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Result and Performance Analysis of Rainfall Prediction System Based on Deep Neural Network

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ABSTRACT

Rainfall prediction is useful for all people for decision making in all fields, such as out door gamming, farming, traveling, and factory and for other activities. We studied various methods for rainfall prediction such as machine learning and neural networks. There is various machine learning algorithms are used in previous existing methods such as naïve byes, support vector machines, random forest, decision trees, and ensemble learning methods. We used deep neural network for rainfall prediction, and for optimization of deep neural network Adam optimizer is used for setting modal parameters, as a result our method gives better results as compare to other machine learning methods.

Keywords : Deep Neural Network, Model Optimization, Model Parameters.

I. INTRODUCTION

As weather is changing day by day, it is difficult to predict rainfall accurately. The need of rainfall prediction is useful for individuals, factory, industry, traveling and for farmers to take decision for doing their activities. We studied various methods for rainfall prediction such as machine learning and neural networks. There is various machine learning algorithms are used in previous existing methods such as naïve byes, support vector machines, random forest, decision trees, and ensemble learning methods. We have used deep neural network for rainfall prediction, and for optimization of deep neural network Adam optimizer is used for setting modal parameters, modal parameters are weights and bias. It is very important to set proper modal parameters, if proper modal parameters are not set then modal will not gives accurate results. Modal parameters are sets during training of deep neural networks. Adam optimizer is used to set modal parameters and back propagation deep neural network is used for modal training. In this our method prediction is based on classification method, classification method is a supervised learning method where labeled data is provided for training modal. Result is in the form of binary value like it will rain today or it will not rain today. There are 13 input nodes and 3 hidden layers and 1 output node in this deep neural network. As we have used deep neural network and for optimization of deep neural network Adam optimizer is used as a result our method gives better prediction result as compare to other machine learning algorithms.

II. RELATED WORK

M.K. Nallakaruppan, Shaziya Nazz explained in paper (2019) that model gives better rainfall prediction results when using random forest as compared to other machine learning algorithms [1]. Experimental result for short–term rainfall forecasting by Xunlai Chen, Guangjun He, Yuanzhao explained in paper (2018) that by using support vector machine

algorithm it gives good prediction results for short-term rainfall forecast as compared to other machine learning algorithms [2]. Artificial neural network based rainfall prediction paper by Pallavi (2016), explains that other methods are better than adaptive fuzzy [4]. High accuracy with low mean square error can be obtain by using back propagation artificial neural network explained by, Mislan, Haviluddin, Sigit Hardwinarto, Sumaryono, Marlon Aipassa, Rainfall Monthly Prediction Based on Artificial Neural Network (2015) [5]. Mean square error can be decreases when neuron increases, model implemented based on back propagation neural network for rainfall prediction explained by Ankita Sharma, Geeta Nijhawan (2015) [6]. When using neural network for rainfall prediction some problems occurs explained by Mohini P. Darji (2015), rainfall can be predict by using feed forward neural network and it performs better for monthly data and for yearly rainfall data time delay neural network is better. Mohini P. Darji, Vipul K. Dabhi, Harshadkumar B. Prajapati [7]. Results are great by using RBM and DB for time series network dataset, model gives results with high accuracy (2016) [8].

III. PROPOSED METHOD

We are utilizing deep neural network for rainfall forecast, precipitation by utilizing deep neural network are as per the following:

- **Data Collection**

Information is gathered from Australia climate division site, dataset comprises of 25 segments and 900 lines, and dataset is in a CSV file.

- **Data Preprocessing**

Information preprocessing is a procedure of cleaning information expelling missing qualities, feature extraction choosing the features which are essential for issue.

- **Dataset Split**

Parting dataset for training dataset, test dataset, where train dataset is use for training model and test dataset is utilized for testing the forecasts of model.

- **Model Training**

Training model on dataset implies mapping input information to out names in directed learning strategy by setting weights and bias.

