International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8 Issue-4, November 2019

Soft Computing Techniques for Weather Change Predictions in Delhi

Jibendu Kumar Mantri, Suvendra Kumar Jayasingh

Abstract**:** ***Weather forecasting and warning is the application of science and technology to predict the state of the weather for a future time of a given location. The emergence of adverse effects of weather has endangered the life of general public in previous years. The unpredicted flood and super cyclone in many places have created havoc. The government and private agencies are working on its behaviours but still it is challenging and incomplete. But, the application of soft computing techniques in weather prediction has made a significant perfomance now a days. This research work presents the comparative study of soft computing techniques like MultiLayer Perceptron(MLP), Support Vector Machine(SVM) and J48 Decision Tree for forecasting the weather of Delhi with ten years data comprising of temperature, dew, humidity, air pressure, wind speed and visibility. This paper tries to describe the comparison among above models using four different error values like Relative Absolute Error(RAE), Mean Absolute Error(MAE), Root Mean Squared Error(RMSE) and Root Relative Squared Error(R^2) with a proposed model by defining new algorithm. Further the performance can be enhanced if textmining will be applied in this proposed model.***

Keywords**:** ***Weather Forecasting, MLP, SVM, J48 Decision Tree, Data mining.***

I. INTRODUCTION

Weather forecasting is a very important and crucial requirement in daily life. It is one of the most complex equations to solve. Forecasting the rainfall is substantially important for reservoir operation and prevention of flood. Prediction of weather plays a vital role in Delhi because of the rise in temperature, humidity, mist and loss of visibility etc. The tourism, industry, business and commerce get affected by the bad weather and natural calamities in the capital city of India.

A huge amount of weather data are gathered from satellites, different ground stations and sensors. Weather forecasting models foresee the weather for next few hours, few days and some months together. There are many ways of forecasting the weather which may be simply by looking at the sky and other weather parameters or by very complex techniques involving difficult equations, statistics and data mining techniques. Accurate forecasting of weather is a challenge despite much advancement in the technology and mechanisms of predicting weather. Recently many weather forecasting techniques like data mining techniques are utilized for better weather prediction.

In this research work, many time series weather data like average temperature, average dew, average humidity, average air pressure, average wind speed and average visibility of Delhi are collected from different sources for last ten years from 2008 to 2017. These data were incorporated in the forecasting data models like Multi Layer Perceptron (MLP), Support Vector Machine (SVM) and J48 Decision Tree to predict the weather and they were evaluated on the basis of different statistical indices and compared.

This article is organized in the following manner to explain the proposed work.

2. Literature Review
3. Data Analysis and Case Study Review
4. Multi Layer Perceptron
5. Support Vector Machine
6. J48 Decision Tree
7. Performance Comparison Techniques
8. The proposed model
9. Discussion and Test results
10. Conclusion and future work

II. LITERATURE REVIEW

Weather forecasting plays a very important and challenging area of science and technology today because of the practical value in meteorology and disaster control department in every country. The Government has to take precautions to save the people and the property taking in view of the disasters and calamities to come in near future.

Tektas M. [1] has compared the ANFIS and ARIMA models for weather forecasting as a case study in Istanbul and found that ANFIS was better when compared on the basis of MAE, RMSE and R^2. Kaur et al. [2] have introduced improved J48 classifier which increased the accuracy of the data mining in predicting diabetes. Nayak et al. [3] have made a survey on Rainfall prediction using different Artificial Neural Network techniques like MLP, BPN, RBFN, SOM and SVM and suggested that significant result could be found in comparison to the traditional methods. Talib et al. [4] have used J48 decision tree to create decision trees and rules for classification of parameters of weather. Kumar et al. [5] have proposed a new methodology for weather forecasting using artificial neural network and concluded that back propagation neural network had shown high accuracy and efficiency to predict the weather.

Manuscript published on November 30, 2019.
* Correspondence Author
Jibendu Kumar Mantri*, PG Department of Computer Application, North Orissa University, Baripada, India, Email: jkmantri@gmail.com
Suvendra Kumar Jayasingh, PG Department of Computer Application, North Orissa University, Baripada, India, Email: sjayasingh@gmail.com

