USE of VARIOUS INTEGRATED TECHNOLOGIES in PREVENTING FLOOD DISASTER

J. Michael Antony Sylvia1, Dr.M.Pushpa Rani2
Department of Computer Science, Mother Teresa Women's University, Kodaikanal, India.
1 minusylvia@yahoo.co.in
Department of Computer Science, Mother Teresa Women's University, Kodaikanal, India.
2 drpushpa.mtwu@gmail.com

INTERODUCTION

Abstract - **Monitoring and analyzing the environmental parameters accurately predict the occurrence of flood disaster. Appropriate disaster warning in turn would support the concerned authorities to take precautionary measures. Traditional technologies step behind in efficient disaster management process. Hence need arouse in further technological development to accurately predict and warn people about the disaster occurrence. Recently developed disaster management systems with integrated technologies such as IoT, Machine Learning, Deep Learning, Crowd Sourcing and Artificial Intelligence have enhanced the entire process of disaster management with few limitations. This paper surveys the various existing integrated technologies used in disaster management process.**

Keywords: Internet of Things, Machine Learning, Deep Learning, Crowd Sourcing, Artificial Intelligence, Disaster Warning, Disaster Management.

I. INTRODUCTION

Disasters mostly happen in areas of human livelihood. Either natural or man-made, mishaps have moved out of control of human resistive mechanisms. Over the past decade, flood the huge deadly natural disaster has become highly responsible for more than 800,000 human lives and 300 billion USD economic losses. Extreme effect of meteorological events significantly reflects in the frequency and intensity of flood happenings [9]. To mitigate the occurrence of causalities and environmental / infrastructure damage and to pre-plan supportive measures these disasters necessitates anticipatory process.

Effective monitoring, early and accurate prediction and timely warning of flood status are essential for flood disaster management. Internet based technology caters to this purpose. IoT is a widespread technology which has embedded devices to gather data from sensors and predict flood hazards. Other than IoT use of analytics has also served the need in flood prediction and management. Due to rapid growth in internet and connectivity, information can easily be shared among people. Implementation of recent methods integrating IoT highly benefits the performance of disaster management process. Recent research works on related studies is reviewed in this paper.

II. LITERATURE SURVEY

Abdullahi et. al in [7] developed a flood warning system. Sensor data was stored on ThingSpeak Cloud through NodeMCU ESP8266 for real time visualisation. Flood status was predicted using a two

class Neural Network model of Microsoft Azure based on a predefined rule. Prediction results showed 98.9% of highest accuracy and 100% of precision with three hidden layers.

Suresh et. al in [1] developed a flood prediction system where DNN was employed to predict the flood occurrence based on temperature and rainfall intensity. Comparing with other ML classification algorithms such as SVM, Naive Bayes and KNN the proposed method DNN with multiple hidden layers outperformed with better accuracy of 89.71%.

M. Anbarasan et. al, in [2] designed a system for detecting flood disaster using IoT, big data and CDNN. Input is taken from big data and repeated data are reduced using HDFS map reduce() function. Data is preprocessed and a rule is generated. CDNN classifies the rule that is given as its input as chances of flood occurrence and no chances of flood occurrence. Comparative analysis shows better accuracy of 93.23%.

In [4] Viet-Nghia Nguyen et. al, suggested a new modelling approach for spatial prediction in flash flood. Dataset from flood inventory map and geospatial database was trained and verified using CHAID-RS-BBO model. Predictive analysis was done with statistical metrics and the results show a highest predictive performance with overall accuracy of 90%.

III. FLOOD DISASTER MANAGEMENT TECHNIQUES

A. Flood Prediction and Analysis

Flood occurrence can be predicted using various methods. Fig1 depicts the different phases involved in flood prediction. Initial stage is to collect the sensor monitored environmental parameters through Raspberry pi microcontroller. Collected data is then transmitted and stored in cloud using Wifi module.

