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# Enhanced Prediction of the Rainfall Using Machine Learning Techniques

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**ABSTRACT:** Rainfall prediction is the one of the important technique to predict the climatic conditions in any country. This paper proposes a rainfall prediction model using Multiple Linear Regression (MLR) for Indian dataset. The multilayered artificial neural network with learning by back-propagation algorithm configuration is the most common in use, due to of its ease in training. In back-propagation algorithm, there are two phases in its learning cycle, one to propagate the input patterns through the network and other to adapt the output by changing the weights in the network. The back-propagation-feed forward neural network can be used in many applications such as character recognition, weather and financial prediction, face detection etc. a local rainfall (precipitation) prediction system based on artificial neural networks (ANNs). Our system can automatically obtain meteorological data used for rainfall prediction from the Internet. Meteorological data from equipment installed at a local point is also shared among users in our system. The final goal of the study was the practical use of “big data” on the Internet as well as the sharing of data among users for accurate rainfall prediction.

**KEYWORDS:** *Multiple Linear Regression, rainfall, prediction, machine learning, accuracy*

## I. INTRODUCTION

Rainfall prediction is a serious concern and has gained importance in government, public health sectors and scientific research. Rainfall predictions play a major role in forecasting as they are used to protect human lives and re- sources. Rainfall prediction is a challenging and critical task because of dynamic change in climate. Rainfall prediction with good accuracy is very useful in preventing the flood. Furthermore, rainfall is very much important for agriculture which affects the economy of the country to a great extent. Rainfall prediction model is difficult to build because of the dynamic changes in atmospheric processes. Thus accurate rainfall prediction is the major challenge for the meteorology department in spite of much advancement in weather pre- diction in recent years.

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Rainfall prediction remains a serious concern and has attracted the attention of governments, industries, risk management entities, as well as the sciatic community. Rainfall is a climatic factor that affects many human activities like agricultural production, construction, power generation, forestry and tourism, among others. To this extent, rainfall prediction is essential since this variable is the one with the highest correlation with adverse natural events such as landslides, coding, mass movements and avalanches. These incidents have affected society for years. Therefore, having an appropriate approach for rain- fall prediction makes it possible to take preventive and mitigation measures for these natural phenomena.

The metrological department to outline the trends and variations that are being observed within this time period and to highlight the rain cycles for each that will effective for prediction. The graph outlines that the cycle of the rainfall is varying for each year but the rain circle is constant as observed. Each rain circle starts from November and ends in May that shows the winter season in Erbil is very cold and rainy.

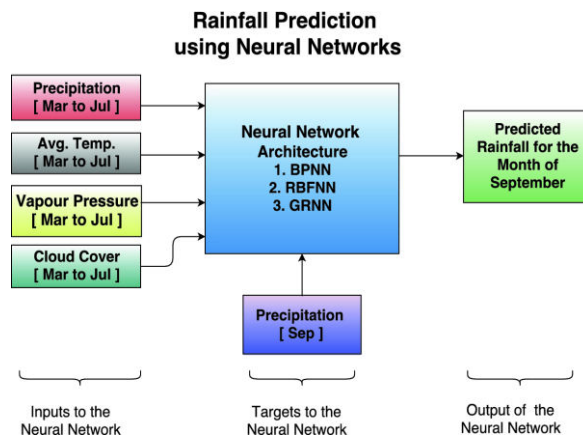


Fig 1 Architectural Designs

### III. PROPOSED SYSTEM FOR RAINFALL PREDICTION

The proposed model is developed using multiple linear regression. The proposed method uses Indian meteorological data to predict the rain fall. Usually machine learning algorithms are classified into two major categories: (i) unsupervised learning (ii) supervised learning. All the clustering algorithms come under supervised machine learning. The different classification of machine learning algorithms. The rainfall prediction research based on neural network for Indian scenario. Even though many models have developed, but it is necessary for doing research using machine learning algorithms to get accurate prediction. The error free prediction provides better planning in the agriculture and other industries.

- The proposed method MLR based Rain Fall Prediction.
- A model to predict the rainfall precipitation by using Deep Learning Architectures (LSTM and ConvNet).
- LSTM and ConvNet Architectures are used to model and predict the Global monthly average rainfall for 10368 Geographic Locations around the globe for 468 Months.
- RMSE of the proposed system, LSTM is 2.55 whereas the RMSE of ConvNet is 2.44. By increasing the hidden layers errors can be still reduced.

