B.Tech Professional Communication Report

Medical Diagnostic Systems

Using

Artificial Intelligence (AI) Algorithms

Submitted in partial fulfilment of the award of the

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Submitted by

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CERTIFICATE

This is to certify that the seminar report entitled **"MEDICAL DIAGNOSTIC SYSTEMS USING ARTIFICIAL INTELLIGENCE (AI) ALGORITHMS"** is a bona fide record of the professional communication report carried out in the second semester by **NAMITHA MANOJ** (**LMC21CS051**) under my supervision and guidance, in partial fulfillment for the award of the Degree of Bachelor of Technology in Computer Science and Engineering from the Kerala Technological University for the year 2022.

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ABSTRACT

Disease diagnosis is the identification of a health issue, disease, disorder, or other condition that a person may have. 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. Diseases may affect a person physically and mentally, and it considerably manipulates the living style of the affected person. 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. Neural networks can be trained to detect lung cancer, breast cancer, Stroke in less time than a trained radiologist. Using medical expert systems, doctors can diagnose patients more accurately and prescribe the most suitable treatment.

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CHAPTER-1 INTRODUCTION

Diseases are any cause or circumstances that lead to pain, illness, Dysfunction, or eventually, a human being's death. Diseases may affect a person physically and mentally, and it considerably manipulates the living style of the affected person. In the field of healthcare, the study of disease diagnosis plays a vital role. Traditionally, diseases are diagnosed by a medical expert by the symptoms. Basic check-ups are done by them in order to understand the health condition. But this is error prone since, many diseases have similar symptoms. Finding the disease in the first stage is very important since certain fatal diseases cannot be cured at the last stages. This would cause problems in the healthcare field since death may occur due to the carelessness of the medical experts.

So here by the advent of artificial intelligence, this condition can be rectified to a large extend. Machine learning algorithms makes it easy for the results. Deep learning and artificial neural networks can find complicated diseases at early stages. In future, this would lead to better lifestyle as well as decreased death rates.
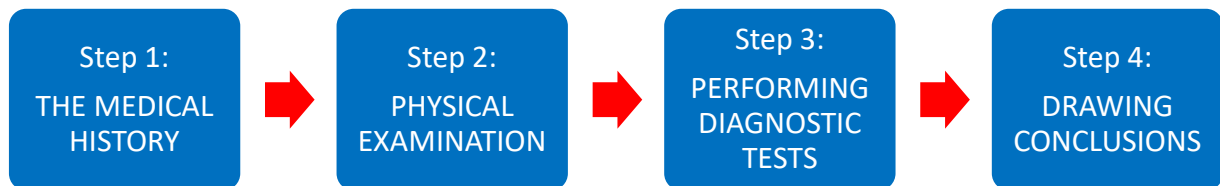
CHAPTER-2
DIAGNOSIS PROCESS

Disease diagnosis at the first stage could save life from many fatal diseases. **Diagnosis process** include mainly four steps.

1. **The Medical History:** It includes collecting the data about the patient so as to assess the health conditions as well as to understand the medications which he/she is currently going through. This include collecting data regarding allergies and other diseases which the person has experienced. Other data about when the symptoms started and what are the issues can also be asked to the patient.

2. **Physical Examination:** This includes the check up by the examiner. Our body temperature, blood pressure, etc. would be analyzed by the examiner. This is mainly for understanding the current situation of the body.

3. **Performing Diagnostic Tests:** We would be asked to carry out different diagnosis for understanding the accurate diagnosis of the disease. Blood test, MRI scans, x rays, etc. are very common tests which we would be asked to carry out for understanding the disease. Precise knowledge of the disease can be obtained by conducting these tests.

