

Analysis of CAS using Improved PSO with Fuzzy Based System

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Abstract— Coronary artery Syndrome (CAS) is myocardial infarction angina pectoris, CAS is one of the most common public syndrome in our country. Coronary artery syndrome involves the occurrence of pathological changes, arteriosclerosis, in the partitions of one or more of the coronary vessels. Physical immobility is a potent risk factor for coronary artery disease, but old age, high blood pressure, blood lipid disorders, male gender and heredity, as well as smoking, diabetes and overweight also increase the risk of developing the syndrome. The main aim of this paper demonstrates a fuzzy based coronary artery syndrome (CAS) analysis system using advanced improved Particle Swarm Optimization. In this proposed system based on the Cleveland and Hungarian Heart syndrome datasets. Since the datasets having numerous input points, decision tree (DT) was employed to loosen the characteristics that give towards the study. The output of the decision tree was adjusted into crisp if- then rules and then altered into fuzzy rule base. Improved Particle Swarm Optimization (IPSO) was utilized to correct the fuzzy membership functions (MFs).

Key words: CAS, IPSO, DT, MFs

I. INTRODUCTION

Coronary artery syndrome engross the creation of pathological transformations in the wall of one of more of the coronary arteries, so-it's described hardening of the arteriosclerosis or arteries, and is the most important widespread reason of sensitive coronary events, that is, acute unstable angina pectoris or myocardial infarction.

Atherosclerosis (Hardening of the arteries) is the most important reason of sharp coronary artery syndrome. Atherosclerosis principally attacks the deepest layer of the artery partition, the intima, which is invented of endothelial cells. Initially, a amassing of blood fats (lipids) takes places among the where inflammatory cells, macrophages, endothelial cells, ingest the fat. The macrophages ingest the lipids until they rupture and become so-described "foam cells". A fibrous mass then develops around the foam cell, figuring a plaque. These atherosclerotic plaques do not hit the complete vessel but emerge in scrapes. The area in the region of the arterial limb points is mainly vulnerable

Analysis and assessment of prediction should be originated as early as likely parallel to establishing treatment. With a patient history, ECG and biochemical signs of myocardial injure, the analysis can be complete and projection determined within the foremost few hours in most patients. For moments supplementary examinations are required, such as echocardiography, coronary radiology and/or a stress test with ECG observations. If sensitive coronary artery syndrome is deduced, the patient should constantly be divulged to hospital and delighted, with PCI for example, as soon as possible

A. Fuzzy logic:

Fuzzy logic is a structure of several-valued logic in which the precision values of variables may be any actual number between 1 and 0. By dissimilarity, in Boolean logic, the precision values of variables may only be 1 or 0. Fuzzy logic has been expanded to hold the perception of fractional fact, where the exactness value may range among wholly true and totally false. Furthermore, when linguistic variables are employed, these degrees may be supervised by particular functions. The first distinguished purpose was on the speedy train in Sendai, in which fuzzy logic was clever to get better the financial system, precision of the ride and comfort. It has also been utilized in credited of hand written cipher in flight aid for helicopters; Sony pocket computers; managing of subway systems in order to get better driving console, exactitude of bring to an ending, and power financial system; improved fuel expenditure for auto mobiles; single-button control for washing machines; habitual motor control for vacuum cleaners with appreciation of surface state and degree of soiling.

II. DATA SETS

To evaluate the proposed system, two input data sets in heart syndrome have been utilized. Both information datasets are offered by the University of California at Irvine. The datasets are the Cleveland Clinic and Hungarian Institute of Cardiology, Budapest, and datasets. There are 597 proofs in overall. There are 76 characteristic in the datasets, of which all researches presently utilize 14: 13 of them as input data's and 1 trait as a result. The 13 input characteristics consist of chest pain type, maximum heart rate, blood pressure, age, cholesterol, serum sex, blood sugar, and exercise-persuaded angina, resting ECG, slope, fluoroscopy, thallium scan and old peak. The yield variable is the angiography condition.

III. FUZZY EXPERT SYSTEM

The extracted rules commencing the decision tree (DT) will alter to fuzzy rules. This necessitates having a fuzzy representation. To generate a fuzzy representation, there are 3 most important steps to perform: fuzzification, fuzzy deduction system, and defuzzification process. The fuzzy model design procedure contains the following descriptions: 1) input and output variables, 2) fuzzy rule., and 3) fuzzy MFs for every unpredictable data's.

The input data variable is intended based on features picked by a decision tree (DT). The yield datavariabale is the class field in the dataset. Fuzzy MFs are described based on the limit values of every branch of the DT (decision tree). Fuzzy rules are designed based on decision tree rules, and membership functions. The proposed fuzzy expert system components are illustrated in Fig. 1. As revealed in Fig. 1, after the preprocessing step, heart syndromes data are came into the fuzzy inference system,

and are classified. This classification and presumption are based on knowledge base information.

