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CHAPTER 1
INTRODUCTION

The advancements of computer technology are playing a
important role in diagnosis of medical systems. Medical diagnosis is full of uncertainty and dynamically
changed according to the situations. Now a day the use of computer technology is essential in every filed and
medical diagnosis area is not an exception. The diagnostic decision depends upon experience,

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Expertise and use of proper method with powerful logical
reasoning ability. We know very well that these fields, in which the computers are used, have very high
complexity and irregularity and the use of expert systems such as fuzzy logic, artificial network and genetic
algorithm have been developed. Expert Systems is an intelligent computer-based decision-making tool that uses
data sets and rules to solve real problems based on the knowledge gained by one or more experts in specific
areas. The medical diagnostic system is a system that can diagnose any disease by controlling the symptoms.
The diagnosis of human diseases is one of the most complex and difficult processes and requires a high level of
competence. The Fuzzy Expert System is one of the best systems to diagnose medical conditions, because
every disease diagnosis involves so many uncertainties and a fuzzy logic is the best way to handle uncertainties.
Despite the limitations due to information, education and other reasons, these systems are widely recognized in
medical institutions.

1.1 Introduction
to Fuzzy Fuzzy logic (FL) is a multi-valued logic that has been used to solve many complex challenges including
clinical diagnostics. FL handles approximate values in place of fixed and precise values. Professor Lotfi A. Zadeh
first introduced the terms

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in the mid -1960's [1-2]. According to Zadeh, fuzzy logic is an addition of the classic logic. Classic
logic is based on boolean logic, where the information is either true or false. In classic logic the membership of a
component belonging to a set is represented by 0 if it does not belong to the set, and 1 if it is in the set, i.e. {0, 1}.
On the other hand, in fuzzy logic this set is extended to the interval of [0, 1].

1.1.1 Membership Function
A membership function (MF) is a distribution that maps each and every point in the input space (i.e., universe of
discourse which represents the set of the entities)

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to a membership value between 0 and 1.

There are different types of membership functions of fuzzy set such as triangular membership function,
trapezoidal membership function, Gaussian membership function, and etc. [3]. The types of MF depend on the
concept that is being represented, and the context of it is use. This study used triangular and trapezoidal
membership functions. In triangular membership function, the curve is a vector function x to be determined by
three scalars a, b, and c. In fig. 1.1, a triangular membership function is illustrated [3]. a bc

Figure 1.1: Triangular Membership Function

In trapezoidal membership function, the curve is a vector function x, determined by four scalars a, b, c, and d. In the
following figure (1.2), a trapezoidal membership function is illustrated [3-4]. a b c d

Figure 1.2: Trapezoidal Membership Function

Membership function can be the combination of both of them. For example, in the following
figure (1.3), the triangular and the trapezoidal membership functions (MF) are illustrated:Low
However, Gaussian, Sigmoid, and other types of linear functions can also be applied to characterize the fuzzy sets. Non-linear functions can also be used but they will cause additional computational complexity to the algorithm [5].

1.1.2 Types of Fuzzy Sets

There are mainly two types of fuzzy sets: type-1 fuzzy sets (T1FS) and type-2 fuzzy sets (T2FS). T1FS were first introduced by L. A. Zadeh in 1965 [1]. However, type-1 fuzzy sets failed to model uncertainty properly. Uncertainty indicates the degree of truth of the value in attribute. For example, the age of John is 36 right now, might be 80% true. The issues with T1FS led to the introduction of T2FS. In order to model uncertainty and imprecision in a superior way, type-2 fuzzy set was initially presented by Lotfi Zadeh, and the concepts were presented by Mendel and Liang [6]. In case of T2FS, the degree of membership is type-1 fuzzy set.
or (OR) operators. The fuzzy IF-THEN rule looks like the following:

Rule: 1 IF x is A1 OR y is B1 THEN z is C1.
Rule: 2 IF x is A2 AND y is B2 THEN z is C2.
Rule: 3 IF x is A3 THEN z is C3.

Where A, B and C are the linguistic values and x, y, and z are the linguistic variables.

Fuzzy Inference System

A fuzzy inference system (FIS) uses fuzzy set theory in order to map input to output. All information is involved in the FIS process, i.e. membership functions, logical operators and IF-THEN rules. A sample FIS that includes four functions illustrated in figure 1.7.

Input

Defuzzifier

Inference

Fuzzifier

Rule Base

Figure 1.7: FIS Structure

There are two types of FIS [93] i.e. the Mamdani [8] and the Sugeno [11]. Such FIS are used in many research such as expert system and decision support system. Mamdani Type FIS

If-then rules are applied in mamdani based FIS for inputs and output. For example: IF X is Negative Big AND Y is Negative Small THEN Z is Zero.

Figure 1.8: Mamdani based fuzzy inference system

Sugeno Type FIS

Sugeno type systems are used to model any inference system in which membership functions are linear or constant. This fuzzy inference system was introduced in 1985. It is also called Takagi-Sugeno-Kang. The functions of belonging to the Sugeno (z) output are linear or constant. A typical rule in a fuzzy model of Sugeno is: IF Input 1 = x and Input 2 = y, then Output is z = ax + by + c

For a zero-order Sugeno model, the output level z is a constant (a=b =0).

Figure 1.9: Sugeno type fuzzy inference system

Mamdani FIS can be used for similar tasks. The rule base and the fuzzification remain the same for the variables. There are several defuzzifiers that can be selected for a FIS Mamdani. These editors also have similar results in a FIS Sugeno. There is a certain overlap between the two types of system. Mamdani FIS is used more often. It is used for decision support applications because of its intuitive and interpretable nature. The consequences of the rules in a FIS Sugeno do not have a direct semantic average. This means that they are not linguistic concepts. Even this interpretability is partially lost. The consequences of Sugeno's FIS rules can have many parameters per rule. So, Sugeno FIS translates into more degrees of freedom than Mamdani FIS. Thus, it offers greater flexibility. Many parameters can be used in the consequences of the rules of a FIS Sugeno. A zero order FIS Sugeno can reasonably approach a Mamdani FIS. From a mathematical point of view, a FIS Sugeno is more effective than a Mamdani FIS.

This because; Sugeno FIS does not involve an intense process of defuzzificazione IT. In addition, a FIS Sugeno always produces consistent surfaces. The continuity of the output interface is very important. Any existence of discontinuity translates into similar inputs that produce substantially different results. This will be an undesirable situation from the point of view of control / surveillance. Because of the continuous structure of the output functions, a FIS Sugeno is also better and more suitable for the functional analysis of a Mamdani FIS. This thesis uses the Muddani inference method. This is the most used fuzzy method for its simple structure of

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from the point of view of

control / surveillance. Because of the continuous structure of the output functions, a FIS Sugeno is also better and more suitable for the functional analysis of a Mamdani FIS. This thesis uses the Muddani inference method. This is the most used fuzzy method for its simple structure of

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operations. The Mamdani method was proposed in 1975 by Professor Ebrahim Mamdani at the University of London [8]. Muddani's fuzzy deduction process includes four phases: fuzzification; Evaluation rule; Power unit (s); and the defuzzification described below [12-13]:

1. Fuzzification

In fuzzification process the crisp input values are transformed into the grades of membership function (MF) for linguistic values of fuzzy sets. The membership function provides a grade for each linguistic value. Step 2: Rule Evaluation

After successfully defining the input and output variables, and the corresponding MFs, it is necessary to design the rule-base of the fuzzy knowledge-base. The rule-base of FIS design is composed of IF antecedents THEN conclusion rules. These rules are then transformed from an input to an output, based on MFs that inform the projected outcomes. The total number of rules depends on the total number of linguistic variables and MFs. In Mamdani, the AND operator is applied on each rule for rule evaluation.

Step 3: Aggregate output(s)

After evaluating all the rules, the rules must be grouped in a particular approach to make a decision. The aggregation method is used to group the fuzzy output set after evaluating the rules. In Mamdani, the OR operator
is used to aggregate fuzzy output sets. After aggregation, the final result is a single fuzzy set. Step 4: Defuzzification

The defuzzification is placed after all other processes of fuzzy inference. This method is used to generate a precise number from the fuzzy set of a single output obtained by aggregating the rules in step 3. Several methods are used for defuzzification, such as the value of centroid (and the center of gravity or COG) [12], the bisector (bisector) [12], the average value of the maximum value (MOM) [12], the smallest (absolute) of the maximum value (SOM) [12] and finally the largest (absolute) value of the maximum (LOM) [12]. The centroid method is the most common defuzzification method [12]. The centroid defuzzification method is used to determine the point indicating the center of gravity of the fuzzy set. In the case of a FIS project, all the previous steps must be taken into consideration. Elements of the conceptual schema include tables, views, constraints, domain definitions, and other constructs that describe the schema. For the definition of a fuzzy database system, it can be described how the database system now uses fuzzy logic to support vague, inaccurate and uncertain information. In other words, the fuzzy database is called a fuzzy database [3], [14]. 1.3 Fuzzy Inference System in General Application

This section describes a simple fuzzy inference system for the Hotel Advisory System (HAS) [93]. Nagi et al. [15] have developed an expert blurred hotel selection system called Hotel Advisory System (HAS). The system is divided into three modules. The modules are the hotel fuzzy search form, hotel information and the hotel's virtual tour module. Each form is used for a specific activity. A user interface is designed so that the user can enter data and return information to the user. The system used a fuzzy inference system to provide linguistic terms such as cheap, moderate, expensive for the price of the hotel and the fuzzy rules of the system were used to determine the cost of staying in the hotel. This fuzzy expert system is more convenient and easier for the user to choose the hotel based on their demand such as cheaper hotel, expensive hotel. The system was tested by the potential users and hotel experts. It can be used to improve the operations by reducing the cost of enquires, and providing quick information about the hotel search.

