

EXPERT SYSTEM TO DIAGNOSE HEART DISEASE USING SOFT COMPUTING TECHNIQUES

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By

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TOPIC APPROVAL PERFORMA



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ABSTRACT

There are numerous Artificial Intelligence (AI) techniques that are being applied within certain applications in such a manner that the requirements are satisfied. Providing solutions to the issues which simulate human behavior of experts used within the specific areas is done with the help of Expert Systems (ES's). The Shells are used in order to generate the ES which are further utilized by the users. The expert system can be designed using the technique of artificial intelligence. The fuzzy logic is the technique of artificial intelligence in which output is generated on the basis of given inputs. In this research, the heart disease prediction expert system is designed on the basis of certain parameters. To increase efficiency of the system, ECG parameter will be added in future which increase accuracy of heart disease prediction.

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DECLARATION STATEMENT

I hereby declare that the research work reported in the dissertation entitled " EXPERT SYSTEM To DIAGNOSE THE HEART DISEASE USING SOFT COMPUTING TECHNIQUES" in partial fulfilment of the requirement for the award of Degree for Master of Technology in Information technology at Lovely Professional University, Phagwara, Punjab is an authentic work carried out under supervision of my research supervisor Mrs. Vishu Madaan. I have not submitted this work elsewhere for any degree or diploma.

I understand that the work presented herewith is in direct compliance with Lovely Professional University's Policy on plagiarism, intellectual property rights, and highest standards of moral and ethical conduct. Therefore, to the best of my knowledge, the content of this dissertation represents authentic and honest research effort conducted, in its entirety, by me. I am fully responsible for the contents of my dissertation work.

Signature of Candidate

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SUPERVISOR'S CERTIFICATE

This is to certify that the work reported in the M.Tech Dissertation entitled **“DIAGNOSIS OF HEART DISEASE USING SOFT COMPUTING TECHNIQUE”**, submitted by **Sumit Sharma** at **Lovely Professional University, Phagwara, India** is a bonafide record of his / her original work carried out under my supervision. This work has not been submitted elsewhere for any other degree.

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Introduction

1.1 Introduction to Expert Systems

There are numerous complex issues arising within the research areas which are needed to be solved. There are numerous Artificial Intelligence (AI) techniques that are being applied within certain applications in such a manner that the requirements are satisfied. Providing solutions to the issues which simulate human behavior of experts used within the specific areas is done with the help of Expert Systems (ES's). The Shells are used in order to generate the ES which are further utilized by the users [1]. There are some questions provided to the users which are answered by them and then final results are presented. This helps in generating a Shell that further helps in generating the Expert System. An expert system is the one which:

- Helps in solving the complex issues of real world that need the interpretation of an expert within them.
- A computational model is used for solving these problems which has a proper logics just like a human experts because the human have to add the knowledge according to their perspective to the system. The similar conclusions that would be met by a human expert if he faced these problems are to be met here.

The expert of the particular domain is a person which goes through the different training processes and with the help of experience they gain proper knowledge in a particular area as same as compared to human knowledge. He is very efficient in doing the different thing that others cannot do. The experts have the useful information for Expert Systems(ES) to represent the reliability and accuracy of human experts. It also have the ability to make the solutiojns og the problems with its creativeness. That makes it more accurate with results to more efficient. This ability of representing the set of rules which can be used by the experts to recognize and make the solution for the problem .The application of expert systems will allow to reach the solution with economical way.

1.2 Limitations of ES: Some of the limitations are given below [3]:

- Don't use the common sense in making decision

- Creative Responses are not there as humans
- Knowledge is not always readily available.
- Unable to recognize when there is no output or answers. .
- Time pressure is there.
- Users have some limits.
- Expert System able to work well within particular domain with the use particular knowledge.
- Due to the lack of independent means the experts system will unable to check the output results.
- It is difficult to understand with lack of vocabulary.
- It is very costly and the knowledge require from the experts is very difficult.
- End user should not have to take risk by depending only on the systems knowledge.
- Biases in transformation of Knowledge.

1.3 Success factors are [4]:

- Level of knowledge must be high.
- Increases the accuracy by avoiding the human errors
- The process of decision making should be centralized
- Reducing the manpower which automatically reduces the cost
- Experts must be available at least one expert is needed to complete the work.
- The problem to be solved must be fuzzy.
- The user interface needs to be friendly to any users.
- Developers with good knowledge and skills are needed.
- Favorable impact should be there.
- Support of Management must be needed.

1.4 Applications

- **Engineering & Manufacturing:** The result of advance technologies provides different applications for different fields of studies like engineering, medical science etc. that can not be explained easily. Nowadays some of the technical products are found everywhere

which makes our life easier and comfortable. Example:- vehicle that are used to save the time of distance travelled, remote control are used to operate the machine from the long distance, etc.

