International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 03 | Mar 2021 www.irjet.net p-ISSN: 2395-0072

Heart Disease Prediction System using Fuzzy Logic

B.W.Balkhande[1], Manasi Bhoir[2], Rutuja Desai[3], Vrushali Deshmukh[4]

[1]*Prof. B.W. Balkhande, Professor, Dept. of Computer Engineering, Bharati Vidyapeeth College of Engineering, Maharashtra, India.*
[2]*Manasi Bhoir, Student, Dept. of Computer Engineering, Bharati Vidyapeeth College of Engineering, Maharashtra, India.*
[3]*Rutuja Desai, Student, Dept. of Computer Engineering, Bharati Vidyapeeth College of Engineering, Maharashtra, India.*
[4]*Vrushali Deshmukh, Student, Dept. of Computer Engineering, Bharati Vidyapeeth College of Engineering, Maharashtra, India.*

Abstract – *Treating people with ill health is a major problem in developed and undeveloped countries. However, countries remain unable to satisfy the demand for ideal medical services of their citizens due to the shortage of medical expertise in various hospitals. Heart diseases are rapidly increased thanks to the food habit, stress, genetic reason and also lack of exercise. The prediction of the guts disease helps the people to require care of their health. However, the analysis tools and methods are insufficient for identifying hidden relationships in the symptoms of heart disease. In most of the cases, heart condition leads to death. Medical Diagnosis is a difficult task and most of the time done by experts in domain. The aim of this work is to develop a fuzzy expert system to identify heart disease risk in the patients. There are several factors to analyze the heart disease in the patient and it is not the easier task, which makes the physician's job difficult. However, the experts want an accurate tool which considers and identifies the risk factors on the basis of provided information. This paper uses Fuzzy expert system for prediction of heart disease. The fuzzy system is designed with the help of fuzzy rules and membership functions so that classification can be carried out within the fuzzy system designed. The system would help the doctors to automate heart condition diagnosis and to reinforce the medical aid .*

Key Words: **Heart disease, Fuzzy expert system, Medical diagnosis, Fuzzy rules, Analysis tools.**

1. INTRODUCTION

Now a day the use of computer technology is essential in every field and medical diagnosis area is not an exception. The World Health Statistics 2012 report enlightens the very fact that one in three adults worldwide has raised vital sign that causes around half all deaths from stroke. Heart disease, also referred to as disorder (CVD), encloses variety of conditions that influence the heart – not just heart attacks. Heart disease also includes functional problems of the guts like heart-valve abnormalities or irregular heart rhythms. These problems can lead to heart failure and a host of other problems. Medical mining involves computerized tools and techniques that help in providing the benefits to health systems. The fuzzy logic is a tool for providing solution to the problems that deal with fuzzy input data .The proposed work takes to the fuzzy logic for classification. The dataset chosen is the heart disease dataset that contains records of patients with and without heart disease. Effective automated heart disease prediction systems can be beneficial in healthcare sector for heart disease prediction. This automation will reduce the number of tests to be taken by a patient. The objective of this work is to design a model that can help in predicting whether an incoming patient has heart disease or not.

1.1 DATA SET

The heart disease dataset is taken from the UCI machine learning repository. This data set has been used by researchers for classification using fuzzy logic. The information contained in the dataset is effective and helps in identifying the hidden pattern. Not all the attributes are effective but only a few are relevant for classification and prediction of the disease. Identifying the important attribute set is an important task that helps in data cleaning, eliminating irrelevant attributes, removing noise from the data etc. The attributes in the dataset are as follows : age of the patient, gender, the chest pain type, the resting blood pressure in mmHg, serum cholesterol in mg/dl, the fasting blood sugar in mg/dl, resting electro cardio graphic results, thalach (maximum heart rate achieved), exercise induced angina, oldpeak, slope, number of major vessels colored by fluoroscopy and finally thal with values as normal, fixed defect and reversible defect.

2. FUZZY LOGIC

The primary task of our work is to perform classification using fuzzy logic. In 1965 Lotfi A. Zadeh proposed a fuzzy set theory that is more applicable to artificial intelligence, especially, for the problems that have uncertain input values. Fuzzy logic may be a sort of uncertain or many – valued logic. This logic provides approximate solutions instead of accurate because it handles the concept of partial truth where the reality value are often within the range between completely true and completely false. The proposed method during this research work is an extended version of the model that mixes the genetic algorithms for feature selection and fuzzy expert system for effective classification.