1.4 Related Works of Fuzzy Inference System in Medical Diagnostic Systems

In this section, different contributions of researchers using fuzzy inference system (FIS) is discussed [93]. Many research work has been developed using fuzzy logic in the diagnosis of various diseases using MATLAB simulation platform. Adeli et al. [16] proposed an expert system for diagnosing heart disease using fuzzy logic. In this research, in order to get fuzzy values crisp rules are fuzzified. The expert system used these fuzzy values and generate fuzzy rules. The fuzzy output was then defuzzified to obtain a single output, which is a crisp value to indicate the stage of heart disease. Durai et al. [17] used the fuzzy inference system in order to diagnose lung cancer. In this research domain specific dataset is prepared which includes features such as symptoms, levels of malignant cells and recommended treatments which helps in efficient diagnosis of the lung cancer.

Soni et al. [18] proposed a weighted associative classifiers for prediction of heart disease. This research work was simulated using Java platform and MS Access as a data server. This research work classified the patient records in two classes i.e. normal and abnormal case. Neshat et al. [19] developed a diagnosis system using fuzzy logic for liver disorders. This paper proposed the binary classification system for classification of patient records into healthy or non-healthy patients.

Kadhim et al. [20] implemented a back pain diagnosis system using a fuzzy expert system. In this research work, first of all different decision trees are created and fuzzy rules are designed for these decision trees in order to effectively classify the patient into healthy or non-healthy person. Kalpana et al. [21] developed a diabetes diagnosis system using fuzzy rules. The simulation is performed using MATLAB. The experimental result is performed on the data of persons of age group of 26-30. Binary classification is performed in this work into healthy or non-healthy person.

Parvin and Abhari [22], presented the medical diagnosis system using FIS. This research follows the work in [15] using FIS to diagnosis disease. This research work is also based on the concepts presented in Adeli et al. [16] for heart disease prediction.

Kalpana et al. [21] presented the research work for diabetes mellitus, and Neshat et al. [19] presented the research work for liver disorders. Both research work was presented using fuzzification rules to develop fuzzy inference system and simulated using MATLAB. Fuzzy rules uses the features or symptoms in order to predict and detect diseases. As stated in [16], [19] and [21], fuzzy inference system is used for feature detection or symptoms detection for heart disease. For example, cholesterol level determines the heart disease level or type. The sensitivity of choosing variety of inputs was done by implementing the heart illness application in MATLAB once with a similar variety of inputs, output, and fuzzy rules employed in [16]. The result obtained from these research work shows the effectiveness of proposed work. All these experimental simulations are performed using MATLAB and MS Access for database. In the area of medical sciences, numerous expert systems have been developed. These are: PUFF: Pulmonary disease diagnosis VM: Monitoring of patients need intensive care ABEL: Diagnosis of acidic materials and electrolytes AI/COAG: Blood disease diagnosis AI/RHEUM: Rheumatic disease diagnosis CADUCEUS: Internal medicine diagnosis ANNA: Monitoring and treatment analysis BLUEBOX: Depression diagnosis and treatment.
Peripheral artery disease and Venous thrombosis. Heart diseases may develop due to certain abnormalities in Cardiomyopathy, Cardiacarhythmia, Congenital heart disease, Valvular heart disease, Aortic aneurysms, which are quite common are stroke, heart failure, hypertensive heart disease, rheumatic heart disease, which begin to set a feeling of tiredness should not be ignored. Sweating Some other cardiovascular diseases in the left side. Feeling Dizzy and Light Headed Things that lead to the loss of balance. Fatigue Simple chores more than men. Pain in the Arms The pain often starts in the chest and then moves towards the arms, especially Pain These are some of the often overlooked symptoms of heart attack. Women tend to show these symptoms heart attack, he may feel pain, tightness or pressure in the chest. Nausea, Indigestion, Heartburn and Stomach. Chest pain It is the most common symptom of heart attack. If someone has a blocked artery or is having a symptoms of heart attack are as follows

Chapter 2:
In this chapter, we describe the literature survey of the existing research related to our topic starting from the beginning till the current year and summarize the chapter. Chapter 3: In this chapter a brief report of proposed fuzzy logic based algorithm have been designed for the diagnosis of heart related disease. The proposed expert system is designed by the help of fuzzy logic toolbox and used mamdani interface system. In this work, 10 input variables and 679 fuzzy rules are used over Cleveland Clinic Foundation database (200 patients) [23]. For defuzzification, centroid technique is utilized. It is one of the most efficient methods to create an expert system and diagnosis the heart disease. Chapter4: This chapter presents fuzzy expert system to raise the diagnosis level of dengue fever and early detection of dengue in patient. Fuzzy expert system is one of the most traditional artificial intelligence techniques to diagnose any disease. Chapter 5: In this chapter a detailed discussion is presented on the result analysis done for the two identified diseases through MATLAB simulation environment. It contains the overall snapshots of our implementation in MATLAB for the mentioned contexts for the comparison and validation with the dataset used in UCI repository and obtained from SAIMS Hospital, Indore. The proposed fuzzy controller makes the machine to take intelligent decisions as similar to that of humans. 1.

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Chapter 6:
This chapter describes the conclusion and the future work involved in our proposed techniques. CHAPTER 2 LITERATURE SURVEY
This chapter is classified into two different classes; literature related to heart disease diagnosis techniques and literature related to dengue disease diagnosis techniques.

2.1 Noteworthy Contributions
in the field of Heart Disease DiagnosisHeart attack is a common cause of death worldwide. Some of the common symptoms of heart attack are as follows [94]. Chest pain It is the most common symptom of heart attack. If someone has a blocked artery or is having a heart attack, he may feel pain, tightness or pressure in the chest. Nausea, Indigestion, Heartburn and Stomach Pain These are some of the often overlooked symptoms of heart attack. Women tend to show these symptoms more than men. Pain in the Arms The pain often starts in the chest and then moves towards the arms, especially in the left side. Feeling Dizzy and Light Headed Things that lead to the loss of balance. Fatigue Simple chores which begin to set a feeling of tiredness should not be ignored. Sweating Some other cardiovascular diseases which are quite common are stroke, heart failure, hypertensive heart disease, rheumatic heart disease, Cardiomyopathy, Cardiacarhythmia, Congenital heart disease, Valvular heart disease, Aortic aneurysms, Peripheral artery disease and Venous thrombosis. Heart diseases may develop due to certain abnormalities in
the functioning of the circulatory system or may be aggravated by certain lifestyle choices like smoking, certain eating habits, sedentary life and others. If the heart diseases are detected earlier then it can be treated properly and kept under control. Here, early detection is the main key. Being well informed about the whys and wherefores of heart disease will help in prevention summarily.

Baihaqi et al. [24] used artificial intelligence for diagnosis of disease. A fuzzy expert system is used in this paper for enhancement of accuracy. In this research work CAD is dataset taken from UCI machine repository. Agrawal-Chopde [25] reviewed on CAD. In this research work author used adaptive neuro fuzzy inference system (ANFIS) in order to diagnose heart disease and compared the results with all the techniques and concluded that ANFIS results in better efficiency. Krishnasree-Rao [26] leads to the Bayesian regularization model for the calculation, which is the non-linear dataset of one of the statistical models. In this work, they achieved this model and implemented precision of 91%. Muthukaruppan [27] proposed a particle swarm optimization (PSO)-based fuzzy expert system for the diagnosis of heart disease. Feature attributes are extracted from dataset using decision tree (DT). Nagar-Jain [28] presented a study on diagnosis of heart disease. Author presented information about proper features selection for efficient performance of inference system to diagnose diseases and used the heart disease data available on UCI repository. Wagh-Paygude [29] implemented neuro fuzzy system for diagnosis of heart disease and achieved accuracy of about 90%. The simulation results are compared with with and without genetic algorithm based neuro fuzzy system. Rathod-Gawande [30] proposed a fuzzy expert system to diagnosis heart disease. About 11 features are selected in this work and fuzzy rules are generated using these features. The result analysis shows that this work achieved about 94% of accuracy.

