Dr. D Y PATIL TECHNICAL CAMPUS

Dr. D Y PATIL SCHOOL OF ENGINEERING

Dr. D Y Patil Knowledge City, Charholi Bk, Via Lohegaon, PUNE 412 105

A PROJECT REPORT

ON

"IOT BASED FLOOD MONITORING AND ALERTING SYSTEM"

submitted to the Savitribai Phule Pune University

In partial fulfillment of the requirement for the award of the Degree of

BACHELOR OF ENGINEERING

IN

ELECTRONICS AND TELECOMMUNICATION ENGINEERING

by

Miss.Prajakta Chavan (Seat No. B190883012)

Miss.Divya Yuvaraj Salunke (Seat No. B190883017)

Miss.Vaishnavi Kiran Pabalkar (Seat No. B190883044)

Under the guidance of

Prof. Nalini Tiwari

Department of Electronics and Tele-Communication Engineering

Ajeenkya D Y PATIL SCHOOL OF ENGINEERING

A.Y. 2023-24

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CERTIFICATE

This is to certify

Miss.Prajakta Chavan Seat No. B190883012

Miss.Divya Yuvaraj Salunke Seat No. B190883017

Miss.Vaishnavi Kiran Pabalkar Seat No. B190883044

have satisfactorily completed project part-I and presented report on topic titled “IOT BASED FLOOD MONITORING AND ALERTING SYSTEM” at DR. D Y PATIL SCHOOL OF ENGINEERING in partial fulfillment of requirement of Savitribai Phule Pune University, Pune, for the degree of BE (Electronics and Telecommunication Engineering) in semester VIII during academic year 2023-2024.

Guide	Coordinator	H.O. D	Principal
Prof.Nalini Tiwari	**Prof. Prajakta Khairnar**	**Dr.Saniya Ansari**	**Dr.F B. Sayyad**

Examiner 1Name:

Examiner 2Name:

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ABSTRACT

We live in a time of computing technology, therefore having an internet connection is a must for everything and everyone. IOT technology is moving us closer to achieving this objective. Our project includes a modest prototype for a flood detection and alerting system, a smart water monitoring system. This report describes how each component that makes up our project operates and how its workflow is organized. The sensors pick up on environmental cues and transmit real-time data to the cloud (Thing speak cloud), where users may access and view it on a mobile device. Once the water level reaches a certain height, the model issues a warning.The model functions well since it is a small-scale prototype for a flood warning and avoidance system. Real-time modifications are made in the mobile application by precisely uploading and altering the data in the cloud to the sensor. By using this model, the number of casualties in a catastrophic flood can be significantly decreased.India has a subtropical monsoonal climate, which is characterized by intense rainstorms that result in significant flooding. It is crucial to keep an eye on and get timely emergency alerts regarding the water flow and level status based on the riverbed in order to avoid such disasters. This project focuses on creating a system using cutting-edge sensors and a Wi-Fi module to monitor the flow and level of water in riverbeds. If the level crosses a certain threshold, the system will send out early SMS alerts warning everyone about the possibility of a flood. All of the sensors are connected to an Raspberry pi, which enables us to process and store data. To reach a wider audience, the system can also send SMS warnings.

CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

In an era defined by technological innovation, Innovative solutions that tackle major issues faced by communities globally have been made possible by the combination of Internet of Things (IOT) technology with environmental monitoring. The development of sophisticated flood monitoring and alerting systems has been prompted by the growing frequency and intensity of flooding events, among other issues. An example of a state-of-the-art solution is the Flood Monitoring and Alerting System, which is based on the Internet of Things. It is a revolutionary method that uses real-time data analysis and linked devices to reduce the effects of floods and improve readiness for disasters. Floods are a serious hazard to people, property, and the ecosystem. To lessen the effects of floods, early detection and prompt action are crucial.

In this context, we introduce an Internet of Things (IoT)-based Flood Monitoring and Alerting System that is intended to offer data-driven insights, real-time monitoring, and early warning for efficient flood management. Our system makes use of Internet of Things (IOT) technology to gather data from a variety of sensors placed throughout flood-prone locations, such as flow sensors, ultrasonic sensors, and water flow sensors. These sensors securely send data to a central server or cloud platform while continuously monitoring the surrounding environment. Our technology forecasts possible flood events, evaluates their severity, and sets off automated alarms when predetermined thresholds are surpassed using sophisticated data analytics and predictive modeling. Our technology generates warnings that are distributed through several communication channels, including SMS and mobile apps, guaranteeing that local authorities, emergency services, and people receive accurate and timely information.
This makes it possible to make preemptive decisions and coordinate actions, such as asset protection and evacuation plans. It integrates seamlessly with existing disaster management systems and infrastructure, enhancing overall disaster preparedness and response capabilities.

Evolution of Flood Monitoring Systems from traditional methods to modern Iot solutions.

Traditional Methods

1. Manual Observation and Reporting:

Historically, flood monitoring relied heavily on manual observation. Individuals stationed near rivers and flood-prone areas would physically measure water levels using staff gauges and record the data.Communication of flood threats was done via telephone, radio, or in-person, leading to delays and potential miscommunication.

2. Rain Gauges and Water Level Recorders:

Rain gauges measured precipitation to provide data for predicting potential floods. These devices required regular maintenance and manual data collection.Water level recorders, which used float-operated mechanisms, provided more continuous data but still needed manual reading and periodic maintenance.

3. Early Warning Systems:

Basic early warning systems involved rudimentary alarm systems triggered by rising water levels. These were localized and often did not provide sufficient lead time for large-scale evacuation or preparation.

4. Meteorological Forecasting:

Weather forecasts provided general information about potential heavy rains or storms, but lacked the precision and local specificity needed for accurate flood predictions.

Transitional Technologies

1. Automated Water Level Measurement:

The introduction of automated water level measurement devices in the 20th century allowed for more continuous monitoring and data logging, reducing the reliance on manual observations.Telemetry systems started to be used to transmit data from remote locations to central monitoring stations.

2. Satellite and Remote Sensing:

Satellites provided valuable data on weather patterns, precipitation, and river basins, improving the ability to predict floods. Remote sensing technologies helped in mapping flood-prone areas and assessing flood extents post-event.

3. Geographic Information Systems (GIS):

GIS technology enabled better visualization and analysis of flood data, including floodplain mapping and risk assessment. This helped in urban planning and the development of flood defenses.

Modern IoT-Based Solutions

1. IoT Sensors and Networks:

Modern flood monitoring systems employ a network of IoT sensors, including water level sensors, flow sensors, and weather sensors. These sensors provide real-time, continuous data on various environmental parameters.Wireless communication technologies such as LoRaWAN, NB-IoT, and LTE-M allow for efficient and reliable data transmission from remote sensors to central servers or cloud platforms.

2. Data Analytics and Predictive Modeling:

Advanced data analytics and machine learning algorithms process the collected data to identify patterns, forecast potential flood events, and assess their severity. Predictive models enhance the accuracy of flood warnings and improve preparedness.Historical data combined with real-time data allows for more precise flood predictions and risk assessments.

3. Automated Alerts and Communication:

IoT-based systems trigger automated alerts when certain thresholds are exceeded. These alerts are sent through multiple communication channels, including SMS, mobile apps, emails, and public address systems, ensuring timely and widespread dissemination.Integration with social media and community networks enhances the reach and effectiveness oflood warnings.

4. Integration with Smart City Infrastructure:

Modern flood monitoring systems can be integrated into broader smart city frameworks, allowing for coordinated disaster management and response.They work in conjunction with other IoT-based systems, such as traffic management and public safety networks, to provide a comprehensive approach to disaster resilience.

5. Real-Time Data Visualization and Decision Support:

Advanced visualization tools provide real-time data dashboards and interactive maps, helping authorities and the public understand the current situation and make informed decisions.

Decision support systems based on real-time data enable emergency services to plan and execute evacuation and relief operations more effectively.

The evolution of flood monitoring systems from traditional manual methods to modern IoT-based solutions represents a significant advancement in disaster management. Traditional methods, though foundational, were limited by manual processes and delayed communications. Transitional technologies brought improvements but still lacked the real-time precision offered by modern IoT systems. Today's IoT-based flood monitoring systems provide real-time data, advanced predictive analytics, and automated alerting mechanisms, vastly improving the ability to prepare for, respond to, and mitigate the impacts of flooding. This evolution highlights the critical role of technological innovation in enhancing community resilience against natural disasters.

The Need for IoT-Based Flood Monitoring and Alerting Systems

The need for IoT-based flood monitoring and alerting systems is driven by the increasing frequency and severity of floods, limitations of traditional methods, and the numerous advantages offered by modern IoT technologies. By providing real-time data, accurate predictions, automated alerts, and seamless integration with existing systems, IoT-based solutions enhance disaster preparedness, response, and community resilience. As climate change and urbanization continue to pose significant challenges, the adoption of IoT-based flood monitoring systems becomes essential for safeguarding lives, property, and the environment.

1.2 AIM

To develop and deploy an Internet of Things (IoT) based Flood Monitoring and Alerting system for real-time flood monitoring and alert notification.

1.3 Objective

- To utilize advanced IoT technologies to continuously track and assess flood conditions.
- Providing timely alerts to relevant authorities and residents to ensure prompt and effective responses.
- Minimizing potential damage and enhancing public safety.

