IDENTIFICATION OF HEARTAL DISORDER USING BACK PROPAGATION

Pooja Sharma
RCET Bhilai
Ms.Lakhwinder Kaur

ABSTRACT

The etymology of electrocardiograph is derived from Greek word electro, because it is related to "electrical activity", cardio for "heart", and graph is a Greek root meaning to "write". Electrocardiogram (ECG), a noninvasive technique is used as a primary diagnostic tool for cardiovascular diseases. The main objective is to make the analysis of normal and abnormal beats easy so that the patient could be diagnosed for the heart problems in less time as well more accurately so that the medical practitioners have primary information about the ailment and could start a treatment early. NN tool is trained by using Back propagation algorithm.

INTRODUCTION

An artificial neural network (ANN) is a computational model that attempts to account for the parallel nature of the human brain. An (ANN) is a network of highly interconnecting processing elements (neurons) operating in parallel. These elements are inspired by biological nervous systems. As in nature, the connections between elements largely determine the network function. A subgroup of processing element is called a layer in the network. The first layer is the input layer and the last layer is the output layer. Between the input and output layer, there may be additional layer(s) of units, called hidden layer(s).

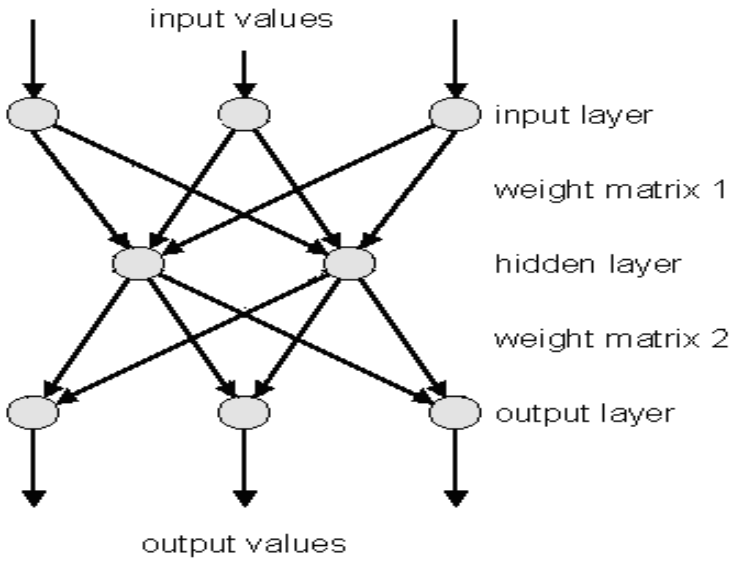

Fig.1 The typical neural network

Fig.1 represents the typical neural network. Neural Networks are ideal in recognizing diseases Based on the way they learn, all artificial neural networks are divided into two learning categories: supervised and unsupervised. In supervised learning, the network is trained by providing it with input and output patterns. During this phase, the neural network is able to adjust the connection weights to match its output with the actual output in an iterative process until a desirable result is reached. An ANN of the unsupervised learning type, such as the self-organizing map, the neural network is provided only with inputs, there are no known answers. The network must develop its own representation of the input stimuli by calculating the acceptable connection weights. That is self-organization by clustering the input data and find features inherent to the problem.

THE PROPOSED DIAGNOSIS MODEL

Feed-forward neural networks are widely and successfully used models for classification, forecasting and problem solving. A typical feed-forward back propagation neural network is proposed to diagnosis diseases. It consists of three layers: the input layer, a hidden layer, and the output layer. A one hidden with 20 hidden layer neurons is created and trained. The input and target samples are automatically divided into training, validation and test sets. The training set is used to teach the network. Training continues as long as the network continues improving on the validation set. The test set provides a completely independent measure of network accuracy. The information moves in only one direction, forward, from the input nodes, through the hidden nodes and to the output nodes. There are no cycles or loops in the network. The proposed neural networks are shown in Fig.2

