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Rainfall Prediction for Solapur City (Maharashtra State) Using Artificial Neural Networks (ANN)

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Abstract: ***Predictive rainfall data is extremely important in fields where rainwater is primarily used for crop irrigation. In this study attempt has been made to predict rainfall of Solapur city, Maharashtra state. The rainfall data from 2010 to 2019 was collected. The length of the training data set varied from 70% to 90%. The study evaluates the performance of Artificial intelligence and its applicability to rainfall prediction modelling specifically applied to Solapur city. Computational networks with biological inspiration are called artificial neural networks (ANNs). Among the various types of ANNs , in this study, We focused on learning methods for feed-forward back propagation. The most popular ANNs, which can be used for a wide range of problems comprise three layers: input, hidden, and output, which are based on a supervised process. The outcome suggest that the artificial neural networks (ANNs) prediction model demonstrate satisfactory accuracy.***
Keywords*: Artificial Neural Network, Rainfall Prediction, Humidity, Temperature, Wind Speed, Back Propagation Algorithm.*

I. INTRODUCTION

Rainfall is the total amount of precipitation, either on land or in water, that falls to Earth's surface as rain (water from clouds). It appears when air masses pass over moist land surfaces or warm bodies of water. The moisture, or water vapor, is carried upward into air masses by atmospheric turbulence and convection, where it condenses as clouds. This water vapour ultimately gets released by the clouds and falls as rain. The amount of water vapor in the air is what decides its humidity. The gaseous form of water, known as water vapor, is usually invisible to the naked eye. The chance of precipitation, dew, or fog can be determined by humidity. Wind pressure and temperature have an impact on humidity. Essentially wind speed is the amount of air pressure that passes from a high point to a low point, typically as a result of temperature variations. The measurement of heat or cold, stated in terms of numerous scales, such as Celsius and Fahrenheit, is known as temperature. The direction that the wind is blowing and the direction that the air is traveling is known as the wind direction. It is not the direction in which the wind is flowing. Any kind of weather where something is falling from the sky, such as rain, snow, sleet, or hail, is considered precipitation. There is more to precipitation than mere particles falling from the sky.

A. Artificial Neural Networks Approach

An artificial intelligence (AI) engineering idea defined as the artificial neural network (ANN) was developed by utilizing the human nervous system. Whereby the brain's nerve cells the fundamental building block of information processing make up the majority of the nervous system's processing in humans. Neurons are the fundamental information processing units in the notion of artificial neural networks (ANNs).

They process information instantly and in parallel. Also, there are further forms and applications for the ANN training process, such as Perceptron's, Backpropagation. An artificial neural network is a network of interconnected nodes that was created by simplifying the framework of neurons in the brain. An arrow indicates a connection between the input of one artificial neuron and the output of another in this instance, and each circular node represents an artificial neuron. Artificial neurons, which resemble neurons in a biological brain somewhat, are a group of interconnected units or nodes that form the foundation of an ANN. Similar to the synapses in a living brain, every link has the ability to communicate with other neurons. After getting and analysing signals, an artificial neuron can communicate with other neurons in its network. Each neuron's output is determined by a non-linear function of the sum of its inputs, and the "signal" at a connection is a real number. We refer to the links as edges. Generally, the weight of neurons and edges alters during the learning process. The signal strength at a connection is affected by the weight. Neurons are generally arranged into layers. It is possible for different layers to alter their inputs in different ways. Signals may pass through the layers more than once before arriving to the last layer, which is the output layer, from the first layer, which is the input layer. If a network includes two or more hidden layers, it is usually referred to as a deep neural network.

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B. The Climate of Solapur City

The centre experiences 44 wet days and 735 mm of annual rainfall on average. The rainy season lasts for 20 weeks, starting in the third week of June and finishing in the second week of November. There is a range of 194 mm to 1147 mm in the monsoon seasonal rainfall, with an average of 545 mm from June to September. Peak rainfall falls in the last week of September. The last week of December has a daytime variation in temperature of 29.8°C, while the first week of May has a night-time temperature change of 13.3°C, the third week of December, and 25.0°C (first and second weeks of May). Tropical cyclones are headed for Solapur. With two intensity peaks before and after the monsoon (in late April to early June and in October–November), cyclones typically occur from April to December. The city is not impacted by cyclones at full intensity because we are away from the coast, yet they may still bring significant amounts of rainfall.

