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Artificial Bee Colony (ABC) Optimization for the Prediction of Coronary Heart Disease

Sowmya N. and Dr. R .Vijayabhanu,
Department of Computer Science,
Avinashilingam Institute for Home Science and Higher Education for Women,
Coimbatore,Tamilnadu, India.

***Abstract*:** Prediction of deadly disease like Coronary Heart Diseases is quite impressive these days with modern robotic technologies. The medical organization contains a huge amount of data which can pre-processed with the data mining techniques. The revealed information is evaluated with help of soft computing techniques such as fuzzy systems to predict the presence of the disease. The prediction accuracy is computed with Swarm Intelligent optimization such as Artificial Bee Colony Optimization. This accuracy in percentage helps us to diagnosis the disease effectively.

Keywords— *Artificial Bee Colony Optimization, Coronary Heart Disease, Data Mining, Fuzzy System, Mat lab, Swarm Intelligent Optimization*

I. INTRODUCTION

Plaque is a deposition of substance such as fat, cholesterol, calcium and other substances. These depositions are built upon the walls of the artery muscles, which blocks the flow of blood through these arteries. The arteries are responsible for supplying oxygen affluent blood from the lungs to the heart muscles. Whenever the oxygen rich blood deliver to the muscles fails nearly or completely blocked, it leads to chest pain or angina, heart attacks and sudden deaths. The aetiologist coins this as **Atherosclerosis or Coronary Heart Disease (CHD).**

Earlier detection of the plaque formation in the arteries can prevent the assassination of a person. But this type of fatal disease's symptoms frequently fluke with several other diseases. So, the prediction process becomes complicated by considering these facts. The prediction of CHD with best accuracy is possible now-a-days through artificial intelligences and modern preset technologies such as data mining and soft computing.

Knowledge Discovery in Database (KDD) process is multidisciplinary approach for extracting, analyzing, and understanding information and different patterns from a large database. Recent day data mining tools are becoming incredible in decision making and telecasting future intelligence. As they can easy collaborate with other technologies their usage has increased tremendously.

Being a data mining classifier, decision trees can classify both the numerical and categorical data sets and attributes. Classification and regression tree (CART) generates a regression tree with probability distribution. They are capable of representing any discrete values and easy handle errors and missing values. CART decision tree uses cost-complexity pruning and are self explanatory.

Fuzzy Systems are capable of constructing modules that are enabled to structure and describe activities and observations which differ from each other only vaguely and to formulate them in models that are used for various purposes such as problem solving and decision creation.

Swarm Intelligent (SI) Optimization is based on the behavior of animals like fish, honey bees, birds, etc. Their natural phenomenon explains us the recognition, communication and interaction with each entities, this knowledge helps us to formulate a problem by minimizing their total cost. Artificial Bee Colony (ABC) is one of the most recently defined SI algorithms by Dervis Karaboga in 2005 [8], motivated by the intelligent behavior of honey bees.

II. LITERATURE REVIEW

Persi Pamela I. *et al.* [13], performed on "**A Fuzzy Optimization Technique for the Prediction of Coronary Heart Disease Using Decision Tree"** in which data mining along with soft computing techniques are used with only 14 attributes to efficiently diagnosis coronary heart disease. From these attributes crisp rules have been obtained by employing CART decision tree algorithm, which have been then applied to the fuzzy system. A Particle Swarm Optimization (PSO) technique is applied for the optimization of the fuzzy membership functions where the parameters of the membership functions are altered to new positions. The result interpreted from the fuzzy system predicts the prevalence of coronary heart disease and also the system's accuracy was found to be good.

"A Data Mining Technique for Prediction of Coronary Heart Disease Using Neuro-Fuzzy Integrated Approach Two Level" by Ashish Kumar Sen *et al.* [2] has defined a two layered approach for identifying the heart disease possibility. The critical factors that are mandatory for occurrence of coronary heart disease have been taken at first level and the rest one are taken at second level. This two level approach shows an increase in the performance of the work as it helps in predicting disease chances accurately. The heart disease datasets are used to train the neural network and then fuzzy rules are applied to predict the chances of coronary heart disease as low, medium or critical.

Markos G. Tsipouras *et al.* [11] proposed a system of **"Automated Diagnosis of Coronary Artery Disease Based on Data Mining and Fuzzy Modeling"** to predict the disease by automatically generating from an initial annotated dataset, and then using a four stage methodology as decision tree, a set of rules, a fuzzy model and optimization of the parameters. The system offers several advantages since it is automatically generated, it provides CAD diagnosis based on easily and noninvasively acquired features, and is able to provide interpretation for the decisions made.

