international-law/
- https://www.digitaltrends.com/cool-tech/chinas-artificial-islands-news-rumors/
- https://www.petrofac.com/en-gb/regions/middle-east/projects/upper-zakum-oil-field/
- https://thediplomat.com/2020/01/are-chinas-south-china-sea-artificialislands-militarily-significant-and-useful/
- https://www.lowyinstitute.org/issues/southchina-sea
- https://www.csis.org/analysis/launch-stephenson-oceansecurity-project
- https://weather.com/travel/news/amazing-artificial-islands-world-photos-20130827
- https://www.keralatourism.org/destination/willingdon-island-kochi/181

HOD

Department of civil engineering

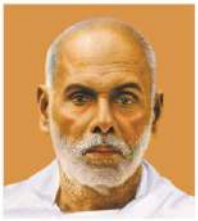
Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR



Est. 2003

Sree Narayana Guru College of Engineering & Technology

CHALAKKODE P.O., KOROM, PAYYANUR, KANNUR-670 307



DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CSQ413 SEMINAR

SEMINAR TOPIC DETAILS WITH GUIDE – 2019-23 BATCH

REGISTER NUMBER	NAME OF THE STUDENT	TOPIC	NAME OF THE GUIDE
SNC19CS001	Aathish	When Agile Security meets 5G	Mrs. Veena K K
SNC19CS002	Abhinav A P	Challenges and Opportunities for Efficient Serverless Computing at the Edge	Mrs. Thulasibai A
SNC19CS003	Ahmed Adil	Lio-A Personal Robot Assistant for Human-Robot Interaction and Care Applications	Ms.Haritha M V
SNC19CS004	Ajmal	Parallel SVM Model for Forest Fire Prediction	Ms. Vijina Vijayan
SNC19CS005	Althaf	Design and implementation of a feasible model for the iot based ubiquitous health care monitoring system	Mrs.veena k k
SNC19CS006	Amar Rajendran	An Industrial Cloud-Based Iot System For Real-Time Monitoring And Controlling Of Waste Water	Mrs. Varsha M
SNC19CS007	Amritha Rajeevan M	Diebetic Retinopathy Detection using VGG NIN a Deep Learning Architecture	Mr. Sunder V
SNC19CS008	Anagha K	"DISTFAX: A toolkit for measuring inter process communications quality of distributed systems.	Mr.Sunder V
SNC19CS009	Anagha M	Progress and Challenges in Intelligent Remote Sensing Satellite Systems	Ms. Vijina Vijayan
SNC19CS010	Archana Chithran K	Underwater Polarization Imaging Recovery Based on Polarimetric Residual Dense Network	Mrs.Varsha M
SNC19CS011	Avantika K	A Novel cloud architecture for internet of space things	Ms.Haritha M V
SNC19CS013	Fathimathu Sahala Beevi	Medical Diagnostic Systems Using Artificial Intelligence (AI) Algorithms: Principles and Perspectives	Ms. Vijina Vijayan
SNC19CS014	Hridyasree Valsan	Incremental Knowledge Extraction from IoT-Based System for Anomaly Detection in Vegetation Crops	Ms. Nimisha M K
SNC19CS015	Hryshika Pradeep	Efficient and Secure Blockchain for Digital Content Trading	Mrs. Thulasibai A
SNC19CS016	Jeeva Narayanan	The Internet of Space Things/CubeSats	Mrs. Veena K K

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

SNC19CS017	Kavya Devi M K	Internet of things technology in monitoring system of sustainable use of soil and land resources.	Mrs. Veena K K
SNC19CS018	Manila Mahesh	Renewable energy integration into cloud and IoT based smart agriculture.	Mrs. Thulasibai A
SNC19CS019	Megha P. K.	Automatic Detection of Mind Wandering from Video in the Lab and in the Classroom	Mr.Sunder V
SNC19CS020	Mishab CP	IoT-Equipped and AI-Enabled Next Generation Smart Agriculture: A Critical Review, Current Challenges and Future Trends	Ms.Vijina Vijayan
SNC19CS021	Muhammad Jishan PTK	Edge Artificial Intelligence for Industrial Internet of Things Applications	Mrs.Varsha M
SNC19CS022	Muhammed Rishal Ikbal	COVID-19 detection in X-ray images using convolutional neural networks	Mrs. Veena K K
SNC19CS023	Muhammed Zahid AP	Internet of Water Things: A Remote Raw Water Monitoring and Control System	Ms. Vijina Vijayan
SNC19CS024	Nipun S Anand	A Real-Time Density-Based Traffic Signal Control System	Ms. Nimisha M K
SNC19CS025	Pallavi Swaroop Kumar	Intercept Cloud Network from Brute Force and DDoS Attacks via Intrusion Detection and Prevention System	Mrs. Thulasibai A
SNC19CS026	Parvathi k	Phishing URL Detection: A Real-Case Scenario Through Login URLs	Mrs. Veena K K
SNC19CS027	Ramritha Rajeevan	Advanced GENOME disorder prediction model empowered with DEEP LEARNING	Ms. Nimisha M K
SNC19CS028	Safa Fathima	An efficient light weight integrated blockchain(ELIB) model for IoT security and privacy	Mr.Sunder V
SNC19CS029	Safa Sayeed V	An application to detect cyber bullying using machine learning and deep learning techniques	Ms. Vijina Vijayan
SNC19CS030	Sidharth K	6G Massive Radio Access Networks: Key Applications, Requirements and Challenges	Mrs.Varsha M
SNC19CS031	Smijith M	Reliable, Secure, and Efficient Hardware Implementation of Password Manager System Using SRAM PUF	Ms.Haritha M V
SNC19CS032	Sravan R	Identification of retina issues using svm and clustering algorithms	Ms. Veena K K
SNC19CS033	Sreehari v	Less Is More: Lighter and Faster Deep Neural Architecture for Tomato Leaf Disease Classification	Mr. Sunder V
SNC19CS034	Sreenandana T V	Decision model for Human Resource Allocation in Project Management of Software development	Mrs. Thulasibai A
SNC19CS035	Sreenisha KP	Artificial Intelligence for Enhanced Mobility and 5G Connectivity in UAV-based Critical missions	Mrs. Veena K K
SNC19CS036	Thanmaya Sanjeev	Real time detection of apple leaf diseases using deep learning approach based on	Ms. Haritha

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

		convolution neural networks	
SNC19CS037	Thanya Mohan	Cipher Block Chaining Support Vector Machine For Secured Decentralized Cloud Enabled Intelligent IoT Architecture	Mrs. Varsha M
SNC19CS038	Theja Rajesh	Credit card fraud detection using state-of-the-art machine learning and deep learning algorithms	Mr. Sunder V
SNC19CS039	UV vaishnav	Novel and secure blockchain framework for health application in IoT	Mr. Sunder V
SNC19CS040	Varun	SOC critical path: A defensive kill chain model	Mrs. Varsha M
SNC19CS041	Vishnu Prabhakaran	Measuring and Improving Agile Processes in a Small-Size Software Development Company	Ms. Haritha M V
SNC19CS042	Vishnu R	Identification for Recycling Polyethylene Terephthalate (PET) Plastic Bottles by Polarization Vision	Ms. Vijina Vijayan
SNC19CS043	V K Aysha	A novel algorithm for detecting the drowsiness onset in real-time	Ms. Nimisha M K
LSNC19CS044	Abhijith Ram Raj PK	An intelligent recommender and decision support system (IRDSS) for effective management of software project	Ms. Nimisha M K
LSNC19CS045	Adarsh K	Defining Security Requirements With the Common Criteria: Applications, Adoptions, and Challenges	Mrs. Thulasibai A
LSNC19CS046	Jijo Jaison	NileOS: A Distributed Asymmetric Core Based Micro-Kernel for Big Data Processing	Mrs. Veena K K

7/10/22

Dated Signature of the Seminar coordinator

Dated Signature of the HoD

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

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

FATHIMATHU SAHALA BEEVI (SNC19CS013)

Under the Guidance of

Prof.VIJINA VIJAYAN

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY, PAYANNUR

AFFILIATED TO A P J ABDUL KALAM TECHNOLOGICAL UNIVERSITY, KERALA

2022-2023

HOD/CSE

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY, PAYYANUR

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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.

NAME OF THE GUIDE: Prof. VIJINA VIJAYAN

DATED SIGNATURE 19/12/22

NAME OF THE COORDINATOR: Prof. VEENA K K

DATED SIGNATURE 19/12/22

4/1/2023

HEAD OF THE DEPARTMENT

DATED SIGNATURE

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

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.

NAME OF THE STUDENT : **FATHIMATHU SAHALA BEEVI**

REGISTER NUMBER : **SNC19CS013**

DATED SIGNATURE : 19/12/22

Place: **PAYYANUR**

Date: 19/12/22

HOD/CSE

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

ACKNOWLEDGEMENT

I would like to thank God for giving strength, courage and blessings to complete this work. I would like to extend my gratitude to everyone who helped me in the completion of this seminar.I express my sincere gratitude to our Management **SREE BHAKTHI SAMVARDHINI YOGAM, TALAP, KANNUR** for having me provided with all the facilities required for the success of this presentation.

I would like to express my sincere gratitude to our Principal **DR. LEENA A V** for providing the necessary tools. I am greatly obliged to **Prof. SUNDER V**, Head of the Department of CSE for giving me this opportunity and encouragement throughout the presentation.

I would like to thanks to seminar coordinator, **Prof. SUNDER V** , Head of the Department of CSE and **Mrs.VEENA K K** ,Assistant Professor, Department of CSE, Sree Narayana Guru College of Engineering and Technology, Payyanur for providing the guidelines for the seminar.

I would like to thank my guide, **Ms. VIJINA VIJAYAN** , Assistant Professor, Department of CSE, Sree Narayana Guru College of Engineering & Technology, Payyanur for her great support and guidance. I, on this occasion, remember the valuable suggestions and constructive criticism from my teachers which were inevitable for the successful completion of my seminar. I express my thanks to all staff members and friends for all the help and co-ordination extended in bringing out this seminar successfully in time. Last but not the least; I am very much thankful to my parents who guided me in every step which I took.

Thanking you,

FATHIMATHU SAHALA BEEVI

HOD/CSE

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

INDEX

HOD/CSE

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

HOD/CSE

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

LIST OF FIGURES

HOD/ISE

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

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

HOD/ISE

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

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.

HOD/CSE

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

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

[redacted] deploying medical diagnostic systems using AI algorithms, including the need for large [redacted], computational power, and expertise in machine learning and data science. Additionally, [redacted] discuss the potential impact of medical diagnostic systems using AI algorithms on the [redacted]care system, including their potential to improve patient outcomes, reduce medical errors, [redacted] increase efficiency.

