IoT based Flood Monitoring and Alerting System

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Abstract— In this paper "IoT based Flood monitoring and Alerting System" is to develop a system which is efficient enough to predict the water level conditions in the river beds and we can measure the level of water using Ultrasonic sensor that alerts the authorities about an imminent flood is introduced. So that preventive measures are to be taken in prior. To achieve this, we are developing a hardware prototype which will be developed by Arduino, NodeMCU, GSM module 800C (Wi-Fi module) and Ultrasonic sensor. By using Embedded C technology, we are developing this project. The main objective of this project is to develop ***"IoT Based Flood Monitoring and Alerting System"*** so that our project highlights the possibility to provide an alert system that will overcome the risk of flood. This work explains workflow of all the components present inside our project. This model can be used to greatly reduced the causalities in a devasting event of flood. In this paper, we propose IoT approach that is known as flood alert system with android applications.

Keywords: *NodeMCU (Node Micro Controller Unit), GSM (Global System for mobile communication), IoT (Internet of Things)*

1.INTRODUCTION

We are aware of the flooding incidents that takes place in majority of the Indian States each year leading to massive destruction of both lives and property. Floods are natural existences where an area or land that is normally dry abruptly becomes underwater in water.

Flooding occurs in many ways due to overflow of streams, rivers, lakes or oceans or as a result of extreme rain.

Flood is one of the Natural disasters. It causes a huge amount of damage to our atmosphere and living beings as well. So, in these cases, it is very important to get emergency alerts of the water level situation, in changed conditions in the river bed. Every year the rainy season, floods have caused significant damage and losses to human lives and livelihoods within these southern flooded plains.

This project aims at alerting the authorities about an imminent flood by monitoring the water level which causes severe damage. The information enables the authorities to be more prepared in the cause of a flood. Also, an alert will be provided if the values are not within the safe levels. The alert includes SMS alert, E-Mail alert to the concerned authority using Blynk platform.

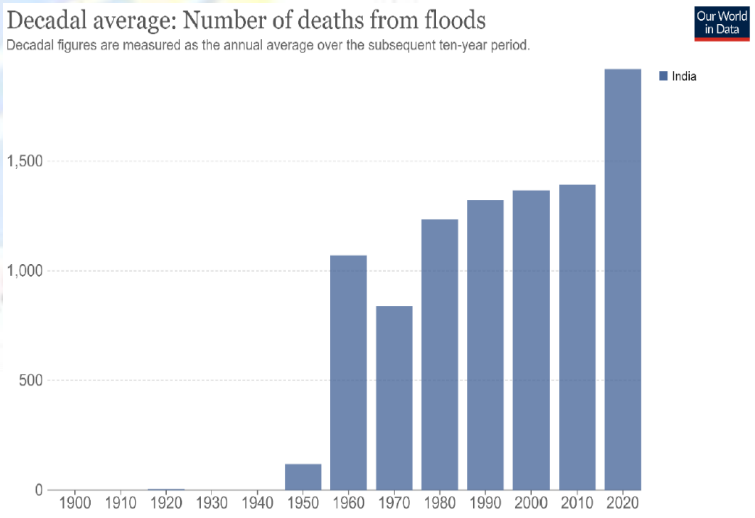


Fig. 1.1 Number of deaths caused by Flood from 1900 to 2020

The number of deaths from natural disasters can be extremely variable from year to year, some year pass with very few deaths before a large disaster event claims many lives. This project helps to detect the water level of river beds and to check if they are in the normal condition. If

they reach beyond the edge, then it alerts people through Buzzer sound as well as internet applications. Here, we are using the ultrasonic HC-SR04 sensor to observe the river level and NodeMCU (ESP8266) Microcontroller for data processing. The processed data will be uploaded to the ThingSpeak Cloud Platform (Wi-Fi Module). The ESP8266 is a microcontroller with minimum power consumption. The ESP8266 has wireless tools which can be integrated with internet , were river levels can be monitored graphically.