4. **Drawing Conclusions:** Usually this is done by the medical examiner and every data and test results would be analyzed for the final

conclusions. But at many situations this cannot be done most accurately since there are chances of manual error.

| Step 1: THE MEDICAL HISTORY | → | Step 2: PHYSICAL EXAMINATION | → | Step 3: PERFORMING DIAGNOSTIC TESTS | → | Step 4: DRAWING CONCLUSIONS |

CHAPTER-3
ARTIFICIAL INTELLIGENCE & DISEASE DIAGNOSIS

Artificial intelligence (AI) is intelligence exhibited by machines. In computer science, the field of AI research defines itself as the study of "intelligent agents": any device that perceives its environment and takes actions that maximize its chance of success at some goal. The vital need for any intelligent system is learning. So, this could be attained by using machine learning and deep learning techniques.

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. 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. A Rule-based intelligent system, provides a set of if-then rules in healthcare, which act as a decision support system. Results in very less human intervention. In this paper, we focus on the three main branches of AI: Fuzzy logic, Machine learning, Deep Learning.

Another significant application of AI is the Internet of Medical Things that helps to collect healthcare data using IoT Devices. This could considerably reduce detection errors compared to exclusive human expertise. Results in better medical decisions in rapid speed. Also, accurate results from the diagnosis process with reduced costs.

Examples:

i. **Bronchiolitis**

- Lung infection commonly seen in younger children and infants.
- Machine learning can be used to overcome limitations of predictive modeling.

ii. **Sepsis**

- Life-threatening condition
- Occurs due to your body's response to infection, which causes inflammation that result in multiple organ failures at the same time.

Advantages:

Algorithms also analyze medical images such as MRIs, X-rays, and CT scans and diagnose specific diseases by just spotting signs. Neural networks can be trained to detect lung cancer, breast cancer, and stroke in less time than a trained radiologist. It can also classify the types of different fatal diseases.
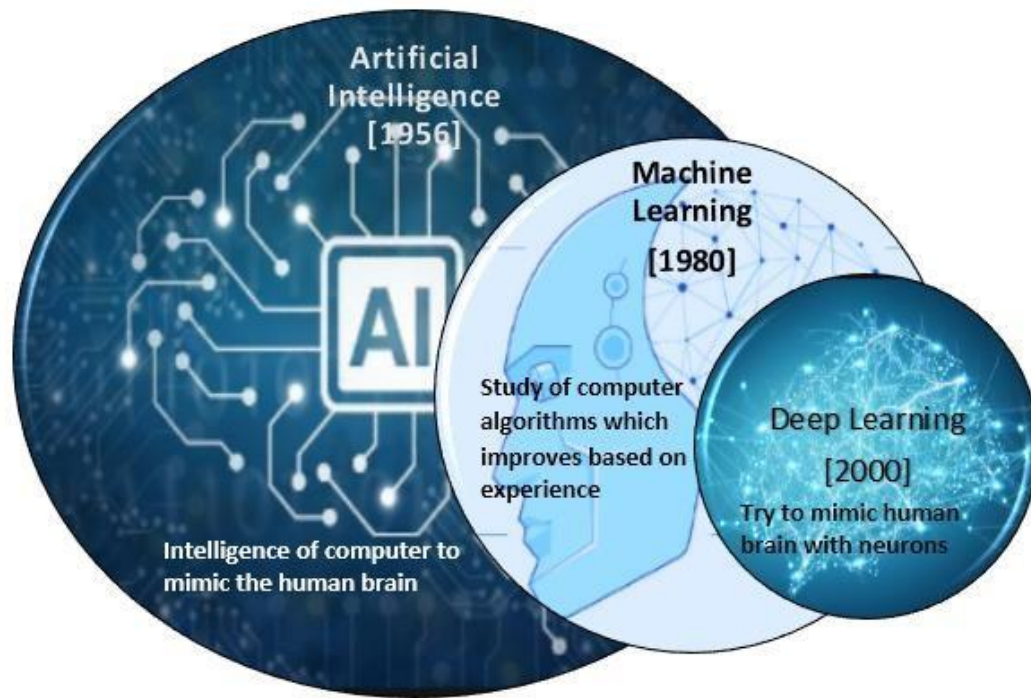
CHAPTER-4
FUZZY LOGIC & MEDICAL DIAGNOSIS

Fuzzy logic provides dynamic methods that deal with difficult problems. 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. 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. Various clinical diagnoses systems created depend on the fuzzy set model and applied in the medical field.

