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HEART DISEASE PREDICTION BY ANALYSING VARIOUS PARAMETERS USING FUZZY LOGIC

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ABSTRACT

In modern world, heart diseases are rapidly increased due to the food habit, stress, genetic reason and also lack of exercise. The prediction of the heart disease helps the people to take care of their health. Nowadays, Health care institutes contains huge amount of information, which contains hidden information of patients health. This hidden information is useful for making effective decisions. This research mainly focuses on the patient even before facing a sign of angina pectoris. This heart disease attacks a person so instantly that it hardly gets treated with. Hence medical fraternity has a challenging task to diagnose a patient correctly on time. Till now, a minimum of 13 to 15 parameters were used to predict the heart disease. But as an advancement of the existing system, only five main parameters are used in this. The factors such as high cholesterol, high blood pressure, blood sugar level, obesity are the major risk causes heart diseases. We designed the system using Matlab. Computer based information along with advanced Data mining techniques like fuzzy logic is used for predicting Heart disease diagnosis.

KEYWORDS: Fuzzy logic, Rule base, Data Sets, Fuzzification and Defuzzification.

INTRODUCTION

Heart is the most important part of our human body. Life of the individuals certainly depends on the efficient working of the heart. Heart disease is the major factor for malfunction of kidney, brain and many parts of the body. About 25 per cent of death occurs in the age group of 25 to 69 is because of heart disease. In rural areas, percentage of death due to heart ailments is 32.8 percent and in urban areas the percentage is 32.8 percent (Dinesh, 2010). Nearly 17.5 million people die each year by CVDs, an estimate of 31 per cent of all deaths worldwide. By using the patients normal health parameter like high density lipid level, low density lipid level, triglycerides, systolic pressure, diastolic pressure, fasting blood sugar level, resting ECG, obesity in Body Mass Index, family history of heart disease, physical inactivity, gender, chest pain type, thal, exang, smoking, alcohol intake, age many predicting strategy has made but in this very few parameters are enough for prediction. With the help of these parameters can predict the occurrence of heart disease in human beings (Lavanya et al., 2012, Nidhi et al., 2012). The computerised patient records to predict the heart diseases proposed system has integrated the clinical decision support that could reduce medical errors, decrease unwanted practice variation, enhance patient safety and enhance patient outcome (Subbalakshmi et al., 2011). Hence, experts require an accurate decision that considering the risk factors thereby designed an expert system using some prediction algorithms to diagnose the heart disease. This system can be implemented in urban as well as rural areas, to make them experience the expertise diagnosis for heart ailments.

The prediction algorithm used for this project is Fuzzy logic. Fuzzy logic is nothing but, method to compute the analysis based on their precision. They compute based on the statistics written in natural language rather than normal computation which are done using Boolean logic of 0s and 1s. They work as our human brain. The fuzzy logic algorithm at first separates the data into two as: training set and test set (Jameer Basha and Kanmani, 2016).

About 80% of the data has been allocated for training set and remaining 20% is allocated for test set. In training set, these data sets have been used to build a rule set. The test set uses their data sets to estimate the quality and their use for predictive relationships. The predication of best resources in cloud had been identified using Fuzzy Logic and Auto-associative memory network (Kowsigan and Balasubramanie, 2015; Kowsigan and Balasubramanie, 2016).

Fuzzy sets are the sets that have members of same extent of relationship. Fuzzy logic maps the membership functions to predicates into fuzzy sets. It is the process of converting the fuzzy values into crisp sets.

MATLAB is a set of tools used to represent graphically the concept of fuzzy logic in the form of models. This software helps to analyse, and interpret the output for the given conditions (Vanisree and Singaraju, 2011).

Rules engine used to evaluate fuzzy datasets in java. They enable to bring in fuzzy logic in java.

The operations over input data sets and producing the output are enabled in java using rules engine. The varying nesting operations are done in the left part of the rule and multiple assignment operations are performed in the right part of the rule.

Fuzzy rules–All the logical evaluations in fuzzy are represented in symbolic form this representation in the symbolic form helps the analyst to find the errors and understand the logic clearly. Various fuzzy rules are 'if', 'is', 'and/or', 'LV' and so on.