[redacted]ly, we provide recommendations for future research and development in the field of medical [redacted]gnostic systems using AI algorithms, including addressing ethical concerns, improving data [redacted]ity and quantity, and exploring new techniques and technologies. Overall, this paper aims to [redacted]de insights into the principles and perspectives of medical diagnostic systems using AI [redacted]gorithms, 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

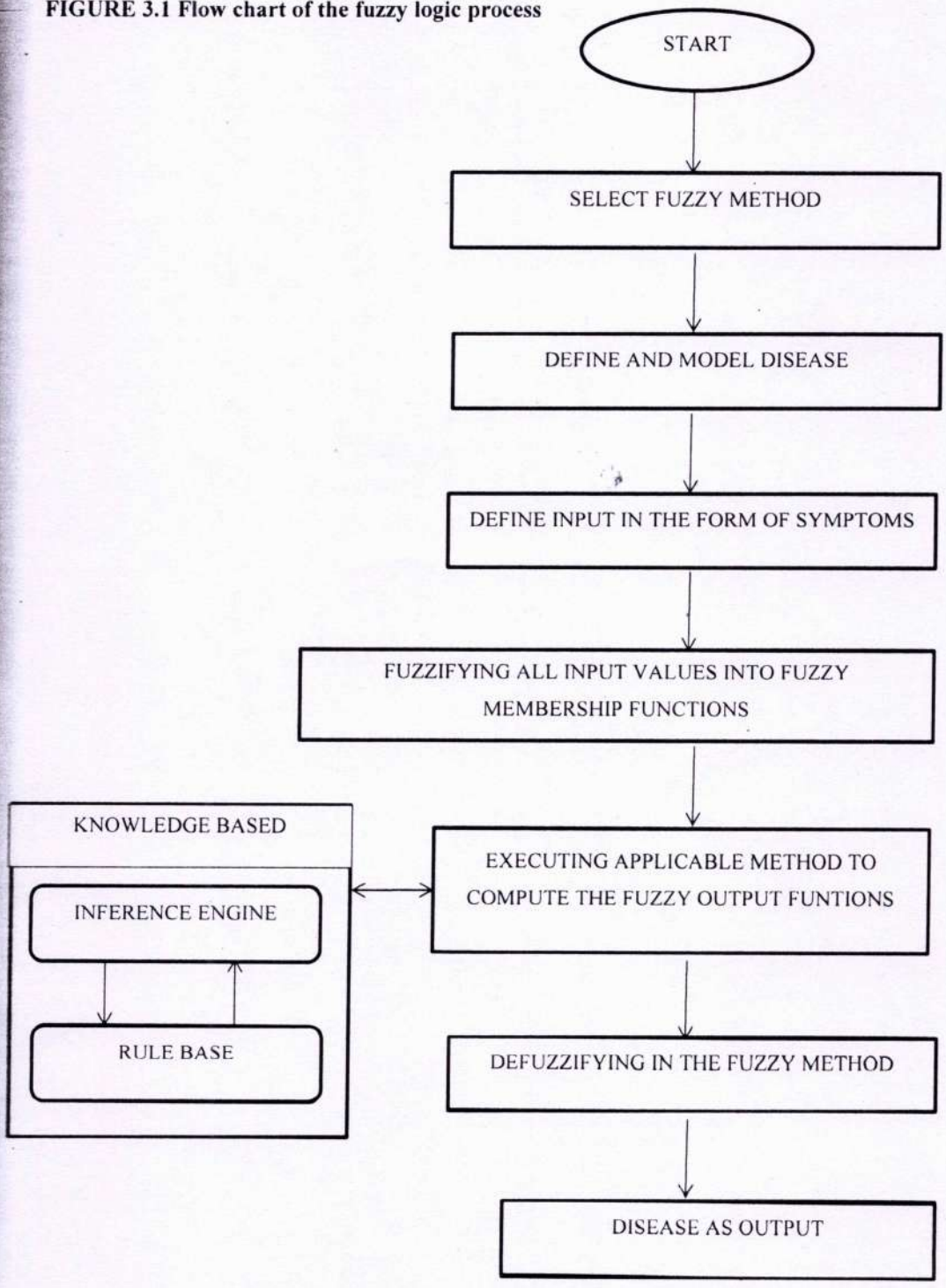
Fuzzy logic has the ability to portray information and outcomes in the form of semantic articulation. It tends to be valuable since most diagnosis processes have been performed based on

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 could 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.

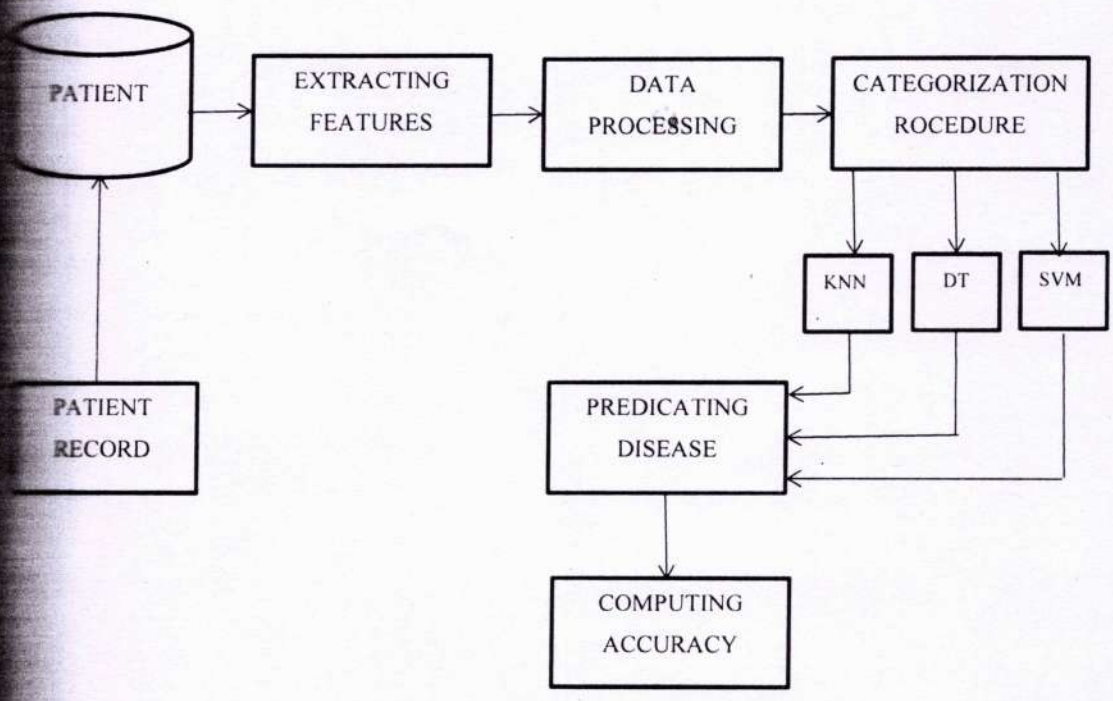


FIGURE 3.2 Machine Learning System

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

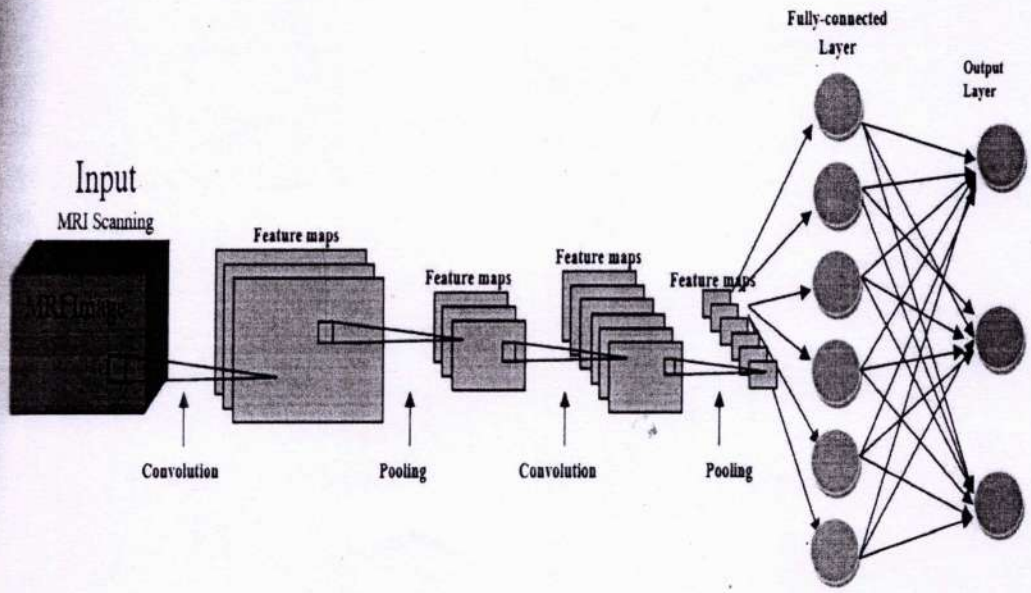


FIGURE 3.3 DEEP PROCESS TO DIAGNOSIS A DISEASE

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.

