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Early Flood Warning System for Disaster Management

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Abstract: Now a days, natural disasters are increasing due to factors like global warning, pollution, and ozone depletion, deforestation etc., among many disasters, flood can be predicted and intimated priory. Though there are several types of natural disaster, one of the most vulnerable is Flood Disaster, which will have large consequences for individuals & Communities. Whenever, flooding happens, people living near the riverbank and downstream area are affected severely than others. They need to be alerted much earlier to have extra time to evacuate immediately. The main objective of the proposed system is to develop an early warning system to detect flood and send notifications to the authority so that they can evacuate people earlier and avoid loss of life and property. This project is designed on the IoT based platform, where data from the sensor is collected at the Microcontroller and alert is generated and transmitted as SMS to smart phones.

Index Terms **- Internet of Things, Flood Level, Water Level Sensor, Water Flow Sensor, Disaster Management.**

I. INTRODUCTION

Disasters are the natural phenomenon that attracts major global interest. There are several varieties of natural disaster and one in every of the foremost vulnerable is flood disaster, which might have large consequences for people and communities. River flooding happens in the floodplains of bigger rivers. Also, urban flooding happens in towns, on flat or low-lying surfaces mostly where surface drainage more or less does not exist, or where existing drainage has been blocked with waste. Dams are among the most important human creations in the hydrological cycle built to impound water in reservoirs amid times of high flow, with the goal that it can be utilized to meet human water prerequisites amid times that natural flows are deficient in disasters.

Floods in Madras, Bihar, Maharashtra, Orissa, Assam, Uttarakhand and Jammu and Kashmir have accounted for an oversized loss of life and property. Whenever, flooding happens, people living near the riverbank and downstream area are affected severely than others. They need to be alerted much earlier to possess overtime to evacuate immediately. The most effective flood warning methods extend beyond the installation of gages and telemetry equipment, and use qualified staff and thoroughly designed procedures to produce the earliest warning about whether a flood should be expected. The foremost objective of the proposed system is to develop an early warning system to detect flood and send notifications to the authority so as that they shall evacuate people earlier and avoid loss of life and property.

II. LITERATURE SURVEY

[1] This paper proposed an IoT based system that alerts the authorities about the flood. IR sensor has been used to detect water flow rate and an Ultrasonic sensor used for water level detection. If the received sensor values vary beyond a particular threshold, a SMS alert is sent to their mobile for notification. The proposed system also developed a website which provides the plot of the water levels and water flow rates .Also the weather forecast information obtained from the Internet is provided in the website. This paper was published on IEEE Explore, 2015.

[2] This paper proposed and implemented an intelligent flood prediction and alerting system using IoT and Raspberry Pi. Water and rain sensors has been used for alerting the authorities and monitoring of water level in a lake or river. If the received sensor values vary beyond a particular threshold, they sent a notification alerts to the people in nearby villages. They have also recommended the use of a global positioning system (GPS) that monitors device positioning in the target area and Solar power instead of conventional methods to save the power usage. This paper was published in ICRAEM 2020.

[3] In this proposed system, Raspberry Pi is used to collect data from the water sensor and transmit the data to GSM module for sending an alert via SMS. The analysis was to show how the Raspberry Pi would be integrated with the smartphone to give an alert. The project is an IoT based which significantly in line with the Industrial Revolution 4.0, supporting the infrastructure of Cyber-Physical System. This paper was published in (IJACSA) International Journal of Advanced Computer Science and Applications, 2018

[4] This paper consists of flood detection and avoidance system using the IoT technology. The sensors present in this are used to estimate the water levels, humidity, and temperature and send the real-time data to the cloud and the users can access the data via the mobile app. This model is widely used to alarm the people before a flood occurs and necessary precautions could be taken. This paper was published in International Journal of Engineering and Advanced Technology (IJEAT) April 2021.

III. PROPOSED SYSTEM

OBJECTIVES:

The main objectives of the proposed system:

- To create high professional Early Flood Warning System for Disaster Management.
- To track the flood level and water flow.
- To monitor the humidity and temperature.
- To send quick messages via Short Message Service.
- To create a suitable mobile application.