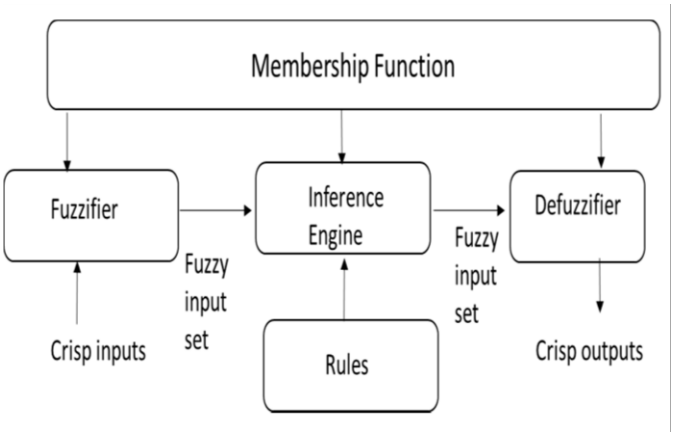

Fig -1: System Architechture

Fuzzy pure mathematics and symbolic logic are highly suitable for developing knowledge based systems in healthcare for diagnosis of diseases. In the proposed system, the input is that the set of all the chosen features and therefore the output of the system is to realize a worth 0 or 1 that indicates the absence or presence of heart disease in patients. In symbolic logic process, initially fuzzification is performed by collecting the crisp set of input file and converting it to a fuzzy set using fuzzy linguistic variables and membership functions. After that, an inference is formed supported a group of rules and lastly, defuzzification step is performed. This system generates the fuzzy rules supported the support sets obtained.

3. MEMBERSHIP FUNCTION

Fuzzy membership functions are devised supported the matter to be solved and therefore the fuzzy set chosen for the same. Membership function represents the fuzzy set and provides a measure of the degree of similarity of an entity to a fuzzy set. Most commonest shapes for design of membership functions are triangular, trapezoidal, linear, Gaussian, bell-shaped etc. Within the proposed work the Gaussian membership function is chosen because it is comprehensible and appropriate to the matter. A membership function for a fuzzy set A on the universe of discourse X is defined as μA: X → [0, 1], where each element of X is mapped to a worth between 0 and 1. This value, called membership value quantifies the grade of membership of the element in X to the fuzzy set A. Membership functions used to represent a fuzzy set graphically. The x axis represents the universe of discourse, whereas the y axis represents the degrees of membership within the [0, 1] interval.

$$\mu_A(x, c, s, m) = exp\left[-\frac{1}{2}\left|\frac{x-c}{s}\right|^m\right]$$

c : centre

s : width

m : fuzzification factor (e.g., m=2)

c=5, s=2, m=2

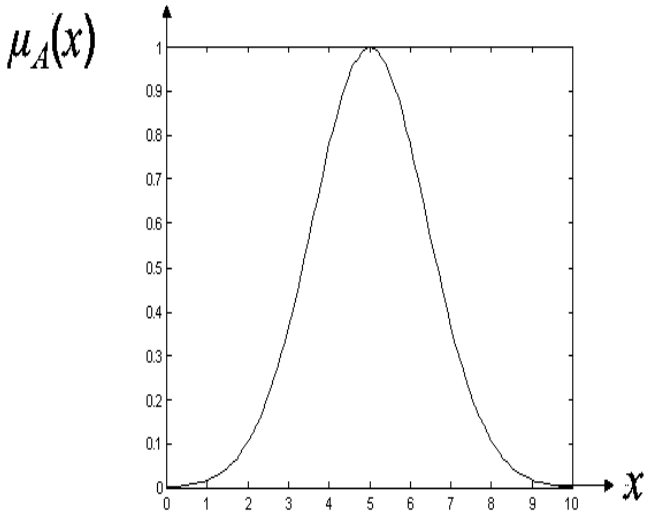

Fig -2: Gaussian membership function

4. FUZZY INFERENCE SYSTEM

A fuzzy inference system helps in mapping the inputs to the corresponding output using predefined fuzzy rules available within the knowledge domain . The knowledge domain consists of if-then rules that specify the connection between the input and output fuzzy sets. because it requires the input in fuzzy values, the input is fuzzified and for the user to raised understand the output, the output from the

inference system is defuzzified. The inference system is developed with a series of activities like

1. Developing the fuzzy rules.
2. Fuzzifying the input values supported the membership function.
3. Combining the fuzzy input and therefore the fuzzy rules to get the rule strength.
4. The rule strength consequence is again combined with the output membership function to generate the output distribution.
5. Finally the output is defuzzified to offer the output in crisp value.

5. FUZZY CLASSIFICATION

Fuzzy classification may be a supervised learning method where the fuzzy model understands the info with its rules and sophistication label of the training data and predicts the target value for the set of test data. The proposed work uses the stratified 10 fold technique which may be a popular choice for estimating the test error on classification algorithms. It divides the training set into 10 disjoint subsets. Each subset has roughly equal size and also an equivalent class proportions as within the training set. The steps involved within the process are to spot a subset for testing with all the opposite subsets as training subsets. Using the trained model the testing subset is assessed. This process continues for ten times with different training and testing data. Finally the typical accuracy if calculated. The proposed work contains different labels supported the values of the attributes available within the dataset. The Table 1 provides the small print about the attributes and their modified labels. The fuzzy rules also supported these labels. A number of the sample rules are given below:

Rule 1 : if a1 is 3 and a2 is 1and a3 is 1 and a4 is 2 and a5 is 2 and a6 is 2 and a7 is 2 and a8 is 2 and a9 is 2 and a10 is 2 and a11 is 3 and a12 is 4 and a13 is 2 then result is "healthy".