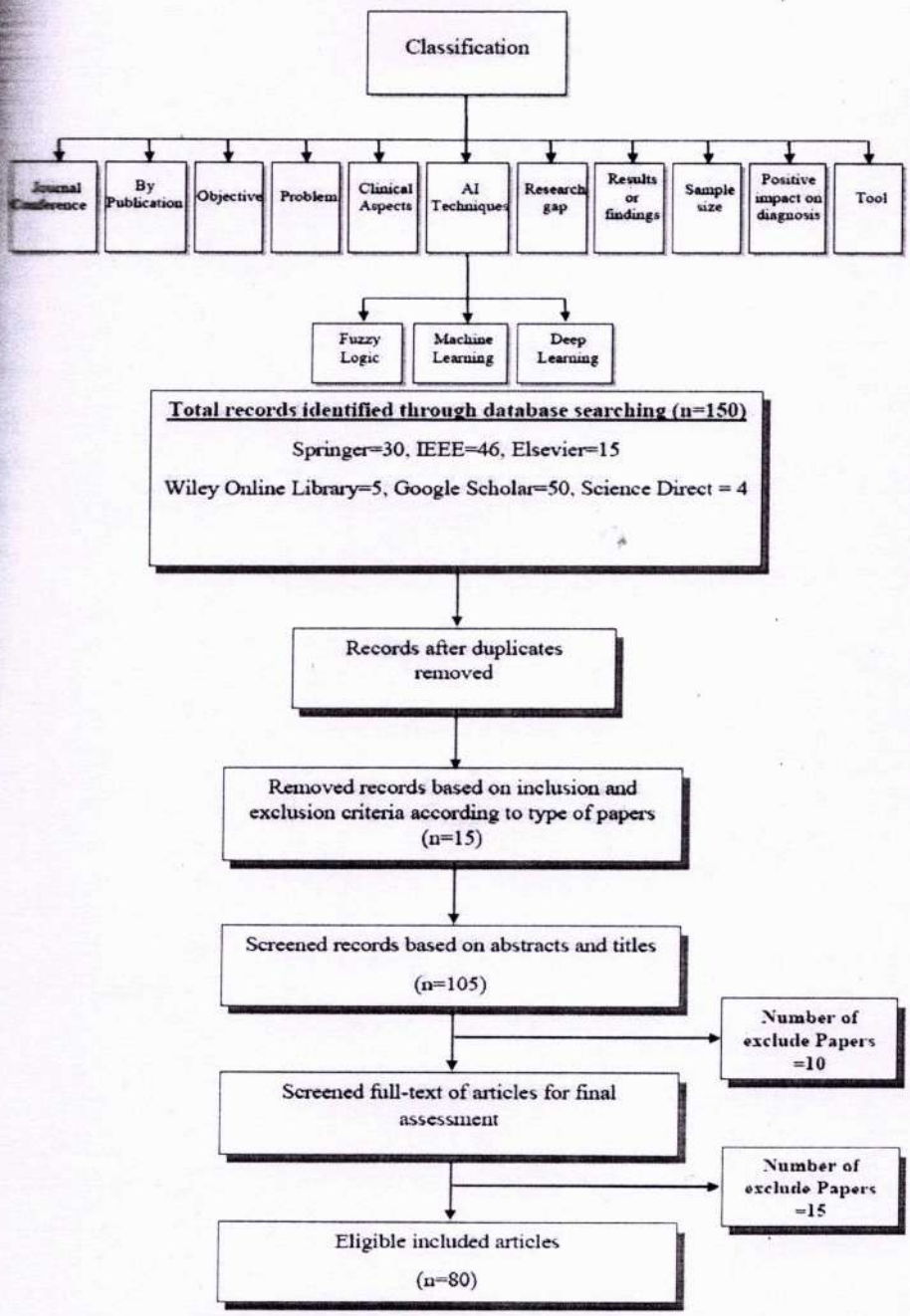


FIGURE 4: PRISMA METHOD FOR REVIEW

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.

BIBLIOGRAPHY

[1] J. L. Scully, ''What is a disease?'' EMBO Rep., vol. 5, no. 7, pp. 650–653, 2004.

[2] R. Leaman, R. Islamaj Dogan, and Z. Lu, ''DNorm: Disease name normalization with pairwise learning to rank,'' Bioinformatics, vol. 29, no. 22, pp. 2909–2917, Nov. 2013.

[3] N. Armstrong and P. Hilton, ''Doing diagnosis: Whether and how clinicians use a diagnostic tool of uncertain clinical utility,'' Social Sci. Med., vol. 120, pp. 208–214, Nov. 2014.

[4] J. Rubin, R. Abreu, A. Ganguli, S. Nelaturi, I. Matei, and K. Sricharan, ''Recognizing abnormal heart sounds using deep learning,'' 2017, arXiv:1707.04642. [Online]. Available: http://arxiv.org/ abs/1707.04642

[5] K. H. Miao and J. H. Miao, ''Coronary heart disease diagnosis using deep neural networks,'' Int. J. Adv. Comput. Sci. Appl., vol. 9, no. 10, pp. 1–8, 2018.

[6] W. Sun, B. Zheng, and W. Qian, ''Computer aided lung cancer diagnosis with deep learning algorithms,'' Proc. SPIE, vol. 9785, Mar. 2016, Art. no. 97850Z.

[7] F.-C. Chen and M. R. Jahanshahi, ''NB-CNN: Deep learning-based crack detection using convolutional neural network and Naïve Bayes data fusion,'' IEEE Trans. Ind. Electron., vol. 65, no. 5, pp. 4392–4400, May 2018.

[8] J. P. Kandhasamy and S. Balamurali, ''Performance analysis of classifier models to predict diabetes mellitus,'' Procedia Comput. Sci., vol. 47, pp. 45–51, 2015.

[9] T. V. Sriram, M. V. Rao, G. S. Narayana, D. Kaladhar, and T. P. R. Vital, ''Intelligent Parkinson disease prediction using machine learning algorithms,'' Int. J. Eng. Innov. Technol. (IJEIT), vol. 3, no. 3, pp. 1568–1572, 2013.

[10] C. Salvatore, A. Cerasa, I. Castiglioni, F. Gallivanone, A. Augimeri, M. Lopez, G. Arabia, M. Morelli, M. Gilardi, and A. Quattrone, ''Machine learning on brain MRI data for differential diagnosis of Parkinson's disease and progressive supranuclear palsy,'' J. Neurosci. Methods, vol. 222, pp. 230–237, Jan. 2014.

[11] A. López Pineda, Y. Ye, S. Visweswaran, G. F. Cooper, M. M. Wagner, and F. Tsui, ''Comparison of machine learning classifiers for influenza detection from emergency department free-text reports,'' J. Biomed. Informat., vol. 58, pp. 60–69, Dec. 2015.

[12] S. A. Dwivedi, R. Borse, and A. M. Yametkar, ''Lung cancer detection and classification by using machine learning & multinomial Bayesian,'' IOSR J. Electron. Commun. Eng. (IOSR-JECE), vol. 9, no. 1, pp. 69–75, 2014.

[13] S. Marsland, Mach. Learning: Algorithmic Perspective. Boca Raton, FL, USA: CRC Press, 2015.

[14] I. Kononenko, I. Bratko, and M. Kukar, ''Application of machine learning to medical diagnosis,'' Mach. Learn. Data Mining: Methods Appl., vol. 389, p. 408, Jun. 1997.

[15] K. Suzuki, ''Overview of deep learning in medical imaging,'' Radiol. Phys. Technol., vol. 10, no. 3, pp. 257–273, 2017.

[16] Y. LeCun, Y. Bengio, and G. Hinton, ''Deep learning,'' Nature, vol. 521, pp. 436–444, May 2015.

[17] T. R. Insel and B. N. Cuthbert, ''Brain disorders? Precisely,'' Science,vol. 348, no. 6234, pp. 499–500, May 2015.

[18] N. N. Gopal and M. Karnan, ''Diagnose brain tumor through MRI using image processing clustering algorithms such as fuzzy c means along withintelligent optimization techniques,'' in Proc. IEEE Int. Conf. Comput.Intell. Comput. Res., Dec. 2010, pp. 1–4.

[19] H.-L. Chen, C.-C. Huang, X.-G. Yu, X. Xu, X. Sun, G. Wang, andS.-J. Wang, ''An efficient diagnosis system for detection of Parkinson'sdisease using fuzzy k-nearest neighbor approach,'' Expert Syst. Appl.,vol. 40, no. 1, pp. 263–271, 2013.

[20] S. Patra and G. Thakur, ''A proposed neuro-fuzzy model for adultasthma disease diagnosis,'' Comput. Sci. Inf. Technol., vol. 3, pp. 191–205,Mar. 2013.

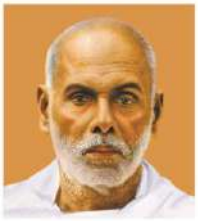
HOD/CSE

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

Est. 2003

Sree Narayana Guru College of Engineering & Technology

CHALAKKODE P.O., KOROM, PAYYANUR, KANNUR-670 307



DEPARTMENT OF ELECTRONICS AND COMMUNICATIONS ENGINEERING

SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
B.Tech Seminar

Group No:	Register Number	Names of Students	Seminar Topics	Guides Names
1	SNC19EC001	ARJUN ASHOK K	MC.NFV Molecular Communication NFV in 6G Network	Ms. THRISHNA S
2	SNC19EC002	JITHIN SASIDHARAN N V	Deep Learning-Based Compression for Phase-Only Hologram	Ms. LEENA NARAYANAN
3	SNC19EC003	KEERTHANA C V	Automatic Detection of Mind Wandering from video in the lab and in the classroom	Ms. MEERA M
4	SNC19EC004	MARIYAMBI	IOT based indoor object location tracking solution	Ms. VANI R
5	SNC19EC005	SANISHMA SACHITHANAND	Information Purification Network for Remote Sensing Image Super Resolution	Ms. ABHAYA D K

Signature of faculty

13/10/22

HOD 13/10/22

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY

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

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.

Seminar coordinator

11/01/23

Ms. THRISHNA S
Asst. Professor
ECE Dept.

11/1/23

Prof. LEENA NARAYANAN
Head of Department
Electronics &Communication

DR. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY
KANNUR

ACKNOWLEDGMENT

I would like to express my wholehearted gratitude to all who helped this endeavour. I also take this opportunity to thank our management, **SREE BHAKTHI SAMVARDHINI YOGAM, KANNUR**. I also thank our principal **Dr LEENA AV** for having provided me with all facilities required for successful completion of my seminar. My sincere thanks to Professor **LEENA NARAYANAN**, Head of department of ECE, Sree Narayana Guru College of Engineering and Technology, Payyanur for his encouragement and well wishes to carry out this seminar.

I express my heartfelt gratitude to our seminar guide and seminar co-coordinator **Ms. THRISHNA S, Ms. MEERA M and Ms. ABHAYA D K** Assistant Professor of ECE, Sree Narayana Guru College of Engineering and Technology, Payyanur for their valuable suggestion and guidance.

I pay my regards to all our teachers and non-teaching staffs in our college for the knowledge they have imparted for us. I am also grateful to our family members and friends for their cooperation and support. 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 endeavour success.

HOD ECE

PRINCIPAL
SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY PAYYANUR
KANNUR

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.

HOD ECE

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

TABLE OF CONTENTS

HOD ECE

Dr. LEENA A. M.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

LIST OF FIGURES

HOD ECE

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

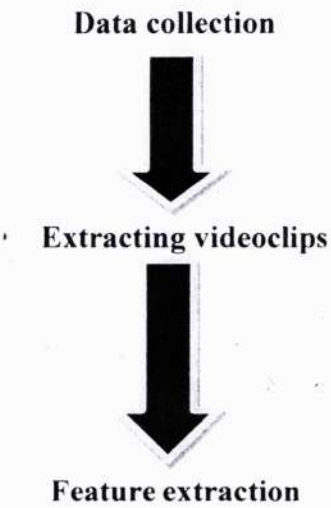


Fig 2.1 Flow chart

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.

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

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).

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

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.

REFERENCE

1 S. K. D'Mello, "Giving eyesight to the blind: Towards attention aware AIED," *International Journal of Artificial Intelligence in Education*, vol. 26, no. 2, pp. 645–659, Jun. 2016.

2 D.N. Rapp, "The value of attention aware systems in educational settings," *Computers in Human Behavior, vol. 22, no. 4, pp.* 603–614, Jul. 2006.

