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PRINCIPLES AND PERSPECTIVE OF MEDICAL DIAGNOSTIC SYSTEMS USING ARTIFICIAL INTELLIGENCE (AI) ALGORITHMS

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***Abstract*— Disease diagnosis means the identification of a health problem, disorder, or the other condition that a person may suffer. This identification could be very easy or tricky too. Data sets are available in large quantity; however, there are certain limitations of tools that are used for identification or prediction. The methods which were use before AI was error prone. Using Artificial Intelligence (AI) predictive techniques benefits us by auto diagnosis and also reduces error detection as compared to the methods used before. The paper also provides few current literature reviews. A detailed analysis on those articles is done in order to classify the most used Artificial Intelligence techniques and algorithms in disease identification process. The paper contains discussion on various disease along with Artificial Intelligence (AI) techniques used such as Fuzzy Logic, Machine Learning and Deep Learning. In this paper, we review the current technologies for disease diagnosis with the help of Artificial Intelligence.**

Keywords— **'**Fuzzy Logic', 'Machine Learning', 'Deep Learning', 'Disease prediction'.

I. INTRODUCTION

The study of disease diagnosis has become a very crucial part in healthcare field. A disease is a particular abnormal condition that affects the structure or a particular organ in a negative way. Sometimes it affects the functioning of organs too. It's a medical condition with signs and symptoms. The pathological process is the casual study of disease. Disease diagnosis is nothing but the process to identify, what is happening internally in the body and figuring out based on the individual's symptoms as shown in Fig 1. In order to identify the disease, a doctor or medical expert have to perform a process that contains various steps in order to collect maximum data of disease. For a medical care professional, Disease diagnosis is a very pivotal phenomenon before having any conclusion. A suitable support system is required in order to achieve results accurately and with lesser cost.

Classification of illness that depends on various parameters is a complex task for human experts but AI would make it easier to detect and handle such type of cases. In today's world, various AI techniques have been adopted in the field like medical to achieve accurate results within short span of time. Artificial intelligence is the research and development of computer systems that can accomplish activities that would ordinarily need human intelligence.

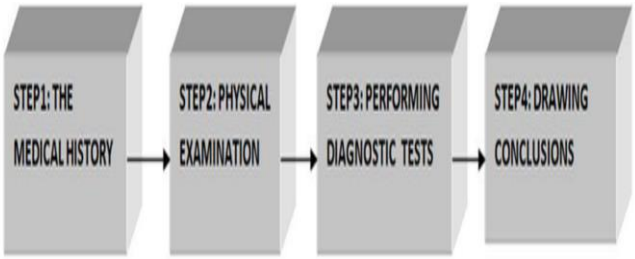

FIG. 1 Block diagram of the diagnosis process from [1]

AI has been impacting various domain since 1950s. AI in healthcare and disease diagnosis is evolving the medical industry by providing a helping hand.AI models trained itself continuously and have more chances to produce more accurate and precise results than before. Rule- based intelligent systems are some specific methods that are significant in the medical field. It provides a set of if-then rules which then act as a decision support system.

A neural network, often known as an artificial neural network (ANN), is a huge collection of neural units modelled on biological neurons in the brain. It's a replica of the human brain that works just like the real thing. Each neuronal unit is connected to a large number of other neurons in a bipartite graph-like pattern. Such systems learn and get trained automatically. Deep learning is a subset of Machine learning and it is based on algorithms. It is used to assist domain experts and doctors for the examination of any disease or disorder.

In this paper, we have focused on three main branches/techniques of AI: Fuzzy Logic, Machine Learning and Deep Learning. These algorithms help specialist to analyses medical images such as CT scans, X-rays, MRI's and detect disease even before its occurrence just by the symptoms. This paper contributes in three folds.

- We first describe how Artificial Intelligence (AI) techniques work in order to detect disease.
- We later make use of the well-known PRISMA approach in order to provide analysis of few existing works done before,
- We then present a summary for those selected articles, on the disease that are targeted and how AI techniques are used to tackle them followed by future scope in the field.

II. PROPOSED ALGORITHM

1 FUZZY LOGIC AND DISEASE DIAGNOSIS

In this section we first describe the current related work done based on fuzzy logic followed by the fuzzy logic process in disease diagnosis.

A. Existing Techniques using Fuzzy Methods

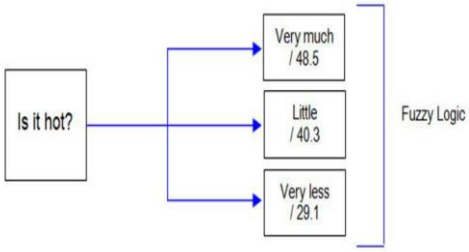

Fig 2. Fuzzy logic Process from [1]

Fuzzy logic is the super set of Boolean logic. It represents about uncertainty or inaccuracy. Fuzzy logic gives you a lot of flexibility when it comes to reasoning. In short, it is reasoning method that resembles human reasoning. This approach is as same as how human perform decision making. This logic involves all possibilities between yes and no. Suppose, there is a question asked that – Is it cold? The answer in the Boolean logic will be either a yes or a no that means it only consider the value as either 1 or 0. But, in fuzzy logic we get different answers such as very much cold, not too much cold, very less cold as shown in Fig 2. Here you get intermediate possibilities between yes and no. the computer won't just takes the values 0 and 1, instead it works on levels of possibilities in order to achieve a definite and precise output. The fuzzy logic was invented by Lotfi who observed that unlike computers, humans have a different range of possibilities between yes and no. A large number of articles have been written in order to discover diabetics. One of them is published by A. Rajeswari, M. S. Sidhika, M. Kalaivani, and C. Deisy [2] on diabetic prediction with the help of an associative classification method that is based on fuzzy logic in order to tackle the issue of the boundary value confusion while partitioning risks.