Mandal et al.[6] have implemented soft computing approach in different types of time series data like stock market, financial data, market demand and supply prediction. Jayasingh et al. [7] have applied text mining approach for faster weather forecasting. Saxena et al. [8] have presented a survey using artificial neural network for weather forecasting which yielded good results and could be treated as an alternative to traditional metrological systems. Sanghani et al. [9] have made a review of soft computing techniques for time series forecasting and suggested that hybridizing of models by exploitation of the strength of individual models could be a new analysis space in time series. Hamidi et al. [10] have made a comparative study of SVM and ANN in predicting precipitation in Iran and suggested that SVM model was a promising technique for predicting variations of precipitation. Jain et al. [11] have made a study of time series models ARIMA and ETS using Akaike's Information Criteria (AIC) and Bayesian Information Criteria (BIS) to find out the best model for weather prediction. Babu et al. [12] have made a comparison of ANFIS and ARIMA model for weather forecasting and suggested that ARIMA was the most effective method for predicting the same. Narvekar et al. [13] have made daily weather forecasting using ANN and proposed for ANN with back propagation for better weather forecasting. Rao et al. [14] have proposed an efficient approach for weather forecasting using SVM and suggested that proper selection of parameters can replace the few neural networks by SVM. Chawsheen et al. [15] have made seasonal time series modelling and forecasting of monthly mean temperature for decision making in the Kurdistan Region of Iraq. Shivaranjani et al. [16] have made a review of weather forecasting using Data Mining Techniques and suggested that yield of crop could be improved by implementation of data mining techniques for rainfall prediction. Rupa et al. [17] have made a review study of rainfall prediction using neuro fuzzy inference system and suggested that it is an alternative to traditional metrological approaches in rainfall prediction. Nayak et al. [18] have made the prediction for Indian Stock Market and suggested that Decision Boosted Tree performed better than SVM and Logistic Regression. Bushara et al. [19] have made a review on computational intelligence in weather forecasting. Orreli et al. [20] have deliberated model error in weather forecasting. Sharma et al. [21] have made weather forecasting using soft computing techniques and concluded that ANFIS is highly appreciated for temperature forecasting. Wang et al. [22] have made the application of seasonal time series model in the precipitation forecast and suggested that the SARIMA model has good mdel fitting degree in decision making for agricultural irrigation.

III. DATA ANALYSIS AND CASE STUDY REVIEW

The time series weather data of Delhi has been collected for ten years from 2008 to 2017. The data collected might contain some erroneous or irregular value which was removed in the 1st phase of pre processing of data. In one year, we have 365 number of weather records, thereby, for ten years we have $3.65X10^3$ number of records. Each record contains the value of average temperature, average dew, average humidity, average air pressure, average wind speed, average visibility and events of Delhi. The events may be some of the types like rain, no rain, fog, thunderstorm, tornado, hail etc. There is strong correlation of the weather events with the different weather parameters like temperature, dew, and humidity etc.

3.1. Temperature

The most influential parameter, temperature, usually decides the upcoming weather conditions in near future. Historical temperature data collected from meteorological stations are used for prediction of weather for next few hours, days and months etc. The temperature of Delhi for the period of ten years from 2008 to 2017 is shown in figure - 1 which ranges from degree 6 degree Celsius to 39 degree Celsius.

3.2. Dew

Dew plays an important role in the month of winter in Delhi. It makes the time table of airways, trains and many official activities to change in Delhi due to its high impact in the climate and logistics in Delhi. The dew in Delhi for the period of ten years from 2008 to 2017 is shown in figure - 2 which ranges from -3 to 28.

3.3. Humidity

Humidity has direct correlation with the temperature and rain of the atmosphere. In general, high value of humidity refers to more water droplet in the atmosphere which leads to rain in near future. Low value of humidity implies dry atmosphere. The humidity in Delhi for the period of ten years from 2008 to 2017 is shown in figure - 3 which ranges from 13 to 100.

3.4. Pressure

Barometric pressure makes the local weather to change in its condition, making the barometric pressure a vital and important weather forecasting tool. High barometric pressure zones are prone to fair weather where as low pressure areas are prone to very poor weather. In weather forecasting, the absolute value of barometric pressure value has less importance whereas change in barometric pressure has more impact on weather conditions. Generally rise in barometric pressure leads to improvement of weather whereas falling in air pressure leads to deteriorating climate conditions. The barometric pressure in Delhi for the period of ten years from 2008 to 2017 is shown in figure - 4 which ranges from 994 to 1023.

3.5. Wind Speed

Wind is always considered as one of the most complex metrological parameter in weather forecasting. It is more significant in winter when the temperature is very low. When the temperature is below freezing point, wind plays major role deciding the cooling rate. The wind speed in Delhi for the period of ten years from 2008 to 2017 is shown in figure - 5 which ranges from 0 to 40.

3.6. Visibility

Visibility in the distance is defined as the path which is visible in necked eye. In the month of winter, the atmospheric fog and dust makes the hindrance in visibility of distant roads in morning sometimes till mid of the day. The visibility in air decides the climatic condition. The low range of visibility leads to poor climatic condition where as high range of visibility leads to fair weather. The visibility in Delhi for the period of ten years from 2008 to 2017 is shown in figure - 6 which ranges from 0 to 7.

Retrieval Number: D7382118419/2019©BEIESP
DOI:10.35940/ijrte.D7382.118419
Journal Website: www.ijrte.org

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

3.7. Events

The climatic events for which the proposed soft computing models will predict are rain, no rain, fog, thunderstorm, tornado, hail etc. Generally in simple way of looking at the sky and other weather parameters, the weather predictions were done in ancient days. Nowadays the climate has become more complex and it is very difficult to predict the weather in simple ways as it was done in earlier days.