3 K. K. S zpunar, N. Y. Khan, and D. L. Schacter, "Interpolated memory tests reduce mind wandering and improve learning of online lectures," *PNAS, vol. 110, no. 16, pp. 6313–6317, Apr. 2013.*

4 S. K. D'Mello, C. Mills, R. Bixler, and N. Bosch, "Zone out no more: Mitigating mind wandering during computerized reading ,"in *Proceedings of the 10th International Conference on Education DataMining (EDM2017), 2017, pp. 8–15.*

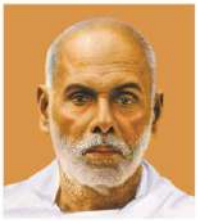
HOD ECE

Dr. LEENA A V
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY
PAYYANUR, KANNUR

Est. 2003

Sree Narayana Guru College of Engineering & Technology

CHALAKKODE P.O., KOROM, PAYYANUR, KANNUR-670 307



DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SREE NARAYA GURU COLLEGE OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SEVENTHTH SEMESTER (2022-23)

Presentation Schedule

ROLL NUMBER	REGISTER NUMBER	NAME OF STUDENT	SEMINAR TOPICS	Guides name	Date	Time
1	SNC19EE001	ANUSHA JYOTHI	SIMULATION AND ON SITE INSPECTION TECHNOLOGY OF 500KV HVDC CIRCUIT BREAKER	Mr. Abhilash Krishnan T K	30-11-2022	9:00-9:30a.m
2	SNC19EE002	DEVIKEERTHANA T P	BIG DATA MANAGEMENT IN SMART GRID	Mr.Manu C	30-11-2022	9:30-10:00a.m
3	SNC19EE003	VAISHNAV T V	FUZZY LOGIC CONTROL FOR SOLAR PV FED MODULAR MULTI LEVEL INVERTER.	Mr. Vaishakh M Nayanar	30-11-2022	10:00-10:30a.m
4	SNC19EE004	VISHAL K	AIRBORNE WIND ENERGY SYSTEMS	Mrs. Prabha Chandran	30-11-2022	10:30-11:00a.m

SEMINAR COORDINATOR

Vaishakh. M. Nayanar

HOD 9/11/22

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

HOD(EEE)

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

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

Mr. VAISHAKH M.NAYANAR
(Seminar Co-ordinator and Guide)
Assistant Professor
Dept. of Electrical and Electronics Engg.
SNGCET Payyanur

15/12/22

Prof. ABHILASH KRISHNAN T.K.
(Head of the Department)
Dept. of Electrical and Electronics Engg.
SNGCET Payyanur

Date : 15/12/2022
Place : Payyanur

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

ACKNOWLEDGEMENT

At the outset, I thank the lord almighty for the grace, strength and hope to make my endeavor a success. I express my deep felt gratitude to DR. LEENA A.V, SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY, PAYYANNUR for providing the necessary facilities.

I extend my sincere gratitude towards Prof. ABHILASH KRISHNAN T.K., Head of Department , Electrical and Electronics Engineering for giving us his valuable knowledge and wonderful technical guidance.

I am profoundly grateful to, Mr. VAISHAKH M.NAYANAR and for their valuable guidance, support, suggestions and encouragement.

Furthermore, I would,like to thank all others especially my parents and numerous friends. This seminar report would not have been a success without the inspiration, valuable suggestions and moral support from them throughout the course.

Vaishnav T V

15th December 2022

HODEEE

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANNUR
KANNUR

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.

HODEEE

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

TABLE OF CONTENTS

HODEEE

DR. LEENA A. V.
PRINCIPAL
NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY,
KANNUR

TABLE OF FIGURES

HOD EEE

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAY
KANNUR

LIST OF TABLES

HODEEE

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.

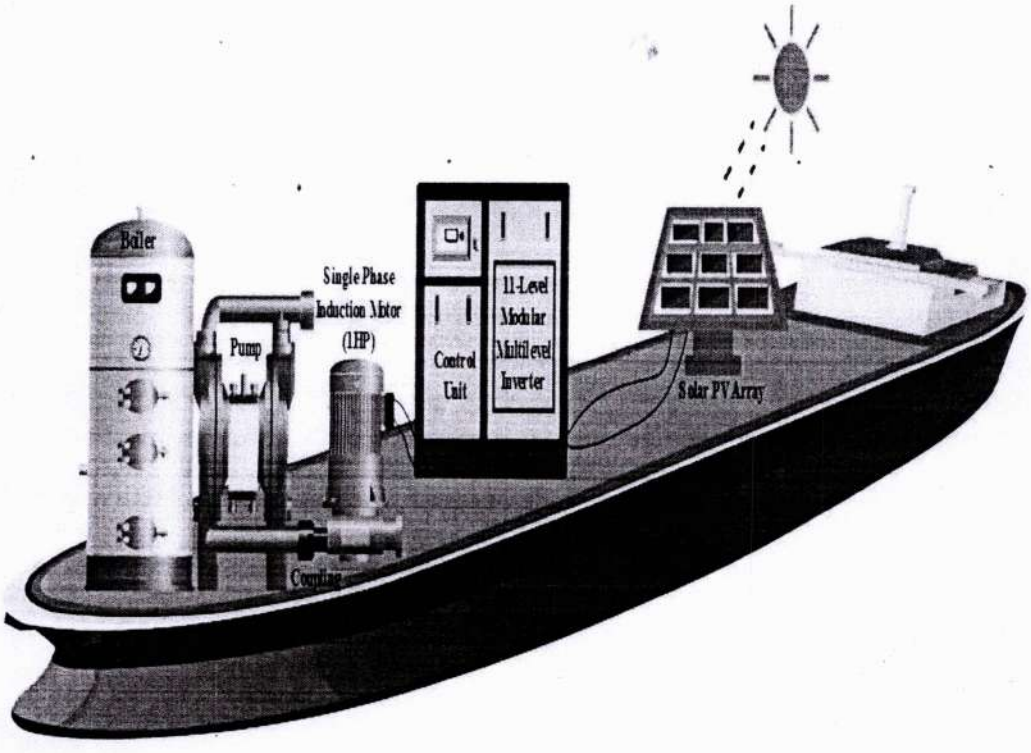


FIGURE 1. Schematic diagram of the Proposed 11-Level Inverter

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/M^2, 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 ($P_{max} = V_{mp} \times I_{mp} = 17 \times 0.588 = 9.96W$).

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.

$$V_{out} = \frac{V_{in}}{1 - D} \qquad (8)$$

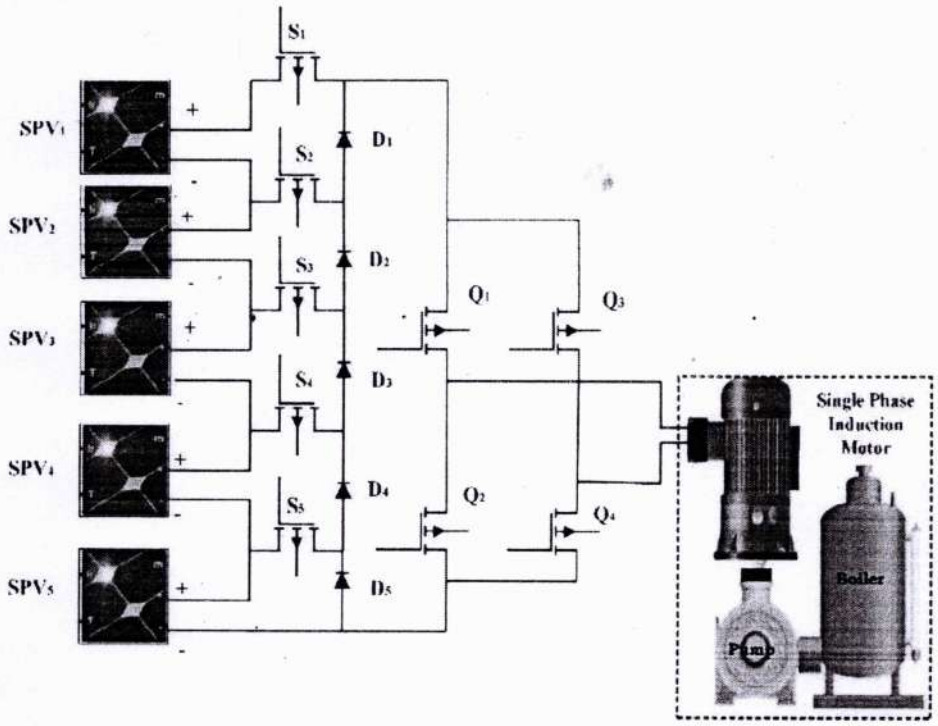


FIGURE 2. Proposed Multilevel Inverter.

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.

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

$$\Delta I_L = (20\% - 40\%) * I_{out(max)} * \frac{V_{out}}{V_{in}} \quad (10)$$

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

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

3.1.3 DESIGN OF CAPACITOR

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

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

$$\Delta V_L = (20\% - 40\%) * V_{out(max)} * \frac{I_{out}}{I_{in}} \quad (12)$$

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

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

$V_{out(max)}$ 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].

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

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

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).

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

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

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 implementation of PI and FL based controllers in improving the performance of an IM drive operating along with MMI.

