Indian Rainfall Prediction Using Machine Learning & Deep Learning Techniques

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ABSTRACT

Rainfall plays an important role in the formation of fauna and flora of natural life. It is not just significant for human beings but also for animals, plants and all living things. It plays a significant role in agriculture and farming . In India, Agriculture is the key point for survival and for agriculture, rainfall is most important. These days rainfall prediction has become a major problem. Prediction of rainfall gives awareness to people and they know in advance about rainfall to take certain precautions to protect their crops from rainfall. Many techniques came into existence to predict rainfall. Machine Learning algorithms are mostly useful in predicting rainfall. Some of the major Machine Learning algorithms are ARIMA Model(AutoRegressive Integrated Moving Average, Artificial Neural Network, Logistic Regression, Support Vector Machine and Self Organizing Map. Two commonly used models predict seasonal rainfall such as Linear and Non-Linear models. The first models are the ARIMA Model. While using Artificial Neural Network(ANN) predicting rainfall can be done using Back Propagation NN, Cascade NN or Layer Recurrent Network. Artificial NN is same as Biological Neural Networks

Keyword : - *Rainfall ,Prediction, Artificial Neural Network,Deep Learning , Machine Learning*

1. INTRODUCTION

Rainfall plays an important role in the formation of fauna and flora of natural life. It is not just significant for human beings but also for animals, plants and all living things. It plays a significant role in agriculture and farming and undoubtedly water is one of the most natural resources on earth. The changing climatic conditions and the increasing greenhouse emissions have made it difficult for the human beings and the planet earth to experience the necessary amount of rainfall that is required to satisfy the human needs and its uninterrupted use in everyday life.

Therefore, it has become significant to analyze the changing patterns of the rainfall and try to predict the rain not just for the human needs but also to predict natural disasters that could be caused by the unexpected heavy rainfalls. The precise and correct rainfall prediction can not only contribute to the effective and efficient utilization of this natural resource but it can also help in managing the projects and plans for power generation.Artificial Neural Network for rainfall prediction is one of the most suitable and reliable systems for the rainfall prediction that has already benefited the operators for rainfall prediction .

ANN has the ability to access input information and process it for a useful output. ANN does not need a previous knowledge of the processing of information that gives it an advantage over other data processing systems. The rainfall prediction will also integrate adaptive Neuro-Fuzzy with ANN for an increased accuracy and enhanced quality of the predicted output . The Neuro-Fuzzy is also one of the effective algorithms used for data analysis for the classification. It assigns categories and allocates cases to similar groups/categories. So, each time a data is analyzed; it assigns that data to the most suitable or most similar category it belongs to.

2. METHODOLOGY

The creation of a database from inputs and outputs; the succeeding phase is the training of the input through back propagation algorithm, NARX and hybrid models. The training of the input data is done by the MATLAB software by using the NNTOOL and ANFISTOOL. Training is the preceding step to testing of the input data with acceptable error. The NNTOOL automatically retains 30% of the input data for testing and validation and 70% of input data for the training. The ANFISTOOL requires manual retention of the input data for training, testing and validation. The ANFISTOOL manually fed 60% of the input for training and 40% for testing.
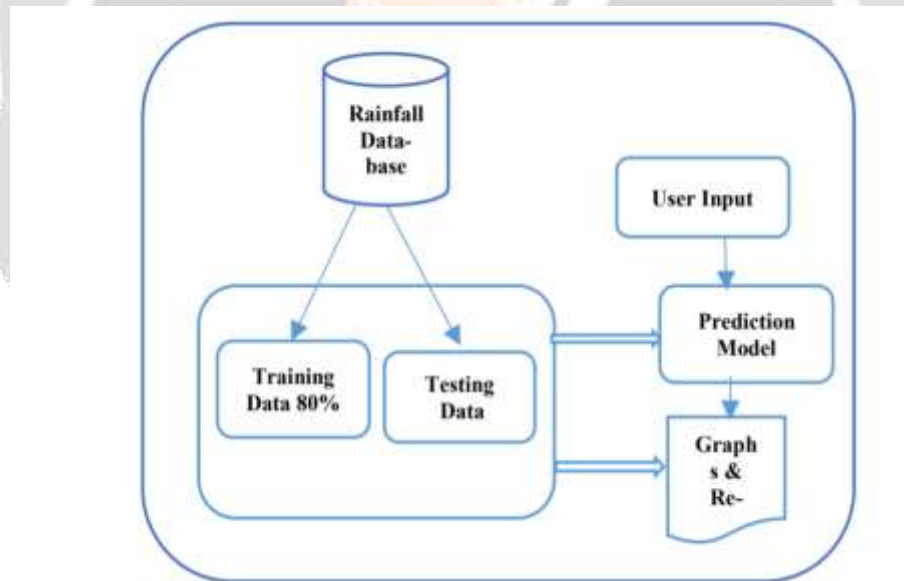