Figure 1
Time series temperature data

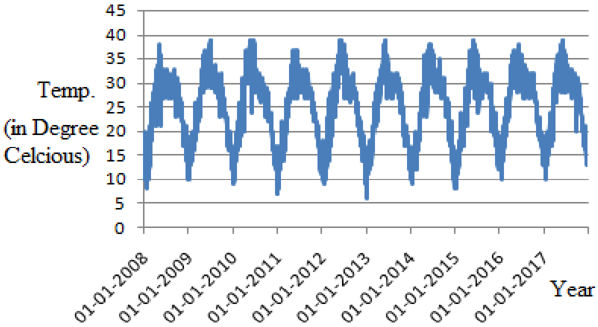


Figure 2
Time series dew data

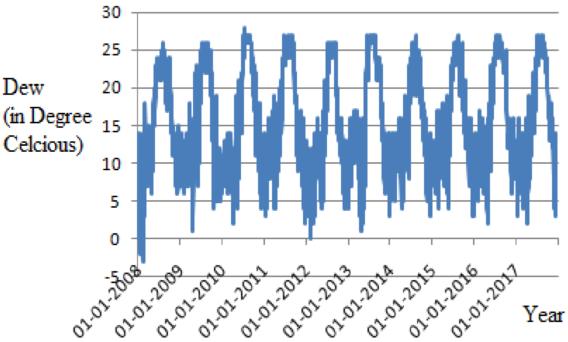


Figure 3
Time series humidity data

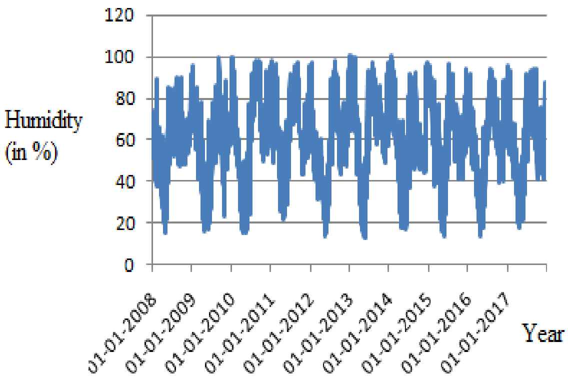


Figure 4
Time series air pressure data

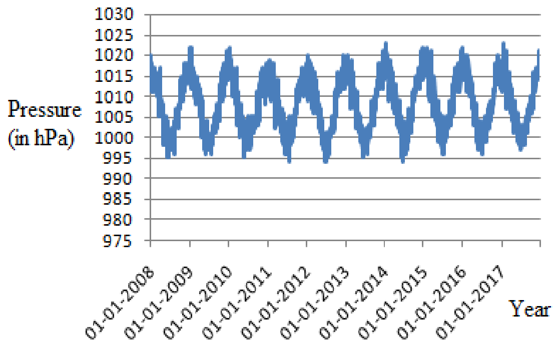


Figure 5
Time series visibility data

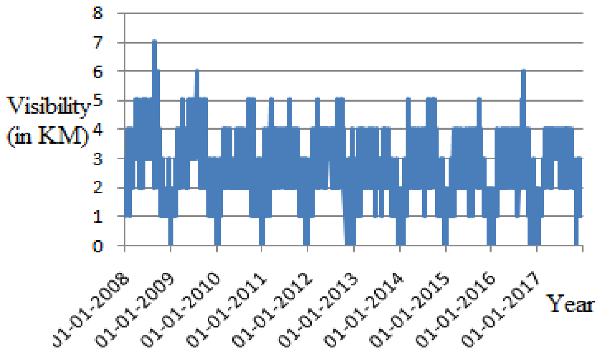
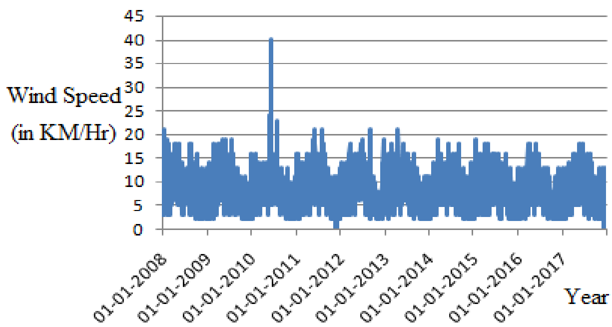


Figure 6
Time series wind speed data



IV. MULTI LAYER PERCEPTRON

The Multi Layer Perceptron (MLP) is based on the biological nervous system. It is a class of artificial neural network which consists of at least 3 layers. Except the input nodes, all other nodes are neurons which take help of a non linear activation function. It uses supervised learning technique called back propagation. The multiple layers and non linear activation function make it distinguished from the linear perceptron. It distinguishes data which is not separable linearly.

Activation Function – The nodes in the Multi Layer Perceptron are called neurons that use some algebraic function to map the weighted inputs to output. The activation function may be non linear which is used to fire the biological neuron.

Retrieval Number: D7382118419/2019©BEIESP
DOI:10.35940/ijrte.D7382.118419
Journal Website: www.ijrte.org

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

V. SUPPORT VECTOR MACHINE

Similar to Artificial Neural Network, the Support Vector Machine (SVM) is found to be very effective technique for regression, classification and pattern recognition. It is a classifier that is derived from statistical learning theory.

In SVM, the input vector x is mapped into high dimensional feature space Ø(x), the kernel function.

If (x, y) is a set of N samples, where x € R^m is an input vector of m components and y is a corresponding output value.