II. METHODOLOGY

A. Study Area

In this study rainfall prediction for Solapur was carried using ANN model . The geographic coordinates of Solapur are 17.68°N 75.92°E. It is situated at an average elevation of 1502 feet, or 458 meters from the mean sea level . The districts of Ahmednagar to the north and Osmanabad to the north and northeast encircle it. The Koppen climate classification places Solapur in the dry (arid and semiarid) climate category. There are three distinct seasons in the city: summer, monsoon, and winter. March through May are considered the typical summer months, with highs of between 30 and 45 °C (86 and 113 °F). May and April are Solapur's warmest months. The maximum temperatures typically reach 40 °C (104 °F) or higher. May 1988 recorded the hottest temperature ever measured, which was 46.0 °C (114.8 °F).

B. Data Collection

The rainfall prediction is carried using temperature, wind speed and humidity as input variable and rainfall is taken as output variable as shown in table no 2 and all the data is obtained from online web sites of government and Wikipedia. The data is used from 2010 to2019 monthly rainfall in Solapur district. Data used for prediction of rainfall in Solapur city the sample data is shown in table no 1. For ANNs, 10 years data set is selected and then for training and testing data is sub divided to get best results

Table 1 . Input Data

Year	Month	Humidity (%)	Wind speed (km/hr)	Temperature (Celsius)
2010	January	60	0.9	32.2
2010	February	56	2.4	33.9
2010	March	38	2.9	38.1
2010	April	42	3.2	38.9
2010	May	51	3.5	39.6
2010	June	77	4.9	34.5
2010	July	83	3.9	31.7
2010	August	84	3.5	31.2
2010	September	80	3.6	32.2
2010	October	74	2	33.2
2010	November	62	2	32.8
2010	December	62	1.7	32.2

Table 2. Input And Output Variables

Input variables	Output
Temperature	Rainfall
Humidity	
Wind speed	

C. ANN Model

In this ANNs model multiple iteration has been done to get to know which network shows best result. For training the ANN network feed-forward backprop algorithm was used. In this study ANNs model TANSIG & PURELIN this two-transfer function are used and is presented in Fig 2. The 10 years data is used for the ANNs model and further it is sub-divided for training and testing. The architecture of ANNs is given in Fig 1.