Rule 2 : if a1 is 3 and a2 is 1and a3 is 4 and a4 is 2 and a5 is 3 and a6 is 2 and a7 is 2 and a8 is 1 and a9 is 1 and a10 is 1 and a11 is 2 and a12 is 3 and a13 is 1 then result is "Sick".

Rule 3 : if a1 is 3 and a2 is 1and a3 is 4 and a4 is 1 and a5 is 2 and a6 is 2 and a7 is 2 and a8 is 2 and a9 is 1 and a10 is 2 and a11 is 2 and a12 is 2 and a13 is 3 then result is "Sick" .

Rule 4 : if a1 is 1 and a2 is 1and a3 is 3 and a4 is 1 and a5 is 2 and a6 is 2 and a7 is 3 and a8 is 3 and a9 is 2 and a10 is 2 and a11 is 3 and a12 is 4 and a13 is 1 then result is "healthy".

Table -1: The modified labels of the attributes for fuzzy classifier

Attribute No	Attribute names	Actual labels	Modified Labels
1	age	Integer	1,2,3
2	sex	0,1	1,2
3	cp	1,2,3,4	1,2,3,4
4	trestbps	Integer	1,2,3
5	chol	Integer	1,2,3
6	fbs	0,1	1,2
7	restecg	0,1,2	1,2,3
8	thalach	Integer	1,2,3
9	exang	0,1	1,2
10	oldpeak	Real number	1,2,3
11	slope	1,2,3	1,2,3
12	thal	3,6,7	1,2,3

6. DEFUZZIFICATION

Defuzzification is that the process of manufacturing a quantifiable end in symbolic logic , given fuzzy sets and corresponding membership degrees. it's the method that maps a fuzzy set to a crisp set. it's typically needed in fuzzy control systems. the foremost commonly used defuzzification method is that the center of area method (COA), also commonly mentioned because the centroid method. This method determines the middle of area of fuzzy set and returns the corresponding crisp value. Defuzzification methods are used to convert the fuzzy values to their corresponding crisp and understandable values. There are five defuzzification methods . They are centroid, bisector, Smallest Of Maximum (SOM), Middle Of Maximum (MOM) and Largest Of Maximum (LOM). The defuzzification method used for the proposed work is centroid method because it is depicted in Fig -3. During this type it returns the middle of area under the curve.

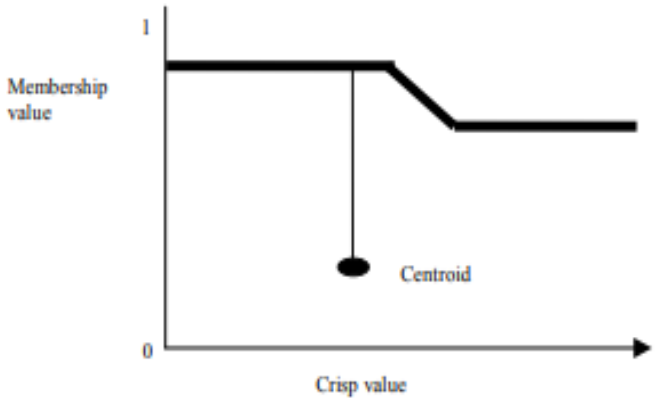

Fig -3: Defuzzification method

7. CONCLUSIONS

A system that aids the physicians for accurate prediction of heart disease in patients has been devised using fuzzy logic. Amidst various classification and prediction models this model is evaluated to be better providing an accuracy. The fuzzy inference system predicts the test data with the assistance of fuzzy Gaussian membership function and centroid defuzzification method. The longer term work includes the implementation of the proposed model for disease diagnosis using the opposite health related datasets. Because the fuzzy classifier is suitable for uncertain data the proposed work are often extended for any data with uncertainty. The time and space complexities are often taken into consideration for overall performance of the proposed method.

8. ACKNOWLEDGEMENT

We express our deepest gratitude to our Project Guide Mr. B. W. Balkhande for providing technical support, guidance, encouragement and moral support in successful completion of the project and also for giving us time to time feedback.

9. REFERENCES

[1] Era Singh Kajal and Nishika, Prediction of Heart Disease using Data Mining Techniques, Indian Journal of Advance Research and ideas and Innovation in Technology 2(3): (2016).

[2] E.P.Ephzibah, Dr. V. Sundarapandian, "Framing Fuzzy Rules using Support Sets for Effective Heart Disease Diagnosis"; International Journal of Fuzzy Logic Systems (IJFLS) Vol.2, No.1, February 2012.

[3] Jyoti Soni, Sunita Soni et al., —Predictive Data Mining for Medical Diagnosis: An Overview of Heart Disease Prediction||; International Journal of Computer Applications (0975 – 8887) Volume 17– No.8, March 2011.

[4] Rajeswari K, Vaithiyanathan V, Amirtharaj P. Prediction of risk score for heart disease in India using machine intelligence. International Conference on Information and Network Technology; Singapore: IACSIT Press; 2011. p. 19–22.