WORKING PRINCIPLE:

The main sensors used in this proposed system are water level sensor and water flow sensor. Water level sensor is used to check whether the water reaches a certain level, and then it triggers the Arduino board to send the alerting messages. It consists of a circuit board, which can be programmed and Arduino IDE (Integrated Development Environment), is used to write and upload the computer code to the physical board. If the water continues to rise and reaches the threshold level, it's considered now as dangerous, an alert SMS once more sent to the resident and authorities through GSM module and authorities can make necessary arrangement according to the protocol. Water flow sensor is used to measure the flow rate of the water. The sensor data are sent to Arduino Uno microcontroller and then the details are displayed in LCD display continuously. The sensor data also sent to the database server and stored. A suitable mobile application is also developed for viewing the data stored on the server. The Fig.1 shows the block diagram of the project.

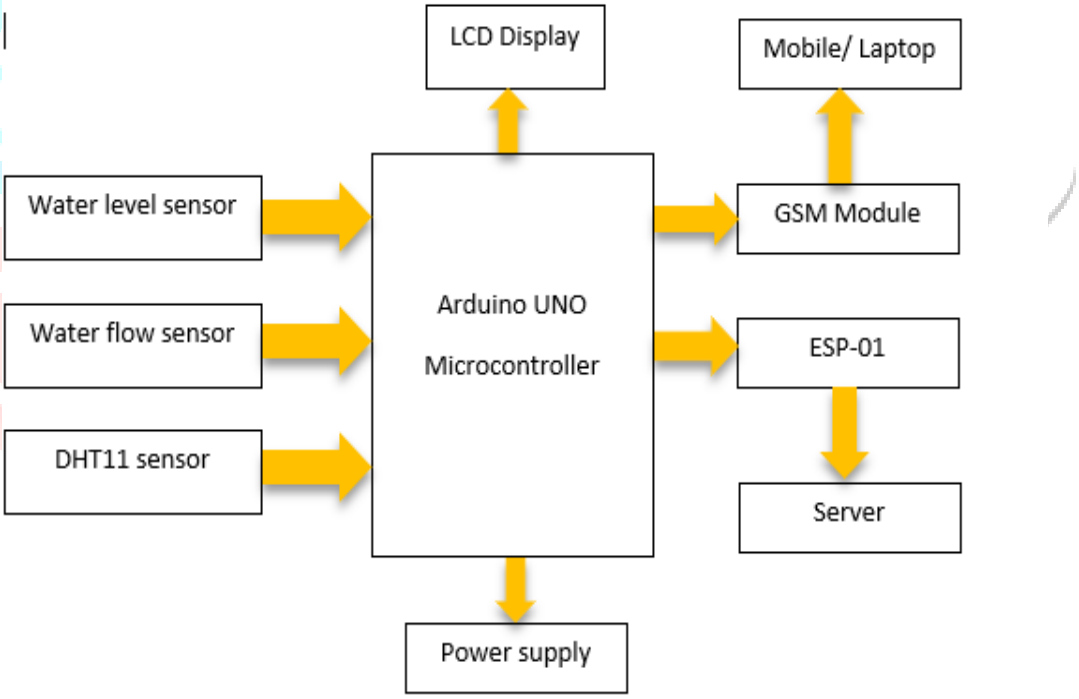

Fig.1-BlockDiagram

ADVANTAGES:

- Easy to track the water level
- Cost Effective
- Improved Efficiency
- Data can be monitored around the world
- More sensors can be added
- Long working life of the equipment
- Creation of historic data for Administrations.

IV. SYSTEM DESIGN AND IMPLEMENTATION

HARDWARE REQUIRED:

- **Arduino UNO**

  Arduino is an open- source electronics platform predicated on easy- to- use attack and software. With its simple and accessible user experience, Arduino has been used in thousands of different systems and operations. The Arduino software is easy- to- use for beginners, yet flexible enough for advanced stoners. It runs on Mac, Windows, and Linux.
- **NodeMCU**

  NodeMCU is an open-source microcontroller used for a firmware development kit which can connect objects and let data transfer using the Wi-Fi protocol. It can solve many of the project's needs alone.
- **GSM Module**

  GSM stands for Global System for Mobile communication it is used to send an alert message to the specified mobile number when the water level crosses a threshold value.
- **Water Level Sensor**

  This is an electronic device that measures the distance between the sensor and object by sending ultrasonic sound waves and converting the reflected sound into an electrical signal. Ultrasonic sensors have consist of two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after traveling to and from the target).
- **Water Flow Sensor**

  Water flow sensors are kept on the pipelines to measure the speed of the water that passes through the pipe and calculate the amount of water also.
- **LCD**

  LCD stands for Liquid Crystal Display it displays the data which comes from the Arduino UNO microcontroller.

