ISSN: 2321-7782 (Online)
Volume 2, Issue 12, December 2014
International Journal of Advance Research in Computer Science and Management Studies
Research Article / Survey Paper / Case Study
Available online at: www.ijarcsms.com

Survey on Real-Time Flash-Flood Monitoring, Alerting and Forecasting System using Data Mining and Wireless Sensor Network

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Abstract: In this paper, we present Real-Time Flash-Flood Monitoring, Alerting and Forecasting System using Data mining and wireless sensor Network.

Our System not only Measures River Water level and Different weather conditions such as temperature, humidity and vibration through wireless sensor nodes but also we can forecast possibility of future disasters by using Data mining algorithm on our database.

Hazardous condition information and forecasted information is employed for early-warning with the use of server to different types of mobile phones. a>Android mobile phones or smart phone connected via a web service. b>Non-smart phones are connected via SMS (Short Message Service)

We use micro-controller for connecting server to the different sensors like Level sensor, temperature sensor and Vibration sensor with the help of RS-232 and ADC.

We also used our database to store the log files containing information about history of atmospheric conditions to help to forecast and study the future alerting.

Keywords: Wireless Sensor Network(WSN),Short MessageService(SMS),ADC.

I. INTRODUCTION

Everyone is aware of damage caused by flash floods. That kill more people worldwide than any other natural disaster in an average year, flash floods kill more than 5,000 unsuspecting people and cause millions of dollars of property damage.

During floods especially in flash floods the people's asset like roads, bridges, farms, houses and automobiles are destroyed.so many People become homeless. Additionally, the government deploys firemen, police and other emergency apparatuses to help the affected; that usually takes years for affected communities to recover and be re-built and business to come back to normalcy.

In 2011, a huge tsunami hits the Japan's; causing that sea water flooded a part of the coastline. That flooding caused massive leakage in nuclear plants this causes high radiation in that area. Authorities in Japan fear that Fukushima radiation levels are 18 times higher than even thought.

On 30 July 2014, a landslide occurred in the village of Malin in the Ambegaon taluka of the Pune district in Maharashtra, India. The landslide, which hit early in the morning while residents were asleep, was believed to have been caused by a burst of heavy rainfall, and killed more than 160 people.

Flash-Flooding or flooding is extremely dangerous and that has the capability to not only wipe away an entire city, coastline or area, but also it causes extensive damage to life and the property. Flash-Flooding or flooding also has great erosive power and can be extremely destructive, even if it is a foot high. This is a natural event or occurrence where a piece of land (or area) that is usually dry land, suddenly gets submerged under water. Some floods can occur suddenly and recede quickly. When floods happen in an area that people live, the water carries along objects like houses, bridges, cars, furniture and even people.

A flood warning is when an official announcement is given (by TV, Radio, Text Message or Phone, Email or other means) of an impending flood or an already flood that has already occurred. So we need a system that not only gives us a warning but also it tell us approximate date or month that there is possibility of Flash-flood so the people move to safe places or at least they prepare before some damage happens.

II. LITERATURE SURVEY

International Workshop on Flash Flood Forecasting held in San Jose, Costa Rica from 13-17 March 2006 in this workshop the topic of world-wide flash flood guidance systems was raised; this workshop was organized by the World Meteorological Organization and the U.S. National Oceanic and Atmospheric Administration/National Weather Service that is known as WMO and NWS respectively. During this workshop both NWS &WMO indicates strong need for global, remote sensing-based solutions to the flash flood problems throughout the world, especially for helping to resolve these issues in third world and developing countries.

World Meteorological Organization (WMO) indicated that early warning systems must be supported by strong governance and organizational coordination mechanisms. This is necessary to make sure that warnings are developed properly and the received messages are understandable and disseminated to those at risk and those that have the responsibility to take action in a timely fashion to ensure safety of lives, livelihoods and property.

Jong-uk Lee, Jae-Eon Kim, Daeyoung Kim, and Poh Kit Chong [1] presented the Real-time Flood Monitoring System with Wireless Sensor Networks which is deployed in two volcanic islands Ulleung-do and Dok-do located in the East Sea near to the Korean Peninsula and developed for flood monitoring. RFMS Measures River and weather conditions through wireless sensor nodes equipped with different sensors.

In Real-time Flood Monitoring System with Wireless Sensor Networks WSN[1] paper Firstly The base station Collects the packets from sensor nodes & then transfers them to back-end server via CDMA/ADSL. a web-enabled camera is used to survey the current status of actual environment. Back-end networks are then verify the measured data delivered from sensor nodes in real-time. Secondly Data from each river is stored in the database which is designed to the measured data by rivers and sensor nodes. Thirdly The GUI-based web service providing 3D model, data graph, and other representation materials for better readability for users.