Fuzzy Rule Based System (FRBS) is a frequently used technique in healthcare that drives from Fuzzy Inference Systems (FIS). FRBS applies IFTHEN rules for information portrayal. The main feature of fuzzy logic is that it can alleviate the inaccuracies and uncertainties of any situation.
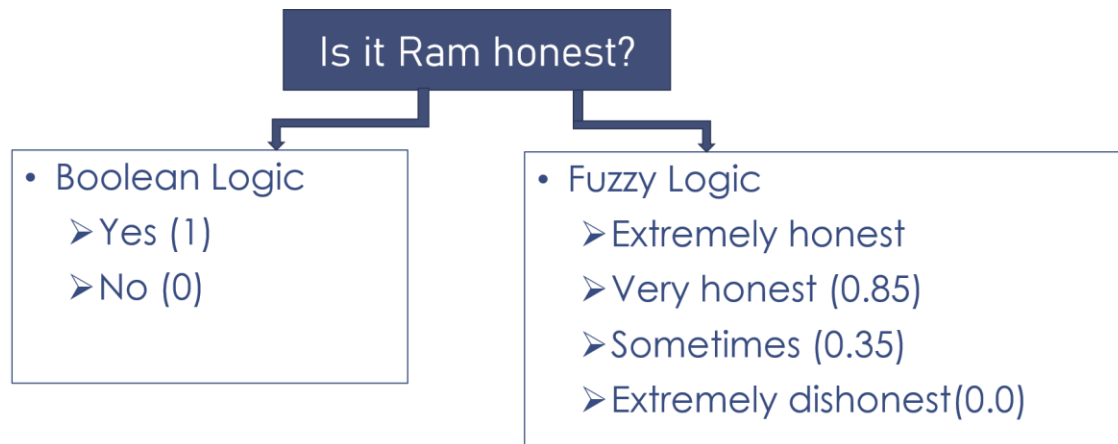
Examples:

i. **Ebola Virus Disease (EVD):**

- This is a fatal infectious disease.

- Ebola fuzzy informatics system was designed to diagnose EVD.

- According to the performance of their system, we can say that their system is a valuable addition to fight against Ebola.

ii. **Breast cancer:**

- It is a sort of sickness caused by bumps found in the breast that frames the cells.

- Miranda and Felipe inter-operated on the Fuzzy Omega algorithm, an automated tool to detect breast lesions.

Steps of Medical Diagnosis process using Fuzzy Logic

1. **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.

2. **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.

3. **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.

4. **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.