Fuzzy logic is gaining popularity in disease diagnosis using different factors or parameters in medical field from past few years. Dental Diagnosis System was designed by L. H. Son, H. Fujita, N. Dey, and A. S. Ashour [3] in order to find out dental problems from X-Ray images that depend on the hybrid technique of fragmentation, classification and decision making. They observed 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 neighbour (80%), prim spanning tree (58%) and Kruskal spanning tree (58%). Bacterial diseases like Cholera arises after drinking polluted or infected water. This kind of disease can cause drying out, diarrhea and if not handle at the perfect time, then can lead to the death as well.

B. Medical Diagnosis Process Using Fuzzy Logic:

Fuzzy logic is a method of thinking that uses "degrees of truth" rather than the traditional "true or false" approach. (1 or 0)

Following are the blocks use for disease detection using fuzzy logic:

1. Fuzzifier: This is the very first step where fuzzification takes place. Fuzzifier is the block where fuzzification process takes place. Fuzzification is a process where a crisp input value gets converted into fuzzy set. The symptoms of the patient are crisp input value here and gets converted into fuzzy membership functions later.
2. Inference Engine: Once the fuzzification process is done, then the fuzzy value is processed by the Inference Engine with the help of set of rules which then act as the collection of rules to the knowledge base.
3. Knowledge Base: In the step, all the rules, structured data and unstructured data are stored in this block. These rules and fuzzy classes are defined by doctors or the expertise.
4. De-fuzzifier: In this block, the process of converting the fuzzy output value from the inference engine into the crisp logic.

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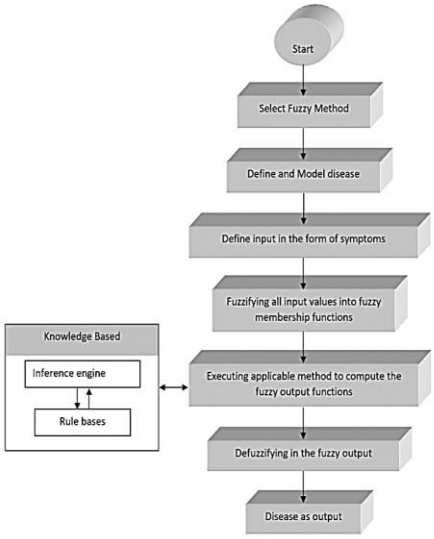

Fig 3. Fuzzy logic system from [1]

So here you can see, after selecting fuzzy method, we define modal disease. Then we take symptoms as an input which is converted into fuzzy sets. This sets or classes further goes to knowledge based where inference engine classify the input with the help of certain rules, we have defined in knowledge based. So, once we get this fuzzy output set, it is then passed to the de-fuzzifier where defuzzification takes place. It converts the fuzzy sets into a crisp output value which is nothing but disease as output.

In fuzzy logic, intelligent behaviour is gained by creating fuzzy classes of some parameters. As the rules and fuzzy classes has to be defined by doctors or expertise, it requires huge amount of human intervention. Also, the statistical models fail to detect large data values, missing values, and holds on categorical data. Hence the statistical model used for approximation does not produce good performance as expected. Hence, it was not up to the mark. That is the reason scientist develop other techniques like Machine Learning Algorithms.

2 MACHINE LEARNING AND DISEASE DIAGNOSIS

In this section we first have a look on existing work using machine learning. Later a brief description on the machine learning process for disease diagnosis is shown.

A. Existing Techniques using Machine Learning.

Machine learning is a sub domain of AI in which models or machine learn itself and perform various task by training themselves. It contains algorithms for supervised learning as well as for unsupervised learning. Supervised learning is done with more human intervention as it requires to guide the machine. Also, in supervised learning we are aware about the input and its outcomes. Unsupervised learning is done with less human intervention where we are not aware about the outcomes. Examples are given to the machines in order to learn a concept and patterns models are created that are supposed to distinguish between two or more objects and make better decision. This type of models assist doctors and experts, handles large and complex data and helps in output predictions. This output further can be used for research purpose. Trust level of patients in order to disease detection are increased by using machine learning algorithms. Also, machine learning is used to detect disease in early stage even before its occurrence or it becomes hazardous to someone. Algorithms like K-Nearest Neighbour (KNN), Decision Trees, Support Vector Machine are used to detect diseases.

One of the key goals is to let machine learn and train themselves without or with less human guidance and adjust the response accordingly. Kidney Disease is one of the harmful disorders that affects the structure and functioning of kidney. Kidney failure is one of the serious outcomes of chronic renal disease. The kidney gets either slowly start functioning less or sometimes, completely gets damaged and stops to function, if not detected early. So, techniques like SVM, KNN, Decision Tree Classifier and Logistics Regression. A. Charleonnan, T. Fufaung, T. Niyomwong, W. Chokchueypattanakit, S. Suwannawach, and N. Ninchawee [5] classified their analysis on performing a comparative analysis based on the techniques mention above and compared their performance in their article ‘‘Predictive analytics for chronic kidney disease using machine learning techniques,’’. They observed that SVM gives more accurate result of 98.3% than the rest three techniques. Breast Cancer is another dangerous and common disease for females. It can lead to the death if precaution is not taken. Machine learning algorithms help to detect breast cancer. H. Asri, H. Mousannif, H. A. Moatassime, and T. Noel [6] categorized their study on breast cancer based on different Machine Learning techniques. Comparison was done between KNN, SVM and Decision Tree techniques using breast cancer dataset. The key goal was to assess the accuracy in classifying data, in each technology in terms of precision and sensitivity. The outcomes gained by this comparison showed that the SVM technology provides high accuracy rate than the others in breast cancer detection. ARTHRITIS is one of the ailments where soreness and stiffness of one or more joints are experienced along with the miserable pain. This ailment become worse as the age of person increases. There are various types of ARTHRITIS such as rheumatoid arthritis, osteoarthritis. So, it is necessary to detect this disease at early stage. ML techniques play a vital role in early detection of ARTHRITIS. In this study with the help of ML techniques, N. Bhargava, R. Purohit, S. Sharma, and A. Kumar [7] predicted arthritis disease using classification and regression tree algorithm. The presented a system to and classify the information data that was taken from Koch and then categorized the given data on factors such as identity, gender, age and treatment and used CART algorithm to find out true or false rates.