"**Decision Support System for Precluding Coronary Heart Disease (CHD) Using Fuzzy Logic"** was designed by K Cinetha *et al.* [6] illustrates us the data mining functionalities that are used to identify the level of risk factors to help the patients in taking precautionary actions to stretch their life span. To prevent development of any risk factors, fuzzy logic and decision tree are used for predicting.

"Fuzzy expert system approach for coronary artery disease screening using clinical parameters" was premeditated by Debabrata Pal *et al.* [7] which have developed a screening expert system that will help to detect Coronary Artery Disease at an early stage. Rules by fuzzy expert system approach were taken to cope with uncertainty present in medical domain. This paper focuses on rule organization using the concept of modules, meta-rule base, rule address storage in tree representation and rule consistency checking for efficient search of large number of rules in rule base.

Muthukaruppan S. *et al.* [12] devised **"A hybrid particle swarm optimization based fuzzy expert system for the diagnosis of coronary artery disease"** was based on decision tree to retrieve if- then rules which are transformed into fuzzy rule base. The obtained result are the tuned by particle swarm optimization to yield best accuracy. The major advantage of this approach is the ability to interpret the decisions made from the created fuzzy expert system, when compared with other approaches.

Dursun Delen *et al.* [9] show us **"An analytic approach to better understanding and management of coronary surgeries"** by applying data mining techniques with support vector machines that has been followed by decision tree and neural networks. This study exemplify us the fact that accurate prediction and better understanding of such complex medical interventions can potentially lead to more favorable outcomes and optimal use of limited healthcare resources. Chih-Lin Chi *et al.* [5] intend **"A decision support system for cost-effective diagnosis**" by proposing a machine learning expert system algorithm to optimize the prediction and assist diagnostic decisions in a sequential decision-making setting. This new approach that dynamically estimates and determines the optimal sequence of tests that provides the most information based on a patient's available information.

III. PRESENT WORK

A. Coronary Heart Disease

Arteries are the hollow tubes that provide the adequate blood supply that flow free all over the heart muscles. The muscles of the arteries are made up of endothelium, a layer of cells that are smooth and elastic in nature. Whenever the blood flows through these arteries, the cellular waste products, vitamin substances and fats deposits to form a block like material called the plaque. This cause the narrow downing of the arteries and blocks the flow of oxygen contained blood to the heart muscles. The heart muscles starve for the oxygen rich blood and other essential vitamins and nutrients for its proper working state. In some course of time the blood clot or plague develops in the arteries by partially or completely blocking the blood supply. These blood clots are known as **Coronary thrombus** causing serious coronary syndromes. The following fig 1 shows the development of plague on the walls of an artery

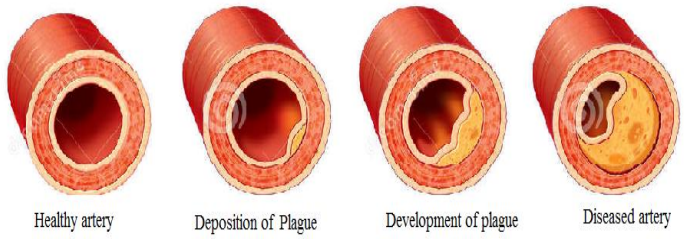

Fig 1 Coronary Heart Disease

B. Artificial Bee Colony (ABC) Optimization

Artificial Bee Colony (ABC) Optimization is one of the Swarm Intelligent optimization which is commonly used to solve combinatorial optimization problems. This optimization was carried out by Karaboga in 2005 [10]. The observation on the behavior of real bees in their process of collecting nectar and sharing the details of food sources to the fellow bees provides us the proceeding ABC algorithm [4]. There are three groups of bees involved in this process

Employee bees: Almost 50% of the bee population in a hive belongs to this group. They randomly discover the neighborhood for the information of food sources.

Onlooker bees: All the other bees of the hive other than the employee bees, estimate the food sources to select a particular source with rich nectar.

Scout bees: The food source that has been evaluated now becomes the scout bees. About 5-10% of the employee bees become the scouts.

The bees evaluate the food source through the fitness value of a particular food source is higher than the previous food source. The bee deletes the memory of the prior one and memorizes the existing one. This type of optimizing the food sources are through greedy selection. ABC algorithm is used commonly in modern optimization problems and feed forward neural networks [1].

