Overwhelming Flow of Water using Machine Learning Techniques

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Abstract: ***Floods are rare and dangerous disaster in minimum duration, which have the most destructive impact within urban and rural areas. This research in flood prediction models contributed to risk reduction, to prevent the loss of human life, and reduce the property of damage in floods. This study implements the automated machine learning models, using the Support Vector Machine (SVM) and Artificial Neural Network (ANN). The rainfall data and various meteorological parameter which include temperature data are used in this study. Concurrent daily records of inflow and discharge are taken into consideration to calculate the water level to quantify the importance of the lake flow. It aims to discovering accurate and efficient for the flood forecasting model. This paper attempts to forecast flood by modelling water level, temperature and rainfall data in the region of Korattur lake, Chennai, India. In this study, ultrasonic sensor used to capture the measurement of water level to predict from ultrasonic waves and input of same implemented in BPNN and Support Vector Machine (SVM) were used for flood forecasting. The water level flow is deducted in this research using ultrasonic sensor, proves the best efficient models applied for flood forecasting. This study can be used as a predicting the flood by choosing the proper Machine Learning (ML) algorithm such as Support Vector Machine (SVM) and Artificial Neural Network (ANN) algorithm for showing higher accuracy. To get more accurate result of the models, three standard statistical performance evaluation parameters, Root Mean Square Error (RMSE), Mean Absolute Error (MAE) and coefficient of determination (R^2) were used to analyse the performance of the model developed. As a result, the proposed model proves the most efficiency and accuracy for predicting the flood forecasting.***

Keywords**:** ***ultrasonic waves, metrological parameter, ultrasonic sensor***

I. INTRODUCTION

Flood are the most dangerous disaster to the people and nature. Floods occur every year in every part of India. In southern India, they have terrible flood by the rise of water in the rivers. Floods make many people lose their resources and destroy crop in the fields and cause famine. To prevent the flood, many methods are taken from the government. Some steps are derived from technical aspects. With the evolution of computer developing computation model for the purpose of flood forecasting become more accurate. In this paper, the study on Artificial Intelligence (AI) in Machine Learning (ML) helps to predict the flood forecasting. Machine Learning has the ability to adapt to new circumstance and to detect and recognize pattern. The scope of this research is applied on application of machine learning in artificial intelligence. Today's major flood prediction models are mainly data-specific and include various simplified assumptions. There are numerical weather prediction model have improved their performance, but they are not unable to provide accurate models for expected resolution. A comparison of Machine Learning (ML) techniques Artificial Neural Network (ANN) and Support Vector Machine (SVM) has been taken into consideration to predict the flood forecasting for higher accuracy. In recent years, Artificial Neural Network (ANN) is the main algorithm of Machine Learning (ML) has widely used in developing the predictive models. ANN is a subset of machine learning. ANNs are used in prediction, classification and clustering. Another main algorithm of machine learning is Support Vector Machine (SVM). This technique for classifying and regression and also employs a hyper plan to separate data points. Machine learning algorithms have important characteristics that need to be carefully taken into consideration. Finally, the effective algorithm to build the classification model and the most influential attributes for flood detection were defined.In this paper, weather related historical year wise data of Chennai district in South India are provided. To Predict the flood, water flow is an important aspects of water resources management. This water flow considering inflow and discharge of the river data are collected. The temperature and humidity data have chosen to determine the atmospheric stability.

The objectives are

- The main objectives of this research is to analyse the flood forecasting from the Red hills lake,Chennai. In details, Artificial Neural Network (ANN) and Support Vector Machine (SVM) model are being initiated.
- The proposed study is used to determine the water level using ultrasonic sensor. This technology helps to predict flood through ultrasonic waves. This system analysed to measure the performance evaluation for better accuracy in flood prediction.
- The systematic approach has developed to detect water level from ultrasonic sensor and the same compared and validated using ANN and SVM model.

II. LITERATURE REVIEW

A thorough study of several paper based on the Artificial Neural Network (ANN), Support Vector Machine (SVM) and Back Propagation (BP) algorithm to understand the