B. Medical diagnosis process using machine learning

Machine learning is an area of artificial intelligence (AI) and computer science that concentrates on using data and algorithms to mimic the way humans learn, with the goal of steadily improving accuracy. In simple terms, you are going to take huge amount of data and feed it to your machine and your machine is going to try and understand and interpret this data by using ML model and ML algorithms and it finally going to predict the outcome based on that data.

The basic steps require for disease detection using ML is described in detail as follows:

1. Data collection- This is the very first yet essential step as quality and quantity affect the overall performance of the system. It is a process of collecting the data on targeted variables. Here, test data is collected along with the patient's data.
2. Data Preparation- After the data is collected, it then is pre-processed. Raw data gets converted into useful data which is further used for decision making. It is also known as Data Cleaning.
3. Choose a model- Choosing the model means, it is a process of selecting one final machine learning model from among various other models for a training dataset. (e.g., SVM, KNN, etc.)
4. Train the model- Model training involves providing various algorithms (that is, the learning algorithms) with training data to learn from.
5. Evaluate the model- After choosing and training the model, it is necessary to evaluate the model. It aims to check the accuracy of the model on future data.
6. Parameter Tuning-This step is usually a trial-and-error process by which the expert changes some parameters, run the algorithm on the data again and then compare its performance in order to know which gives the more accuracy.

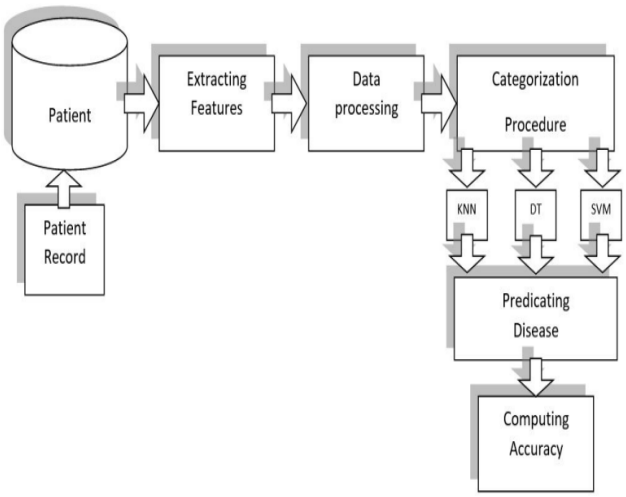

FIG 4. MACHINE LEARNING SYSTEM [1]

The patient record i.e., the test data along with the patient details is first collected. In extracting features block, the extraction process takes place where it selects the attributes that are needed for disease prediction. The dataset is then selected and process after the selection of attributes in data processing block. Further, in categorization procedure, various algorithms like KNN, DT, SVM as shown in figure no. 3 can be applied to pre-process the data set to evaluate the accuracy of disease prediction. The accuracy and performance obtained by each classifier is then compared with each other in order to select the best classifier with highest accuracy.

Although Machine Learning has made disease detection easier, there are certain limitations too. In order to minimize the complications of data and to develop patterns which would easily visible to ML algorithms, the features are being extracted by the doctors. Also. When the data is in very huge quantity, it affects the accuracy and performance. So, when tremendous amount of data is involved, we opt for Deep Learning Algorithms.

3 DEEP LEARNING AND DISEASE DIAGNOSIS

A. Existing Techniques using Deep Learning

Deep Learning is a subset of Machine Learning. Limitations of Machine Learning led to the evolution of Deep Learning. The purpose of Deep Learning Techniques is to solve the problems end to end whereas machine learning methods required to break down the problem statement into sub parts and then solve each part and their final output is integrated at the end. Deep learning plays a crucial role in every field especially in medical image analysis. Deep learning refers to utilization of neural network models. A study done by J. Betancur and F. Commandeur expands the automatic prediction of obstructive disease from fast myocardial perfusion imaging (MPI) was done with the help of Deep Learning as compared with the total perfusion deficit (TPD) [8]. Another study done by R. Anderson, A. Biong, and D. A. Gómez-Gualdrón in "Adsorption isotherm predictions for multiple molecules in MOFs using the same deep learning model,''. They have trained a neural network i.e., a multilayer perceptron (MLP) for predicting of Adsorption isotherm for multiple molecules in MOFs [9]. Skin diseases are mostly external type of disease and is clearly visible as it affects the layers of human skin. But finding the internal reason behind this illness is important in order to cure it. A study done on skin disease by D. A. Shoieb, S. M. Youssef, and W. M. Aly, is by using SVM [10] approach as a classifier and used CNN in order to train the model using skin image data. The model detected the parts of skin that are infected and then extraction of features was done using CNN. They found that the result using Deep Learning technique produce higher accuracy than before. Diabetes is a chronic illness caused by hormonal imbalance in body. The rates of diabetic patients are increasingly. G. Swapna, R. Vinayakumar, and K. Soman [11]

represented a model for classified diabetic and normal heart rate signals using deep learning system. Features were extracted using CNN and HIV data was used as input in this model. SVM technique was used to classify the features. This system was used to predict diabetes using ECG signals and produce high accuracy of result. Another study was done by D. Sisodia and D. S. Sisodia [12] on early detection of diabetes disease, in which their main goal was to develop a model that can predict the possibilities of diabetics with maximum accuracy. Algorithms like Naïve Bayes, Decision Tree and SVM was used to detect diabetes at an early stage. Experiments was performed using the Pima Indians Diabetes Database. The result shows that the Naïve Bayes produces maximum accuracy of 0.76 compared with the previous models. This comparison was based on factors such as precision, F-measure and accuracy. K. H. Miao and J. H. Miao [13] invented a model based on enhanced deep neural network (DNN) for heart disease detection. The model was based on deeper multilayer perception framework in which the model classifies the data based on the training set. 303 test data were taken from patient suffering from coronary disease in order to study the performance of model. Their model produces 93% of sensitivity and 83% of accuracy.

