EARLY FLOOD MONITORING SYSTEM USING IoT APPLICATIONS

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Abstract - *Flood is an unavoidable natural disaster in all over the world, causing heavy flow of water and also severe damage to properties and lives. For this reason we need to create a flood detection system to monitor rising water residential areas. By using ultrasonic sensors we need to create flood level sensing devices which will detect the water level. This system is integrated to the microcontroller board which will help to send the data each time the water reaches the threshold value. The Raspberry pi module will help to connect the internet and keep track of data on a daily basis. The data through the Raspberry pi module will be stored in a cloud. The data stored in the cloud will help to send it to the users. The user can get real-time information on monitoring flooded roads through android application. Due to the android application it is user friendly and helps to get information in one touch. Updates will be given to the rescue team and to the residents of the locality. And in order to alert the person in charge of the control unit, the buzzer and LED will give information. The rescue team can also predict the flood with the help of previous records they stored. This system can also predict the possibility of flooding. It can be done from the historic data stored in the cloud. Machine learning algorithms can be used for this prediction.*

Key Words: Internet of Things, Raspberry pi module, Ultrasonic sensor.

1. INTRODUCTION

Flood is an unavoidable natural disaster in all over the world, causing heavy flow of water and also severe damage to properties and lives. Material, human, economic and social losses in flood areas, infection from water are the main effects of flood. As well as the risks to life suffered by families in these areas, the economic damage has also imposed the burden of having to recover from their financial losses. Flash floods and massive traffic jam on roads also caused by heavy rain . Thus, it is important to be able to warn the people who are most at risk, so that the effects of these disasters can be reduced.

Nature is a blessing for the humanity. But sometimes this scenario changes as the natural calamities take place. Natural disasters have become a major concern throughout the world. especially in the developing countries such as Bangladesh, Malaysia etc. Flood is also one of the natural calamity. In order to prevent the devastating effects of floods before such events occur, early warning for people to evacuate in the nearby areas can be effective in saving lives and to prevent disasters . Generally, flooding cannot be stopped and unavoidable, but early detection or warning system can be used to reduce losses faced by the citizen and government.

For this reason, we need to create flood level sensing devices which will detect the water level. This system is integrated to the microcontroller board which will help to send the data each time the water reaches the threshold value .Ultrasonic sensor is used to detect the water level. The Raspberry pi module will help to connect the internet and keep track of data on a daily basis. The data through the Raspberry pi module will be stored in a cloud. If water level reaches threshold value, people will get alert messages on their phone through android applications. And LED and Buzzer can be used to alert people. This will be done through prediction algorithms. Machine learning can be used for prediction. This system can also predict the possibility of flooding before flooding takes place.

2. LITERATURE SUMMARY

A literature review is an objective, critical summary of published research literature relevant to a topic under consideration for research. The summary is presented here.

Table -1: Summary of literature survey

Sr no.	Paper details	Advantages and Disadvantages
1.	**Title :** Flood Prediction Using Flow And Depth Measurement With Artificial Neural Network In Canals. **Author :** Nikhil Binoy C, Arjun N, Keerthi C, Sreerag S, Ashwin H Nair. **Year :** 2019	**Advantages :** - If we have required data accurate prediction can be done. - By providing accurate prediction, one can allocate resources to those in need or can predict the possibility of flood. **Disadvantages :** - Inability to produce highly accurate results, - If there is no sufficient data flood prediction cannot be done.
2.	**Title :** A Data Science Methodology Based on Machine Learning Algorithms for	**Advantages :** - Machine Learning Algorithms provides computational efficiency, flexibility and intuitive simplicity. -Artificial Neural Networks(ANN)