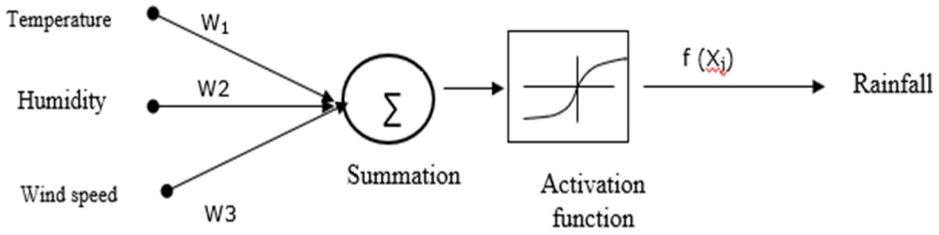


Fig. 1. Structure of Artificial Neuron

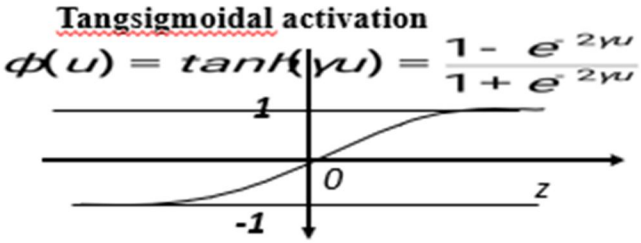
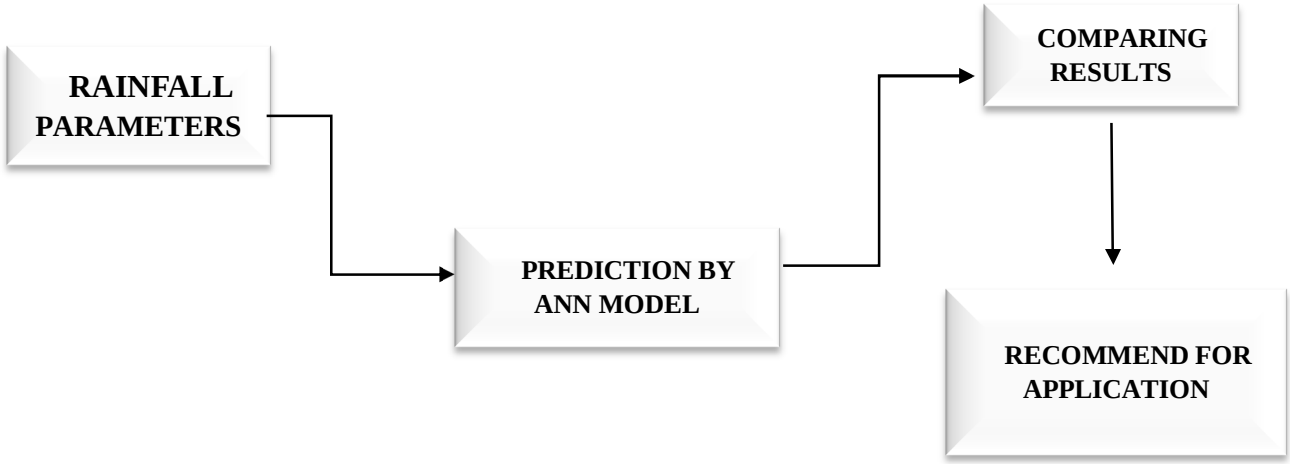


Fig. 2. Transfer Function

D. Methodology

Following methodology is used for the prediction of rainfall



Flowchart Of Methodology

III. RESULTS AND DISCUSSION

In this study multiple iteration is done to get best result Total data is used of past 10 years and it is sub-divided for training and testing as shown in table no 3. The data used for training is 7 years; 8 years; 9 years respectively and for testing the same reaming data is used 3year; 2year ;1 year respectively.

Table 3. Training and Testing 10 Years Data

Training	Testing
7 yeas	3 years
8 years	2 years
9 years	1 years

In this ANNs model TANSIG & PURELINT this two-transfer function are used. Using the MATLAB ‘ nntool’ command prediction of the rainfall is done and multiple iteration is carried out to know which network is suitable for the prediction of rainfall and gives best results .

In the following table no 4 the number of hidden neurons and transfer function used is shown.

Table 4 .Neurons And Transfer Function

Data Training	Number of Neurons	Transfer Function
7 yeas	90	TANSIG
8 years	10	TANSIG
9 years	100	TANSIG & PURELIN

The network is trained until the R square vale is near to 0.999 or 1 . The results of training and testing as shown in following fingers no 3 to 8.