CHAPTER 2

LITERATURE REVIEW

2.1 LITERATURE SURVEY

[1] IOT BASED FLOOD MONITORING AND ALERTING SYSTEM (2022) by Kiran Jadhav, Aniket Patil, Ajay Yamkar, Mrunmai Nagtodege proposed a system which uses Arduino Uno, Sensors and Wi-Fi module that will sense the current water level and flow of water in riverbeds, in case of the level reaching the threshold, system will generate early email alerts making everyone aware of the flood possibilities.

[2] FLOOD MONITORING AND ALERTING SYSTEM BASED ON IOT (2021) by Harshali S. Mali, Ashwini R. Marathe, Priyanka K. Patil, Mr. Harshad Patil proposed a system especially for parking spaces that will alert and warn the vehicle owner using Arduino Mega 2560 as the main microcontroller and Blynk Application for notification.

[3] IOT BASED FLOOD MONITORING AND CONTROLLING SYSTEM (2020) by Bhushan Moundekar1, Nitish Halde1, Priyanka Waghulkar1, Sunakshi Ganvir, Prof. S.D. Kakde proposed a system which can automatically sense the water level at a reservoir and cannels using ultrasonic sensor and ATMEGA328P microcontroller then send these values to the control room through the Wi-Fi module along with this it gives an SMS alert through the GSM module.

[4] IOT-BASED FLOOD MONITORING AND ALERTING SYSTEM USING RASPBERRY PI (2020) by k Subramanya Chari, Maturi Thirupathi2, Hariveena. Ch proposed a system that uses rain and water sensor along with Raspberry Pi as main controller when exceeds the threshold limit value then the system reckons the time duration that would assume to flood in an area and alert the village people.

[5] IOT BASED FLOOD MONITORING AND ALERTING SYSTEM (2022) by K. R.Jaware, D. S. Chavan, and P. M. Mane proposes a system that uses a variety of sensors, including water level sensors, rainfall sensors, and humidity sensors, to collect data on floodrelated parameters. The system uses an Arduino microcontroller to process the sensor data and send flood alerts to residents and authorities via SMS and email.

[6] FLOOD PREDICTION AND ALERTING USING IOT AND MACHINE LEARNING by A. Kumar and S. Kaur provides a comprehensive overview of IoT-based flood prediction and alerting systems. The paper also discusses the use of machine learning techniques to improve the accuracy of flood predictions.

[7] THE IMPLEMENTATION OF AN IOT-BASED FLOOD ALERT SYSTEM by Wahidah Md. Shah, Fahmi Arif, A.A. Shahrin, and Aslinda Hassan suggested a system that could do more than just detect the water level—it could also calculate the rate at which the water level is rising and alert the resident.The methodology is based on the waterfall concept. In order to send an SMS alarm, data from the water sensor is collected by Raspberry Pi and forwarded to a GSM module.

[8] INTERNET OF THINGS (IOT) FLOOD MONITORING AND WARNING SYSTEM by Anisha N. In order to create a flood monitoring and alerting system, Daniel P. J., Abhishek M. L., Frelbin Nazeer, and Ann Johny suggested employing an Arduino Mega boards with water/rain sensors. Officials can swiftly assess issues because this approach provides them with real-time data on variations in river levels. Upon detecting flooding, it promptly sends out IoT notifications to authorities.

[9] IOT BASED FLOOD MONITORING AND ALERTING SYSTEM WITH WEATHER FORECASTING by Garima Singh, Nishita Bisht, Pravesh Bisht, Prajjwal Singh proposed the development strategies for a flood alerting and monitoring system based on the Internet of Things that uses open weather API for weather forecasting.

[10] IOT BASED FLOOD MONITORING AND ALERTING SYSTEM by Abhishek Raj , Nancy Hazra, Dr. Manoj R. Hans proposed the system using Raspberry pi , Thingspeak-an IOT platform and a Global System for Mobile communication (GSM) and short message service (SMS) to relay data from sensors to computers or directly alert the People of that area through their mobile phone.

Selected paper from Literature Survey

[1] IOT BASED FLOOD MONITORING AND ALERTING SYSTEM (2022)

by Kiran Jadhav, Aniket Patil, Ajay Yamkar, Mrunmai Nagtodege proposed a system which uses Arduino Uno, Sensors and Wi-Fi module that will sense the current water level and flow of water in riverbeds, in case of the level reaching the threshold, system will generate early email alerts making everyone aware of the flood possibilities.

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Overcome the Literature

In [1] author uses a Arduino Uno for processing sensors data . We'll be using a Raspberry Pi 3B+ for processing sensors data.

In[10] author uses a GSM for sending SMS alerts instead we'll be using an internet based SMS gateway services "Fast2SMS".

Motivation

The motivation behind an IoT-based flood monitoring and alerting system is rooted in the need to address the significant and growing challenges posed by flooding. Such a system leverages the capabilities of the Internet of Things (IoT) to improve flood management, response, and mitigation efforts. The motivation for implementing an IoT-based flood monitoring and alerting system is driven by the need to enhance public safety, improve disaster management, protect critical infrastructure, and better adapt to the challenges posed by flooding and climate change. By harnessing the power of IoT technology, communities can become more resilient in the face of this ongoing threat.

2.2 PROBLEM STATEMENT

Enhancement of an existing IoT-based flood monitoring and alerting system by integrating Raspberry Pi 3B+ as the main controller and incorporating a combination of sensors including ultrasonic, water flow, rain, humidity, and DHT11 sensors. The system should leverage cloud platforms such as ThingSpeak for data aggregation and analysis, and Fast2SMS for real-time alert notifications.

CHAPTER 3

DESIGN

3.1 BLOCK DIAGRAM

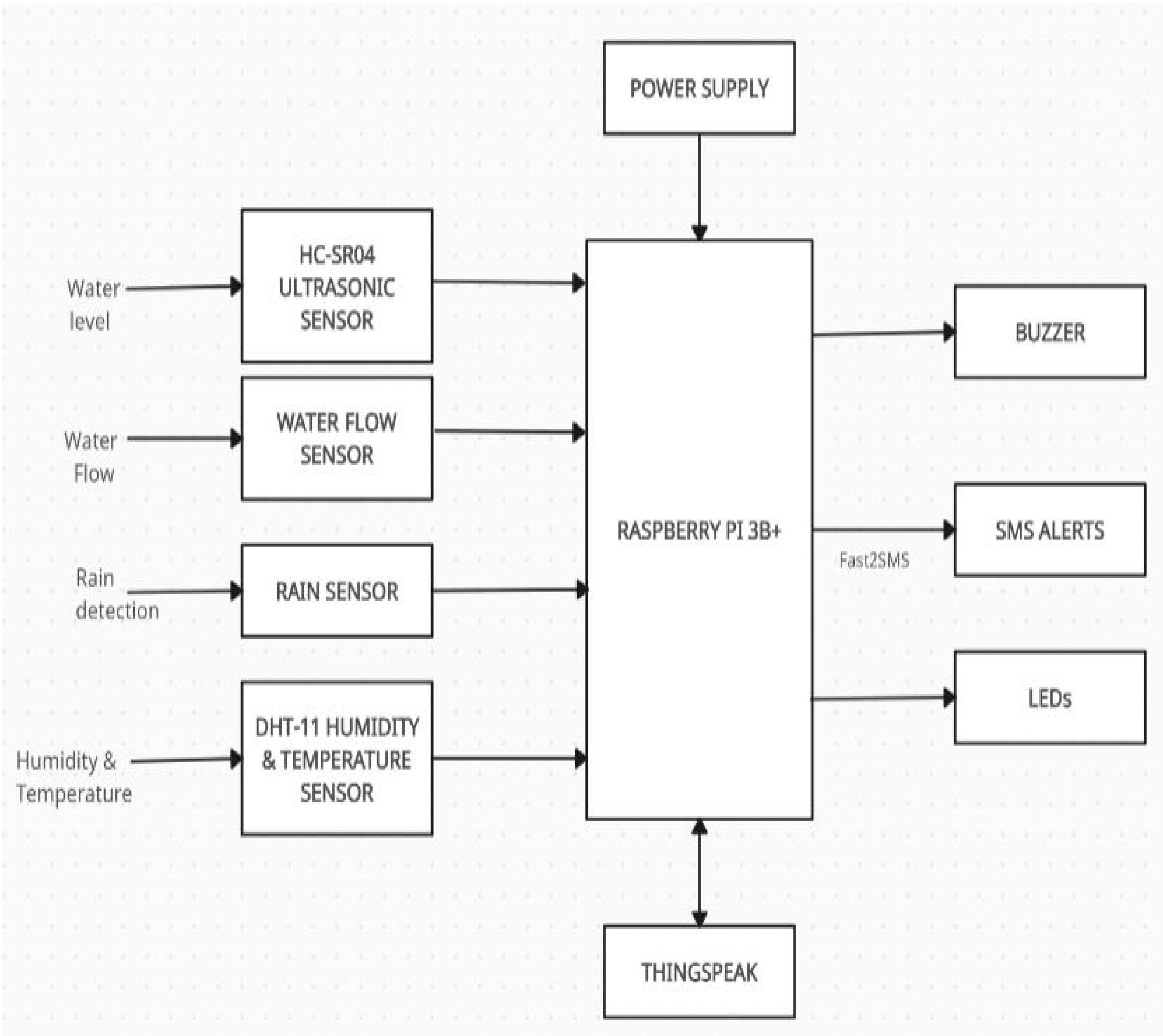

Figure 1: Block Diagram

This block diagram illustrates the architecture of an IoT-based flood monitoring and alerting system, detailing the components and their interactions.