This paper has high concern for the society to prevent the heart disease for the people facing the heart attack without knowing the signs of cardiac syndrome. In many countries, the risk of heart attack is so high and precautious measures are also increased in their food habits and in their life style. Since there are no necessary measures had been taken for the inventions about the devices regarding to heart disease in laboratories and also in health care institutions. Our Proposed method will be a solution for the people to lead a normal life without bothering the serious signs of heart disease.

MATERIALS AND METHODS

The most significant application of fuzzy system is in uncertain issues of the problem. When a problem has dynamic behaviour, then fuzzy logic is a suitable tool to deal with.

a) Steps to be followed:

Determine the input and output variable. (There are 5 input variables and 3 output variables)

1. Designing a member function for each input variable.
2. These member functions decide the object to fuzzy sets.
3. Describe the input variable with the member function.
4. Assigning the output variable with its member function.
5. Framing the rules of the system.

The advantage of this model is that prediction of heart disease even before the angina pectoris arises (chest pain). The very purpose of these data is to diagnose the present, absence or chance of getting heart disease using various medical tests carried out on a patient. This system uses 5 attributes for input and 3 attributes for result (Shamira and Tamilselvi, 2016).

b) Data sets: The ultimate purpose of the datasets is to diagnose the presence or chance or absence of the heart disease given the results of the various medical laboratory tests are carried out on a patients, in order to determine the output.

Few factors that would predict the heart disease in an individual are the following:

- High blood pressure (hypertension).
- High LDL cholesterol (Bad cholesterol).
- Low HDL cholesterol (Good cholesterol).
- High triglycerides.
- High blood glucose level.
- Family history of premature heart disease.
- Cigarette smoking.
- Physical inactivity.

c) Blood Pressure: In Blood pressure there are two categories one is systolic pressure and the other one is diastolic pressure. Under this two types there are three membership functions they are normal, at risk (prehypertension), High. The range of each member functions is mentioned in TABLE I.

TABLE -I: .BLOOD PRESSURE LEVELS

FUZZY SET	RANGE
NORMAL	Systolic: Below 120 mmHg Diastolic: Below 80 mmHg
At risk (prehypertension)	Systolic: 120-139 mmHg Diastolic: 80-89 mmHg
High	Systolic: 140 mmHg and above. Diastolic: 90 mmHg or above.

d) *Total cholesterol:* Cholesterol has salient affect on the result and can change the result easily. For this input we use the values of low density lipoprotein (LDL) cholesterol, high density lipoproteins (HDL) cholesterol, and triglycerides with varying member functions.

Total Cholesterol = HDL Cholesterol + LDL cholesterol + triglycerides*0.2.

TABLE-II: LOW DENSITY LIPOPROTEIN CHOLESTEROL

RANGE	FUZZY SET
Below 100	Ideal
100 to 129	Close to ideal
130 to 159	Borderline high
160 to 189	High
190 and above	Very high

TABLE III.HIGH DENSITY LIPOPROTEIN CHOLESTEROL

RANGE	FUZZY SET
Below 40	Low (high chance of heart disease)
40 to 59	Normal
Above 60	Best

TABLE - IV: TRIGLYCERIDES

RANGE	FUZZY SET
Below 150	Ideal
150 to 199	Border line
200 to 499	High
Above 500	Very high

e) Blood sugar level: Blood sugar level there is three member functions they are normal, high, very high. This is one of the most functions that change the result.

d) Physical inactivity: Lack of physical activity can worsen other risk factors for heart disease, causes such as unhealthy heart, unhealthy blood cholesterol.

e) Cigarette smoking: Smoking causes high blood pressure, reduces the amount of oxygen in the blood, can causes angina, heart attack or a stroke and affect blood vessels. When the patient is a smoker then chances of getting heart disease certainly increases.

f) Rules: Rule base is the deciding part of fuzzy inference system and the accuracy, quality of the system depends on the fuzzy rules. This system has 17 rules.

With these 17 rules, we can predict as such an expert decision. The rules are the following.

RULE1: If low density lipids is very low and high density lipids is high and triglycerides is low and systolic is low and diastolic is low – heart disease will not occur.