SOFTWARES REQUIRED:

- **Firebase**

  Firebase is a database that is used for authentication on the mobile application like sign in and signs up option, it logs every user's data in the firebase database.
- **ThinkSpeak**

  ThinkSpeak is a real-time data processing and visualizing IoT platform, which visualizes our data sent from Arduino UNO to the ThinkSpeak channel.
- **Android Studio**

  Android Studio is the open-source SDK (Software Development Kit) used for developing android applications and android games.
- **Arduino IDE**

  It is open-source software, used to write and upload the code to the Arduino UNO microcontroller. The IDE application is suitable for many operating systems such as Windows, Mac OS X, and Linux.
- **Programming Languages**: C, Java, XML

HIGH LEVEL DESIGN (HLD) DIAGRAM:

The system architecture is shown in the following High-Level Design (HLD). This design (HLD) shows the architecture that was used to develop a system. The architecture diagram provides an overview of an entire system, identifying the main components that would be developed for the proposed system and their interfaces.

INTERFACING ARDUINO UNO WITH SENSORS:

INTERFACING ULTRASONIC SENSOR TO ARDUINO UNO

STEP 1: Connect the Ultrasonic Sensor Vcc to 5V Power Supply on Arduino UNO.

STEP 2: Connect the Ultrasonic Sensor Trig to A2 Pin on Arduino UNO.

STEP 3: Connect the Ultrasonic Sensor Echo to A3 Pin on Arduino UNO.

STEP 4: Connect the Ultrasonic Sensor GND to GND on Arduino UNO.

INTERFACING WATER FLOW SENSOR TO ARDUINO UNO

STEP 1: Connect the Water Flow Sensor Vcc to 5V Power Supply on Arduino UNO.

STEP 2: Connect the Water Flow Sensor Digital Out to D2 Pin on Arduino UNO.

STEP 3: Connect the Water Flow Sensor GND to GND on Arduino UNO.

INTERFACING DTH11 SENSOR TO ARDUINO UNO

STEP 1: Connect the DTH11 Sensor Vcc to 5V Power Supply on Arduino UNO.

STEP 2: Connect the DTH11 Sensor Digital Out to A0 Pin on Arduino UNO.

STEP 3: Connect the DTH11 Sensor GND to GND on Arduino UNO.

INTERFACING GSM MODULE TO ARDUINO UNO

STEP 1: Connect the GSM Module RXD Pin to TXD Pin on Arduino UNO.

STEP 2: Connect the GSM Module TXD D7 Pin to RXD Pin on Arduino UNO.

STEP 3: Connect the GSM Module Power Adapter to 5V Power Supply on Arduino UNO.

STEP 4: Connect the GSM Module GND to GND on Arduino UNO.