- **Medical:** In The field of medical sciences, the technology also used in treatments. The expert system is used in the medical field for consultation to detect the disease and provide appropriate diagnosis. All medical experts are not have proper experience to handle the patient. So, the expert system can also be used to detect the disease in an accurate manner with less error. For example:- The concept of PHR is increases day by day in which the user can online check their status of health. The use of technology in medical field saves the patient's life.
- **Management:** In the field of Management, Expert systems are building to provide the ease of doing business in organization. It helps different departments of organization such as CEOs, Deputy Mangers, accountant, consultant, etc. In development of the expert system in the field of management will help to solve the in strategic planning such as budget controlling, share market, export and import[6].Expert systems is very useful in modern businesses.
- **Military:** The technologies used in an artificial intelligence(AI) for military purposes and are widely used because they are durable, efficient and more reliable. It is more helpful in dealing with the security , operational issues, control and maintenance, training areas etc [7]. The ability of an expert system is to solve many major problems for the military .
- **Education & Training:** Currently education teaching processes and training applications that are well developed by advanced technology to make the education easy and more interesting. Teachers would teach by chalk-talk method in which the teacher teaches with the help of a chalk, board and explain the concept. The students were just listening to them and according to their explanation they make their note [8]. Therefore some researchers has have developed an expert system which is very useful for teaching and learning methods.

1.5 Design challenges for efficient expert system:

1. Do not have sufficient knowledge of their domain which means that the system does not understand like humans.
2. Do not have proper flexibility in the system as the problem occurs in the system that is not contained in their knowledge databases and cannot be able to
 - Solve that particular problem which is out of the knowledge bases,
 - Recognize their inability to solve the problem,
 - Will not be able to develop a strategy to solve the problem;
3. Inability to provide deep explanations on the subjects. [9]
4. Verification is very difficult;
5. Systems will not be able to learn from the experience as they need some experts or knowledge databases.

1.5.1 Development and run-time programming environments:

AI LANGUAGES AND ENVIRONMENTS:

Implementation of the project is the next stage for developing the expert system in which the programs are checked. Applications projects in Artificial Intelligence (AI) are mostly implemented with the combinations of high-level programming languages. That are:

- Use of Normal programming languages
- Representation languages for general purposes
- Expert system frameworks are independent of framework

1.5.2 Knowledge acquisition:

This includes the method for acquiring the knowledge with the help of experts. Having an expert is one of the major steps because without the help of an expert there is no existence of an expert system. Which includes the three major steps for gathering the knowledge.:-

- Topic idea must be identified

- Must be clear about the concepts that are used in that topic
- The idea must have proper algorithm to reach its optimal solution

This focus on the first step of developing the expert system by gathering the knowledge with the help of experts .

1.5.3 Selection of task and their different development stages:

Selection of the task is done carefully so that it must embed the expert system which must be necessary for the development of the expert system and its successful implementation. Different methods are used to choose the projects. After the selection of the topic , the researcher will able to write the summary about the task which help to obtain the result with optimal solutions [12]. This method includes the initial stage i.e. identificaton. The task to be modeled in an expert system must be:

- Topic or task must be clearly explain in detail
- To obtain the accuracy of result the reasons should be appropriate

1.6 Fuzzy Logic and Neuro fuzzy:

The concept of Fuzzy set is proposed by Zadeh [14] and it is a concept for modeling human reasoning uncertainty. Fuzzy logic is suitable to represent the vague data and concepts of an intuitive basis, just like human language description, e.g. the expressions such as approximately, large, young. The conventional set, also called the crisp set, which can be treated as a special form of fuzzy set. Fuzzy logic uses of membership Functions which is not in binary logic. A fuzzy set is determined from its membership function (MF), and it is also related to the human linguistically meaningful term.

Fuzzy logic is mathematical related term. Fuzzy reasoning is a formalization to encode the human knowledge or common sense in a numerical terms and Fuzzy Inference System(FISs) can approximate arbitrarily well any continuous function on a compact domain [15]. FISs and feed forward neural networks (FNNs) can approximate each other in terms of degree of accuracy. Fuzzy logic is found to be popular applications in control systems, where an Fuzzy Inference Systems(FIS) is developed by codifying the human knowledge in the way of linguistic IF-THEN rules.

Neuro Fuzzy:

The development of fuzzy system in terms of performance is not an easy task. The fuzzy systems become popular in industrial application and its problem to find the membership functions(MF), appropriate rules is very time consuming technique with errors. In order to remove the issues of fuzzy systems one researcher has proposed a idea to apply the learning algorithms on fuzzy systems [16]. To support or automate the development of tuning fuzzy systems has presented an alternative to use neural networks that have efficient learning algorithms. In 1991, jang, Lin and Lee have stated working on neuro-fuzzy systems. They have used it in application of process control. Further, data analysis and classification, imperfections of detection and decision-making, etc., applications have also started using neuro fuzzy [17]. I order to remove the issues of neuro and fuzzy systems they both can be combined to use their advantages. The interpretation and clarity of systems representation has been achieved by adding computational characteristics of neural networks into fuzzy systems. The use of neural network capacities will help in compensating the disadvantages of fuzzy systems.