Components and Their Functions

1. Power Supply:

Provides necessary electrical power to all components in the system, ensuring continuous operation.

2. Sensors:

HC-SR04 Ultrasonic Sensor:

Measures water level by emitting ultrasonic waves and calculating the distance based on the time it takes for the waves to return. This data helps in monitoring rising water levels.

Water Flow Sensor:

Measures the rate of water flow through a channel. It helps in assessing the velocity and volume of water, which is crucial for understanding the flood intensity.

Rain Sensor:

Detects the presence and intensity of rainfall. This data is vital for predicting potential flooding due to heavy rains.

DHT-11 Humidity & Temperature Sensor:

Monitors ambient humidity and temperature. These parameters can influence weather patterns and precipitation levels.

3. Raspberry Pi 3B+:

Acts as the central processing unit (CPU) of the system.

Receives data from all sensors, processes it, and makes decisions based on predefined thresholds and algorithms.

Interfaces with other components to trigger alerts and upload data.

4. ThingSpeak:

A cloud-based IoT analytics platform.

Receives processed data from the Raspberry Pi, allowing for real-time monitoring, visualization, and analysis.

Stores historical data for trend analysis and predictive modeling.

5. Alerting Mechanisms:

Buzzer:

Emits an audible sound when water levels or flow rates exceed safe thresholds, providing an immediate, local alert.

SMS Alerts:

Sends text message alerts to designated recipients using the Fast2SMS service, ensuring timely communication to residents, emergency services, and authorities.

LEDs:

Visual indicators that light up when certain conditions are met (e.g., red for high water levels, yellow for moderate levels), providing an immediate visual alert.

Data Flow and Process

1. Sensor Data Collection:

Each sensor continuously collects data relevant to its function (water level, flow rate, rain detection, humidity, and temperature).

This data is transmitted to the Raspberry Pi 3B+ for processing.

2. Data Processing and Analysis:

The Raspberry Pi 3B+ processes the incoming sensor data.

It analyzes the data using programmed algorithms to detect potential flood conditions.

If the data indicates that predefined thresholds are exceeded, the system takes appropriate actions.

3. Triggering Alerts:

Local Alerts: The buzzer sounds, and LEDs light up to provide immediate warnings to anyone in the vicinity.

Remote Alerts: SMS alerts are sent out via Fast2SMS to inform key stakeholders and the community, allowing them to take preventive measures.

4. Data Upload and Monitoring:

The processed data is uploaded to ThingSpeak for real-time monitoring and visualization.

ThingSpeak also stores the data for historical analysis, enabling better understanding and predictive capabilities regarding flood patterns.

3.2 CIRCUIT DIAGRAM

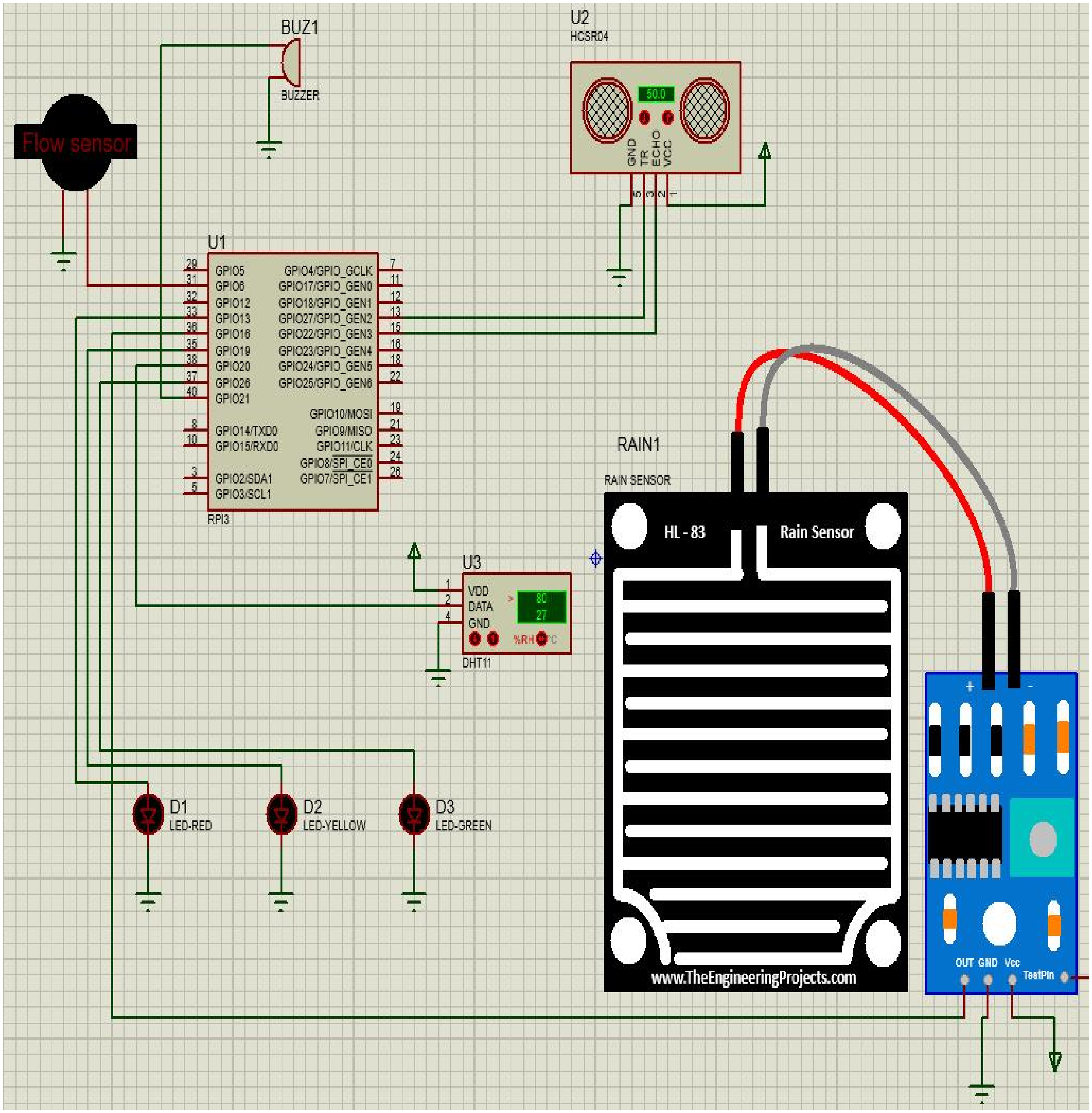

Figure 2: Circuit Diagram

This circuit diagram illustrates the hardware connections for an IoT-based flood monitoring and alerting system, focusing on various sensors connected to a Raspberry Pi 3 (RPI3) for real-time flood monitoring and alerting.

1. Raspberry Pi 3 (U1)

Acts as the central processing unit, receiving data from all sensors, processing it, and controlling the alert mechanisms.

Different GPIO (General Purpose Input/Output) pins are used for interfacing with sensors and alerting devices.

2. Sensors

HC-SR04 Ultrasonic Sensor (U2)

Measures water level by calculating the distance between the sensor and the water surface. It has four pins: VCC (power), GND (ground), Echo (output), and Trig (input).

The Echo pin connects to a GPIO pin on the Raspberry Pi to receive the distance measurement.

Water Flow Sensor

Measures the rate of water flow. It is connected to a GPIO pin on the Raspberry Pi for monitoring water flow rates.

Rain Sensor (RAIN1)

Detects the presence and intensity of rain. It consists of two parts: a rain detection board and a control board. The rain detection board sends data to the control board, which then sends the signal to the Raspberry Pi.

DHT11 Humidity & Temperature Sensor (U3)

Measures ambient humidity and temperature. It has three pins: VCC (power), DATA (signal), and GND (ground).

The DATA pin is connected to a GPIO pin on the Raspberry Pi to send humidity and temperature readings.

3. Alert Mechanisms

Buzzer (BUZ1)

Emits an audible sound when a flood condition is detected. It is connected to a GPIO pin on the Raspberry Pi for activation.

LED Indicators (D1, D2, D3)

- Provide visual alerts based on the severity of the flood condition.
- D1 (Red LED): Lights up for high alert conditions (e.g., severe flooding).
- D2 (Yellow LED): Lights up for moderate alert conditions (e.g., rising water levels).
- D3 (Green LED): Lights up for normal conditions (e.g., no flooding).

Circuit Connections

1. Power Supply

The sensors and the Raspberry Pi are powered by a common power supply, ensuring they operate within their required voltage ranges.

2. Sensor Connections

HC-SR04 Ultrasonic Sensor:

- VCC to a 5V pin on the Raspberry Pi.
- GND to a ground (GND) pin on the Raspberry Pi.
- Trig to a specific GPIO pin configured for output.
- Echo to a specific GPIO pin configured for input.

Water Flow Sensor:

Connected to a GPIO pin on the Raspberry Pi to monitor the pulse signal indicating flow rate.

Rain Sensor:

Connected to the control board, which is then connected to a GPIO pin on the Raspberry Pi.

DHT11 Sensor:

- VCC to a 3.3V or 5V pin on the Raspberry Pi.
- GND to a ground (GND) pin on the Raspberry Pi.
- DATA to a specific GPIO pin configured for data input.

3. Alert Mechanism Connections

Buzzer:

Connected to a GPIO pin for control.

The other terminal is connected to ground.

LEDs:

Each LED (Red, Yellow, Green) is connected to a respective GPIO pin on the Raspberry Pi.