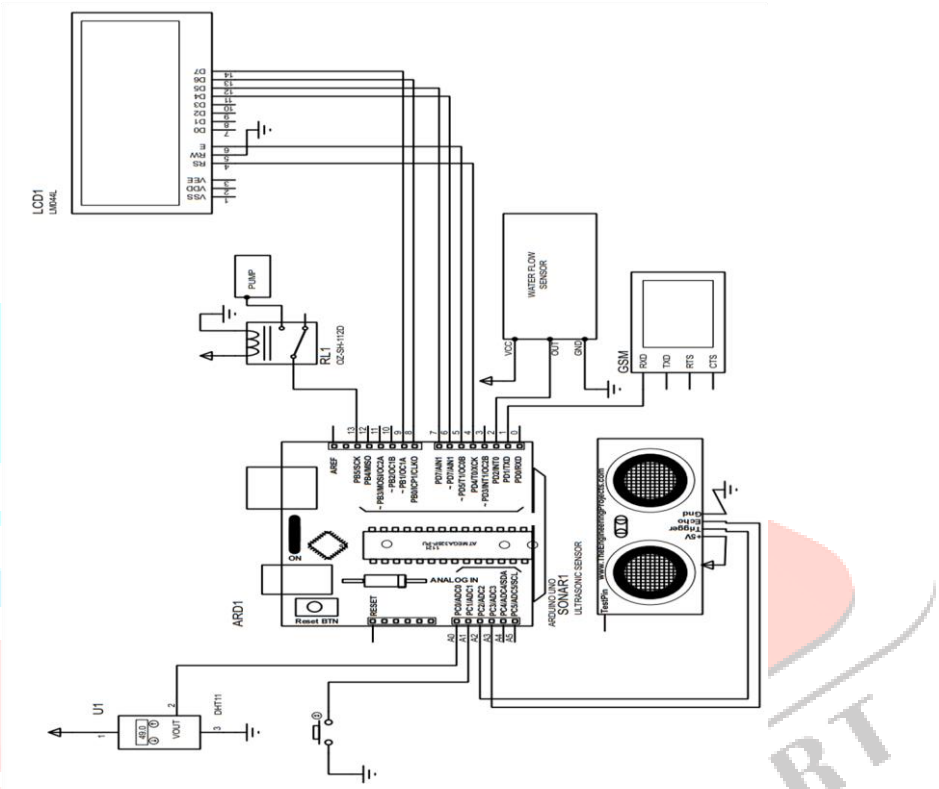

Fig.2-HLD Diagram

DATA FLOW DIAGRAM:

A data-flow diagram (DFD) is a graphical way of representing a flow of data through a process or a system. The following DFD also provides information about the outputs and inputs of each entity and the process itself.

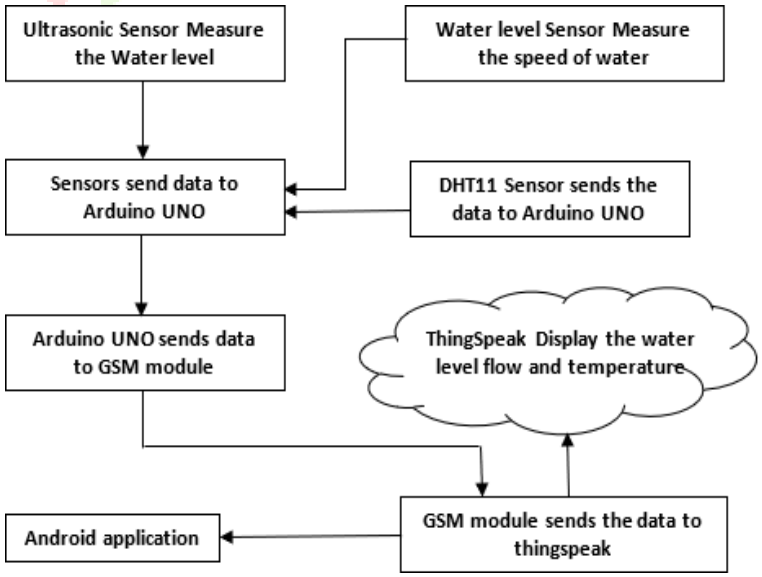

Fig.3-Data Flow diagram

THINGSPEAK:

ThinkSpeak is an open source IoT application which gives real time database, real time data processing, visualization and data analysis. It uses HTTP (HyperText Transfer Protocol) application layer for communication. We can send live data to the devices using ThinkSpeak channel. It also displays live data visualization based on the data comes from the Arduino UNO microcontroller. The database creates automatic update on the dataset and we can export those data in the CSV, HTML, JSON formats. When the Arduino UNO is turned on the data starts coming to the channel, the channel contains six columns S. No, Date and Time, Humidity, Temperature, Water Flow, and Water Level. And these data are dynamically converted into flow graph by ThinkSpeak. This platform has now collaborated with MATLAB for Mathematical work and Visualization. Firstly we have to sign in to ThinkSpeak using MathWorks account, then click on channels to create a new channel for the project. Now we enter channel name, Field1 name, Field2 name, and click on save button to create the channel. There are two view modes on ThinkSpeak: Private view and Public view. Private view is visible only for the admin or account owner, and public view is visible for everyone who use internet. It monitors and logs the data comes from the Arduino UNO continuously.

FIREBASE:

Firebase is a platform used to develop high level mobile and web application. It helps the developers to build, manage and grow their application. It provide services to android, IOS, web, and unity platforms. The Firebase has real-time cloud based NoSQL database on the cloud. We have used Firebase for providing authentication services to the users by merging the accounts with database.

V. RESULT

STEP 1:

Arduino UNO board is interfaced with Water Level Sensor, Water Flow Sensor, DTH11 Sensor, NodeMCU, Water Pump and LCD. The proto type of the proposed system is shown in Fig.4.