Revised Manuscript Received on December 30, 2019.
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prediction of flood in machine learning using artificial intelligence. In [1], Active Learning Method (ALM) is compared with Support Vector Machine (SVM) to predict long term simulation of daily stream flow in river. The daily discharge data were utilized for training and testing of the models. It results SVM is a well-known method for run-off simulation and its capabilities have been demonstrated. In [2], aimed to forecast the River Nile in Sudan using an Artificial Neural Network (ANN). This model validates the accuracy against the actual flow. This analysis indicates that ANN provide a reliable flood detecting in the River Nile. In [3], authors explore of machine learning methods for flood forecasting in river. This analysis based on several machine learning algorithm and set of upstream and downstream flood was tested. Its results Bayesian Linear model used for forecasting of extreme flood events. In [4], authors present the knowledge of current and emerging trends in Artificial Neural Network (ANN) application research. This paper proposed feed forward and feedback propagation ANN model for research based on data analysis like accuracy, performance, volume, convergence and processing speed. In [5], authors have proposed a two-level approach for clustering large data set for rainfall data prediction with Support Vector Machine (SVM). In this approach perform well direct clustering and to reduce the computation time.In [6], authors have proposed Artificial Neural Network (ANN) are component to improve rainfall forecast. This technique was used to provide more monthly rainfall forecast and it has an application where there is temperature and rainfall data.In [7], authors propose a deep learning approach by integrating Stacked Auto Encoders (SAE) and Back Propagation Neural Network (BPNN) for the prediction of stream flow. This experiment research result in SAE-BP integrated algorithm perform much better. In [8], Artificial Neural Network (ANN) model were applied in River to forecast the flood. The observation of data were river-stage and rainfall are validated since the river-stage observation has started. The input and output data of the neural network in river-stage predicted that it has very good accuracy.In [9], authors describe Artificial Neural Network (ANN), feed-forward back propagation networks, radial basis network used for modelling the stream flow. This result ANN has the capacity to forecast the stream flow of the river and hydrological parameters are difficult to obtain.In [10], authors propose a flood forecasting model is present that exploits the real time information and to predict the water-level evolution. Accurate prediction is obtained using a two-year data set of input data. It results, as per the flow-rate increase in the data, the accuracy of prediction increases. In [11], Linear Least Square and Simplex optimization (LLSSIM) is used to examine the ability of a three-layer feed forward Artificial Neural Network (ANN) to apply in various climate regimes. In this ANN model capable of simulating well the daily high and low flows and validating pseudo-precipitation.In [12], here the Average Mean Square Error (AMSE) for each kernel is evaluated and the kernel having minimum Mean Square Error (MSE) is selected for rainfall prediction. It results in Support Vector Machine (SVM) model is polynomial kernel and has low MSE among alIn [13], authors propose Artificial Neural Network (ANN) model for the prediction of flooding in Nigeria using deep feed-forward neural network. The dataset was used to train the network using the back-propagation algorithm. This result in average accuracy of the model in flood prediction.In [14], Dynamic Regression Model which is statistically based model for historical flows and climate data of the basin to generate a forecast. Artificial Neural Network (ANN) model for river flow forecasting and also considered two ANN model which is General Regression Neural Network (GRNN) and Back Propagation Neural Network (BPNN).In [15], Feed Forward Neural Network (FFNN) model is used to prediction rainfall data. The input layer indicates the past values and the output layer indicates the current values. Back propagation algorithm is applied in training and validating process. The prediction result be evaluated in Least Mean Square Error (LMSE).

III.DATA COLLECTION

The table predicts the average rainfall in the years

YR	A.R: JUL	A.R: AUG	A.R: SEP	A.R: OCT	A.R: NOV	E.R: JUL	E.R: AUG	E.R: SEP	E.R: OCT	E.R: NOV
1901	155.8	191.5	138.4	137.1	622.9	-1.7	-10.1	-18.5	-15.1	-11.4
1902	118.9	214.4	159.7	193.7	686.7	-25.3	0.2	-6.2	19.9	-2.6
1903	141	300.2	206.2	212.5	859.9	-12	39.6	20.7	31.3	21.5
1904	191.9	191.4	89.5	130.6	603.5	19.4	-11.1	-47.6	-19.3	-14.9
1905	153.5	120.6	187.6	99	560.6	-4	-43.1	10.4	-38.6	-20.3
1906	174	219.9	221.8	110.8	726.5	8.6	3.1	30.7	-31.3	3.1
1907	184.8	206.3	216.3	129.3	736.8	14.7	-4	26.5	-20.1	3.9
1908	125	240.1	155.1	247.6	767.7	-22.7	11.6	-9.1	53.3	8.3
1909	157.3	227.5	196	148.2	729	-2.1	6.3	15	-8.2	3.2
1910	180	211.1	209.4	172.8	773.4	12.2	-2	22.5	6.5	9.1
1911	189.6	191.6	103.5	104.2	588.9	18.1	-11	-39.5	-35.8	-17
1912	144.8	253.3	196.6	142.3	737.1	-9.4	16.8	15.2	-13.1	3.6
1913	133.9	228.8	98.8	130.9	592.5	-15.9	5.7	-42.3	-20	-16.6
1914	157.6	280.4	211.6	186.5	836.1	-1.3	29.3	24.2	13.9	17.7