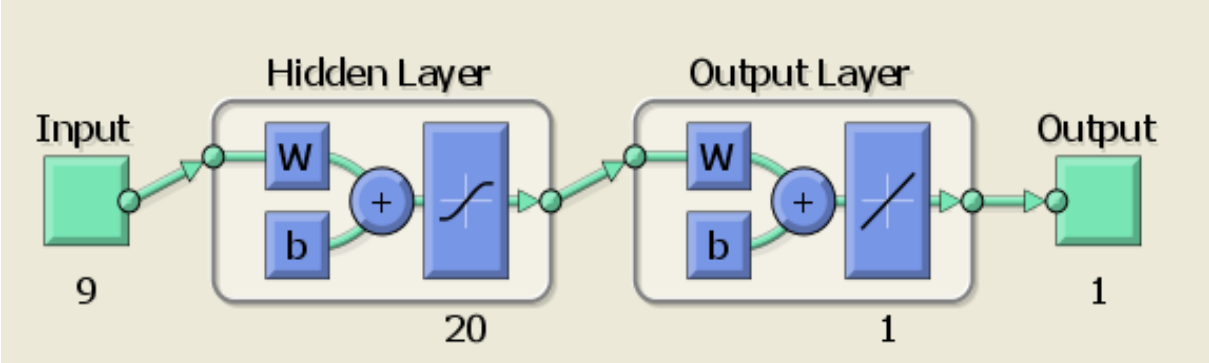

Fig 2 Proposed Neural Network

Feed-forward neural network allows signals to travel one-way only; from source to destination; there is no feedback. The hidden neurons are able to learn the pattern in data during the training phase and mapping the relationship between input and output pairs. Each neuron in the hidden layer uses a transfer function to process data it receives from input layer and then transfers the processed information to the output neurons for further processing using a transfer function in each neuron. The output of the hidden layer can be represented by

$$YNx1 = f\,(WNxM\ XM,1 + bN,1\ ) \qquad (1)$$

where *Y* is a vector containing the output from each of the *N* neurons in a given layer, *W* is a matrix containing the weights for each of the *M* inputs for all *N* neurons, *X* is a vector containing the inputs, *b* is a vector containing the biases and *f(·)* is the activation function .