COVID-19(coronavirus) disease is an infectious virus that easily get transmitted through droplets to many people when in contact with the infected person. The symptoms of this disease are high temperature, cold, cough, difficulty in breathing. Millions of people across the world have lost their life within 2 years because of this disease. Also, due to increasing number of cases rapidly and the shortage of medical kit, it becomes difficult to detect the presence of COVID and control it. The need of X-RAYS was arisen at that point. It became easy to detect COVID disease when researchers use X-RAYS with the help of AI. Lately. A deep-learning-assisted model is invented with four phases. They are – Data augmentation phase, pre-processing phase, stage-I, and stage-II deep network model designing. The model has been executed on 1215 X-RAY images. First, in stage I the model differentiates induced pneumonia, bacteria-induced pneumonia and normal/healthy people with accuracy of 93.01%. Then, the images detected with viral-induced pneumonia are passed to stage II for COVID 19 detection that has achieved accuracy of 97.22%. Overall, the result obtained by this model is accurate, precise, fast and reliable. Most often, doctors get confused between COVID 19 Disease and other lung infection and it becomes difficult task to diagnosis the correct disease. In order to avoid such confusion and for quick diagnosis, it can be possible using different deep models. Using chest X-ray pictures, we discovered a unique Convolutional CapsNet. With a binary classification rate of 97.24 % and a multi-class classification rate of 84.22%, the model produces accurate findings. A pre-trained deep neural network was employed to diagnose COVID-19 on chest CT images in this study. A brain haemorrhage is a type of bleeding that occurs within the brain and can be caused by tumour, a clot, or high blood pressure. When there is a haemorrhage, oxygen is unable to reach the brain cells, and the brain cells die quickly. A new convolutional neural network based on ResNet is also being developed to identify and forecast the kind of brain bleeding. To perform this research, 752,803 DICOM files were obtained. The model had a 93.3% accuracy rate.

B. Medical diagnosis process using deep learning

As previously indicated, the traditional automated diagnostic method relied on a machine learning system in which a clinical expert manually extracted features from diagnosis reports. However, extracting features from huge datasets might be problematic at times. As a result, as shown in Fig. 5, those methods suffered from a lack of accuracy and efficiency. Deep learning algorithms have a significant challenge when key data is missing. Medical research currently uses electronic health records, but there is no consistent method for evaluating EHRs, implying that the accuracy of automated diagnostic systems may be limited. The model will not work if the system fails to collect accurate data.

Sometimes, it becomes very difficult and complex to extract features from large datasets. And it then leads to decrease in accuracy and efficiency as well. This further can become an obstruction for accurate disease diagnosis and for proper treatment. In order to avoid this, a Deep CNN Model is used for detection. An artificial intelligence technique that mimics the workings of the human brain and creating patterns for decision making is known as deep learning [1]. Deep Learning is implemented using deep network which is nothing but neural networks with multiple hidden layers. There are 3 components of Deep Learning. i.e., Input layer, output layer and in between of them lies multiple hidden layers. As the name suggests deep learning convolutes an input deep until it finds a pattern. When the pattern is discovered, the process is repeated for each input. These patterns are then put together to get the output with maximum efficiency and accuracy.

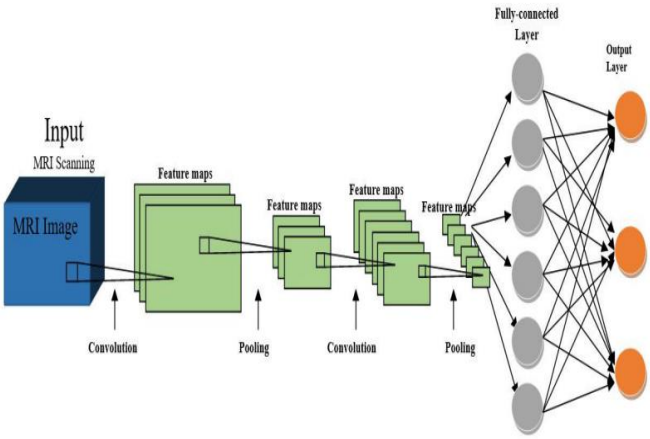

Fig.5 Deep Learning Process [1]

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The architecture system of Deep Learning consists input, output and there will be multiple hidden layers. These three parts are the components of Deep Learning. Through this input layers, we'll receive the input and it convolutes an input deep until it finds a pattern. When the pattern is discovered, the process is repeated for each input. These patterns are then passed to fully connected layer which is a very dense layer and there then are put together to get the output with maximum efficiency and accuracy.

