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Early Prediction of Heart Attack Using ENN-TLBO Classifier

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ABSTRACT: According to WHO's (World Health Organization) recent report, about 17.9 million people die each year from heart-related diseases and are rising rapidly. With the rising population and illness, diagnosis and caring the infected are becoming a problem at the right time. However, there is hope that recent technical developments in public health have accelerated through the introduction of innovative biomedical functional solutions. Predicting an outcome based on already existing data is a popular application of machine learning. In this work, a hybrid method called the Elman Neural Network –Teaching Learning Based Optimization (ENN –TLBO) classification is used to increase the accuracy of poor algorithms. The Cleaveland dataset from UCI machine learning repository is utilized for making heart disease predictions in this research work. Experiments are conducted for the proposed work and the final output shows that the proposed work outperforms well compare to the Decision tree and Naïve Bayes.

KEYWORDS: Data mining –Heart disease prediction – classification- ENN –TLBO

I. INTRODUCTION

Heart attacks that can strike at any moment and often the silent killer attack the people that are not even expected by the doctors are the deadliest diseases. Because of limited resources of available specialists and increasing misdiagnosed cases that forced the researchers to develop new data mining techniques and various machine learning techniques to predict cardiovascular disease for the last two decades, data mining has become very common for its ability to predict trends and add consistency to data sets. This helps researchers to create different attributes or classes and to classify them. Data mining seeks a solution by combining the classification methods with the qualified data sets to recognize the secret trends in the medical data sets.

The primary objective of this research is to predict silent heart attacks by defining the core trends and characteristics gathered from medical data. For this to pick the proper attributes, classification algorithms are used. Naïve Bayes, Neural Network, Decision Tree etc. are some of the common data mining techniques proposed by researchers in the prediction of heart diseases.

II. RELATED WORKS

Many researchers have been involved in classification techniques for data mining, particularly in the prediction of different diseases in earlier stages. Chitra et al [1] proposed a review on heart disease prediction system using data mining and hybrid intelligent techniques. In this paper, they concluded the neural network with offline training is good for disease prediction, and a pre-processed and structured dataset can provide good system efficiency.

Golande et al. studied various MLLs, algorithms that can be used for heart disease classification. Analysis has been conducted to research Decision Tree, KNN and algorithms from K-Means that can be used for classification and classification We contrasted their accuracy [2]. This thesis concludes the precision obtained by Decision Tree was

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still the highest. It was concluded that it can be made successful by combining various methods and tuning of parameters.

III. PROPOSED SYSTEM

One of the major drawbacks of these works is that the main focus has been on the application of classification techniques for heart disease prediction, instead of studying different data cleaning and pruning methods which prepares and makes a dataset appropriate for mining. This will provide much better accuracy than an unclean dataset with missing values. Then selecting proper data mining techniques for data cleaning and classification algorithms will enhance the accuracy prediction of the developing system.

So in our proposed work, we are planning to introduce an ENN-TLBO technique for better classification. The Elman neural network feeds an input layer, a hidden layer, an output layer and a special layer called the background layer to the forward network. The output of each secret neuron is copied to the real neuron in the background layer. In the Elman network, the weights from the secret layer to the context layer are set to one and fixed since the values of the context neurons need to be copied exactly. The Elman network can be educated in methods of gradient descent back propagation and optimization.

The TLBO is used to optimize ENN's weight and to improve classification accuracy. TLBO is also a population-based methodology which utilizes a range of alternatives to lead to the global solution. A community of learners or a class of learners is the population. The TLBO method is split into two parts: the 'Teacher Phase consists of the first part and the 'Learner Phase' consists of the second part. The 'Teacher Phase' is the teacher's learning, and the 'Learner Phase' is the learning process by learner interaction.