In data analysis module, flood data from the cloud is being preprocessed in order to eliminate the redundant features and extract the necessary ones to enhance further learning process at a minimum time.

Required features from the flood data are then recognized and extracted for further process in the next stages of feature extraction and selection.

Machine learning techniques are applied on the selected features to predict flood occurrence.

In prediction of flood occurrence an immediate warning is sent through a mobile app.

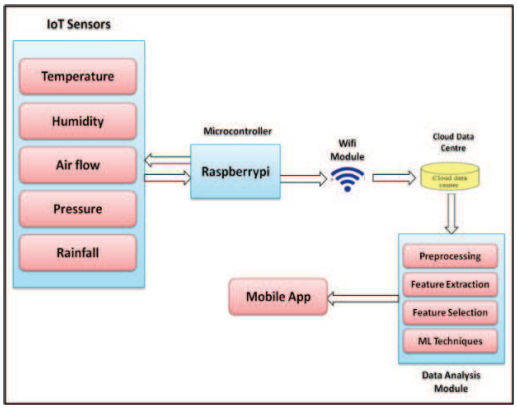

Fig. 1. Stages of Flood Prediction

B. Flood Prediction using 2 Class NN

Abdullahi et. al [7] uses Microsoft's Azure Machine Learning with an in built 2-class neural network to predict flood status according to a predefined rule. Real time monitored data is been gathered from two sensors: water level sensor and pressure gauge sensor. Data collected is then stored in a ThingSpeak cloud platform for further process using Node MCU ESP8266. Pressure gauge meter proves the strong correlation between water flow rate and its pressure. Flood status of the new inputs is predicted through Web service provided. Analysis shows highest accuracy of prediction in using 3 hidden layers.

C. Flood Prediction and Forecasting using DNN

Suresh et. al in [2] utilized DNN for flood prediction and forecasting. Dataset consisted of observed

rainfall and minimum and maximum temperature. Dataset is preprocessed and split as training and testing sets. The system is then defined and trained. DNN with multiple hidden layers is used to classify the dataset. If a high bias is seen then the model is not suitable and has to be redefined. Until lower bias is done the process is redone. Once lower bias is seen the model is tested and deployed.

D. Detecting Flood Disaster using CDNN

M. Anbarasan et. al, in [1] employed CDNN classifier to detect flood disaster. This system gathered data from big data. Redundant data were reduced using HDFS map reduce() function. Implementing missing value imputation and normalization function the data was then pre-processed. On application of combination of attributes method a rule was generated based on the pre-processed data. The rule generated was given as input to CDNN classifier to classify it as chances of flood occurrence and no chances of flood occurrence. Analysis show highest prediction accuracy.

E. Flood Level Classification using Gait Analysis

The gait characteristics in different flood levels are captured using smart phone sensors, which are then used to classify flooding levels. In order to accomplish this smart phone sensor data, reading have been taken by 12 volunteers in pools of different depths, and have been used to train machine learning models in a supervised manner. Support vector machines, random forests and naive bayes models have been attempted, of which support vector machines perform best with classification accuracy. The most relevant features of classification match the intuitive understanding of gait in different flooding levels.

TABLE I
COMPARISON OF INTEGRATED TECHNOLOGIES FOR FLOOD DISASTER MANAGEMENT

Purpose	Technology used	Dataset	Accuracy
Flood Prediction	Azure ML	Sensor Data	98.9%
Flood Prediction and Forecasting	DNN	Temperature and Rainfall Intensity	89.71%.
Detecting Flood	CDNN	Big data	93.23%.
Flood Level Classification	Gait analysis	Sensor data	99.45%