An SVM estimator is represented by

f(x)= w Ø(x) + b

where w is the weight vector and b is the bias.

SVM is treated as a very good classifier as its performance is very high without help of any priori knowledge though the input space is of very high dimension.

SVM was initially designed for binary classification, but later on it could be used for multi class classification problems. For a linearly separable dataset, a linear function is used as the classifier. But for non linear dataset, this classification needs a function that separates two hyper planes.

VI. J48 DECISION TREE

A decision tree is a classifier that is used to classify the input instance space. Classification is the process of building different classes from set of records that contains different labels of classes. Decision tree algorithm is used to find out the class to which an instance will go. By use of the J48 classification algorithm, it becomes easy for classifying instances into the appropriate class group. J48 is an open source algorithm which is the enhancement of ID3 algorithm for classification problems.

The J48 decision tree model contains a root node and many intermediate nodes. The intermediate nodes are test nodes which perform a test to generate out going nodes. The nodes which do not have out going nodes are called leaf nodes.

VII. PERFORMANCE COMPARISON TECHNIQUES

The efficiency of different soft computing models used for prediction of weather events in Delhi is compared on the basis of the following performance criteria.

Mean Absolute Error (MAE):

The Mean Absolute Error (MAE) is defined as the average of difference between actual value and predicted value for n number of weather instances.

$$MAE = \frac{1}{n}\sum_{i=1}^{n} | y - \hat{y} |$$

Relative Absolute Error (RAE):

The Relative Absolute Error (RAE) is defined as the average of sum of difference of actual value and predicted value for n number of weather instances divided by the sum of differences between actual value and the standard deviation of n number of weather instances.

$$RAE = \frac{\sum_{i=1}^{n} | y - \hat{y} |}{\sum_{i=1}^{n} | y - \bar{y} |}$$

Root Mean Squared Error (RMSE):

The Root Mean Squared Error (RMSE) is defined as the square root of sum of squares of differences between actual value and predicted values of n number of weather instances.

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n} (y - \hat{y})^2}$$

Root Relative Squared Error (RRSE):

The Root Relative Squared Error (RRSE) is the Root Mean Squared Error (RMSE) divided by the Root Mean Prior Squared Error (RMPSE). The Root Mean Prior Squared Error (RMPSE) is the Root Mean Squared Error (RMSE) of the prior (e.g., the default class prediction).

$$RRSE = \sqrt{\frac{\frac{1}{n}\sum_{i=1}^{n} (y - \hat{y})^2}{\sum_{j=1}^{n} (y_j - \bar{\bar{y}})^2}}$$

In the above expressions of calculating the error,

y= Actual value of one weather parameter

$\bar{y}$ = Standard deviation of n number of values of one parameter of weather instances

$\hat{y}$ = Predicted value of one parameter of weather instances

n = Number of instances

VIII. THE PROPOSED MODEL

The weather data of Delhi of ten years from 2008 to 2017 having the parameters like temperature, dew, humidity, sea level pressure, visibility, wind speed and weather events are collected from meteorological stations. The collected data set is cleaned by removing the missing valued instances in the database. The following algorithm is followed in the proposed work in our research.

Algorithm

Step 1 – Collect the historical weather data of Delhi for 10 years from 2008 to 2017

Step 2 – Preprocess and clean the data

Step 3 – Generate ensemble for MLP, SVM and J48 Decision Tree

Step 4 – Set target and predictor variables

Step 5 – Select sample data Fin, i (i=1,2,...,3650)

Step 6 – Select N_t, the training data among the sample data

Step 7 – Estimate weather target value with MLP, SVM and J48 Decision Tree

Step 8 – Repeat steps 5 to 7 one hundred times, with training data being selected randomly

Step 9 – Calculate MAE, RAE, RMSE and RRSE with the Resultant Lout and Actual Lout

Step 10 – Set mae[], rae[], rmse[] and rrse[] with the error values obtained in Step 9

Step 11 - Set error[4][3]={1,1,1,1,1,1,1,1,1,1,1,1}, Set error_sum[4]={0,0,0,0}

Step 12 – Set min_1=mae[0], min_2=rae[0], min_3=rmse[0] and min_4=rrse[0]

Step 13 – for a=1 to 2 increment a

If(min_1>mae[a]), set min_1=mae[a], If(min_2>rae[a]), set min_2=rae[a], If(min_3>rmse[a]), set min_3=rmse[a], If(min_4>rrse[a]), set min_4=rrse[a].

Step 14 – for a=0 to 2 increment a

If (min_1=mae[a]), set error[0][a]=0, If (min_2=rae[a]), set error[1][a]=0, If (min_3=rmse[a]), set error[2][a]=0, If (min_4=rrse[a]), set error[3][a]=0.

