Smart Flood Prediction and Alert System

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Abstract— **Floods are natural disasters causing distractions including loss of life and damage to buildings and other structures, including bridges, roadways, and canals. Floods are caused by meteorological events such as prolonged rainfall. Around 1, 07,487 people died due to flood in 64 years. Damage to crops, houses and public utilities that approximates to around Rs.3,65,860 crore. Major causes of distractions due to flood identified are unexpected change in climatic parameters, inefficient early warning systems etc. This paper compares a flood prediction and early warning system that employs Artificial Neural Network (ANN) with one that employs Support Vector Machine (SVM). After the comparative study the most efficient and accurate system is implemented in this project. Proposed system utilizes the daily records of data such as temperature, humidity, pressure and rainfall from the past five years for machine learning and then the system predicts rainfall based on the real time data obtained as sensor outputs. The hardware system has sensor for collecting data, then a cloud for storing them and the computer system with trained network for predicting flood. Proposed system can thus reduce the destructions caused by flood by predicting in advance and hence enabling to take necessary preventive measures.**

Keywords—artificial neural network, support vector machine, machine learning

I. Introduction

Floods are natural disasters causing distractions including loss of life and damage to buildings and other structures, including bridges, roadways, and canals. Floods are caused by meteorological events such as prolonged rainfall. Around 1,07,487 people died due to flood in 64 years. Damage to crops, houses and public utilities that approximates to around Rs.3,65,860 crore. Major causes of distractions due to flood identified are unexpected change in climatic parameters, inefficient early warning systems etc. This paper compares a flood prediction and early warning system that employs Artificial Neural Network (ANN) with one that employs Support Vector Machine (SVM). After the comparative study the most efficient and accurate system is implemented here. Proposed system utilizes the daily records of data such as temperature, humidity, pressure and rainfall from the past five years for machine learning and then the system predicts rainfall based on the real time data obtained as sensor outputs. The hardware system has sensor for collecting data, then a cloud for storing them and the computer system with trained network for predicting flood. Proposed system can thus reduce the destructions caused by flood by predicting in advance and hence enabling to take necessary preventive measures.

In August 2018, the state of Kerala (India) saw expansive scale flooding, which influenced a large number of individuals and caused at least 400 deaths[11]. When conducted a study on the return period of extreme rainfall and the potential role of reservoirs in the recent flooding in Kerala state, it was found that Kerala experienced 53 percentage above normal rainfall during the monsoon season (till August 21st) of 2018. Moreover, 1, 2, and 3-day extreme rainfall in Kerala during August 2018 had return periods of 75, 200, and 100 years. Six out of seven major reservoirs were at more than 90 percentage of their full capacity on August 8, 2018, before extreme rainfall in Kerala. Extreme rainfall at 1–15 days durations in August 2018 in the upstream of the three major reservoirs (Idukki, Kakki, and Periyar) had the return period of more than 500 years. Extreme rainfall and almost full reservoirs resulted in a significant release of water in a short-span of time. Therefore, above normal seasonal rainfall (before August 8, 2018), high reservoir storage, and unprecedented extreme rainfall in the catchments where reservoirs are located worsened the flooding in Kerala. Reservoir operations need be improved using a skillful forecast of extreme rainfall at the longer lead time (4–7 days). This paper is ought to predict the rainfall pattern using artificial intelligence.

The following session II deals with the studies related to the current work, session III explains the experimental setup and working of the proposed model and finally the results are discussed in session IV.

