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Forecasting Weather System Using Artificial Neural Network (ANN): A Survey Paper

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Abstract: Forecasting weather is the eminent function of Science and Technology that predicts the upcoming status of the weather for particular place. Weather forecast are furnish by collecting required data (i.e. parameters) about the specified location status of the atmosphere.This paper, has presents a neural network-based algorithm for predicting the weather status. The Neural Networks package supports different types of learning or training algorithms. Of which one of the algorithm is Back Propagation Neural Network (BPN) technique. The main benefit of the BPN neural network method is that it can properly approximate a large class of functions. This method is more efficient than numerical differentiation. The simple meaning of this term is that our model has potential to capture the complex relationships between many factors that contribute to certain temperature. The idea is examined with the real time dataset. Real time processing of weather data indicate that the BPN based weather forecast has shown improvement not only over guidance forecasts from numerical models, but over official local weather service forecasts as well. The results which being extracted will be compared with practical working condition of meteorological department weather data like(min temperature & max temperature, Humidity, rainfall) which will confirm that this model has the potential for successful application to forecasting weather in near future. In this survey paper, an author has used brief survey of various weather forecasting systems using Artificial Neural Network (ANN) has been presented and recommendations has been provided for the future research and reference one can implement.

Keywords: Artificial Neural Network (ANN), Back Propogation, Weather Forecasting Techniques, Multi Layer Perception.

1. Introduction:

The information regarding weather forecasting is required as it plays an important role since they are used to protect life and property. Presently weather conditions are obtained by ground observations that includes information taken from satellites and several other weather stations followed by aircraft, ships etc. Due to chaotic nature of the atmosphere, the massive computational power is required to solve the equations that describe the atmosphere, error involved in measuring the initial conditions, and an incomplete understanding of atmospheric processes. This means that forecasts become less accurate as the difference in current time and the time for which the forecast is being made (the range of the forecast) increases. The use of ensembles and model helps narrow the error and pick the most likely outcome [27].

2. Concepts of Artificial Neural Network

In this 21st century soft computing deals with approximate models where an approximation answer or results are achieved. Soft computing has basic three components namely Artificial Neural Network(ANN),Genetic Algorithm and Fuzzy Logic. Among of which ANN is commonly used by researchers in building up weather forecasting system[31].

An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the new structure of the information processing system. It is composed of a huge number of highly interconnected processing elements (neurons) working in unison to solve specific problems. ANNs, like people, learn by example. An ANN is configured for a particular application, such as pattern recognition or data classification through a learning process. Learning in biological systems adds adjustments to the synaptic connections that exist between the neurons. A neural network model is a structure that can be adjusted to produce a mapping from a given set of data to features of or relationships among the data. The model is adjusted, or trained, using a collection of data from a given source as input, typically referred to as the training set. After successful training, the neural network will be capable to perform classification, estimation, prediction, or simulation on new data from the same or similar sources. A neural network is a powerful data modelling tool that is able to capture and represent complex input/output relationships[31].

3. Methodology

The below given types of Neural Networks are used by several researchers for weather forecasting system.

3.1 Back Propagation Neural Network (BPN)

The back-propagation learning algorithm is one of the most important developments in neural networks. This network is still the most popular and most effective model for complex, multi layered networks. This learning algorithm is applied to multilayer feed-forward networks consisting of processing elements with continuous differentiable activation functions. The networks associated with back-propagation learning algorithm are also called back-propagation networks (BPNs). It is a supervised learning method. For a given set of training input-output pair, this algorithm provides a procedure for changing the weights in a BPN to classify the given input patterns correctly. The basic concept of this algorithm is, it consists of two passes through the different layers of the network: a forward pass and a backward pass. In the forward pass, an input vector is applied to the sensory nodes of the network and its effect propagates through the network layer by layer. Finally a set of outputs produced as the actual response of the network. During the forward pass the synaptic weights of the networks are all fixed. During the backward pass, on the other hand, the synaptic weights are all adjusted in accordance with an error correction rule. Specifically, the actual response of the network is subtracted from the desired (target) response to produce an error signal. This error signal is then propagated backward through the network, against the direction of synaptic connections, hence the name “error back- propagation”. The synaptic weights are adjusted to make the actual response of the network move closer to the desired response in a statistical sense The typical back-propagation network contains an input layer, an output layer, and at least one hidden layer. The number of neurons at each layer and the number of hidden layers determine the networks ability on producing accurate outputs for a particular data set. Most of the researchers have been used this network for rainfall prediction[31].

