www.ijsrnsc.org

Available online at www.ijsrnsc.org

IJSRNSC

Volume-5, Issue-1, April 2017
Review Paper

Int. J. Sc. Res. in Network Security and Communication

ISSN: 2321-3256

A Rainfall Prediction Model Using Articial Neural Network

L. Shaikh[1*], K. Sawlani[2]

[1]Department of Electronics Engineering, K.J Somaiya college of engineering, Mumbai, India
[2]Department of Electronics Engineering, K.J Somaiya college of engineering, Mumbai, India

Corresponding Author: lubna.shaikh@somaiya.edu

Received 28th Feb 2017, Revised 14th Mar 2017, Accepted 24th Mar 2017, Online 30th Apr 2017

Abstract—Back propagation algorithm is most commonly used in neural network projects because it works faster than earlier approaches to learning and for its accuracy. Back propagation is a workhorse of learning in neural network. In back-propagation algorithm, there are two facets in its learning cycle, one to generate input pattern and another one to adjust the output by changing the weights of the network. There are many applications of feed forward neural network such as weather and financial predictions, face and signature detections etc. Thispaper describes the training, testing of data sets and finding the number of hidden neurons using back propagation algorithm for better performance. In the research, rainfall prediction in the region of Mumbai has been analyzed using feed forward network. In formulating artificial neuralnetwork based predictive models three layered network has beenconstructed.

General terms: *Rainfall, Prediction*
Keywords—feed forward Network, artificial neural network, back propagation algorithm, multilayer artificial neural network component.

I. INTRODUCTION

Rainfall forecasting is one of the most complicated and demanding operational responsibilities carried out by meteorological services all over the world. Rainfall prediction is difficult procedure to perform accurately. Prediction requires large amount of data from past records. Rainfall prediction is useful for water management and flood forecasting. There are many factors which affects rainfall prediction such as temperature, humidity, wind speed, pressure, dew point etc. The reason is that ANN (Artificial Neural Network) model is based on 'prediction' by smartly 'analyzing' the trend from an already existing voluminous historical set of data. ANN has better accuracy than statistical and mathematical model. These models works on the principle of biological neurons. Back propagation is mostly widely used method for training ANN. It is supervised learning method which needs dataset of desired output from several inputs making up training set. This may lead to a compromise in accuracy, but give us a better advantage in 'understanding the problem', duplicating it or deriving conclusions from it. Amongst all weather happenings, rainfall plays the most imperative part in human life. Human civilization to a great extent depends upon its frequency and amount to various scales. Several stochastic models have been attempted to forecast the occurrence of rainfall, to investigate its seasonal variability, to forecast yearly/monthly rainfall over some geographical area.

The paper aims to develop ANN using back propagation feed forward neural network for predicting the rainfall in Mumbai region of India.
Indian economy depends on monsoon and seasonal rainfall so it is necessary and challenging for meteorological researchers to forecast rainfall in different regions of country.

II. LITERATURE SURVEY

Hu (1964) started the implementation of ANN in weather forecasting. He used an adaptive system called adaline for pattern classification.Since thelast few decades, ANN a voluminous development in the application field of ANN has opened up new avenues to the forecasting task involving environment related phenomenon (Gardener and Dorling, 1998; Hsiesh and Tang, 1998). In 1991 Cooke and Wolfe presented a neural network for prediction of temperature. In 1994 scoffed presented an ANN technique for heavy consecutive rainfall estimation Michael ides et al (1995) compared the performance of ANNwith multiple linear regressions in estimating missing rainfalldata over Cyprus. Kalogirou et al (1997) implemented ANN toreconstruct the rainfall over the time series over Cyprus. Lee etal (1998) applied ANN in rainfall prediction by splitting the available data into homogenous subpopulations. Wong et al (1999) constructed fuzzy rules bases with the aid of SOM andback-propagation neural networks and then with the help of the rule base developed predictive model for rainfall over Switzerland using spatial interpolation. Toth et al. (2000) compared short-time rainfall prediction models for real-timeflood forecasting.

Different structures of auto-regressive moving average (ARMA) models, ANN and nearest-neighborsapproaches were applied for forecasting storm rainfall.
Abraham et al. (2001) used an ANN with scaled conjugate gradient algorithm (ANN-SCGA) and evolving fuzzy neural network (EfuNN) for predicting the rainfall time series. In thestudy, monthly rainfall was used as input data for trainingmodel. The authors analyzed 87 years of rainfall data inKerala, a state in the southern part of the Indian Peninsula.The empirical results showed that neuro-fuzzy systems wereefficient in terms of having better performance time and lowererror rates 5 compared to the pure neural network approach.Nevertheless, rainfall is one of the 20 most complex anddifficult elements of the hydrology cycle to understand and tomodel due to the tremendous range of variation over a widerange of scales both in space and time (French et al.1992).

