Forward and Backward Propagation Network based Heart Disease Prediction

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Abstract
Heart is a very important part of play in human body. Cardiovascular disease effect from wide range of conditions that affect the heart, blood vessels in which blood is pumped and circulated through the body. Heart diseases kill the person every 34 seconds researched by United States. Cardiovascular diseases handled by medical systems were very difficult to diagnose. Further, new algorithms and new tools are developing day by day to diagnose heart disease. Diagnosing of heart disease is one of the important issue but many researchers is investigated to develop medical good decision support systems. In our proposed method, a new machine learning algorithm is developed by combining forward propagation and backward propagation algorithms to implement heart disease prediction system. This method achieves highest accuracy of 96%. Heart disease prediction in accuracy results so that is better and efficient of comparing to other systems.

Keywords: Forward Propagation Network, Backward Propagation Network, Heart Disease Prediction, Cardiovascular Disease Prediction, Artificial Neural Network

1. Introduction

The blood is pumped by the organ that is the heart over blood vessels going to the different body parts with adequate proportion of oxygen and other essential nutritional components that are required. The life of any organism is totally dependent on the proper functioning of the heart and if there is some problem in the not pumping of the heart, suddenly it reflects the affected from the brain and human body parts. In Cardiovascular disease occur due to shortage of sufficient blood that it requires because of cholesterol and fat that is deposited on inside wall of the arteries that supply the blood to heart. Which is also known as a sudden heart attacks but the path in the coronary artery is blocked due to the clotting of blood on the wall of the artery that supply the blood to the heart. So human body react the symptomin angina chest pain occurs due to the sufficient blood not supply that is inadequate to the heart as a result. Many diseases available of this category are valvular heart disease, abnormal heart rhythms or arrhythmias, Aorta disease and Marfa syndrome, congenital heart disease, Coronary artery disease, Deep vein thrombosis, pulmonary embolism, Heart muscle disease (Cardiomyopathy), Heart attack, Heart failure and Stroke etc. The disease diagnosis process in the medical field has different types of medical decision making system by applying clinical data. In this today's world, large number of people is affected from

different types of heart diseases. Mostly age above 35 people suffering and dying from these heart disease day by day increases in nos. So there is a need of early style detection of heart disease with proper and adequate treatment which can be save the life of many people. But unfortunately, due to the complicated processes, different symptoms and pathological tests, the correct diagnosis of heart disease is very less. Hence we are in need of a new system for heart disease prediction should be developed. This can help the medical expert's system using early style prediction of heart disease and diagnosis of heart disease.

2. Literature Survey

Rajkumar et al. [1] applied SVM for the detection of the syndrome in heart has the features from the phase and magnitude the signal obtained from thoracic, abdominal respiratory effort and evaluation and classification.

In G.M. Nasira et al. [2], Decision Trees, Naïve Bayes and Neural Network method were applied in heart disease dataset for the future extraction of pattern from the heart disease warehouses to find out the heart attack prediction.

A.T. Sayad et al. [3] suggested that the back-propagation algorithm can be effectively trained by neural networks. The back-propagation algorithm can be divided into two phases: propagation and weight module.

Ruba Sounder et al. [4] dealt with Artificial Neural Network structure consist of several layers of artificial neurons, interconnections between layer neurons and an activation function of each neuron. Artificial Neural Network has combined layer of input, hidden and output layers. In each level of hidden layers somebody added to the weight level for itself.

Akruti Dave et al. [5] presented neural network implementation with a combined approach of recurrent fuzzy neural network and radial basic function for heart disease prediction and back propagation for error reduction and final predicted of output.

Ruba Sounder et al. [6] proposed back propagation algorithms for non-linear relationship for classification of heart disease prediction. Large numbers of features are also considered in neural network for finally evaluated and predicted outputs are show on over fitting values.

Liaqat Ali et al. [7] presented deep neural network to show output evaluation and performance was good on both testing and training data for the prediction of heart diseases.

J. Amutha et al. [8] proposed a method based on neural network and genetic algorithm for the prediction of heart disease relevant syndrome predicted by features.