1.7 Why heart disease detection is needed

The problem of heart attack is also named as heart stroke occur due to its reduction, not proper supply artery over certain period, its leads to major heart problems which, when if ignored or cannot be treated can lead to death of tissues.

Heart disease occurs when a plaque substance builds up in arteries and this can be develop in anyone including children. This result in reducing blood flow in heart due to the size of arteries that reduces with time. The risk rate of having heart disease increases by smoking, eating an unhealthy diet and not getting enough exercise [18].

The risk of heart diseases also increases by having high cholesterol, high blood pressure, or diabetes. There is need to concern with doctor in order to prevent and treating with those medical conditions. According to CCS,2010 the average morality rate of annual report of heart failure is 10% year. (CCS, 2010).

The major cause of death now a days is due to the heart disease or (CVD), the survey represents nearly 30% of deaths only because of heart disease or cardiovascular disease. On Worldwide level, about 17.5 million people die because of Heart Attacks every year, according to the WHO

[19]. After the death of person because of heart attack there family members could not even the major cause of pain because they don't they considered as a normal pain. They can think the pains developed due to some other physical problem or disease like fatigue or other problems. So it can minimize the casualties , if we properly know that from where the pain occurred .

Our Heart condition can be measured by using stethoscope to measure the beats of the heart per minute. Usually, have four types of heart sound from which the first two heart sound is audible and two is not audible. So, all these factors show that there is need of detecting heart diseases. If patient will be able to detect it then a precautions and medication can be taken that help in saving his/her life.

1.8 The risk factors due to which they are caused:

1.8.1 Lipids

- **Total cholesterol :** Total cholesterol is the ratio of good cholesterol (HDL) and Poor cholesterol (LDL) ranges in men and women which are similar up to the age of of bith adults.i.e. 20yrs [20]. As compared to some decades, cholesterol levels there is rapid increase in men as compared to women.

1.8.2 Smoking:

Smoking is the major risk factor for the development of Coronary Heart Disease(CHD). In the United States(US) of America, nearly 24% of women and 28% of men that are at the age of 18 years and are current smokers have higher possibility of having heart disease[21]. Second hand smokers are those who inhale the smoke of the cigarette from the smoke exhausted by the smoker. Number of cigarettes smoked and the increase of risk of Coronary Heart Disease shows the relationship of dose and response relationship. The Heart risk is increased in the persons that are more smokers as the smoke can make a pressure in the arttries and in the chest which may leads to heart disease.

1.8.4 Diabetes:

Diabetes is also major risk factor for Coronary Heart Disease(CHD).due to which the person have 50% of chance to have diabetes. Near about 80% of adult who are suffering from the

diabetes have cardiovascular diseases or heart disease, and near about 75% of the deaths are caused by coronary Heart Disease [23].

1.8.5 Obesity:

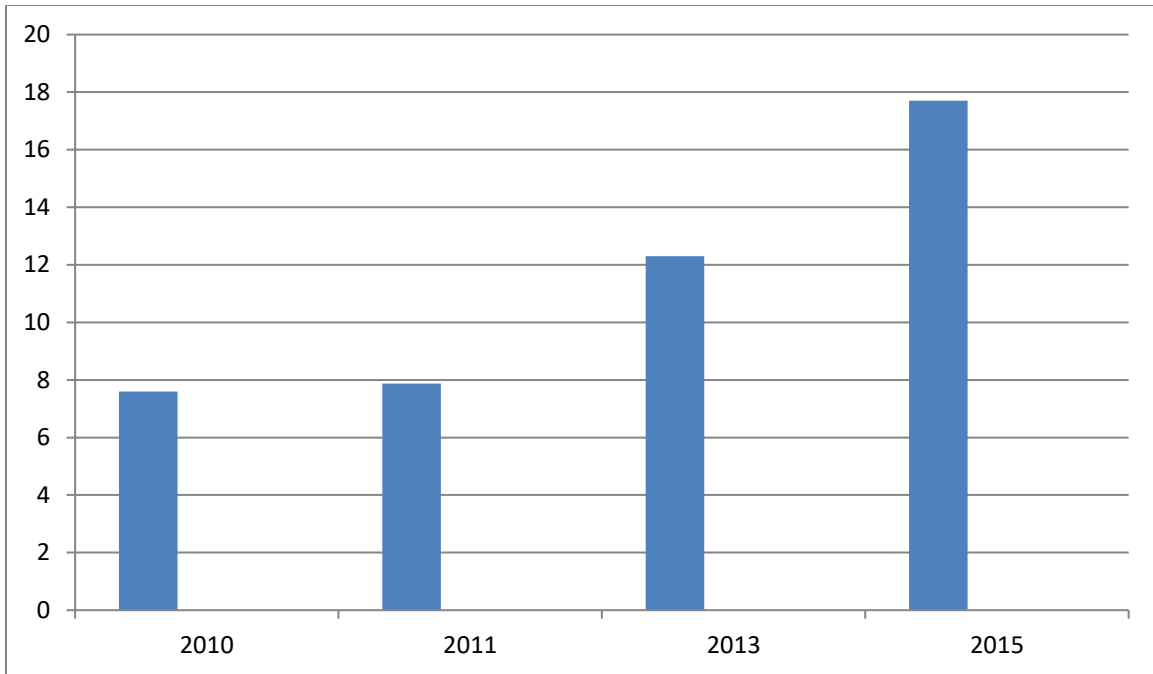
Obesity is an independent risk factor for Coronary Heart Disease(CHD) in both women as well as in men. Willet and colleagues [24] have data from the Nurses' Health Study that even women with a increased body mass index(BMI of:- 25 and 29 kg/m) had twice the risk of Coronary Heart Disease(CHD) as the leanest women (body mass index ,21 kg/m). So the obesity, the distribution of fat in the body is a major factor to predict cardiovascular risk.