II. METHODOLOGY

Methodology includes initial step of data mining. Data is collected from different meteorological websites, input and target data are decided for the prediction, and database is created accordingly. For input and target previous data has been taken for prediction. The input and target data have to be normalized because of having different units. For normalization the mean of all the data i.e. humidity, wind speed and rainfall is calculated.
Let mean be M,

M = Sum of entries/number of entries

Standard deviation of every value is calculated and then each value is described in terms of parameters

Normalized value = (x-M)/SD
Normalization helps in preserving the relationship between the actual data values.

A)PROPOSED ANN ARCHITECTURE

An Artificial Neural Network is based on information processing concept that is inspired by the way biological nervous systems such as the brain process the information.

Feed Forward Network
In this type of network, representing forward flow of information, network having this structure is called feed forward network. The layer composed of several neurons and makes independent computation of data that it gets and passes to other layer.Each neurons process independent computation depends on weighted sum of its input. The initial layer is input layer and the last layer is output layer ,the layer in between these 2 layers are hidden layer.The processing elements called neurons in which signals are transmitted by a connection link. A threshold function which is used in calculation of activations in given net and to calculate the output of neuron in output layer. Even though our subject matter deals with artificialneurons, we will simplify them as neurons

Feedback network
Feedback networks have signals travelling in both the directions because of loops. These networks are dynamic they changes their states continuously.