Step 15 – for b=0 to 3 increment b

Set s=0

Step 16 - for c=0 to 3, increment c

Retrieval Number: D7382118419/2019©BEIESP
DOI:10.35940/ijrte.D7382.118419
Journal Website: www.ijrte.org

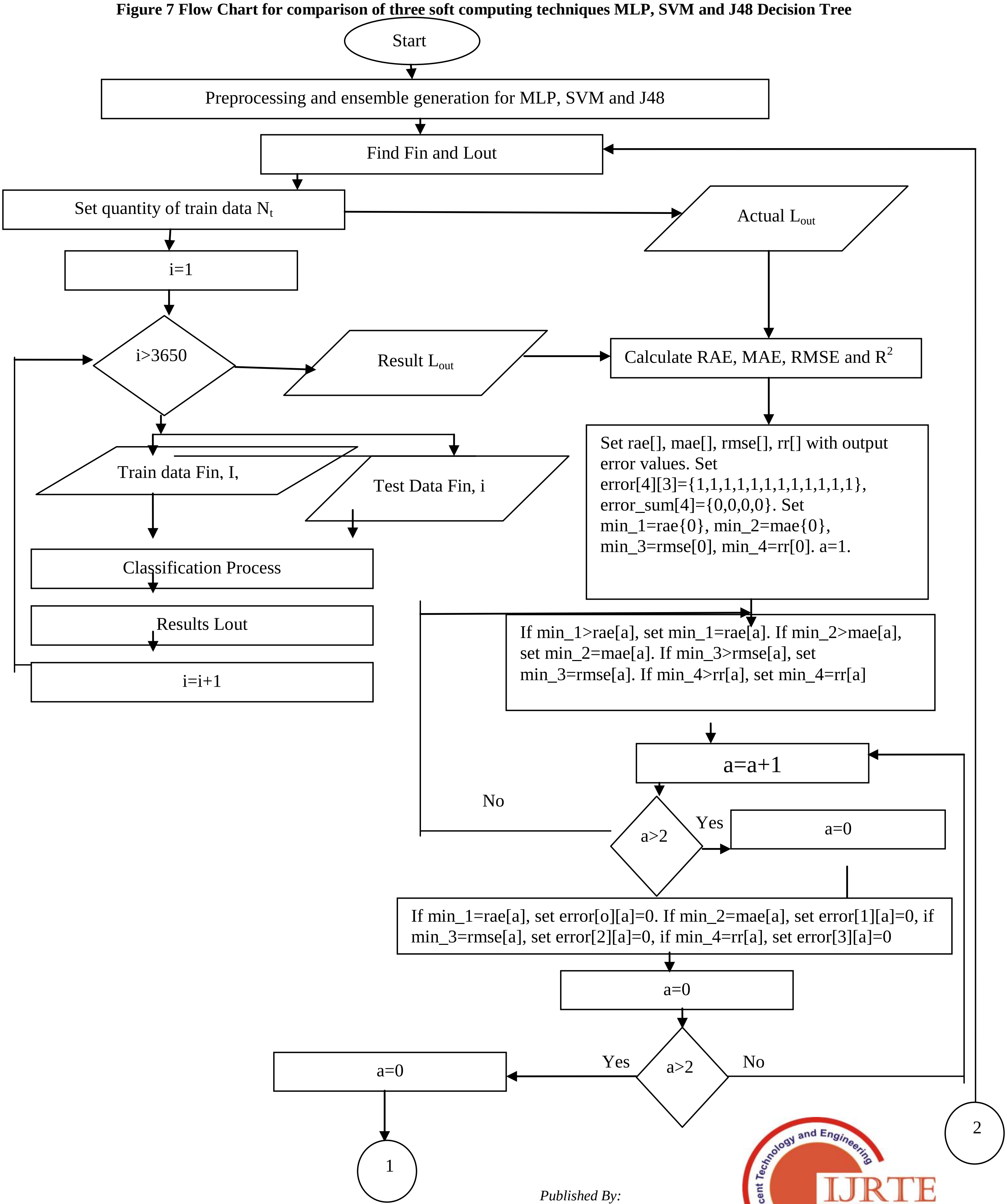
Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

Set s=s+error[c][b]
error_sum[b]=s

Step 17 – If error_sum[0]=0, then MLP is the best, else if error_sum[1]=0, then SVM is the best, else If error_sum[2]=0, then J48 Decision Tree is the best.