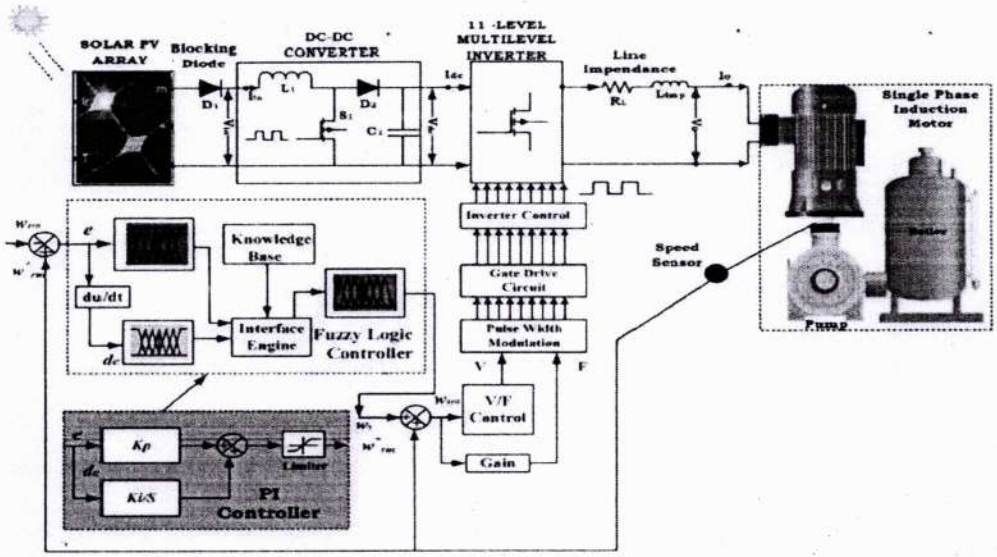


FIGURE 3. Control Topology

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,

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

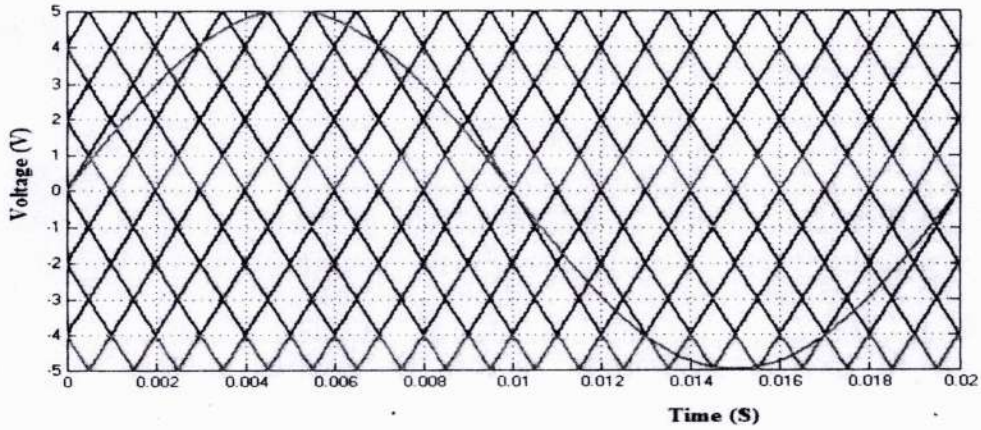


FIGURE 4. APOD Control Signal

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

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

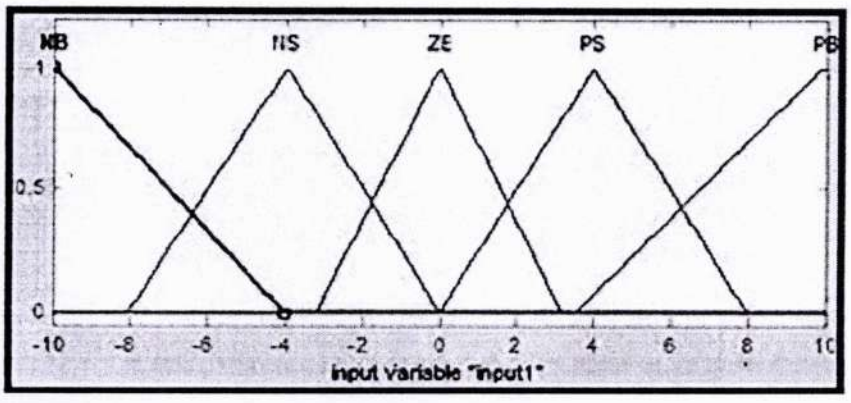


FIGURE 5. Allocation of Range for Subsets

TABLE 1. Fuzzy Rules.

e/ce	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)

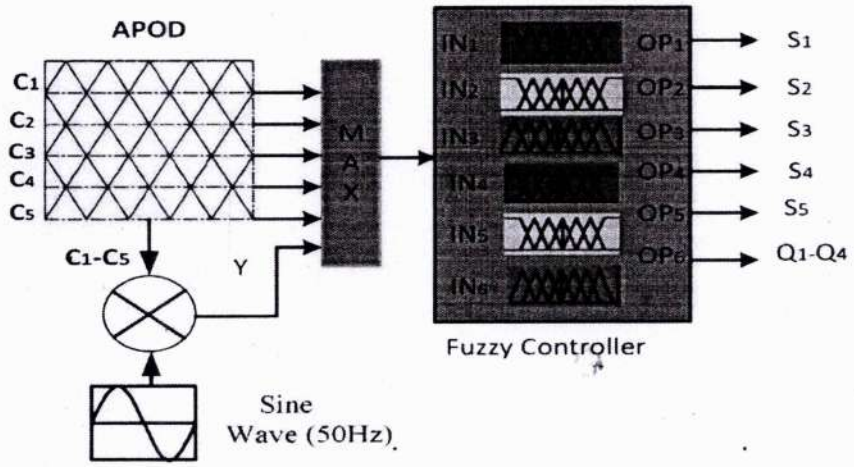


FIGURE 6. FL Controller Switching Pulse Generation Structure.

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.

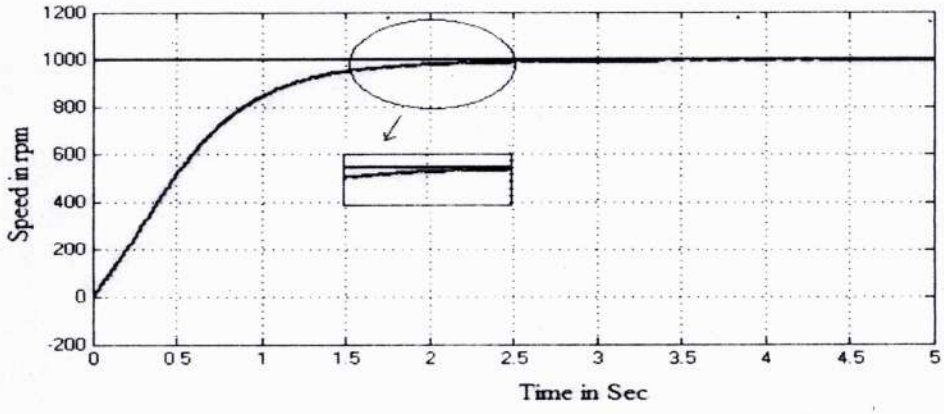


FIGURE 7. Speed Response of PI Controller at 1000 rpm.

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

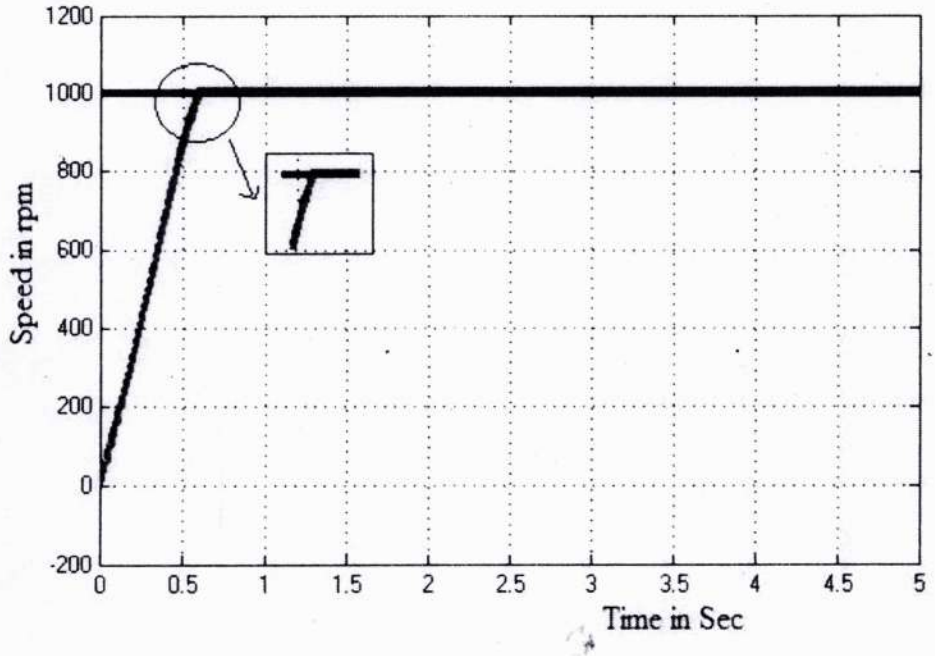


FIGURE 8. Speed Response of FLC at 1000 rpm.

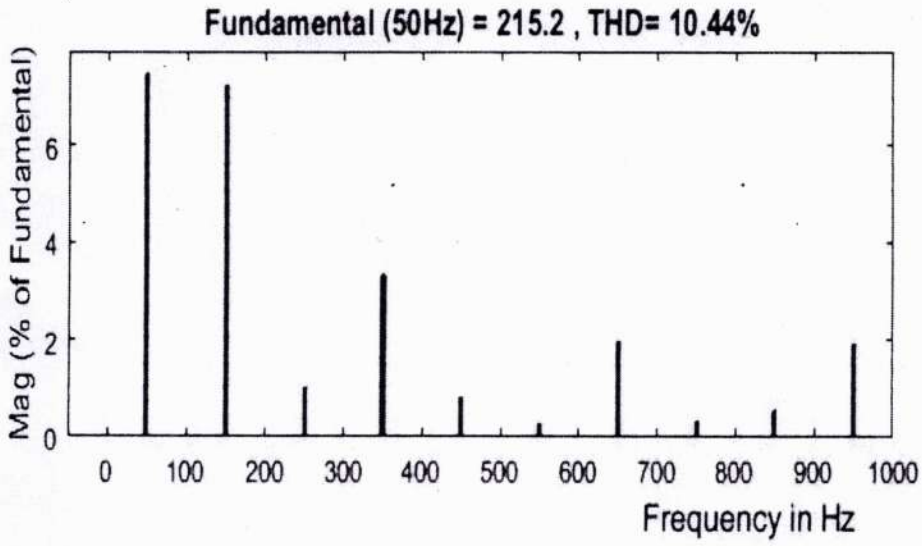


FIGURE 9. HARMONIC ANALYSIS WITH PI CONTROLLER.

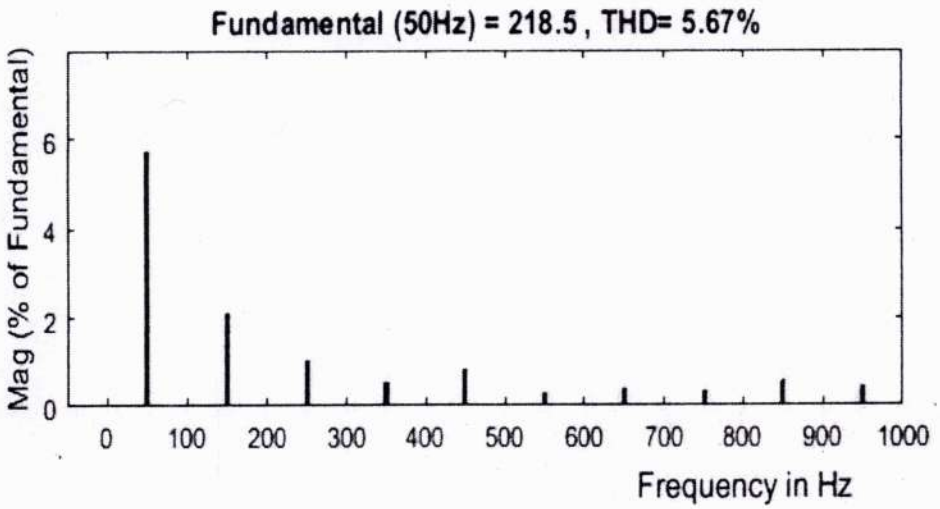


FIGURE 10. Harmonic Analysis with FL controller.

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.