3.2 Radial Basis Functions Neural Network(RBF)

RBF Networks are the class of nonlinear layered feed forward networks. It is a different approach which views the design of neural network as a curve fitting problem in a high dimensional space. The hidden units provide a set of “functions” that constitute an arbitrary “basis” for the input patterns (vectors) when they are expanded to the hidden space, these functions are called radial-basis functions. The construction of a RBF network involves three layers with entirely different roles: the input layer, the only hidden layer, and the output layer. When a RBF network is used to perform a complex pattern classification task, the problem solved by transforming it into a high dimensional space in a nonlinear manner. RBF networks and MLPs (Multi Layer Perceptrons) are examples of nonlinear layered feed forward networks. They are both universal approximators. However, these two networks differ from each other. An RBF networks has a single hidden layer, whereas an MLP may have one or more hidden layers. The hidden layer of an RBF network is nonlinear and the output layer is linear, where as the hidden and output layers of an MLP are usually all nonlinear [1]. Several researchers have used this network for accurate rainfall prediction and got valuable results.

4. Literature Survey

[1] Hu (1964) started the implementation of ANN in weather forecasting. He used an adaptive system called Adaline for pattern classification. This system, when trained on 200 winter sea level pressure and 24-hr pressure change patterns covering the area from 25N to 65N and 110W to 170W, was able to make “rain”-“no rain” forecasts for the San Francisco Bay area on 100 independent cases that compared favourably with the official U.S. Weather Bureau forecasts for the same periods. After this research, he suggested that adaptive systems have the capability of making useful predictions or specifications of weather without complete understanding of the dynamics or complete measurement of the physical parameters involved.

[2]An Artificial Neural Network model has developed by McCann (1992) to give 3-7 hr forecast of significant thunderstorms on the basis of surface based lifted index and surface moisture convergence. The two

neural networks produced by them were combined operationally at National Severe Storms Forecast Center, Kansas City, Missouri to produce a single hourly product and was found to enhance the pattern recognition skill.

[3]An important research work in applying ANN for rainfall forecasting was undertaken by French et al. (1992), which employed a neural network to forecast two-dimensional rainfall, 1 h in advance. Their ANN model used present rainfall data, generated by a mathematical rainfall simulation model, as an input data. That work was, however, limited in a number of aspects. For example, there was a trade-off between the interaction and the training time, which could not be easily balanced. The number of hidden layers and hidden nodes seemed insufficient, in comparison with the number of input and output nodes, to reserve the higher order relationship needed for adequately abstracting the process. Still, it has been considered as the first contribution to ANN's application and established a new trend in understanding and evaluating the roles of ANN in investigating complex geophysical processes.

[4]Chen and Takagi (1993) have proposed a feature based neural network approach for rainfall prediction in the area of the open sea near Shikoku, Japan. A four-layer neural network was used to automatically learn the internal relationship between geostationary meteorological satellite GMS data and rainfall intensity distribution. They have used Back propagation learning algorithm for training and infrared and visible imagery of GMS image as the input data to the network.

[5]In 1994 Zhang and Scofield presented an artificial neural network (ANN) technique for heavy convective rainfall estimation and cloud merger recognition from satellite data. They have developed an Artificial Neural network expert system for Satellite-derived Estimation of Rainfall (ANSER) in the NOAA/NESDIS Satellite Applications Laboratory and found that using artificial neural network group techniques, the following can be achieved: automatic recognition of cloud mergers, computation of rainfall amounts that will be ten times faster, and average errors of the rainfall estimates for the total precipitation event that will be reduced to less that 10 per cent.

[6]Michaelides et al. (1995) compared the performance of ANN with multiple linear regressions in estimating missing rainfall data over Cyprus. They have proposed a technique that can be put forward in order to generate a sufficiently long time series of rainfall records for those locations for which the existing time series is either discontinued (forward extension) or where the archives have a relatively recent start (backward extension). The method uses artificial neural networks for the estimation of daily rainfall at particular observation sites in Cyprus (termed target stations) using as input daily rainfall observations from neighboring sites that had a sufficiently long and complete archive of data (termed control stations). In this way, the technique can be used to fill in missing data from the rainfall observation network but also for checking suspected data by using the records from surrounding stations. This technique of using neural networks is contrasted to the traditional multiple linear regression method. Here, the target station was considered as the dependent variable and the control stations as the independent variables.

