IoT Based Early Flood Detection System Using Arduino

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Abstract- **India frequently experiences floods, which have a serious negative impact on both infrastructure and human life. For successful reaction and mitigation, floods must be detected early. Using an Arduino ultrasonic sensor and a GSM module, a proposed IoT-based early flood warning system is made in this context. The device continuously monitors water levels and sends notifications when a predefined threshold is crossed, indicating a potential flood situation. The system offers real-time data and makes evacuation or rescue activities possible in a timely manner by combining Arduino technology, ultrasonic detection, and GSM connectivity. This article gives a general overview of the system deployment's hardware configuration, coding logic, power supply, network connectivity, and maintenance considerations. The early flood detection system built on the Internet of Things (IoT) offers a proactive strategy to reduce flood damage in India and may be installed in flood-prone locations to assist local governments and communities with flood preparedness and response.**

Keywords: **Arduino, Ultrasonic Sensor, GSM Module, Jumper Wires, LCD Display, Power Supply.**

I. INTRODUCTION

Technologies for early flood detection are essential for reducing the effects of floods and taking prompt preventive action. Implementing IoT-based technologies can assist in real-time flood detection and monitoring in India, where floods are a frequent natural hazard. This article focuses on developing an early flood detection system using an Arduino ultrasonic sensor and a GSM module.

An ultrasonic sensor for measuring water levels, a GSM module to deliver SMS alerts, and an Arduino board serve as the system's primary controllers. The device may identify rising water levels predictive of a potential flood by tracking the water levels and comparing them to a predefined threshold. The system alerts selected contacts about the flood scenario once the threshold is crossed by sending a GSM module alert.

This IoT-based strategy has a number of advantages. It makes it possible to continuously monitor water levels, providing real-time information for anticipating and responding to floods. The technology is deployable in parts of India that are prone to flooding, helping local governments, communities, and people take preventative action to lessen flood damage. Additionally, the incorporation of GSM technology guarantees the prompt and reliable transmission of alerts, enabling rapid evacuation or rescue operations. Such a system's deployment necessitates careful consideration of the hardware configuration, programming, power supply, network connectivity, and maintenance.

The system's functionality during severe flood occurrences depends on proper installation and routine maintenance. For improved accessibility and analysis, it may also be advantageous to investigate other features like real-time monitoring, data logging, or integration with cloud systems.

Early flood detection systems can greatly help to reduce flood-related hazards and safeguard lives and infrastructure in India by integrating Arduino technology, GSM connection, and the power of the IoT.

II. LITERATURE SURVEY

[1] IoT BASED EARLY FLOOD DETECTION AND AVOIDANCE presented by Ayushi Patel et al., at the 2nd International Conference on Advancement in Electronics & Communication Engineering The study "IoT Based Early Flood Detection and Avoidance" suggests an IoT-based system for real-time flood detection and mitigation. The system can track and identify floods by using sensor nodes positioned in flood-prone locations, allowing for prompt alerts and preparations. Three essential parts are an Arduino UNO as the CPU, a Bolt IoT Wi-Fi module for networking, and an HC SR04 ultrasonic sensor for measuring water level. Groundwater levels are determined using moisture sensors (Y89), and dam gates are operated by a servo motor. On the Bolt IoT platform, an Android app has been integrated, enabling users in affected areas to get flood notifications. The article contains information about the sensors' hardware specs as well as information about their software, including the Arduino IDE, Twilio for alerts, Bolt IoT Cloud for monitoring and control, and Mailgun for email notifications. The authors highlight the applicability of this IoT-based technique for flood monitoring and mitigation, particularly in rural regions, and underline its scalability and cost-effectiveness. A list of references is provided for additional research.