1.1 SCOPE

This study is conducted to solve the problems carried about by floods. The device contains the following features: It has ultrasonic sensor (HC-SR04), sense the distance of water level. It includes Serial Communication to send alert messages with the content of water level and road accessibility. The unit contains the sensor to suggest, to be placed in front of our system. The fixed position of the sensor should be placed perpendicular to the flood water or else, there will be a defective reflection of ultrasonic waves and cause measurement faults. The sensor which is recommended to be placed on a pole with a height of 3 to 3.5 meters. The flood sensors and the microcontrollers will be powered by a Solar Power Bank with an 80, 000 Ampere Ampere-Hour (mAh) for the help of continuous operation of water flood height detection and network data transmission. And when water reaches to the threshold level the alert messages through internet applications like blynk and E-Mail alerts will be sent the concerned people, the causing effects that floods can have on people and their environments, flood monitoring systems have been developed to help and prepare to warn people of emanating risk. The systems can help prevent massive damage and loss as a result of flooding and possibly save lives.

1.2 SOCIAL / ENVIRONMENTALL IMPACT/ NOVELTY OF IDEA

Harmful environmental effects of flooding can cause soil and river banks erosions, bed erosions, siltation and landslides, where it can damage vegetation and pollutants carried by flood water can affect the water quality, habitats of flora and fauna. Flooding can however play an important role in natural habitats.

For example : -

Fig 1.2 Before and After Flood

Images show how entire communities in Sydney's North West were completely submerged by floods. The before and after shows the aerial shots lush, green communities now swamped by musky brown floodwater.

The next images show how recent floods are occurred in Pakistan: -

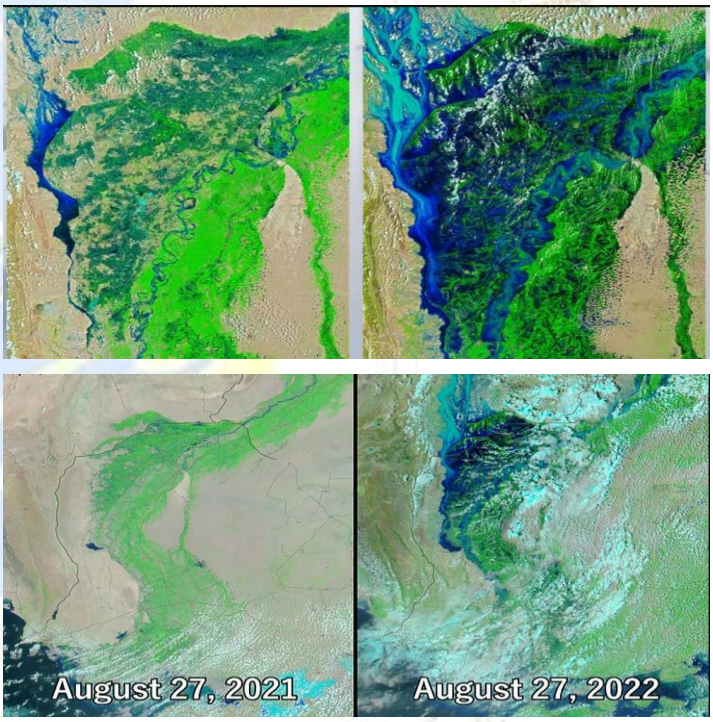


Fig 1.2.1 Recent floods in Pakistan

Satellite images reveal nearly 100 km wide inland lake formed during flooding in Pakistan where the area along the Indus River in the provinces of Punjab, Khyber Pakhtunkhwa, Balochistan, and Sindh, on August 4 and after math of flooding in the same areas on August 28.

2.LITERATURE SURVEY

[1] In this paper "Flood Monitoring and Alerting System "presents an approach for detecting the water level in one particular area can be measured, this system comprises of three parts. The first part is to measures the height of the water using ultrasonic distance measuring sensor(HC-SR04). The second part is sending the height of information to web page using the Ethernet. The third part is to make calls to residences to alert them about flood through voice messages. The calls are made through the most popular mobile standard Global System for Mobile Communication (GSM), and ARP33A3 is used to play the verified recorded voice messages. Further it can used to enhance and monitor the water level in multiple locations.

[2]In this paper" IoT Based Flood Detection and Notification System using Decision Tree Algorithm" presents an approach for the design and implementation of flood detection and notification system based on Decision Tree algorithm is proposed in this work. These system divides the flood level into three stages, for gathering data from sensors and which is processed using PIC Microcontroller. The implementation and comparison of Decision Tree and HyperPipes Algorithm are made for around 120 datasets of sensor data collected from different sensors. The analysis of flood data was carried out to classify from typical and at dangerous condition in which the proposed Decision Tree algorithm gives better classification accuracy with lesser possibility of error than HyperPipes classification.