1.8.6 Family history: Family problem relayed to CHD has been studied in both women and men [25]. Research that is done on family history shows that the patient who have the cardiovascular disease int their family members may have the possibility of 10-20% in them. So the family history can be taken as the risk factor to predict the heart disease or cardiovascular disease . But this risk factor is complicated by the methodology of logical factors such as identify the disease in their family history because some have minor problem which some patient don't even know the the existence of the particular disease in their family.

1.9 Analysis of number of deaths caused due to heart diseases:-

The statistics speak for themselves. It has been seen that number of heart disease is getting increased by years. It has been reviewed that number of deaths was 58 million in year 2005 out of that 30% accounted for cardiovascular disease.

In year 2010, death rate was 7.6 in million then it increase to 7.8 million in 2011. It has been analyzed by World Health Organization (WHO) that death rate has been drastically increased from 7.8 to 12.3 million. There was death rate of 17.7 million in year 2015 and it has been estimated by WHO that its number will increase by 23.6 million in year 2030.



Graph. 1: Graph comparing death rates over the years (for cardiovascular disease)

1.10 Types of classifiers:

- k-Nearest Neighbor(KNN) Classification Technique:** In this classifier, the pattern of Y is classified by assignment of class. The class with minimum average distance is used to assign a test pattern that shows that this method is sensitive to distance function. The Euclidean distance metric is employed for getting minimum average distance [26]. All features are normalized into same range this is the main requirement of this metric approach. The k-nearest neighbor classifier is a conventional nonparametric classifier that is said to yield good performance for optimal values of k .
- Bayesian Classifier :** In supervised parametric classifiers theory, most general approach used is quadratic discrimination. When dealing with d -dimensions the obtained decision boundaries by these classifiers can become very complicated. Most of the discriminant function generation computation has been done off-line. This approach can be more affected by curse of dimensionality as in this quadratic discriminant a large number of

parameters need to be considered. In case of small training samples its performance is affected drastically.

- **Multi-layer Perceptron (MLP) Classification Technique:** The multi-layer perceptron classifier is a feed forward network in ANN. In which they used single layer and have used a single hidden layer for accurate and reliable performance of the classification. The hidden weights were selected differently for each data set. The number of neurons present in the hidden layer was found out with the help of experiment by doing some practice.
- **SVM Classification Technique:** SVM is a technique for the classification in which the different algorithm which is generally based on technique of optimization [28].where the object is viewed on n-dimensional vector. Which gets separated the objects with the n-dimensional hyper plane. This method is separation of object is called linear classifier. More than one hyper plane is used to classify the data

Objective Of Study

The proposed system is developed to diagnose the different heart diseases by using soft computing techniques. This helps to predict the risk factor getting the particular disease related to heart. The proposed system gets the different inputs from the user like age, gender, Blood pressure(BP), Heart Beats, Chest Pain, Smoking Habits, family History, Diabetes Test, Lipid Profile Test And EC that increases the accuracy ..

Following are the various research objectives of this study

1. To study and analyze various fuzzy based techniques to design expert system
2. To proposed improvement in existing fuzzy system for the heart disease prediction
3. The proposed improvement will be based on the add ECG parameter in the fuzzy system
4. Implement proposed system and compare with existing system in terms of various parameters

Scope Of Study

- Passing the knowledge to upcoming generations in the medical field or either in the information technology that would help to extend their services in the field of medical diagnosis.
- Use of the ECHO, ANGIOGRAPHY, SCANNING as an input to detect the more heart disease that are major cause of death.
- Diagnose the other heart diseases which are costly to operate and so that at the initial stage the disease can be detected.
- The doctors can also this system to assist their juniors for their regular practice.
- Can also be extended by using PHR technique through which the user must aware about their health. PHR is technique which is done taking patient's routine data like FOOD (Breakfast, lunch, dinner), Workout, cholesterol report, appointment by the doctor etc and the system will analyze and provide the notification of what the patient have done in the whole day and how they can balance their health Example:- if the person eats more calories then the notification occurs you have to do more exercise.