III. EXPERIMENT AND RESULT.

A systematic review was carried out using the PRISMA approach (Preferred Reporting Items for Systematic Reviews and Meta-Analysis). In this procedure, data from the research included in the survey are collected and examined methodically before being critically assessed. Meta-analysis is a statistical, formal, quantitative research design technique for systematically evaluating and combining the data of included studies or earlier studies in order to reach a conclusion. In order to summaries information related to the efficacy and safety of medical care treatments with precision and confidence, researchers use systematic reviews and meta-analyses. The smallest collection of elements in a systematic review approach is based on evidence and meta-analyses that TABLE 1. Various published articles were chosen for the literature review, as well as their frequency. summaries and analyses reliable scientific material using a structure method based on specified questions that may be employed by a variety of scholars. Different findings and concepts that have been published in traditional papers by different scholars can be explored using a systematic review approach with a correct and full analysis. An investigator can use the PRISMA approach to conduct systematic reviews and meta-analyses with a high level of precision, allowing them to lead research in a well-structured manner

Publisher	Articles	Percentage
Elsevier	11	23.40
IEEE	18	35.29
Springer	10	19.60
ACM	5	9.80
BMC	1	1.96
IOSPress	1	1.96
BioMed central	3	5.88
Wiley online library	2	3.92
Total	51	100

TABLE 1. Different published articles selected for the literature review along with frequency.[1]

A. Literature Search

In this study, various 8 databases were extracted for accurate review: BMC, Springer, ACM, IEEE, Elsevier, Google Scholar, Wiley digital library and ACM were selected based on our research questions. Based on predefined questions and goals, the literature search was done by utilizing the keywords including ''fuzzy logic'', ''machine learning'', ''deep learning'', ''disease prediction''. Previous useful articles were extracted and recognized by a search strategy. For each of the journals listed in Table 1, the search approach has yielded results. 150 articles have been extracted and the detailed selection process is displayed using the PRISMA diagram in Fig. 6.

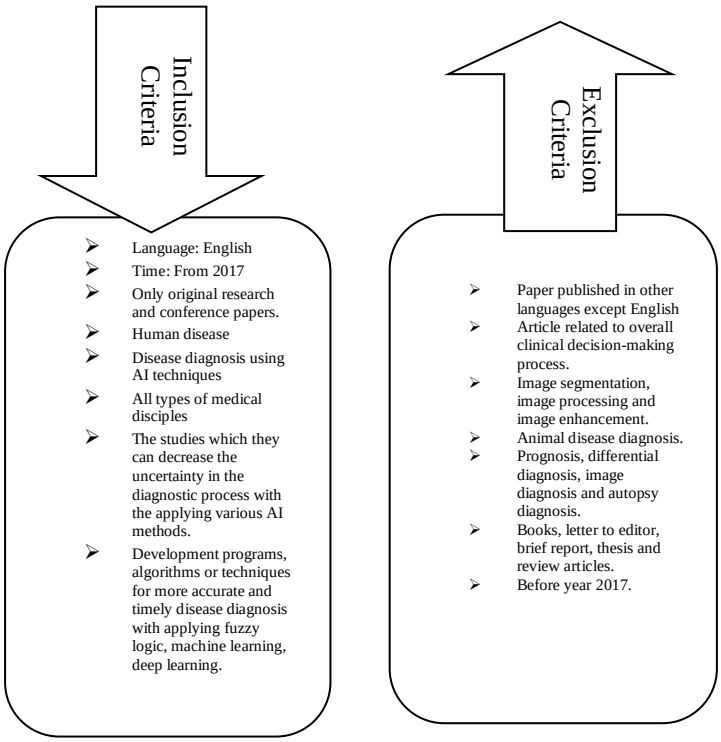

Fig. 6 Article selection process

B. Distribution of papers by journals.

In the study, 7 reputed journals have been selected to search for papers. Following table shows the various database providers. Table 1 shows the names of publishers which were selected, the number of articles selected and corresponding percentages. As shown in the Table 1, IEEE, Elsevier, Springer ranked first with 35.29%, 23.40% and 19.60% respectively.

C. Study selection and eligible paper

In this segment, the outcome of 14 research articles was taken into consideration. As shown in Fig. (article selection process) those research articles were chosen or taken into consideration based on inclusion and exclusion criteria. Only qualifying papers and chapters from books, theses, and summary reports were chosen based on the exclusion criteria. Journal editorials, newsletter and papers which were not in English were excluded. According to inclusion criteria, we considered the following criteria: reference of the author, year of publication, where it belongs to a journal or conference

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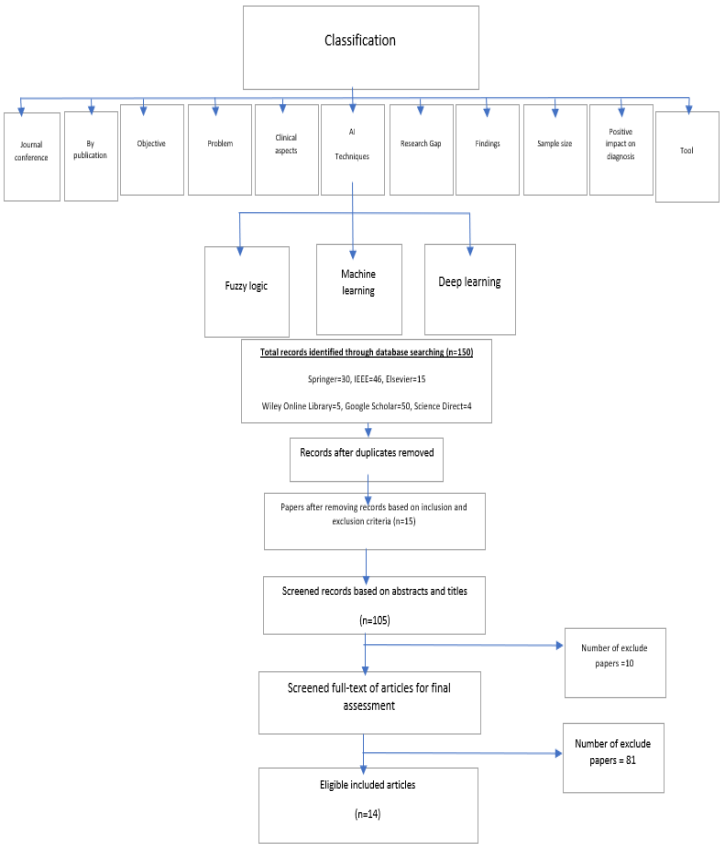
proceeding, the definition of the diseases; its types and complications, objectives, a loophole in the research, type of fuzzy methods used, type of machine learning methods used, type of deep learning methods used, results and concluding remarks. In connection with this, 15 academic papers were excluded and 105 articles included. After reviewing all collected articles, only 14 papers qualified the eligibility criteria from where relevant articles were chosen for in-depth analysis and study. Furthermore, we proceeded by scrutinizing the abstract and summary of the chosen articles to investigate whether the selected articles fully satisfy the inclusion criteria. All insignificant and unrelated articles were discarded in this stage. Similarly, all academic research papers which did not match the inclusion criteria of disease diagnosis were discarded while selecting appropriate articles. In total, 14 articles were qualified as per the inclusion criteria and were found to be compatible with our study and were taken into account in this systematic review. Table 2 contains the primary keywords used to search the relevant contents.