Pathania-Ritika [31] implements a fuzzy controller for disease diagnosis and used 6 features to identify the risk level and achieved 92% accuracy. Kumar-Kaur [32] developed disease diagnosis system using fuzzy logic using dataset that is taken from Parvati Devi hospital, Ranjit Avenue and EMC hospital Amritsar and International Lab. 6 features are used to diagnose using fuzzy algorithm and achieved about 90% of accuracy. Abushariah et al. [33] proposed an adaptative Neuro-Fuzzy Inference System (ANFIS) for diagnosis of diseases and developed an expert system using MATLAB tools. Venkatalakshmi-Shivsankar [34] designed a Naïve Bayes, Decision tree and Clustering algorithm to diagnosis heart disease diagnosis. They have used UCI machine database and also given performance comparison to above mention algorithm. Senthil Kumar [35] developed an expert system to diagnosis heart disease by using advance fuzzy resolution mechanism. In this paper, they have used MATLAB tool and Cleveland dataset for implementation process with 93.88% accuracy. Eswara Rao-Govinda Rao [36] implemented a fuzzy expert system using mamdani interface and UCI machine repository dataset. Author has used 11 input parameters with their membership functions and rules. Sen et al. [37] presented a paper on data mining techniques using neuro fuzzy expert system to diagnosis heart disease. In this paper, they have used MATLAB tool with 11 input parameter and UCI machine dataset. Khatibi-Montazerac [38] proposed a hybrid interface engine to find out risk level and achieved 91.58%. Their prediction model was based on Dempster-Shafer theory of evidence and fuzzy sets theory. Chitra-Seenivasagam [39] designed a Supervised Learning Algorithm is adopted for heart disease prediction. In this paper, they have used 270 patient databases from UCI with confusion matrix. Barman-Choudhury [ + 2 more resources!}
analyzed the association's rules in the concept of train and test for a series of data to predict heart disease. The Support Vector Machine (SVM) and the artificial neural network (ANN) were the two main methods used in this system. A three-layer multilayer perceptual neural network (MLPNN) was used to develop a decision support system for diagnosing heart disease. This neural network with multilayer perceptrons was formed by a backward propagation algorithm, which is an efficient method from a computer point of view. The results showed that an MLPNN with a reverse proliferation technique can be used successfully (with an accuracy of 90-97%) to prescribe drugs against heart disease. AH Chen et al. [47] planned a prediction system for heart disease supported the structural equation model (SEM) and therefore the fuzzy cognitive map (FCM). They used the CCHS 2012 knowledge set (Canadian Community Health Survey). Twenty important attributes were used here. SEM is employed to get the weight matrix of the FCM model, that thus provides a possible for disorder. A SEM model is outlined with a correlation between ccc 121 (a variable that defines whether or not the respondent has heart disease) and twenty attributes. To construct the MMF, it's initial necessary to construct a coefficient matrix that represents the strength of the causal relationship between the ideas. The SEM outlined within the previous section is currently used as FCM although it's reached the desired ingredients (weight matrix, concepts and causality). 80% of the data set was used to form the SEM model and the remaining 20% to test the FCM model. The accuracy obtained with this model was 74%.Carlos Ordonez [48] studied the association's rules in the concept of train and test for a series of data to predict heart disease. The rules of the mining association have the disadvantage of producing a very large number of rules, most of which are medically irrelevant. Generally, association rules are used for all registrations without validation for an independent sample. To solve this problem, the author has developed an algorithm that uses search constraints to reduce the number of rules. The algorithm then looks for the association rules in a learning set and then validates them in an independent set of tests. The medical meaning of the found rules is then evaluated with support, safety and vitality. Search constraints and check cluster validation significantly cut back the amount of
association rules and produce a collection of rules with high predictive accuracy. These rules represent valuable medical data. Prajakta Ghadge et al. [49] worked on an intelligent cardiac predictive system with big data. Heart attacks must be diagnosed early and effectively because of their high prevalence. The purpose of this research article is to find a prototype of a predictive system of intelligent heart attack using large data modeling techniques and large data modeling. This system can extract hidden knowledge (patterns and relationships) associated with heart disease from a historical database on heart disease. This approach uses Hadoop, an open source software infrastructure written in Java for distributed processing and storage of large data sets. Apache Mahout by Apache Software provides a free implementation of distributed or scalable machine learning algorithms. A record of 13 attributes (age, sex, serum cholesterol, fasting glucose, etc.) was obtained from the Cleveland Heart database, available on the Internet. The models were extracted using three techniques, i.e. Neural network, naive Bayes and decision tree. The future purpose of this system is to provide more sophisticated predictive models, risk calculation tools and features extraction tools for other clinical risks. Asha Rajkumar et al. [50] worked on the diagnosing of heart disease with a classification based on supervised self-learning. The Tanagra tool is employed to classify data, a 10-fold cross validation is employed to judge the data and therefore the results are compared. Tanagra may be a free data processing software for educational and analysis functions. It offers many data processing strategies as well as instructive knowledge analysis, applied mathematics learning, machine learning and database domain. The data set is split into 2 parts: 80% of the data is used for training and 20% for the tests. Of the three techniques, Naive Bayes has a lower error rate and takes less time. K. S. Kavitha et al. [51] proposed and developed an evolutionary neural network for the detection of heart disease. This research describes a new system for detecting heart disease using advanced neural architecture and the genetic algorithm. The proposed system aims to provide a simpler, less expensive and more reliable diagnosis of heart disease. The data set is obtained from the UCI repository. The nodal weights for the artificial neural network at 13 input nodes, 2 hidden nodes and 1 output node are adjusted once with a gradient descent algorithm and then with a genetic algorithm. The performance of these methods is compared and it is concluded that the genetic algorithm can actually select the optimal set of weights. In the genetic algorithm, tournament selection is a method of selecting a person among a population of individuals. This work indicates that more members come from offspring. This is an indication of the generation of mechanisms that lead to greater diversity and exploration of the research space. With the help of this work, expert systems for disease prediction can be developed in the future. K. Sudhakar et al. [52] studied the prognosis of heart disease using data mining. The data generated by the health sector are huge and informative. Therefore, it can not be interpreted manually. Data mining can be used effectively to predict diseases from these data sets. In this article, various data mining techniques are analyzed in the heart disease database. Here are used classification techniques such as the decision tree, Naïve Bayes and the neural network. Associative classification is a new and effective technique that integrates the extraction of association rules and classification into a predictive model and allows maximum precision. In summary, this article analyzes and compares the operation of different classification algorithms in a database on heart disease. Shantakumar B. Patil et al. [53] have obtained important models from the heart disease database for the prediction of heart attacks. Unfortunately, huge amounts of data collected from the health sector are not processed properly to find hidden information that can predict a heart attack. Here, the authors proposed the MAFIA algorithm (algorithm of the set of maximum frequencies) to do it with Java. The data are first pre-processed, then grouped into two groups using the k-means algorithm, and the significant group for myocardial infarction is obtained. Thus, frequent patterns are extracted from the element set and significant weights of frequent data are calculated. Based on these attributed weights (age, blood pressure, cholesterol and many others), the selected models are significant for a heart attack. This model can be used to develop heart attack prediction systems.

Sairabi H. Mujawar et al. [54] predicted heart disease with modified k-agents and naive Bayes. Diagnosis of heart disease is a complex task that requires great skills. The data set is from the Cleveland Heart Disease database. The