Fuzzifier ➤ Inference engine ➤ Knowledgebase ➤ Defuzzifier

Flowchart of the Fuzzy Logic Process
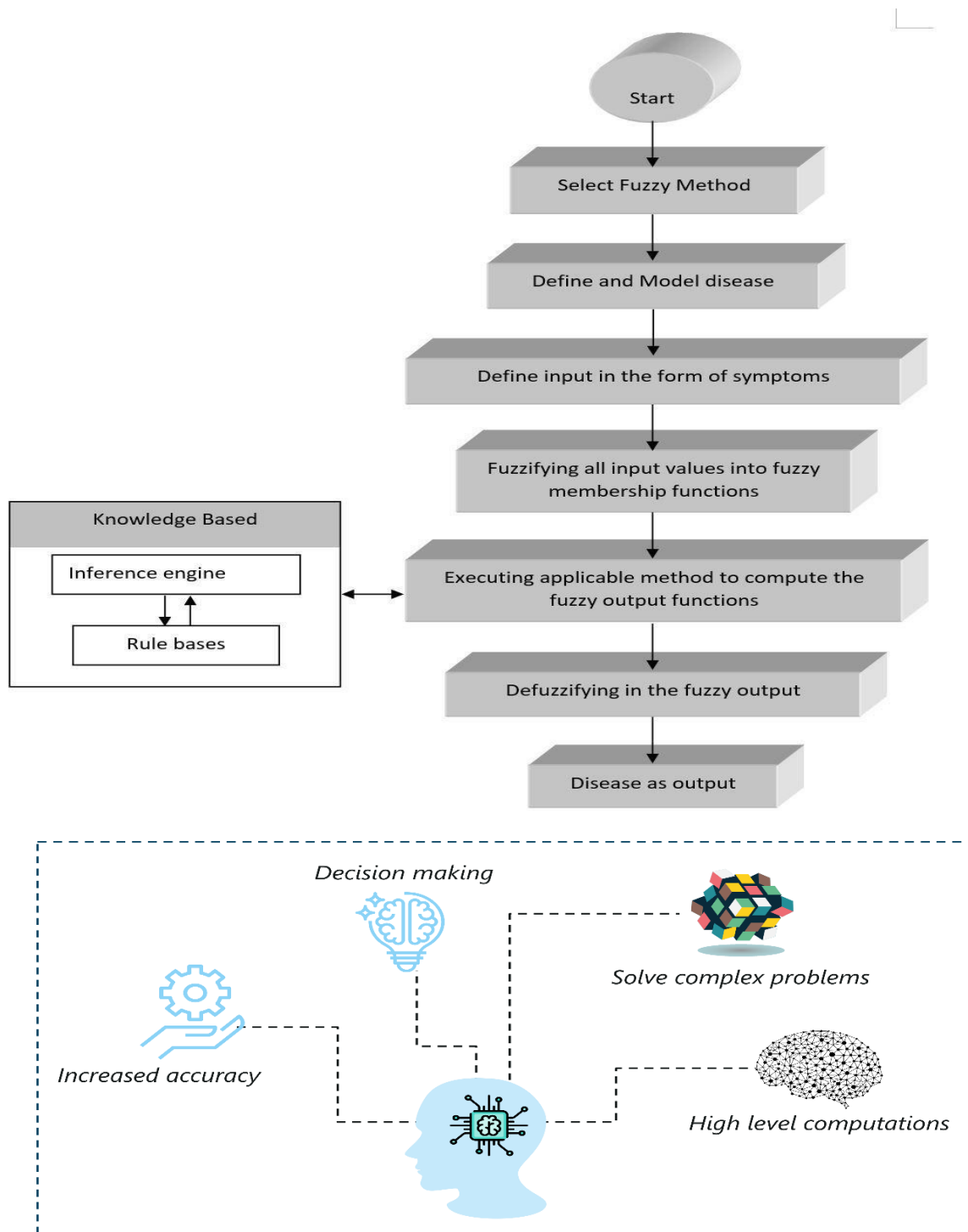
CHAPTER-5

MACHINE LEARNING IN MEDICAL DIAGNOSIS

Machine Learning (ML) is the subfield of computer science. According to Arthur Samuel in 1959, gives "computers the ability to learn without being explicitly programmed. It explores the study and construction of algorithms that can learn from and make predictions on data. This overcomes following strictly static program instructions by making data driven predictions or decisions, through building a model from sample inputs. Thus, requiring very little human intervention or domain expert's service.

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 assists the experts to handle large and complicated medical data and also helps to investigate the results.

Medical Diagnosis Process Using ML

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 pre-processing. 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 pre-processed 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

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 pre-process 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.