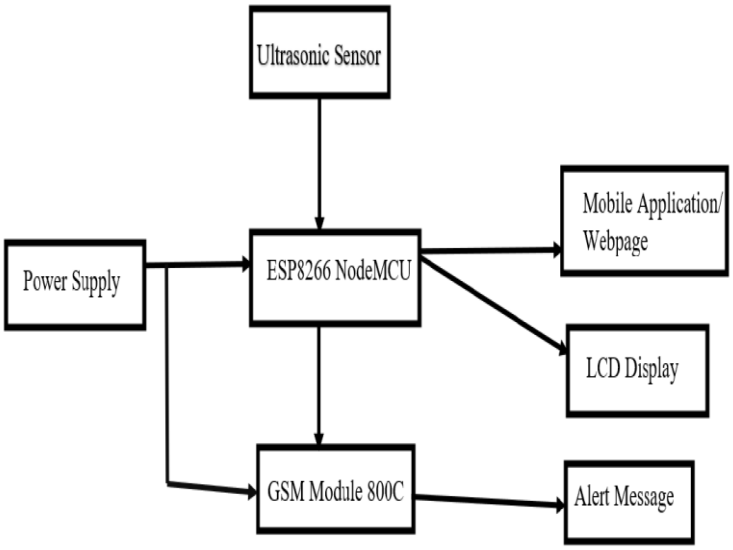
[3]In this paper "Implementation of Flood warning System using IoT " The current system is capable of detecting floods by using the data from the sensor and the weather forecast. The system can issue a warning by sounding an alarm and also by SMS in the eventually of a Flood. The website also provides the real-time information. A more advance system will allow the authorities to divert the water using gates and hence provide greater control.

[4]In this paper "Low Cost based Flood Monitoring and rainfall prediction using Machine Learning and Neural Networks" in this machine learning models won't work well for prediction of rainfall due to fluctuations in rainfall. However, this method can be used for prediction for any state of India, with the given data. Designed and implemented the flood monitoring and alerting system and also helps to predict rainfall for the future use successfully. The result is that a much of the water gets into soil, leading stagnation and causing flooding in the area prone to flood.

[5] In this paper "Flood Prediction using IoT and Artificial Neural Networks with Edge Computing" In this paper we present a system for on-the-fly short-term flood prediction. The system monitors real-time rainfall and water level time series and uses the temporal correlative information for ahead-of-time prediction of flood water levels using LSTM. The results indicate that our model is appropriate for real-time flood prediction. Furthermore, we obtain a low response time for running the ANN prediction computation on the low power edge device. The application of ANN with edge computing will help improve the efficiency and reliability of flood early warning systems by bringing the prediction computation close to where data is collected.

[6] In this paper "Early Flood Monitoring using IoT Applications" In this paper ; This project based on the Early Flood Monitoring using IOT to detect & monitor the water level. We are using components such as Raspberry pi, LED, Buzzer, ultrasonic sensor, Android Applications. Through these Android Application the user can get information about floods. The rescue team will be alerted, using LED & Buzzer that will give information about the person in risk. Whereas this system can also predict the flood by using historic data. Prediction of flood is done by Machine Learning (ML) Algorithms. Through this system one can monitor and predict the flood caused.

3. WORKFLOW DIAGRAM



Iot-based flood monitoring systems work by collecting data from sensors located in the areas prone to flooding. This data is used to detect potential flooding and track the amount of water in the area. The collected data is sent to a central server, where it can be monitored and analyzed to determine if a flood is likely to occur. If a flood is detected, alarms and alerts can be sent to warn people in the area and appropriate measures can be taken to protect against flooding. Additionally, the data collected can be used to inform flood risk management strategies, such as developing strategies for flood prevention and mitigation.