Literature Review

S. Amrollahi Biyouki, et.al (2015) presented in this paper a fuzzy rule-based expert system in order to diagnose the thyroid disease. There are three steps involved within this proposed system which are pre-processing that is also known as feature selection, the neuro-fuzzy classification as well as the system evaluation. The vagueness and uncertainty of the final decision is computed through the diagnosis process carried out within the proposed system. The fuzzy logic was used to control the imprecise knowledge available. The k-means algorithm was used to first create the initial fuzzy rules within the neuro-fuzzy classification step. The optimum values of parameters were further determined with the help of scaled conjugate gradient algorithm (SCG). The modulation and evaluation of the system was done in the final step with the help of generated fuzzy rules. The non-experts who were doubted to have thyroid function were identified through this system along with the people who were diagnosed of having this disease. This helped the experts as well as the non-experts to provide diagnosis to people suffering [29].

Assemgul Duisenbayeva, et.al (2016) presented in this paper the various problems that are arising during the design of Fuzzy Expert System in order to diagnose the cardiovascular diseases. The fuzzy variables are utilized as inputs and outputs in order to construct these systems. The results are achieved here as the number of people in which the disease is identified. The application of Fuzzy logic concepts in order to solve such issues with the generation of fuzzy expert systems is presented in this paper. Each input and its parameter was generated depending on the knowledge of the professional using the Fuzzy Expert System. The decisions of the physicians are made on the basis of this system which the time for identifying the disease can be minimized. This will help in preventing the faults to occur [30].

Novita Hanafiah, et.al (2015) presented in this paper the study which is related to Discus Fish. This type of fish is known for its beauty and unique features related to its style, color and shape. Due to its high price, this fish is exported overseas for providing profitable business to the farmers. However, this fish is susceptible to numerous diseases which make it difficult to handle it. This issue is resolved by diagnosing the diseases of discus fish with the help of an expert system that uses fuzzy logic in it. The main concern here is to detect the disease at the earliest so

that they can be diagnosed. In order to prevent and treat the Discus fish, this desktop-based application can be exploited which can result in providing more important information. As per the conducted experiments and the results achieved it is seen that there is higher accuracy achieved with the application of this proposed algorithm [31].

Genady G. Kalach, et.al (2016) presented in this paper various algorithms that are utilized for implementing the loosely coupled navigation system. The inertial data is adjusted here with the coordinates computed by the receiver of global navigation satellite system (GNSS). On the basis of fuzzy logic, three blocks of expert data is utilized within these algorithms. The weighting factors for computing the azimuthal angle are computed within the initial block. The state of mobility of the object is given by the second block. The height of the object above sea level is computed with the help of GNSS readings and the altimeter within the third block. Thus, the readings of the sensors are combined within this algorithm which helps in identifying the blurred boundaries of any transition object from a state of rotation [32].

Dian Saadillah Maylawati, et.al (2017) stated a study based on the pregnancy which is an important part of human lives. The most of the cases that involve miscarriage are caused due to the fact that the women do not know about their pregnancy at early stages. Any abnormalities are good to be warned at the early stage of pregnancy to avoid later mis-happenings also. Numerous disorders have been known within the pregnancies which need to be avoided. In order to predict the pregnancy disorders at early stages, an expert system is generated in this paper with the help of Artificial Neural Network (ANN) and the Back Propagation algorithm. A dataset of various pregnancy records was generated and used in order to conduct an experiment here. As per the various simulation results achieved it was seen that there was higher accuracy of results achieved with the application of ANN based technique [33].

Mina Asadi Sanjani, (2015) presented in this paper that the prediction of electric load is very important within the power systems as there is higher time consumed while making decisions and also the costs are relatively higher. The occurred electric load prediction is an important concern here which is to be based on the country's electric import and export as well as the load peak of the annual electric utilization. The overall electric cost can be calculated with the help of this statistical information achieved related to the load peak utilized, the import as well as the export of electric power over the years. On the basis of various comparisons the increment and

decrement of cost over the years can be computed easily. With the help of receiver operating characteristic curve, the evaluation of performance of fuzzy expert system was done. It was seen that the level of accuracy was higher within this approach. The analysis of receiver operating characteristic curves was utilized for testing the correctness of the system function [34].