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disease
achieved the accuracy of about 95%. Jaymin neural networks. The genetic algorithm was used to improve the learning of the neuro-fuzzy system and Bayesian classifiers, nearest k-neighborhood classification (k-NN), vector machine support (SVM) and artificial System Neural System) algorithm for diagnosis of heart disease and compared with decision trees, naive Bayes, and hybrid models and achieved about 76%, 85% and 69% of accuracy respectively and achieved 96% accuracy in hybrid system. Deepali Chandna [62] used hybrid model learning algorithm for diagnosis of disease. The data set is used by UCI repository. The dataset have 76 attributes, out of 76 attributes 14 attributes are selected and adaptive neuro-fuzzy inference (ANFIS) is used to classify dataset. The accuracy of the proposed approach is 98.24%. S. Pravabathi et al. [63] proposed a DNFS (Decision Based System Neural System) algorithm for diagnosis of heart disease and compared with decision trees, naive Bayesian classifiers, nearest k-neighborhood classification (k-NN), vector machine support (SVM) and artificial neural networks. The genetic algorithm was used to improve the learning of the neuro-fuzzy system and achieved the accuracy of about 95%. Jaymin
Patel et al. [64] compared different decision tree classification algorithms for better performance in diagnosing heart disease with WEKA. The J48 algorithm, the logical model tree and the random forest algorithms were compared. Records were taken from the UCI repository, which consisted of 303 and 76 attribute cases, of which 13 attributes were selected to perform the tests. The best algorithm is J48 with the maximum precision of 56.76% and the total time for the construction of the model is 0.04 seconds. Vikas Chaurasia et al. [65] presented a new model that improves the accuracy of the decision tree for the identification of heart disease in patients. Decision-making algorithms include CART (classification tree and regression), ID3 (iterative dichotomous version 3) and C4.5. The CART model recursively separates observations in branches to build a tree to improve prediction accuracy. Gunsai Pooja Dineshgar et al. [66] studied the latest knowledge discovery techniques in databases using data mining techniques and created a prototype of an intelligent heart Erkrankungs prediction system with the diagnosis of heart disease has enabled the historic center database. Data mining clustering techniques such as K-means and K-medoid algorithms are analyzed in order to achieve global cluster-based optimality on partitions. The k-means algorithm divides a set of n objects into the desired k clusters. After examining the previous work with the algorithm used K-medoid the authors proposed the integration of this method to assign records to effectively and profitably predict heart disease. Kamal Kant et al. [67] proposed a prototype for heart disease prediction using data mining techniques, Naive Bayes, above. Naive Bayes is a statistical classifier that does not assign dependency between attributes. The posterior probability must be maximized to determine the class. Once again, the Naive Bayes classifier works well. In statistical probability and the real-time expert system Naïve Bayes appears to be the most effective model for predicting the disease, followed by neural networks and decision trees. Sharan Monica L et al. [68] investigated current database discovery techniques using data mining techniques such as J48, NB Tree, and simple CART to more accurately predict heart disease with fewer attributes in the WEKA instrument. J48 is an open source Java C4.5 implementation that uses information to make decisions. The Naive Bayes classifier creates models with predictive functions, preferably for continuous data sets. Classification and regression trees (CARTs) are used to quickly display important data relationships. These three decision tree algorithms have been applied in WEKA. CART achieved the highest accuracy of 92.2%. Nidhi Bhatla et al. [69] analyzed various data mining techniques introduced in recent years to predict cardiopathies. The observations showed that the 15 attribute neural networks outperformed all other data mining techniques and that the decision tree was also very accurate with the genetic algorithm and the selection of functional subsets with WEKA. 3.6.6. This research was supported by two additional features: i.e. Obesity and smoking are recorded separately from other common features for an effective diagnosis. The genetic algorithm was applied using a natural evolutionary methodology. It continues to generate until it develops a population P in which each rule P satisfies the suitability threshold starting from zero. The decision tree was 99.62% accurate with 15 attributes. Furthermore, the decision tree associated with a 6-attribute genetic algorithm was 99.2% efficient. Sumitra Sangwan et al. [70] developed a hybrid algorithm that uses the k-media and a priori algorithm to extract large amounts of data and extract useful information. First, grouping is performed using the k-means grouping algorithm. Therefore, a previous algorithm is used to find frequent sets of objects. It is also used to determine groups of terms that are common to the Boolean association rule. Apply an “ascending” approach, i.e. H. Frequent subsets are incremented by one element at a time and groups of candidates are tested with data. The results show that clustering is a priori a better predictor of heart disease. Rishi Dubey et al. [71] studied different data extraction techniques to predict heart disease. Much of the work they examined shows that hybrid techniques are more accurate than a single classification technique. They found that the neural
network is an effective predictive technique. If the system is properly trained with genetic algorithms, the system shows very promising results. This method can also be used to select appropriate treatments for a patient in the future, rather than simply predicting the risk of heart disease in patients. Ashish Chhabbi et al. [72] studied various data mining techniques to extract models hidden from a series of data that can answer complex questions of predictive cardiopathy. The record was collected from the UCI repository. They used Naïve Bayes and the modified K-Means algorithm. The results show that modified k means better precision than simple k (with the number of predefined clusters). Shadab Adam Pattekari et al. [73] developed a predictive system for heart disease using Bayes, decision trees and naïve neural networks. It is implemented in a web application. Then it retrieves the hidden data from the stored database and compares the user's values with the format record. The system uncovers and extracts hidden knowledge about heart disease in a historical heart disease database. It can answer complex questions about the diagnosis of a disease. A set of 15 attributes was selected and the Naïve-Bayes classification method was used to determine the probabilities of heart disease. Boshra Baharami et al. [74] have evaluated different classification techniques such as J48 Decision tree, k-Nearest Neighbors(k-NN), Naive Bayes (NB) and SMO(SMO is widely used for training SVM). On the dataset feature selection technique (gain ratio evaluation technique) is used to extract the important features. WEKA software is used for implementing the classification algorithms. 10 fold cross-validation techniques is used to test the mining techniques. J48 shows the highest accuracy of 83.732%. Dhanashree S. Medhekar et al. [75] presented a classifier technique for the heart sickness prediction and likewise they’ve confirmed how Naïve Bayes can be used for the classification purpose. They categorized clinical knowledge to five distinct classes namely no, low, normal, excessive, very excessive. If any unknown sample is discovered, the method will classify it into respective class label. The dataset used here is the Cleveland medical institution ground work coronary heart disease set which contains 303 observations and 14 parameters. The system works in two phases i.e. coaching phase and testing phase. In the coaching segment, the classification is supervised. The checking out segment involves the prediction of the unknown knowledge or the lacking values. The Naïve Bayes algorithm is used which is based on the Bayesian theorem. The outcome proves that the accuracy has been obtained by altering the number of occasions within the given dataset. Noura Ajam [76] has studied those artificial neural networks (ANN) show significant results in heart disease diagnosis. The architecture of a neural network is formed by the number of processing units (neurons) and connections between them. A subgroup of processing elements is called layer. The number of neurons and the layers depends upon the complexity of the system. Artificial neural network is widely used in medical diagnosis and health care applications because of it’s high predictive power as classifier, fault tolerance and learning from environment. Artificial neural network is unsupervised learning type provided only with inputs associated with unknown targets. It is self organized. The dataset used here is obtained from Cleveland dataset which consists of 14 attributes and 303 instances. Artificial neural network is trained using back propagation learning algorithm on the data. Input and target samples are divided as 60% training set, 20% validation set and 20% test set. The activation function used is tangent sigmoid for hidden layers and linear transfer function for output layer. Mean square error (MSE) is calculated which is equal to 0.1071 and the classification accuracy for heart disease is 88%. S. Florence et al. [77] proposed a system which uses neural network and the Decision tree (ID3) for the prediction of heart attacks. The dataset used is provided by the UCI machine learning repository. CART, ID3, C4.5 Decision tree algorithms used Giniindex to measure the impurity of a partition or set of training attributes. The dataset contains six attributes like age, sex, cardiac duration, signal, possibility of attack etc. The final outcome is the class label. Depending upon the attribute values present in the dataset, the corresponding class label is predicted. 75% of the data is used for training and 25% is used for testing the system. The knowledge obtained from the classification is used to test the system. In the neural network, the input layer has 6 nodes, the hidden layer has 3 nodes and the output layer consists of 2 nodes. Finally it shows 2 outputs, that is the possibility of heart attacks. The prediction is done using the tool called RapidMiner Studio. Results are generated by using Decision tree as well as neural networks. They have used this method to predict whether there is an attack or not. Figure 2:1: Accuracy of Diagnosis achieved by various Authors2. 2 Noteworthy Contributions in the field of Dengue Disease Diagnosis The dengue fever, also known as life-threatening disease, is caused by dengue virus. It is also referred to break bone fever which is one amongst the major deadly diseases around the world transmitted by blood-feeding-mosquito i.e. Aedes aegypti. According to data provided by National Vector Born Disease Control Program, Delhi and Maharashtra have the highest mortality rate in India whereas as per WHO, 40% population of world is affected by this disease. A lot of viral infection exists in the world, but dengue fever virus infection causes more illness and death. It comes severe for
the people who have weak immune system. An early diagnosis of this disease can help for quick recovery in patient. It can be broadly classified into three categories which are Dengue Fever (DF), Dengue Hemorrhagic Fever (DHF) and Dengue Shock Syndrome (DSS) [78]. In all the three types, DSS are the most dangerous type of dengue fever and the recovery is even more difficult as compare to DF & DHF. Table 2.1: Sign and symptom table with short investigation.

<table>
<thead>
<tr>
<th>Type</th>
<th>Sign &amp; Symptoms</th>
<th>Investigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dengue Fever (DF)</td>
<td>High Fever</td>
<td>WBC count Decrease</td>
</tr>
<tr>
<td></td>
<td>Throat Infection</td>
<td>AST/ALT Increase</td>
</tr>
<tr>
<td></td>
<td>Chills &amp; Headache</td>
<td>Platelets may or may not be decreased</td>
</tr>
<tr>
<td>Dengue Hemorrhagic Fever (DHF)</td>
<td>High Fever, Low Bleeding</td>
<td>WBC count Decrease</td>
</tr>
<tr>
<td></td>
<td>Headache</td>
<td>AST/ALT Increase</td>
</tr>
<tr>
<td></td>
<td>Abdominal Pain</td>
<td>Platelets Decreased</td>
</tr>
<tr>
<td></td>
<td>Restlessness</td>
<td>CT Abnormal</td>
</tr>
<tr>
<td></td>
<td>WBC count Decrease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AST/ALT Increase</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Platelets Decreased</td>
<td></td>
</tr>
<tr>
<td>Dengue Shock Syndrome (DSS)</td>
<td>Very High Fever, Higher Abdominal Pain, Bleeding &amp; Rashes, Hypothermia, Very High Weakness, Consciousness level Decreased, WBC count Decrease, AST/ALT Increase quickly, Platelets Decreased</td>
<td>BP Falls Electrolyte Embalancing</td>
</tr>
</tbody>
</table>

Numerous researchers have done good work in the diagnosis of dengue fever disease using artificial intelligence techniques. In 2015, Varinder Pabbi [78] implemented a fuzzy expert system using MATLAB. In this paper, the author gives complete details like symptoms, input variable with their ranges and rules. It uses the local data set provided by hospitals. Kaur et al. [79] proposes a viral infection diagnosis system for chicken box, swine flu and dengue. They implement a common fuzzy expert system for all three infections disease and used all the common in nature. The proposed system demonstrates fuzzy expert system for determination of the risk level of the patient, possibly affected by infection. Faisal et al. [80] designs an adaptive neuro fuzzy interface system for the diagnosis of dengue disease. The proposed expert system achieves 86.13% accuracy. In this paper, authors give complete details about ANFIS with its architecture and subtractive clustering algorithm. They use 9 input variables and evaluate their system through performance table. In 2016, Princy-Muruganandam [81] implements a dengue fever disease by using Informatica tool and oracle database. The patient data is gathered from local hospitals. In this paper, complete detail about implementation and analysis of dataset is given by the author. Sharma et al. [82] develops a decision support system for the diagnosis of
One of the main objectives of the present study is to develop a control system to enhance the efficiency to diagnose heart disease related to human. The developed fuzzy expert system can explore crisp and linguistic data with loosely defined boundary conditions for decision-making. It is implemented in MATLAB for the mentioned contexts for the comparison and validation with the dataset used in UCI repository. The proposed fuzzy controller makes the machine to take intelligent decisions as similar to that of humans. 3.1 Database used for Diagnosis of Heart Disease

The database used in this work has been taken from the UCI (Machine Learning Repository) and this dataset contains intelligent decisions as similar to that of humans. The validation with the dataset used in UCI repository. The proposed fuzzy controller makes the machine to take decisions.