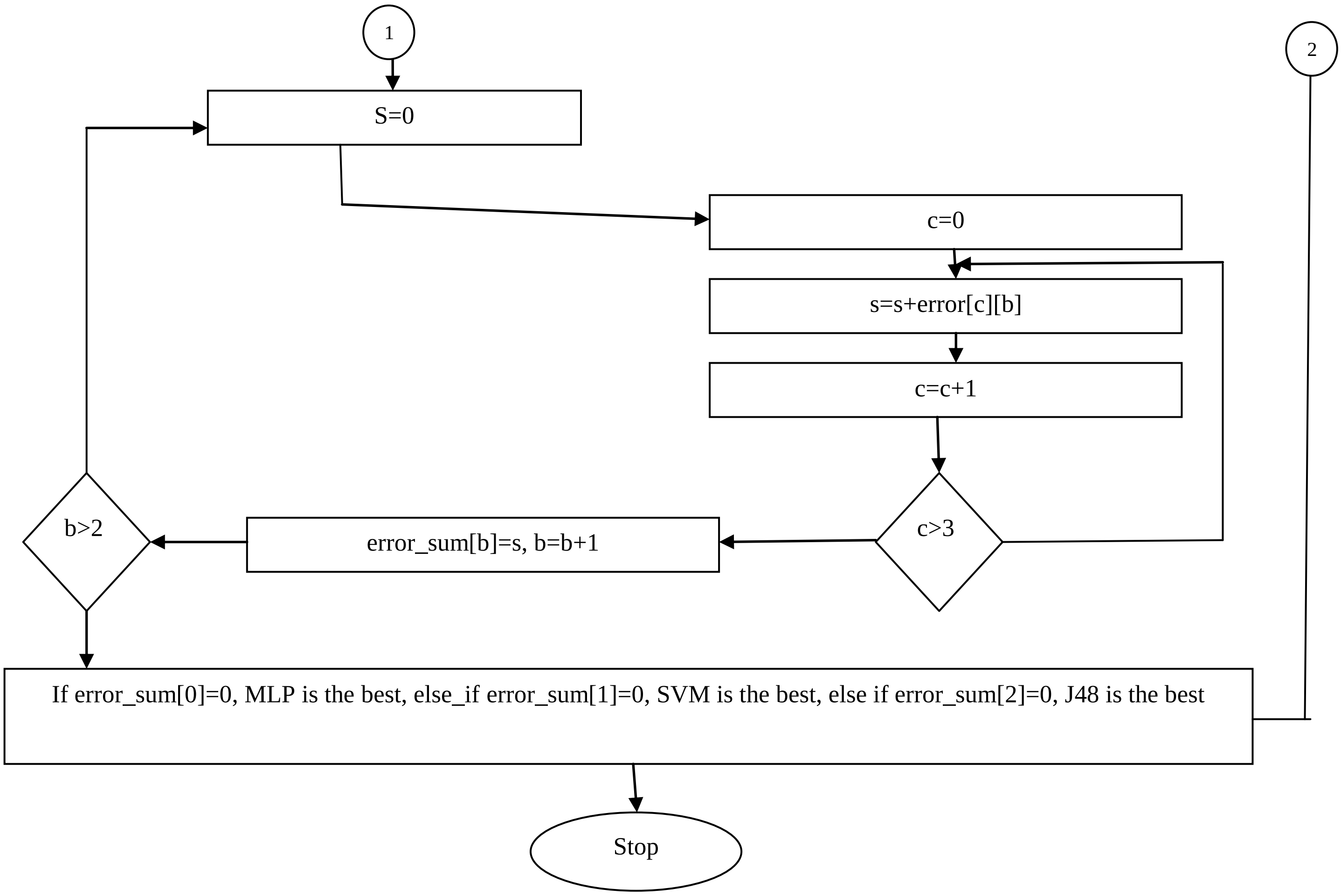
The equivalent flow chart for the above algorithm is shown below.

Figure 7 Flow Chart for comparison of three soft computing techniques MLP, SVM and J48 Decision Tree



Retrieval Number: D7382118419/2019©BEIESP
DOI:10.35940/ijrte.D7382.118419
Journal Website: www.ijrte.org

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)



IX. DISCUSSION AND TEST RESULTS

The time series weather data of ten years were used in the aforesaid three soft computing models. In this research work, 6 input parameters and one output parameter were used to predict the weather events at Delhi. Out of ten years of weather instances, 75% of instances were used for training and 25% weather instances were used for test in the WEKA for different soft computing models. The following error values were obtained after successful execution of models.

Table 1
Comparison of three soft computing techniques MLP, SVM and J48 Decision Tree on the basis of different error values

	MLP	SVM	J48
Accuracy	70.9589	71.5068	69.863
MAE	0.0616	0.1402	0.0545
RAE	57.2412	130.2932	50.6885
RMSE	0.1796	0.2579	0.1651
RRSE	77.5058	111.2872	71.2448

The comparison of different error values in three different models are shown below in Figure – 8, 9, 10, 11 and 12..

Figure 8

Comparison of three soft computing techniques MLP, SVM and J48 Decision Tree on the basis of MAE

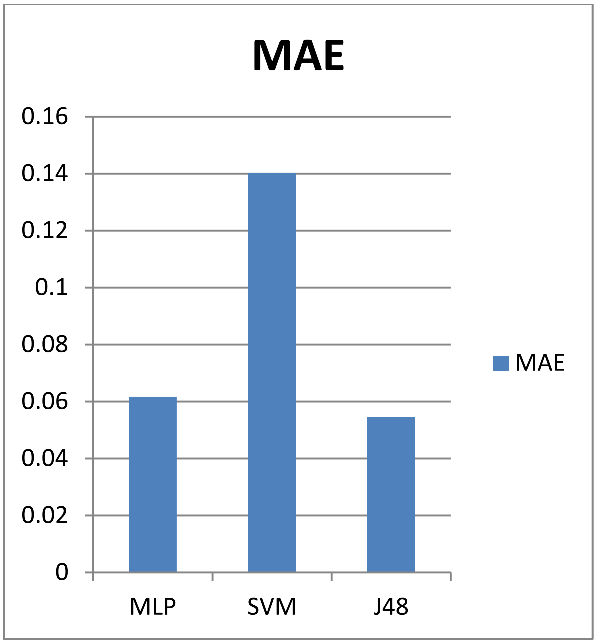


Figure 9
Comparison of three soft computing techniques MLP, SVM and J48 Decision Tree on the basis of RAE