II. Related Works

In [1] an IoT based flood monitoring and artificial neural network (ANN) based flood prediction is designed. IoT approach is deployed for data collection from the sensors and communication over Wi-Fi. Also two different algorithms , Gradient Descent With Adaptive Learning Algorithm and Levenberg-Marquardt Algorithm are compared to find the better result. Multi Linear Perceptron (MLP) based ANN's Feed Forward (FF) and Back Propagation (BP) algorithm is used to predict flood in [2]. Flood forecasting technique [3] based on an artificial neural network (ANN) model, namely, Multi-layer Perceptron (MLP). A disaster management strategy may be divided into two sequential phases, namely, pre-disaster management and post-disaster management. Prior to a disaster, management activities are pre-disaster planning, and disaster prediction. A good disaster prediction technique plays a crucial role in an efficient mitigation of disaster such as flood. A novel regression technique, called Support Vector Machine (SVM), based on the statistical learning theory is explored in [4]. In [5] an IoT and machine learning based embedded system is proposed to predict the probability of floods in a river basin. The model uses a modified mesh network connection over ZigBee for the WSN(Wireless Neural Network) to collect data, and a GPRS module to send the data over the internet. The data sets are evaluated using an artificial neural network model. [6] proposed ANN modeling for flood water level prediction

for early warning system using BPNN with NN Inverse Model placed at the output for performance improvement. The Back Propagation algorithm was applied based on dataset obtained from the Department of Irrigation and Drainage Malaysia. The algorithm seeks to minimize the value of error function based on the complexity and performance of the Artificial Neural Network. This is done by adjusting the model parameters values to obtain optimal results.S[7] presents a river flood prediction using support vector machine technique. The performance of the SVM models are compared with that of Multilayer Perceptron (MLP) model. The experimental results shows that the SVM models can perform better than the MLP models.

III. EXPERIMENTAL SETUP AND WORKING

The hardware consists of the sensor BMP180 that can measure both temperature and pressure simultaneously. This is now interfaced with the processor i.e, Raspberry pi module.

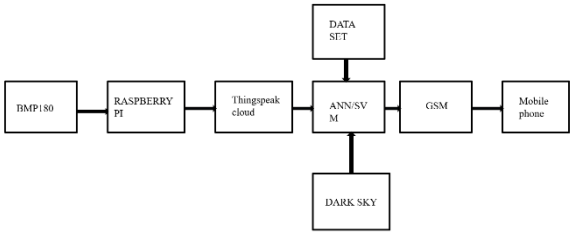


Fig1:Proposed system

The Raspberry pi then uploads the sensor outputs to the ThingSpeak cloud through WiFi. Now the ANN or SVM network can access the sensor measured values of temperature and pressure from the cloud. The present rainfall data is accessed here from a site called 'Darksky' which is considered to be the most accurate.

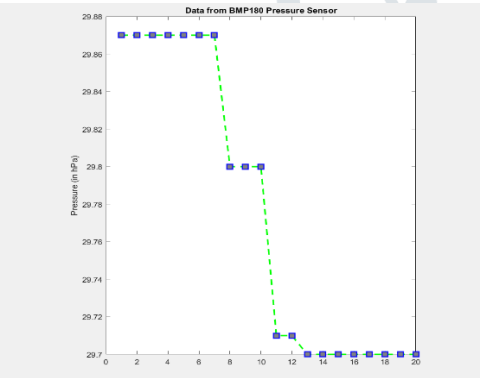
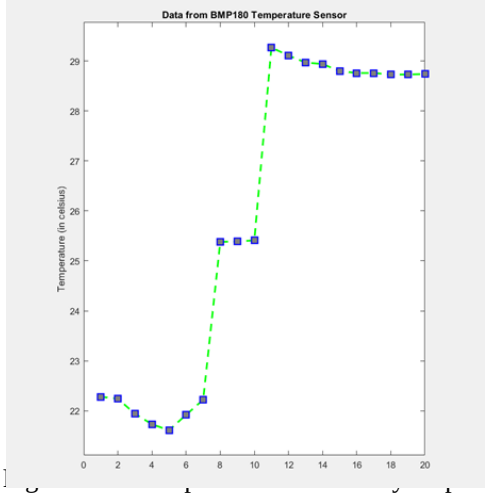


Fig2:Plot of pressure values recorded by bmp180



ANN/SVM predicts the rainfall and thus flood can be foreseen and alert people. The GSM technology is employed to send alert messages to the desired group.