3.2 Database used for Diagnosis of Dengue Fever

The existing database so that we reach closely to create a perfect system for medical diagnoses. The proposed system will solve the problem by selecting a subset of useful feature from a set of features. The existing systems have various drawbacks like some were used for a particular type of dataset, some needed dataset of good quality. Therefore there is a need of a system of good quality that considers all the parameters, uses the best technique and predicts the diseases with greater accuracy. Fuzzy logic and expert system are important and very promising techniques in medical environment as it incorporates the knowledge and experience of physician and based on that information the system will predict the heart disease. With the help of fuzzy rule-based system we can avoid cost of conducting the test for the disease diagnosis. With this research we must be find out the accuracy of our system with the existing database so that we reach closely to create a perfect system for medical diagnoses.
This dataset consists of 76 input attributes and 1 output attribute for result. In the proposed system, 10 input attributes are used which are blood pressure, Cholesterol, blood sugar, chest pain type, maximum heart rate and old peak, thallium scan, ECG, Gender and Age. The output field referred to diagnosis of heart disease in the patient and the result shows that the patient has the heart risk or not. It consists of integer value from 0 (no presence) to 4 (distinguish presence (values 1, 2, 3 and 4). Here, increasing value shows increasing heart disease risk. The proposed Fuzzy Logic Controller is designed using MATLAB fuzzy logic tool for heart disease diagnosis which consists of 10 Linguistic Inputs and produces 1 output. 3.2 Proposed Fuzzy Expert System for Heart Disease Diagnosis

3.2.1 Input and Output Parameters

Input Parameters
- A1: Blood Pressure
- A2: Selindorme Cholesterol
- A3: Maximum Heart Rate
- A4: Chest Pain Type
- A5: ECG
- A6: AGE
- A7: FBS
- A8: OP
- A9: TScan
- A10: Gender

Output Parameters
- DC: Patient Condition

3.2.2 Proposed Algorithm

Algorithm 1 Algorithm for Diagnosis of Heart Disease

Require: Crisp Value for Input.

INPUT
Input the fuzzy set for A1, A2, A3, A4, A5, A6, A7, A8, A9 and A10

OUTPUT
Output the fuzzy set for DC

METHOD

Begin
For each input do

Step 1: Input the crisp values for A1, A2, A3, A4, A5, A6, A7, A8, A9 and A10.
Step 2: Set the triangular membership function for the fuzzy number with equation. OR
Step 3: Built the fuzzy numbers for A1, A2, A3, A4, A5, A6, A7, A8, A9 and A10 for input set

Step 3.1:
Built the fuzzy number for DM for the output set

Step 4: Fuzzy inference are executed by Mamdani's method.
Step 4.1: Input the rule as \{Rule 1, 2...k\}.

Step 5:

Plagiarism detected: 0.07% http://ijsrcseit.com/paper/CSEIT183... id: 39

3.1: Built the fuzzy number for DM for the output set.

Step 4: Fuzzy inference are executed by Mamdani's method.

Plagiarism detected: 0.26% http://ijsrcseit.com/paper/CSEIT183... id: 40

4.1: Input the rule as \{Rule 1, 2...k\}.


Step 5:

Plagiarism detected: 0.22% http://ijsrcseit.com/paper/CSEIT183... id: 41

Defuzzify into the crisp values by DC = \( Z_i \) means the weight for \( u(Z_i) \) and \( u(Z_i) \) means the number of fuzzy numbers of the output fuzzy variable DC.

Step 6: Present the knowledge in the form of human...
3.2.3 Parameters of Proposed Membership Functions

Following are the member functions with their ranges of variable.

BP:
Following are the ranges of BP-Input Filed

Ranges
Fuzzy Variables

<table>
<thead>
<tr>
<th>Fuzzy Set Value</th>
<th>BP</th>
<th>Ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>A11</td>
<td>100 - 134</td>
</tr>
<tr>
<td>Medium</td>
<td>A12</td>
<td>127 - 153</td>
</tr>
<tr>
<td>High</td>
<td>A13</td>
<td>142 - 172</td>
</tr>
<tr>
<td>Very High</td>
<td>A14</td>
<td>154 - 320</td>
</tr>
</tbody>
</table>

SCHL:
Following are the ranges of SCHL-Input Filed

Ranges
Fuzzy Variables
Fuzzy Set Value

<table>
<thead>
<tr>
<th>Fuzzy Set Value</th>
<th>SCHL</th>
<th>Ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>A21</td>
<td>40 - 197</td>
</tr>
<tr>
<td>Medium</td>
<td>A22</td>
<td>188 - 250</td>
</tr>
<tr>
<td>High</td>
<td>A23</td>
<td>217 - 307</td>
</tr>
<tr>
<td>Very High</td>
<td>A24</td>
<td>281 - 681</td>
</tr>
</tbody>
</table>

MHR:
Following are the ranges of MHR-Input Filed

Ranges
Fuzzy Variables
Fuzzy Set Value

<table>
<thead>
<tr>
<th>Fuzzy Set Value</th>
<th>MHR</th>
<th>Ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>A31</td>
<td>70 - 141</td>
</tr>
<tr>
<td>Medium</td>
<td>A32</td>
<td>111 - 194</td>
</tr>
<tr>
<td>High</td>
<td>A33</td>
<td>152 - 400</td>
</tr>
</tbody>
</table>

CP:
Following are the ranges of CP-Input Filed
<table>
<thead>
<tr>
<th>Ranges</th>
<th>Fuzzy Variables</th>
<th>Fuzzy Set Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP</td>
<td>0 - 2</td>
<td>A41</td>
</tr>
<tr>
<td></td>
<td>TAngina</td>
<td>1 - 3</td>
</tr>
<tr>
<td></td>
<td>ATAngina</td>
<td>2 - 4</td>
</tr>
<tr>
<td></td>
<td>NonAngina</td>
<td>3 - 5</td>
</tr>
<tr>
<td></td>
<td>Asynpt</td>
<td></td>
</tr>
<tr>
<td>FBS</td>
<td>-1 - 1</td>
<td>A51 False</td>
</tr>
<tr>
<td></td>
<td>0 - 2</td>
<td>A52 True</td>
</tr>
<tr>
<td>OP</td>
<td>0 - 2</td>
<td>A53 Low</td>
</tr>
<tr>
<td></td>
<td>1.5</td>
<td>A54 Medium</td>
</tr>
<tr>
<td></td>
<td>- 4.2</td>
<td>A55 High</td>
</tr>
<tr>
<td>ECG</td>
<td>-0.5</td>
<td>A61 Normal</td>
</tr>
<tr>
<td></td>
<td>- 0.4</td>
<td>A62 ST_T_abnormal</td>
</tr>
<tr>
<td></td>
<td>0.25</td>
<td>A63 HypertrophyThaScan</td>
</tr>
<tr>
<td></td>
<td>- 1.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.4 - 2.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>73</td>
<td></td>
</tr>
</tbody>
</table>
Fuzzy Variables
Fuzzy Set Value
ThaScan
1 - 5
A81
Normal
4 - 8
A82
FixedDef
5.5 - 10
A83
RevDef

Gender :
Following are the ranges of Gender-Input Filed
Ranges
Fuzzy Variables
Fuzzy Set Value
Gender
-1 - 1
A91
M
0 - 2
A92
F

Age :
Following are the ranges of Age-Input Filed
Ranges
Fuzzy Variables
Fuzzy Set Value
Age
20 - 38
A101
Young
33 - 45
A102
Medium
40 - 58
A103
Old
52 - 100
A104
VeryOld

DC
: Following are the ranges of DC-Input Filed
Ranges
Fuzzy Variables
Fuzzy Set Value
DC
-1 - 1
DC1
Healthy
1 - 2
DC2
LowRisk
2 - 3
DC3
Risk
3 - 4
DC4
HighRisk
### Table 3.1: Parameters of Proposed Membership Functions

<table>
<thead>
<tr>
<th>Representation of Fuzzy Variables</th>
<th>Fuzzy Numbers</th>
<th>Representation of Fuzzy Numbers</th>
<th>Fuzzy Triangular Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood Pressure (BP)</td>
<td>Low A1</td>
<td>[100 100 111 134]</td>
<td>Medium A12</td>
</tr>
<tr>
<td></td>
<td>Low A11</td>
<td>[127 139 153]</td>
<td>High A13</td>
</tr>
<tr>
<td></td>
<td>High A13</td>
<td>[142 157 172]</td>
<td>Very High A14</td>
</tr>
<tr>
<td></td>
<td>Very High A14</td>
<td>[154 171 320 320]</td>
<td></td>
</tr>
<tr>
<td>Cholesterol (SCHOL)</td>
<td>Low A2</td>
<td>[40 40 151 197]</td>
<td>Medium A22</td>
</tr>
<tr>
<td></td>
<td>Low A21</td>
<td>[188 215 250]</td>
<td>High A23</td>
</tr>
<tr>
<td></td>
<td>Very High A24</td>
<td>[281 347 681 681]</td>
<td></td>
</tr>
<tr>
<td>Maximum Heart Rate (MHR)</td>
<td>Low A3</td>
<td>[70 70 100 141]</td>
<td>Medium A32</td>
</tr>
<tr>
<td></td>
<td>Low A31</td>
<td>[111 152 194]</td>
<td>High A33</td>
</tr>
<tr>
<td></td>
<td>High A33</td>
<td>[152 216 400 400]</td>
<td>Chest Pain (CP)</td>
</tr>
<tr>
<td></td>
<td>Non Angina A4</td>
<td>[0 1 2]</td>
<td>A4</td>
</tr>
<tr>
<td></td>
<td>Non Angina A4</td>
<td>[1 2 3]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non Angina A4</td>
<td>[2 3 4]</td>
<td></td>
</tr>
<tr>
<td>ASynpt</td>
<td>A44</td>
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<tr>
<td>---------</td>
<td>------</td>
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<td></td>
</tr>
<tr>
<td>[3 4 5]</td>
<td>FBS</td>
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<tr>
<td>A5</td>
<td>False</td>
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</tr>
<tr>
<td>A51</td>
<td>[-1 1]True</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A52</td>
<td>[0 2]OP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A6</td>
<td>LOW</td>
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<td></td>
</tr>
<tr>
<td>A61</td>
<td>[0 2]Medium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A62</td>
<td>[1.5 4.2]High</td>
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<td></td>
</tr>
<tr>
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<td>[2.55 5]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECG</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>A7</td>
<td>Normal</td>
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<td></td>
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</tr>
<tr>
<td>STtabnormal</td>
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<td></td>
</tr>
<tr>
<td>A72</td>
<td>[0.25 1 1.8]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertrophy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A73</td>
<td>[1.4 2 2.5 2.5]ThaScan</td>
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<td>A8</td>
<td>Normal</td>
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</tr>
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<td>A81</td>
<td>[1 5]FixedDeV</td>
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</tr>
<tr>
<td>A82</td>
<td>[4 8]RevDef</td>
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</tr>
<tr>
<td>A83</td>
<td>[5.5 10]Gender</td>
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<tr>
<td>A9</td>
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<td>[-1 -1]</td>
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</tr>
<tr>
<td>Female</td>
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</tr>
<tr>
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<td>[0 2]AGE</td>
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</tr>
<tr>
<td>A101</td>
<td>[20 20 29 38]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A102</td>
<td>[33 38 45]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Old</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A103</td>
<td>[40 48 58]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very Old</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A104</td>
<td>[52 60 100 100]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Disease Condition
(\text{DC})
\text{Healthy}
\text{DC1} 
[-1 0 1] 
\text{Low Risk}
\text{DC2} 
[1 1.5 2] 
\text{Risk}
\text{DC3} 
[2 2.5 3] 
\text{High Risk}
\text{DC4} 
[3 3.5 4] 
\text{Very High Risk}
\text{DC5} 
[4 4.5 5]