1) ABC Algorithm

The fig 2 illustrates the following, in employee bee phase a random exploration is made and the efficient information are collected. The gathered information then enters the on-looker bee phase where the information is evaluated with a probabilistic approach. The random search is prepared to carry out the exploration in the last phase of the algorithm. After this the best solution so far is memorized. These above three phases exist in a loop after the initialization of the algorithm. The process loop continues until the predetermined number of trials called **limit.** The limit values are mostly specified by the user of the users. After reaching the limit, the best optimized solution is memorized [3].

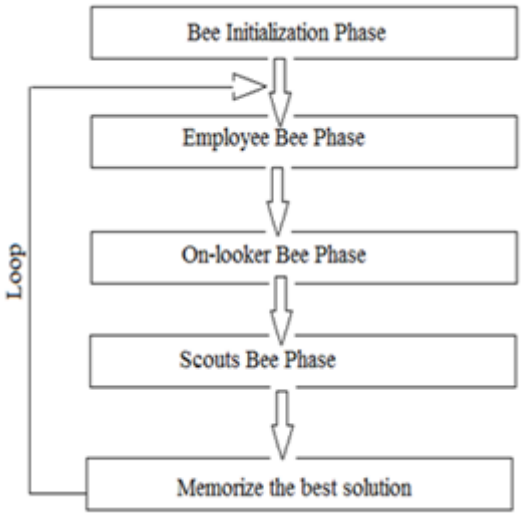

Figure 2: ABC Algorithm

C. Objective of present work

1. Prediction of coronary heart disease with 14 essential attributes.
2. Classifying the attributes into a tree structure.
3. Removing the fuzziness to get absolute rules for the prediction process.
4. Optimizing the prediction results to obtain the best accuracy.

D. Flow chart

The fig 3 shows the flow of the present work

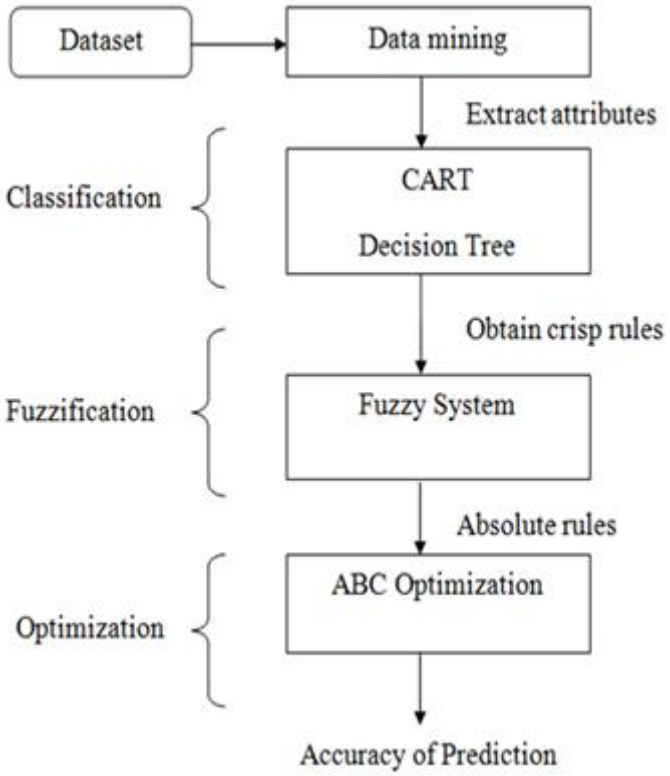

Figure 3: System Flow

IV. RESULTS

A. Simulation Tool

MATLAB is a high-performance and user friendly language that provides technical computation and visualization. The problems and solutions are more familiar to that of the mathematical notation. This interactive system is widely used to solve application-specific problems by *learn* and *apply* focused technology. The area of MATLAB includes signal processing, control systems, neural networks, fuzzy logic, wavelets, simulation, and many others.

B. Prediction Result Driven

The heart disease dataset is the one with almost 76 attributes. The UCI machine learning repository provides us with 14 attributes. These attribute accounts to be essential for the prediction of deadly coronary heart disease. These data attributes are mined for their consistency and are classified using the decision tree.

1) Classification IF THEN Rules

The predefined function in Mat lab is a data mining classifier provides as attributes in tree structure as shown in fig 4 and classification rules as in fig 5.