Mohammad Reza Heidari Iman, et.al (2015) presented in this paper that there is an increase in demand of the non-functional requirements by the users with the growth in software technologies over the years. Usability is one of the non-functional requirements. Higher quality of interface is very important when considering that there will be direct user interaction and the user has to be satisfied. Thus, a suitable usability is required for software user interface. In order to evaluate the software usability, various actions have been performed. However, there are numerous challenges faced while providing the quantitative evaluation of the qualitative concepts which might help in providing software usability. In order to avoid facing such challenges, a fuzzy expert system is proposed in this paper which also helps in identifying higher number of problems and the deficiencies present in the design of interface. With the application of this method, the users can easily identify their problems and remove them which can help them develop a better interface [35].

Monire khayamnia, et.al (2017) presented in this paper a study related to the patients suffering from migraine headache. The recognition stage is the very initial stage for diagnosing a migraine patient. The enigmatic and imprecise aspects can be presented with the help of fuzzy logic which is thus utilized within the system model. The identification of migraine with the utilization of fuzzy logic and systems is the main concern in this paper. The LFE algorithm is used here in order to propose a fuzzy expert system in order to detect migraine. The MAXMIS is utilized as OR-AND operations within the Mamdani model that is utilized for fuzzy inference engine. In order to provide the defuzzification method, the Centroid approach was utilized. The LFE algorithm was utilized to train the migraine diagnostic system. The various parameters such as accuracy, precision, sensitivity, and specificity of the system were computed and average of 80 pieces of IF-THEN rules was generated for the fuzzy system. When the knowledge is to be expressed by the human expert, the common issue that might arise is the incompleteness of linguistic rules. Rather than involving human expert systems the LFE algorithm can be used to avoid such issues and provide early diagnosis and accurate results [36].

Feng Zheng, et.al (2017) presented in this paper the new product design process using the fuzzy TOPSIS which has linguistic assessments that will help in establishing the relationship amongst the product form and the requirements of the consumers. Here, there is a subjective and imprecise expression of the choices of the consumer. A fuzzy TOPSIS expert system is built in this paper which uses the neural network model for providing help to the product designers to choose an appropriate combination of the design of the new product. Due to the huge variety of experiences, the fragrance bottle form design is selected. Around 20 thousands of different combinations of the fragrance bottle form can be designed with the utilization of soft, classical and fashionable image values provided. This helps in creating an expert system. A set of desirable image values can be specified by the product designers in order to design a new fragrance bottle. The optimal combination of design form elements can be attained with the help of an expert system [37].

V. A. Suzdaltsev, (2017) presented in this paper the utilization of fuzzy rules in order to conduct the predictive diagnostics with the help of expert system. A novel approach which will help in designing the fuzzy rules system is generated here with the help of gradient method. This also helps in evaluating the prediction accuracy of the system. With the help of practical experience of construction and operation of the expert system for the pregnancy report predictions, the validity of the fuzzy rules achieved is confirmed. The data set of certain pathology departments was gathered and experiments were conducted in order to evaluate the performance of the proposed system [38].

Kostrov B. V., (2017) presented in this paper a novel technique for smart management of the computing resources on the basis of set-theoretic explicit and implicit clustering techniques. On the basis of explicit clustering, the rules of explicit structures were used to perform the frame modeling of the knowledge. The implicit clustering was utilized in order to handle the fuzzy structures. For the multi-criterion fuzzy management of the selection as per the technical specification, a set of modeling software was developed. A multi-criterion fuzzy selection of the structure of the computing system was utilized to enable the analysis of implicit parallelism. An expert system with a user interface was developed here in order to analyze the achieved explicit and the fuzzy structures as per the technical specifications. As per the various results achieved, it

was seen that the level of accuracy was improved along with the enhancement in various other parameters [39].

Antika Thapar, et.al (2016) proposed in this paper the designing of a fuzzy expert system that helped in identifying whether an infant was suffering from malnutrition or not. It also helped in identifying the severity or extent to which the malnutrition had spread. The thirteen different input variables were utilized here within this technique on the basis of which the computations were made. These included the family size, protein intake, energy intake, mother's education level and many other factors. With respect to some specific categories, the presence of malnutrition and its severity were identified. Not only under nutrition is in the category of malnutrition, but over nutrition also its part. The Mamdani inference technique was utilized by the design expert system. It is seen through the achieved results that the level of nourishment can be detected here in accurate level and can help in providing benefits to the users which can help prevent it [40].

Research Methodology

5.1. Problem Formulation

The expert system is the system which is used to drive results from the existing values. The fuzzy logic is the system which is applied to generate output on the given set of input values. This research work is based to predict heart disease from the input symptoms. The 19 symptoms are taken as input on the basis of which chances of heart disease is predicted that whether it is low, medium or high. In this research work, the input parameters can be increased which increase the accuracy of heart disease prediction.