The cathode (negative) of each LED is connected to ground, and the anode (positive) is connected to the GPIO pin via a current-limiting resistor (not shown in the diagram but typically necessary).

Functionality

Data Collection: Sensors continuously collect environmental data and send it to the Raspberry Pi.

Processing: The Raspberry Pi processes the incoming data, checking for predefined thresholds.

Alerts:

- If a threshold is exceeded, the Raspberry Pi activates the buzzer and the corresponding LED indicator.
- In severe conditions, the red LED lights up and the buzzer sounds.
- For moderate conditions, the yellow LED lights up.
- The green LED indicates normal conditions.

Real-Time Monitoring: The Raspberry Pi can also upload the data to a cloud service like ThingSpeak for real-time monitoring and analysis.

3.3 ALGORITHM

1.Start

2. Initialize Raspberry Pi 3B+

- Set up the Raspberry Pi board & necessary connections.

3. Monitor temperature and humidity

- Read data from the temperature and humidity sensor.

4. Display temperature and humidity:

- Show the obtained temperature & humidity values.

5. Monitor Rain using Rain Sensor:

- Check the status of the rain sensor.
- If rain is detected:
- Send an SMS alert: "Rain Detected".

6. Monitor Water level using Ultrasonic Sensor:

- Measure the distance between the ultrasonic sensor and the water level.
- If distance > 50cm:
- Normal water level detected, turn on green LED.
- Else if 20cm < distance < 50cm:
- Medium water level detected, turn on yellow LED.
- Else:
- High water level detected, turn on red LED and activate the buzzer.
- Send an SMS alert: "High Water Level Detected, Flood May Occur".

7. Monitor Water Flow using Water Flow Sensor:

- Check the water flow sensor readings.
- If water flow is rising beyond a predefined threshold:
- Send an SMS alert: "Water Flow Rising".
- Else:
- Repeat this step.

3.4 FLOWCHART

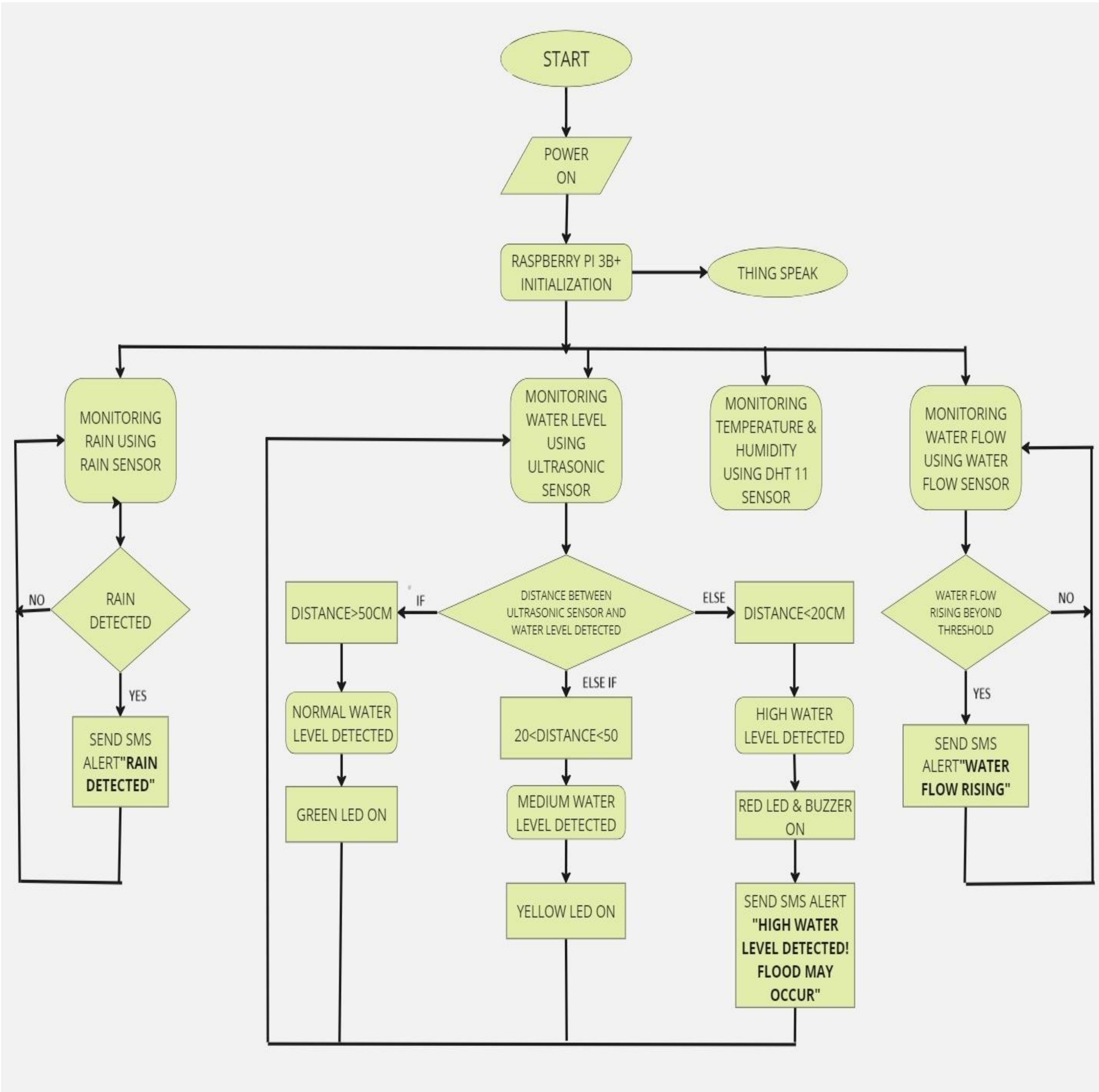

Figure 3: flowchart

This flowchart represents the functioning of a flood monitoring and alert system using a Raspberry Pi 3B+ and various sensors. Here's a step-by-step explanation:

1. Start and Initialization:

The system starts with powering on the Raspberry Pi 3B+.

The Raspberry Pi initializes and connects to ThingSpeak, an IoT platform for data collection and analysis.

2. Monitoring Sensors:

Rain Sensor:

The system checks for rain detection.

If rain is detected, an SMS alert "RAIN DETECTED" is sent.

If no rain is detected, the system continues to monitor.

Ultrasonic Sensor:

Measures the distance between the sensor and the water level.

If the distance is greater than 50 cm, the water level is considered normal, and a green LED is turned on.

If the distance is between 20 cm and 50 cm, a medium water level is detected, and a yellow LED is turned on.

If the distance is less than 20 cm, a high water level is detected, and both a red LED and a buzzer are turned on. An SMS alert "HIGH WATER LEVEL DETECTED! FLOOD MAY OCCUR" is sent.

Temperature & Humidity Sensor (DHT11):

Monitors the ambient temperature and humidity. The details of its actions are not specified in the flowchart, implying continuous monitoring without direct triggers.

Water Flow Sensor:

Checks if the water flow exceeds a predefined threshold.

If the water flow is rising beyond the threshold, an SMS alert "WATER FLOW RISING" is sent.

If the water flow is normal, the system continues to monitor.

3. Flow Decisions:

The system continuously loops through the sensors, monitoring the conditions and sending alerts when necessary.

4. Alerts and Indications:

Various conditions trigger different alerts and LED indicators to provide a visual and auditory status of the environment.

CHAPTER 4

HARDWARE REQUIREMENT

4.1 HARDWARE REQUIREMENT

Raspberry Pi: - Raspberry Pi 3 Model B+ is a single-board computer developed by the Raspberry Pi Foundation. It is a credit-card-sized computer that can be used for a variety of tasks, including programming, media center, and home automation. The 3B+ model features a 1.4GHz 64-bit quad-core ARM Cortex-A53 CPU, dual-band 802.11ac wireless, Bluetooth 4.2/BLE and faster Ethernet.

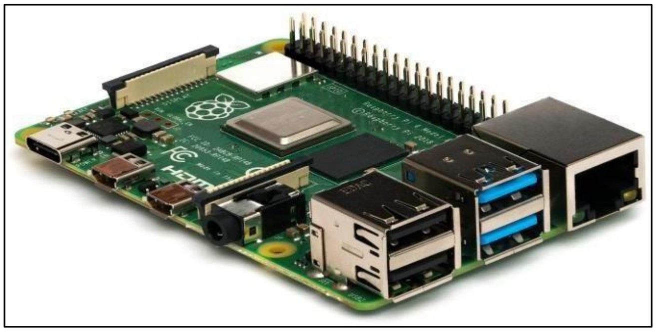

Figure 4: Raspberry Pi 3B+

Features:

- Broadcom BCM2837B0,
- Cortex-A53 (ARMv8) 64-bit SoC @ 1.4GHz CPU.
- 1GB LPDDR2 SDRAM.
- Dual-band 802.11ac wireless LAN and Bluetooth 4.2/BLE.
- Gigabit Ethernet port.
- 4 USB 2.0 ports.
- 40-pin GPIO header for interfacing with other devices.
- 3.5mm audio jack.
- microSD card slot for loading the operating system and storing data.
- 5V DC via micro USB connector (minimum 2.5A).
- Supports a variety of operating systems, including Raspberry Pi OS, Ubuntu, and others.
- Dimensions: 88 x 58 x 19.5 mm, Weight: 46 g.