[7]Monica and Fred (1998) did survey on how effective neural network at forecasting & prediction. They found despite increasing applications of artificial neural networks to forecasting over the past decade opinions regarding their contributions are mixed. Evaluating research in this area has been difficult, due to lack of clear criteria. Here they had identified eleven guidelines that could be used in evaluating this literature. Using it they examined applications of neural networks to business forecasting and prediction. They located 48 studies done between 1988 & 1994.For each they evaluated how effectively the proposed technique was compared with alternatives (effectiveness of validation) and how well the technique was implemented (effectiveness of implementation).They found that eleven of the studies were both effectively validated and implemented. Another eleven studies were effectively validated and produced positive results, even though there were some problems with respect to the quality of their neural network implementations. Of these 22 studies 18 supported the potential of neural networks for forecasting and prediction. Two conclusions emerges. First, neural network when they are effectively implemented & validated show potential for forecasting & prediction. Second, a significant portion of the neural network research in forecasting & prediction lacks validity.

[8]In 2000 Toth et al. compared short-term rainfall prediction models for real-time flood forecasting. They applied three time series models, auto-regressive moving average (ARMA), ANN and k-nearest-neighbors (KNN) method for forecasting storm rainfall occurring in the Sieve River basin, Italy, in the period 1992- 1996

with lead times varying from 1 to 6 h. The result showed that the ANN performed the best in the improvement of the runoff forecasting accuracy when the predicted rainfall was used as inputs of the rainfall run-off model.

([3], [9])Luk et al. (2001) have developed and compared three types of ANN suitable for rainfall prediction i.e. multilayer feed forward neural network (MLFN), Elman partial recurrent neural network (Elman) and time delay neural network (TDNN) [21]. In the same year, Abraham et al. used four soft computing methods: ANN using Scaled Conjugate Gradient Algorithm (ANNSCGA), Evolving Fuzzy Neural Network (EfuNN), Adaptive Basis Function Neural Network (ABFNN) and General Regression Neural Network (GRNN) for predicting the rainfall time series. They have used a regression technique called Multivariate Adaptive Regression Splines (MARS) that uses a specific class of basis functions as predictors. In the study, monthly rainfall was used as input data for training model. The authors analyzed 87 years of rainfall data in Kerala, a state in the southern part of the Indian Peninsula. The empirical results showed that neuro- fuzzy systems were efficient in terms of having better performance time and lower error rates 5 compared to the pure neural network approach. Nevertheless, rainfall is one of the 20 most complex and difficult elements of the hydrology cycle to understand and to model due to the tremendous range of variation over a wide range of scales both in space and time.

[2]Taylor & Roberto(2002)did neural network load forecasting with weather ensemble predictions. As they have shown how weather ensemble predictions can be used in ANN load forecasting for lead times from one to 10 days ahead. We used the 51 ECMWF ensemble members for each weather variable to produce 51 scenarios for load from an ANN. For all ten lead times, the mean of the load scenarios was a more accurate load forecast than that produced by the tradi- tional procedure of substituting a single point forecast for each weather variable in the ANN load model. This traditional pro- cedure amounts to approximating the expectation of the ANN nonlinear function of weather variables by the same nonlinear function of the expected values of the weather variables. The mean of the 51 scenarios is appealing because it is equivalent to taking the expectation of an estimate of the load pdf. The distribution of the 51 load scenarios provides information regarding the uncertainty in the load forecast. However, since the distribution does not accommodate the ANN load model uncertainties, it will tend to underestimate the load forecast un- certainty. In view of this, we rescaled the variance of the load scenarios before using it as an estimator of the load forecast error variance. The resulting estimator compared favorably with benchmark estimators based purely on historical forecast error. Using the same variance estimator as a basis for estimating pre- diction intervals also compared well with benchmark methods. We, therefore, conclude that there is strong potential for the use of weather ensemble predictions in ANN load forecasting.