	Flood Severity Prediction. **Author :** Mohammed Khalaf, Abir Jaafar Hussain, Dhiya Al-Jumeily, Thar Baker, Robert Keight, Paulo Lisboa, Paul Fergus, AlaS. Al Kafri. **Year :** 2018	model provides stronger results in terms of accuracy and credibility in comparison with other neural network architecture for flood prediction. **Disadvantages :** - Support vector machines(SVM) are less capable of classifying the dataset. - Linear Neural Networks(LNN) are incapable of learning specifically the non-linear components.
3	**Title :** Flood Alert system with Android Application **Author :** Mohamad Nazrin Napiah, Ismail Ahmedy, Mohd Yamani Idna Idris, Md Asri Ngadi **Year :** 2017	**Advantages :** - This system gives a warning to the user in real time regarding the flood disaster and also gives other information. -When there is danger, it gives notification to the user with an alarm on the mobile phone. -It provides location to the user. -It reduces the cost of the whole system. -Zigbee protocol has free communication frequency and uses low power consumption and saves hardware cost. **Disadvantages :** - System has some limitations because the devices are built for peer-to-peer connectivity and not built in context of mesh network -The device is not suitable to be implemented in a large network.
4.	**Title:** The Development of Smart Flood Monitoring System using Ultrasonic sensor with Blynk Applications. **Author :** Nor Anum Zuraimi Md Noar, Mahanijah Md Kamal. **Year :** 2017	**Advantages :** - It measures the level of water and gives warning to the person-in-charge. - It creates graphs on the data as if it is safe or dangerous. **Disadvantages :** -It saves the data into the database but doesn't use it, hence wasting the space. -It cannot predict the flood with its historic data.
5.	**Title :** Real-time WSN Based Early Flood Detection and Control Monitoring System. **Author :** Tibin Mathew Thekkil, Dr.N.Prabakaran **Year :** 2017	**Advantages :** - Remote monitoring can identify any environmental threats before it occurs. - The mobile clients can examine the data, sight the condition of the monitoring area by browsing, mails & short message service. - This system is economic, user

		friendly programming. - It uses low power. **Disadvantages :** - Climatic changes. - Network connectivity.
6.	**Title :** Smart flood disaster prediction system using IoT & Neural Networks. **Author :** Swapnil Bande, Prof. Dr. Virendra V. Shete **Year :** 2017	**Advantages :** - It ensures scalability and reliability of the flood management system. - Artificial neural networks(ANN) are used for flood prediction, it gives better results than other methods. **Disadvantages :** - Gradient Descent with adaptive Learning algorithm is used. This algorithm does not indicate sufficient accuracy for rainfall prediction.
7.	**Title :** Development of Flood Monitoring System using WSN and IoT based on Cloud. **Author :** Pallavi C B, Chandrakala V **Year :** 2017	**Advantages :** - It uses N-mote and N-gateway and Wireless sensors which makes this efficient with less hardware flaws. -This system enables both private and government organizations to work on their emergency evacuation and mitigation plans. **Disadvantages :** - It uses wireless sensors which are efficient as well as very costly to maintain.
8.	**Title :** Urban Pluvial Flood Forecasting using Open Data with Machine Learning Techniques in Pattani Basin. **Author:** Jeerana Noymanee, Nikolay O. Nikitin, Anna V. Kalyuzhnaya. **Year :** Elsevier 2017	**Advantages :** - Bayesian Linear methods can provide a good result at a period of time lag up to 12 hours. - Neural networks, boosted decision trees and decision algorithms can handle extremely complex tasks. - Boosted decision tree is good in terms of stability**.** **Disadvantages :** - In Decision forest, a small change in the training set can create radial changes in the model. - Rainfall intensity was found to be a weak prediction of flooding incidents. - In the Bayesian linear method a huge error occurred .