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DHT-11 Sensor: - The DHT11 is a popular temperature and humidity sensor that has an 8-bit microprocessor to output the temperature and humidity measurements as serial data and a specialized NTC to detect temperature.

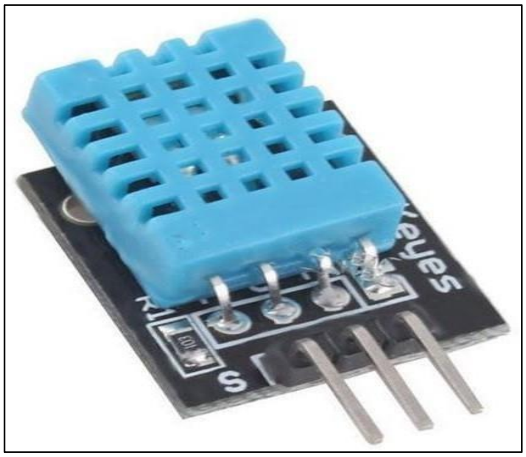


Figure 5: DHT 11 Sensor

Features:

- Ultra low cost.
- 3 to 5V power and I/O.
- 2.5mA max current use during conversion (while requesting data)
- Good for 20-80•Good for 0-50°C temperature readings ±2°C accuracy.
- No more than 1 Hz sampling rate (once every second)
- Body size 15.5mm x 12mm x 5.5mm.
- 4 pins with 0.1” spacing.

Ultrasonic sensor:-An ultrasonic sensor is a device that uses ultrasonic sound waves to calculate an object's distance from it. A transducer is used by an ultrasonic sensor to transmit and receive ultrasonic pulses, which are then used to determine the proximity of an object.

Figure 6: Ultrasonic Sensor

Features:

- Supply current: 15mA.
- Modulation frequency: 40Hz.
- Output: 0 – 5V (Output high when obstacle detected in range).
- Beam Angle: Max 15 degrees.
- Distance: 2cm – 400cm.
- Accuracy: 0.3cm.
- Communication: Positive TTL pulse.
- Supply voltage: 5V (DC).

Water flow sensor: A plastic valve that allows water to pass serves as the water flow sensor's component. To detect and gauge the water flow, there is a water rotor and a hall effect sensor. The rotor turns as water passes through the valve. This allows the motor's speed to alter to be seen. When analyzing a stream or river's discharge, flow patterns, and sediment transport, the Flow Rate Sensor analyzes the water's velocity. Research on the environment or Earth science can make use of the Flow Rate Sensor.

Figure 7: Waterflow Sensor

Specifications:

- Max. Working Current:- 15mA (DC 5V)
- Working Voltage:- DC 5V 15V
- Interface Dimensions:- G1/2Inch
- Flow Rate Range:- 1 25L/min

Rain Sensor:- A board with nickel coating in the shape of lines is called a raindrop sensor.It utilizes the resistance principle to function. When a moisture threshold is exceeded, the raindrop sensor generates a digital output. It does this by measuring the moisture using analog output pins. The LM393 op amp is the foundation of the module.

Rain sensors are cost-efficient installations that conserve water, reduce energy bills, increase the life span of your irrigation system and help keep your garden soil well-nourished.

Figure 8: Rain Sensor

Features:

- This sensor module uses good quality of double-sided material.
- Anti-conductivity oxidation with long time use.
- The area of this sensor includes 5cm x 4cm and can be built with a nickel plate on
- the side.
- The sensitivity can be adjusted by a potentiometer.
- The required voltage is 5V.

LED:- An electrical current passing through a light-emitting diode causes it to emit light. Energy is released in the form of photons when electrons and electron holes in the semiconductor interact again. How much energy electrons need to travel across the semiconductor's band gap determines the hue of the light.

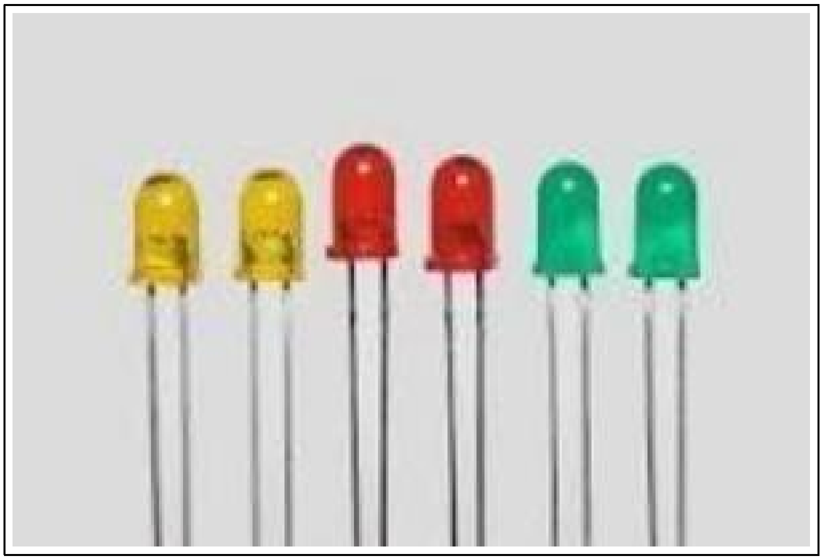


Figure 9:LED

Features:

- LEDs consume less power, and they require low operational voltage.
- No warm-up time is needed for LEDs.
- The emitted light is monochromatic.
- They exhibit long life and ruggedness.

Buzzer:- An auditory signaling device, such as a buzzer or beeper, can be piezoelectric, electromechanical, or mechanical. Buzzers and beepers are commonly used in alarm systems, timers, training systems, and as a means of verifying user input, such as mouse clicks and keystrokes.

Figure 10: Buzzer

Features:

- Color is black.
- The frequency range is 3,300Hz.
- Operating Temperature ranges from – 20° C to +60°C.
- Operating voltage ranges from 3V to 24V DC.
- The sound pressure level is 85dBA or 10Cm.
- The supply current is below 15mA.

CHAPTER 5
SOFTWARE REQUIREMENT

Thingspeak:- ThingSpeak is an Internet of Things (IoT) platform that allows you to collect, analyze, and visualize data from sensors or other devices in real-time. It's often used in various IoT applications such as environmental monitoring, home automation, and industrial automation. ThingSpeak provides APIs for data collection and visualization, making it easy for developers to integrate their devices with the platform and create custom applications. It's owned and operated by MathWorks, the same company behind MATLAB**.**

Fast2SMS:- Fast2SMS is a bulk SMS service provider based in India. It allows businesses and individuals to send large volumes of text messages to their customers or subscribers quickly and efficiently. Fast2SMS offers features such as SMS scheduling, transactional SMS, promotional SMS, SMS API integration for software developers, and more. It's commonly used by businesses for marketing campaigns, transaction notifications, and customer engagement purposes.

Raspbian OS:- Raspbian OS now officially called Raspberry Pi OS, is a Debian-based operating system optimized for the Raspberry Pi hardware. It is designed to provide a user-friendly platform for learning, development, and DIY projects. Raspberry Pi OS includes a comprehensive suite of pre-installed software for programming, multimedia, and general productivity, making it ideal for educational purposes and hobbyist projects. It supports various programming languages such as Python and Scratch, and offers a lightweight, responsive desktop environment tailored for the Raspberry Pi’s capabilities.

Python IDLE:- Python IDLE which stands for Integrated Development and Learning Environment, is a free and basic IDE that comes included with most Python installations. It provides a user-friendly environment specifically for working with Python code. IDLE offers a text editor with features like syntax highlighting, auto-completion, and smart indentation to assist you in writing clean Python code. It also includes an interactive shell where you can type and execute Python code line by line, allowing you to experiment and test your code as you go. Additionally, IDLE has a built-in debugger that helps you step through your code, set breakpoints, and inspect variables, making it easier to identify and fix errors in your programs. While IDLE is not as powerful as professional IDEs and has limitations in its debugging capabilities, it's a great option for beginners learning Python or anyone who needs a simple tool to write and run Python scripts.

CHAPTER 6

WORKING

6.1WORKING

Sensors

1. Ultrasonic Sensor (HC-SR04)

Function: Continuously measures the distance to the water surface to determine water level.

Operation: Emits ultrasonic waves and calculates the time taken for the waves to return after hitting the water surface. The distance is calculated using the speed of sound.

Data Usage: Helps in monitoring rising water levels, crucial for early flood detection.

2. Water Flow Sensor

Function: Detects changes in water flow rate through a channel or pipe.

Operation: Uses a rotor and Hall Effect sensor to measure the velocity of water. As water flows through the sensor, it spins the rotor, generating pulses that are counted to determine flow rate.

Data Usage: Assesses the volume and speed of water, which helps in understanding the intensity of potential flooding.

3. DHT11 Sensor

Function: Measures ambient temperature and humidity.

Operation: Uses a thermistor and capacitive humidity sensor to provide readings of temperature and relative humidity.

Data Usage: Provides environmental context that can affect weather patterns and precipitation levels.

4. Rain Sensor

Function: Detects the presence and intensity of rainfall.

Operation: Consists of a rain detection board that detects water droplets and a control module that processes the signal.

Data Usage: Indicates rainfall conditions, aiding in flood prediction and preparedness.

Processing Unit

Raspberry Pi 3B+

Function: Acts as the central processing unit (CPU) of the system.

Operation: Receives data from all sensors, processes it using predefined thresholds and algorithms, triggers alerts, and communicates with the cloud platform.

Connectivity: Interfaces with sensors via GPIO pins and connects to the internet for cloud communication.