After studying Real-time Flood Monitoring System with Wireless Sensor Networks WSN [1] paper we come to know that this system cannot provide or measures the different environmental conditions using wireless sensor network

Mauricio Castillo-Effen, Daniel H. Quintela, Ramiro Jordan, Wayne Westhoff and Wilfrido Moreno [2] presented the ongoing effort in providing the population of the Andean region of Venezuela with a flash-flood alerting system by making use of state-of-the-art wireless communications and information technologies. A key component of the project is a Wireless Sensor Network (WSN) that is used for monitoring the environment and tracking the disaster while it evolves.

In Wireless Sensor Networks for Flash-Flood Alerting [2] paper, The WSN will comprise three major types;

Firstly the type of nodes used:

- Hydrological Node: this node is Located in the shore along the river and each hydrological node will monitor the water level and water flow.
- Meteorological Node: this node is Located in the surrounding fields next to the river, each meteorological node will monitor light, temperature, humidity, barometric pressure, wind direction, and wind speed.
- Landslide Node: this node is strategically placed in hazardous locations like in the neighboring mountains; the node will have a geophone, a soil moisture sensor, and a creep sensor.

Secondly the Alarm generation In Wireless Sensor Networks for Flash-Flood Alerting [2] to generate alarm messages, the occurrence of a flash flood has to be identified and/or predicted. The life-cycle of a flashflood presented before, can be associated with different alarm levels. Higher levels reflect a more critical situation implying the imminent strike of a flash-flood.

Thirdly the Geographical Information System In Wireless Sensor Networks for Flash-Flood Alerting [2] a Geographical Information System (GIS) is used which has all the features that needed to implement complex environmental models and alert message generation since it allows to access to a database that associates information tied to spatial location. The big additional advantage of GIS systems is the ability to generate the HTML code that can be used for broadcasting the relevant information through the internet.

After studying Wireless Sensor Networks for Flash-Flood Alerting [2] paper we come to know that following disadvantages

- This system cannot provide or measures the different environmental conditions using wireless sensor network.
- Wireless Sensor Networks for Flash-Flood Alerting [2] also not provide forecasting of future disasters.

Gustavo Furquim, Filipe Neto, Gustavo Pessin, Jó Ueyama, João P. de Albuquerque, Maria Clara, Eduardo M. Mendiondo, Vladimir C. B. de Souza, Paulo de Souza, Desislava Dimitrova, Torsten Braun [3] they investigate with machine learning (ML) classification techniques to assist in the problem of flash flood nowcasting, They also evaluated forecasting.

In Combining Wireless Sensor Networks and Machine Learning for Flash Flood Nowcasting [3] paper Firstly They have carried out an investigation with machine learning classification techniques to help in flash flood monitoring. They also build a Wireless Sensor Network that collects measurements from a river located in an urban area.

Secondly in Combining Wireless Sensor Networks and Machine Learning for Flash Flood Nowcasting [3] paper they also used machine learning classification that allow the flash flood monitoring. Which enables the WSN to give alerts to the local population and authorities.

Thirdly in Combining Wireless Sensor Networks and Machine Learning for Flash Flood Nowcasting [3] paper they have evaluated several types of ML with the help of WEKA which allows a better comparison of the results; and they have also evaluated different data representations that can be used as input for the ML techniques

They also evaluated forecasting. Hsieh and Jourdan [4] suggested a riverflow prediction system for the Helmand River in Afganistan. They proposed to use of Artificial Neural Networks to predict the behaviour of the river. They considered years of data and use of ANN to obtain an operational river flow prediction model. This proposed operational river flow prediction model forecast the behaviour of the river in the next few days.

Joel T. de Castro, Gabriel M. Salistre, Jr, Young-Cheol Byun and Bobby D. Gerardo [5] they presented the GSM Modem which is connected to PC to interface with different types of software such as HyperTerminal, Bus Hound and others. They use the AT+CMEE command which used to change the error messages display mode. Whenever the water level reaches at set level, it triggered the sensor and the signal was amplified at the amplifier system then microcontroller responds to the signal which

sent the information to MAX-232 IC to amplify the data and sent it to the transmitter. Lastly whatever was received at the other end was then monitored by the GUI [6].

In Flash Flood Prediction Model based on Multiple Regression Analysis for Decision Support System [5] paper firstly it is Based on the training data captured; the data is capture for seven days, and the regression equation was developed while the actual/real time data were input to the regression model. Then the prediction model was computed with the assumption that water speed has high contributory factor for flashflood. This model is then used to forecast likelihood of flashflood using the readings current data.