9.	**Title:** An Intelligent Flood Monitoring System for Bangladesh Using Wireless Sensor Network. **Author:** Syed Nazmus Sakib, Tanjea Ane, Nafisa Matin and M. Shamim Kaiser. **Year :** 2016	**Advantages :** -Wireless sensor networks are very fast and efficient. -The network can be expanded to a large geographical area with a good communication unit within a limited budget. -It gives a scope for getting the signal of any incident before causing. -Wireless sensor networks can be very helpful for the developing countries because of their robustness, sensing accuracy, operability in the tough environments and very less human interaction. **Disadvantages :** -The performance evaluation reveals that the proposed system accurately sends flood alerts compared to the existing flood alert system.
10.	**Title :** Advance Flood Detection and Notification System based on Sensor Technology and Machine Learning Algorithms **Author :** Mohammed Khalaf, Abir Jaafar Hussain, Dhiya Al-Jumeily, Thar Baker, Robert Keight, Paulo Lisboa, Paul **Year :** 2015	**Advantages :** -Random forest algorithm compared with other classification is more beneficial as it offers more accurate Outcome. **Disadvantages :** -GPS module track is not upgraded in the system -Hyper pipes algorithm considered as having the lowest accuracy percentage.

3. EXISTING SYSTEM ARCHITECTURE

The existing flood monitoring system consists of two microcontrollers and one sensor. The microcontroller used here is nodeMCU and the sensor used is an ultrasonic sensor which senses the level. The ultrasonic sensor continuously monitors the level of water each time it reaches the certain defined level. It records the data through ultrasonic and these data are sent to nodeMCU from time to time. Two nodeMCU are used here, the first one acts as transmitter and second as a receiver. Initially, the first NodeMCU attached with an ultrasonic sensor will detect the flood level. Then, it will display the data on the LCD screen. The data will be sent

to the Blynk application via wireless connection. The data also will be displayed in the Blynk application. At the same time, the data is stored in a CSV database, through email this data can be converted into excel form, as well as being transmitted to the second NodeMCU via Blynk Bridge. This data will alert the local authority for further action once the level reaches warning and critical level which triggers the buzzer and LED. Though this system sends the alert messages to authority and displays it in LCD but this is done only when the water reaches the critical level. It cannot predict the chances of flood prior so that it can be prevented in the first place.
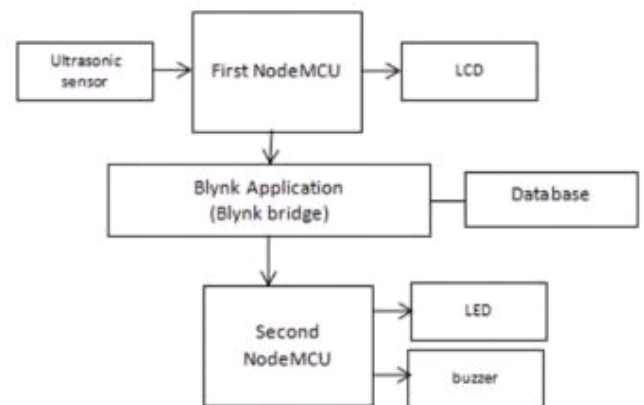

Figure 1: Existing System Architecture

4. PROPOSED SYSTEM ARCHITECTURE

In our proposed system, an Ultrasonic sensor is used to create flood level sensing devices which will detect the water level. Ultrasonic Sensor is connected to an Arduino Uno from which we can see the readings. Arduino Uno is connected to LED and Buzzer is connected. Serial Communication will take place between Arduino Uno and Raspberry pi. Raspberry pi will connect to the cloud. The water level readings will be stored in the cloud. For Prediction purposes we need the data in csv format. From the cloud we can convert the data in csv format because we need historical data for prediction purposes. Then we will use a machine learning algorithm to predict the water level. The Classification algorithm will be used because we have a t r a i n i n g dataset. This algorithm is simple to implement, robust to noisy training data, and effective if training data is large. To Alert the people, LED light and Buzzer can be used and people will get alert messages on their mobile phones through an Android application.
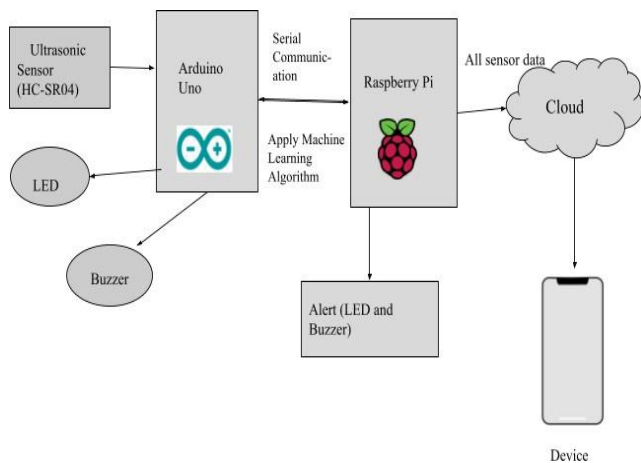
Figure 2: Proposed system Architecture