- **Model Parameter Optimization**

Here Adam optimizer is utilized for advancing model parameters, back propagation neural network in used to set parameters

- **Model Prediction**

Forecast is a yield aftereffect of deep neural network model, in this framework result will be it will rain today or it won't downpour today.

For structuring neural system, essentially there are three layers in neural system, first info layer, second hidden layer, third layer. Information layer is use for taking sources of info and concealed layers are use to process procedure on the given data sources and third layer is utilized for taking yield consequence of neural system. In our proposed framework there are 13 neurons units in input layer, there are 3 hidden layers and each layer comprise of 12 node units and one node in last layer. This is binary classification that is the reason there is just a single neuron in yield layer which gives results as it will rain today or it won't downpour today.

Rainfall prediction system based on deep neural network which predicts rainfall by classification. For model optimization Adam optimizer is used, to optimize modal parameters that are weights and bias. Here deep neural network is used that gives better

performance over the other various machine learning algorithms.

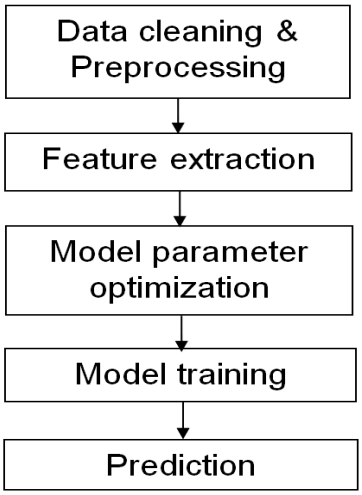

Figure 1. Proposed Method

- **Deep Neural Network**

We have used deep neural network for rainfall prediction, and for optimization of deep neural network Adam optimizer is used for setting modal parameters, modal parameters are weights and bias. It is very important to set proper modal parameters; if proper modal parameters are not set then modal will not gives accurate results. Modal parameters are sets during training of deep neural networks. Adam optimizer is used to set modal parameters and back propagation deep neural network is used for modal training. There are 13 input nodes and 3 hidden layers and 1 output node in this deep neural network. As we have used deep neural network and for optimization of deep neural network Adam optimizer is used as a result our method gives better prediction result as compare to other machine learning algorithms.

- **Random Forest**

It is an easy to use machine learning algorithm that yields an extraordinary outcome without a hyper-parameter tuning. As the name proposes a random forest is made. So it is an assortment of numerous choice trees that are consolidated together to acquire an increasingly exact forecast. It is a multi-reason calculation that guides in finding the answer for replace and order. It has the equivalent hyper parameters as a choice tree or a packing classifier it rather goes with the best element over the subset of arbitrary trees as opposed to looking through the most fundamental element. It additionally may include a subordinate element while isolating a hub looking for the best element among the subset. Extra edges can likewise be included while finding the most ideal limit. Another crucial quality of arbitrary trees is that it is so easy to understand the relative critical of each element while anticipating. There are different instruments present to quantify this and the exceptionally essential hyper parameters.

IV. PERFORMANCE MEASURES

Precision is calculated as the number of true positives divided by the total number of true positives and false positives.

$$\text{Precision} = \frac{\text{True Positives}}{\text{True Positives + False Positives}}$$

Recall is a metric that quantifies the number of correct positive predictions made out of all positive predictions that could have been made.

Unlike precision that only comments on the correct positive predictions out of all positive predictions, recall provides an indication of missed positive predictions.

$$\text{Recall} = \frac{\text{True Positives}}{\text{True Positives + False Negatives}}$$

Classification accuracy is widely used because it is one single measure used to summarize model performance.

F-Measure provides a way to combine both precision and recall into a single measure that captures both properties.

Alone, neither precision nor recall tells the whole story. We can have excellent precision with terrible recall, or alternately, terrible precision with excellent recall. F-measure provides a way to express both concerns with a single score.