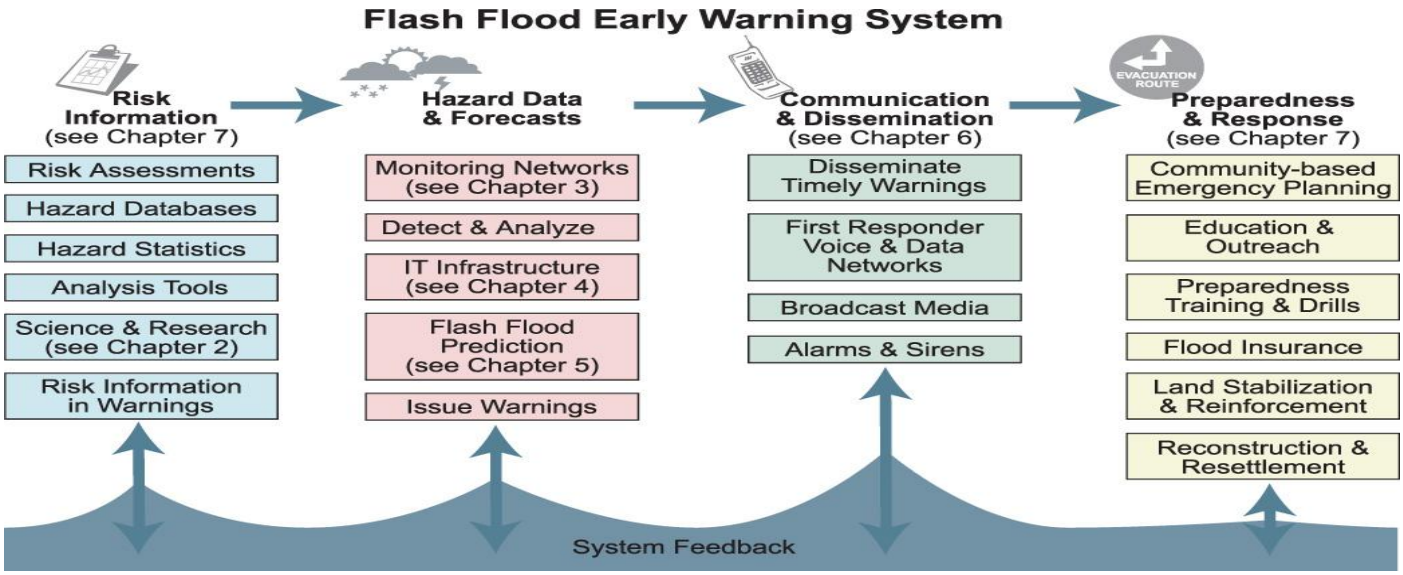

Fig. 1 Components of a flash flood [7]

Figure 2 shows flood stage/bankfull and the threshold runoff with water in the stream,they calculated threshold runoff value by using bankfull stage from field surveys of ungauged streams. It is then possible using rainfall/runoff curves to calculate how much rainfall will produce this threshold runoff.

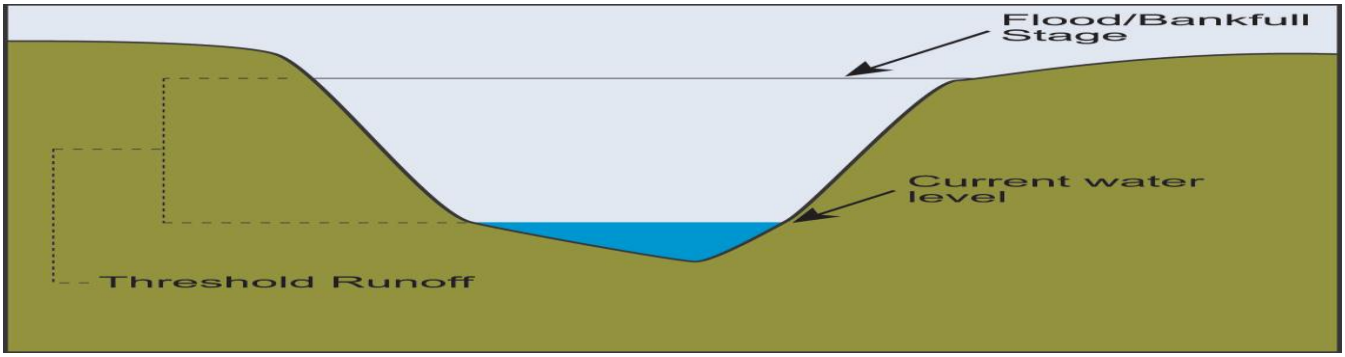

Fig. 2 Threshold Runoff [7]

III. NEED

There is a strong need for the implementation of a flash flood guidance system globally. Very few local human-machine systems are available throughout the world to provide early warning against these devastating events and many such systems that are implemented provide no significant early warning for these disasters. Presently, vast flash flood prone areas remain without any surveillance with unmitigated threat for millions of people worldwide.