[2] FLOOD MONITORING SYSTEM USING ARDUINO, by Prof. Supriya Shigwan et al., in IJCRT
The paper describes an Arduino-based ATmega328P microcontroller board-based flood monitoring system. The technology attempts to deliver in-the-moment analysis and flood warnings. It uses a wireless sensor network (WSN) to process and analyse

data, a GSM module for computations, and a variety of hardware elements, such as water float sensors, ultrasonic sensors, LCD panels, LED lights, buzzers, and GSM modules. The suggested methodology emphasises continuous planning, testing, and incremental software development and is based on the Agile Development Model. The flood detection system's administrator can activate or deactivate the system by using ultrasonic sensors to measure water levels. Residents in the area who are close to a flood are sent SMS notifications and updates until the water level recedes. The system's hardware consists of an Arduino Uno, LED lights, ultrasonic sensors, float sensors, a GSM module, a buzzer, soldering tools, and jumper wires. Software is created using the Arduino IDE version 1.6.7. The technology accurately predicts flood heights, gives information to the public and local officials, and guides passengers away from blocked roads. Early flood monitoring and detection may be improved with the addition of a sensor for rainfall forecasts.

[3] FLOOD DETECTOR SYSTEM USING ARDUINO, Edwin De Guzman et al., International Journal of Management and Applied Science
The paper presents an Arduino-based flood detection system that measures flood levels in residential areas using an ultrasonic sensor and an Arduino Yun microcontroller. By deducting the height of the sensor from the distance to the floodwater, it calculates the height of the flood using livestream and SMS-based services. The system features a user interface for viewing flood levels and delivers updates to the local government and citizens of Barangay Marulas, Valenzuela City, Philippines. Its main objectives are to help drivers, ease traffic, and deliver accurate information. A solar power bank with a sizable capacity for continuous operation powers the system. The report describes the study's goals, which include circuit development, code writing, serial data transmission, flood level identification, and household warning. It highlights the importance of the study for both local government and commuters.
The Metropolitan Manila Development Authority (MMDA) Flood Control Information Centre, which uses CCTV cameras to monitor flood-prone regions in Metro Manila, and the PagAsa Alert System, which provides real-time weather forecasts for the Philippines, are also mentioned. The conceptual framework, the Agile Development Model technique, and the statistical analysis of the collected data for assessment purposes are all covered in this study. It provides a thorough description of the Arduino-based flood detection system and illustrates its potential benefits for monitoring and reducing the effects of flooding in the Philippines.

[4] IoT-BASED EARLY FLOOD MONITORING, DETECTION, AND ALARMING SYSTEM proposed by Soubhagya P et al.,
The study suggests an Internet of Things (IoT)-based flood monitoring system that makes use of a variety of sensors, such as temperature, humidity, water level, and flow sensors, as well as an Arduino microprocessor coupled with an ESP8266 Wi-Fi module. The system intends to track water levels in reservoirs, dams, and rivers as well as temperature, humidity, and other factors. The measured parameters are shown on an LCD and sent via the ThingSpeak platform to a web application for safe data storage. The web application notifies the appropriate parties when there is a flood. The Arduino Uno R3 microcontroller, the ESP8266 Wi-Fi module, the DHT11 temperature and humidity sensor, the HC-SR04 ultrasonic sensor for water level measurement, and a water flow sensor are the hardware elements used in the system. The system seeks to deliver real-time flood monitoring and early warning signals by utilising sensor networks and IoT technologies, allowing government organisations and individuals to act quickly and lessen the effects of floods.

[5] IoT BASED EARLY FLOOD DETECTION AND AVOIDANCE by M. Shoyeb Sayyad et al.,
A method for early flood detection and avoidance based on the
Internet of Things is discussed in the study article in an effort to address the rising number of flood disasters in developing nations like India. The technology allows for real-time monitoring and the identification of flood events by using sensor nodes located in flood-prone locations. The hardware consists of an Arduino-based microcontroller, moisture sensors for detecting soil water levels, an ultrasonic sensor for checking water levels in bodies of water, an ESP8266 Wi-Fi module for internet connectivity, an LCD display for local information, and a servo motor for opening dam gates. Flood warnings are issued by the system after it evaluates the data collected from the sensors.
The Android application connects the sensors and delivers real-time warnings to users. It was created using the Arduino IDE, Eagle software, and the Blynk IoT platform. According to the paper's conclusion, this method enables immediate observation, prompt identification, and prompt warnings to assist appropriate responses, providing a viable solution for flood detection and avoidance. The system's connection to cloud services enables data logging and prospective improvements utilising artificial intelligence or machine learning algorithms for precipitation and flood predictions. Overall, the research suggests an IoT-based system that uses sensor nodes, Wi-Fi connectivity, and an Android app to detect and prevent floods, ultimately limiting their negative effects on people and property.