Retrieval Number: B11351292S319/2019©BEIESP
DOI: 10.35940/ijitee.B1135.1292S319

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1915	193.8	214.5	149.5	198.2	755.9	21.6	-1.1	-12.4	21.3	6.4
1916	199.6	248.9	183.7	190.3	822.6	25.4	15.1	8.1	17.1	16.2
1917	206.4	157.1	198.1	246.8	808.3	29.6	-27.4	16.6	51.8	14.2
1918	114.4	85.5	123.7	110.4	434	-28.1	-60.5	-27.2	-32.1	-38.7
1919	176.2	196.8	127.6	191.5	692.1	10.8	-8.9	-24.8	18.1	-2.1
1920	169	192.5	127.5	136.3	625.3	6.2	-10.9	-24.9	-15.9	-11.6
1921	141.7	282.9	184.5	133.2	742.3	-10.9	30.9	8.7	-17.9	5
1922	146.8	224.8	129.8	109.9	611.3	-6.5	4.2	-23.5	-32.3	-13.3
1923	119.6	295.5	171.6	183.1	769.8	-24.7	36.6	1.4	12.6	8.9
1924	161.6	313.9	176.9	212.7	865.2	1.8	45.1	4	30.5	22.2
1925	167.1	212.6	191	100.2	670.9	5.6	-1.6	11.7	-38.4	-5.2
1926	116.3	231.3	183.5	163.2	694.3	-27.1	6	6.7	0.4	-2.5
1927	180.9	238.9	140.4	178.6	738.8	13.4	9.5	-18.4	10.1	3.8
1928	153.8	190.9	173.2	132.5	650.4	-3.9	-12.5	0.6	-18.3	-8.7
1929	207.1	161.7	119.6	179.2	667.7	29.9	-25.6	-30.3	10.8	-6
1930	185.8	125.1	109.8	172.1	592.8	15.3	-43.8	-37.3	6.7	-17.7
1931	157.4	220.5	229.8	170.3	778	-2	0.1	32.5	6.1	8.8
1932	107.4	230.3	191.4	148.4	677.6	-33.1	4.6	10.5	-7.6	-5.2
1933	209.4	234.9	211.7	198.1	854.1	24.5	2	17.6	21.6	15.2
1934	187	208	172.9	83.5	651.3	11.3	-9.8	-4.1	-48.9	-12.2
1935	137	218.9	190.8	147.3	693.9	-18.7	-5.2	6	-9.7	-6.5
1936	199	212.5	152.2	155	718.7	18.4	-7.5	-15.5	-4.9	-3
1937	122.7	270.1	117.6	126.9	637.2	-27.1	17.5	-34.6	-22.2	-14
1938	200.1	215.1	215.6	208.7	839.6	19.2	-6.3	20.3	28.2	13.5
1939	139.3	186	180.7	121.7	627.6	-17	-18.8	0.9	-25.1	-15
1940	178.2	228.7	228.1	107.1	742.1	6.4	-0.2	27.4	-34.1	0.5
1941	176.7	148.3	156.1	171.4	652.5	5.6	-35.2	-12.7	5.6	-11.5
1942	192.6	234.5	190.7	101.1	718.9	18.6	3.5	9	-36.3	-0.5
1943	172	223.9	104.1	187	687.1	4.8	-2	-41	17.8	-5.6
1944	145	234.9	119.4	149	648.3	-11	3.5	-32	-5.9	-10.4
1945	128.3	265.3	169.8	114.3	677.7	-20.5	16.9	-3.6	-27.5	-6.2
1946	200.5	219	220.5	144.9	784.9	19	-4.3	23.2	-10.6	6.3
1947	133.1	252.9	262.2	202.8	851	-20.4	11	46.3	24.8	15.5
1948	163.8	219.1	206.3	147.1	736.4	-2.1	-4.3	15	-9.7	-0.3
1949	156.7	259.2	188.8	201.8	806.6	-7.4	13.2	5.7	24.3	9.1
1950	133.7	265.6	158.9	211.2	769.5	-20.2	16	-11.4	30	4.2
1951	149.4	256.1	153	140.9	699.4	-11.2	10.9	-15.6	-12.6	-5.7
1952	131.1	170	150	77.3	528.4	-21.9	-26.3	-16.3	-51.9	-28.5
1953	170.1	311.8	183.6	164.4	829.8	2.9	35.7	3	2.7	13.1
1954	158.3	282.3	204.8	143.3	788.7	-3.8	25.2	15.8	-10.7	8.4
1955	184.8	158	208.7	204	755.5	12.6	-29.8	18.1	27.2	4
1956	210.8	277.1	158.8	164.5	811.2	30.7	23.2	-9.9	3.1	12.4
1957	205.8	225.5	209.1	91.6	732	24.7	-0.5	18.6	-42.7	0.6
1958	151	285	258.3	119.4	813.7	-8.6	24.7	46.1	-25	11.5
1959	236.7	342.2	201.3	171.5	951.7	44.3	50.9	13.9	7.5	30.9
1960	153.8	237.2	112.5	228.4	732	-7.8	4.1	-36.4	42.8	0.1
1961	213.2	353.5	207.5	141.5	915.7	27.1	62.5	20.2	-8.4	28.5
1962	92.3	256.8	227.2	208.2	784.4	-45.1	18	32	34.4	10.1
1963	145.5	192.5	240.3	111.1	689.4	-11	-15.1	36.5	-30.4	-5
1964	124.7	252.2	220.6	246.2	843.7	-24.3	12.3	25.3	52.3	16.1
1965	131.9	228	168.7	140	668.6	-19.1	0.2	-4.7	-12	-8
1966	112.6	234.1	138.5	192	677.3	-31.7	5	-20.6	20.8	-6.1
1967	154.2	281.1	156	115.8	707.1	-6	23.4	-11.2	-27.3	-2.7
1960	153.8	237.2	112.5	228.4	732	-7.8	4.1	-36.4	42.8	0.1
1961	213.2	353.5	207.5	141.5	915.7	27.1	62.5	20.2	-8.4	28.5

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DOI: 10.35940/ijitee.B1135.1292S319