[10]Wong et al. (2003) established a rainfall prediction model using soft computing technique that uses ANN and Fuzzy Logic. They have used SOM first to divide the data into sub- population and hopefully reduce the complexity of the whole data space to something more homogeneous. After classification, they have used BPNNs to learn the generalization characteristics from the data within each cluster. They extracted fuzzy rules for each cluster. The fuzzy rule base is then used for rainfall prediction. They have compared this method with an established method, which uses radial basis function networks and orographic effect ([17]). Their results showed that the proposed method could provide similar results from the established method. However, the authors revealed that their method has the advantage of allowing analyst to understand and interact with the model using fuzzy rules.

[11]In 2004 Chistodoulou et al. used an idea is to predict rainfall rate by using weather radar instead of rain-gauges measuring rainfall on the ground. The neural SOM and the statistical KNN classifier were implemented for the classification task using the radar data as input and the rain-gauge measurements as output. The rainfall rate on the ground was predicted based on the radar reflections with an average error rate of 23%. Ultimately, they have observed that the prediction of rainfall rate based on weather radar measurements is possible.

[12]In 2007 Paras et al. proposed a weather forecasting model using Neural Network. They have been predicted the weather parameters like maximum temperature, minimum temperature and relative humidity using the features extracted over different periods as well as from the weather parameter time- series itself. The approach applied there uses feed forward artificial neural networks (ANNs) with back propagation for

supervised learning using the data recorded at a particular station. The trained ANN was used to predict the future weather conditions. The results were very encouraging and it was found that the feature based forecasting model can make predictions with high degree of accuracy. The model could be suitably adapted for making forecasts over larger geographical areas.

[13]Chattopadhyay (2007) formulated a feed forward Artificial Neural Network model to predict the average summer-monsoon rainfall in India. In formulating the ANN based predictive model, three-layer network has constructed with sigmoid non-linearity. The monthly summer monsoon rainfall totals, tropical rainfall indices and sea surface temperature anomalies have considered as predictors while generating the input matrix for the ANN. The data pertaining to the years 1950–1995 have explored to develop the predictive model. Finally, he compared the prediction performance of neural net with persistence forecast and Multiple Linear Regression forecast and the supremacy of the ANN established over the other processes.In the same year Kumar et al. have presented an Artificial Intelligence approach for regional rainfall forecasting for Orissa state, India on monthly and seasonal time scales. They have employed an Artificial Neural Networks (ANNs) methodology to handle the highly non-linear and complex behavior of the climatic variables for forecasting the rainfall. Genetic Optimizer (GO) was used by them to optimize the ANN architecture. [14] In another research Chattopadhyay et al. (2007) developed an ANN model step-by-step to predict the average rainfall over India during summer-monsoon by exploring the data available at the website (http://www.tropmet.res.in). To develop this model, the monsoon months (June-August) data of year y have used to predict the average monsoon rainfall of year (y+1). They have used 75% of the available data as training set and remaining 25% as test set. The model was trained up to 50 epochs. The learning rate parameter was fixed at 0.4 and the momentum rate was chosen 0.9. Finally, they have compared the performance of the neural net model with conventional persistence forecast and found that the Neural Net, in the form of Multilayer Perceptron was adroit in the prediction of monsoon rainfall over India.

[15]Chattopadhyay and Chattopadhyay (2008a) constructed an ANN model to predict monsoon rainfall in India depending on the rainfall series alone. They have developed nineteen neural network models with variable hidden layer size. Total rainfall amounts in the summer monsoon months of a given year used as input and the average summer monsoon rainfall of the following year used as the desired output to execute a supervised back propagation learning procedure. After a thorough training and test procedure, a neural network with eleven nodes in the hidden layer was found to be the most proficient in forecasting the average summer monsoon rainfall of a given year with the said predictors. Finally, they have compared the performance of the eleven hidden- nodes three- layered neural network with the performance of the asymptotic regression technique. Ultimately they have concluded that the eleven-hidden-nodes three-layered neural network has more efficacy than asymptotic regression in the present forecasting task.

[16]Hung et al. (2008) employed an Artificial Neural Network model to forecast rainfall for Bangkok, Thailand with lead times of 1 to 6h. A real world case study was set up in Bangkok; 4 years of hourly data from 75 rain gauge stations in the area were used to develop the ANN model. Ultimately, they have applied the developed ANN model for real time rainfall forecasting and flood management.

[17]In 2009 Xinia et al. have proposed a new model based on empirical mode decomposition (EMD) and the RBF neural network (RBFN) for rainfall prediction. After simulation they have concluded that the method had a high accuracy in denoising and prediction of the rainfall sequence.