The Sugeno fuzzy inference system was utilized for the proposed system. In the fuzzification progression, the set of rules extracted from a decision tree is altered into fuzzy rules. The major part of a fuzzy model is the membership function of all features. The needed datasets have 13 features, in the middle of which just 7 features were used that have more sway than others in decision making. The feature choice task is executed by the decision tree. The features that are selected are:

- resting blood pressure (trest bps),
- chest pain type (cp),
- ST depression induced by exercise relative to rest (old peak),
- number of major vessels colored by fluoroscopy (ca),
- serum cholesterol (chol),
- maximum heart rate achieved

With the normalization step, the range of all data was varied to flank by [0, 1]. The output data variable refers to the existence of heart syndrome in the patient. It has two values (1 and 0), which rest for heart disease condition and health.

A. Preprocessing the Data

The initial step is to preprocess the data sets. This first and foremost comprises the filling of lost values, removal of outliers, and feature selection. The dissimilar preprocessing steps that are utilized are:

- Normalizing the data and attribute selection.
- filling the missing values
- dealing with outliers

Real databases regularly contain missing data for lots of causes, such as the tests not having been performed entirely, or the data being occupied. Handling them is an incredibly important step, because they could inferior the correctness of classification. There are dissimilar techniques for this reason. Two significant techniques are including missing data, removing characteristics, and data accusation, which approximations and calculates the absent values, by processes similar to mean and mode values. The first one is utilized when there are a little number of absent values. In this system, the second procedure is utilized, on account of the moderately high number of absent data from the CAD dataset. The categorical values are put backed with the numerical values and the mode with the mean. Having precise results, the data preprocessing progress were thoroughly done: filling the absent data, removing outliers, and standardizing the data had all been done.

Distance-based outlier's schemes are utilized to sense the outliers, employing the k-adjacent neighbor and Euclidean distance. In the normalization process, the limits of all data were varied to between [0, 1]. Data were standardized with the Eq. (1).

$$\text{Normalize } (x) = \frac{x - x_{\min}}{x_{\max} - x_{\min}} \quad (1)$$

B. Improved Particle Swarm Optimization Algorithm

Improved Particle swarm optimization (IPSO) is a computational process that optimizes a difficulty by iteratively trying to get better a applicant solution with consider to a given evaluation of quality. Improved PSO

optimize a difficulty by having inhabitants of applicant elucidations, here dubbed particles, and moving these particles approximately in the search-space in keeping with easiest mathematical principle over the particle's location and speed. In every particle's progress is controlled by its local finest known location but, is also showed toward the best known locations in the search-space, which are modernized as better places are establish by supplementary particles. This is imagined to shift the swarm in the direction of the best results.

Advanced recorded management in composite supply chains needs successful and vigorous nonlinear optimization due to the stochastic character of demand variations and supply. Application of guesstimated inclines can boost up the meeting of Improved Particle Swarm Optimization (PSO) algorithm but traditional incline computation cannot be applied to tentative and stochastic systems.

Specialized systems are a secondary division of Artificial Intelligence which works out the problems at the level of a human consultant making utilize of specialized information represented by a set of policy. The fuzziness and indistinctness, which is inherited in the biomedical injuries, can be delighted incorporating fuzzy logic. A fuzzy professional system (FPS) is basically a specialized scheme which includes collection of fuzzy rules and membership functions, i.e., knowledge gaining, considered to be the vital problem in the intend of fuzzy professional system. In common, information could be obtained from the specialists in the fastidious area. When there is an enlarge in feasible number of rules of the FPS, experts find it tricky to describe the absolute rule set. Also the recital of the system can also be augmented by regulation of membership function using optimization algorithms (Ganesh Kumar et al., 2012).

C. Proposed System

In this recommended system, we commence fuzzy based coronary artery disease (CAD) analysis system employing improved Particle Swarm Optimization. In this proposed system founded on the Cleveland and Hungarian Heart syndrome datasets. Since the datasets having numerous input points, decision tree (DT) was utilized to unravel the attributes that give towards the investigation. Improved Particle Swarm Optimization (IPSO) was utilized to alter the fuzzy membership functions (MFs). Having used the optimized Membership Functions, the produced fuzzy proficient system. The yield of the decision tree was acclimatized into crisp if- then rules and then altered into fuzzy rule base.

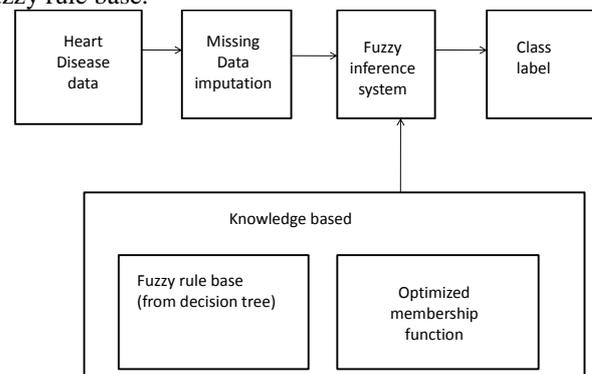


Fig. 1: Proposed Fuzzy Expert System

In order to conquer the weakness of typical PSO, some improved scheme for velocity updating, the exceeding boundary control, international most excellent perturbation and the shortened quadratic interpolation (SQI) machinist are implemented. To show the effectiveness of the proposed technique, a top qualified set of mathematical examples, apprehension with linear as well as planar array, is existed.