4. PROPOSED SYSTEM

It is very much important to monitor and receive timely emergency warnings about the flow of water and water level situation based of the riverbeds. This project focuses on developing a system based on advanced sensors like Ultrasonic sensor and GSM 800C (Wi-Fi module) that will sense the current water level and flow of water level in riverbeds, in these case of the level reaching the threshold level system will generate early email alerts making everyone aware of the flood possibilities. The hardware components are connected all the sensors to Arduino UNO, which helps us to process and store the data. The system is enabled to send SMS/email alerts with the help of Blynk application as well to notify a larger audience.

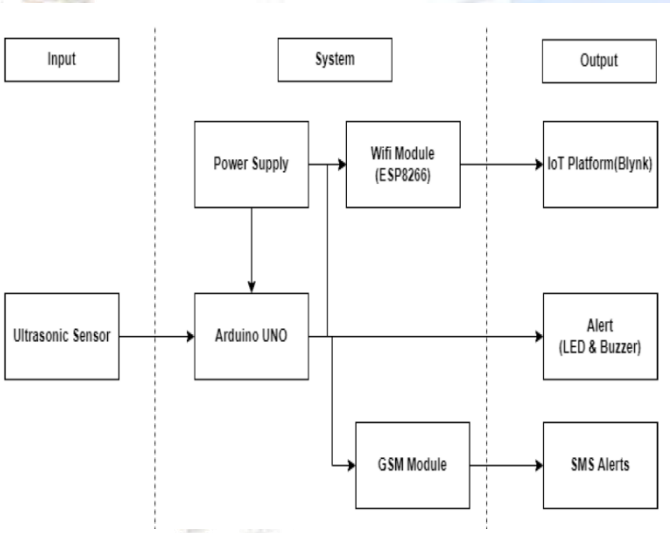


Fig 4.1 Proposed System

HC-SR04 ULTRASONIC SENSOR

The ultrasonic sensor works well, on the principle of ultrasound waves which will be used to determine the distance to an object. An ultrasonic sensor generates high-frequency sound waves. When, this ultrasound hits the object, it reflects as an echo which is sensed by the other end of the receiver. By using the time, it is required for the resonance to reach the receiver, we can calculate the distance to an object we are pointing.

Distance = (Time x Speed of Sound in Air (340 m/s)) / 2

Ultrasonic distance sensor consists of two ultrasonic transducers. Among these, one acts as a transmitter which converts the electrical pulse of microcontroller into ultrasonic sound pulse and the receiver receives for the transmitted pulses. When it receives them, it produces an output pulse whose time period can be used to determine the distance from the object.

Fig 4.1 Ultra sonic Sensor

ESP8266-

The ESP8266 is an affordable price of Wi-Fi microchip with full TCP/IP stack with microcontroller capability. ESP8266 is a small component that allows microcontrollers to connect a Wi-Fi network and make simple TCP/IP connections using Hayes-style instructions. The ESP8285 is an ESP8266 with 1 MB of built-in flash, permitting for single-chip devices capable of connecting to Wi-Fi. There are very few external components in the module, which suggests that it could eventually be very inexpensive and, are attracted many hackers to explore the module, chip, and software on it, as well as to translate the Chinese and other language documentation.

NODEMCU/WI-FI MODULE-

NodeMCU is an inexpensive open-source platform. Originally, it includes firmware running on ESP8266 Wi-Fi SoC from Espressif System, as well as Hardware based module ESP-12.The support for ESP32 32-bit MCU was added. NodeMCU is based on ESP8266 which can connect objects and lets data to transfer using Wi-Fi protocol. The most important features of microcontrollers such as GPIO, PWM, ADC, and etc., which can solve many of the project needs.

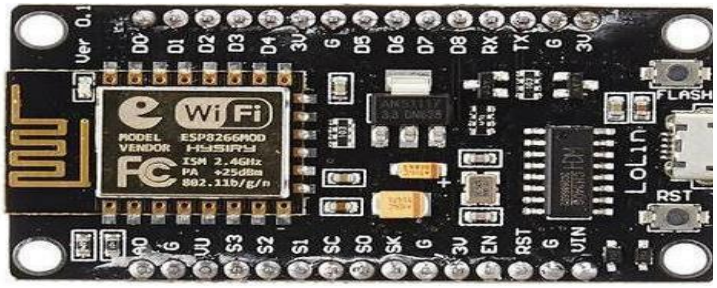


Fig 4.2 NodeMCU

SIM800 GSM MODULE:

SIM800C is a quad-band GSM/GPRS module which works on frequencies' of GSM850MHz, EGSM900MHz, DCS1800MHz and PCS1900MHz. SIM800C features GPRS multi-slot class10 and class12 (is an optional) and supports the GPRS coding arrangements like CS-1, CS-2, CS-3 and CS4.