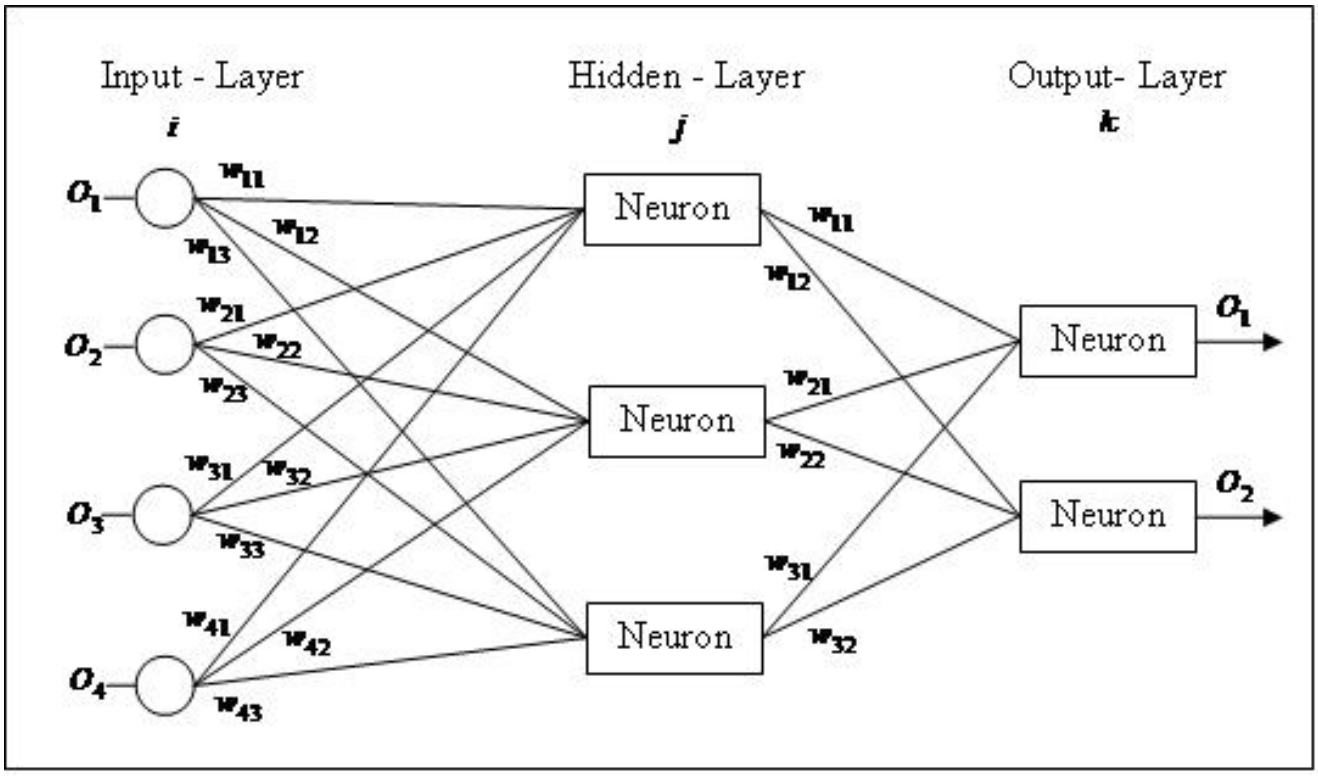

Figure.1 Layout of Feed forward neural network

B) Selection of input and output data

In this research input and target data is calculated for Mumbai.

Database is collected from different meteorological sitesIn Mumbai the months of June to September are identified as rainfall seasons Thus the present study explores the data of 6months from 2013 to 2015 .The input parameters are the average humidity, average temperature and wind speed. The output parameter is average rainfall. The data is retrieved from IMD website.

Feature extraction

Many features like temperature, wind speed, humidity etc affect rainfall.The following features are selected.

Humidity used to describe the amount of water vapor in a mixture of air and water vapor also defined as ratio of partial pressure of water vapor in the air water mixture to the saturated vapor pressure of water at prescribed temperature.

Temperature

It is measure of temperature at different levels of earth atmosphere .Temperature is the intensity aspects of suns energy that strikes the earth surface. It is governed by many factors including humidity and altitude etc.

Wind speed

Wind is a flow of gases on large scale. Wind is caused by difference in pressure. When difference in pressure exists the air is accelerated from higher to lower pressure. Wind speed is affected by numbers of factors including pressure gradient, local weather conditions

C) Training, Testing and Validation

After the normalization of data and creating database, another step is training the input using back propagation algorithm. Training of input data in MATLAB using NNTOOL and NFTOOL. Testing is done after the training of data is complete when the error is below tolerance level. The BPA keeps 30% of input data for testing and validation

D) Comparison of Actual Data and Predicted Data

After the testing is completed all the results are stored in workspace then comparison is made between actual output and predicted output also the graph is plotted. The graph is an efficient way of comparing the two types of data available with us. It can also be used to calculate the accuracy of the model. In this paper when a graph was plotted between the actual and the predicted values, it showed high degree of similarity between them hence proving that our ANN model is quite accurate in prediction. The following is an example of the the graph that is plotted after the testing and validation part is over

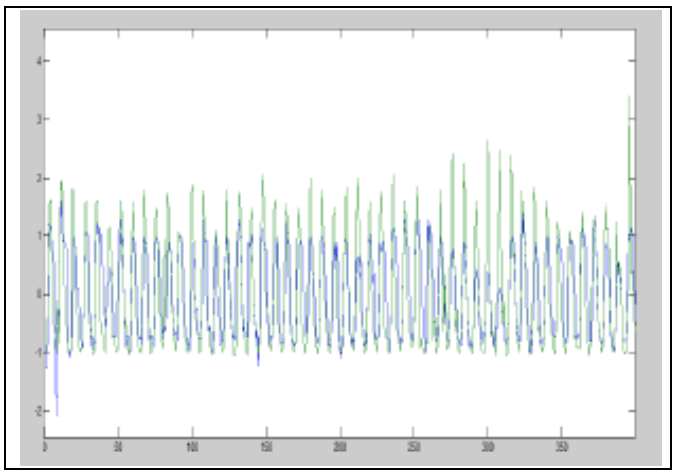

Figure.2 Snapshot of a comparison graph between the actual data and the dedicated data

IV RESULTS AND DISCUSSION

For getting different results MATLAB tools used are NFTOOL and NNTOOL and are described below.

NFTOOL (Neural network fitting tool): It is used for solving data fitting problems consisting of 2layer feed forward network trained with Levenberg marquardt.

NNTOOL (Open network/Data manager): It allows to import, create, use and export neural network and data.

a) Implementation of Back Propagation using NFTOOL

The graph plotted using NFTOOL between predicted and target values show minimized MSE.