Flowchart:
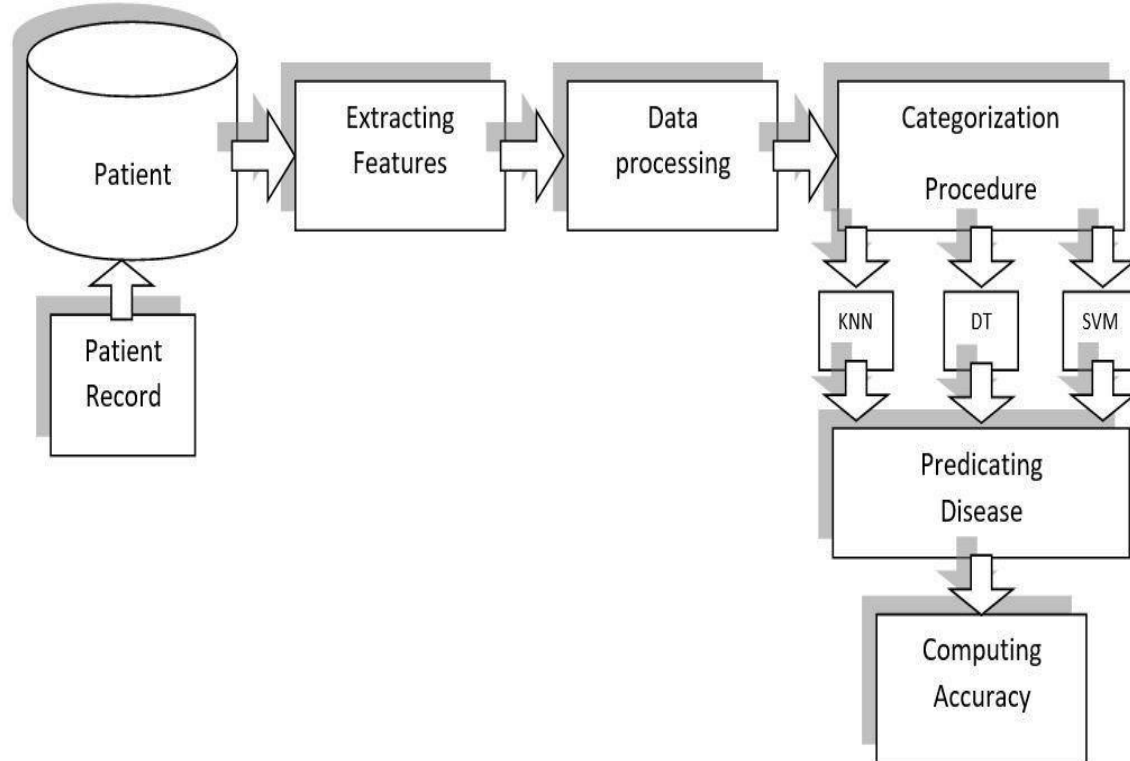
Example:

 i. Arthritis:

  ⊙ There are various sorts of arthritis exist such as osteoarthritis and rheumatoid arthritis which similar and have different impacts.

  ⊙ 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.

CHAPTER-6

DEEP LEARNING IN DISEASE DIAGNOSIS

Deep learning (also known as deep structured learning, hierarchical learning or deep machine learning) is the study of artificial neural networks and related machine learning algorithms that contain more than one hidden layer. 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. Deep learning provides benefits in different fields such as drug discovery, medical imaging, Genome, detecting Alzheimer's disease.