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1962	92.3	256.8	227.2	208.2	784.4	-45.1	18	32	34.4	10.1
1963	145.5	192.5	240.3	111.1	689.4	-11	-15.1	36.5	-30.4	-5
1964	124.7	252.2	220.6	246.2	843.7	-24.3	12.3	25.3	52.3	16.1
1965	131.9	228	168.7	140	668.6	-19.1	0.2	-4.7	-12	-8
1966	112.6	234.1	138.5	192	677.3	-31.7	5	-20.6	20.8	-6.1
1967	154.2	281.1	156	115.8	707.1	-6	23.4	-11.2	-27.3	-2.7
1968	144.1	253.2	85.4	192.2	674.9	-11.6	15.4	-50.5	20.7	-5.5
1969	118.1	240.9	168.9	132.5	660.4	-25.6	10.1	-2.5	-16.4	-6.9
1970	164.6	193.4	266	149.5	773.6	2.7	-13.7	52	-6	7.7
1971	181.5	149.8	160.7	146.9	638.8	16	-32.4	-4.8	-5.3	-9
1972	147.8	181.5	92.6	151.3	573.3	-6.7	-19.4	-46.6	-2.7	-19.6
1973	154.5	191	226.2	114.5	686.2	0.9	-10.3	37.5	-25.3	0.4
1974	105.9	227.6	166.9	221	721.4	-33.2	2.4	-2.5	41.7	1.9
1975	204.4	245.5	225.9	246.4	922.2	28.6	9.4	31	59.4	29.8
1976	94.9	257.7	221.5	93.6	667.6	-41.8	12.4	24.6	-40.8	-8.3
1977	156	221.5	167.7	110.6	655.7	-2.5	-1.6	-3.9	-28.9	-8.3
1978	208.7	264.2	224.1	163.1	860	-12.1	17.2	29	5	20.6
1979	148.5	157.3	122.6	208.7	637.1	-2.7	-21.4	-24.2	34.4	-4.9
1980	188.5	178.1	183.4	119.7	669.7	20.7		10	-22.5	-1.5
1981	180.9	188.3	185.3	235	789.5	20.2	1.8	17.7	51.6	21.9
1982	146.9	174.1	150.4	124.8	596.2	-2.4	-9.1	-5.9	-18.9	-9.1
1983	152.5	206.7	294.6	256.6	910.4	0.6	6	83.4	67.3	37.8
1984	127.7	221.8	76.2	136.9	562.5	-15.8	13.8	-52.4	-10.9	-14.8
1985	168	149.5	146.3	99	562.8	10.7	-23.6	-8.6	-35.4	-14.8
1986	140	119.1	202.7	132.6	594.3	-7.3	-38.5	28.1	-13.1	-9.3
1987	131	107.3	192.8	110.7	541.9	-11	-47.6	19.4	-28.5	-18.9
1988	127.8	283.5	241.1	249.5	901.8	-13.1	39.2	48.5	60.7	35
1989	178.5	312	158.4	183.8	832.7	17.1	45.7	-6.3	15.2	19.8
1990	176.5	167	240.5	133.4	717.4	7.1	-24.3	21.2	-18.3	-4
1991	278	239.3	167.2	135.5	820	69.4	2.5	-9.2	-16.9	10.1
1992	190.9	328.3	207.7	136.9	863.8	15.8	39.4	11.4	-14.7	15.6
1993	139.1	230.8	156.4	126.2	652.4	-15.5	-1.8	-14.9	-22.5	-12.5
1994	167.3	273.6	175.4	88.9	705.2	2.7	17.5	-4.1	-44.9	-4.7
1995	137.7	243.6	203.1	137.7	722.2	-15.5	4.4	10.7	-14.2	-2.5
1996	233.8	198.8	239	203.9	875.5	44.2	-15.2	29	27.4	18
1997	138.1	229.7	181.2	179.7	728.7	-15.4	-0.8	-1.1	12.1	-1.3
1998	173.9	230.9	219.9	238.7	863.4	7.9	0.4	28.5	49	19.5
1999	148.5	214.8	147.3	118.2	628.8	-8.7	-6.6	-18.5	-25.6	-14.1
2000	202.4	169.7	295.5	133.8	801.3	24.5	-26.2	63.4	-15.9	9.4
2001	162.2	159.8	164.8	172.6	659.4	-0.2	-30.6	-8.9	8.7	-10
2002	151.7	95.8	182	77.2	506.7	-8	-59	-5.1	-51.8	-32.5
2003	141.9	227.3	196	82.8	648	-11.5	0	6.2	-48.2	-11.5
2004	143	177.6	134.6	162.1	617.4	-9.9	-21.1	-26.2	1.1	-15
2005	141.9	286	155.8	223.3	807	-9.9	27.9	-14.3	39.4	11.6
2006	158.1	153.9	176.4	196.1	684.5	0.4	-31.2	-2.9	22.5	-5.3
2007	242.5	205.6	223.1	231	902.1	54	-8	22.8	44.3	24.8
2008	135.6	170.8	238.5	147.7	692.6	-13.9	-23.6	31.3	-7.8	-4.2
2009	106.5	216.1	161	198.5	682.2	-32.3	-3.3	-11.4	24	-5.6
2010	163.5	277.9	229.7	177	848.1	3.6	24	26.6	11	17.3
2011	156.8	213.1	219	124.3	713.1	-1.3	-2.9	21.2	-20.6	-0.3
2012	113	178.7	207.3	145	643.9	-28.8	-18.6	14.7	-7.5	-10
2013	206.1	274.6	164.9	180.1	825.6	29.8	25.1	-8.7	14.9	15.4
2014	100.1	199.4	229.1	136.7	665.3	-36.9	-9.1	26.8	12.8	-7