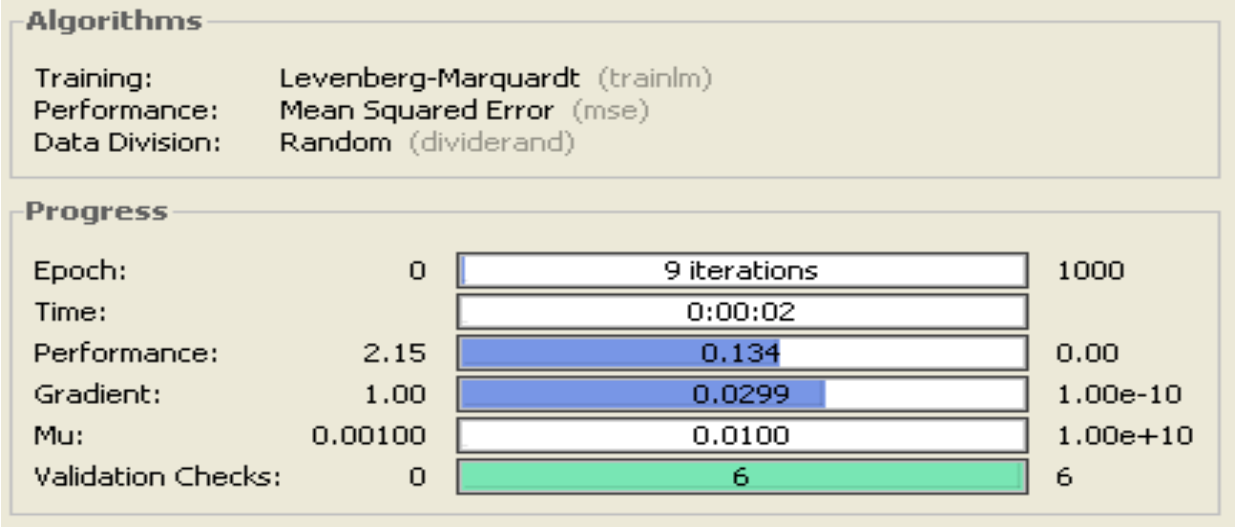

Fig 3 Training process result

Fewer epochs mean network learns in small repetitions it includes 9 iterations. Time required is 0.02 sec. which means network achieved goal easily and shortly. For the data computation Performance is 0.134 which indicates the final MSE achieved. Lower value of MSE represent higher network accuracy.

Regression plot

The regression plot shows the relationship between the outputs of the network and the targets. If the training were perfect, the network outputs and the targets would be exactly equal, but the relationship is rarely perfect in practice. Regression was the first type of regression analysis to be studied rigorously, and to be used extensively in practical applications. This is because models which depend linearly on their unknown parameters are easier to fit than models which are non-linearly related to their parameters and because the statistical properties of the resulting estimators are easier to determine. The three axes represent the training, validation and testing data. The dashed line in each axis represents the perfect result – outputs = targets. The solid line represents the best fit linear regression line between outputs and targets. The R value is an indication of the relationship between the outputs and targets. If R=1, this indicates that there is an exact linear relationship between outputs and targets. If R is close to zero, then there is no linear relationship (ie. random relationship) between outputs and targets shown in fig 4. Training is having R=0.94591 which shows close relation between output and target. For validation R=0.14419 which shows random relationship between output and target. For Test R=0.63876 and for All R=0.7101 represent close relation between output and target