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. Neural networks can be trained to detect lung cancer, breast cancer, Stroke in less time than a trained radiologist.
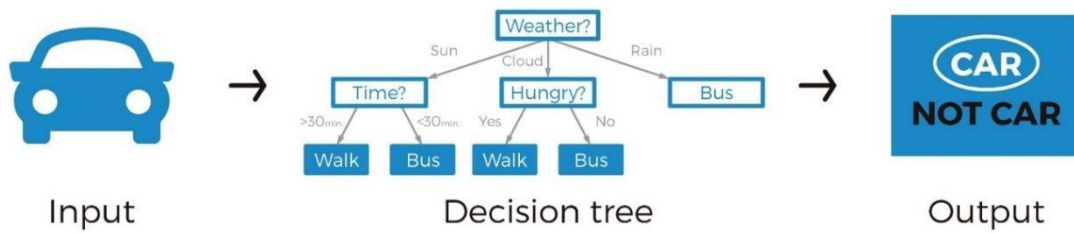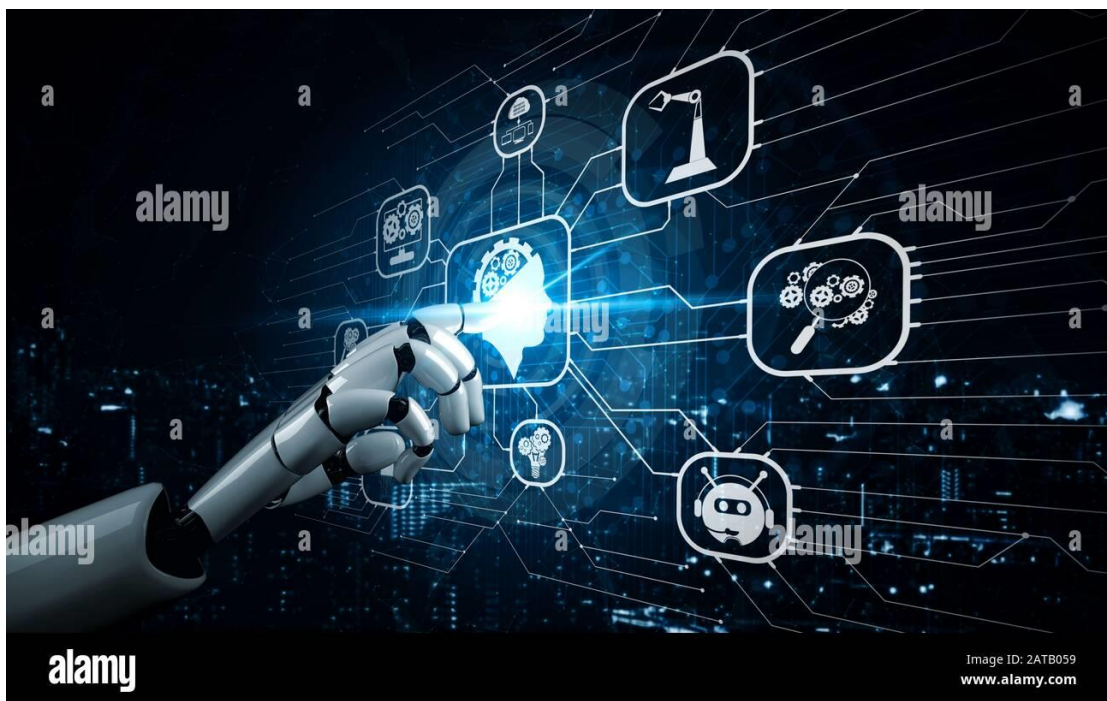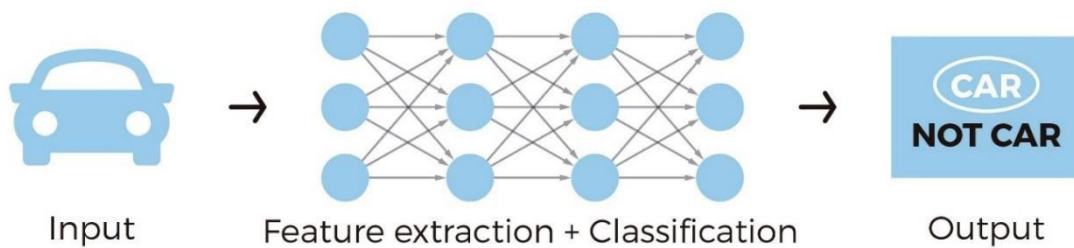
CHAPTER-7

COVID-19 (CORONAVIRUS) DISEASE

- 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, and difficulty in breathing.

- COVID19 has killed millions of people across the world.

- High temperature, cough, difficulty in breathing are the main symptoms of the virus.

- Most often this makes doctors confused with other lungs infection in this condition and diagnosis become a difficult task here.

- Due to the increasing number of cases and limited test kits, it becomes difficult to detect the presence of COVID-19.

- For this, quick diagnosis is required that can be possible with different deep models.