Retrieval Number: B11351292S319/2019©BEIESP
DOI: 10.35940/ijitee.B1135.1292S319

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2015	187.6	110.2	146.2	161	605.1	18.1	-49.9	-19.1	2.8	-15.5
2016	199.1	193.3	108.7	159.2	660.2	25.3	-12.1	-39.8	1.7	-7.8
2017	156.4	189.4	154.8	126.4	640.5	12.5	16.8	15.2	19.7	16.7
2018	126.4	158.4	123.8	111.7	634.8	14.9	18.6	27.6	22.6	19.4

IV.METHODOLOGY

Flowchart of the Proposed System

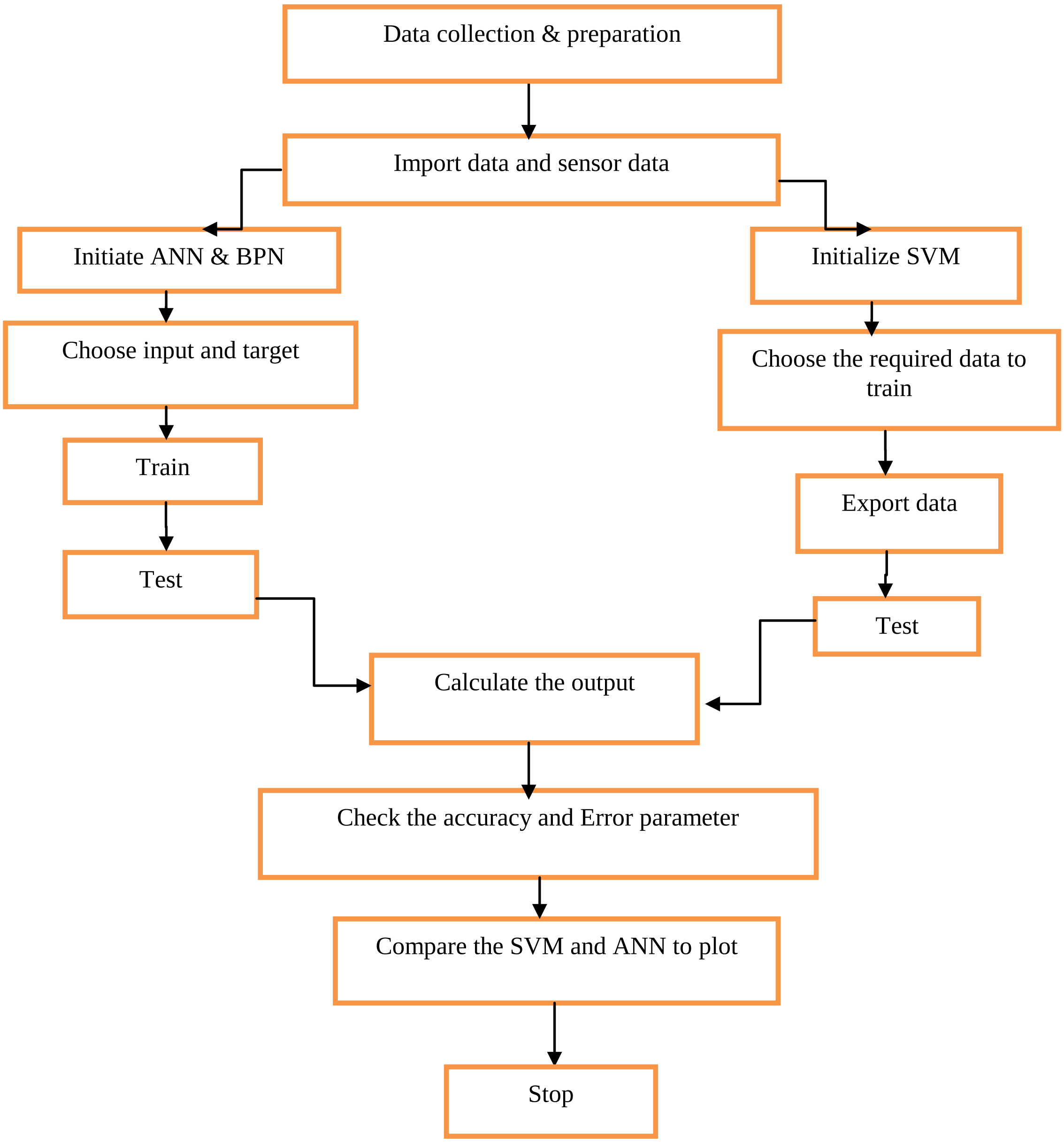

Figure 4.1 Flow diagram of flood prediction using ANN and SVM model

The methods used in this proposed study are Artificial Neural Network (ANN) with Back Propagation Neural Network (BPNN) and Support Vector Machine (SVM). The major dataset are imported to algorithm were trained and tested. The problem defined in flood prediction by calculating rainfall, temperature and water level dataset. In this research, MATLAB tool is used to implement neural network and using classification application for SVM.