Database	Search Strategy
IEEE	(Fuzzy Logic, Machine learning, Deep learning) AND (Disease Diagnosis)
Elsevier	Pub-date > 2009 AND (AI Techniques) AND (Disease Diagnosis)
Springer	(fuzzy logic, Machine learning, Deep learning) AND (Disease Diagnosis) AND Publication Date: (01/01/2009 TO 01/11/2020)
BMC	AI techniques in Abstract AND Disease Diagnosis in Abstract
Taylor & Francis	(AI methods) AND (disease diagnosis)
Google Scholar	"AI methods" AND "Disease Diagnosis" anywhere in articles

TABLE 2. Search strategies in different databases [1]

D. Extraction and Summarizing of Data.

In the last stage, we reviewed all the papers which consisted of 14 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. 7. 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.



Fig, 7 Prisma Method For Research

IV. DISCUSSIONS AND FUTURE RESEARCH DIRECTIONS

A. Lesson learned with research findings.

To begin, we determined which processes had the biggest impact on disease detection and performed our research with that goal in mind. As a result, we investigated acceptable categories for the study of AI approaches such as fuzzy logic, machine learning, and deep learning. Deep learning is quite popular among today's scholars, especially in the field of medical science, according to the findings. Different AI approaches have limits in detecting certain diseases or producing useful results.

However, we attempted to review the top studies using various AI strategies to treat diseases such as cardiology, diabetes, dental difficulties, ARTHRITIS, kidney disease, skin cancer, and breast cancer. This research added to our

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knowledge of how successful AI approaches are in diagnostic examinations. As a result, those working in clinical areas will benefit from this research. Furthermore, we were able to determine which areas and disorders utilized AI approaches and which were neglected based on the findings of this study. For available articles that used fuzzy logics, machine learning, or deep learning, a brief overview of the reviewed studies is also provided in Table. 3, Table 4, Table 5.

Table 3. Review of the fuzzy logic method

study	disease	Research goals	methodology	findings
[4]	Diabetes Disease	Early identification of pre-diabetes and comparison of results with the crisp approach	The fuzzy logic-based associative categorization technique is used.	The proposed method can better understand particular risk factors including Age, Glucose, DPF, BMI, and BP, as well as its proper dangerous assessments, to predict pre-diabetes than the previous method.
[5]	Dental Disease	DDS was the system that was created to solve the problem of dental diagnostics.	They used a semi-supervised fuzzy clustering technique to perform the segmentation process.	The DDS algorithm's accuracy is compared to that of other algorithms. DDS outperformed other algorithms such as prim spanning tree, fuzzy KNN, and affinity propagation clustering by 0.92.

Table 4. Review of the machine learning method

study	disease	Research goals	methodology	findings
[6]	Kidney Disease	By utilising clinical data, assist clinicians in determining the most effective treatment strategies for chronic renal illnesses.	KNN, SVM, decision tree classifiers, and LR are the four types of machine learning methods that have been developed so far.	In comparison to the other three approaches, SVM has the highest sensitivity of 0.99, whilst the sensitivity of Logistic is 0.94, Decision Tree is 0.93, and KNN is 0.96.
[7]	Breast Cancer	The performance of various machine learning algorithms, such as SVM, was compared in this study. On the Wisconsin Breast Cancer datasets, decision trees, NB, and K-NN were used. Following that, the efficiency and efficacy of all algorithms in terms of precision, accuracy, and specificity in classifying data are documented.	WEKA data mining tool.	SVM is found to perform better with the maximum degree of accuracy at 97.13 percent and the least amount of ambiguity.
[8]	ARTHRITIS	Construct a model to analyse the expected improvement in patients with arthritis	On the arthritis dataset The WEKA approach is used in conjunction with the simple CART Algorithm.	This strategy aids in the treatment of more serious cases of Arthritis or the resolution of its problems.

Table 5. Review of the deep learning method

study	disease	Research goals	methodology	findings
[10]	Skin cancer	Human examination can be difficult to detect melanoma in its early stages. As a result, an automated method was required to aid in the early detection of skin cancer.	A multiclass liner Support Vector Machine has been used to create a classifier system. This system was trained using CNN features derived from a dataset of skin photographs.	The accuracy, specificity, and sensitivity of this system's output were all extremely high.
[11]	Diabetes	Using deep learning frameworks, this study provided an approach for classifying diabetes illness HRV signals.	ECG, CNN, and LSTM are all terms used to describe heart rate variability.	ECG signals were produced to help doctors diagnose diabetes. It has a precision of up to 0.95.
[12]	Diabetes	The purpose of this study is to offer a framework that may accurately predict the possibility of diabetes in people.	Naive Bayes, SVM, and decision tree	The findings indicate that Naive Bayes excels with a precision of 0.76.
[13]	Heart disease	The goal of this research was to develop deep neural network learning to diagnose patients and assist clinical experts. It improves the accuracy and consistency of cardiac disease diagnosis and prognosis in patients.	Deep neural network learning.	The model achieves 0.83 accuracy, 0.93 sensitivity, and 0.79 precision.

