Artificial Neural Network for Rainfall Analysis Using Deep Learning Techniques

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Abstract. The estimation of rainfall is one of the most critical and daunting challenges in today's environment. Weather and rainfall are typically extremely nonlinear and dynamic, needing sophisticated machine models and simulation for forecasting accurately. The economy of India is agriculture and is focused primarily on crop production and precipitation. Predictions of rainfall are important for all farmers to assess crop productivity. Rainfall forecast involves the application of science and technology to determine weather conditions. In order to utilize water supplies efficiently, the crop productivity and the pre-program of water systems, it is necessary to determine the precipitation in detail. The actions of such nonlinear processes can be modeled using an Artificial Neural Network (ANN). Most researchers in this area have been effectively utilizing ANN for the past 25 years. This article offers an summary of some of the methodologies valid for using ANN for rainfall prediction by numerous researchers. The survey also states that forecasts of rainfall using ANN technologies are more accurate than conventional mathematical and numerical approaches.

Keywords: Rainfall, Forecast, Economy, Artificial Neural Network (ANN), Agriculture.

1. Introduction

The weather has a profound impact on human culture. Of all forms of environmental phenomena, rainfall plays the most significant function of human life. Regeneration is a common process with complex and challenging forecasts. Accurate rainfall knowledge is important for water supply preparation and control and also for the maintenance of reservoirs and flood mitigation. Moreover, flooding has a major impact on public infrastructure, sewage networks and other human activities. Nonetheless, precipitation is one of the most complicated and challenge factor of hydrology, owing to the nature of the atmospheric processes that create precipitation and the vast number of differences of space and time over a broad range of dimensions [11, 12, 14]. Throughout the past few decades, reliable forecasts of rainfall are still a big obstacle in practical hydrological sciences. Rainfall represents trees, so planting implies survival. The forecast of
regeneration is directly linked to agriculture, which makes a significant contribution to the nation's economy.

At a global scale, many studies have attempted to forecast weather correctly using various techniques. Yet the predictive precision obtained by these methods is also below the acceptable standard owing to the nonlinearity of rainfall. Thanks to their inherent non-linearity, consistency and data guided learning in construction models without any prior awareness of catchment activity or flow processes; the artificial neural network algorithm is an enticing inductive approach to rainfall prediction [2, 5, 7]. Thanks to its capacity to model linear and non-linear processes without the need to presume as implied in most conventional mathematical methods, artificial neural networks were widely used in many fields of science and engineering in these days. ANN was used over the basic linear regression model as an efficient tool.

This report presents a literature overview of the estimation of rainfall utilizing many neural networks employed by numerous scientists. [15] The paper also briefly explores the idea of some neural network architectures, which will support new researchers in this field. There are a broad number of precipitation methods available in India as India is an agricultural nation and the agriculture output depends on precipitation and humidity. In India, there are two major methods to forecast precipitation. They are a complex and analytical process.

2. Implementation On Rain Fall Prediction Using ANN

2.1. Features Extraction:
The development of a network of neurons is when a neuron connects to others through single- or multi-layered synapse. A multi-layer ANN comprises an input neuron sheet, an output neuronal layer and one or more veiled neuronal layers [6]. The secret layer allows executing valuable intermediate calculations before the data is guided to the output layer as shown in fig (1.1).

If a network is designed for a particular application, a network is trained using the inputs and targets it needs until a particular input is associated with a reasonable output. A network is preferably equipped until a fixed value is reached by adjusting weights throughout the training process. If the network has been adequately equipped, accurate outputs will be checked. Based on the large number of synaptic weights on such a network, multi-level networks with several nodes in each layer are able to save the info.

2.2. Back Propagation Network:
One of the most significant advances in neural networks [2] is the Back Propagation Learning algorithm. The most common and powerful model for multi-layered networks still remains this network. This learning algorithm is extended to multi-layer feedback networks composed of elements that can continuously distinguish functions. Back propagation learning algorithm networks are also known as backroom networks. This is a guided form of learning. This algorithm offers a method for adjusting the sizes in a BPN for a particular training input-output pair to accurately distinguish the different input patterns [4,9,13]. This consists of two routes through the different strata of the network: the forward transfer and backwards pass. On the forward transfer, the sensory nodes of the network are connected with an input vector, which propagates the influence across the network layer per line.
Ultimately, the final product of the network was a collection of outputs. The synaptic weights of the networks are set throughout the forward transit. The weights of the reverse are changed according to an error correction law, on the other side during the reverse movement’s particular, an error signal may be produced from the actual response of the network from the desired (target) answer [5] [6]. This error signal is poured out to the path of synaptic lines across the network, which is why the term "error out propagation" is used. The synaptic weight is modified such that the real reaction in the network is significantly equal to the target reaction [1]. This standard backbone network contains an input layer, an output layer and at least one secret layer. The number of neurons per layer and the number of secret layers decide the capacity of the networks to generate specific effects with a given data collection. This rainfall prediction network was used by most researchers.