In order to apply fuzzy logic, it is necessary to establish fuzzy logic rules. After determining the membership functions, a total of 679 rules have been established for defining relationship among the parameters.

3.3 Summary of this Chapter

This chapter reveals the proposed methodology for the diagnosis of heart disease.

The database available with UCI consists of 76 input attributes and 1 output attribute. In the proposed system, 10 input attributes are used which are blood pressure, Cholesterol, blood sugar, chest pain type, maximum heart rate and old peak, thallium scan, ECG, Gender and Age with 1 output. The proposed Fuzzy Logic Controller is designed using MATLAB fuzzy logic tool for heart attack. The proposed algorithm explains the overall methodology behind this.

Chapter 4

PROPOSED FUZZY EXPERT SYSTEM FOR DIAGNOSIS OF DENGUE

The dengue fever, also known as life-threatening disease, is caused by dengue virus. It is also referred to break bone fever which is one amongst the major deadly diseases around the world transmitted by blood-feeding mosquito i.e. Aedes aegypti. According to data provided by National Vector Born Disease Control Program, Delhi and Maharashtra have the highest mortality rate in India whereas as per WHO, 40% population of world is affected by this disease. A lot of viral infection exists in the world, but dengue fever virus infection causes more illness and death. It comes severe for the people who have weak immune system. An early diagnosis of this disease can help for quick recovery in patient. It can be broadly classified into three categories which are Dengue Fever (DF), Dengue Hemorrhagic Fever (DHF) and Dengue Shock Syndrome (DSS).

In all the three types, DSS are the most dangerous type of dengue fever and the recovery is even more difficult as compare to DF & DHF. The biggest problem with dengue fever is, it is identify only when patient is on very critically stage and unfortunately there is no special tool developed for identifying dengue within 1-2 days continues fever. There lots of type fever causes death but dengue fever has highest numbers of death. The proposed system will solve the problem by selecting a subset of useful feature from a set of features.

One of the main objectives of the present study is to develop a control system to enhance the efficiency to diagnose dengue disease related to human. The developed fuzzy expert system can explore crisp and linguistic data with loosely defined boundary conditions for decision-making. It is implemented in MATLAB for the mentioned contexts for the comparison and validation with the data obtained from SAIMS Hospital, Indore. The proposed fuzzy controller makes the machine to take intelligent decisions as similar to that of humans.

4.1 Database used for Diagnosis of Dengue

In this study, different levels of dengue fever are categorized using fuzzy logic toolbox and by the help of hospital dataset. This proposed method used the database provided by SAIMS hospital, Indore. All the patient data belong to year 2017.

In the proposed system, 6 input attributes are used which are Age, WBC Count, AST/ALT, Platelet Count, BP and Fever. The output field referred to diagnosis of dengue in the patient and the result shows that the patient has dengue or not. It consists of integer value from 0-3 (no dengue), 3-5 (DF), 5-8 (DHF) and 8-10 (DSS). Here,
increasing value shows increasing dengue risk. The proposed Fuzzy Logic Controller is designed using MATLAB fuzzy logic tool for dengue diagnosis which consists of 6 Linguistic Inputs and produces 1 output. 4.2 Proposed Fuzzy Expert System for Dengue Diagnosis

4.2.1 Input and Output Parameters

Input Parameters

Output Parameters
R: Result

4.2.2 Proposed Algorithm

Algorithm 1 Algorithm for Diagnosis of Dengue Disease

Require: Crisp Value for Input.

INPUT
Input the fuzzy set for Age, WBC Count, Platelet Count, AST/ALT, BP and Fever

OUTPUT
Output the fuzzy set for Result

METHOD

Begin
For each input do
Step 1: Input the crisp values for Age, WBC Count, Platelet Count, AST/ALT, BP and Fever

Step 2:
Set the triangular membership function for the fuzzy number with equation OR

Step 3:
Built the fuzzy numbers for Age, WBC Count, Platelet Count, AST/ALT, BP and Fever

Step 3.1:
Built the fuzzy number for Result for the output set

Step 4: Fuzzy inference are executed by Mamdani’s method.

Step 4.1: Input the rule as {Rule 1, 2,...,k}


Step 5:
Defuzzify into the crisp values by \( R = \sum Zi \) means the weight for \( u(Zi) \) and \( u(Zi) \) means the number of fuzzy numbers of the output fuzzy variable DC.

Step 6: Present the knowledge in the form of human nature language.

End. End of the Algorithm

4.2.3 Parameters of Proposed Membership Functions

Following are the member functions with their ranges of variable.

Age:
Following are the ranges of age-Input Filed

Ranges
Fuzzy Variables
Fuzzy Set Value
Age
0 - 14
A11
Child
14 - 44
A12
Young
44 - 100

Plagiarism detected: 0.03% http://ijsrcseit.com/paper/CSEIT183...

Plagiarism detected: 0.13% http://ijsrcseit.com/paper/CSEIT183...

Plagiarism detected: 0.05% http://ijsrcseit.com/paper/CSEIT183...

Plagiarism detected: 0.15% http://ijsrcseit.com/paper/CSEIT183...

Plagiarism detected: 0.22% http://ijsrcseit.com/paper/CSEIT183...
A13
Old
WBC Count: Following are the ranges of WBC-Input Filed
Ranges
Fuzzy Variables
Fuzzy Set Value
WBC_Count
A21
Low
4 - 11
A22
Normal
11 - 16
A23
High
AST/
ALT: Following are the ranges of AST/ALT-Input Filed
Ranges
Fuzzy Variables
Fuzzy Set Value
AST/ALT
A31
Low
1 - 7
A32
Normal
7 - 55
A33
High
Platelet Counts: Following are the ranges of Platelet counts-Input Filed
Ranges
Fuzzy Variables
Fuzzy Set Value
PlateletCount
A41
Low
15 - 40
A42
Normal
40 - 50
A43
High
Blood Pressure: Following are the ranges of blood pressure-Input Filed
Ranges
Fuzzy Variables
Fuzzy Set Value
BP
A51
Low
60 - 90
A52
Normal
90 - 120
A53
High
Fever: Following are the ranges of fever-Input Filed
Ranges
Fuzzy Variables
Fuzzy Set Value
Fever
94 - 99
A61
Normal
99- 102
A62
High
102 - 108
A63
Very High
Result: After creating membership function of all input variable, we need to use membership function for output which is called result. Following are the ranges of Result.Output Filed
Ranges
Fuzzy Variables
Fuzzy Set Value
Result
0 - 3
R1
No Dengue
3 - 5
R2
DF
5 - 8 R3
DHF
8 - 10 R4
DSS
Table 4.1: Parameters of Proposed Membership Functions
Fuzzy Variables
Representation of Fuzzy Variables
Fuzzy Numbers
Representation of Fuzzy Numbers
Fuzzy Triangular Numbers
Age
A1
Child
A11
[0 7 14]
Young
A12
[14 30 44]
Old
A13
[44 70 100 100]
WBC Count
A2
Low
A21
[3 3.5 4]
Normal
A22
[4 7 11]
High
A23
[11 13 16]
AST / ALT
A3
Low
A31
[1 3 7]
4.3 Summary of this Chapter

This chapter reveals the proposed methodology for the diagnosis of dengue disease. In this study, different levels of dengue fever are categorized using fuzzy logic toolbox and by the help of hospital dataset. This proposed method used the database provided by SAIMS hospital, Indore. All the patient data belong to year 2017. In the proposed system, 6 input attributes are used which are Age, WBC Count, AST/ALT, Platelet Count, BP and Fever. The output field referred to diagnosis of dengue in the patient and the result shows that the patient has dengue or not. It consists of integer value from 0-3 (no dengue), 3-5 (DF), 5-8 (DHF) and 8-10 (DSS). Here,
increasing value shows increasing dengue risk. CHAPTER 5
SIMULATION ENVIRONMENT AND RESULT ANALYSIS
5.1 Snap-shot of Proposed Fuzzy Expert System.