Once precision and recall have been calculated for a binary or multi-class classification problem, the two scores can be combined into the calculation of the F-Measure.

$$F1\ Score = 2 \times \frac{(Precision * Recall)}{(Precision + Recall)}$$

- **Model Accuracy**

  - Training accuracy = 0.9988
  - validation accuracy = 0.9981

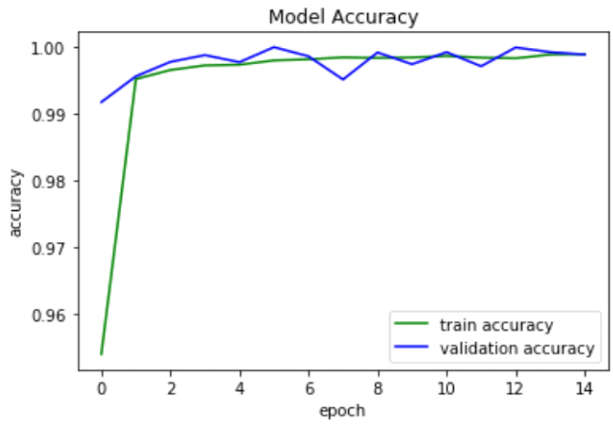

Figure 2. Proposed Method training and validation accuracy

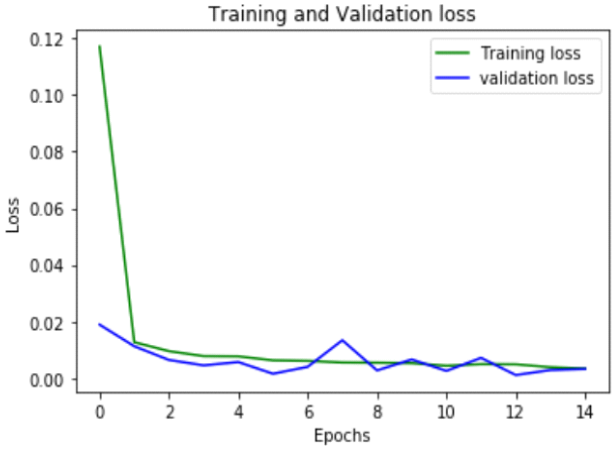

Figure 3. Proposed Method training and validation loss

V. RESULT AND COMPARISION

We used deep neural network for rainfall prediction, and for optimization of deep neural network Adam optimizer is used for setting modal parameters, as a result our method gives better results as compare to random forest machine learning algorithm.

Performance result of proposed system precision, recall and f1 score are as follows:

- Precision = 0.9984
- Recall = 0.9934
- F1 Score = 0.9959

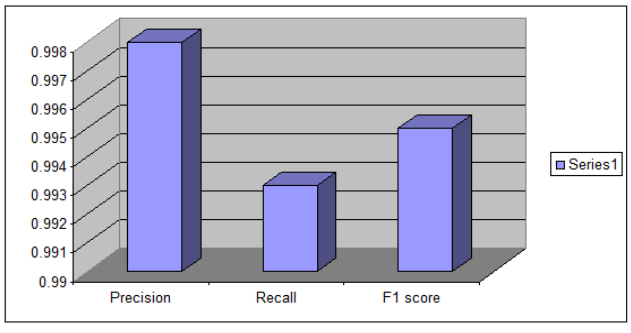

Figure 4. Proposed Method performance Precision, Recall and F1 score

- **Summary of the performance estimation of the random forest**

Parameters Predicted Values Correlation Coefficient : 0.9958
Mean absolute error : 0.0248
Root mean squared error : 0.0359
Relative absolute error : 9.2391
Percent Root relative squared error : 10.7107

VI. CONCLUSION

Rainfall prediction system is based on deep neural network which predicts rainfall by classification. For model optimization Adam optimizer is used, to optimize modal parameters. In this proposed system deep neural network is used that gives better performance over the other machine learning models.

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