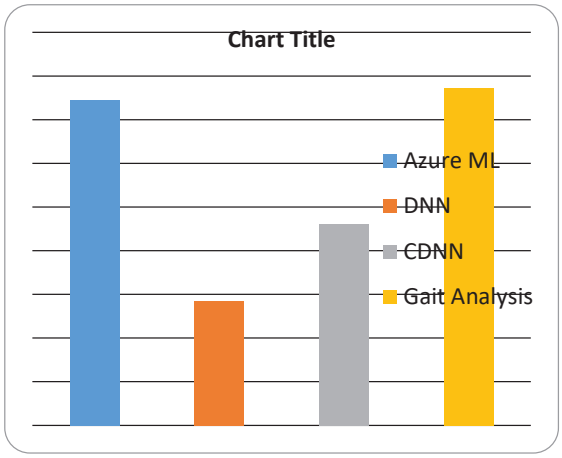

FIG. 2. GRAPHICAL REPRESENTATION OF ACCURACY

IV. CONCLUSION

This paper highlighted the review on various integrated technologies proposed for flood prediction and forecasting in different literatures. Most of these innovations in the research progress is still in the starting time and there is a huge path to penetrate through. Research works can be extended with intelligent based techniques for effective flood prediction and forecasting with minimum time and accuracy.

REFERENCES

1. *Suresh Sankaranarayanan, Malavika Prabhakar, Sreesta Satish, Prerna Jain, Anjali Ramprasad and Aiswarya Krishnan, "Flood Prediction Based on Weather Parameters Using Deep Learning", Journal of Water and Climate Change, 2019.*

2. *M. Anbarasan, Bala Anand Muthu, C.B. Sivaparthipan, Revathi Sundarasekar, Seifedine Kadry, Sujatha Krishnamoorthy, Dinesh Jackson Samuel R., A. Antony Dasel "Detection of Flood Disaster System based on IoT, Big Data and Convolutional Deep Neural Network", Computer Communications, Elsevier, Pp. 150-157, November 2019.*

3. *Ujjawal K.Panchal, Hardik Ajmani and Saad Y. Sait "Flooding Level Classification by Gait Analysis of Smartphone Sensor Data", IEEE Access, Vol 7, Pp. 181678-181687, 2019.*

4. *Viet-Nghia Nguyen, Peyman Yariyan, Mahdis Amiri, An Dang Tran, Tien Dat Pham, Minh Phuong Do, Phuong Thao Thi Ngo, Viet-Ha Nhu, Nguyen Quoc Long and Dieu Tien Bui, "A New Modeling Approach for Spatial Prediction of Flash Flood with Biogeography Optimized CHAID Tree Ensemble and Remote Sensing Data", Remote Sensing, MDPI, 2020.*

5. *Partha Pratim Ray, Mithun Mukherjee and Lei Shu, "Internet of Things for Disaster Management: State-of-the-Art and Prospectus", IEEE Access, October 2017.*

6. *Syed Attique Shah, Dursun Zafer Seker, Sufian Hameed and Dirk Draheim, "The Rising Role of Big Data Analytics and IoT in Disaster Management: Recent Advances, Taxonomy and Prospects", IEEE Access, Pp. 54595-54614, Vol 7, May 2019.*

7. *Salami Ifedapo Abdullahi, Mohamed Hadi Habaebi and Noreha Abd Malik, "Intelligent Flood Disaster Warning on the fly: Developing IoT Based Management Platform and Using 2-Class Neural Network to Predict Flood Status", Bulletin of Electrical Engineering and Informatics, Vol. 8. No. 2, Pp. 706-717, ISSN:2302-9285, June 2019.*

8. *Nur-adib Maspo, Aizul Nahar Harun, Masafumi Goto, Mohd Nasrun Mohd Nawi, Nazul Azam Haron, "Development of Internet of Things(IoT) Technology for Flood Prediction and Early Warning System(EWS)", International Journal of Innovative Technology and Exploring Engineering, Vol. 8, Issue 4, February 2019.*

9. *D. Vito, Politecmico di Milano, "Use of Multivariate Machine Learning Analysis Techniques For Flood Risk Prevention", The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Vol XLII-3/W4, 2018.*