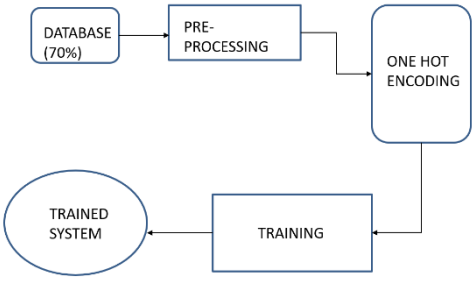


Fig4:Training system

Fig5:Testing system

Here 70% database is used for training the ANN and 30% database is used for testing the ANN.

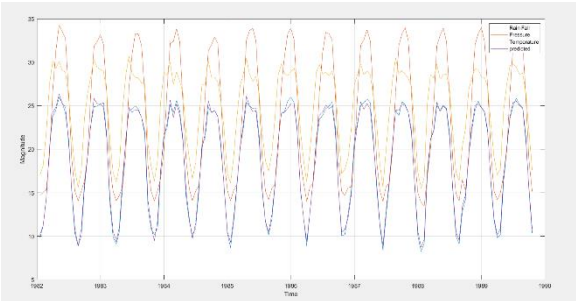


Fig6:Plot of dataset by SVM

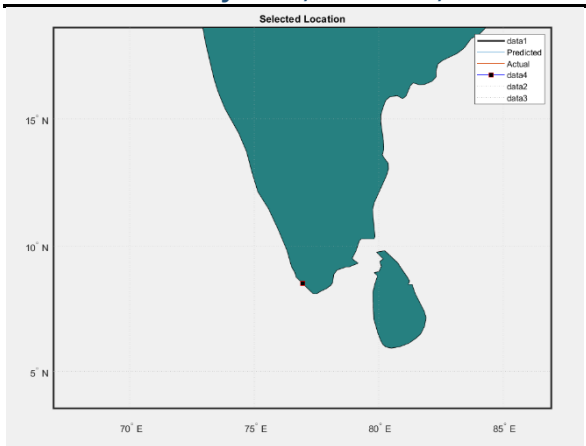


Fig7:Location where the prediction is done

Here the data such as temperature and pressure that are recorded by the BMP180 sensor are uploaded to the thingSpeak cloud using internet of things technology. The BMP180 sensor records both temperature and pressure. Now this sensor is connected to the Raspberry pi module using I2C serial communication protocol. The Raspberry pi is connected to a wi-fi over which we access the cloud. In the ThingSpeak cloud we have a channel each for temperature and pressure separately.

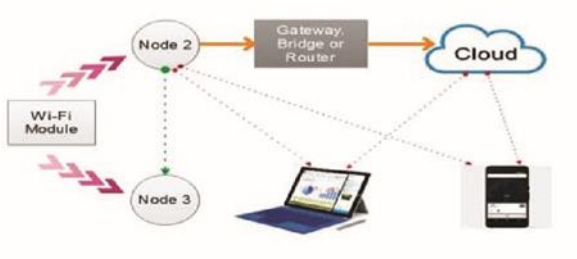


Fig8:Communication model

Now using the wi-fi the recorded data is uploaded to the corresponding channels. An ID and secret key are required for uploading the data. Now the trained neural network or SVM network that is present in the PC connected to wi-fi will retrieve the data from the cloud using another ID and secret key. Thus communication between cloud and the hardware is made possible by adopting the technology called internet of things.

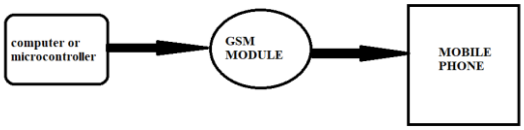


Fig9: Sending alert message

The GSM technology is employed to send alert messages to the people in the locality or to the desired authority. This technology is a scalable and flexible one. In other words the message can be of different purposes. Firstly it can be an alert to the occupants of an area in which prediction is being done then it can be just a message with rainfall data sent to the concerned authority and the authority makes decision about the flood.

IV. Results and Discussion

The graph of actual rainfall plotted against the predicted rainfall during the testing stage is shown in the figure below. It is evident that the deviation is quite small and the system can be considered almost accurate. This system can be effectively used to predict the actual rainfall of the area under observation and send proper communication about the same.