Fig 4.3 GSM800C

LCD (LIQUID CRYSTAL DISPLAY)-

LCD is the technology used to display in notebook and other smaller computers. Light - emitting diode (LED) and gas-plasma technologies, LCDs allows to display thinner than cathode ray tube (CRT) technology. Liquid crystal display or LCD draws its description from its name itself. It is a combination of two states of matter the solid and the liquid. LCD uses a liquid crystal to produce an observable image. Liquid crystal displays are super-thin technology, display screen that are generally used in laptop computer screen, TVs, mobiles and portable video games. LCD's technologies allow to display to be much thinner when compared to cathode ray tube (CRT) .

Fig4.4 LCD display

5. FLOWCHART

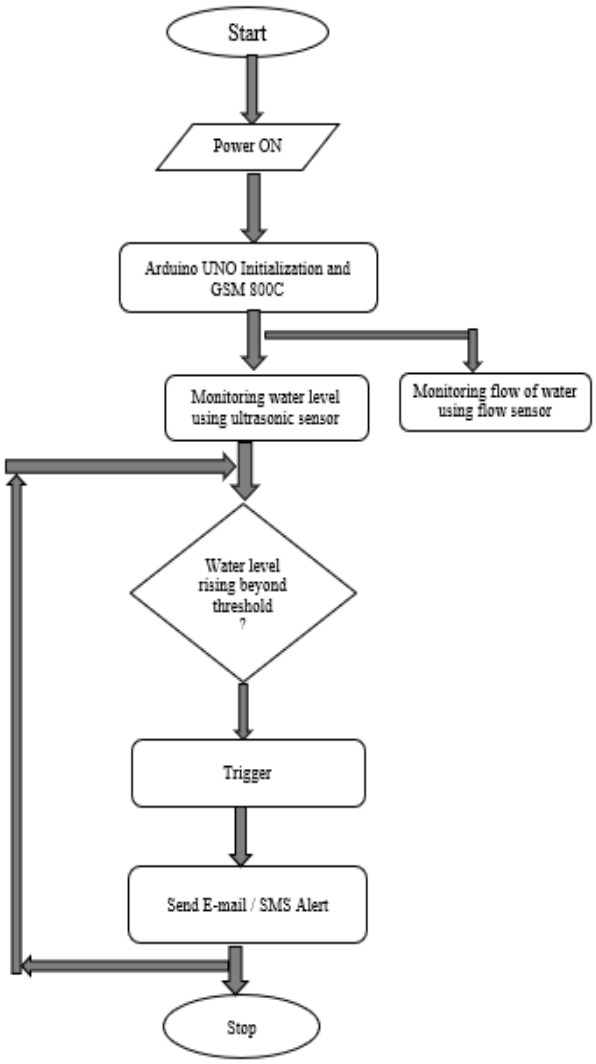


Fig 5.1 Flowchart

6.METODOLOGY

The proposed framework is: There are many earlier works provided by the researchers in the field of IOT but most of them either lacks precision or they are highly expensive. Thus, they are inaccessible to the user. In this module, we are making a device which will sense the possibility of flood, firstly by analyzing values from the IOT device and then checking the water level and water flow. The work will not end here, it will keep on reading the values at each and every second and updating if it is higher than threshold. So, by installing it know you can easily save your life as well as your society. The implementation of the system which includes all the wiring that is to be installed on the breadboard along with microcontroller and other sensors. Adding internet permission is a must as we require internet connectivity in these to send the alert Messages. It will work as we decided earlier and early warning will be sent to user.