RULE2: If low density lipids is low and high density lipids is high and triglycerides is low and systolic is low and diastolic is low – heart disease will not occur.

RULE3: If low density lipids is nearly high and high density lipids is high and triglycerides is low and systolic is low and diastolic is low – heart disease is a chance to occur.

RULE4: If low density lipids is high and high density lipids is high and triglycerides is low and systolic is low and diastolic is low – heart disease is chance to occur.

RULE5: If low density lipids is very high and high density lipids is high and triglycerides is low and systolic is low and diastolic is low – heart disease is chance to occur.

RULE6: If low density lipids is very low and high density lipids is moderate and triglycerides is low and systolic is low and diastolic is low – heart disease is chance to occur.

RULE7: If low density lipids is very low and high density lipids is low and triglycerides is low and systolic is low and diastolic is low – heart disease is chance to occur.

RULE8: If low density lipids is very low and high density lipids is low and triglycerides is high and systolic is low and diastolic is low – heart disease is chance to occur.

RULE9: If low density lipids is very low and high density lipids is low and triglycerides is very high and systolic is low and diastolic is low – heart disease will occur.

RULE10: If low density lipids is very low and high density lipids is low and triglycerides is very high and systolic is average and diastolic is low – heart disease will occur.

RULE11: If low density lipids is very low and high density lipids is low and triglycerides is very high and systolic is high and diastolic is low – heart disease will occur.

RULE12: If low density lipids is very low and high density lipids is low and triglycerides is very high and systolic is low and diastolic is low – heart disease will occur.

RULE13: If low density lipids is very low and high density lipids is low and triglycerides is very high and systolic is very high and diastolic is high – heart disease will occur.

RULE14: If low density lipids is very low and high density lipids is low and triglycerides is very high and systolic is high and diastolic is very high – heart disease will occur.

RULE15: If low density lipids is low and high density lipids is high and triglycerides is low and systolic is very high and
diastolic is low – heart disease will not occur.

RULE16: If low density lipids is very low and high density lipids is moderate and triglycerides is low and systolic is low
and diastolic is low – heart disease will not occur.

RULE17: If low density lipids is very low and high density lipids is moderate and triglycerides is low and systolic is low and diastolic is low – heart disease will not occur.

FUZZIFICATION AND DEFUZZIFICATION

Fuzzification means making the crispy set of fuzzy set. All the information represented by a fuzzy set is contained in the membership function. Then an inference is made based on the set of rules. Finally, the resulting fuzzy output is mapped to a crisp output called defuzzification (Sanjeev and Gursimranjeet, 2013). These membership functions are used to retranslate the fuzzy output into crisp set of values. It also evaluates the fuzzy inference by the rules stored in fuzzy rule base. Defuzzification means converting fuzzy inference to real crisp values. Computing each term using linguistic variable and lastly the result is determined by balancing out the result using centre of sum, centre of area, centre of area mean of maximum these different methods (Jameer Basha, and Kanmani, 2016).

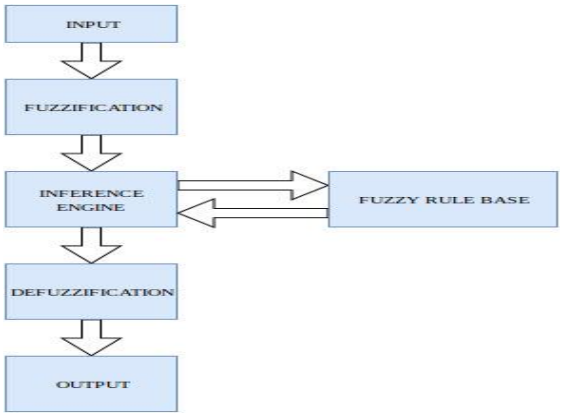

Figure-1. Fuzzy System Schema.

RESULTS

Thus, fuzzy system for heart disease prediction is designed Successfully with following member functions, input variables, rule base and output variables. Designed system using fuzzy logic has improved results and patients itself can recognise the heart disease with the laboratory test parameters as a precautious diagnosis. If the value of the input is high then the patient has high risk of heart disease and if the value of the inputs are low then the patient has the less risk of heart disease and similarly if the value of the inputs are normal then the result will also be normal or chance of getting heart disease in case of borderline high (Manoj Krishna et al., 2016).