Retrieval Number: D7382118419/2019©BEIESP
DOI:10.35940/ijrte.D7382.118419
Journal Website: www.ijrte.org

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

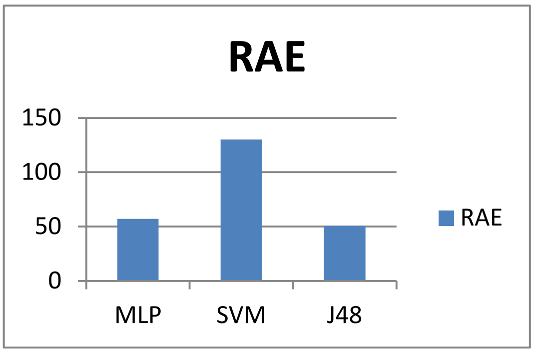


Figure 10
Comparison of three soft computing techniques MLP, SVM and J48 Decision Tree on the basis of RMSE

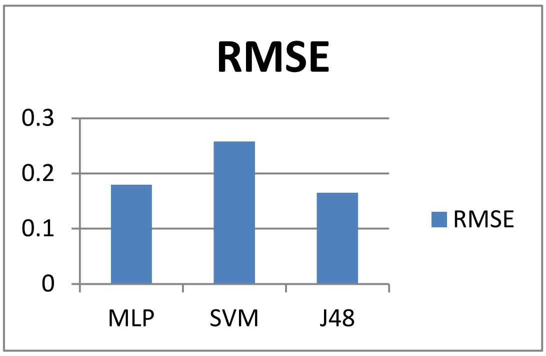


Figure 11
Comparison of three soft computing techniques MLP, SVM and J48 Decision Tree on the basis of RRSE.

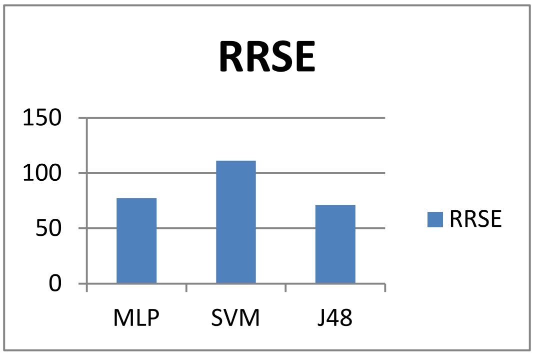


Figure 12
Comparison of three soft computing techniques MLP, SVM and J48 Decision Tree on the basis of Accuracy

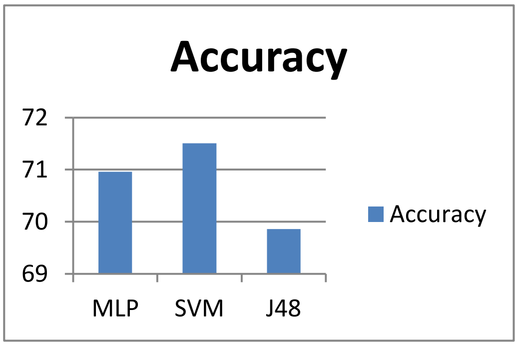


Table – 2
Time complexity and Space complexity

	Time Complexity	Space Complexity
MLP	$O(N^3)$	$O(N^3)$
SVM	$O(N^3)$	$O(N^2)$
J48 Decision Tree	$O(N^2)$	$O(N^2)$

The time complexity and space complexity of different soft computing models used for predicting the weather are calculated and presented in table – 2. In the above table, N represnts the size of the training data. On the basis of the time and space complexity of afore mentioned different soft computing models, the J48 Decision Tree could outperform among all others.

X. Conclusion and Future Work

Here, J48 Decision Tree outperformed among all the three soft computing models used in predicting the weather events at Delhi by taking six weather parameters for ten years on the basis of statistical error parameters. The performance of J48 Decision tree was found to be the best as compared to MLP and SVM on the basis of the MAE, RAE, RMSE and RRSE. On the basis of accuracy, SVM was found to be better than J48 Decision Tree. So J48 Decision Tree os SVM may be used for predicting other time series values to get better and accurate results. The time complexity and space complexity indicates that the performance of J48 Decision Tree is better than the other two. The J48 Decision Tree can be the best model for weather forecasting and this model can be further enhanced to be used in many other forecasting like stock market etc. Further, text mining can be used in above models which may give faster and accurate result as desired in weather forecasting.

