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Diagnosis of thyroid disorders using Back-propagation method

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Abstract: The diagnosis of thyroid disorders using back propagation algorithm by training feed-forward neural network has been discussed in this paper. The body's metabolic rate is controlled by thyroid hormones secreted by Thyroid Gland. Any malfunction in thyroid hormone will leads to thyroid disorders. There occurs under-activity and over-activity of thyroid hormone which causes hypothyroidism and hyperthyroidism. This paper explains the diagnosis of thyroid disorders using Back Propagation algorithm. In this work, back propagation algorithm is implemented in its gradient descent form, the working of back propagation algorithm to train ANN is verified with intensive MATLAB simulations. Here the model is developed by using the approach of artificial neural network i.e feed forward network with back propagation algorithm. In this way, with Back-Propagation algorithm we can classify the diagnosis of Thyroid Disorders.
Keywords: Thyroid Disorders, Back-Propagation Algorithm, Feed-Forward neural networks, Artificial Neural Network (ANN), Thyroid data-set.

I. INTRODUCTION

In this paper feed-forward neural networks is considered where Thyroid dataset is taken and is trained using Back-propagation algorithm. The thyroid gland is an endocrine gland. The thyroid gland which releases thyroxine and triiodothyronine into the blood stream are the principal hormones. The function of the thyroid hormones is to regulate the metabolism rate and affects the growth. The most common problems of thyroid disorder are Hyperthyroidism and Hypothyroidism. Hyperthyroidism means it releases too much amount of thyroid hormone into the blood due to over active of thyroid and Hypothyroidism means when the thyroid is not active it releases too low thyroid hormone into the blood. By attaining the correct classification the disease can be diagnosed. For this classification, the techniques we use should be able to handle a large volume of data. Also, it is vital to make effective and reliable decision. In medical science, decision making plays

the physicians. For each task of the decisions propagation algorithm is significant. Neural networks have recently attracted more attention due to their ability to learn complex and non-linear functions. Artificial neural networks can be viewed as parallel and distributed processing systems that consists of a large number of simple and massively connected processors. These networks can be trained offline for determining various faults in complicated mapping, and can be used in an efficient way in the online environment. Feed-forward neural networks are considered where back-propagation algorithm is applied and trains the given thyroid dataset. By training the given thyroid dataset we can classify the diagnosis of thyroid disorders. Back propagation algorithm has been applied to many pattern recognition problems. The neural network architecture have a common property that all neurons in a layer are connected to all neurons in adjacent layers through unidirectional branches. BP algorithm provides best results for this problem. In this paper, MATLAB is used for simulations

II. LITERATURE REVIEW

J.JACQULIN MARGARET [1] proposed the diagnosis of thyroid disorders using Decision tree attribute splitting rules. There are five different splitting methods for the construction of decision tree. The splitting criteria are Information Gain, Gain Ratio, Likelihood Ratio Chi-Squared Statistics Gini Index, and Distance Measure. Among the above mentioned splitting rules three of the rules belong to Impurity based splitting criteria and other two rules are Normalize Impurity based. In this way, the thyroid disorders are classified into 3 classes using decision trees.

L.PINJARE [2] proposed back propagation algorithm. It is implemented in its gradient descent form as per to train the neural networks to work as the basic digital gates and also for image compression. The working of the back propagation algorithm is used to train the ANN for basic gates and image compression can be verified with intensive mat lab simulations.

LALE OZYILMAZ [3] focused on proper interpretation of the thyroid data besides the clinical examination. Complementary investigation is an important issue for the diagnosis of thyroid disease. Various neural network methods such as fast back-

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propagation (FBP), Perceptron network with multilayered (MLP) with back-propagation (BP) algorithm, adaptive Conic Section Function Neural Network (CSFNN), Radial Basis Function (RBF), and have been used and are compared for the diagnosis of thyroid disease.