2.3. Radial Basis Function Network:
RBF nets are a form of feed forward networks that are non-linear. This is another method that views the architecture of the neural network in a high dimensional space as a curve-mount problem. The concealed units include a set of "functions." Such functions are called radial-base functions and provide an arbitrary "basis" for input patterns (vectors). The RBF network consists of three layers of entirely separate functions: the reference layer, the only secret layer and the output layer ([3], [4]).
For an RBF network conducts a complicated pattern recognition operation, the problem is solved by nonlinear translation of the RBF network into a wide room. Examples of nonlinear distributed feed forward networks are RBF networks and MLPs (Multi Layer Perceptrons). All approximates are identical. [10,16] Such two networks, though, vary. An RBF network has a secret layer, so an MLP may have a secret layer or more. The cached layer of the RBF network is nonlinear with a linear output layer, whereas a cached layer and an MLP output layer are usually nonlinear [1].

2.4. Support vector Machine:
Support Vector Machine help is one of the major feed network groups for multi-layer load. With multiple layer perceptions and radial function networks, enabling vector machines for sequence and non-linear regression may be used. Vapnik and his co-workers have been established with the aid of Vector Machines (SVMs) as an assistant for supervised learning because of (i) better generalized efficiency than other NN models (ii) SVM is unique, optimal and absent from local minima because it utilizes linear restricted quadratic programming problem. Kernel Methods involve a range of mathematical learning algorithms including classification and regression SVM, kernel PCA, kernel-based clustering, collection and reduction of dimensionality, etc.[1]. SVM has been identified over the last few years to be an effective strategy for solving multiple classifications. This technique was used for rainfalls by a very few researchers from this area and the findings were satisfactory.

3. Result And Discussion
Soft computation includes indirect models in which an approximation answers or outcome is obtained [11]. Three central constituents of soft computing are the ANN, Fuzzy and Genetic algorithms. Soft-computing structures include the following. In the area of forecasting weather, ANN is widely used by researchers. Human brain (information processing system) is a highly dynamic, nonlinear and parallel computer. Simplified representations of biological neurons are the neural networks. The analysis of rainfall prediction as shown in tab (1.1)

| Algorithm | Humidity | Pressure | Temperature | Perceptron |
|-----------|----------|----------|-------------|------------|
| BPN       | 0.20     | 0.56     | 0.88        | 0.56%      |
| RBFN      | 0.35     | 0.65     | 0.38        | 0.68%      |
| SVM       | 0.65     | 0.78     | 0.98        | 0.93%      |

A neural network is a massively parallel, distributed system comprising basic processing units with a strong tendency to store experiential information and making it accessible for use [12]. It will get information, process and generate the correct outcome much like the normal neuron in the human brain does. A basic model in the frame may be used quantitatively to describe a neuron. Then Final prediction report as shown in the fig (1.2)
Figure (1.2) analysis chart for rainfall prediction using ANN

The above results and chats proved that the prediction on rainfall analysis in support vector machine classifiers is in high perception values while compare to other neural networks. The calculations are mainly depending on humidity, temperature, pressure and cloud coverage. The highest perception value (0.93%) is achieved in support vector machine classifier.

4. Conclusion
This paper presents a comprehensive study of forecasts of rainfall over 25 years utilizing various models of the neural networks. The study showed that most researchers employed a rainfall forecast back propagation network and had good results. This study also suggests that MLP, BPN, RBFN, SOM and SVM simulation strategies are sufficient in order to forecast precipitation over other strategies such as statistics and statistical structures. Nevertheless, there have been several limitations in these approaches. ANN researchers will be beneficial in reliably predicting rainfall in the future through detailed references to the numerous advances in ANN’s work found in this article.

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