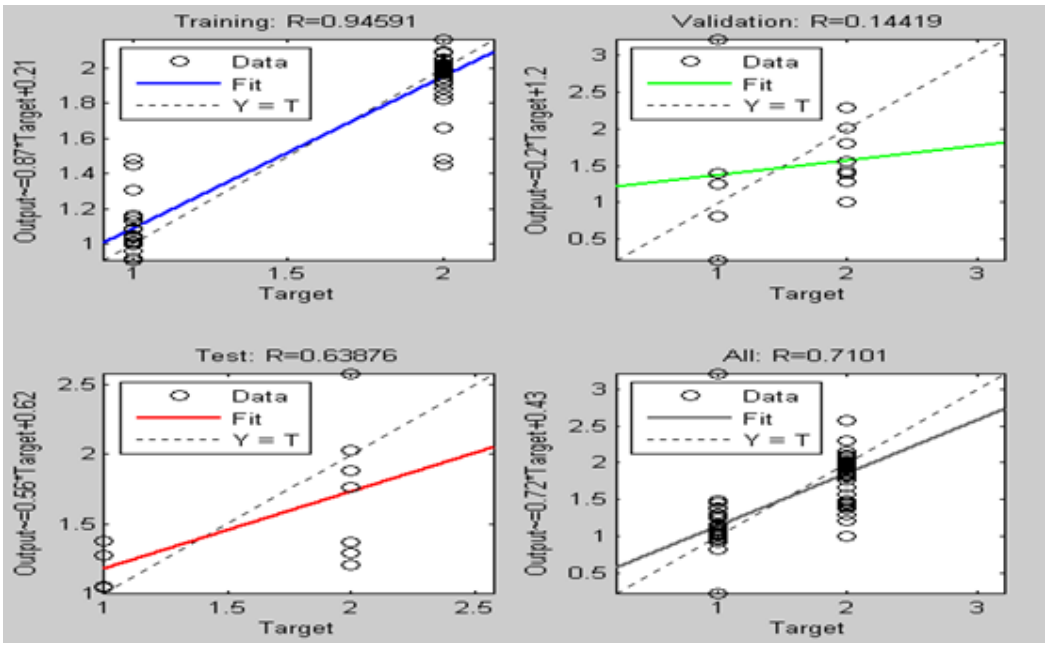

Fig 4 Regression plot

PERFORMANCE EVALUATION

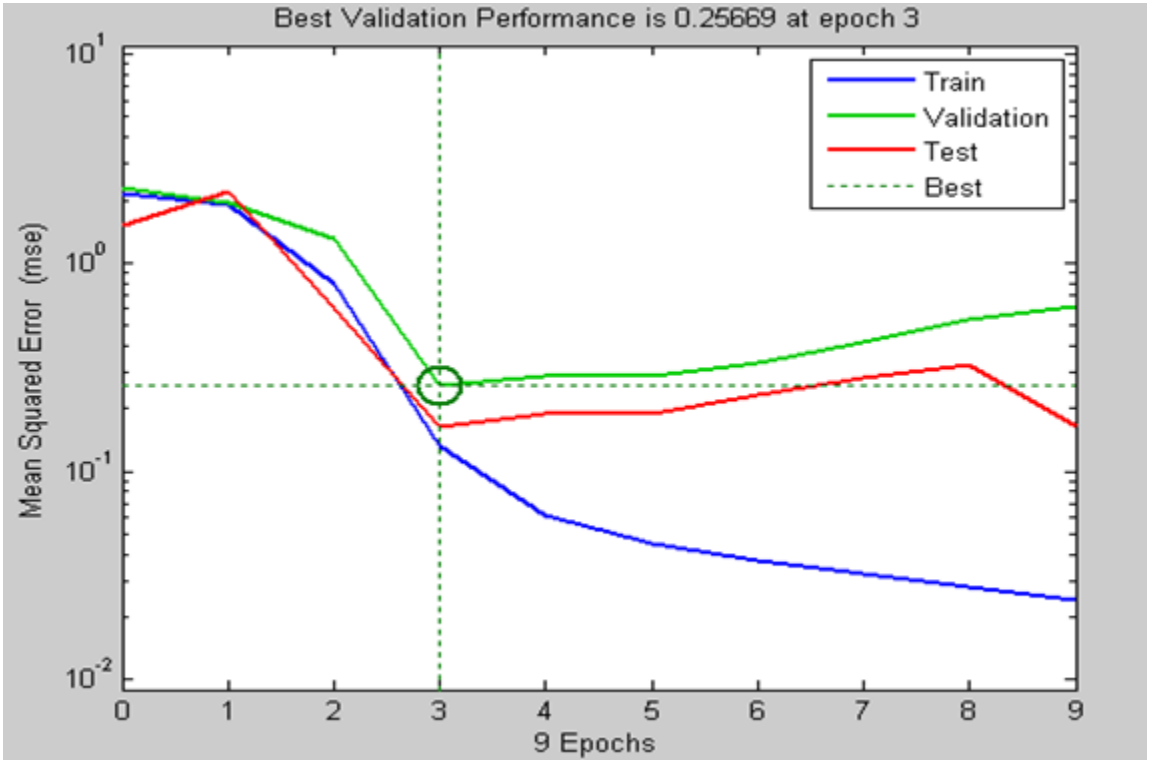

Fig. 5 Performance Plot

Levenberg-Marquardt back propagation algorithm was used with train the network. Training automatically stops when generalization stops improving, as indicated by an increase in the mean square error (MSE) of the validation samples. The results of applying the artificial neural

networks methodology to distinguish between healthy and unhealthy person based upon selected symptoms showed very good abilities of the network to learn the patterns corresponding to symptoms of the person. The network was simulated in the testing set. (i.e. cases the network has not seen before). The results were very good; the network was able to classify 99% of the cases in the testing set. Best validation performance is 0.25669 at epoch 3 as shown in Fig.5. The mean squared error (MSE) is the average squared difference between outputs and targets. Lower values are better while zero means no error. The percent correctly classified in the simulation sample by the feed-forward back propagation network is 99 percent. Levenberg-Marquardt back propagation algorithm was used with train the network. The results of applying the artificial neural networks methodology to distinguish between normal and abnormal person.