III. METHODOLOGY

BLOCK DIAGRAM:

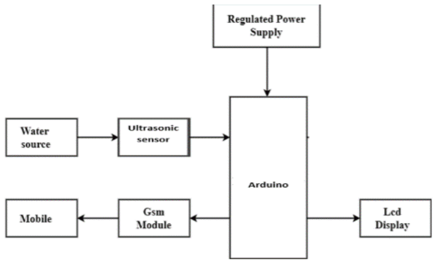

Fig-1 Block Diagram of IoT Based Early Flood Detection Using Arduino

IoT technology is used by the system shown in the block diagram to provide early flood detection and timely notifications. It uses an ultrasonic sensor to detect the depth of the water by sending out ultrasonic waves and timing how long it takes for them to bounce back off the water's surface. As the main controller, the Arduino board analyses the sensor data to determine the water level and communicates with the GSM module to provide notifications. In the event of a flood, the system may send SMS notifications to programmed phone numbers thanks to the GSM module's facilitation of communication over the cellular network. Digital pins are used for serial communication to establish communication between the Arduino and the GSM module. The system needs a power supply, which, depending on the deployment scenario, may be a battery or an adaptor. Even though it is not explicitly depicted in the block diagram, a user interface can be used to offer extra control options and visual feedback. This interface can be an Arduino-connected laptop, smartphone, or special display.
The Arduino's digital pins are utilised for serial communication with the GSM module as well as for initiating and receiving the echo signal from the ultrasonic sensor. The Arduino analyses the measured distance with the threshold when the water level reaches a preset limit and, if necessary, issues an alert. The Arduino instructs the GSM module to send an SMS alert when it realises the water level has risen above the preset limit. To send the warning message to the predetermined phone numbers, the GSM module makes use of cellular network communication.

HARDWARE REQUIREMENTS:

1. Arduino

Fig-2 Arduino

The Arduino board serves as the main controller. It receives information from the ultrasonic sensor, which uses ultrasonic vibrations to measure the water level. By comparing this data to a preset threshold, Arduino analyses it to estimate the water level. The Arduino turns on the GSM module for cellular network communication when the water level exceeds the threshold. The GSM module is then told to deliver SMS messages alerting predefined phone numbers to the flood scenario.
For increased functionality, the Arduino can also be connected to other devices, like an IoT display or extra sensors. In order to provide early flood detection and rapid notifications in the system, the Arduino board processes data, makes judgements, and initiates actions.

2. Ultrasonic Sensor

Fig-3 Ultrasonic Sensor

The ultrasonic sensor uses ultrasonic waves to measure distance, as the name suggests. The device is made up of a sensor head that both emits these waves and collects them once they are reflected back from the target. The ultrasonic sensor can calculate the target's distance by timing the interval between emission and reception. The ultrasonic sensor utilizes a single ultrasonic element for both emission and reception, unlike an optical sensor, which normally uses separate transmitter and receiver components. With this design, the sensor can be made simpler and the sensor head may be made smaller. When using a reflecting type ultrasonic sensor, a single oscillator alternately transmits and receives ultrasonic waves, allowing for the efficient and portable design of the sensor head.