Output Devices

1. Buzzer

Function: Emits an audible alarm when a flood risk is detected.

Operation: Activated by the Raspberry Pi when water levels or flow rates exceed safe thresholds, providing immediate auditory alerts to nearby individuals.

2. LEDs (Red, Yellow, Green)

Function: Provide visual indication of flood risk levels.

Operation:

Red LED: Lights up to indicate high flood risk.

Yellow LED: Lights up to indicate moderate flood risk.

Green LED: Lights up to indicate normal conditions.

Usage: Allows for quick visual assessment of flood risk.

Cloud Platform

ThingSpeak

Function: Stores sensor data and enables remote monitoring and visualization.

Operation:

Collects and stores data sent from the Raspberry Pi.

Provides real-time graphs and charts for data visualization.

Allows historical data analysis to identify trends and improve predictive capabilities.

Usage: Facilitates remote monitoring of environmental conditions and aids in decision-making processes.

Alerting Service

Fast2SMS

Function: Sends SMS alerts to designated recipients during high-risk situations.

Operation:

The Raspberry Pi interfaces with the Fast2SMS service to send predefined alert messages to pre-registered phone numbers when high-risk conditions are detected.

Usage: Ensures timely communication to residents, emergency services, and local authorities, enhancing preparedness and response efforts.

Data Flow

1. Data Collection

- Sensors continuously collect data on water level, flow rate, temperature, humidity, and rainfall.
- This data is transmitted to the Raspberry Pi for processing.

2. Data Processing

- The Raspberry Pi receives and processes sensor data.
- Based on predefined thresholds and logic, it determines the current flood risk level.
- Algorithms analyze the data to identify patterns and predict potential flood events.

3. Alert Triggers

Buzzer: Sounds an alarm for immediate attention if a flood risk is detected.

LEDs: Change color to indicate the level of flood risk:

- Red: High flood risk, indicating immediate danger.
- Yellow: Moderate flood risk, indicating caution is needed.
- Green: Normal conditions, indicating no immediate flood threat.

4. Cloud Communication

The Raspberry Pi uploads sensor data to ThingSpeak for real-time monitoring and historical analysis.

Data visualization tools on ThingSpeak provide insights into environmental conditions and trends.

5. High-Risk Alerts

If a high-risk scenario is detected, the Raspberry Pi uses Fast2SMS to send SMS alerts to pre-registered numbers.

These alerts provide timely warnings, enabling recipients to take necessary precautions.

6.2 PROJECT CODES

Ultrasonic Sensor Code

```
import RPi.GPIO as GPIO
import time
#Thinkspeak
import sys
import urlopen
import urllib
import requests
GPIO.setwarnings(False)
from time import sleep
# Enter Your API key here
User1API = 'QRWGC0BPTRTCX820'

# URL where we will send the data, Don't change it
baseURL1 = 'https://api.thingspeak.com/update?api_key=%s' % User1API

# Define GPIO pins
TRIG_PIN = 27  # Trigger pin of ultrasonic sensor (BCM numbering)
ECHO_PIN = 17 # Echo pin of ultrasonic sensor (BCM numbering)
GREEN_LED_PIN = 26  # Green LED pin (BCM numbering)
YELLOW_LED_PIN = 19  # Yellow LED pin (BCM numbering)
RED_LED_PIN = 13  # Red LED pin (BCM numbering)
BUZZER_PIN = 21 # Buzzer pin (BCM numbering)


# Setup GPIO
GPIO.setmode(GPIO.BCM)
GPIO.setup(TRIG_PIN, GPIO.OUT)
GPIO.setup(ECHO_PIN, GPIO.IN)
GPIO.setup(GREEN_LED_PIN, GPIO.OUT)
GPIO.setup(YELLOW_LED_PIN, GPIO.OUT)
GPIO.setup(RED_LED_PIN, GPIO.OUT)
GPIO.setup(BUZZER_PIN, GPIO.OUT)
GPIO.output(GREEN_LED_PIN, GPIO.LOW)
GPIO.output(YELLOW_LED_PIN, GPIO.LOW)
GPIO.output(RED_LED_PIN, GPIO.LOW)
GPIO.output(BUZZER_PIN, GPIO.LOW)
```

```
def measure_distance():
    # Send a pulse to trigger the ultrasonic sensor
    GPIO.output(TRIG_PIN, GPIO.HIGH)
    time.sleep(0.00001)
    GPIO.output(TRIG_PIN, GPIO.LOW)

    pulse_start_time = time.time()

    # Measure the duration of pulse from the echo pin
    while GPIO.input(ECHO_PIN) == 0:
        pulse_start_time = time.time()
    while GPIO.input(ECHO_PIN) == 1:
        pulse_end_time = time.time()

    # Calculate distance in centimeters
    pulse_duration = pulse_end_time - pulse_start_time
    distance = pulse_duration * 17150
    distance = round(distance, 2)
    return distance

def turn_on_green_led():
    GPIO.output(GREEN_LED_PIN, GPIO.HIGH)
    GPIO.output(YELLOW_LED_PIN, GPIO.LOW)
    GPIO.output(RED_LED_PIN, GPIO.LOW)

def turn_on_yellow_led():
    GPIO.output(GREEN_LED_PIN, GPIO.LOW)
    GPIO.output(YELLOW_LED_PIN, GPIO.HIGH)
    GPIO.output(RED_LED_PIN, GPIO.LOW)


def turn_on_red_led():
    GPIO.output(GREEN_LED_PIN, GPIO.LOW)
    GPIO.output(YELLOW_LED_PIN, GPIO.LOW)
    GPIO.output(RED_LED_PIN, GPIO.HIGH)

def turn_on_buzzer():
    GPIO.output(BUZZER_PIN, GPIO.HIGH)

def turn_off_buzzer():
    GPIO.output(BUZZER_PIN, GPIO.LOW)
```

```
try:
    while True:
        distance = measure_distance()
        print("Distance:", distance, "cm")
        conn = baseURL1 + '&field4=%s' % (distance)
        request = urllib.request.Request(conn)
        responce = urllib.request.urlopen(request)
        responce.close()

        if distance > 20:  # Normal level
            turn_on_green_led()
            turn_off_buzzer()
        elif 10 < distance <= 20:  # Medium level
            turn_on_yellow_led()
            turn_off_buzzer()
            url="https://www.fast2sms.com/dev/bulkV2"
            params={


"authorization":"kJx0SpQ5Nut0zsQcu0B0ZVm19Tl1UGDMGmnmfoCvRILNJZVf9VDo2mP
YZVtV",
                "sender_id":"SMSINI",
                "message":"Medium water level",
                "language":"english",
                "route":"q",
                "numbers":"7058187392"
            }
            rs=requests.get(url,params=params)

 else:  # High level (flood)
            turn_on_red_led()
            turn_on_buzzer()
            url="https://www.fast2sms.com/dev/bulkV2"
            params={


"authorization":"kJx0SpQ5Nut0zsQcu0B0ZVm19Tl1UGDMGmnmfoCvRILNJZVf9VDo2mP
YZVtV",
                "sender_id":"SMSINI",
                "message":"Be alert! High Water level detected..",
                "language":"english",
                "route":"q",
                "numbers":"7058187392"
            }
```

```
            rs=requests.get(url,params=params)

        time.sleep(1)  # Adjust sleep time as per requirement

except KeyboardInterrupt:
    pass

finally:
    GPIO.cleanup()
```

Rain Sensor Code

```
import RPi.GPIO as GPIO
import time
import requests
import urllib

# Define GPIO pins
RAIN_SENSOR_PIN = 16  # GPIO pin where the rain sensor output is connected
buzzer = 21

# Setup GPIO
GPIO.setmode(GPIO.BCM)
GPIO.setup(RAIN_SENSOR_PIN, GPIO.IN)
GPIO.setup(buzzer,GPIO.OUT)


GPIO.setwarnings(False)
print("Rain Sensor Ready.....")
print(" ")

#Thinkspeak
import sys
import urlopen
import urllib

from time import sleep
# Enter Your API key here
User1API = 'NWQRAVIZY6YYJWM6'

# URL where we will send the data, Don't change it
baseURL1 = 'https://api.thingspeak.com/update?api_key=%s' % User1API
msg="Rain detected.."
```

```
def sms_send():
    url="https://www.fast2sms.com/dev/bulkV2"
    params={


"authorization":"kJx0SpQ5Nut0zsQcu0B0ZVm19Tl1UGDMGmnmfoCvRILNJZVf9VDo2mP
YZVtV",
        "sender_id":"SMSINI",
        "message":msg,
        "language":"english",
        "route":"q",
        "numbers":"7058187392"
    }
    rs=requests.get(url,params=params)

   try:
    while True:
        c = GPIO.input(RAIN_SENSOR_PIN)
        print(c)
        if GPIO.input(RAIN_SENSOR_PIN) == GPIO.LOW:
            print("Its raining!")
            sms_send()
        else:
            print("It's not raining!")
            conn = baseURL1 + '&field3=%s' % (c)
            request = urllib.request.Request(conn)
            responce = urllib.request.urlopen(request)
            responce.close()
         time.sleep(1)  # Check rain status every 1 second

except KeyboardInterrupt:
    pass

finally:
    GPIO.cleanup()
```