IV. ELMAN NEURAL NETWORK

Elman Neural Network is a feed-forward neural networks, in which the neurons are in the form of a network are linked together. Information flows to output neurons from input neurons into the network in one direction, and there is no feedback link in the architecture of such networks. Jordan has identified a network that has recurrent connections. Such recurrent networks connect static patterns with sequentially ordered output patterns. To serve as a guide for subsequent behavior, hidden nodes visualize their own previous performance. In the network, memory is supplied with recurring connections. In Figure 2, the ENN structure is present, where z-1 represents time delay, W1'W2'W3 is the weight matrix between the input and hidden layer, the weight matrix between the hidden and output layer, and the weight matrix between the background and the hidden layer. Vector compositions at sth iteration are x (s) I Ɛ X,i = 1,2,...,n,y (s) j Ɛ Y, j = 1,2,...,m,z (s) k = Z,k = 1,2,...,l,c (s) I = C I = j, where X is the vector of the input layer, Y is the vector of the hidden layer, Z¯ is the vector of the output layer and C¯ is the vector of the context layer, whereas I j, k and I are the number of their respective nodes. The background units, however, communicate only with the secret layer, not with the external layer. There are three layers of neurons in the network architecture of the ENN, namely internal and external input neurons in the input layer. The neurons of the internal input are also called background units or memory. Through their hidden nodes, internal input neurons transmit input. Hidden neurons recognize from external and internal neurons their inputs. Previous outputs of secret neurons in the background units are retained in neurons

The Elman neural network feeds an input layer, a hidden layer, an output layer and a special layer called the background layer to the forward network. In the background layer, the output of a hidden neuron is copied into a specific neuron. The weights from the secret layer to the context layer are set to one in an Elman network and are fixed since the values of the context neurons have to be exactly copied. With gradient descent back propagation and optimization techniques, the Elman network can be educated.

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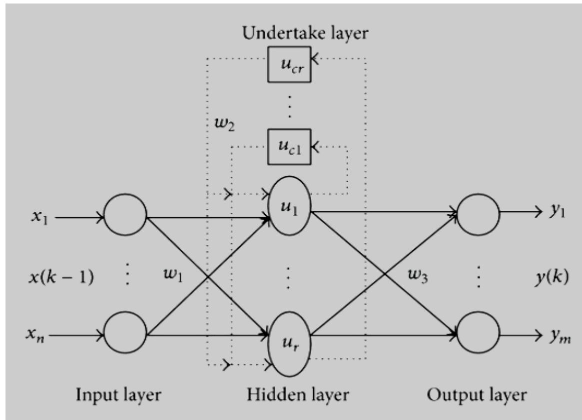

Fig.1: Architecture of ENN

Suppose n input, m output, the number of hidden and undertook neurons is r, the weight of the input layer to the hidden layer is w-1, the weight of the undertaking layer to the hidden layer is w-2, the weight of the hidden layer to the output layer is w-3;u(k-1) is the neural network input, x(k) is the hidden layer output, x-c(k) is the undertaking layer output, and y(k) is the neural network output; then

xk=fw2xck+w1uk-1
(9)

Where xck=x(k-1)

f is the hidden layer transfer function, which is commonly used in S-type function; that is,

fx=1+e-x-1
(10)

g is the transfer function of output layer, which is often a linear function; that is,

yk=gw3xk
(11)

Elman neural network uses BP algorithm to revise weights; the error of network is

E=k=1mtk-yk2
(12)

Where tk is the output vector of object. To enhance the accuracy of ENN prediction, Teaching Learning Based Optimization (TLBO) has been used for optimizing the weight value of ENN.

V. RESULT ANALYSIS

Based on the cardiovascular research data and priorities, three mining targets are determined. The trained models were initially evaluated the findings indicate that the mentioned goals have been accomplished by all three models, which means that they can be used to assist in decision-making for clinical evaluation and the recognition of cardiovascular factors.

Goal 1: Predict patients who, considering their health profiles, are likely to be diagnosed with heart disease.