The performance evaluation are required to simulate accuracy for flood prediction. The measurement of Root Mean Square Error (RMSE), Mean Absolute Error (MAE) and Coefficient of Determination (R2) is predicted in model. This prediction is compared with ANN and SVM model for better accuracy.

The neural network and classification application is used to implement flood forecasting. The following implementation work by resulting regression graph in trained, validated and tested values

RAINFALL

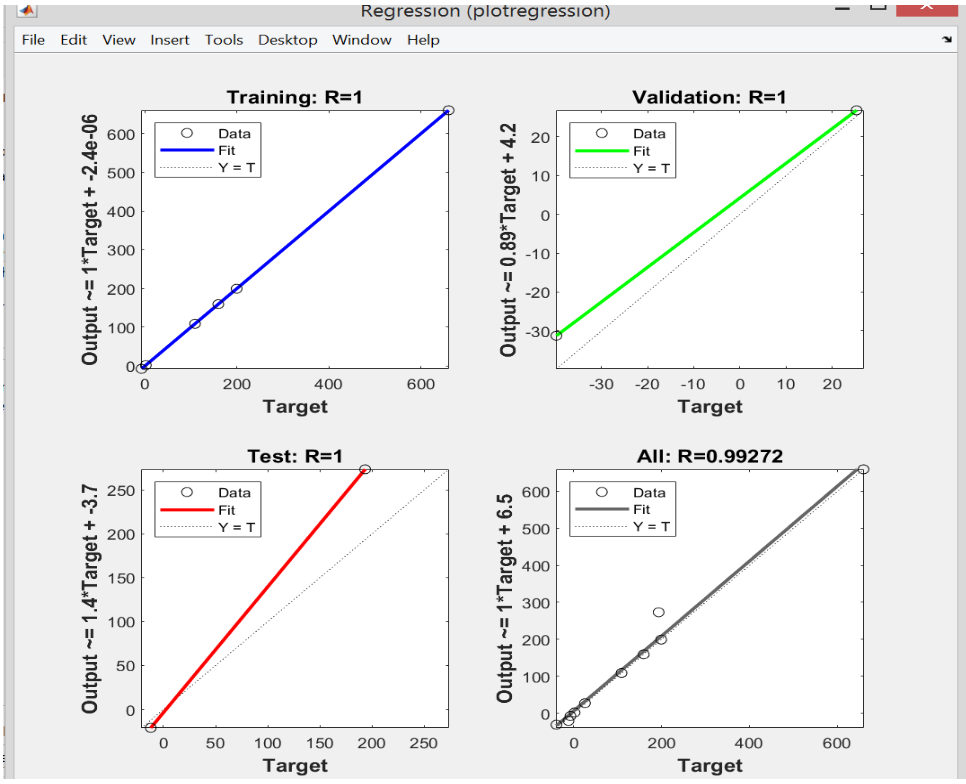