Bandarage et al. [9] presented Coactive Neuro - Fuzzy Inference System (CANFIS) model with fuzzy inputs and modular neural network to provide more accurate results for heart disease prediction.

Salma Banu N.K. et al. [10] proposed a method to Combine KNN, ANN and SVM using Voting Technique for the prediction of heart disease. In voting approach, the original data set is used as a basis

for training each classifier. The proposed technique gives better results.

V. Krishnaiah et al. [11] applied different data mining algorithms such as Support Vector Machine, Decision Tree, Artificial Neural Networks, and Ripper Classifier for Cardiovascular Disease dataset to analyse their performance. The performance is analyzed by many factors such as sensitivity, specificity, accuracy, error rate, and confusion matrix. Analysis shown that among the four classification models SVM predicts Cardiovascular Disease with least error rate and highest accuracy.

Tahira Mahboob et al. [12] constructed a clinical support and decision system for the real time evaluation of ECG signal. It is observed that SVM has the highest precision (i.e. 86.4%).

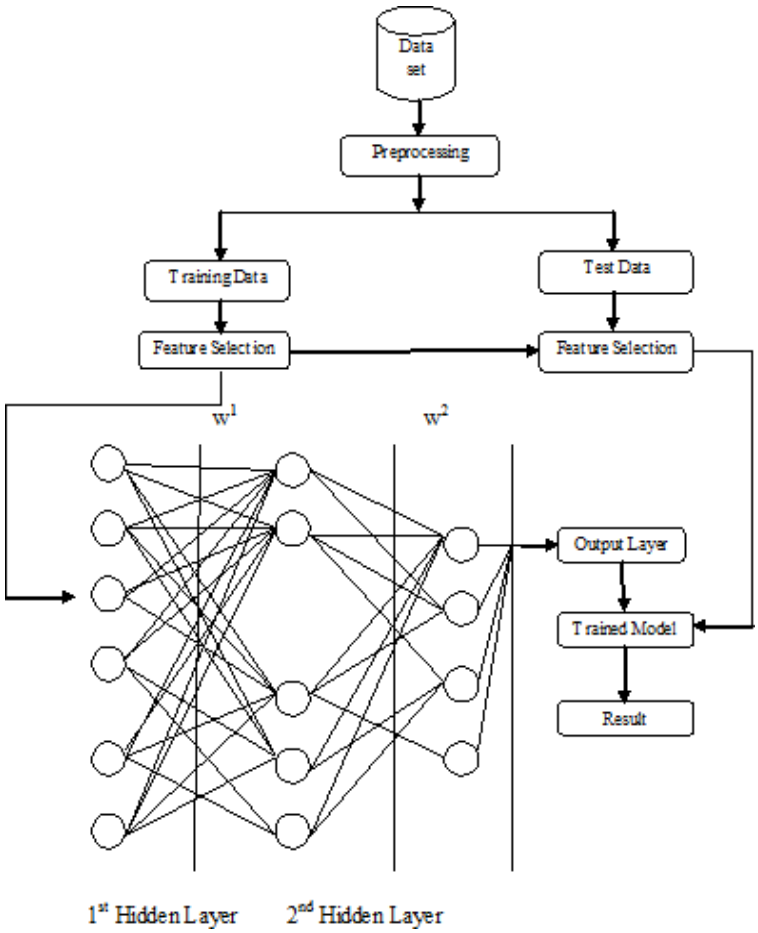
C. Sowmiya et al. [13] presented DM tools to provide accurate and time to time report needed for the practitioners to predict the heart disease.

Balasaheb et al. [14] presented an Artifi Tarlecial Neural Network Based Pattern Classification Algorithm for diagnosis of Heart Disease.

Soumonos Mukherjee et al. [15] constructed a multi-class Convolutional neural network based intelligent heart disease prediction system with the use of TensorFlow concepts.

3. Proposed System

Heart disease data set for this proposed work is collected from UCI Machine Learning Repository. The proposed heart disease prediction architecture is shown in the following figure.



After going to on dataset, *Sklearn train_test_split()* function was used to divide it into training and testing datasets. The Process is performed in neural network for the feature vectors selection, 20% of data is selected for testing and 80% for training approximately. We have applied this to check the training set and test set in our dataset.