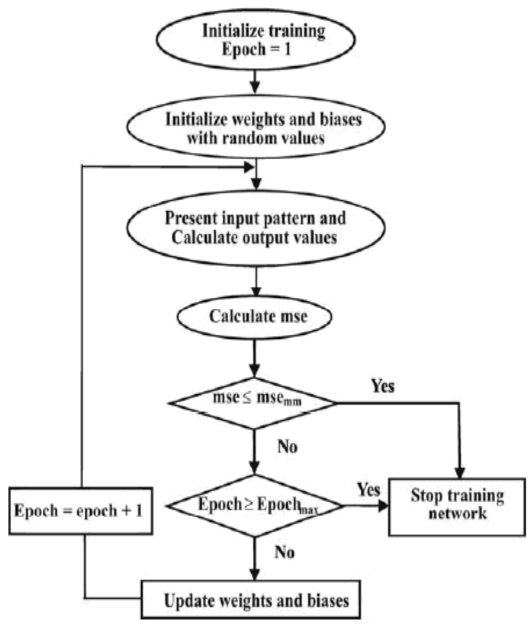
S.RAJAKARUNAKARAN [4] developed the fault detection model by using two different artificial neural network methods, namely feed-forward neural network with back propagation algorithm and binary adaptive resonance network. The testing and training data required are developed for the neural network model that was generated at different operating conditions of the systems by real-time simulation through experimental model.

III. METHODOLOGY

In this paper, feed-forward neural network takes place where back-propagation is applied to train the given thyroid dataset. By implementing this method, it leads to the classification of the patients based on three classes mentioned in the dataset. This section explains about the

Algorithm and formula used for this work. The FLOWCHART for this work is shown in the below Figure.

A training process flowchart:



A. *Description of thyroid dataset*

Thyroid inputs-a 21*7200 matrix consisting of 7200 patients.

Thyroid targets-a 3*7200 matrix of 7200 associated class vectors defining which of 3 classes each input is assigned to. Classes are represented by a 1 in row 1, 2 or 3.

1) Normal-functioning(not hyperthyroid)
2) Hyper-functioning
3) #sub-normal functioning

After training the network to classify the inputs according to the inputs by using back propagation algorithm, we get the results as,

1) Minimizing cross-entropy results in good classification.
2) Percent error indicates the fraction which are miss-classified.

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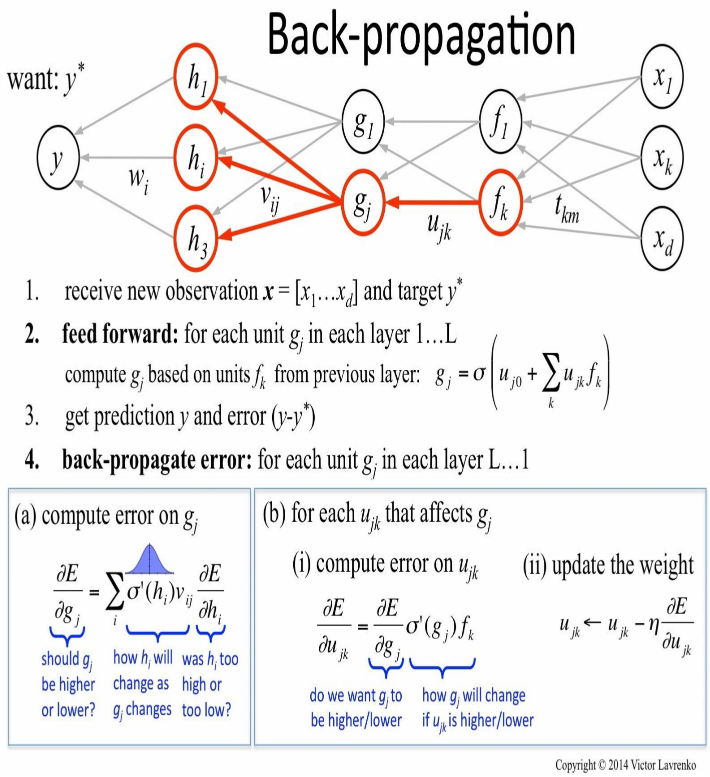
B. Back Propagation Algorithm