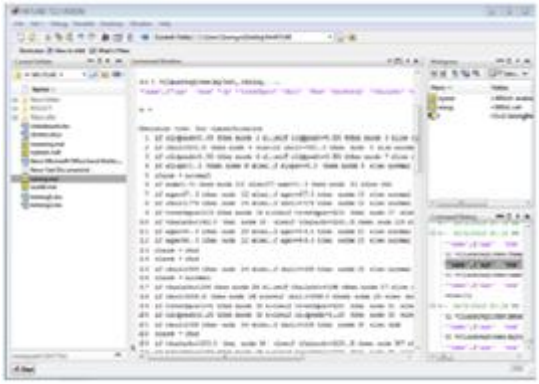

Figure 4: A Part of Rules from Decision Tree

Figure 5: CART Decision Tree Obtained

2) Fuzzy Editor

Fig 6 illustrate the fuzzy editor contains 14 attributes as its inputs which are passed into the fuzzy interference system to predict results as output.

Triangular membership function of the attributes as demonstrated in fig 7.

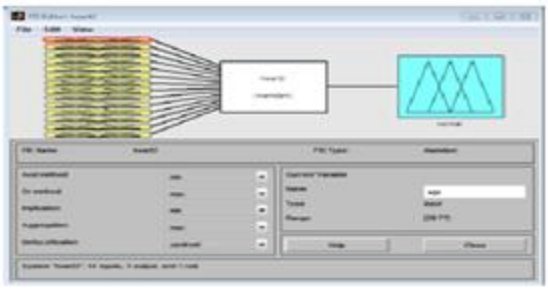

Figure 6: Fuzzy Inference System

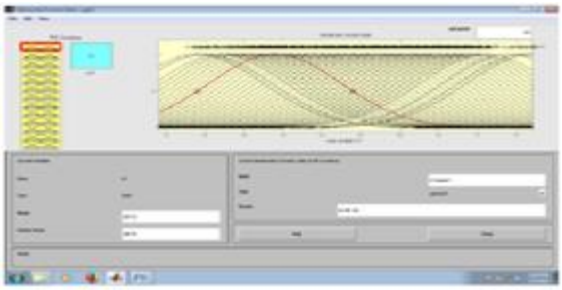

Figure 7: Membership Function for Attributes

3) Mean chart used for optimization

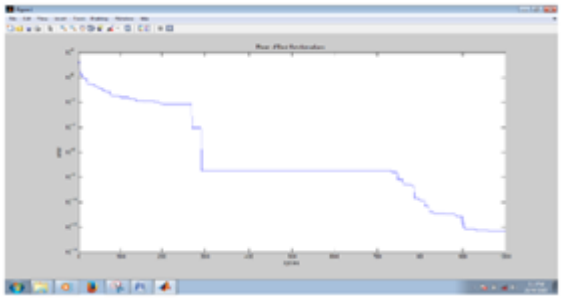

Figure 8: Mean Chart Used for Optimization

Mean values are calculated in fig for optimization fig 8.

4) Rule Viewer After Optimization

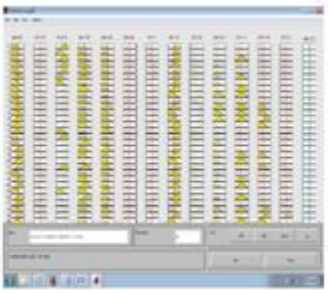

Fig 9: Rule Viewer of The Data After Optimization.

5) Prediction of CHD in Accuracy

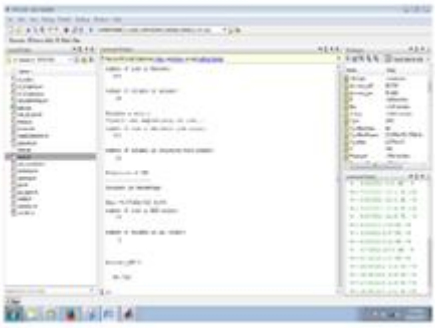

Figure 10: Prediction of CHD

Optimized accuracy in percentage for the prediction of CHD is obtained. Artificial Bee Colony optimization is used for optimization of our dataset has obtained the result as shown in fig 10.

CONCLUSION

A clinical prediction has to be made on time with best accuracy rate. This has been achieved by using ABC Optimization. The ABC algorithm has been widely engaged to solve various multidimensional problems. This flexible algorithm reduces the total cost and is very effective in solving fuzzy tribulations. From the above study, we can conclude that this probabilistic algorithm has performed better to produce the best accuracy rate. The intelligent behavior algorithm can be recommended for solving highly complicated optimization problems.

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