#### MLR BASED RAIN FALL PREDICTION

The proposed method is based on the multiple linear regressions. The data for the prediction is collected from the publically available sources and the 70 percentage of the data is for training and the 30 percentage of the data is for testing. Figure 2 describes the block diagram of the proposed methodology. Multiple regressions is used to predict the values with the help of descriptive variables and is a statistical method. It is having a linear relationship between the descriptive variable and the output values. The following is the equation for multiple linear regressions:

A neural network consists of a set of neurons and neurons are connected by weights. The neuron is the basic element in a neural network. The neuron receives features as input and calculates an output by multiplying with the weights. Each input is associated with a weight, which is assigned based on the importance of the input features.

#### A. Rainfall Prediction

Rainfall prediction is the one of the important technique to predict the climatic conditions in any country.

#### B. Multiple Linear Regression

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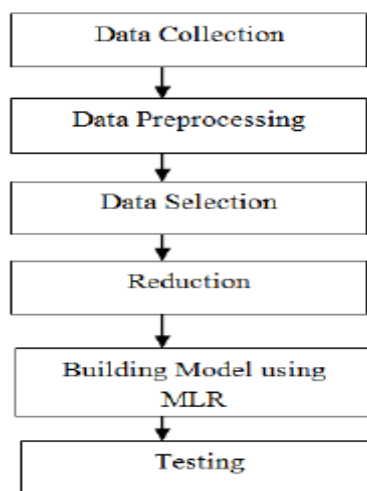


**C Back-Propagation Algorithm**

The Back propagation algorithm looks for the minimum value of the error function in weight space using a technique called the delta rule or gradient descent. The weights that minimize the error function are then considered to be a solution to the learning problem.

**D. Artificial Neural Networks**

An artificial neural network (ANN) is the piece of a computing system designed to simulate the way the human brain analyzes and processes information. It is the foundation of artificial intelligence (AI) and solves problems that would prove impossible or difficult by human or statistical standards.



**Fig 2 MLR Based Rain Fall Prediction**

**Processing:**

1. Collection of the open source weather data.
2. Preprocessing of the data.
3. Building the FFNN model with the training data.
4. Validating the FFNN model with the test data.
5. Evaluating the model by taking the difference between predicted output and desired output.

**Data Acquisition**

The rainfall data have been collected from the major influence on the rainfall were taken for predicting the rainfall. Dataset contains the following parameters like Temperature, Cloud cover, Vapor pressure and Precipitation. The rainfall data taken is divided into two distinct sets, training set and test set. The division gives the accurate prediction results.

**Preprocessing**

The collected rainfall data is preprocessed using normalization to improve the prediction accuracy. The rainfall data will be normalized between the range 0 and 1 which is used to minimize the overall error and produces the better performance. The min-max normalization is performed on X by using the following equation:

Accuracy=

Where

$$Normalized(X) = \frac{X_a - X_{min}}{X_{max} - X_{min}}$$

Actual data to be normalized.  $\sum N_{ij}$   
 each parameter, it gives the maximum value from input data.  $\sum N$   
 In each parameter, it gives the minimum value from input data.



$$RMSE = \sqrt{\frac{1}{y} \sum_{t=1}^y (Pred_t - Obs_t)^2}$$

**Building FFNN Model**

After the data has been normalized, the Feed Forward Neural Network Algorithm is trained with the training dataset. The algorithm is trained using the 60 percent of data from the input dataset. From the total of 212 samples, 119 samples are used for training. This data is selected randomly from the input dataset. Remaining 40 percent data is available for testing.

**Validating the Model**

The FFNN model is built with the training data. Then the built model is tested using the test data. The FFNN takes 40 percent data from the input dataset for testing. From the total of 212 samples, 93 samples are taken for testing.

**Performance Evaluation**

After the testing is done, the actual output and the predicted output is compared. Confusion matrix [11] contains two rows and two columns. The matrix represents the number of true positives, true negatives, false positives and false negatives. This matrix was used to measure the accuracy as given in Table 1.