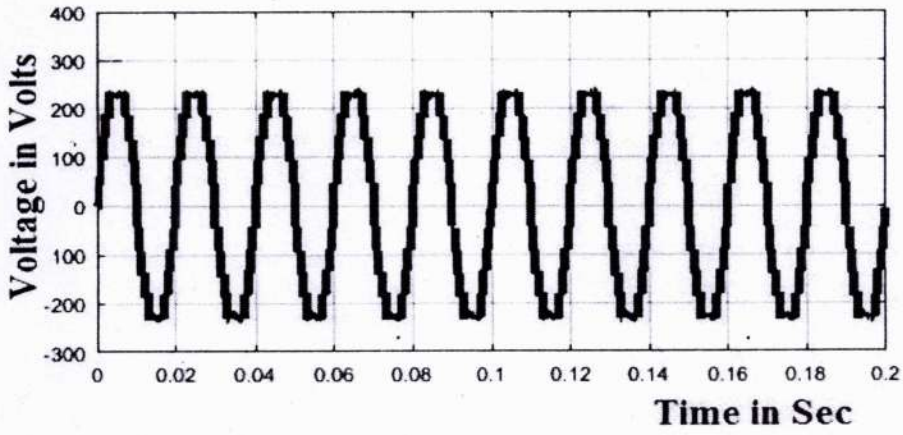


FIGURE 11. Output Voltage Waveform of a 11-Level Inverter

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].

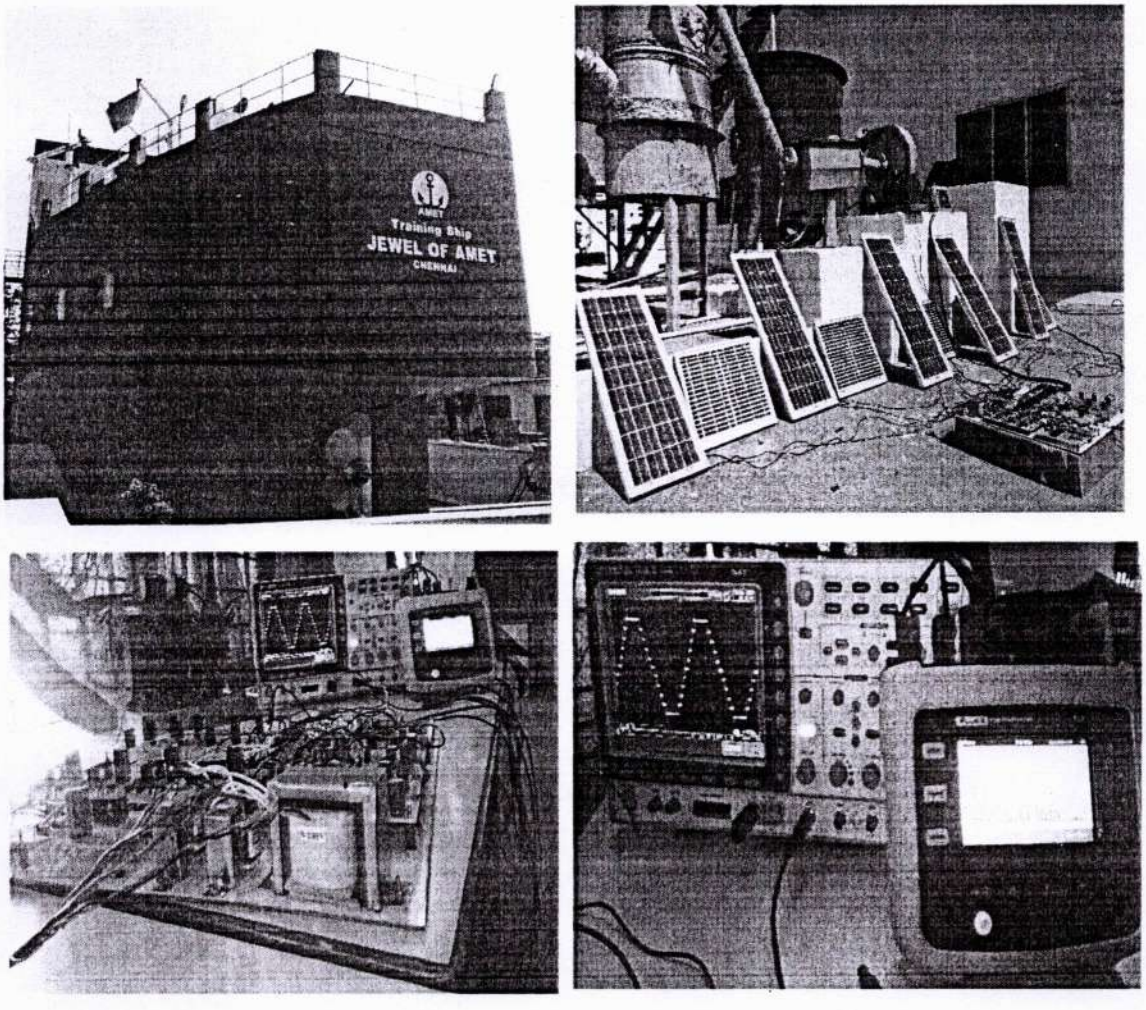


FIGURE 12. Experimental Setup.

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.

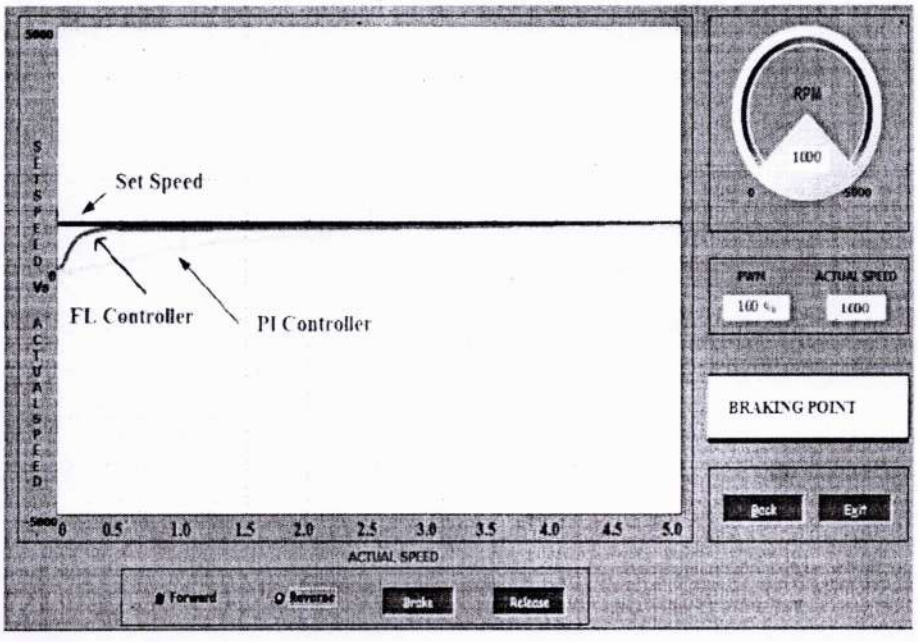


FIGURE 13. Speed Response with PI-FL based Controllers

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.

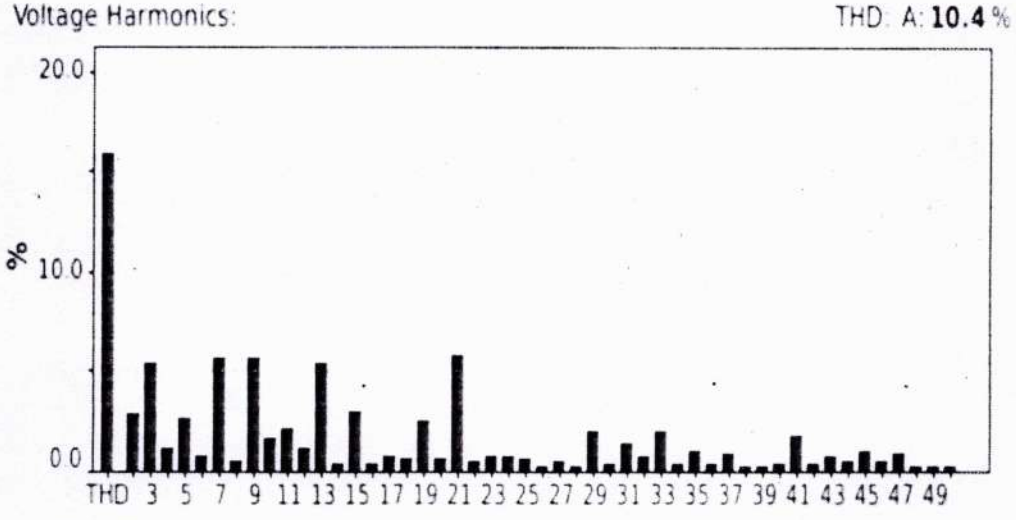


FIGURE 14. Harmonic Analysis with PI Controller.

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.

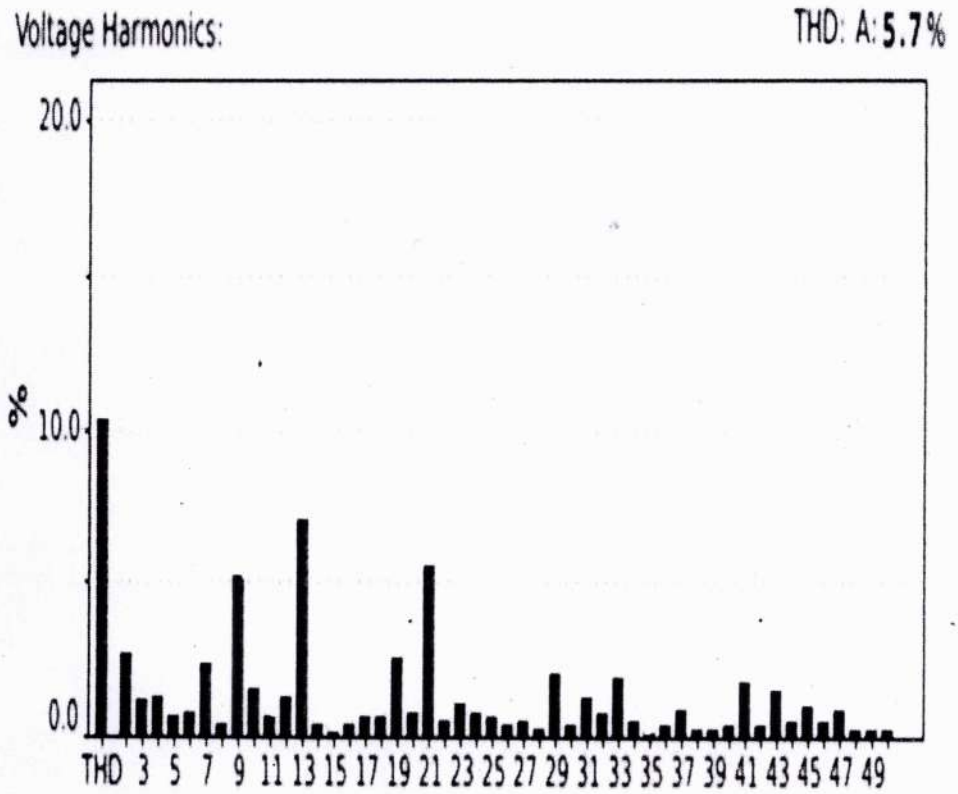


FIGURE 15. Harmonic Analysis with Fuzzy Controller.

