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Neural Network For Kidney Disease Prediction

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Abstract —In recent year's artificial neural network has found its application in diagnosing the disease, based upon prediction from previously collected dataset. In this paper, four different artificial neural networks are proposed for disease diagnosis, which uses four back propagation algorithm for training the neural networks. The proposed model has been tested on a dataset about kidney disease collected from Apolo hospital. The algorithm used is capable of distinguishing amongst infected person or non-infected person. The results from the two models are compared and analyzed to show the efficiency of prediction by ANNs in medical diagnosis.

Keywords- CKD, ANN, Feed-forward Network, back-propagation algorithm, Matlab.

I. INTRODUCTION

Chronic kidney disease (**CKD**), also known as **chronic renal disease**, is progressive loss in kidney function over a period of months or years. The symptoms of worsening kidney function are not specific, and might include feeling generally unwell and experiencing a reduced appetite. Often, chronic kidney disease is diagnosed as a result of screening of people known to be at risk of kidney problems, such as those with high blood pressure or diabetes and those with a blood relative with CKD. This disease may also be identified when it leads to one of its recognized complications, such as cardiovascular disease, anemia, pericarditis or renal osteodystrophy (the latter included in the novel term CKD-MBD). CKD is a long-term form of kidney disease; thus, it is differentiated from acute kidney disease (acute kidney injury) in that the reduction in kidney function must be present for over 3 months. CKD is an internationally recognized public health problem affecting 5–10% of the world population [11].

As people's life level become more and more modernized and life span become longer in our society, chronic kidney disease (CKD) becomes more common which may result in developing different levels of ill-function and damage of patient kidneys. Once a person gets CKD, he/she will suffer from the disease which may decrease his/her working ability as well as live quality. It is also very likely to develop other chronic diseases like high blood pressure, anemia (low blood count), weak bones and cause poor nutritional health and nerve damage. In the meantime, kidney disease increases patient risk of contracting heart and blood relevant diseases. Chronic kidney disease may be caused by other chronic disease such as diabetes, high blood pressure and other disorders. High CKD risk groups include those who have diabetes, hypertension, and family history of kidney disease. Early detection and treatment can often keep chronic kidney disease from getting worse. When kidney disease progresses, it may eventually lead to kidney failure which even requires dialysis or even proceeds to kidney transplant to maintain patient life [10].

II. LITERATURE REVIEW

Title	AUTHOR	Methodology/Work	Conclusion
Comparing performances of logistic regression, decision trees , and neural networks for classifying heart disease patients	Anchana Khemphila , Veera Boonjing (2010)	Logistic regression, decision trees , and ANN	ANN is Best
Heart Function Monitoring, Prediction and Prevention of Heart Attacks: Using Artificial Neural Networks	D. K. Ravish , Nayana R Shenoy (2014)	Levenberg Marquadt	Best Performance

HDPS: Heart Disease Prediction System	AH Chen, SY Huang, (2011)	LVQ	Accuracy near 80%
Artificial neural networks applied to cancer detection in a breast screening programmer	L. Álvarez Menéndeza, F.J. de Cos Juez (2010)	Support vector machine	80.28 % accuracy
A Novel Neural Network Based Automated System for Diagnosis of Breast Cancer from Real Time Biopsy Slides	Seema Singh, Harini J, Surabhi B R (2014)	SCG, Bayesian Regularization	Bayesian regularization perform well as compared to SCG
Approach of Neural Network to Diagnose Breast Cancer on three different Data Set	Vaibhav Narayan Chunekar , Hemant P. Ambulgekar (2009)	Jordan Elman	Neural network aided breast cancer diagnosis gives promising Results.
On The Application of BP Neural Network Based On Levenberg Marquardt Algorithm In The Diagnosis of Mental Disorders	Yujie Cui1, Hailing Xiong (2012)	Levenberg Marquardt	LM improves the prediction accuracy

III. METHODOLOGY

In the system for kidney disease prediction, feed forward network architecture of neural network is used. The system consists of two steps, in the first step 24 clinical attributes are accepted as input and then the training of the network is done with training data by back-propagation learning algorithm.

A. Feed-forward networks

A simple neural network type where synapses (connection) are made from an input layer to zero or more hidden layers and ultimately to an output layer. Feed-forward ANNs allow signals to travel one way only; from input to output. A straightforward neural system type associations are produced using an information layer to zero or more hidden ultimately to last layers and layer. Feed forward ANNs permit signs to travel one path just; from first layer to output layer [7, 5].