WaterFlow Sensor Code

```
import RPi.GPIO as GPIO
import time
import requests
# Define GPIO pins
FLOW_SENSOR_PIN = 6  # Use GPIO 14 (BCM) or pin 8 (BOARD)
BUZZER_PIN = 21       # Use GPIO 18 (BCM) or pin 12 (BOARD)

# Setup GPIO
GPIO.setmode(GPIO.BCM)
GPIO.setup(FLOW_SENSOR_PIN, GPIO.IN, pull_up_down=GPIO.PUD_UP)
GPIO.setup(BUZZER_PIN, GPIO.OUT)
GPIO.output(BUZZER_PIN, GPIO.LOW)

#Thinkspeak
import sys
import urlopen
import urllib
from time import sleep
# Enter Your API key here
User1API = 'QRWGC0BPTRTCX820'

# URL where we will send the data, Don't change it
baseURL1 = 'https://api.thingspeak.com/update?api_key=%s' % User1API


msg="High water flow detected.."
def sms_send():
    url="https://www.fast2sms.com/dev/bulkV2"
    params={


"authorization":"kJx0SpQ5Nut0zsQcu0B0ZVm19Tl1UGDMGmnmfoCvRILNJZVf9VDo2mP
YZVtV",
        "sender_id":"SMSINI",
        "message":msg,
        "language":"english",
        "route":"q",
        "numbers":"7058187392"
    }
    rs=requests.get(url,params=params)
```

```
def countPulse(channel):
    global pulses
    pulses += 1

  def buzz_on():
    GPIO.output(BUZZER_PIN, GPIO.HIGH)

  def buzz_off():
    GPIO.output(BUZZER_PIN, GPIO.LOW)

  # Configure event detection
  GPIO.add_event_detect(FLOW_SENSOR_PIN,    GPIO.FALLING,    callback=countPulse,
  bouncetime=20)

  # Main loop
  pulses = 0
  try:
    while True:
      time.sleep(1)
      flow_rate = pulses / 7.5  # Pulse frequency to flow rate conversion, adjust according to
  your sensor
      print("Flow rate: %.2f L/min" % flow_rate)
      conn = baseURL1 + '&field5=%s' % (flow_rate)
      request = urllib.request.Request(conn)
      responce = urllib.request.urlopen(request)
      responce.close()

      # Check if flow rate exceeds a certain threshold (example: 10 L/min)
      if flow_rate > 5:
        print("High water flow detected! Activating buzzer...")
        buzz_on()
        sms_send()

   else:
        buzz_off()

      pulses = 0  # Reset pulse count for the next interval

  except KeyboardInterrupt:
    pass

  finally:
    GPIO.cleanup()
```

DHT-11 Sensor Code

```
import RPi.GPIO as GPIO
import dht11
import time

# initialize GPIO
GPIO.setwarnings(False)
GPIO.setmode(GPIO.BCM)
instance = dht11.DHT11(pin=20)

#Thinkspeak
import sys
import urlopen
import urllib

from time import sleep
# Enter Your API key here
User1API = 'QRWGC0BPTRTCX820'

# URL where we will send the data, Don't change it
baseURL1 = 'https://api.thingspeak.com/update?api_key=%s' % User1API

print("***********DHT 11 sensor activated ***********")
while True:
    result = instance.read()
    if result.is_valid():
        a = result.temperature
        print("Environment Tempreture:"+str(a))

        b = result.humidity
        print("Environment Humidity:"+str(b))
        print("-------------------------------")
        conn = baseURL1 + '&field1=%s&field2=%s' % (a , b)
        request = urllib.request.Request(conn)
        response = urllib.request.urlopen(request)
        response.close()
```

CHAPTER 7

ADVANTAGES , DISADVANTAGES AND APPLICATIONS

7.1 ADVANTAGES:

7.1.1 Early Warning:

Life-Saving Alerts: The system's real-time data collection and analysis provide early warning capabilities, enabling communities to evacuate, secure their properties, and prepare for flood events in advance. Early warnings help in saving lives by providing critical time for evacuation and emergency measures.

Prompt Communication: The ability to send immediate alerts via SMS or other communication methods ensures that information reaches the affected population quickly, reducing the time taken for individuals to react.

7.1.2 Improved Preparedness:

Strategic Planning: Access to accurate and up-to-date information empowers local authorities and individuals to take proactive measures to protect lives and property. They can implement emergency response plans and deploy resources more effectively, ensuring that rescue and relief operations are well-coordinated.

Training and Drills: Continuous monitoring and alert systems allow for regular training and preparedness drills, helping communities and emergency responders to stay ready and informed about the best practices in flood situations.

7.1.3 Reduced Economic Impact:

Infrastructure Protection: Early warnings and improved preparedness can help reduce the economic impact of floods. By minimizing damage to infrastructure, agricultural lands, and businesses, communities can save substantial financial resources. Protecting critical infrastructure like roads, bridges, and communication networks helps maintain economic stability.

Business Continuity: Early alerts enable businesses to take precautionary measures, reducing downtime and maintaining operations even during flood events. This helps in sustaining local economies and reducing long-term financial losses.

7.1.4 Enhanced Public Safety:

Real-Time Monitoring: The continuous monitoring of environmental parameters ensures that any changes in water levels, rainfall, and other critical factors are detected promptly. This proactive approach helps in maintaining public safety.

Risk Mitigation: By identifying potential flood risks early, communities can take measures to mitigate those risks, such as reinforcing levees, creating barriers, and improving drainage systems.

7.1.5 Data-Driven Decision Making:

Historical Data Analysis: The system can store historical data, which can be analyzed to understand patterns and trends in flooding. This information is valuable for long-term planning and development of flood-resistant infrastructure.

Policy Formulation: Reliable data from the monitoring system can inform government policies and strategies for disaster management, urban planning, and environmental conservation.

7.1.6 Environmental Benefits:

Ecosystem Protection: By preventing uncontrolled flooding, the system helps protect natural ecosystems, including wetlands and forests, which can be adversely affected by excessive water flow.

Sustainable Water Management: Monitoring water levels and flow can contribute to more sustainable water management practices, ensuring that water resources are used efficiently and conserved.

7.1.7 Community Awareness and Engagement:

Educational Tool: The monitoring system can serve as an educational tool for communities, increasing awareness about the importance of flood preparedness and encouraging proactive behavior.

Community Involvement: Engaging local communities in monitoring and responding to flood alerts fosters a sense of responsibility and collective action towards disaster management.

7.1.8 Technological Integration:

Smart City Development: Integration of flood monitoring systems with other smart city technologies can enhance overall urban management, contributing to safer and more resilient cities.

IoT and Automation: Leveraging Internet of Things (IoT) devices and automated systems can streamline flood monitoring and response processes, making them more efficient and reliable.

7.2 DISADVANTAGES:

7.2.1 Environmental Impact:

Energy Consumption: The deployment of IoT sensors and infrastructure for flood monitoring may have environmental consequences. Continuous operation of sensors requires energy, which can contribute to the carbon footprint, especially if the energy sources are non-renewable.

Manufacturing and Disposal: The production and eventual disposal of electronic components involve the use of hazardous materials and rare earth elements. Improper disposal can lead to environmental contamination, affecting soil and water quality.

Habitat Disturbance: Installing sensors in natural habitats might disturb local wildlife and ecosystems. For instance, placing sensors in rivers and wetlands can interfere with aquatic life and alter natural water flow patterns.

7.2.2 Forecast Uncertainty:

Sensor Accuracy: While IoT-based systems provide real-time data, the accuracy of flood forecasts depends on various factors such as the quality of sensor data. Inaccurate or faulty sensors can lead to incorrect data, affecting the reliability of forecasts.

Model Reliability: The reliability of predictive models is crucial for accurate forecasts. These models need continuous updates and validation against real-world data. Without regular updates, the models might fail to predict unusual or extreme weather events accurately.

Weather Unpredictability: Extreme weather events are inherently difficult to predict due to their complex and dynamic nature. Even with advanced technology, there is always an element of uncertainty in forecasting such events.

7.2.3 Infrastructure Limitations:

Power Sources: The effectiveness of an IoT-based flood monitoring system relies on robust and well-maintained infrastructure. In remote or underdeveloped areas, consistent and reliable power sources might not be available, leading to system downtime.

Communication Networks: Reliable communication networks are essential for real-time data transmission. In areas with poor network coverage or outdated infrastructure, maintaining a seamless flow of information can be challenging.

Maintenance Challenges: Sensor networks require regular maintenance and calibration to function correctly. In regions with limited technical expertise or resources, maintaining the system's operational efficiency can be difficult.

7.2.4 High Initial Costs:

Installation Expenses: Setting up an IoT-based flood monitoring system involves significant initial costs for purchasing sensors, communication devices, and setting up the necessary infrastructure.

Operational Costs: Besides installation, ongoing operational costs include maintenance, energy consumption, and possibly, data transmission fees. These costs can be a burden for communities with limited financial resources.

7.2.5 Data Privacy and Security Concerns:

Data Vulnerability: IoT devices are susceptible to cyber-attacks, which can compromise the data collected and the overall integrity of the monitoring system. Ensuring data privacy and security is a critical challenge.

Sensitive Information: The data collected by these systems might include sensitive information about water resources and local infrastructure, which, if accessed by malicious entities, could pose security risks.

7.2.6 Technical Complexity:

Integration Challenges: Integrating various sensors and ensuring they work harmoniously within a single system can be technically complex. Each component must be compatible and able to communicate effectively.

Skill Requirements: Operating and maintaining an IoT-based flood monitoring system requires specialized technical skills. Training personnel and ensuring they are capable of handling the system's complexities can be a significant challenge.