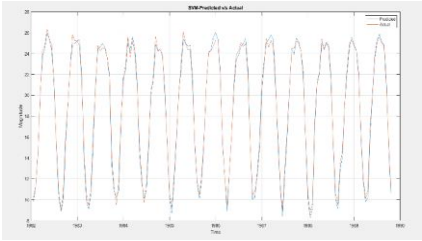


Fig10: Comparison of SVM predicted rainfall

The figure below shows the plot of rainfall predicted using NARX network in ANN and the actual rainfall from database.

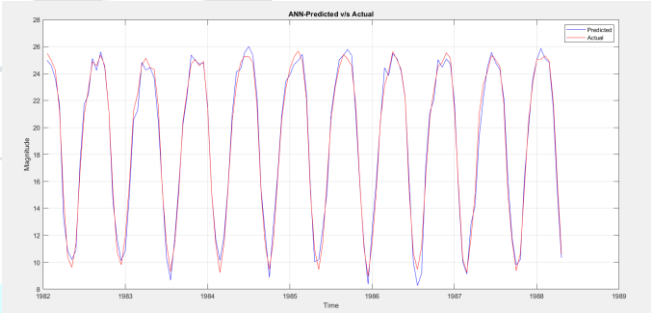


Fig11: Comparison of ANN predicted rainfall

On comparing the performance of SVM and ANN, it was found that for a given number of hidden layer size defined for the ANN network, the SVM provided a better prediction within a very short time span.

References

[1] Abhjit Paul and prodipto Das ,"Flood prediction model using ArtificialNeural Network",july 2014.

[2] V. Seal, A. Raha, S. Maity, S. K. Mitra, A. Mukherjee, and M. K. Naskar, "A Simple Flood Forecasting Scheme using Wireless Sensor Networks," International Journal o Ad hoc, Sensor & Ubiquitous Computing (IJASUC), vol.3, no.1, pp. 45-60, 2012.

[3] V. Sehgal and C. Chatterjee,"Auto Updating Wavelet Based MLR Models for Monsoonal River Discharge Forecasting," International Journal of Civil Engineering Research, vol. 5, no. 4, pp. 401-406, 2014

[4] Shie-Yui Liong and Chandrasekaran Sivapragasam." Flood Stage Forecasting with Support Vector Machines", VOL. 38, NO. 1, February 2002

[5] M. B. Kia, S. Pirasteh, B. Pradhan, A. R. Mahmud, W.N. A. Sulaiman, and A. Moradi, "An artificial neural network model for flood simulation using GIS:Johor River Basin,Malaysia," Environ Earth Sci. Available:doi:10.1007/s12665-011-1504-z.

[6] S. Fang, L. Xu, H. Pei, Y. Liu, Z. Liu, Y. Zhu, J. Yan,and H. Zhang, "An Integrated Approach to Snowmelt Flood Forecasting in Water Resource Management,"Industrial Informatics, IEEE Transactions on, vol. 10, no. 1, pp. 548-558, 2014.

[7] Y. Chakhchoukh, P. Panciatici, and L.Mili, "Electric Load Forecasting Based on Statistical Robust Methods," Power Systems, IEEE Transactions on, vol. 26, no. 3, pp.982-991, 2011.

[8] Z.J. Haas, T. Small, "A new networking model for biological applications of ad hoc sensor networks,"Networking, IEEE/ACM Transactions on, vol. 14, no. 1, pp. 27-40, 2006.

[9] F. Hossain, E.N. Anagnostou, and T. Dinku, "Sensitivity analyses of satellite rainfall retrieval and sampling error on flood prediction uncertainty," Geoscience and Remote Sensing, IEEE Transactions on, vol. 42, no. 1, pp. 130-139, 2004.

[10] Y. Zhang, Y. Hong, X. Wang, J.J. Gourley, J. Gao, H.J. Vergara, and B. Yong, "Assimilation of Passive