Feed-forward systems usually utilize the BP learning calculation to progressively change the weight and boas values for every neuron in the system. Feed-forward networks are especially suitable for applications in restorative imaging where the input and output are numerical and sets of input/output vectors give a reasonable basis to preparing in a supervised way [8,6].

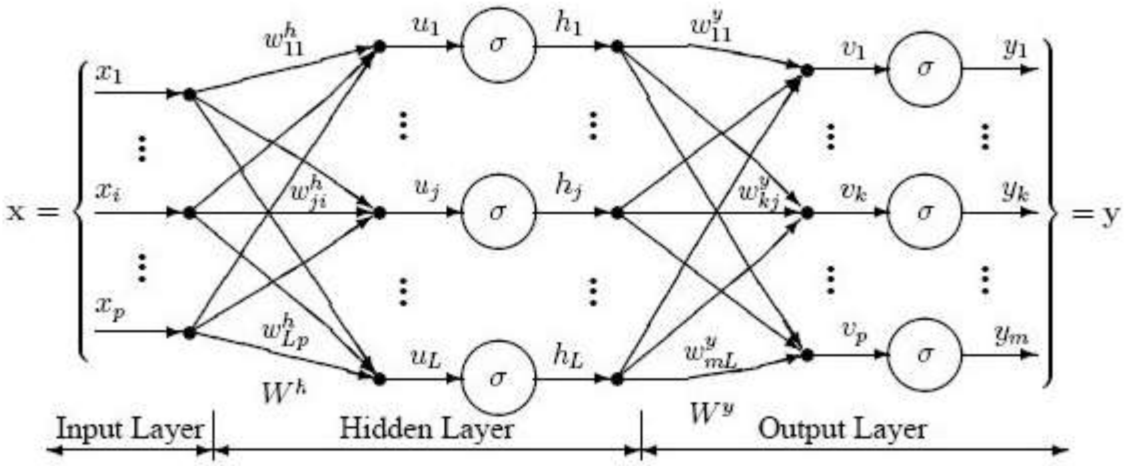

Fig 1:Feed Forward Neural Network [5]

B. Back Propagation Network

The back-propagation algorithm is the popular algorithm for the training of the neural network. This algorithm is generally used to train multilayer perceptron and many other neural networks. In back-propagation algorithm, the output obtained is compared with the target or expected output and the error is computed. This computed error is then again given to the neural network (fed back or back propagated) and weights are adjusted using this error so that the resulting output will get closer to the target or expected output. This process is repeated for number of times such that at each iteration the error value gets reduced and the output gets more and closer to the target or expected output. This process is known as "training of neural network. The algorithmic steps are as follows [1,4].

1) Weights of each neuron are initialized to some random values.
2) From the set of training data receive the input signal and transmit it to hidden unit.
3) In the hidden unit calculate the net input by using the following equation:

$$Z= V_{aj} + \sum_{i=1}^{n} x_i v_{ij} \qquad (1.1)$$

Where v is the bias on each hidden unit and xi is the input signal.
4) Now compute the output of hidden unit by applying activation function over z and send it to output layer units.
5) For each output unit calculate the net input by using the following equation and then output signal is computed by applying the activation function:

$$Y== W_{aj} + \sum_{i=1}^{n} z_i w_{jk} \qquad (1.2)$$

Where w is the bias on each output unit and zj is the input signal.
6) Each output unit receives the target signal corresponding to input signal and then the error correction factor is computed using following equation:

$$\delta_k = (t_k - y_k) f'(y_{ink}) \qquad (1.3)$$

Where tk and yk is the target output and current output, fink is the net input to output layer.
7) On the basis on computed error weight and bias correction term between output and hidden layer unit is computed.
8) Compute the error term between hidden and input layer unit and also calculate change in weights and bias value.
9) Update the change in weights and bias on output unit and then hidden unit.
10) Repeat steps 2 to 9 until specified number of epochs is reached.

IV. EXPERIMENTAL RESULTS

A. Data Set

The performance of the system is evaluated on Cleveland kidney disease database that was taken from dataset repository of UCI. This database consists of 303 records with each having 24 clinical attributes *Performance Evaluation*. The system for prediction for heart disease using multilayer perceptron neural network is implemented in MATLAB R2013. In this system the database is divided in to two sets randomly that is training set and testing set. Out of total records 70% records are used for training and testing is done by using remaining 30% records. The evaluation of performance of the system is done by computing the percentage value of different parameters like Accuracy, Specificity and Sensitivity by using following equations [1, 4, 3].