Figure 5.1: MATLAB Screen with various options

Figure 5.1 describes the MATLAB screen with various options. It consists of menu bar with the menu tool command window with the fuzzy logic tool box. Figure 5.2: Mamdani Fuzzy Inference System (Heart Disease)

Figure 5.3: Membership Function for BPBP :

Following are the ranges of BP-Input Filed

Ranges
Fuzzy Variables

<table>
<thead>
<tr>
<th>Fuzzy Set Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BP</td>
</tr>
<tr>
<td>100 - 134</td>
</tr>
<tr>
<td>A11</td>
</tr>
<tr>
<td>Low</td>
</tr>
<tr>
<td>127 - 153</td>
</tr>
<tr>
<td>A12</td>
</tr>
<tr>
<td>Medium</td>
</tr>
<tr>
<td>142 - 172</td>
</tr>
<tr>
<td>A13</td>
</tr>
<tr>
<td>High</td>
</tr>
<tr>
<td>154 - 320</td>
</tr>
<tr>
<td>A14</td>
</tr>
<tr>
<td>Very High</td>
</tr>
</tbody>
</table>

Figure 5.4: Membership Function for SCHL

Following are the ranges of SCHL-Input Filed

Ranges
Fuzzy Variables

<table>
<thead>
<tr>
<th>Fuzzy Set Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCHL</td>
</tr>
<tr>
<td>40 - 197</td>
</tr>
<tr>
<td>A21</td>
</tr>
<tr>
<td>Low</td>
</tr>
<tr>
<td>188 - 250</td>
</tr>
<tr>
<td>A22</td>
</tr>
<tr>
<td>Medium</td>
</tr>
<tr>
<td>217 - 307</td>
</tr>
<tr>
<td>A23</td>
</tr>
<tr>
<td>High</td>
</tr>
<tr>
<td>281 - 681</td>
</tr>
<tr>
<td>A24</td>
</tr>
<tr>
<td>Very High</td>
</tr>
</tbody>
</table>

Figure 5.5: Membership Function for MHR

Following are the ranges of MHR-Input Filed

Ranges
Fuzzy Variables

<table>
<thead>
<tr>
<th>Fuzzy Set Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MHR</td>
</tr>
<tr>
<td>70 - 141</td>
</tr>
<tr>
<td>A31</td>
</tr>
<tr>
<td>Low</td>
</tr>
<tr>
<td>111 - 194</td>
</tr>
<tr>
<td>A32</td>
</tr>
<tr>
<td>Medium</td>
</tr>
<tr>
<td>152 - 400</td>
</tr>
<tr>
<td>A33</td>
</tr>
</tbody>
</table>
**Figure 5.6: Membership Function for CPCP**

Following are the ranges of CP-Input Filed

<table>
<thead>
<tr>
<th>Ranges</th>
<th>Fuzzy Variables</th>
<th>Fuzzy Set Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 2</td>
<td>A41</td>
<td>Tangina</td>
</tr>
<tr>
<td>1 - 3</td>
<td>A42</td>
<td>TAngina</td>
</tr>
<tr>
<td>2 - 4</td>
<td>A43</td>
<td>NonAngina</td>
</tr>
<tr>
<td>3 - 5</td>
<td>A44</td>
<td>Asynpt</td>
</tr>
</tbody>
</table>

**Figure 5.7: Membership Function for FBS**

Following are the ranges of FBS-Input Filed

<table>
<thead>
<tr>
<th>Ranges</th>
<th>Fuzzy Variables</th>
<th>Fuzzy Set Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1 - 1</td>
<td>A51</td>
<td>False</td>
</tr>
<tr>
<td>0 - 2</td>
<td>A52</td>
<td>True</td>
</tr>
</tbody>
</table>

**Figure 5.8: Membership Function for OPOP**

Following are the ranges of OP-Input Filed

<table>
<thead>
<tr>
<th>Ranges</th>
<th>Fuzzy Variables</th>
<th>Fuzzy Set Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 2</td>
<td>A61</td>
<td>Low</td>
</tr>
<tr>
<td>1.5 - 4.2</td>
<td>A62</td>
<td>Medium</td>
</tr>
<tr>
<td>2.55 - 5</td>
<td>A63</td>
<td>High</td>
</tr>
</tbody>
</table>

**Figure 5.9: Membership Function for ECG**

Following are the ranges of ECG-Input Filed

<table>
<thead>
<tr>
<th>Ranges</th>
<th>Fuzzy Variables</th>
<th>Fuzzy Set Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.5 - 0.4</td>
<td>A71</td>
<td>Normal</td>
</tr>
<tr>
<td>0.25 - 1.8</td>
<td>A72</td>
<td>ST_T_abnormal</td>
</tr>
<tr>
<td>1.4 - 2.5</td>
<td>A73</td>
<td></td>
</tr>
</tbody>
</table>
Hypertrophy

Figure 5.10: Membership Function for ThaScan
Following are the ranges of ThaScan-Input Filed

Ranges
Fuzzy Variables
Fuzzy Set Value
ThaScan
1 - 5
A81
Normal
4 - 8
A82
FixedDef
5.5 - 10
A83
RevDef

Figure 5.11: Membership Function for Gender
Following are the ranges of Gender-Input Filed

Ranges
Fuzzy Variables
Fuzzy Set Value
Gender
-1 - 1
A91
M
0 - 2
A92
F

Figure 5.12: Membership Function for Age
Following are the ranges of Age-Input Filed

Ranges
Fuzzy Variables
Fuzzy Set Value
Age
20 - 38
A101
Young
33 - 45
A102
Medium
40 - 58
A103
Old
52 - 100
A104
VeryOld

Figure 5.13: Membership Function for DC
Following are the ranges of DC-Input Filed

Ranges
Fuzzy Variables
Fuzzy Set Value
DC
-1 - 1
DC1
Healthy
1 - 2
DC2
LowRisk
2 - 3
DC3
Risk
3 - 4
DC4
HighRisk
4 - 5
DC5
VeryHighRisk

Figure 5.14: Fuzzy Rule Editor (Heart Disease)
Figure 5.15: Fuzzy Rule Viewer (Heart Disease)
Figure 5.16: Mamdani Fuzzy Inference System (Dengue)
Figure 5.17: Membership Function for Age
Age:
Following are the ranges of age-Input Filed
Ranges
Fuzzy Variables
Fuzzy Set Value
Age
0 - 14
A1
Child
14 - 44
A2
Young
44 - 100
A3
Old

Figure 5.18: Membership Function for WBC Count
WBC Count:
Following are the ranges of WBC-Input Filed
Ranges
Fuzzy Variables
Fuzzy Set Value
WBC_Count
3 - 4
A1
Low
4 - 11
A2
Normal
11 - 16
A3
High

Figure 5.19: Membership Function for AST/ALT
AST/ALT:
Following are the ranges of AST/ALT-Input Filed
Ranges
Fuzzy Variables
Fuzzy Set Value
AST/ALT
1 - 7
A1
Low
7 - 55
A2
Normal
55 - 65
A3
High

Figure 5.20: Membership Function for Platelet Count
Platelet Counts:
Following are the ranges of Platelet counts-Input Filed
Ranges
Fuzzy Variables
Fuzzy Set Value
PlateletCount
5 - 15
A1
Low
15 - 40
A2
Normal
40 - 65
A3
High
Figure 5.21: Membership Function for BP
Blood Pressure: Following are the ranges of blood pressure
Input Filed
Ranges
Fuzzy Variables
Fuzzy Set Value
BP
60 - 90
60
Low
90 - 120
Low
Normal
120 - 180
Normal
High
Figure 5.22: Membership Function for Fever
Fever: Following are the ranges of fever
Input Filed
Ranges
Fuzzy Variables
Fuzzy Set Value
Fever
94 - 99
94
Normal
99 - 102
99
Normal
102 - 108
102
High
Very High
Figure 5.23: Membership Function for Result
Result: After creating membership function of all input variables, we need to use membership function for output which is called result. Following are the ranges of Result.
Output Filed
Ranges
Fuzzy Variables
Fuzzy Set Value
Result
0 - 3
0
R1
No Dengue
3 - 5
3
R2
DF
5 - 8
5
R3
DHF
8 - 10
8
R4
DSS
Figure 5.24: Fuzzy Rule Editor (Dengue)
Figure 5.25: Fuzzy Rule Viewer (Dengue)

5.2 Performance Measures
For the present research work, accuracy of diagnosis of a patient is considered as performance measure.