[18]Karmakar et al. (2009) have developed a three layer perception feed forward back propagation deterministic and probabilistic artificial neural network models to predict long- range monsoon rainfall over the subdivision EPMB. 61 years data for 1945-2006 have used, of which the first 51 years (1945-1995) of data were used for training the network and data for the period 1996-2006 were used independently for validation. However they have found that the performance of the model in probabilistic forecast was better evaluated over deterministic forecast.

[19]In a Case Study on Jarahi Watershed, Solaimani (2009) has studied Rainfall-runoff Prediction Based on Artificial Neural Network and he concluded that Artificial Neural Network method is more appropriate and efficient to predict the river runoff than classical regression model.

[20]Chadwick et al. (2011) employed an artificial neural network approach to downscale GCM temperature and rainfall fields to regional model scale over Europe [43]. A novel modular-type Support Vector Machine (SVM) have presented by Lu and Wang (2011) to forecast monthly rainfall in the Guangxi, China. Ultimately, they have showed that the prediction by using the SVM combination model was generally better than those obtained using other models presented in terms of the same evaluation measurements. The authors strongly believed that it could be used as an alternative forecasting tool for a Meteorological application in achieving greater forecasting accuracy and improving prediction quality further.

[21]El- Shafie et al. (2011) have developed two rainfall prediction models i.e. Artificial Neural Network model (ANN) and Multi Regression model (MLR) and implemented in Alexandria, Egypt. They have used statistical parameters such as the Root Mean Square Error, Mean Absolute Error, Coefficient Of Correlation and BIAS to make the comparison between the two models and found that the ANN model shows better performance than the MLR model.

[22]A committee of artificial neural networks (ANNs) based model with wavelet decomposition was proposed by Charaniya et al. (2011) for prediction of monthly rainfall on accounts of the preceding events of rainfall data. Wavelet transform was used for extraction of approximate and detail coefficient of the rainfall data series. These coefficients were used along with a ANN for learning and knowledge extraction processes. They have tested the model on rainfall data for different geographical region of India and also for entire country and found that the proposed model was capable of forecasting monthly rainfall one month in advance.

[23]El-Shafie et al. (2011) compared and studied two different static neural networks and one dynamic neural network namely; Multi-Layer Perceptron Neural network (MLP-NN), Radial Basis Function Neural Network (RBFNN) and Input Delay Neural Network (IDNN), respectively. Those models had been developed for two time horizon in monthly and weekly rainfall basis forecasting at Klang River, Malaysia. Ultimately, they concluded that IDNN could be suitable for modeling the temporal dimension of the rainfall pattern, thus, provides better forecasting accuracy.

[24]Geetha and Selvaraj (2011) developed a back propagation neural network model for rainfall prediction in Chennai, India. The mean monthly rainfall was predicted by them using that model. The model can perform well both in training and independent periods.

[25]Maitha ,Ali,Hejse(2011) developed a model for the prediction of Global Solar Radiation(GSR) in Al Ain city, UAE. They also developed scripts use built-in commands and functions for customizing data processing network architecture, training algorithms and testing performance of the ANN models which is more efficient. They have work where, MATLAB tools are used to predict average global solar radiation in A1 Ain City, UAE, weather data between 1995 & 2004 are used for training the neural network, while data between 2005 & 2007 are used for testing. Eleven models with different input combination are modelled with Multi Layer Perception (MLP) and Radial Based Function(RBF) Artificial Neural Network(ANN) techniques. The obtained results confirm the superiority of the RBF technique over MLP technique in most of the cases. Currently their focus is on modelling the GSR for UAE cities and comparing the optimal ANN models with classical empirical regression and time series regression models.

[26] In 2011 Santhanam,& Subhajini published a paper with details as BPN and RBF are trained with sample of six hundred patterns. The performance of the RBF is compared with performance of the BPN for weather forecasting. The training of RBF is faster compared that of BPN. The classification to predict rainfall is enhanced by RBN. To experiment the proposed system a sample dataset is taken from metrological department. These data sets contain real time observation of the weather for a particular period of time. For this experiment, an observation of the complete previous ten year of data is collected from meteorological department, Kanya kumari District. The data set contain many attribute. The basic input data for classification needs preprocessing and the above attributes are processed for weather forecasting using BPN and RBF classification Improvement of classification accuracy in weather forecasting is an important issue. The factors temperature, air pressure, humidity, cloudiness, precipitation, wind direction wind speed of weather forecasting are consolidated from meteorological experts. RBF are trained with samples and outputs are namely no rain and rain. Neural network has gained great popularity in weather prediction because of their simplicity and robustness. In this study, the performance of back propagation neural network (BPN) and radical basis functioned neural network (RBF) is compared. Back propagation algorithm is too time consuming and the performance is heavily dependent on the network parameters. Compared to BPN, RBF gives the overall best results in terms of accuracy and fastest

training time. RBFN are much faster and more reliable for the weather forecasting. These proportions make it more effective for fast real time weather forecasting.