Figure 4.2 Implementing Regression plot in Rainfall data using Neural Network

TEMPERATURE

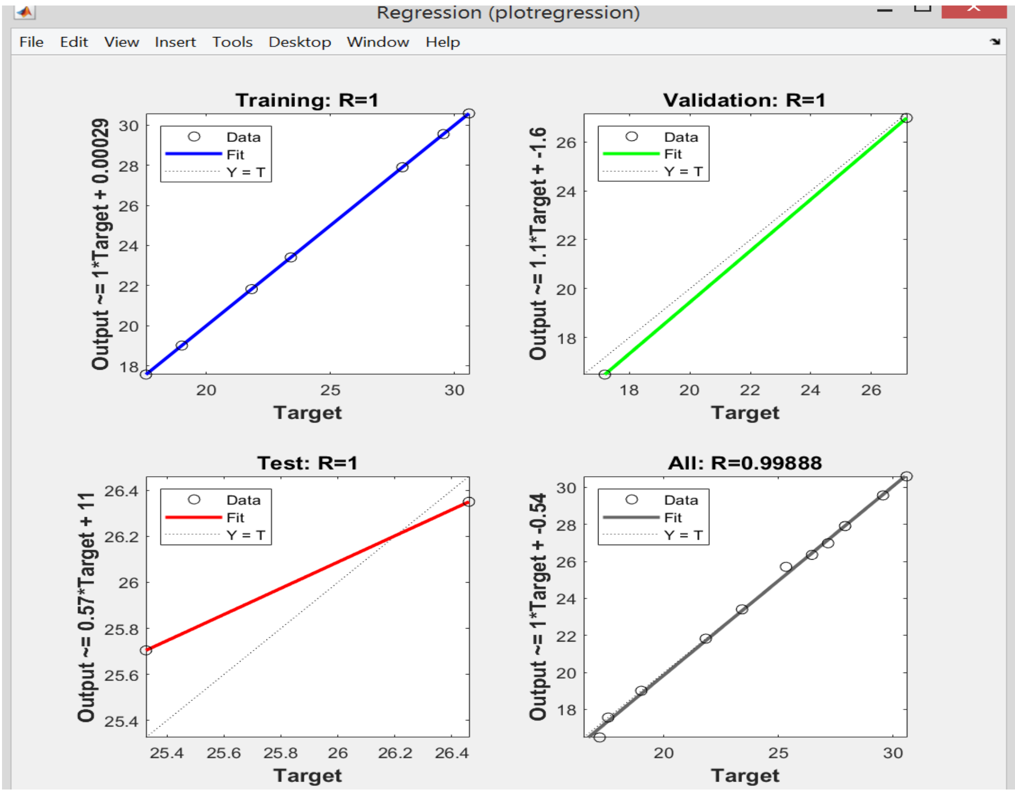

Figure 4.3 Implementing Regression plot in Temperature data using Neural Network

Retrieval Number: B11351292S319/2019©BEIESP
DOI: 10.35940/ijitee.B1135.1292S319

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Blue Eyes Intelligence Engineering
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WATER LEVEL

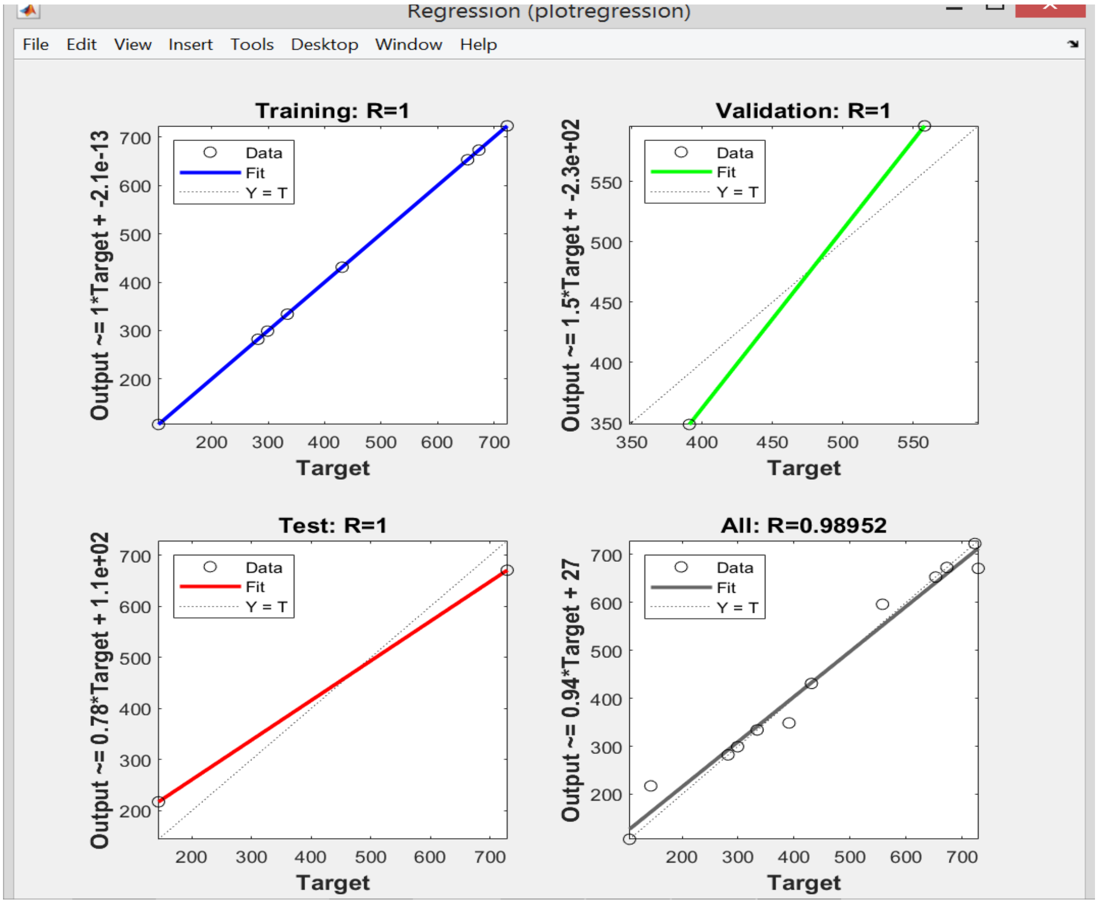

Figure 4.4 Implementing regression plot in trained water level data using Neural Network