Heart disease prediction is based on scenarios of what if". The users are packed with all medical characteristics to diagnose heart attack patients. Our proposed process, ENN-TLBO, shows the highest probability

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of 902 supporting cases (99.28 percent), closely followed by Naïve Bayes with the probability of 863 supporting cases (94.93 percent) and Neural Network (92.84 percent) with 844 supporting cases. Compared to the other approaches, the Decision Tree has the lowest likelihood with 88.86 percent precision and 808 supporting instances. Because of the high levels, doctors may recommend that the patient undergo a further cardiac examination. Thus, "What if" possibilities avoid potential heart attacks.

Goal 2: Identifies the significant influences and associations of heart disease in the decision on the basis of medical input.

The likelihood ratio of the most significant factor affecting heart disease is shown in Table 1. It is very clear from the table that "Chest Pain Type" plays a vital role in causing cardiac disease. Fasting blood sugar is another cause of heart failure next to that factor, which is the least factor, i.e. 89.1% in the case of Neural Networks, while Naïve Bayes and the decision tree have a likelihood of 92.3% and 90.8% respectively. This knowledge can be used by physicians to better examine the strengths and disadvantages of heart disease-related medical attributes. By using this data, doctors can further determine the strengths and limitations of clinical features associated with cardiac disease.

Goal 3: Identify the clinical effect and relationship of cardiac disease-predictable disorder

The proposed system is more likely (99.52 percent) to suggest that patients with heart disease are present in the relationship between attributes:' Chest Pain Type=4 and CA=0 and Exang=0, and Trest Blood Pressure >= 142 and <159.' Instead of all prospective patient characteristics, physicians may use this data as the basis for their medical testing of these four attributes. Clinical, research and operating expenses are minimized. There was a minimization of health, administrative and research threats.

Evaluation Criteria	**Classifiers**			
	Decision Tree	**Neural Network**	**Naïve Bayes**	**ENN-TLBO**
Model Building Time(in sec)	0.90	0.70	0.75	0.67
Correctly classified instances	371	387	403	414
Incorrectly Classified Instances	45	29	13	2
Accuracy %	89.18%	93.02%	96.87%	99.52%

Table 1 Performance Comparison of DT, NN, NB and ENN-TLBO.

The least effect information (7%) is included in the relationship between attribute(s), "Chest Pain Type not= 4 and Sex= F" The relationship is also provided between attributes in patients with non-heart disease. "Chest Pain Type not= 4 and Sex= F"Chest Pain Type not= 4 and Sex= F"Chest Pain Type= 4 and CA=0 and Exang=0 and Trest Blood Pressure >= 142 and <159"Chest Pain Type= 4 and CA=0 and Exang=0 and Trest Blood Pressure >= 142 and <159. Additional data can also be accessed using a drill by means of functions such as patient recognition and medical profiles based on selected nodes..

Experiments are performed to assess the effectiveness and efficiency of various heart disease prediction classification algorithms. Of the 909 reports, 416 records include heart disease patients, while 493 records include heart disease-free patients.

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Compared to the Decision tree, Neural Networks and Naïve Bayes models, Table 2 shows the performance analysis of the ENN-TLBO in terms of model building time, correctly classified instances, incorrectly classified instances and percent accuracy.

From the above table it is clear that the construction time of the model is much shorter, i.e., 0.67 sec for ENN-TLBO compared to 0.9sec for DT and 0.70sec for NN and 0.75sec for NB. Similarly, our proposed methodology precisely classifies 412 instances out of 416 instances with a precision of 99.52 percent compared to 89.18 percent, 93.02 percent and 96.87 percent of DT, NN and NB.

Table 1 also shows that the number of instances classified by DT, NN, and NB are 371, 387, and 403. Similarly, the incorrect instances classified by DT, NN and NB are 45, 29 and 13, while there are only 2 in the case of ENN-TLBO.