So we need a system that not only gives us a warning but also it tell us approximate date or month that there is possibility of Flash-flood so the people move to safe places or at least they prepare before some damage happens.

- To gather relevant data from the threatened region where the flash-flood and landslides originate.
- To Extract and graphically display relevant information to assist authorities to make decisions.

- To Register the collected data and store it for later use.
- To generate alerting signals to peoples with the help of alarm and by sending SMS to peoples and authorities.
- To monitor, alert and forecast hazardous conditions.
- To allow the users to interact with the system via mobile portable devices.

IV. PROPOSED SYSTEM

After studding literature survey we modified these papers works and trying to build a Novel technique that will give us best result like Notifications to the user that something bad might happen to their mobile phones as well as give future forecasting predictions to the users so the people move to safe places or at least they prepare before some damage happens.

First of all we collect different sensor values and send it to the ADC for Analog to digital conversion then these digital signals are forwarded to microcontroller then microcontroller have task to convert this digital data into user define format and send data to server with the help of RS-232. Every collected values or Data Logs are store in Database, by applying the Data mining on database we can get the future prediction values.

We use data mining as a naive Bayes classifier is a simple probabilistic classifier based on applying Bayes' theorem with strong (naive) independence assumptions. A more descriptive term for the underlying probability model would be "independent feature model"

In simple terms, a naive Bayes classifier assumes that the presence (or absence) of a particular feature of a class is unrelated to the presence (or absence) of any other feature, given the class variable. For example, a fruit may be considered to be an apple if it is red, round, and about 4" in diameter. Even if these features depend on each other or upon the existence of the other features, a naive Bayes classifier considers all of these properties to independently contribute to the probability that this fruit is an apple.

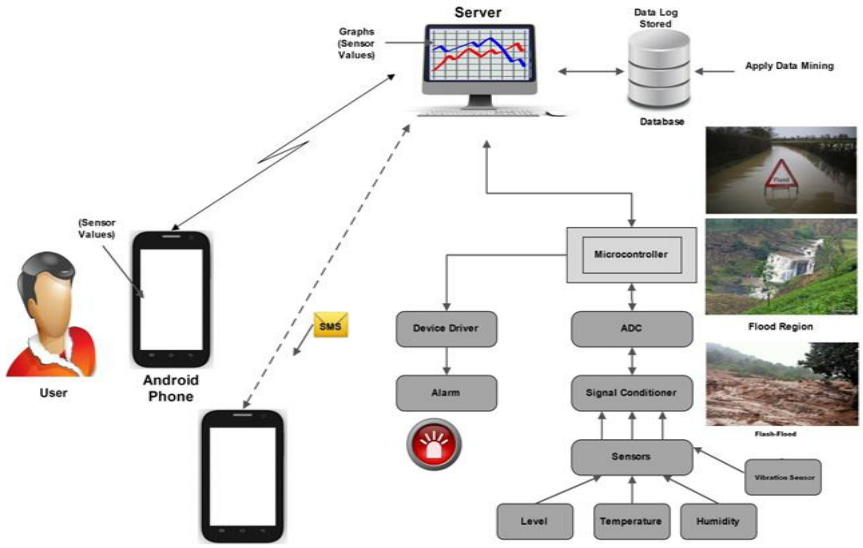

Fig.3 System Architecture

First step in Database Design is to use data structures like Vectors and Lists. These come under Java Collections API. Secondly we declare our own classes using these data structures. E.g. A class Student to hold all the student information. Now these classes need to be pre-compiled and called within Java application as libraries. This is called as a Java Class Library.

Fig. 4 Steps to Acquire and Process

Now class objects cannot be saved to hard drive directly. We need to convert these objects to bytes so that they can be saved to hard drive. To do this we must use a concept called as Serialization. Basically it is a concept where in objects are converted to byte streams so that they can be saved to hard drive or sent via internet and vice versa. The reverse process is called as deSerialization. Finally to save these bytes to hard drive or to send them via network we need Java I/O.

V. CONCLUSION

We are trying to build a Novel technique that will give us best result to get better understanding of the Environmental conditions and to alert in and before hazardous conditions to the authorities and uses.

That include not only monitoring and alerting to to the authorities & uses but also it provides future predictions for the future disasters to the user.

Our system not only just monitors hazardous conditions and Alert hazardous conditions but also it forecast hazardous conditions and allow the users to interact with the system via mobile portable devices like android phones and non- android phones via SMS (Short Message Service).

Hence we come to conclusion that Real-Time Flash-Flood Monitoring, Alerting and Forecasting System is more advanced technique that can provide us best features.

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