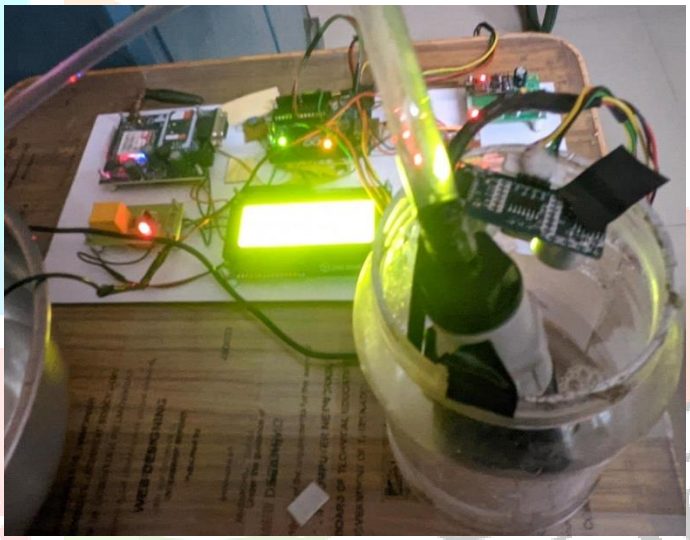

Fig. 4-Arduino with Sensors

STEP 2:

When the water level (DISTANCE) is below the threshold value, the LCD displays "**WATER LEVEL NORMAL** "message as shown in Fig.5. If the water level crosses the threshold value, it displays "**WATER LEVEL FULL**" message on LCD display as in fig.6.

Fig. 5-Water Level is normal

Fig. 6-Water level is full

STEP 3:

The water flow rate (F) is also measured and displayed on LCD as shown in fig.7.

Fig. 7-Water Flow data

STEP 4:

The GSM module sends the humidity sensor (DTH11) data to ThingSpeak cloud and plotted it to a graph as shown in Fig.8.

Fig. 8-DTH11 graph

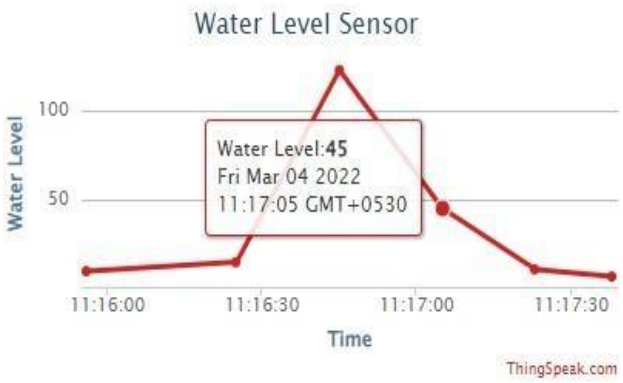

Fig. 9-Water Level graph

STEP 5:

The GSM module sends the water level data to ThingSpeak cloud and plotted it to a graph as shown in Fig.9.

STEP 6:

An android application is created to view the details of water level, water flow rate, temperature and humidity etc... As shown in Fig.10. The History logs can also be viewed as shown in Fig.11.

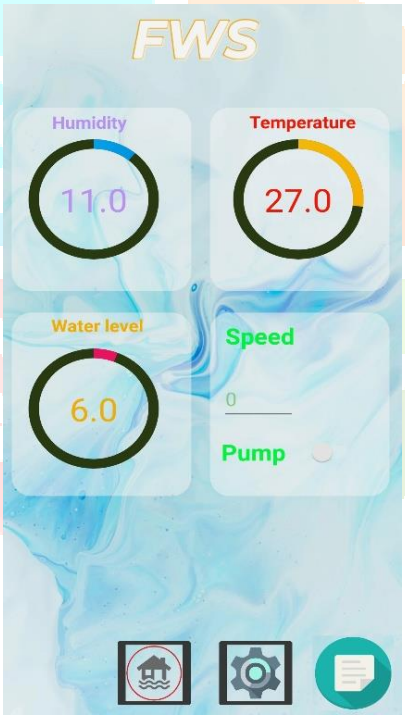

Fig. 10-Application UI

Fig. 11-Logs

VI. ACKNOWLEDGEMENT

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VII. CONCLUSION

The proposed system is developed for disaster management system that can be formed on all over India. This paper aims at monitoring and analyzing the water level in one particular water tank. In future it may be enhanced to monitor multiple locations at the same time and the web site or application must be able to display the info based on the selection done by the authority. System

consists of hardware and software applications to detect water level of rivers, dams etc. The real-time data can be collected from Arduino UNO microcontroller, using ML (Machine Learning) algorithm the rainfall can be predicted. In this proposed we can add more sensors in future.

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