A. Training Data 70% And Testing Data 30% .

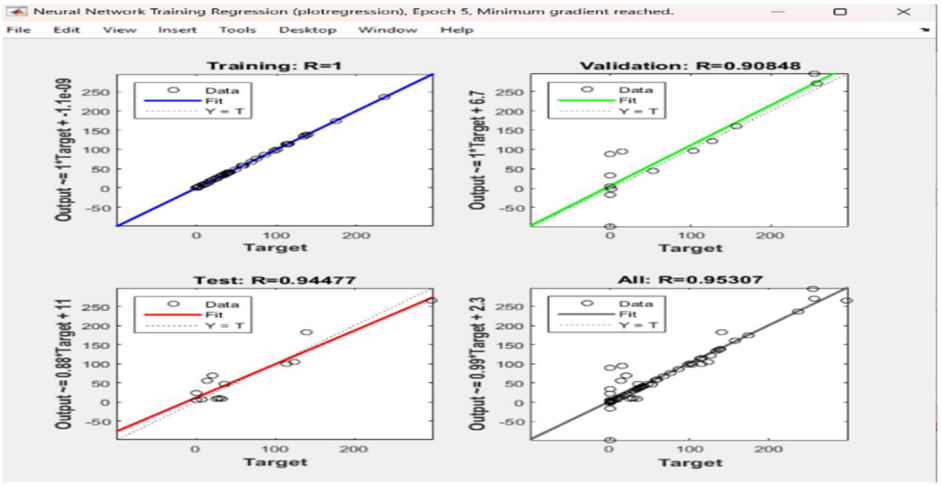


Fig. 3 Plot Regression of 70% data

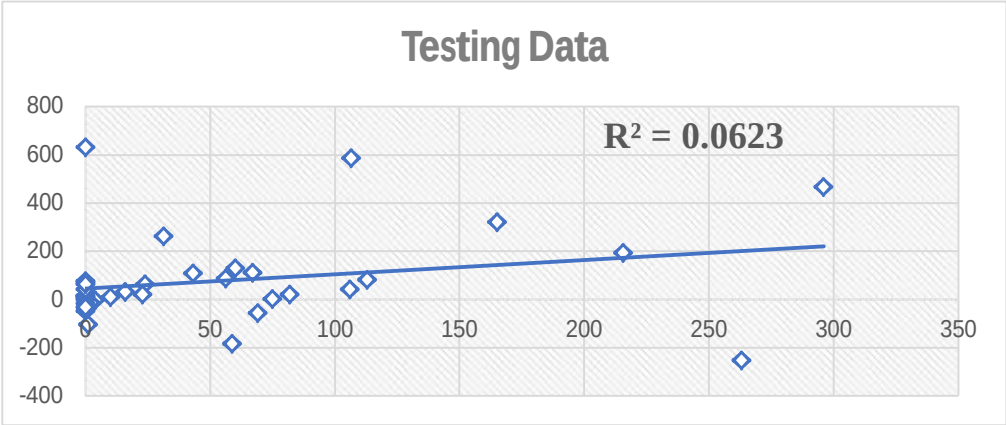


Fig. 4 Coefficient Of Determination

B. Training Data 80% And Testing Data 20%

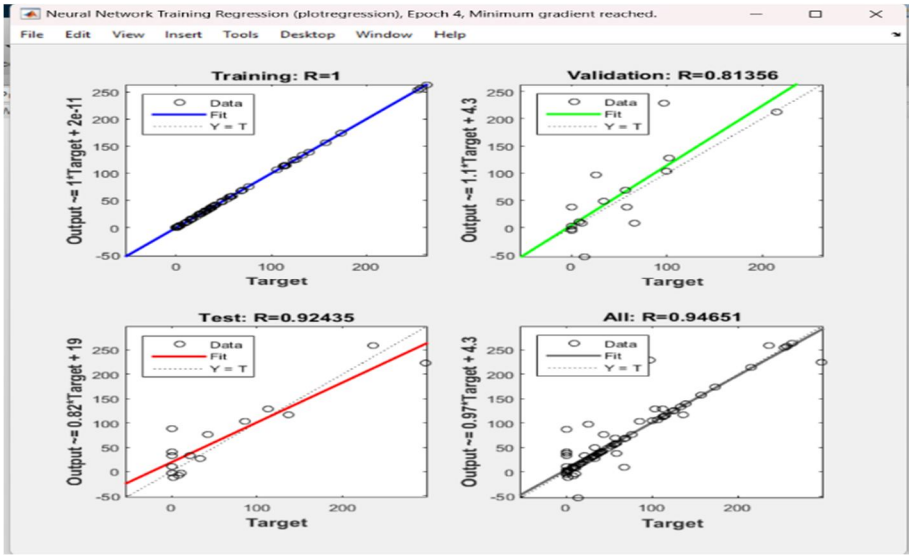


Fig. 5 Plot Regression of 80% data

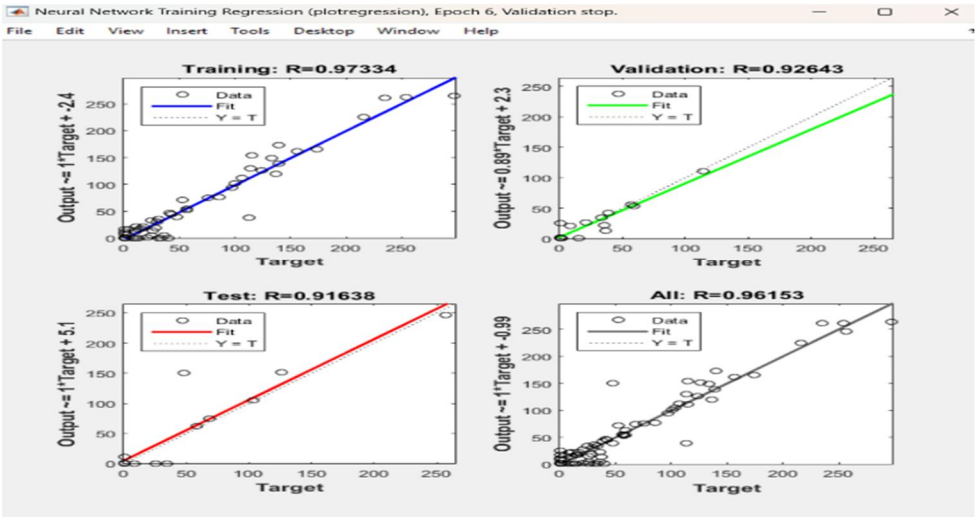


Fig. 6 Coefficient Of Determination