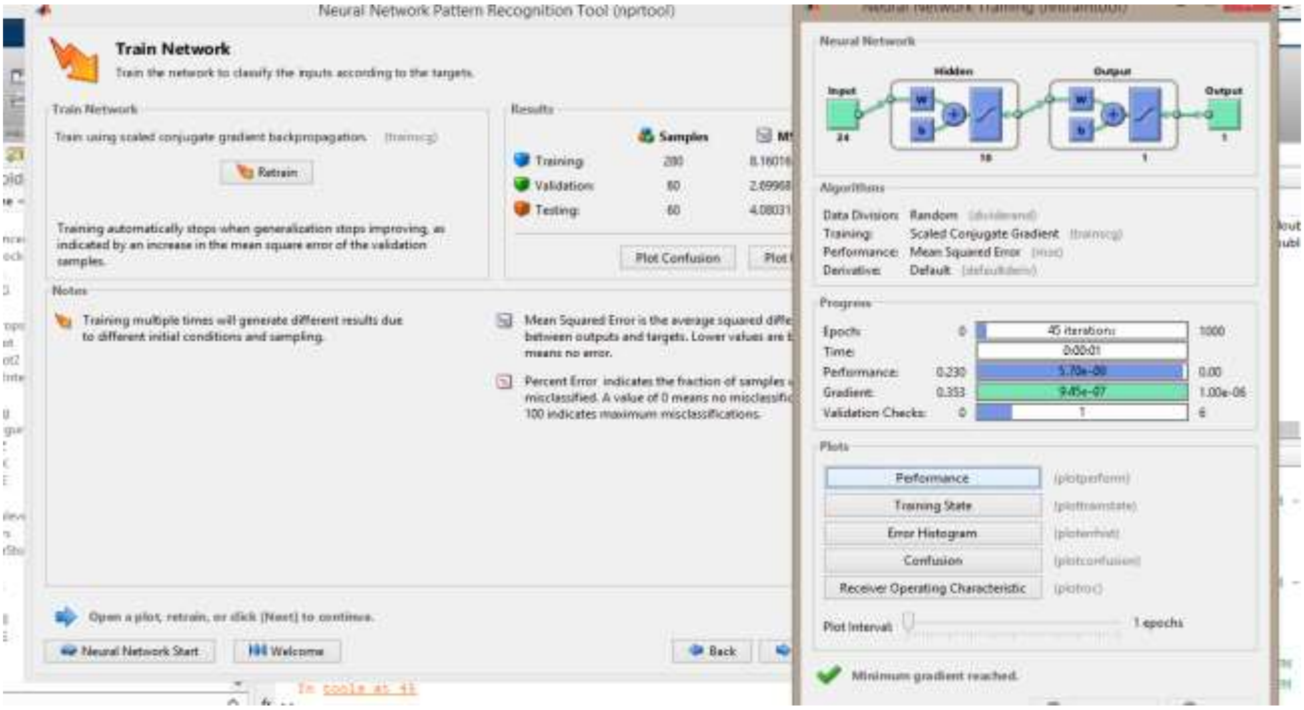

Fig 2:Train Neural Network [2]

$$Sensitivity = \frac{TF}{TP + FN} * 10 \tag{1.4}$$

$$Specificity = \frac{TN}{TN + FP} * 100 \tag{1.5}$$

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN} * 100 \tag{1.6}$$

Where,
TP = number of samples classifies as true while they were true.
TN = number of samples classifies as false while they were actually false
FP = number of samples classifies as true while they were actually false.
FN = number of samples classifies as false while they were actually true.

B. Performance With Different Number of Neurons

Chronic kidney Disease	Accuracy
Levenberg Marquardt	86.00
Bayesian Regularization	83.00
Scaled Conjugate Gradient	82.00
Resilient Back propagation	60.00

Table 1: Performance with different learning algorithms

C. Training time of various algorithms

Chronic Kidney Disease	Training Time (in second)
Levenberg Marquardt	25 s
Bayesian Regularization	30 s
Scaled Conjugate Gradient	9 s
Resilient Back propagation	5 s

V. CONCLISION

In this paper, we tend to evaluate the usage of artificial neural network based system in the field of medical disease diagnosis. As the concept of Neural networks in the arena of medical diagnosis is not very mature, a lot of research is going on. Therefore, in this paper, we proposed four different artificial neural networks. This proposed model has been tested on a dataset that included kidney disease information sets collected from Apollo hospital. We trained these samples using four back propagation algorithms and results are noted. The results from the four models are compared and analyzed to enhance the use of prediction by ANNs in the field of medical diagnosis. Artificial neural networks illustrate significant consequences (or results) in dealing and working with medical data. Results inferred that this diagnosis neural network based model could be valuable for analysis of neural networks in the field of medical diagnosis.

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