C. BP Algorithm

Algorithm: Back-propagation learning algorithm
for d in data do
Forward pass:
Starting from the input layer, using equations do a forward pass through the network, computing the activities of the neurons at each layer.
Backward pass:
Compute the derivatives of the error function with respect to the output layer activities.
for layer in layers do
Compute the derivatives of the error function with respect to the inputs of the upper layer neurons.
Compute the derivatives of the error function with respect to the weights between the outer layer and the layer below.
Compute the derivatives of the error function with respect to the activities of the layer below.
end for
Update the weights.
end for

Feed-forward method: consider the input x and it is fed into the network. The main functions at the nodes and their derivatives are evaluated at each node and are stored.

Back propagation method: consider the constant ‘1’ and it is fed into the output unit and where the network will run backwards. The incoming information to a node will be added and the result is multiplied by the value which is stored in the left side of the unit. Then after the result is transmitted to the left part of the unit. The result which is collected at the input side is the derivative of the network function with respect to x.

IV. BACK PROPAGATION TRAINING ALGORITHM EXPLANATION

Back-propagation training algorithm is one of the supervised learning algorithms for multilayered feed-forward neural network. As BP is a supervised learning algorithm, both the input and target output vectors are provided for the training of the considered

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network. The error data can also be calculated at the output layer using network output and target output. Then the error got is back propagated to intermediate layers, which allows incoming weights to these layers for the updation. This BP algorithm is based on the error-correction learning rule [5].

Basically, the back-propagation error process consists of 2 passes through the different layers present in the feed-forward neural network: a forward pass and a backward pass. In the forward pass, the input vector is applied to the network, and its effect propagates through the total network, layer by layer. Finally, a set of output vectors will be produced as the actual response of the neural network. During the forward pass method the weights of network which are synaptic are all fixed. During the backward pass, on the other hand, the weights are all adjusted according to the error-correction rule. The actual response of this network is subtracted from a desired target response where an error signal is produced. This resultant error signal is then propagated in backward direction through the neural network, against the direction of connections which are synaptic, hence the name is "error back-propagation". The synaptic weights are then adjusted so as to make the actual response of the network move closer the desired response [6].

V. EXPERIMENTAL RESULTS

This section describes the rules and graph obtained from this work. The thyroid data-set named "thyroid disease" obtained from UCI machine learning repository is used for this experiment. It was trained by using Back-Propagation Algorithm [7]. The following results were obtained.

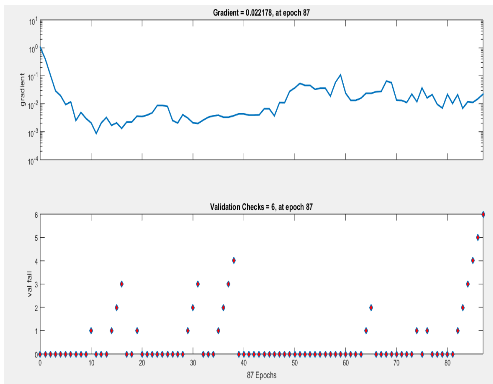

Fig 1: Training state

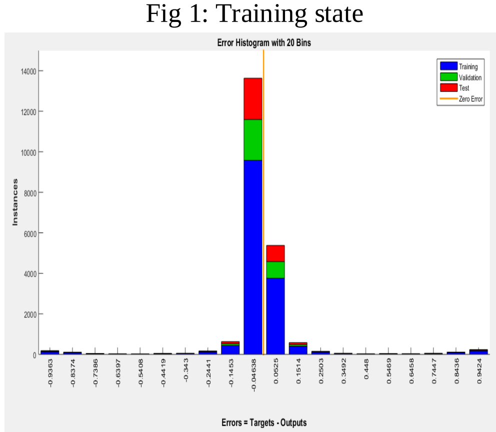

Fig 2: Error Histogram

As we know that Back-Propagation is based on error-correction learning rule, we can derive the error signals in the network and can describe using error histogram.