C. Training Data 90% And Testing Data 10 %

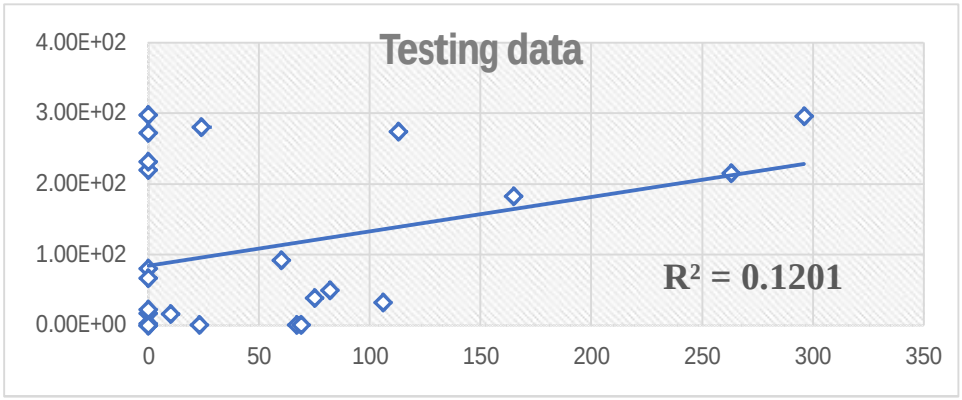


Fig. 7 Plot Regression of 90% data

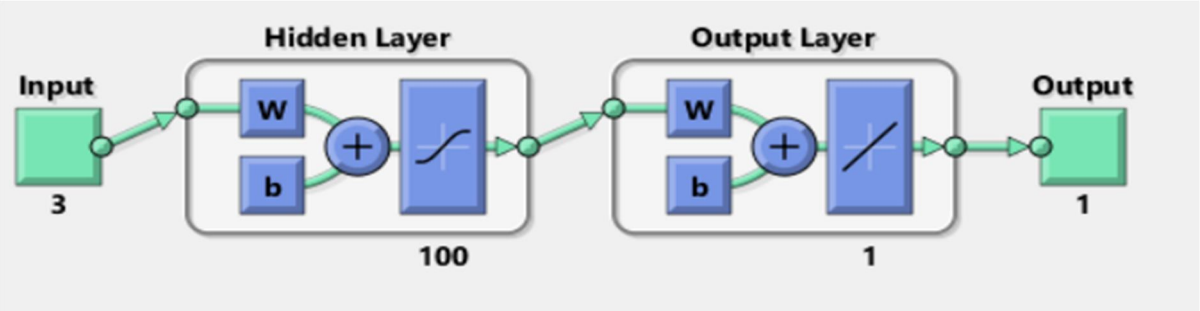


Fig. 8 Coefficient Of Determination

These are the results obtained from the MATLAB after training and testing the network. Coefficient of determination value is obtained from comparing the test results with the past data in excel.
The network is used is given below in fig no 9