- Novel Convolutional Caps Net using chest X-ray images has been introduced. This model provides accurate results with the binary classification of 97.24% and multi-class classification of 84.22%. In this study, a pre-trained deep neural network was used to diagnose COVID-19 on chest CT images.

- When researchers use X-RAYS with AI techniques it becomes easy to detect COVID-19. Using deep learning authors have developed a model with four phases: data augmentation, pre-processing, stage-I, and stage-II deep network model designing.
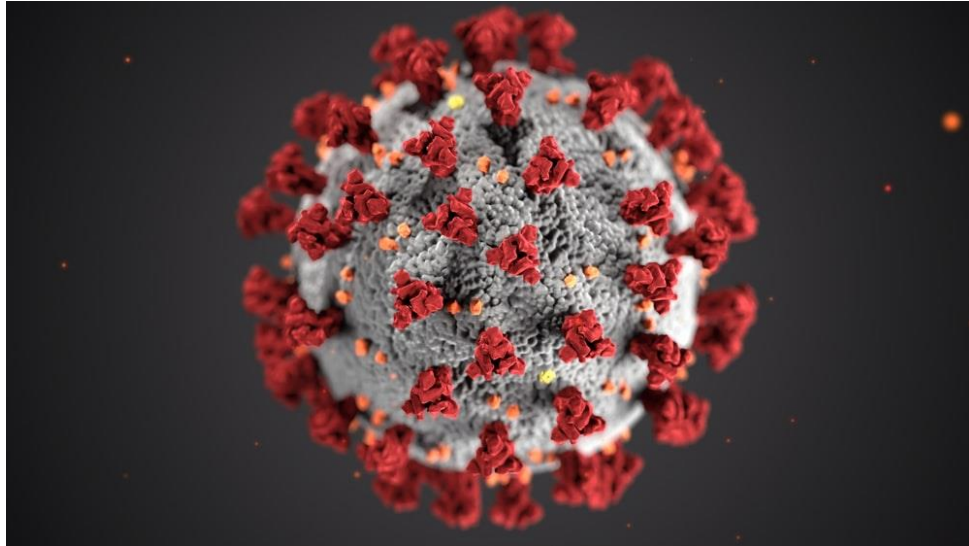
CHAPTER -8

CONCLUSIONS

Since, recent advancements in AI techniques lead to successful applications of AI in healthcare. This had become a sensitive topic of discussion whether AI expert systems will eventually replace human doctors. 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. 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.

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APPENDIX

DIAGNOSIS PROCESS

| Step 1: THE MEDICAL HISTORY | Step 2: PHYSICAL EXAMINATION | Step 3: PERFORMING DIAGNOSTIC TESTS | Step 4: DRAWING CONCLUSIONS |

ROLE OF AI IN DISEASE DIAGNOSIS

- ▶ Artificial intelligence (AI) is intelligence exhibited by machines.
- ▶ A Rule-based intelligent system, provides a set of if-then rules in healthcare, which act as a decision support system.
- ▶ Results in very less human intervention.
- ▶ The neural network or artificial neural network (ANN) is a large collection of neural units designed based on biological neurons connected in the brain.
- ▶ These kinds of systems learn and are trained automatically.
- ▶ It can even detect the disease even before its occurrence by sensing its symptoms.
- ▶ Another significant application of AI is the Internet of Medical Things that helps to collect healthcare data using IOT Devices.

ADVANTAGES OF AI

Reduces detection errors compared to exclusive human expertise.

Better medical decisions in rapid speed.

Accurate results from the diagnosis process with reduced costs.

AI TECHNIQUES USED IN DISEASE DIAGNOSIS

BRONCHIOLITIS

- Lung infection commonly seen in younger children and infants.
- Machine learning can be used to overcome limitations of predictive modeling.

SEPSIS

- Life-threatening condition
- Occurs due to your body's response to infection, which causes inflammation that result in multiple organ failures at the same time.

- Various technologies can be merged to improve the detection process and minimize the risk of using wrong antibiotic.

- AI algorithms can analyze medical images such as MRIs, x-rays, and CT scans and diagnose **specific diseases by just spotting signs**.