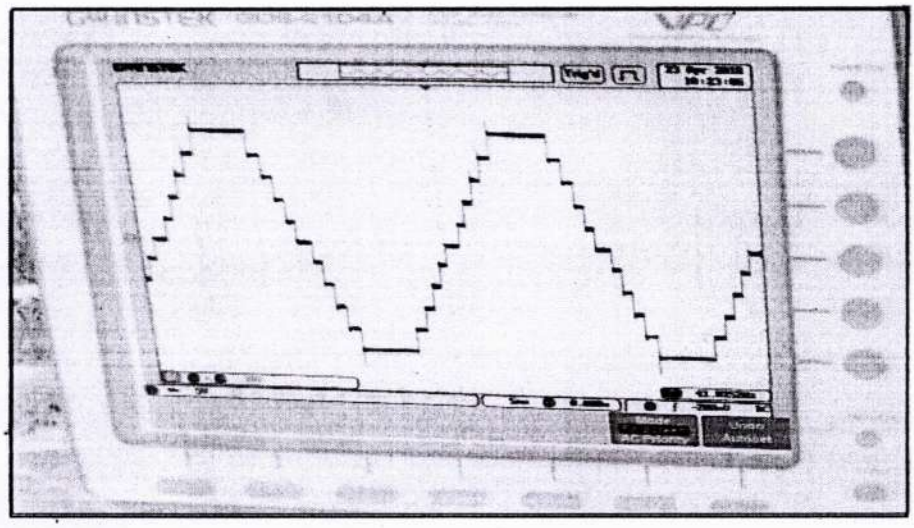


FIGURE 16. Output Voltage Waveform of MMI.

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.

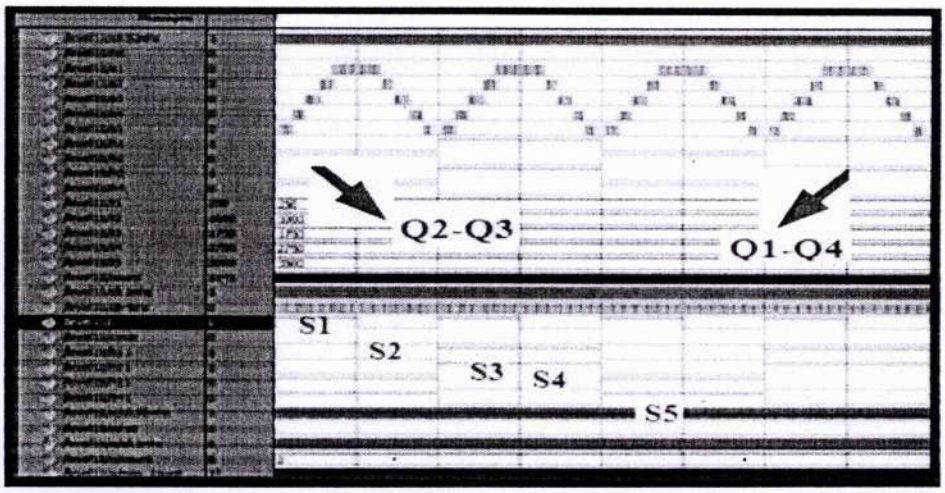


FIGURE 17. Model sim 6.3f based Switching Pulse for Inverter Switches.

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.

CHAPTER 8 REFERENCES

[1] H. Lan, Y. Bai, S. Wen, D. C. Yu, Y.-Y. Hong, J. Dai, and P. Cheng, ''Modeling and stability analysis of hybrid PV/diesel/ESS in ship power system,'' *Inventions*, vol. 1, no. 5, pp. 1–16, 2016, doi: 10.3390/inventions1010005.

[2] S. G. Jayasinghe, L. Meegahapola, N. Fernando, Z. Jin, and J. M. Guerrero, ''Review of ship microgrids: System architectures, storage technologies and power quality aspects,'' *Inventions*, vol. 2, no. 4, pp. 1–19, 2017, doi: 10.3390/inventions2010004.

[3] R. Kumar and B. Singh, ''Single stage solar PV fed brushless DC motor driven water pump,'' *IEEE J. Emerg. Sel. Topics Power Electron.*, vol. 5, no. 3, pp. 1337–1385, Sep. 2017, doi: 10.1109/JESTPE.2017.2699918.

[4] S. Shukla and B. Singh, ''Single-stage PV array fed speed sensorless vector control of induction motor drive for water pumping,'' *IEEE Trans. Ind. Appl.*,

[5] vol. 54, no. 4, pp. 3575–3585, Jul./Aug. 2018, doi: 10.1109/TIA.2018.2810263.

[6] C.-L. Su, W.-L. Chung, and K.-T. Yu, ''An energy-savings evaluation method for variable-frequency-drive applications on ship central cooling systems,'' *IEEE Trans. Ind. Appl.*, vol. 50, no. 2, pp. 1286–1297, Mar./Apr. 2014, doi: 10.1109/TIA.2013.2271991.

[7] B. Singh, U. Sharma, and S. Kumar, ''Standalone photovoltaic water pumping system using induction motor drive with reduced sensors,'' *IEEE Trans. Ind. Appl.*, vol. 54, no. 4, pp. 3645–3655, Jul./Aug. 2018, doi: 10.1109/TIA.2018.2825285.

[8] A. Dolatabadi and B. Mohammadi-Ivatloo, ''Stochastic risk-constrained optimal sizing for hybrid power system of merchant marine vessels,'' *IEEE Trans. Ind. Informat.*, vol. 14, no. 12, pp. 5509–5517, Dec. 2018, doi: 10.1109/TII.2018.2824811.

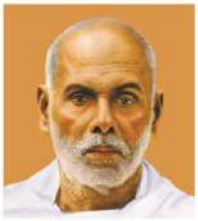
HOD EEE

Dr. LEENA A V
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY
PAYYANUR, KANNUR

Est. 2003

Sree Narayana Guru College of Engineering & Technology

CHALAKKODE P.O., KOROM, PAYYANUR, KANNUR-670 307



DEPARTMENT OF MECHANICAL ENGINEERING

SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

B Tech seminar -Topics

Sl No	Register number	Name of students	Topics	Guide
1	SNC19ME001	ADARSH P K	Investigation of the influence of tyre geometry on the aerodynamics of passenger cars	Mr. Priyesh Padmanabhan
2	SNC19ME002	ADWAIDH BALAN	Tri axial vibration of the head of car driver under different seating conditions	Mr. Athul Raj PP
4	SNC19ME004	ANURAG A	Thermo chemical recycling of waste tyres to oil for automobile applications	Mr. Athul Raj PP
5	SNC19ME005	ARSH IBRAHIM	Abrasive Water Jet machining of CFRP laminates	Mr. Jacob Thomas
6	SNC19ME006	ASWANTH C	Design of portable Cartesian 3D Printer Using Arduino Mega 2560	Mr. Jishnu VN
7	SNC19ME007	ATHUL. B	Ultrasonic metal welding	Mr. Priyesh Padmanabhan
8	SNC19ME008	BIPIN.K	Underwater Robot	Mr. Divyathej MV

HOD ME

Dr. LEENA A V
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY
PAYYANUR, KANNUR

9	SNC19ME009	FARHAN.C	~~Green Engine~~ Desalination using waste heat	Mr. Athul Raj PP
10	SNC19ME010	JASIN.P	Design and analysis of ceramic disc brakes for cars	Mr. Divyathej MV
11	SNC19ME011	MOHAMMED AAFIL ISMAYIL M K	An Electro-Mechanical braking Energy recovery System.	Mr. Priyesh Padmanabhan
12	SNC19ME012	MOHAMMED RAMADAN ANWAR	Laser cleaning	Mr. Jacob Thomas
13	SNC19ME013	MRIDUL.C	Six stroke engine	Mr. Jishnu VN
14	SNC19ME014	NITHIN.A	Maglev Train	Mr. Divyathej MV
15	SNC19ME015	SAFVAN. I M	Micro structure analysis	Mr. Jacob Thomas
16	SNC19ME016	SANDESH K DINESH	Stratified Engine	Mr. Divyathej MV
17	SNC19ME017	SREEHARI S NAMBIAR	Space robotics	Mr. Jishnu VN
18	SNC19ME018	VIDYASAGAR.P	Airless Tyres	Mr. Jacob Thomas

HOD

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

SEMINAR COORDINATOR

"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

PAYYANUR

AFFILIATED TO A P J ABDUL KALAM TECHNOLOGICAL UNIVERSITY, KERALA

December-2022

HOD ME

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

DEPARTMENT OF MECHANICAL ENGINEERING

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.

Guide:

Mr. Priyesh Padmanabhan

Head of department:

Mr. Jacob Thomas

HOD ME

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

ACKNOWLEDGEMENT

At the outset, I thank the lord almighty for the grace, strength and hope to make my endeavor a success. I express my deepfelt gratitude to Dr. LEENA A V, SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY, PAYYANNUR for providing the necessary facilities.

I extend my sincere gratitude towards Mr. JACOB THOMAS, Head of Department , Mechanical Engineering for giving us his valuable knowledge and wonderful technical guidance.

I am profoundly grateful to, Mr. PRIYESH PADMANABHAN and for their valuable guidance, support, suggestions and encouragement.

Furthermore, I would like to thank all others especially my parents and numerous friends. This seminar report would not have been a success without the inspiration, valuable suggestions and moral support from them throughout the course.

Thanking you

ATHUL B

HOD ME

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

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.

HOD ME

Dr. LEENA. A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

CONTENTS

LIST OF FIGURES

HOD ME

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

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%.

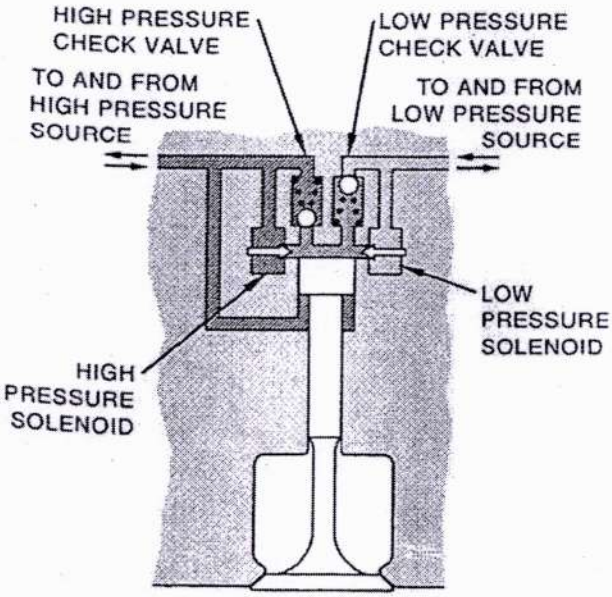


Fig 3.1 Hydraulic Pendulum

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).