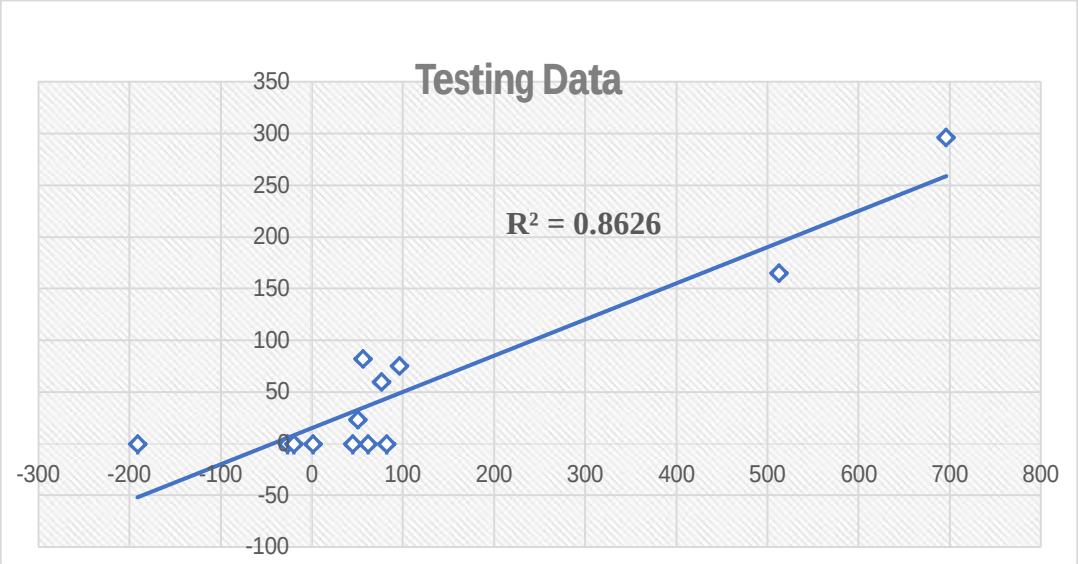


Fig. 9 ANN Network
Comparing the all 3 results and selecting the best from the below table no 4.

Table 5 Results Obtained

Data Training	Number of Neurons	Transfer Function	R^2 Value
7 yeas	90	TANSIG	0.0623
8 years	10	TANSIG	0.1201
9 years	100	TANSIG & PURELIN	0.8626

Table 6. Results Obtained from Plot Regression

Data	R Value Plot Regression Training	R Value Plot Regression Testing
7 yeas	1	0.944
8 years	0.97	0.91
9 years	1	0.92