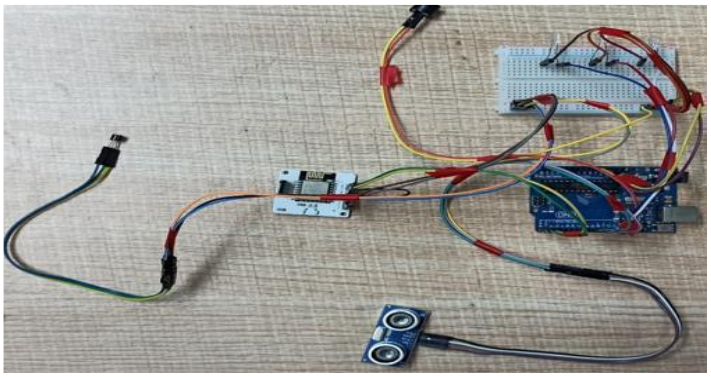


Fig 6.1 Hardware setup

Fig 6.2 Casing of the Hardware components

7. RESULTS

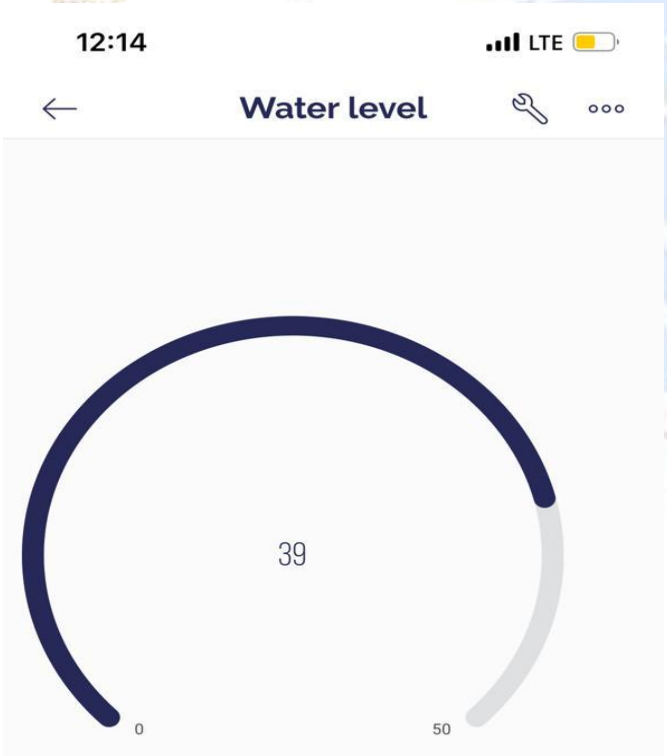


Fig7.1 Water level monitoring

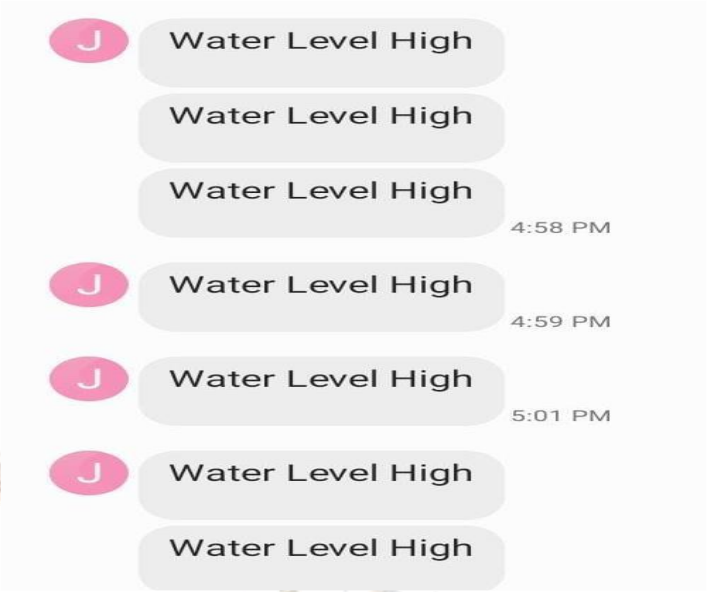


Fig 7.2 Text messages

CONCLUSION

The project Iot based Flood monitoring and Alerting System is used for measuring the water level using the sensors and send the alert messages through the Web or internet applications through Blynk we send SMS alert and E-Mail alert. This system can be into two sensing test of sensor test, GSM Test within the microcontroller (Arduino). Here the ultrasonic sensor senses the water level near the river beds and when water reaches the threshold level it sends a0lert or warning messages to the concerned authorities and the residences. Here in this project the ultrasonic sensor is connected to the Arduino and GSM to control the water level in the water nearby rivers.

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