Sr.NO.	Symptoms
1	Name
2	Age
3	Gender
4	Blood Pressure
5	Heart Rate
6	Cough
7	Chestpain
8	Family having heart disease
9	Smoking habits
10	Fasting Blood sugar
11	Random Blood Sugar
12	Oral gulucose test
13	Glycated hemoglobin (A1C) test
14	Total Cholestrol
15	LDL Cholestrol
16	HDL Cholestrol
17	VLDL Cholestrol
18	Serum Trglycerides
19	ECG

Table 1: Symptoms of Heart Disease

5.2 Objectives

Following are the various research objectives of this study

1. To study and analyze various fuzzy based techniques to design expert system
2. To proposed improvement in existing fuzzy system for the heart disease prediction
3. The proposed improvement will be based on the add ECG parameter in the fuzzy system
4. Implement proposed system and compare with existing system in terms of various parameters

5.3. Research Methodology

This research work, is based on the expert system which is designed to predict the heart disease. In the existing work, the 19 parameters are taken as input to predict the heart disease. In the 19 parameters most important features are Blood Pressure, Heart Rate Cough and Total Cholestrol. On the basis of these parameters the chances of heart disease that whether chances are low, medium or high is predicted. To increase accuracy of the system, the ECG parameter will be added for the heart disease prediction.

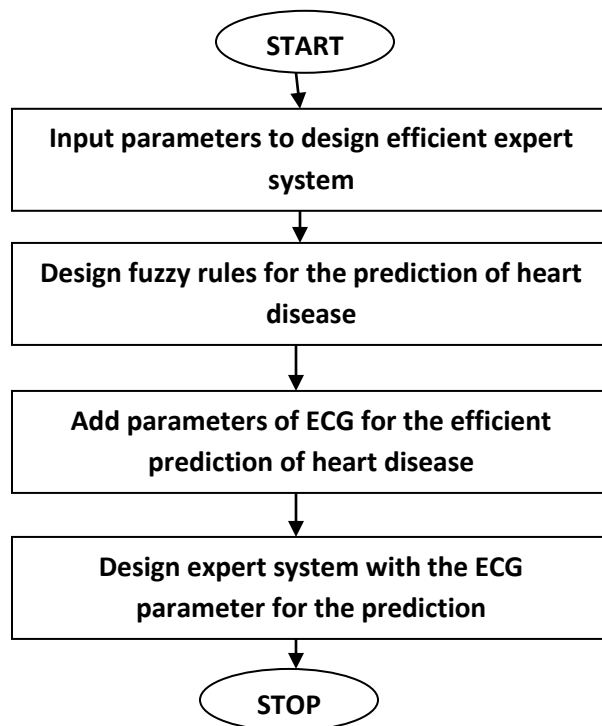


Fig 1: Proposed Flowchart

INPUTS:-

- **Age:-** As the age of the person increases the possibility of having heart disease also increases. According to mayoclinic the men at the age of 45 and women at the age of 55 or older having possibility of getting heart disease.
- **Smoking:-**Smoking the major factor which is responsible for coughing which leads to heart disease. Second hand smoker is high heart disease risk rate.
- **High Blood Pressure:-** High blood pressure damage the arteries that effect your heart by atherosclerosis. Blood pressure increases due unhygienic food, Smoking, any operations , diabetes.
- **Cholestrol:-**

Sr. No.	Name
1	HDL CHOLESTROL
2	LDL CHOLESTROL
3	VLDL CHOLESTROL
4	TRIGLYCERIDE
5	TOTAL CHOLESTROL

Table2:- Types of Cholestrol Test

1. **TRYGLYCERIDE:-**TRYCERIDE is related type of blood fat(Density of blood increases).
 2. **HIGH DENSITY LIPOPROTEIN(HDL) CHOLESTROL:-** It is the good type of the cholesterol that protect the heart from getting the heart disease.
 3. **LOW DENSITY LIPOPRTIEN(LDL) CHOLESTROL:-** It is the Bad cholesterol which is responsible for heart disease.
 4. **TOTAL CHOLESTROL:-** It is the ratio of the HDL and LDL cholesterol i.e. good cholesterol and bad cholesterol.
- **Family History:-** If the patient have heart disease in their family member like parents or sibling that also increases the heart disease risk rate.

- **Lack of physical Activity:-** To maintain the cholesterol level physical activity like jogging or exercise is more important. The people who exercise regularly have less risk of getting heart disease.
- **Diabetes:-**

Sr.No.	Name
1	FASTING BLOOD SUGAR
2	RANDOM BLOOD SUAGR
3	AC1 TEST
4	ORAL GULUCOSE TEST

Table3:- Types Of Diabetes test

1. **RANDOM BLOOD SUGAR:-** random blood sugar is the test done by taking the sample of blood at random time to check the random sugar level.
2. **FASTING BLOOD SUGAR:-** Fasting blood sugar is the test done by taking the blood sample by doing overnight fast
3. **AC1 TEST:-**It is used to measure the percentage of blood sugar level attached to hemoglobin. It indicates the average sugar of the patient.