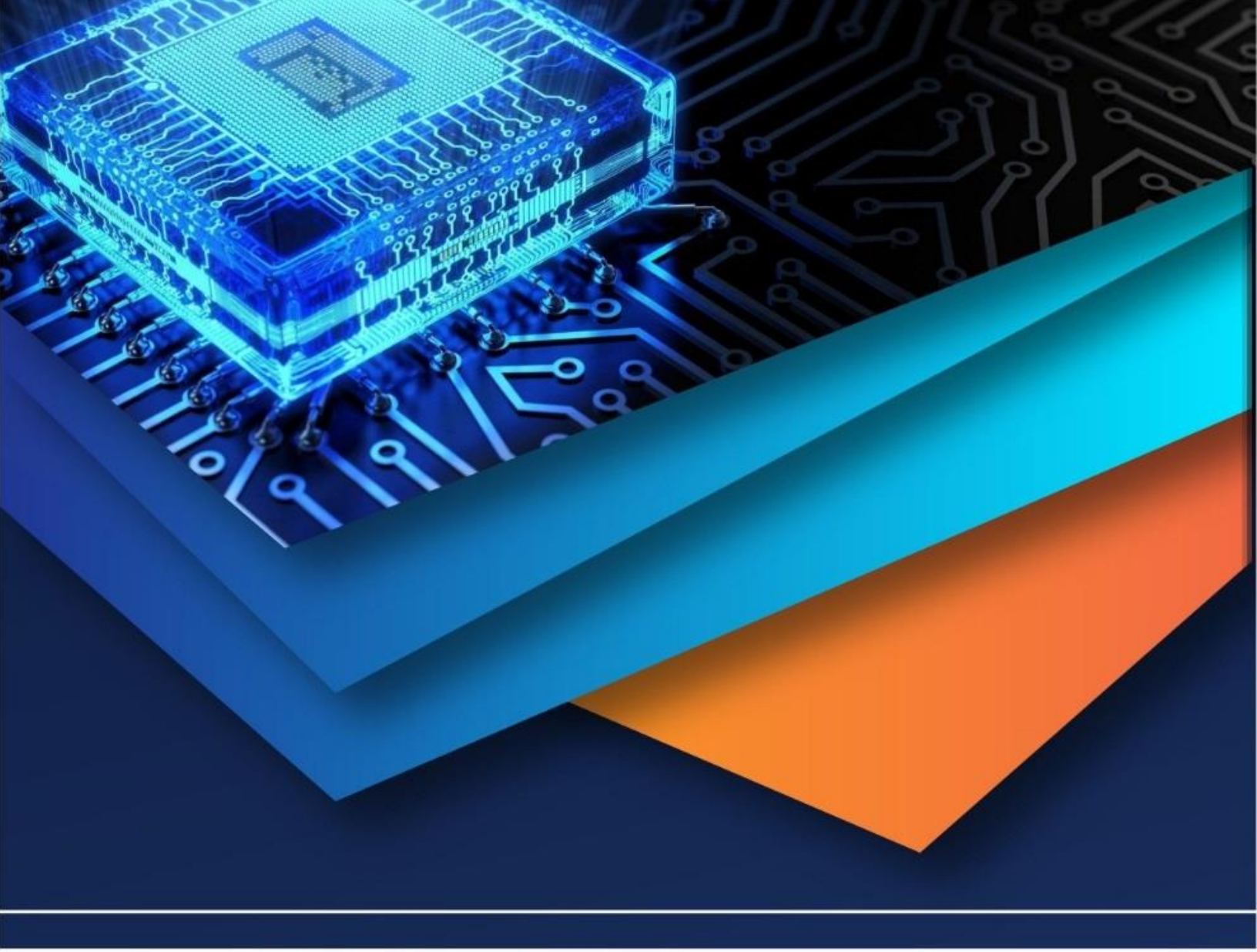
This are the results obtained after training the network and data is used of Solapur city from 2010 to 2019.

IV. CONCLUSION

Predictive rainfall data is extremely important in fields where rainwater is primarily used for crop irrigation. In this study attempt has been made to predict rainfall of Solapur city, Maharashtra state. The rainfall data from 2010 to 2019 was collected. The length of the training data set varied from 70% to 90%. The study evaluates the performance of Artificial intelligence and its applicability to rainfall prediction modelling specifically applied to Solapur city. The conclusion of the study is as follow, the best results are obtained from where the transfer function in layers TANSIG & PURELIN are used and number of neurons are used is 100. For training the ANN network feed-forward back-propagation was used and it gives the acceptable results. After comparing all the results, the acceptable R^2 value obtained is 0.8626.