Accuracy:
The accuracy of a test is its ability to differentiate the patient and healthy cases correctly. Sensitivity: Here, True Positive (TP) means correct identification of Sick people as sick
False Positive (FP) means incorrect identification of Healthy people as sick
True Negative (TN) means correct identification of Healthy people as healthy
False Negative (FN) means incorrect identification of Sick people as healthy
With the help of above MATLAB rule viewer, the result can tested easily. After testing on 200 patient databases (UCI) [23], 94.5% accuracy has been achieved by the proposed diagnosis system. The experimental results are compared with earlier research in Table 5.1 and shows that the proposed system is more efficient and accurate as compare to other existing diagnosis systems. Table 5.1: Comparison of Accuracy of the Proposed System with Existing Approaches (Heart Disease)

<table>
<thead>
<tr>
<th>Diagnosis System</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rathod-Gawande, Sayad-Halkarnikar</td>
<td>94%</td>
</tr>
<tr>
<td>Senthil Kumar</td>
<td>93.88%</td>
</tr>
<tr>
<td>Muthukaruppan</td>
<td>93.27%</td>
</tr>
<tr>
<td>Pathania-Ritika, Kumar-Kaur</td>
<td>92%</td>
</tr>
<tr>
<td>Khatibi-Montazerac</td>
<td>91.58%</td>
</tr>
<tr>
<td>Proposed Method</td>
<td>94.5%</td>
</tr>
</tbody>
</table>

After testing on this implementation system, accuracy & sensitivity of system is 94.5% & 90.19% respectively. We have measured the accuracy and sensitivity by the help of confusion matrix. The following table shows the confusion matrix: Table 5.2: Confusion Matrix of the Proposed System (Heart Disease)

<table>
<thead>
<tr>
<th>Actual Value: NO</th>
<th>Predicated Value: NO</th>
<th>TN=143</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicated Value: YES</td>
<td>FP=6</td>
<td>Actual Value: YES</td>
</tr>
<tr>
<td>TP=46</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 5.26: Accuracy of Diagnosis achieved by Proposed FES (Heart Disease)

In this study, different level of dengue fever categorized using fuzzy logic toolbox and by the help of hospital dataset. In this work, we have used the database provided by SAIMS hospital Indore. All the data belong to the current year, which is 2017. After testing on proposed system, accuracy & sensitivity of system is 92.8% & 94.25% respectively. We have calculated the accuracy and sensitivity by the help of confusion matrix. The following table shows the confusion matrix: Table 5.3: Confusion Matrix of the Proposed System (Dengue)

<table>
<thead>
<tr>
<th>Actual Value: NO</th>
<th>Predicated Value: NO</th>
<th>TN=52</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicated Value: YES</td>
<td>FP=0</td>
<td>Actual Value: YES</td>
</tr>
<tr>
<td>TP=69</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.3 Summary of this Chapter

This chapter illustrates overview of simulation environment and result analysis. It explains the implementation in detail through snapshots of MATLAB based GUI.
With the help of above MATLAB rule viewer, the result can tested easily. After testing our proposed FES for Heart Disease diagnosis on 200 patient databases (UCI) [23], accuracy & sensitivity of system is 94.5% & 90.19% respectively. After testing our proposed FES for diagnosis of Dengue, accuracy & sensitivity of system is 92.8% & 94.25% respectively. CHAPTER 6

CONCLUSION AND FUTURE WORK

6.1 Conclusion
For diagnosis of human disease, there is requirement of high level expert system which is used to solve such complex diagnosis. Such expert system is intended towards use of artificial intelligence such as fuzzy logic. One of the efficient artificial intelligence systems is fuzzy inference system for diagnosis of disease such as heart disease. As there are so many uncertainties while diagnosis of disease and fuzzy logic is the best expert system to deal with uncertainty. So, while diagnosis of any disease expert system should be developed such that it should require less time and achieve high accuracy and error should be minimized. This research work is used to for diagnosis of heart disease and dengue.

In summary, the contributions are as follows:

- Explored the necessity of an expert system for the diagnosis of human diseases more accurately as compared to the existing systems.
- Designed and developed fuzzy expert system for the diagnosis of heart disease.
  - Accuracy & sensitivity of system is 94.5% & 90.19% respectively.
- Designed and developed fuzzy expert system for the diagnosis of dengue.
  - Accuracy & sensitivity of system is 92.8% & 94.25% respectively.

6.2 Future Work
As a future research direction, this research can be an initial step for dealing with fuzziness in the database systems. This study used Mamdani fuzzy inference system to develop the FIS. Another research direction can be the use of other fuzzy inference system named Sugeno method. In terms of membership function, this research used triangular membership function and trapezoidal membership function. Future research can be done by choosing other types of membership functions. While designing the FIS, this study defuzzified the result by centroid defuzzification method. It is worthy to perform future research by using other types of defuzzification methods also. In addition to testing the system with different fuzzy approaches, the fuzzy rules used for each disease can be modified or added by new fuzzy rules to provide better accuracy. Fuzzy controller is used to develop expert systems in different areas such as bioinformatics, traffic signals, biological diagnosis, power system control, etc. The future work of this research work extends the approach towards diagnosis of severe diseases other than heart diseases such as diabetes, liver diseases, kidney diseases, etc.

SUMMARY

In these days, monitoring of different medical parameters can be done easily and all these data can be stored for future analysis and diagnosis. But the huge amount of data needs a lot of storage space which is costly. And another aspect is that all data are not of importance, only a few relevant data are important which poses a big problem in disease diagnosis. To make the disease diagnosis system more effective, the data should be filtered, conditioned and clustered. For clustering the data different contemporary and soft computing based data clustering techniques are available. After the data of different parameters are clustered, an inference mechanism is required to correlate two different parameters to a single cause. The existing systems have various drawbacks like some were used for a particular type of dataset, some needed dataset of good quality. Therefore there is a need of a system of good quality that considers all the parameters, uses the best technique and predicts the diseases with greater accuracy. Fuzzy logic and expert system are important and very promising techniques in medical environment as it incorporates the knowledge and experience of physician and based on that information the system will predict the heart disease. With the help of fuzzy rule-based system we can avoid cost of conducting the test for the disease diagnosis. With this research we must be find out the accuracy of our
system with the existing database so that we reach closely to create a perfect system for medical diagnoses. The proposed system will solve the problem by selecting a subset of useful feature from a set of features.

One of the main objectives of

the present study is to develop a control system to enhance the efficiency to diagnose heart disease related to human. The developed fuzzy expert system can explore crisp and linguistic data with loosely defined boundary conditions for decision-making. It is implemented in MATLAB for the mentioned contexts for the comparison and validation with the dataset used in UCI repository. The proposed fuzzy controller makes the machine to take intelligent decisions as similar to that of humans. The database used in this work has been taken from the UCI (Machine Learning Repository) and this dataset consists of 4 databases (Implemented on 920 Patient) from ftp://ftp.ics.uci.edu/pub/machine-learning-databases/heart-disease/


Hungarian institute of Cardiology, Budapest
V. A. Medical Center, Long Beach, CA and ftp://ftp.ics.uci.edu/pub/machine-learning-databases/heart-disease/

University Hospital, Zurich, Switzerland. This dataset consists of 76 input attributes and 1 output attribute for result. In the proposed system, 10 input attributes are used which are blood pressure, Cholesterol, blood sugar, chest pain type, maximum heart rate and old peak, thallium scan, ECG, Gender and Age. The output field referred to diagnosis of heart disease in the patient and the result shows that the patient has the risk of heart disease or not. It consists of integer value from 0 (no presence) to 4 (distinguish presence (values 1, 2, 3 and 4)). Here, increasing value shows increasing heart disease risk. The proposed Fuzzy Logic Controller is designed using MATLAB fuzzy logic tool for heart disease diagnosis which consists of 10 Linguistic Inputs and produces 1 output. After determining the membership functions, a total of 679 rules have been established for defining relationship among the parameters. The dengue fever, also known as life-threatening disease, is caused by dengue virus. It is also referred to break bone fever which is one amongst the major deadly diseases around the world transmitted by blood-feeding-mosquito i.e. Aedesaegypti. According to data provided by National Vector Born Disease Control Program, Delhi and Maharashtra have the highest mortality rate in India whereas as per WHO, 40% population of world is affected by this disease. A lot of viral infection exists in the world, but dengue fever virus infection causes more illness and death. It comes severe for the people who have weak immune system. An early diagnosis of this disease can help for quick recovery in patient. It can be broadly classified into three categories which are Dengue Fever (DF), Dengue Hemorrhagic Fever (DHF) and Dengue Shock Syndrome (DSS).

In all the three types, DSS are the most dangerous type of dengue fever and the recovery is even more difficult as compare to DF & DHF. As it is known that dengue fever is only identified in extreme cases and unfortunately no special diagnostic tools are developed for diagnosis of dengue fever until fever continues for about 1-2 days. As a consequence of effects of dengue fever results in high death ratio. The proposed system solves the problem by selecting a subset of useful feature from a set of features.

One of the main objectives of

the present study is to develop a control system to enhance the efficiency to diagnose dengue disease related to human. The developed fuzzy expert system can explore crisp and linguistic data with loosely defined boundary conditions for decision-making. It is implemented in MATLAB for the mentioned contexts for the comparison and validation with the data obtained from SAIMS Hospital, Indore. In this study, different levels of dengue fever are categorized using fuzzy logic toolbox and by the help of hospital dataset. This proposed method used the database provided by SAIMS hospital, Indore. All the patient data belong to year 2017. In the proposed system, 6 input attributes are used which are Age, WBC Count, AST/ALT, Platelet Count, BP and Fever. The output field referred to diagnosis of dengue in the patient and the result shows that the patient has dengue or not. It consists of integer value from 0-3 (no dengue), 3-5 (DF), 5-8 (DHF) and 8-10 (DSS). Here, increasing value shows increasing dengue risk. The proposed Fuzzy Logic Controller is designed using MATLAB fuzzy logic tool for dengue diagnosis which consists of 6 Linguistic Inputs and produces 1 output. In summary, the contributions are as follows:

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explored the necessity of an expert system for the diagnosis of
human diseases more accurately as compare to the existing systems. 

Designed and developed

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fuzzy expert system for the diagnosis of heart disease.

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After testing on 200 patient databases (UCI
)

[23], accuracy & sensitivity of system is 94.5% & 90.19% respectively.

Designed and developed

fuzzy expert system for the diagnosis of
dengue. In this work, we have used the database provided by SAIMS hospital Indore. All the data belong to the current year, which is 2017. After testing on proposed

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system, accuracy & sensitivity of system i

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