3.1 Artificial Neural Network Model

A neural network model is a parallel processing and distributed information processing structure consisting of several layers of artificial neurons, interconnections between hidden layers' neurons and activation function of each neuron. Neural network consists of three type of layer namely input layer, hidden layer and output layers, in each of them a neuron has its own summed up input that is connected to that hidden layers' neurons and activation function processing after get it output for each level of layers itself. Each level of layers' neuron is fully interconnected. We are needed to initial added for two parameters: its weight and bias vectors each neurons layers.

The Weight Matrices

$$w^{[1]}, w^{[2]}, w^{[3]} \ldots w^{[n-1]}$$

The Bias Vectors

$$b^{[1]}, b^{[2]}, b^{[3]} \ldots b^{[n-1]}$$

Weight is initialized randomly fixed while bias is set to zero value. These properties define after assign the network's adjustable parameters: its weight matrices and bias vectors. Weight matrices define of layers we going to added to network inputs.

3.2 Forward Propagation

Forward propagation is randomly assigning the weight of all neurons. These weights are edges connecting two neuron layers. Hence the weights of a neuron can be more appropriately thought of as weights between two layers since edges connect each layer. We are using *tanh* activation function in hidden layer.

$$z^{[1](i)} = W^{[i]}\, x^{(i)} + b^{[1]}$$

$$a^{[1](i)} = \tanh(z^{[1](i)})$$

Also, for the each coming output layer, we are using sigmoid activation function.

$$z^{[2](i)} = W^{[2]}\, x^{[1](i)} + b^{[2]}$$

$$\hat{y}^{(i)} = a^{[2](i)} = \sigma(z^{[2](i)})$$

We are using sigmoid activation function implementation of forward propagation method. Once the last hidden activations for the last hidden layer calculated, they are combined by final set of weights between the last hidden layer and the output layer produce an output for a single row calculate the final output.

3.3 Back Propagation

The Backward propagation algorithm mostly using in artificial neural network technique. Back propagation initially weight function randomly assigns the neuron layers.

Training data received output is sigmoid function applying after produce by output neuron layer.

$$C_k = (O - y)^2$$

Those outputs are assumed to be the activation of the output neuron network and y actually produces by output. But to be calculate the error of each output neuron. This state error of neuron rectified the using backward-propagation through the neural network.

$$dZ^{[2]} = A^{[2]} - Y$$

$$dW^{[2]} = \frac{1}{m} dZ^{[2]} A^{[1]} T$$

$$db^{[2]} = \frac{1}{m} np.sum(dZ^{[2]}), axis = 1, keepdims = True$$

$$dZ^{[1]} = W^{[2]T} dZ^{[2]} \times g^{1}, (Z^{[1]})$$

$$dW^{[1]} = \frac{1}{m} dZ^{[1]}, X^T$$

$$db^{[1]} = \frac{1}{m} np.sum(dZ^{[1]}), axis = 1, keepdims = True$$

Once we have calculated error on neuron layer via the back propagation method above. They can be applying to update weight of neuron. Approximately weight of value 0.1 will been update the weight 10% of the update then could not updated in neuron. So that change the weight level automatically reduce by minimize error.

4. Results

We have implemented *prediction()* method in artificial neural network for heart disease prediction accuracy we are seeing that prediction of accuracy level 98%. Out of 150 records the network trained with remaining 150 recordings are used for testing. The heart disease prediction decision systems give the highest accuracy of 98% for 14 neurons in hidden layer with 1000 iterations. In order to prediction system varies training dataset in 50% to 90% using prediction good performances of this system.

Table:1 Heart Diseases Prediction System with Different Number of Training Dataset

Testing Dataset	Train Dataset	Accuracy
50	50	97
40	60	96
30	70	98
20	80	97
10	90	95

5. Conclusions

We have been presented an approach that is based on forward and back propagation neural network to predict the cardiovascular disease that is essential of medical field. However, the high level mortality controlled if the heart disease early stage detects and preventive of methods. It can be performed with various methods in mixtures of machine learning techniques for better prediction. Furthermore, new classification methods can be developed to get for better prediction systems.

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