System training:

TABLE -V: TRIGLYCERIDES TRAINING

CASES	LDL (mg/dL)	HDL (mg/dL)	TRIGLYCERIDES (mg/dL)
1	100	45	120

Surface viewer for high density and low density lipids to Heart Disease has shown in fig. 2.

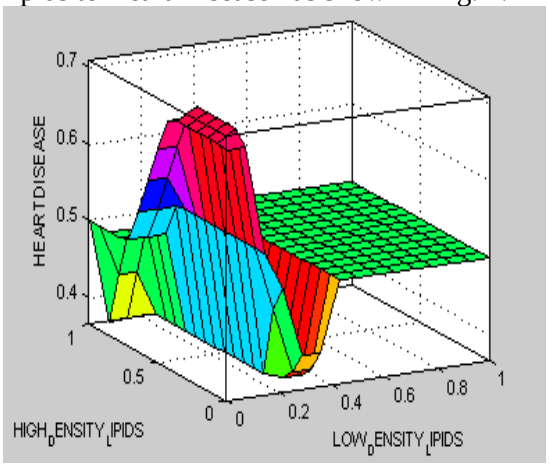

Figure-2. Surface viewer of HDL, LDL and Heart Disease.

With this we can check the patient suffers from the risk of heart disease or not. And mostly this is the simplest and efficient way for diagnosing the heart disease analysis. This system has predicted 90 per cent accurately more than the expert's statistical analysis.

By this prediction of the disease the Doctor can suggest the preventive measures for the patients to reduce the probability of getting a cardiac ailment or reduce the further complication if the patient is already a cardiac victim.

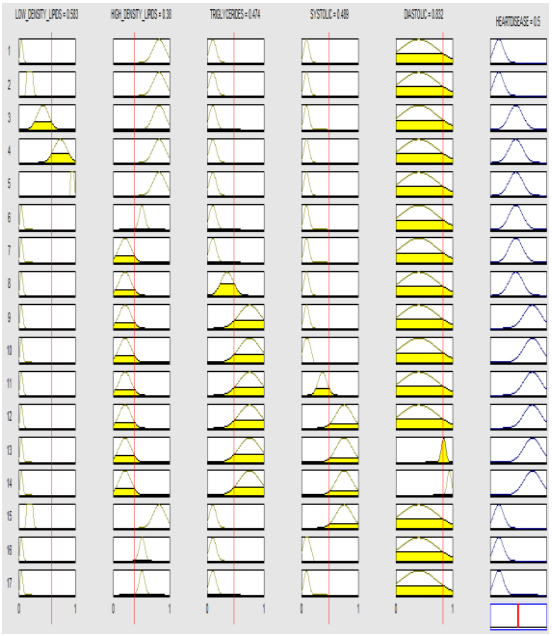

Figure-3. Result of the designed system

DISCUSSIONS

As for other clinical diagnosis problems, prediction systems have been used for heart disease diagnosis problem, too. When the studies in the literature related with this prediction application are examined, a great variety of methods were used which reached high prediction accuracies using the dataset.

Proposal for predictive model for heart disease detection to enhance their liability of heart disease diagnosis using Decision Trees, Naive Bayes, and Neural Network and CRISP-DM methodology used to build mining models on a dataset (Abhishek, 2013).

Artificial neural network in predicting diagnosis neonatal disease which involves Multiple Layer Perceptron with a back propogation algorithm used for training the ANN architecture. This study exhibits 75 per cent accuracy with stability (Chaitrali et al., 2012).

Proposed model on Decision Support System for diagnosing Congenital Heart Disease, which is developed by MATLAB's GUI feature and

implemented Back propagation Neural Network. It uses the back propagation Neural Network for multi layered feed forward Neural Network, which is trained by a supervised Delta Learning Rule. It is 90 per cent accurate system.

Fuzzy expert system to determine coronary disease was proposed in which gave the ratio of the risk factors which recommended one of the following three results such as diet, normal lifestyle and medication. The result of the above system is 79 percent (Era Singh Kajal and Nishika, 2016).

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