A. TECHNIQUE

The system is made up of front-end data acquisition, data processing, data transmission and data reception. The ultrasonic sensor will detect the water level in real time. Processed data will be sent to the cloud using ESP8266 module. Cloud will store the data and can be further used to predict the chances of flood priorly. The arduino and esp8266 module will help to provide the real time data to the people.

Algorithm:

1. Start.
2. Connect all sensors to the microcontroller.
3. Detecting the water level.
4. If water is at level 1, goto step 3.
5. If it reaches threshold value, send an alert message through LED or Buzzer.
6. It sends alert messages to mobile phones through android applications.
7. Meanwhile, Microcontroller will have serial communication with raspberry pi..
8. Raspberry pi will help send data to the cloud.
9. Predicting the chances of flood through historic data using a prediction algorithm.
10. Similarly, detecting the water level through predicted data in the control room.
11. If the predicted value is unsafe, goto step 5.
12. Or else, repeat step 9.
13. Stop.

FLOWCHART:
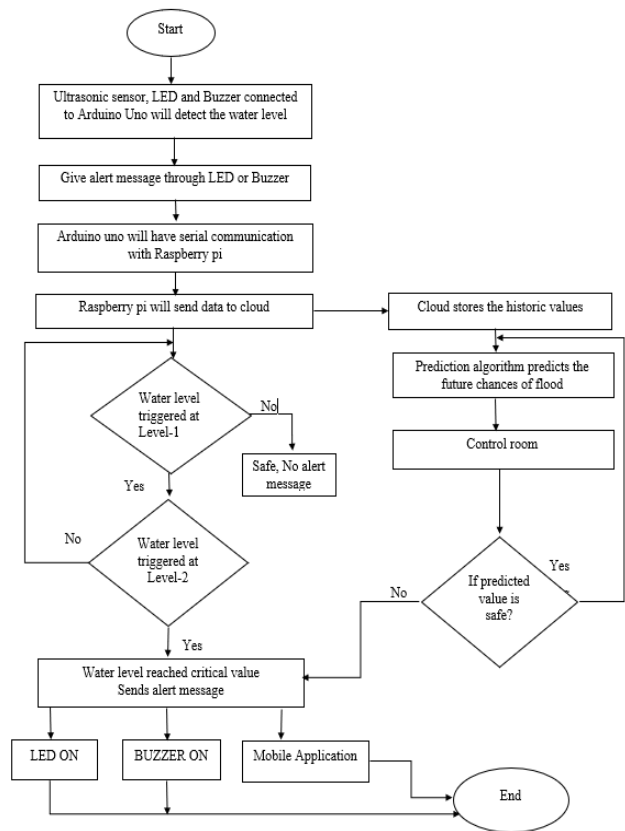
B. Sample dataset used

In this dataset, if the distance between an ultrasonic sensor and water is less then water level is critical and if distance is more than water level is normal. The sample dataset used in the experiment given in the figure.

Distance	Date/Time	Water level
4	10/5/2017 10:48 PM	critical
4.5	10/5/2017 10:49 PM	critical
5	10/5/2017 10:51 PM	critical
6	10/5/2017 10:53 PM	critical
6.6	10/5/2017 10:55 PM	critical
7	10/5/2017 10:56 PM	normal
7.5	10/5/2017 10:57 PM	normal
8	10/5/2017 10:59 PM	normal
8.6	10/5/2017 11:01 PM	normal

9	10/5/2017 11:02 PM	normal
9.8	10/5/2017 11:06 PM	normal
10	10/5/2017 11:07 PM	normal

Table 2 : Sample dataset used

C. Hardware and Software Specifications

The experiment setup is carried out on a computer system which has the different hardware and software specifications as given in Table 2 and Table 3 respectively.