MSE = 0.579

The performance graph can be plotted as

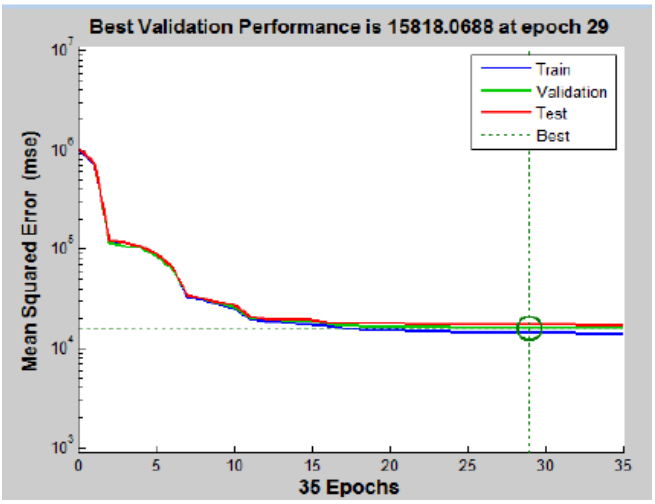

Figure.3 Snapshot of performance graph using NFTOOL

The regression can be plotted as,

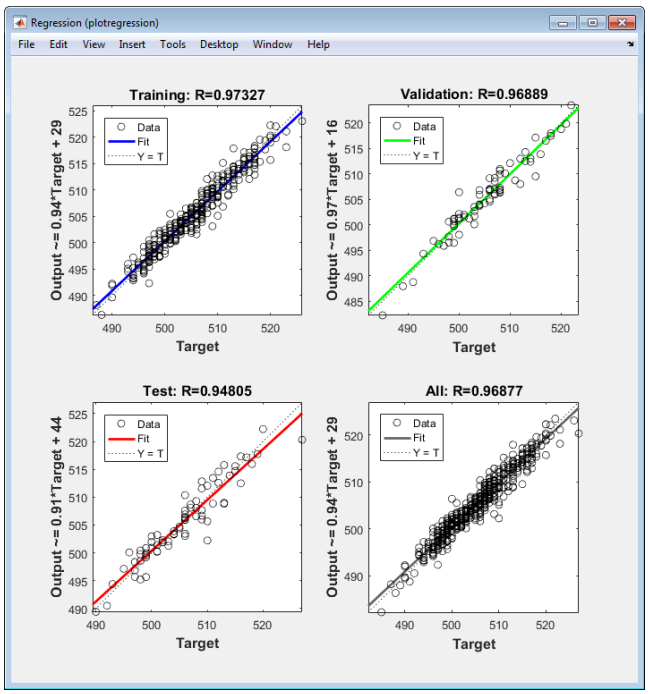

Figure.4 Snapshot of reression using NFTOOL

The above graph shows results using NFTOOL. The MSE observed was under tolerable level. It has high accuracy and minimized error.

NNTOOL used for implementing multilayer architecture.

Different algorithms were tested for multilayer architecture.

1) Back-propagation algorithm
2) Cascaded Back-propagation
3) Layer recurrent network

Multilayer architecture tested with Back-propagation algorithm showed good consistency and accuracy. Two hidden layer were tested with 10-20 neurons in the multilayer architecture.

Back-propagation algorithm tested with sample data using different training function and adaptive learning function gave different results. The result with minimum error is shown in the figure 5.

TABLE 1. BACK-PROPAGATION TESTING CASES

S. No.	Training Function	Adaptive Learning Function	No. of Neurons	MSE
Case1	TRAINLM	Learngdm	10	6.97
Case2	TRAINLM	Learngd	10	10.50
Case3	TRAINLM	Learngdm	20	7.03
Case4	TRAINLM	Learngd	20	**6.58**
Case5	TRAINRP	Learngdm	10	9.81
Case6	TRAINRP	Learngd	10	10.50
Case7	TRAINRP	Learngdm	20	9.92
Case8	TRAINRP	Learngd	20	10.90

In Table 1, case 4 has minimum MSE so it is the best case of back-propagation. The performance graph can be plotted as:

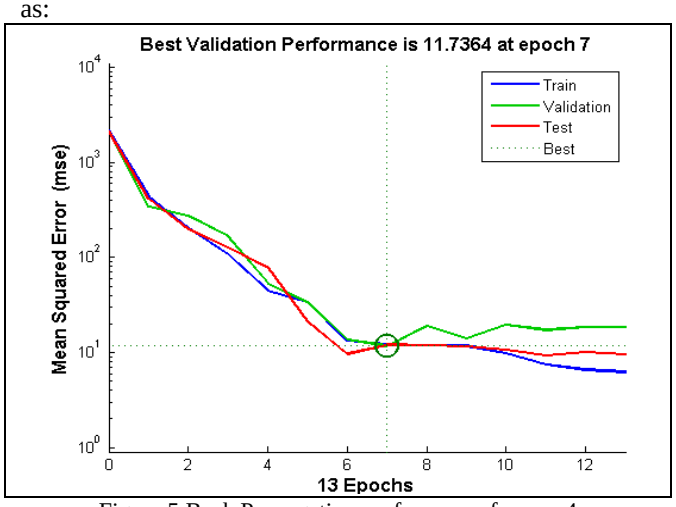

Figure.5 Back Propagation performance for case4

The graph plotted for the performance shows MSE and epochs. The graph clearly shows the best performance at 15 epochs. The training, test and validation is plotted in the performance graph.