Figure 1: Data Division in Training and Testing

2.1 ANN

The artificial neural networks are a multipurpose and feasible set of the system. These are basically the computational methodologies that are used in diverse fields. The artificial neural networks are based on elements called neurons and these neurons receive inputs for processing the required results. The neural networks are multilayered nodes that are nonlinear and connected by the weighted lines (Abraham, 2005). When the input is presented to the neural networks during the training of the data; the successful training then offers the neural networks that are capable of predicting the output. The neural networks are capable of classifying an object, recognizing a particular pattern of multifactorial data, approaching a function and even configuration (Mitchell, 1997). This study will focus on the learning algorithms like the feedforward backpropagation and NARX model to predict the rainfall using the inputs described above.

2.2 Neurons

The artificial neural network performs these complex and huge tasks through the neurons that are fed into the layers and process the data just like the human brain. Neurons operate in the human brain to perform all the tasks and so are the artificial neural network. The neural network is non-linear functions. The neurons in the neural network are first trained with the old data in order to get the new and predicted data.After the training, testing is carried out to check the different results with different data and to obtain the comparison by feeding the system with a different number of neurons. The number of neurons fed to the system is varying and depends on the data and processing complexity. Therefore, the architectures may differ from one another depending on input/output complexity and the layers in the system (Demuth, Beale, Jess, & Hagan, 2014).

2.3 NARX

The NARX is the model that is found in the Autoregressive with Exogenous Input model. The NARX is a nonlinear and recurrent dynamic model. It is a feedback neural network which is efficient in obtaining the output results that are accurate and precise. It is suitable for modeling nonlinear systems like the artificial neural network. The NARX is best for learning with the gradient 24 algorithm. The gradient descent is obtained accurately with NARX.The NARX models are used popularly for the identification and recognition tasks. The predictions are and forecasts could also be made efficiently by using the NARX models. They operate under certain different functions and are autoregressive. This model uses feedback connections (that are neurons sending the information to other neurons) in the several layers of the network for enhanced accuracy. It is based on ARX model that is linear and used to predict the time series commonly (Khamis, Nabilah, & Abdullah, 2014)

3. RESULT And Discussion

In Multilayer perceptron input is taken from multi-levels and predicts the future data from the past data. Neural Network training tool is used. Generally, sensors are taken as input like wind sensor, light sensor etc.. But here using convolution neural networks to take the input from the past data. In this, the data is separated into training and testing and calculating Mean absolute error from this NN training. No of iterations are being calculated and checking the best Epoch value.

SN.	Authors	Technique	Rainfall Predicting Attribute
1	Victor SanchezAnguix2, Vicente Julian3, Javier Palanca3, and N´estor	Deep learning, MLP, Auto-encoder network	temperature, relative humidity, barometric pressure, direction and speed of the wind

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2	2	Artificial Neural Network	Min-Max temperature	
3	3	Artificial Neural Network	Min-Max temperature	
4	4	ABFNN	Precipitation, Wind, temperature,	
5	5	ABFNN	Latitude-Longitude, wind, sea surface pressure, wind, temperature	
6		Nitish Sharma,Hussain Shaikh , Pratiksha Burke , Rohit Patil	MLP ,Deep Learning,Auto-encoder network	Min-Max temperature, Rainfall, Evaporation, Sunshine, Wind Speed, Humidity , Pressure

Table 1 : Various Techniques and Predicting Attribute

4. CONCLUSIONS

Rainfall is one the most significant natural phenomenon that is not only important for the human beings only but the living beings. Due to the changing climatic conditions, rainfall cycles are also changing and the temperature of the earth is rising. The changing temperature is also affecting the agriculture industry and sometimes may cause flooding and landslides. Therefore, it is essential for human beings to keep a check upon this natural phenomenon in order to survive. The study aimed at building a predicting system using neural networks that could predict monthly rainfall accurately and efficiently with minimum error. The study incorporated different areas and used their rainfall data with different neural networks like ANFIS and ANN, through training the networks with these inputs and outputs. The trained data is tested and then validated by making a comparison between actual and predicted data. The system used feature extraction to deduce the output prediction that could be more precise and accurate.

5. REFERENCES

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