Table 2 Hardware details

Processor	3-4 GHz Intel
HDD	1 TB
RAM	8 GB

Table 3 Software details

Operating System	Windows 10
Programming Language	Python
Database	My sql

5. CONCLUSIONS

This project based on the Early Flood Monitoring using IOT to detect & monitor the water level. In this project we are using Raspberry pi, LED, Buzzer, ultrasonic sensor, Android Application. Through Android Application the user can get information about flood. The rescue team will be alert by using LED & Buzzer that will give information about the person in danger. This system can also predict the flood by using historic data. Prediction of flood is done by Machine Learning Algorithm. Through this system one can monitor & predict the flood.

ACKNOWLEDGEMENT

REFERENCES

[1] Nikhil Binoy C, Arjun N, Keerthi C, Sreerag S, Ashwin H Nair "Flood Prediction Using Flow And Depth Measurement With Artificial Neural Network In Canals." by Proceedings of the Third International Conference on Computing Methodologies and Communication (ICCMC 2019), Palakkad, India.

[2] Mohammed Khalaf1, Abir Jaafar Hussain, Dhiya Al-Jumeily, Thar Baker, Robert Keight, Paulo Lisboa, Paul Fergus, AlaS. Al Kafri "A Data Science Methodology Based on Machine Learning Algorithms for Flood Severity Prediction." by 2018 IEEE, UK.

[3] Mohamad Nazrin Napiah , Mohd Yamani Idna Idris , Ismail Ahmedy , Md Asri Ngadi " Flood Alert system with android application" by 2017 IEEE, Skudai, Malaysia.

[4] Nor Anum Zuraimi Md Noar , Mahanijah Md Kamal "The Development of Smart Flood Monitoring System using Ultrasonic sensor with Blynk Applications." by Proc. of the 4th IEEE International Conference on Smart Instrumentation, Measurement and Applications (ICSIMA) 28-30 November 2017, Putrajaya, Malaysia.

[5] Tibin Mathew Thekkil, Dr.N.Prabakaran "Real-time WSN Based Early Flood Detection and Control Monitoring System" by 2017 International Conference on Intelligent Computing, Instrumentation and Control Technologies (ICICICT), Chennai, Tamil Nadu.

[6] Swapnil Bande, Prof. Dr. Virendra V. Shete "Smart flood disaster prediction system using IoT & Neural Networks." by 2017 IEEE, Pune, India.

[7] Pallavi C B, Chandrakala V "Development of Flood Monitoring System using WSN and IoT based on Cloud." by International Research Journal of Engineering and Technology (IRJET) May -2017, Karnataka, India.

[8]   Jeerana Noymanee, Nikolay O. Nikitin, Anna V. Kalyuzhnaya "Urban Pluvial Flood Forecasting using Open Data with Machine Learning Techniques in Pattani Basin." By 6th International Young Scientists Conference in HPC and Simulation, YSC 2017, 1-3 November 2017, Kotka, Finland,2018 The Authors. Published by Elsevier B.V.

[9]   Syed Nazmus Sakib, Tanjea Ane, Nafisa Matin, and M. Shamim Kaiser "An Intelligent Flood Monitoring System for Bangladesh Using Wireless Sensor Network." by 2016 5th International Conference on Informatics, Electronics and Vision (ICIEV), IEEE, Dhaka, Bangladesh.

[10]   Mohammed Khalaf , Abir Jaafar Hussain , Dhiya Al-Jumeily , Paul Fergus Olatunji Idowu " Advanced flood detection and notification system based on Sensor Technology and Machine Learning Algorithms." By 2015 IEEE ,London, UK.

[11]   Google (https://www.google.com)