- Neural networks can be trained to **detect lung cancer, breast cancer, stroke in less time** than a trained radiologist.

FUZZY LOGIC

Is it Ram honest?

▶ Boolean Logic
  - Yes (1)
  - No (0)

▶ Fuzzy Logic
  - Extremely honest
  - Very honest (0.85)
  - Sometimes (0.35)
  - Extremely dishonest(0.0)

FUZZY LOGIC IN DISEASE DIAGNOSIS

- **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.

- The main feature of fuzzy logic is that it can **alleviate the inaccuracies and uncertainties** of any situation

EBOLA VIRUS DISEASE (EVD)

- Fatal infectious disease.
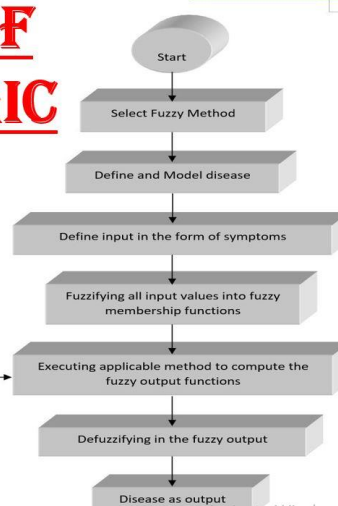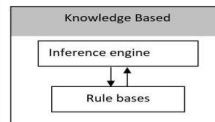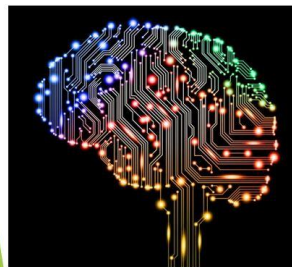- Ebola fuzzy informatics system was designed to diagnose EVD

BREAST CANCER

- 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.
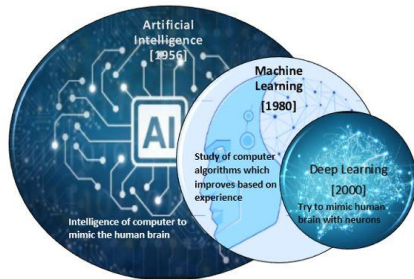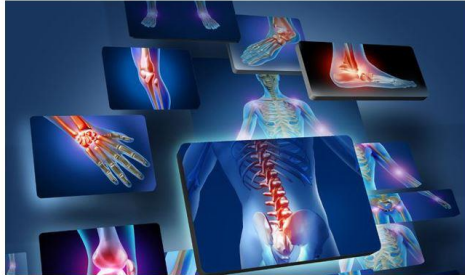
MEDICAL DIAGNOSIS PROCESS USING FUZZY LOGIC

Fuzzifier	Inference engine	Knowledgebase	Defuzzifier

- **Fuzzification process:** Changes crisp input value to the fuzzy set.

- Processed by the inference engine using a set of rules
- Act as a collection of rules to the knowledge base.

- Consists of rules, structured and unstructured data also named the database.

- Converting the output from the inference engine into crisp logic.

FLOW CHART OF THE FUZZY LOGIC PROCESS

Start

Select Fuzzy Method

Define and Model disease

Define input in the form of symptoms

Fuzzifying all input values into fuzzy membership functions

Knowledge Based
Inference engine
Rule bases

Executing applicable method to compute the fuzzy output functions

Defuzzifying in the fuzzy output

Disease as output

MACHINE LEARNING [ML]

Artificial Intelligence [1956]
Machine Learning [1980]
Deep Learning [2000]
Try to mimic human brain with neurons
Study of computer algorithms which improves based on experience
Intelligence of computer to mimic the human brain

- The subfield of computer science
- "Computers that have the **ability to learn** without being explicitly programmed."
- It explores the study and construction of algorithms that can **learn from and make predictions on data** .
- Overcome **following strictly static program** instructions by **making data-driven predictions** or decisions, through building a model from sample inputs.
- Requiring very little human intervention or domain expert's service.