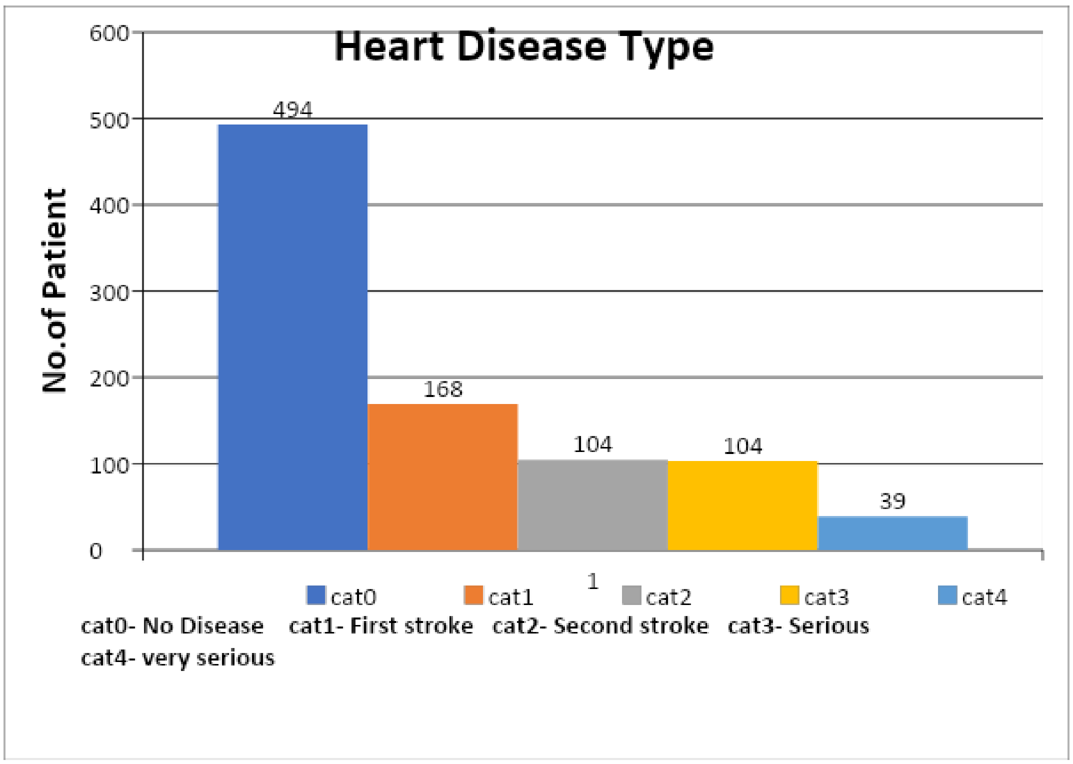

Fig 2 Performance Analysis

Figure 2 shows the classification of patients based on five categories of patients with

Cat 0 - No heart Disease

Cat 1 - First Stroke

Cat 2 - Second Stroke

Cat 3 - serious condition

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Cat 4 - very serious condition.

Out of 909 records, ENN-TLBO exactly classifies 494 patients in cat 0, 168 patients in cat1, 104 patients in cat2, and 104 in cat 4 and 39 patients in cat4.

VI. CONCLUSION

An effective ENN-TLBO method for predicting heart disease is proposed in this research paper. We suggested an approach using machine learning methods to predict heart diseases. There is a comparison of four techniques: Decision Tree, Neural Network, Naïve Bayes and the proposed ENN-TLBO. The findings show that, compared to three other classifiers, the proposed ENN-TLBO system outperforms. An ENN-TLBO algorithm uses dot products with random vectors to find nearest neighbors easily, unlike traditional machine hashes that are designed to return exact matches in O(1) time. A probabilistic guarantee is given by ENN-TLBO that it will return the correct answer. In systems with other sources of error (perhaps because of mislabeled data), the ENN-TLBO error can be reduced below the error due to other sources, thus improving computational performance significantly. In particular, this makes ENN-TLBO and randomized algorithms in general, significant in today's Internet-sized database world. Despite their health profiles, it predicts patients likely to be diagnosed with heart disease, identifies the major factors and links in the predictable state of medical input, and identifies the clinical effect and relationship of the predictable illness. By enhancing in terms of feature reduction and using optimization methods, this study can be improvised.

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