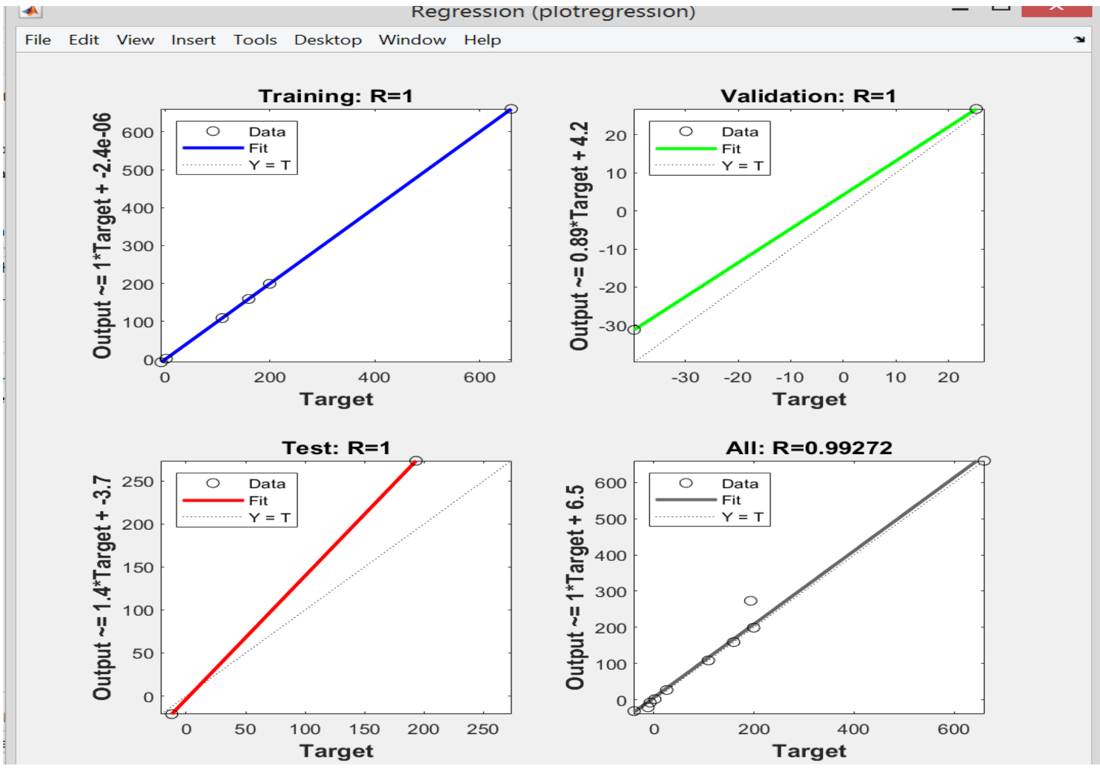

Figure 4.5 Implementing Regression plot in Rainfall data using Neural Network

The neural network and classification application is used to implement flood forecasting. The following implementation work by resulting regression graph in trained, validated and tested values.

COMPARISON OF ANN AND SVM IN RAINFALL

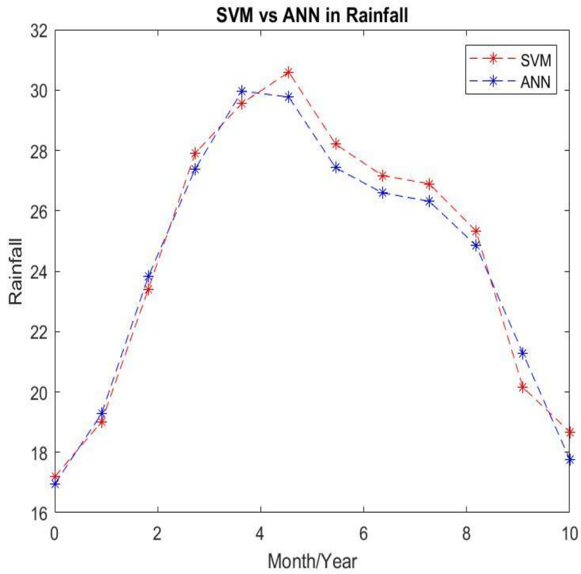

Figure 4.6 Graphical comparison of ANN and SVM model in rainfall data

COMPARISON OF SVM AND ANN IN TEMPERATURE

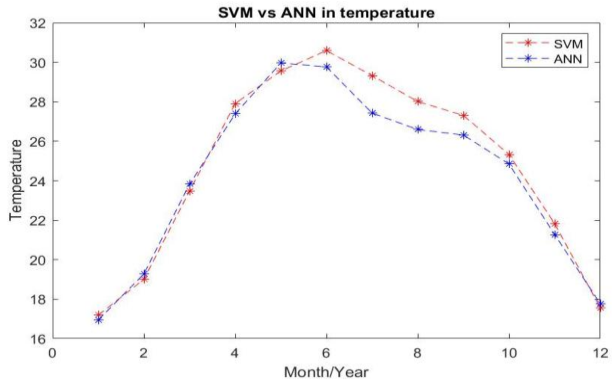

Figure 4.7 Graphical comparison of ANN and SVM model in temperature data

Predicting accuracy of overall dataset between ANN and SVM

ACCURACY	ANN	SVM
RAINFALL	26.1463	27.3959
TEMPERATURE	93.0873	95.1226
WATER LEVEL	88.0225	89.5276

V. CONCLUSION

An automated flood flow was predicted by proposed system in the region of Korattur lake Chennai, Tamilnadu. The focus of this research is to predict flood with higher accuracy using Artificial Neural Network (ANN) and Support Vector Machine (SVM) algorithm with support of ultrasonic sensor to gather data.Earlier prediction of outflow in water level is done with the help of rainfall, temperature and water level dataset. The predicted dataset is evaluated in terms of Root Mean Square Error (RMSE), Mean Absolute Error (MAE) and Coefficient of Determination (R2) for the performance in flood forecasting. The comparison of Artificial Neural Network (ANN) and Support Vector Machine (SVM) algorithm results Support Vector Machine (SVM) is more effective compared with Artificial Neural Network (ANN) for flood prediction. This research is an automated software development of proper planning for early evacuation is done by predicting flood.

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