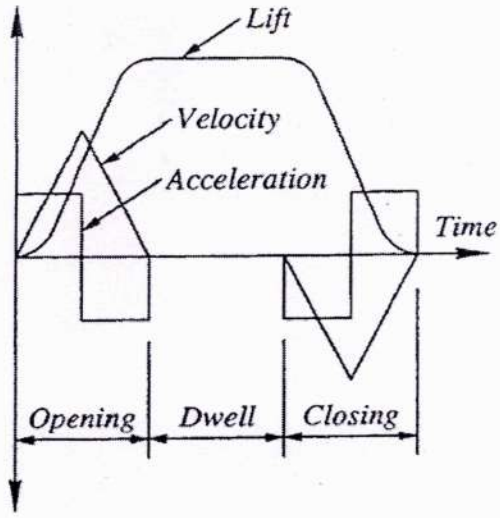


Fig 3.2 Dynamic characteristics of hydraulic pendulum.

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.

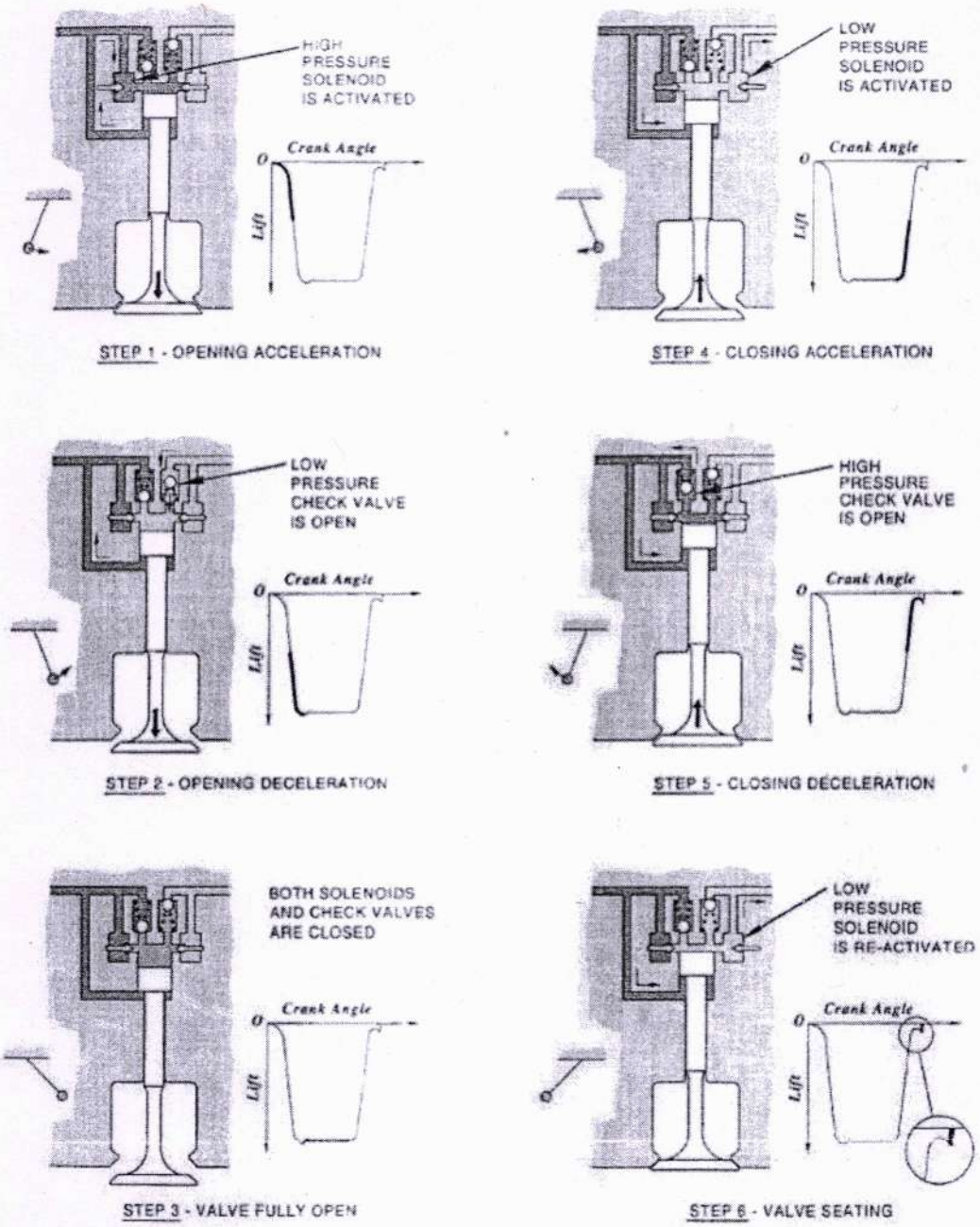


Fig 4.1 Valve opening and closing

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.

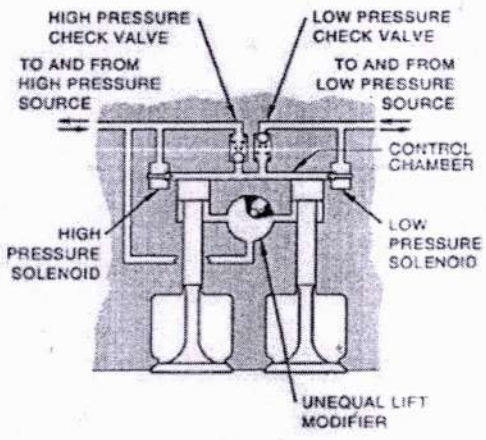


Fig 5.1 Unequal Lift Modifier

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.

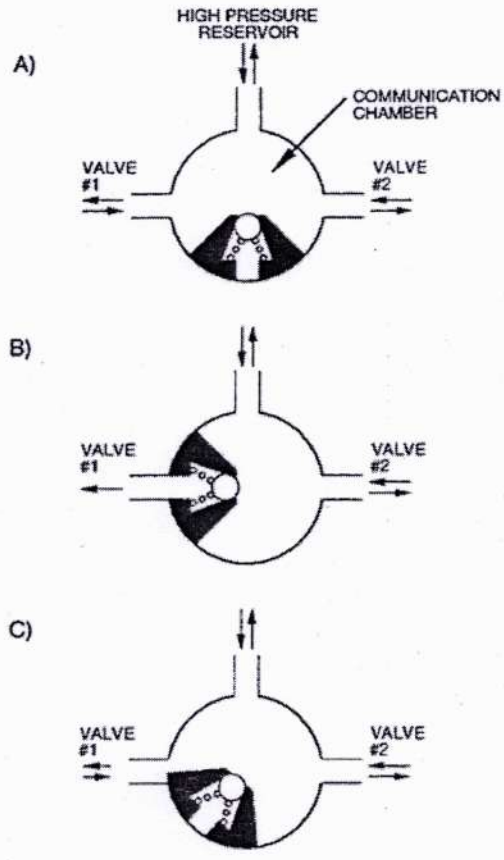


Fig 5.2 Unequal lift control.

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.

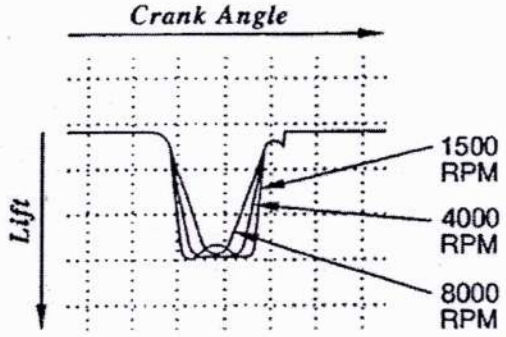


Fig 6.1 Lift traces of engine valve

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).

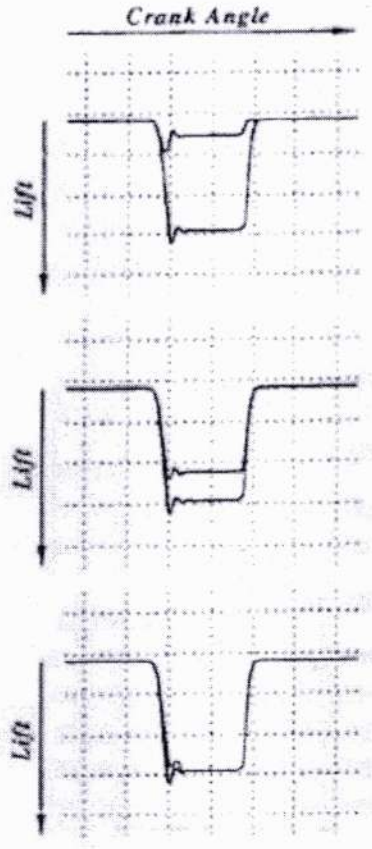


Fig 6.2 Traces of unequal set lifts

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.

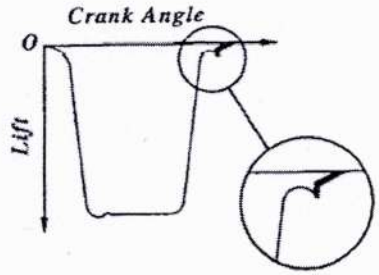


Fig 6.3 Quite seating control

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.

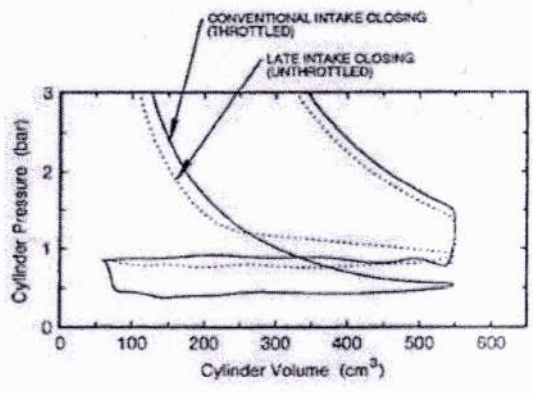


Fig 6.4 Pressure Volume diagram

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.

REFERENCES

[1] Camless Engine Michael M. Schechter and Michael B. Levin Ford Research Lab.

[2] "A Review Study on Working of Electrohydraulic Camless Engine" Gagandeep Singh Mavi, Dinesh Kumar

[3] T. Dresner and P. Barkan, "A Review of Variable Valve Timing Benefits and Modes of Operation", SAE paper 891676

[4] "Toyota develops continuously variable valve timing engine", WARD'S Engine and Vehicle Technology Update, July 15, 1995.

[5] "Honda tweaks VTEC design", WARD'S Engine and Vehicle Technology Update, July 15, 1995.

HOD ME

Dr. LEENA A V
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY
PAYYANUR, KANNUR