B. Future tendencies and open issues.

1. EXPLAIANABLE DIAGNOSIS:

AI models are frequently blamed for their internal, complex decision-making process. AI systems should include world causal models to aid in explanation and comprehension. This is certainly relevant when looking for AI applications in medical diagnostics. According to the researchers, it is critical to look beyond explainable AI. Causability will eventually lea d to an explainable diagnostic that includes measurements for explanation quality.

2. TRAINING OF HIGH QUALITY:

To attain the requisite diagnostic capabilities, machine learning and deep learning algorithms rely heavily on the availability of high-quality training models. Furthermore, because data is at the heart of AI- based medical applications, the issue of data insufficiency is critical. Alternative methods, such as information augmentation and picture synthesis, have been used to provide additional annotated information. However, whether they are suited for AI- based medical diagnostics remains unclear.

3. CLINICAL TRANSLATION:

The use of AI- based systems in healthcare settings will go through several stages and transformations, with many more techniques to come. As previously stated, current research focuses mostly on improving the performance of complex machine learning models while ignoring their explainability. As a result, physicians find it difficult to evaluate these models and believe they are untrustworthy. As a result, it's critical to have dependable and trustworthy connections between medical professionals and AI model experts in order to turn AI- based diagnostic potentials into clinical practice.

4. MEDIAL DATA CHARACTERISTICS:

Medical data is typically large, comes from a variety of sources, and is frequently collected via real-time sensors. As a result, maintaining data quality is a difficult job. With more mobile sources for medical data being used, and complicated applications requiring remote access to healthcare data, storing it in the cloud appears to be a more plausible choice. Despite the fact that several solutions have been offered to address concerns with cloud storage, none of them can accurately handle all elements of medical data characteristics due to the added necessity to maintain compliance with medical data security rules.

5. INTEROPERABILITY AND STANDARDIZATION:

In the area of diagnosis, there are numerous ways for manufacturers to provide a broad range of diagnostic products while integrating a set of AI algorithms chosen from a variety of options. They may not, however, adhere to conventional standards and regulations for interoperable interfaces and protocols across various computing systems. Interoperability concerns arise as a result of this. To address system diversity, immediate initiatives to establish technical standards for AI-based medicine and diagnosis are essential. Various technical and medical organizations, such as the AI group operated by the International Organization for Standardization, the World Health Professionals Alliance, and the World Health Organization, can collaborate in this aspect.

6. SECURE DIAGNOSIS:

Improper hyper parameter selection, even if only slightly alter ed, can cause a significant change in model performance, Resulting in poor diagnosis. Also, in order to be used for other diseases, the algorithms must be retrained with relevant medical data; otherwise, incorrect diagnoses will be unavoidable.
Another key feature of secure diagnostics is the protection of d iagnostic systems against wrongdoers. To break the system, th e attackers take use of the AI algorithms' features. An enemy, for example, could tamper with thetraining parameters and lead the diagnostic system to learn the opposite of what it should. As a result, it's critical to research the properties of AI algorithms in depth, rethink their roles in diagnostic systems, and address the associated issues.

V. CONCLUSION

We explored the potential that an AI expert system can help a human doctor make a better decision or, in some situations, even replace human judgement. Various AI algorithms can assist in the extraction of meaningful information from enormous amounts of clinical data. Furthermore, AI approaches are trained in such a way that they can self-learn, rectify errors, and generate high-accuracy outcomes. The utilization of three AI techniques in disease diagnosis is the subject of this survey. With the PRISMA technique, we examine the influence of AI technologies and their consistency on disease diagnosis to minimize errors in misdiagnosis. We devised a search technique to achieve the primary goal. Another goal of this study was to see which AI technology was the best successful for disease diagnosis according to the majority of the researchers. Based on our findings, we concluded that using AI in healthcare improves the diagnosis process and allows for early detection of disease, allowing for the selection of the most appropriate treatment plan. Another important point to remember is that we looked into three AI approaches (fuzzy logic, machine learning, and deep learning) that are commonly utilized in healthcare and applied these three methods to produce our results. In addition, the impact of each AI technique was evaluated based on the frequency of influence recorded on paper.
Aside from that, we noticed that the papers varied greatly depe nding on the condition.

We may use several AI techniques to detect every type of dise ase or to improve the diagnosis process for all diseases, as sho wn in this study. As a result, we may conclude that this survey will be beneficial in future study. Furthermore, we see in this research paper that over 91 percent of AI algorithms indicated a positive outcome. Another important conclusion in this paper is that most researchers construct AI architecture using technologies like MATLAB, Python, Java, and C#. There are some drawbacks to this study. In future investigations, we plan to look at diagnosis in a broader sense to see if AI methods can be used to diagnose Alzheimer's illness and Parkinson's disease. Furthermore, the functions of AI approaches in diagnostics systems based on sensor based computing frameworks will be examined. Our future work will also include an in-depth analysis of AI's economic influence in health care.

VI. REFERENCE

1. Medical Diagnostic Systems Using Artificial Intelligence (AI) Algorithms: Principles and Perspectives
2. A. Rajeswari, M. S. Sidhika, M. Kalaivani, and C. Deisy, ‘‘Prediction of prediabetes using fuzzy logic-based association classification,’’ in Proc. 2nd Int.