GRADIENT & VALIDATION PLOT

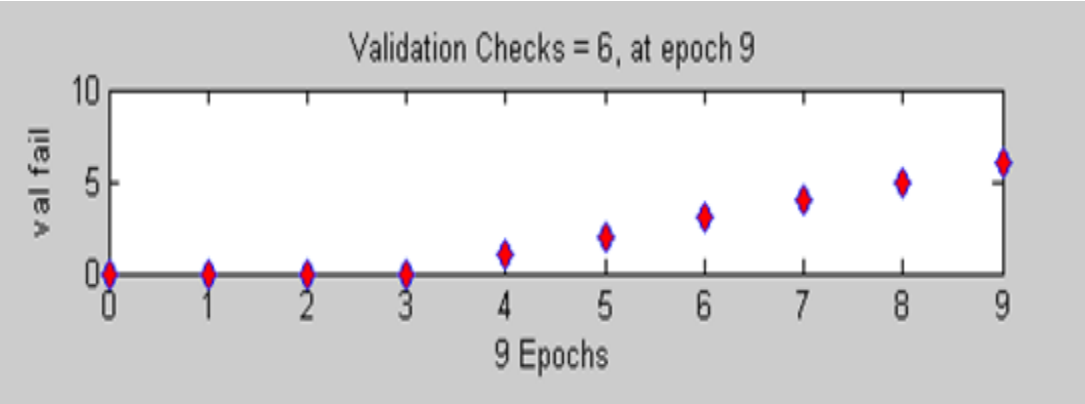

Fig Validation plot

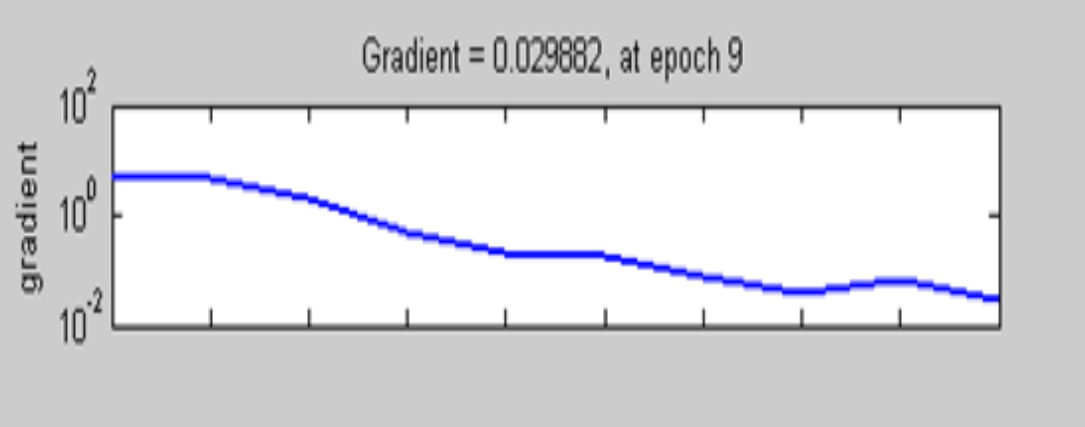

Fig. Gradient plot

low value of gradient plot ie. 0.02988 indicates that the network is learning up to a large extent which means finer adjustments in the weights and bias. This in turn makes network more accurate and reliable, avoiding chances of false predictions. Validation plot shows the point where the network learned sufficiently and passed validation without error. The point where the failures cross the defined limit is the stoppage point of training and indicates the starting of the over fitting of the data. Validation cross the limit after 9 epoch showing the stopping point of training.

CONCLUSIONS

This study aimed to evaluate artificial neural network in disease diagnosis. The accuracy obtained by using neural network is 99%. The feed-forward back propagation neural network with supervised learning is proposed to diagnose the disease. Artificial neural networks showed significant results in dealing with data represented in symptoms and images. Results showed that the proposed diagnosis neural network could be useful for identifying the infected person.

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