ANALYSIS WORK FLOW:-

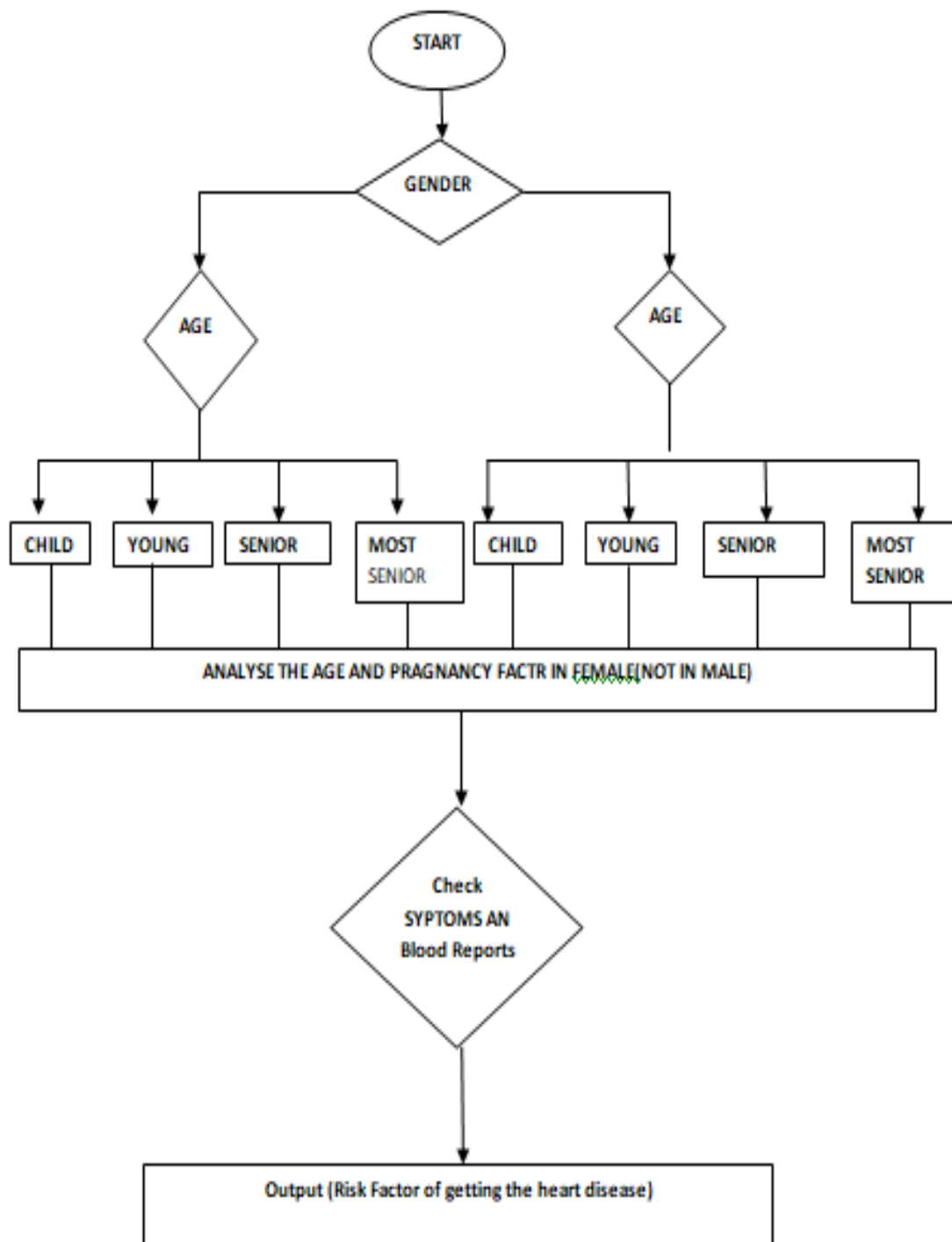


Fig 2:-Flow Chart OF Proposed Work

Expected Outcomes

Following are the various expected outcomes of this research work:-

1. The proposed algorithm can be implement for the prediction of heart disease with the ECG parameter which increase accuracy of prediction
2. The proposed algorithm can be compared with the other expert systems to analyze its reliability
3. Predict the Risk Factor that the patient have the heart disease.

Conclusion

The expert system is designed to take output according to the given input. The fuzzy logic is applied to design efficient expert system. In the fuzzy logic technique certain number of inputs are given on the basis of which output is generated. In this research work, the expert system is designed to predict heart disease. The 19 input parameters are used to derive output system in which chances of heart disease can be low, medium or high is predicted. To increase efficiency of the expert system parameter of ECG will be given as input with the other parameters which predict chances of heart disease.

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