Conf. Inventive Commun. Comput. Technol. (ICICCT), Apr. 2018,

3. H. Son, H. Fujita, N. Dey, and A. S. Ashour, ‘‘Dental diagnosis from X ray images: An expert system based on fuzzy computing,’’ Biomed. Signal Process. Control, vol. 39, pp. 64–73, Jan. 2018.
4. M. Sinha, J. Jupe, H. Mack, T. P. Coleman, S. M. Lawrence, and S. I. Fraley, ‘‘Emerging technologies for molecular diagnosis of sepsis,’’ Clin. Microbiol. Rev., vol. 31, no. 2, Feb. 2018.
5. A. Charleonnan, T. Fufaung, T. Niyomwong, W. Chokchueypattanakit, S. Suwannawach, and N. Ninchawee, ‘‘Predictive analytics for chronic kidney disease using machine learning techniques,’’ in Proc. Manage. Innov. Technol. Int. Conf. (MITicon), Oct. 2016, p. 80.
6. H. Asri, H. Mousannif, H. A. Moatassime, and T. Noel, ‘‘Using machine learning algorithms for breast cancer risk prediction and diagnosis,’’ Procedia Comput. Sci., vol. 83, pp. 1064–1069
7. N. Bhargava, R. Purohit, S. Sharma, and A. Kumar, ‘‘Prediction of arthritis using classification and regression tree algorithm,’’ in Proc. 2nd Int. Conf. Commun. Electron. Syst. (ICCES), Oct. 2017, pp. 606–610.
8. J. Betancur and F. Commandeur, ‘‘Deep learning for prediction of obstructive disease from fast myocardial perfusion SPECT: A multicenter study,’’ JACC: Cardiovascular Imag., vol. 11, no. 11, pp. 1654–1663, 2018.
9. R. Anderson, A. Biong, and D. A. Gómez-Gualdrón, ‘‘Adsorption isotherm predictions for multiple molecules in MOFs using the same deep learning model,’’ J. Chem. Theory Comput., vol. 16, no. 2, pp. 1271–1283, 2020.
10. D. A. Shoieb, S. M. Youssef, and W. M. Aly, ‘‘Computer-aided model for skin diagnosis using deep learning,’’ J. Image Graph., vol. 4, no. 2, pp. 122–129, Dec. 2019.
11. G. Swapna, R. Vinayakumar, and K. Soman, ‘‘Diabetes detection using deep learning algorithms,’’ ICT Exp., vol. 4, no. 4, pp. 243–246, 2018.
12. D. Sisodia and D. S. Sisodia, ‘‘Prediction of diabetes using classification algorithms,’’ Procedia Comput. Sci., vol. 132, pp. 1578–1585, 2018.
13. 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.
14. 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.

[1] B. Corona, M. Nakano, H. Pérez, “Adaptive Watermarking Algorithm for Binary Image Watermarks”, Lecture Notes in Computer Science, Springer, pp. 207-215, 2004.

[2] A. A. Reddy and B. N. Chatterji, "A new wavelet based logo-watermarking scheme," Pattern Recognition Letters, vol. 26, pp. 1019-1027, 2005.

[3] P. S. Huang, C. S. Chiang, C. P. Chang, and T. M. Tu, "Robust spatial watermarking technique for colour images via direct saturation adjustment," Vision, Image and Signal Processing, IEE Proceedings -, vol. 152, pp. 561-574, 2005.

[4] F. Gonzalez and J. Hernandez, " A tutorial on Digital Watermarking ", In IEEE annual Carnahan conference on security technology, Spain, 1999.

[5] D. Kunder, "Multi-resolution Digital Watermarking Algorithms and Implications for Multimedia Signals", Ph.D. thesis, university of Toronto, Canada, 2001.

[6] J. Eggers, J. Su and B. Girod," Robustness of a Blind Image Watermarking Scheme", Proc. IEEE Int. Conf. on Image Proc., Vancouver, 2000.

[7] Barni M., Bartolini F., Piva A., Multichannel watermarking of color images, IEEE Transaction on Circuits and Systems of Video Technology 12(3) (2002) 142-156.

[8] Kundur D., Hatzinakos D., Towards robust logo watermarking using multiresolution image fusion, IEEE Transcations on Multimedia 6 (2004) 185-197.

[9] C.S. Lu, H.Y.M Liao, “Multipurpose watermarking for image authentication and protection,” *IEEE Transaction on Image Processing*, vol. 10, pp. 1579-1592, Oct. 2001.

[10] L. Ghouti, A. Bouridane, M.K. Ibrahim, and S. Boussakta, “Digital image watermarking using balanced multiwavelets”, *IEEE Trans. Signal Process*., 2006, Vol. 54, No. 4, pp. 1519-1536.

[11] P. Tay and J. Havlicek, "Image Watermarking Using Wavelets", in *Proceedings of the 2002 IEEE*, pp. II.258 – II.261, 2002.

[12] P. Kumswat, Ki. Attakitmongcol and A. Striaew, "A New Approach for Optimization in Image Watermarking by Using Genetic Algorithms", *IEEE Transactions on Signal Processing*, Vol. 53, No. 12, pp. 4707-4719, December, 2005.

[13] H. Daren, L. Jifuen,H. Jiwu, and L. Hongmei, "A DWT-Based Image Watermarking Algorithm", in *Proceedings of the IEEE International Conference on Multimedia and Expo*, pp. 429-432, 2001.

[14] C. Hsu and J. Wu, "Multi-resolution Watermarking for Digital Images", *IEEE Transactions on Circuits and Systems- II*, Vol. 45, No. 8, pp. 1097-1101, August 1998.

[15] R. Mehul, "Discrete Wavelet Transform Based Multiple Watermarking Scheme", in *Proceedings of the 2003 IEEE TENCON*, pp. 935-938, 2003.

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