Errors=Targets-Outputs

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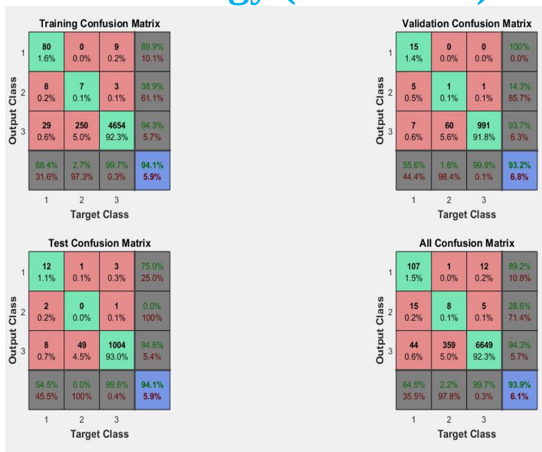

Fig 3: Confusion matrix

A confusion matrix is a matrix table that is often used to explain the performance of a classification model or ("classifier") on a set of data for which the true values are known.

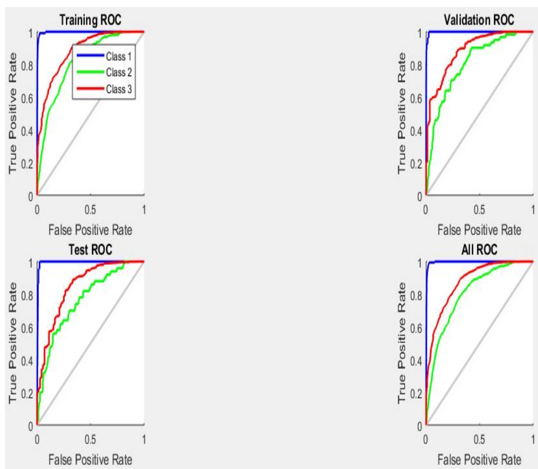

Fig 5: Receiver Operating Characteristic

In the above statistics, a receiver operating characteristic, or ROC curve, is a graphical plot that describes the performance of a classifier system as its discrimination threshold is varied. The curve in the graph is created by plotting the true positive values (TPR) against the false positive values (FPR) at various threshold settings. The true-positive rate (TPR) is also said as sensitivity, or recall in machine learning. The false positive rate is also called as the fall-out and can also be calculated (1 - specificity). The ROC curve is thus the sensitivity as a function of fall-out. Here shortly the ROC graph defines the 3 classes where diagnosis of thyroid disorders of a patient can be estimated.

VI. CONCLUSION AND DISCUSSIONS

By observing the above experimental results, can classify how many patients are normal (not hyper thyroid) or hyper function or in subnormal function. The importance of using Feed-forward neural networks to diagnose disease is to increase the accuracy of performance. The appropriate selection of feed-forward neural network architecture affects the network performance in effective way to reach the higher accuracy. In this paper, we considered the feed-forward neural network where data is trained using back-propagation algorithm type of appropriate activation function, correct selection of layer number and the network complexity takes place as to achieve the efficient result by comparing their performance to reach the best possible answer. This method reaches the classification accuracy for Thyroid disease to 98%. The proposed method in this paper can be a best solution to increase the performance of feed-forward neural network. So,by this method it is proved that it can be generalized to the other disease diagnoses systems of feed-forward neural networks. As compared to the Diagnosis of Thyroid Disorders using Decision Tree Splitting Rules [8] Feed-forward neural networks with Back-Propagation algorithm gives efficient results.