		Prediction	
		Rainfall	No Rainfall
Actual	Rainfall	A	B
	No Rainfall	C	D

**Table 1: Confusion Matrix**

- A – It indicates that the prediction correctly identifies the Rainfall
- B - It indicates that the prediction misses the Rainfall
- C – It indicates that the prediction misses the No Rainfall
- D –It indicates that the prediction correctly identifies No Rainfall

The accuracy is calculated from confusion matrix by using the following equation

$N_{ii}$ - Diagonal elements in the confusion matrix (A+D)

N - Total number of samples in confusion matrix(A+B+C+D)

The RMSE is used for finding the difference between the mean of the actual values and predicted values. If the Root Mean Squared Error (RMSE) value is small, then it concludes that it is the good forecasting model.

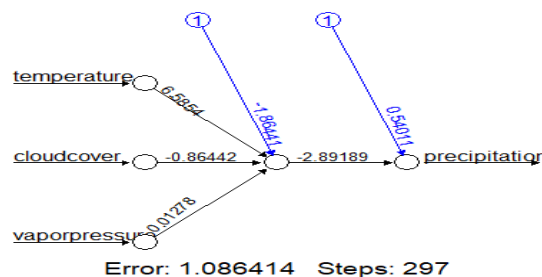
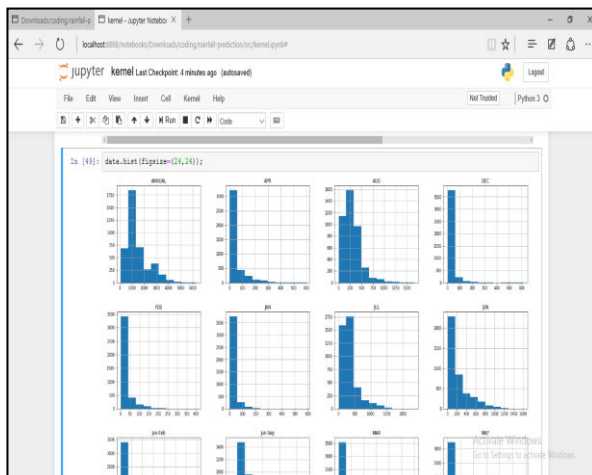
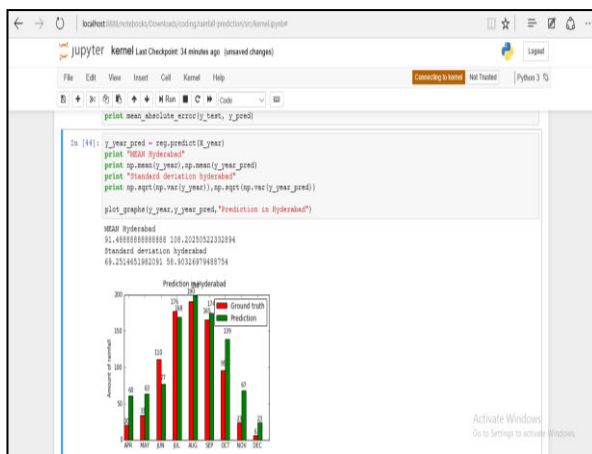
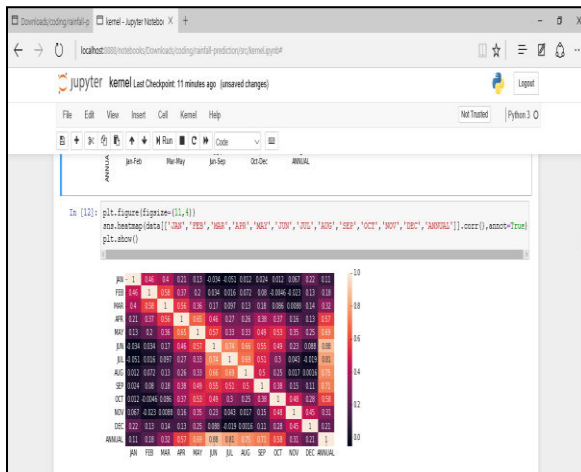


Fig 3: Performance of FFNN model with one hidden layer



IV. RESULTS AND DISCUSSION

In this paper, a Feed Forward Neural Network algorithm is used for building the model and predicting the rain- fall. The accuracy obtained by using the model was 93.55%. The result showed that the FFNN model can be used as a predictive algorithm for rainfall prediction. In future work, the performance of the prediction model could be improved by comparing different classification algorithms and testing the model with large amount of data.





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