[27]Dr.Santosh & I.Kadar(2012) develop a models that has potential to capture the complex relationships between many factor that contributes to certain temperature. Their method is more efficient than the numerical differentiation. They implements the neural network based algorithm Back propagation technique which can fairly approximate a large class of functions and Back propagation based weather forecast have shown improvement not only over guidance forecasts from numerical models, but over official weather service forecasts as well. Through the implementation of this system, it is illustrated how an intelligent system can be efficiently integrated with a neural network prediction model to predict the temperature. This algorithm improves convergences and damps the oscillations. This method proves to be a simplified conjugate gradient method. This approach is able to determine the non-linear relationship that exists between the historical data(temperature, wind speed, humidity, etc)supplied to the system during the training phase and on that basis, make a prediction of what the temperature would be in future.

[28]In the same year 2012 Kadu,Wagh,Chatur brought out a paper that contains a proposed approach of Artificial neural network that uses analysis of data and learn from it for future predictions of temperature, with the combinations of wireless technology and statistical software. Also a review of applications of artificial neural network in weather forecasting area including some limitations and some proven benefits of neural networks are discussed. Accurate weather forecasting has been one of the most challenging problems around the world. Provides an overview of the various models of weather forecasting a& a proposed model of temperature prediction which uses new wireless technology for data gathering with the combination of statistical software. We can extend our efforts by predicting other parameters of weather which can be used for weather forecasting.

[29]Another approach by Ch.Jyotsana,Syam Prasad ,Vagdhan Kumar,BMusala & N.Raja(2012) using the backpropogation where a neural network based algorithm for predicting the temperature is presented. A neural network can learn complex mappings from inputs to outputs, based solely on samples and require limited understandings from trainer,who can be guided by heuristics. The results are compared with practical working of meteorological department and these results confirm that these model have the potential for successful application to temperature forecasting. A 3-layered neural network is designed and trained with the existing dataset and obtained a relationship between the existing non-linear parameters of weather. Now the trained neural network can predict the future temperature with less error.

[30]Chao Xi ,Erihe did a case study in the year 2013 In which this paper presents research on weather forecasts through the historical database which implemented in the local weather station at Telemark University College. Due to non-linearity in climatic physics, neural networks are suitable to predict these meteorological processes. Back propagation using gradient descent method is the most important algorithm to train a neural network for weather forecasting. The neural network training was done using MATLAB and back propagation method was also programmed by MATLAB. The main objective here is to use neural network topologies to predict hour by hour temperature in one or several days based on the historical weather data. The simulation results show the training algorithm performs well in the process of convergence characteristics and improve the convergence rate, a satisfactory approximation.

5. Conclusion

This paper reports a detailed survey on forecasting weather using different neural network architectures and techniques over twenty to thirty years. From The survey after several analysis it has been found that most of the research fellow has used Neural Network Back Propagation(BPN) said that the forecasting weather system can be efficient with the help of Neural Network Back propagation method and by the execution of this forecasting system it is demonstrated that how can an intelligent system be resourcefully combined with a neural network prediction model to predict the status of weather. Back propagation neural network approach for weather forecasting is capable of yielding good results and can be considered as an alternative to traditional meteorological approaches. This approach is able to determine the non-linear relationship that exists between the historical data (min temperature & max temperature, Humidity, rainfall) supplied to the system during the training phase and on that basis, need to make a prediction of status of the weather would be in future. Moreover we can conclude that for more accurate prediction we should have the maximum training data and more parameters. Also we came to see how far the advancement of technology has been come across and such that even the non-linearity of weather parameters can be easily computed and give the optimum results. However some limitations of these methods has also been found. The provided references remain as the support of the different developments of ANN researchers to efficiently predict the weather status in upcoming future.

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7. References

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