VI. CONCLUSION

From the experimental study the following observation were Made:

- As the number of neurons increases in an ANN, the
- MSE decreases.
- BPA is the best algorithm out of the three tested.
- LEARNGDM is the best learning function to train your data with.
- LEARNGD is a bit time consuming.
- TRAINLM is the best training function.
- Multi-layer algorithm is better than single layer algorithm in terms of performance.
- NNTOOLS should be used to implement the prediction algorithms as an it gives an option of implementing algorithms other than BPA.
- Larger the amount of input data, lower is the MSE after training.
- The input /output data should be normalized if they are
- of very high order.

ACKNOWLEDGEMENT

The authors are thankful to Indian Meteorological Department for giving rainfall and meteorological data for project

REFERENCES

[1]. M. Tektaş, "*Weather forecasting using ANFIS and ARIMA models*", Environmental Research, Engineering and Management, Vol.51, Issue.1, pp.5-10, 2010.

[2]. SC. Michaelides, CC. Neocleous, CN. Schizas, "Artificial Neural networks and multiple linear regression in estimating missing rainfall data", In Proceedings of the DSP95 International Conference on Digital Signal Processing, Limassol Cyprus, pp.668-673, 1995.

[3]. SA. Kalogiru, C. Neocleous, CN. Constantinos, SC. Michaelides, NC. Schizas, "*A time series construction of precipitation records using artificial neural networks*, In Proceedings of EUFIT, Germany, pp. 2409-2413. 1997.

[4]. S. Lee, S. Cho, PM. Wong, "*Rainfall prediction using artificial neural network*", Journal of geographic information and Decision Analysis, VOl.2, Issue.2, pp.233-42, 1998.

[5]. WK. Wong, PM. Wong, TD. Gedeon, CC. Fung, "*RainfallPrediction Using Neural Fuzzy Technique*", pp.213-21, 1999

[6]. E. Toth, A. Brath, A. Montanari*," Comparison of short-term rainfall prediction models for real-time flood forecasting"*, Journal of Hydrology, Vol.239, 132–147, 2000.

[7]. K. Koizumi, "*An objective method to modify numerical model forecastswith newly given weather data using an artificial neural network*", Forecast, Vol.14, pp.109–118, 1999.

[8]. NQ. Hung, MS. Babel, S. Weesakul, NK. Tripathi, "An Artificial Neural network Model for rainfall Forer casting in Bangkok, Thailand", Hydrology and Earth System Sciences, Vol.13, Issue.8, pp.1413-25, 2009.

[9]. KK. Htike, OO. Khalifa, "*Research paper on ANNmodel using focused time delay learning*", International Conference on Computer and Communication Engineering, Kuala Lumpur, pp.23-41, 2010.

[10]. A. Abraham, D. Steinberg, NS. Philip, "*Rainfall Forecasting Using Soft Computing Models and Multivariate Adaptive Regression Splines*", IEEE SMC Transactions, Special Issue on Fusion of Soft Computing and Hard Computing in Industrial Applications, NY, pp.1-6 2001.

[11]. RD. Stern, RA. Coe, "*model fitting analysis of daily rainfall data*", Journal of the Royal Statistical Society: Vol. 147, No. 1 (1984), pp. 1-34Series A (General), Vol.147, No.1, pp.1-34, 1984.

[12]. K. Gurney, "An introduction to neural networks", CRC Press, USA, pp.1-234, 1997.

[13]. SS. Baboo, IK. Shareef, "*An efficient WeatherModel using Artificial Neural Network*", International Journal of Environmental Science and Development, Vol.1, No.4, pp.321-326, 2010.

[14]. E. Vamsidhar, "*Prediction of rainfall Using BackpropagationNeural Network Model"*, International Journal on ComputerScience and Engineering Vol. 02, No. 04, pp.1119-1121, 2010.