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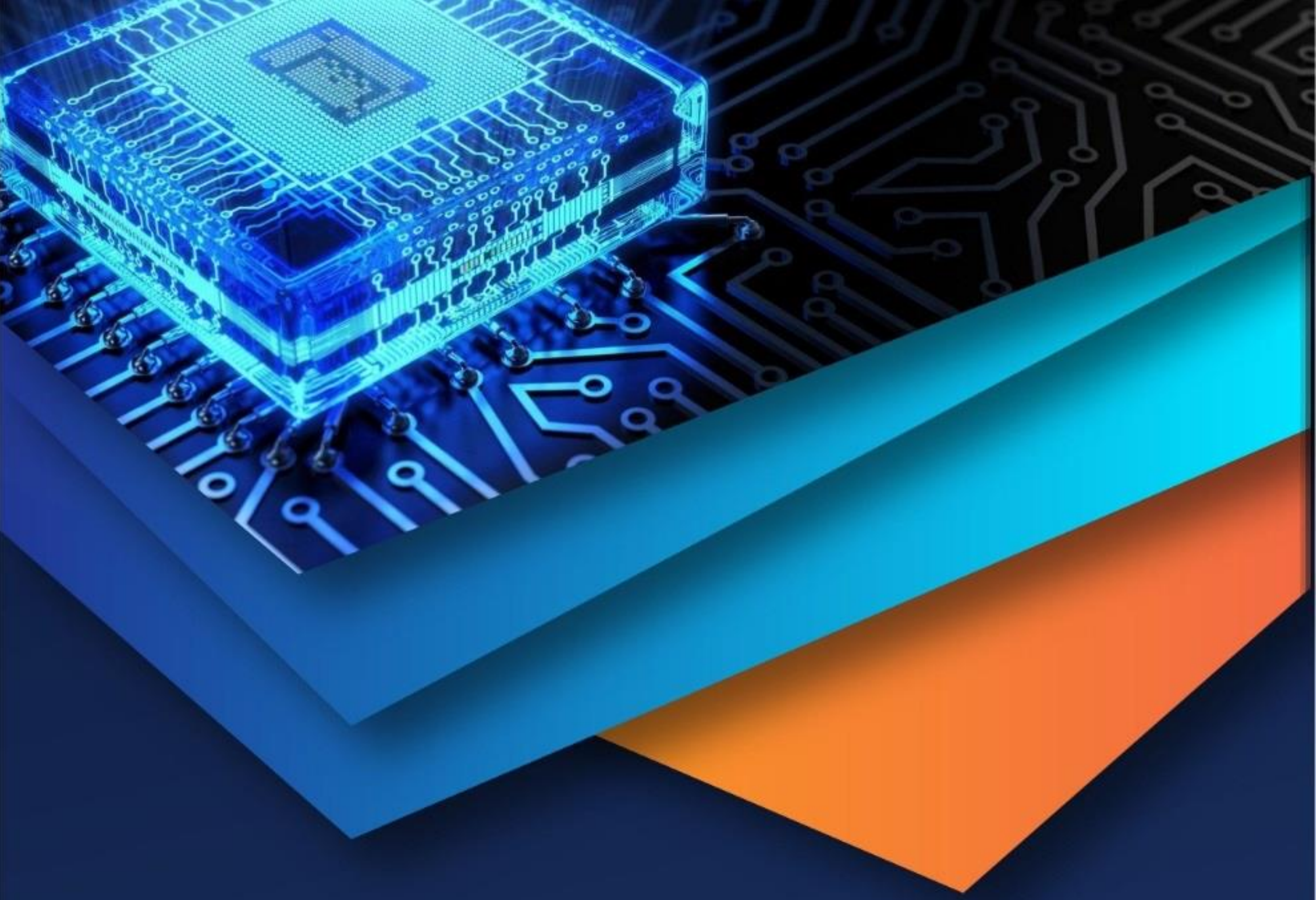

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