3. LCD Display

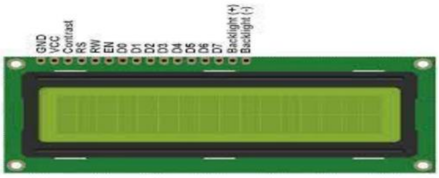

Fig-5 LCD Display

A flat panel display, electronic visual display, or video display that makes use of liquid crystals' light-modulating capabilities is known as a liquid-crystal display (LCD). Liquid crystal displays do not directly emit light, in contrast to other display technologies. Instead, they alter the light that passes through them to produce images. Seven-segment displays and LCDs both use comparable technologies. However, LCDs produce arbitrary images by using a huge number of tiny pixels, whereas other displays use larger elements.

4. GSM Module

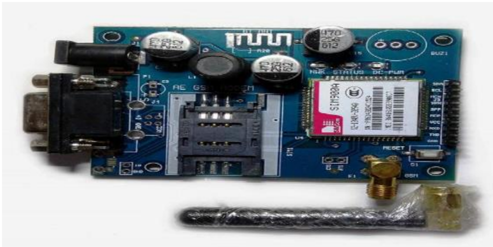

Fig-4 GSM Module

In this project, the GSM module is used to enable wireless sensor data transmission to a PC system. In particular, a GSM SIM900 modem is used, often installed on the Arduino. This module has capabilities for voice conversations, SMS sending and receiving, and creating connections to the widely used GPRS network. The Arduino board needs to be connected to a computer using a USB cable in order to upload drawings or programs to it. The uploading of the sketch to the board takes place through the Arduino Integrated Development Environment (IDE). The board can be unplugged from the computer and powered by an external power source after the sketch has been successfully uploaded. The GSM library handles communication between the Arduino and the GSM shield. An application called HyperTerminal is used to configure a GSM module. An RS232 cable is used to connect the module to the serial port on the PC. To create the connection and set up the GSM module, the PC must have the HyperTerminal program installed.

5. Jumper Wires

Fig-6 Jumper Wires

Jumper wires are employed to create electrical connections between the system's various components. Typically, they are constructed from insulated wires that include connections or pins at each end. Between the Arduino, sensors, GSM module, and other parts, power and signal transmission is made possible by jumper wires.

SOFTWARE SPECIFICATION:

1. Arduino IDE:

ARDUINO

Fig-7 Arduino IDE

Arduino IDE is an open-source software platform that is used for compiling code, feasible in C and C++. It is a legitimate Arduino program that is simple and well-known to utilize. The editor and compiler in the IDE environment are used to compile and upload the code to the Arduino module.

2. Twilio:

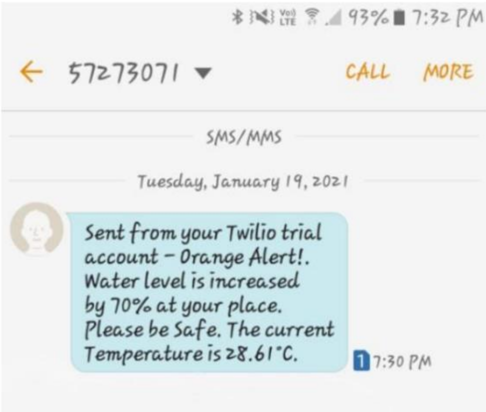

Fig-8 Twilio messaging service sample

Twilio creates web service APIs that let programmers create their own dependable SMS and alert communication channels. It translates actual events into digital signals that computer software can process, enabling the transmission of messages and warnings.

IV. CONCLUSION

This study demonstrates how IoT technology can be used to create an effective and affordable early flood detection system. The device can precisely track water levels and velocity by fusing Arduino and sensors, sending timely alerts to governmental bodies, nearby citizens, and users via a mobile application. For coastal areas and towns at risk of flooding, the system's capacity to continuously monitor flood conditions and deliver early warnings is very essential. Overall, this IoT-based flood detection initiative offers notable enhancements in effectiveness, accessibility, and preparedness against the threats of flooding, assisting society and minimising the effects of this natural disaster.

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