REFERENCES

1. Tektas M. (2010) Weather Forecasting using ANFIS and ARIMA models. A case study for Istanbul, Environmental Research, Engineering and Management, 1(51): 5-10
2. Kaur G., Chhabra A. (2014) Improved J48 Classification Algorithm for the Prediction of Diabetes, International Journal of Computer Application, 98(22), 13 – 17.
3. Nayak D. R., Mahapatra A., Mishra P., (2013) A survey on Rainfall Prediction using Artificial Neural Network, International Journal of Computer Application, 72(16), 32 – 40
4. Talib M. R., Ullah T., Sarwar M. U., Hanif M. K., Ayub N., (2017), Application of Data Mining Techniques in Weather Data Analysis, 17(6), 22 -28
5. Kumar N., Kaur R., (2015), A new proposed Methodology for Weather Forecasting Using Artificial Neural Network, International Journal of Advanced Research, 2(2)
6. Mandal S. N., Choudhury J. P., Bhadra S. R., Choudhury S. R. B., De D., (2008), Soft Computing Approach in Prediction of a time series data, Journal of Theoretical and Applied Information Technology, 3131-3141
7. Jayasingh S.K., Mantri J.K., Gahan P. (2016), Application of Text Mining for Faster Weather Forecasting, International Journal of Computer Engineering and Information Technology, Vol 8(11) 213-219
8. Saxena A., Verma N., Tripathi K.C., (2013), A review study of Weather Forecasting Using Artificial Neural Network Approach, International Journal of Engineering Research & Technology, 2(11), 2029 – 2035
9. Sanghani A., Bhatt N., Chauhan N.C., (2016), A review of Soft Computing Techniques for Time Series Forecasting, Indian Journal of Science and Technology, 9(1), 1 – 5
10. Hamidi O., Poorolajal J., Sadeghifar M., Abbasi H., Maryanaji Z., Faridi H. R., Tapak L., (2015) A comparative study of Support Vector Machines and artificial neural networks for predicting precipitation in Iran, Springer, 723 – 731

11. Jain G., Mallick B., (2017), A study of time series models ARIMA and ETS, International Journal of Modern Education and Computer Science, Vol – 4, 57 – 63
12. Babu N. R., Babu B. C. A., Reddy D. P., Gowtham M., (2015), Comparison of ANFIS and ARIMA model for Weather Forecasting, Indian Journal of Science and Technology, 8(S2), 70 – 73
13. Narvekar M., Fargose P., (2015), Daily Weather Forecasting using Artificial Neural Network, International Journal of Computer Application, Vol – 121, 9 – 13
14. Rao T., Rajasekhar N., Rajinikanth T. V., (2012), An efficient approach for Weather forecasting using Support Vector Machines, International Conference on Computer Technology and Sciences, Vol – 47, 208 – 212
15. Chawsheen T. A., Broom M., (2017), Seasonal time series modelling and forecasting of monthly mean temperature for decision making in the Kurdistan Region of Iraq, Journal of Statistical Theory and Practice, 11(4), 604 – 633
16. Shivaranjani P., Karthikeyan K., (2016) A review of weather forecasting using data mining techniques, International Journal of Engineering and Computer Science, 5(12): 19784 – 19788
17. Rupa, Jain S., (2015) A review study of Rainfall prediction using Neuro Fuzzy Inference System, International Journal of Engineering Sciences & Research Technology, 4(8), 918 – 922
18. Nayak A., Moharana Pai M. M. and M. Pai R., (2016), Prediction Models for Indian Stock Market, Elsevier, Science Direct Procedia Computer Science, 441 – 449
19. Bushara N. O., Abraham A., (2013), Computational Intelligence in Weather Forecasting, Journal of Network and Innovative Computing, Vol - 1, 320 – 331
20. Orreli D., Smith L., Barkmeijer J., Palmer T. N., (2001), Model error in weather forecasting, Nonlinear Processes in Geophysics, Vol - 8, 357 – 371
21. Sharma M., Mathew L., Chatterji S., (2014), Weather Forecasting using Soft Computing Techniques, International Journal of Advanced Technology in Engineering and Science, 2(7), 437 – 479
22. Wang S., Feng J., Liu G., Application of seasonal time series model in the precipitation forecast, Mathematical and Modelling, Elsevier, 677 – 683.

AUTHORS PROFILE

Dr J. K. Mantri pursed Master of Technology in Computer Sc. from Utkal University in year 2002 and Ph.D degree in Computer Application from Sambalpur Univeresity in year 2010. He is currently working as Reader in Department of Computer Application, North Orissa University, India, He is a life member of ISTE and ISCA. He has published 5 books and more than 58 research papers in reputed international journals including Thomson Reuters (SCI and Web of Science) and conferences including IEEE and Springer. His main research work focuses on Cryptography, Software Engineering and Computational Intelligence. He has 28 years of teaching experience.

Mr. Suvendra Kumar Jayasingh has completed his Bachelor of Engineering in Compter Science and Engineering with Honours from University College of Engineering (UCE), Burla, Odisha (Now VSSUT, Burla) in the year 2003. He got selected in Odisha Public Services Commission (OPSC) in the year 2005 to serve in Institute of Management and Information Technology, Cuttack, a constituent Collge of Biju Patnaik University of Technology (BPUT), Odisha. He has completed M. Tech. in Computer Science and Engineering from JRN RVU, Udaipur. Now, he is pursuing his Ph. D. in Computer Science and IT in North Orissa University, Baripada. His main research work focuses on Data Mining, Computational Intelligence and Soft Computing. He has 16 years of teaching experience.

Retrieval Number: D7382118419/2019©BEIESP
DOI:10.35940/ijrte.D7382.118419
Journal Website: www.ijrte.org

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)