REFERENCES

[1] Dr S. Santosh Baboo and I. Khadar Shareef, "An efficient Weather Forecasting Model using Artificial Neural Network", International Journal of Environmental Science and Development, Vol. 1, No. 4, October 2010.
[2] E.Toth, A.Brath, A.Montanari," Comparison of short-term rainfall prediction models for real-time flood forecasting", Journal of Hydrology 239 (2000) 132–147
[3] Enireddy Vamsidhar et. al.,"Prediction of rainfall Using Back propagation Neural Network Model", International Journal on Computer Science and Engineering Vol. 02, No. 04, 2010, 1119-1121
[4] K C Luk, J E Ball, A Sharma, "An Application of Artificial Neural Networks for Rainfall Forecasting".
[5] Dr S. Santosh Baboo and I. Khadar Shareef, "An efficient Weather Forecasting Model using Artificial Neural Network", International Journal of Environmental Science and Development, Vol. 1, No. 4, October 2010.
[6] M. Zhu, M. Fujita and N. Hashimoto, "Application of Neural Networks to Runoff Prediction," In: K. W. Hipel, et al., Eds., Stochastic and Statistical Method in Hydrol- ogy and Environmental Engineering, Vol. 3, Kluwer, Dordrecht, 1994, pp. 205-216.
[7] K. P. Sudheer, A. K. Gosain and K. S. Ramasastri, "A Data Driven Algorithm for Constructing Artificial Neural Network Rainfall-Runoff Models," Hydrological Proc esses, Vol. 16, No. 6, 2002, pp. 1325-1330.
[8] K. Hsu, H. V. Gupta and S. Sorooshian, "Artificial Neural Network of the Rainfall-Runoff Process," Water Resourc- es Research, Vol. 31, No. 10, 1995, pp. 2517-2530.
[9] A. Sarkar, A. Agarwal and R. D. Singh, "Artificial Neural Network Models for Rainfall-Runoff Forecasting in a Hilly Catchment," Journal of Indian Water Resources Society, Vol. 26, No. 3-4, 2006, pp. 1-4.
[10] Kyaw Kyaw Htike and Othman O. Khalifa, "Research paper on ANN model using focused time delay learning", International Conference on Computer and Communication Engineering (ICCCE 2010), 11-13 May 2010, Kuala Lumpur.
[11] Abhishek, K., et al., A Rainfall Prediction Model using Artificial Neural Network. 2012 IEEE Control and System Graduate Research Colloquium (ICSGRC 2012), 2012.
[12] Charaniya, N.A. and S.V. Dudul, Design of Neural Network Models for Daily Rainfall Prediction. International Journal of Computer Applications, 2013. **61**(14, January 2013): p. 23-26.
[13] Paras, Sanjay Mathur, Avinash Kumar, and Mahesh Chandra, "A feature based on weather prediction using ANN"World Academy of Science, Engineering and Technology 34 2007
[14] Haviluddin and R. Alfred, Daily Network Traffic Prediction Based on Backpropagation Neural Network. Australian Journal of Basic and Applied Sciences, 2014. **8(24)**(Special 2014): p. 164-169.
[15] Ben Krose and Patrick van der Smagt , "An introduction to neural networks", Eighth edition, November 1996.
[16] Abdulkadir, T., Salami, A. and Kareem, A. (2012). Artificial Neural Network of Rainfall in Ilorin, Kwara State, Nigeria, USEP Research information in Civil Engineering, 9, pp. 108-120.
[17] Johnson, J.A., Assesing Impact of Climate Change in Borneo. World Wildlife Fund's Enviromental Economic, 2012.
[18] D N Kumar, M J Reddy, R Maity, "Regional Rainfall Forecasting using Large Scale Climate Teleconnections and Artificial Intelligence Techniques", Journal of Intelligent Systems, vol 16, no 4, pp. 307 – 322, 2007
[19] Michaelides, S. C., Neocleous, C. C. & Schizas, C. N. "Artificial neural networks and multiple linear regression in estimating missing rainfall data." In: Proceedings of the DSP95 International Conference on Digital Signal Processing, Limassol, Cyprus. pp 668–6731995.
[20] A. M. Kalteh, "Rainfall-Runoff Using Artificial Neural Networks (ANNs) and Understanding," Caspian Journal of Environmental Science, Vol. 6, No. 1, 2008. pp. 53-58



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