D. Simulation Result

After determining the input parameters, output parameters are specified, the different stages in the development process of the disease which is fuzzy set output parameter (CAD). It should be noted that in general, the complete accuracy of detection based on just the physical symptoms and is quite not possible, But with considered symptoms, this disease can be detected with high accuracy, hence CAD disease might be detected in early stages or at least before progressing the disease to advanced stages, thus, Getting into the treatment program as sooner as possible.

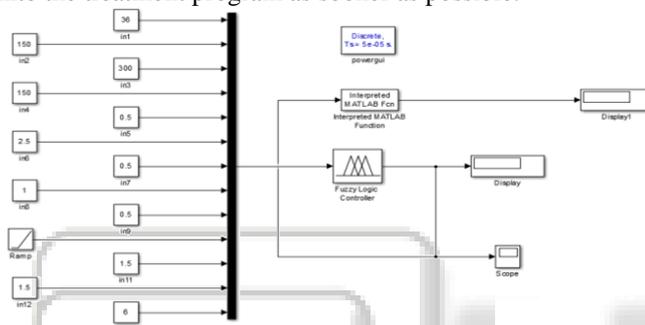


Fig. 2: Simulink diagram for CAS syndrome analysis

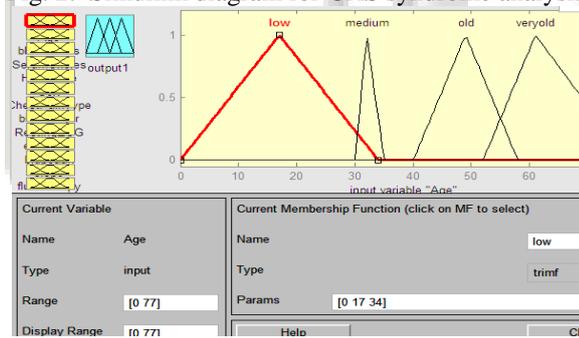


Fig. 3: Input field patient

This input variable has three fuzzy sets, high, intermediate and low. Membership functions of these fuzzy sets are triangular and trapezoidal. A fuzzy set range of disease analysis is shown in Fuzzification of this variable is done by the following function.

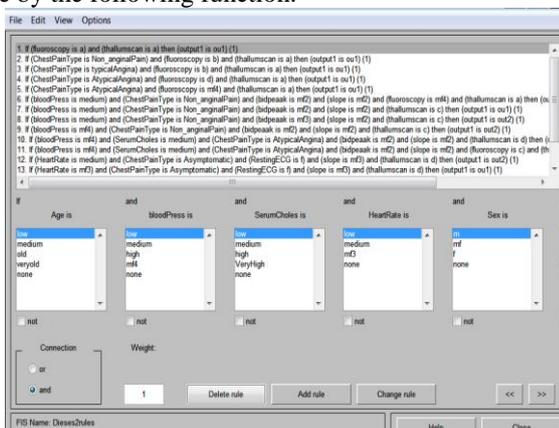


Fig. 4: Fuzzy rule data

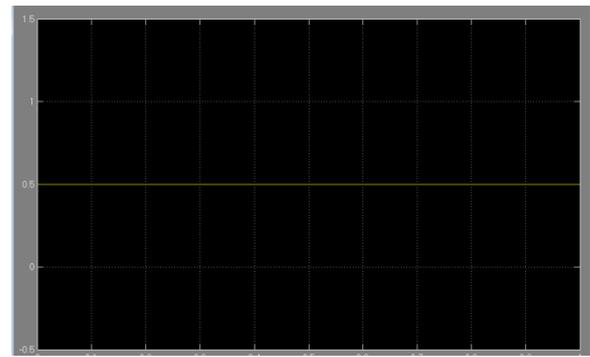


Fig. 5: Output result

E. Comparison for Results

Author	Method	Accuracy
(Cheung 2001)	BNNF	80.96
(Polat et al., 2007)	Fuzzy-AIRS-Knn based system	91.18
(Senthil Kumar, 2011)	ANFIS	87.00
(Senthil Kumar, 2012)	Fuzzy resolution mechanism	91.83%
(S.Muthukaruppan, 2012)	PSO based fuzzy Expert system	93.27%
Proposed System	IPSO based fuzzy expert system	93.50%

Table 1: Comparison

IV. CONCLUSION

In this revision, a fuzzy specialized system based on improved particle swarm optimization (PSO) was extended in Matlab’s Simulink in order to heart syndrome and healthy provision. With this anticipated approach, 93.50% precise sorting on the test set could be realized. The recognition of the important attributes and fuzzy rules was attained using the decision tree algorithm. The consequence of determining vital and relevant fuzzy rules without the assist of the specialists opens the option of knowledge discovery. The main compensation of the FPS as a knowledge attainment tool is the following: (1) a little number of rules are obtained (2) the obtained rules can be easily interpreted. These results imply promising research areas utilizing decision trees and fuzzy professional system in several sorting problems

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