7.2.7 Dependence on Technology:

System Failures: The system's reliability is heavily dependent on technology. Hardware malfunctions, software bugs, or connectivity issues can lead to system failures, potentially causing delays or inaccuracies in flood warnings.

Human Oversight: Over-reliance on automated systems might lead to reduced human oversight. It is essential to have human intervention to verify and act upon the data collected by the system.

7.3 APPLICATIONS

7.3.1 Early Warning Systems:

Continuous Data Collection: An IoT-based flood monitoring system can continuously collect data from various sensors, such as water level sensors, weather stations, and river gauges. These sensors transmit real-time information to a central server, ensuring that the data is up-to-date and accurate.

Real-Time Analysis: By analyzing this data, the system can detect sudden changes in water levels and weather conditions. Advanced algorithms and predictive models can identify patterns indicative of potential flooding, allowing for timely detection.

Automated Alerts: Once a potential flood risk is identified, the system can automatically issue early flood warnings to local authorities and residents via SMS, email, or other communication channels. This timely notification helps communities take immediate action to mitigate the impact of the flood.

Integration with Emergency Services: Early warning systems can be integrated with emergency response services, enabling coordinated efforts during a flood event. This ensures that resources are allocated efficiently, and rescue operations are conducted swiftly.

7.3.2 Infrastructure Planning and Design:

Historical Data Utilization: By collecting historical flood data and monitoring current conditions, urban planners and engineers can analyze long-term trends and identify flood-prone areas. This data-driven approach helps in designing infrastructure that can withstand future flood events.

Strategic Location Selection: Planners can use flood data to decide where to build or upgrade flood control infrastructure, such as levees, floodwalls, and drainage systems. By placing these structures in strategic locations, the risk of flood damage can be minimized.

Adaptive Infrastructure: The system can provide insights into how existing infrastructure performs during flood events. This information can be used to make necessary adjustments and improvements, ensuring that flood control measures remain effective over time.

Cost-Effective Solutions: By understanding flood patterns, planners can prioritize investments in infrastructure, ensuring that funds are allocated to the most critical areas. This helps in maximizing the impact of available resources.

7.3.3 Water Resource Management:

Efficient Water Use: Flood monitoring is crucial for managing water resources. By collecting data on water levels and flows, the system can help ensure the efficient use of water resources, especially in agriculture and water supply management.

Reservoir Management: Real-time data on water levels can assist in the management of reservoirs and dams. Operators can make informed decisions about water release to prevent overflow and ensure a stable water supply.

Irrigation Planning: In agriculture, accurate water level data can help farmers plan irrigation schedules more effectively, ensuring crops receive the right amount of water without wastage.

Drought Mitigation: By monitoring water resources, the system can also aid in drought mitigation efforts, ensuring that water is conserved and distributed efficiently during dry periods.

7.3.4 Environmental Protection:

Water Quality Monitoring: Floods can have significant environmental impacts, including water pollution and habitat destruction. An IoT-based system can monitor water quality by measuring parameters such as pH, turbidity, and chemical contaminants. This allows for the detection of pollution events and the implementation of remedial actions.

Ecological Impact Assessment: The system can monitor ecological conditions during flood events, such as changes in soil moisture, vegetation health, and wildlife habitats. This information can help in assessing the impact of floods on local ecosystems.

Proactive Mitigation Measures: By providing real-time data on environmental conditions, the system enables authorities to take proactive measures to mitigate environmental damage. For example, they can implement buffer zones, restore wetlands, or regulate industrial discharges during floods.

Sustainable Development: The data collected by the flood monitoring system can inform sustainable development practices, ensuring that new projects do not negatively impact the environment and are resilient to future flood events.

7.3.5 Disaster Response and Recovery:

Resource Allocation: During a flood event, real-time data can help emergency services allocate resources more effectively. For example, knowing the exact locations of rising water levels can guide the deployment of rescue teams, medical supplies, and relief materials.

Post-Flood Analysis: After a flood, the collected data can be analyzed to understand the extent of the damage, identify affected areas, and plan recovery efforts. This helps in rebuilding communities more effectively and preparing for future events.

Community Support: The system can facilitate communication between authorities and residents, providing updates on flood status, evacuation routes, and relief centers. This enhances community support and coordination during and after a flood event.

7.3.6 Insurance and Risk Assessment:

Risk Mapping: Insurance companies can use data from flood monitoring systems to create detailed risk maps, assessing the likelihood and potential impact of floods in different areas. This information is crucial for setting insurance premiums and coverage options.

Claims Processing: During a flood, real-time data can expedite the claims process by providing insurers with accurate information about the extent and location of damage. This helps in processing claims more efficiently and providing timely assistance to policyholders.

Risk Mitigation Incentives: Insurers can offer incentives for policyholders who implement flood mitigation measures, such as installing flood sensors or improving drainage systems. This encourages proactive risk management and reduces overall claims.

CHAPTER 8

FUTURE SCOPE

8.1 FUTURE SCOPE

It is becoming more and more crucial to integrate flood monitoring and alerting systems with other disaster management systems. This includes early warning systems, emergency response systems, and transportation management systems. By combining these systems, we can improve the efficiency and coordination of our flood response.

8.1.1 Artificial Intelligence (AI)-Driven Flood Forecasting Systems:

Real-Time Predictions: AI-driven flood forecasting systems leverage machine learning algorithms to process vast amounts of data from various sources, including weather forecasts, river levels, and historical flood patterns. These systems can anticipate flood inundation areas and water depths in real time, providing precise and timely predictions.

Dynamic Updates: The ability to continuously learn and adapt from new data allows AI models to improve their accuracy over time. This dynamic updating enhances the reliability of evacuation plans and early warning systems, ensuring communities receive the most current information.

Scenario Analysis: AI can simulate multiple flood scenarios based on different weather conditions and human interventions, helping authorities prepare for various possibilities and plan effective response strategies.

8.1.2 Intelligent Flood Warning Systems:

Customized Alerts: Intelligent flood warning systems use demographic data, geographic information, and community-specific needs to tailor alerts. For instance, a densely populated urban area may require more frequent and detailed alerts compared to a rural community, which might need broader notifications covering larger areas.

Multichannel Communication: These systems can disseminate alerts through various channels such as SMS, social media, radio, and public announcement systems, ensuring that the information reaches all segments of the population, including those without internet access.

Behavioral Insights: By analyzing how different communities respond to flood warnings, these systems can refine their alert mechanisms to increase effectiveness and compliance with evacuation orders.

8.1.3 Infrastructure that is Resistant to Flooding:

Smart Infrastructure: Bridges, roads, and buildings can be equipped with sensors to monitor structural health and environmental conditions. These sensors can detect early signs of wear, damage, or potential failure, allowing for timely maintenance and repairs.

Resilient Design: Data from flood monitoring and alerting systems can inform the design of infrastructure that can withstand flooding. For example, elevated roads, flood-resistant building materials, and improved drainage systems can be implemented based on insights from flood data.

Adaptive Infrastructure: The development of adaptive infrastructure, which can adjust to changing conditions such as rising water levels, is another future scope. This includes retractable flood barriers and buildings designed to float during floods.

8.1.4 Flood Insurance:

Risk Assessment: Flood monitoring and alerting systems provide detailed risk profiles for different areas, helping insurance companies to assess the likelihood of flooding accurately. This information is crucial for setting premiums and coverage options.

Claims Verification: Real-time data from these systems can expedite the claims process by providing accurate information about the extent and location of damage, reducing fraudulent claims and ensuring timely payouts.

Incentivizing Risk Mitigation: Insurance companies can offer lower premiums to policyholders who take proactive measures to reduce flood risk, such as installing flood sensors, improving drainage systems, or elevating buildings. This incentivizes individuals and businesses to invest in flood resilience.

8.1.5 Integrated Water Resource Management:

Holistic Approaches: Future flood monitoring systems can integrate with broader water resource management frameworks, ensuring that flood control measures are part of a comprehensive strategy that includes drought management, water conservation, and sustainable development.

Cross-Sector Collaboration: Collaboration between different sectors such as agriculture, urban planning, and environmental protection can be enhanced through integrated data sharing and joint planning, leading to more effective water resource management.

8.1.6 Public Awareness and Education:

Community Engagement: Advanced flood monitoring systems can engage communities through educational programs and interactive platforms, increasing public awareness about flood risks and preparedness measures.

Training Programs: Authorities can use data from these systems to design training programs for emergency responders, ensuring they are well-prepared for flood events and can act swiftly and efficiently.

8.1.7 Enhanced Disaster Response:

Resource Allocation: Real-time data can help authorities allocate resources more effectively during a flood event, ensuring that rescue teams, medical supplies, and relief materials are deployed where they are needed most.

Post-Flood Recovery: Data-driven insights can aid in post-flood recovery efforts, guiding the rebuilding of communities and infrastructure in a way that enhances resilience to future floods.

8.1.8 Climate Change Adaptation:

Long-Term Planning: As climate change increases the frequency and severity of flooding, advanced monitoring systems can provide the data needed for long-term adaptation strategies. This includes updating flood maps, revising building codes, and implementing nature-based solutions such as wetland restoration.

Policy Development: Governments can use insights from these systems to develop policies that address the root causes of increased flood risks, such as deforestation, urban sprawl, and inadequate drainage systems.

CHAPTER 9

RESULTS AND DISCUSSION

9.1 HARDWARE SETUP

Figure 11 shows Hardware Setup of Iot Based Flood Monitoring And Alerting System

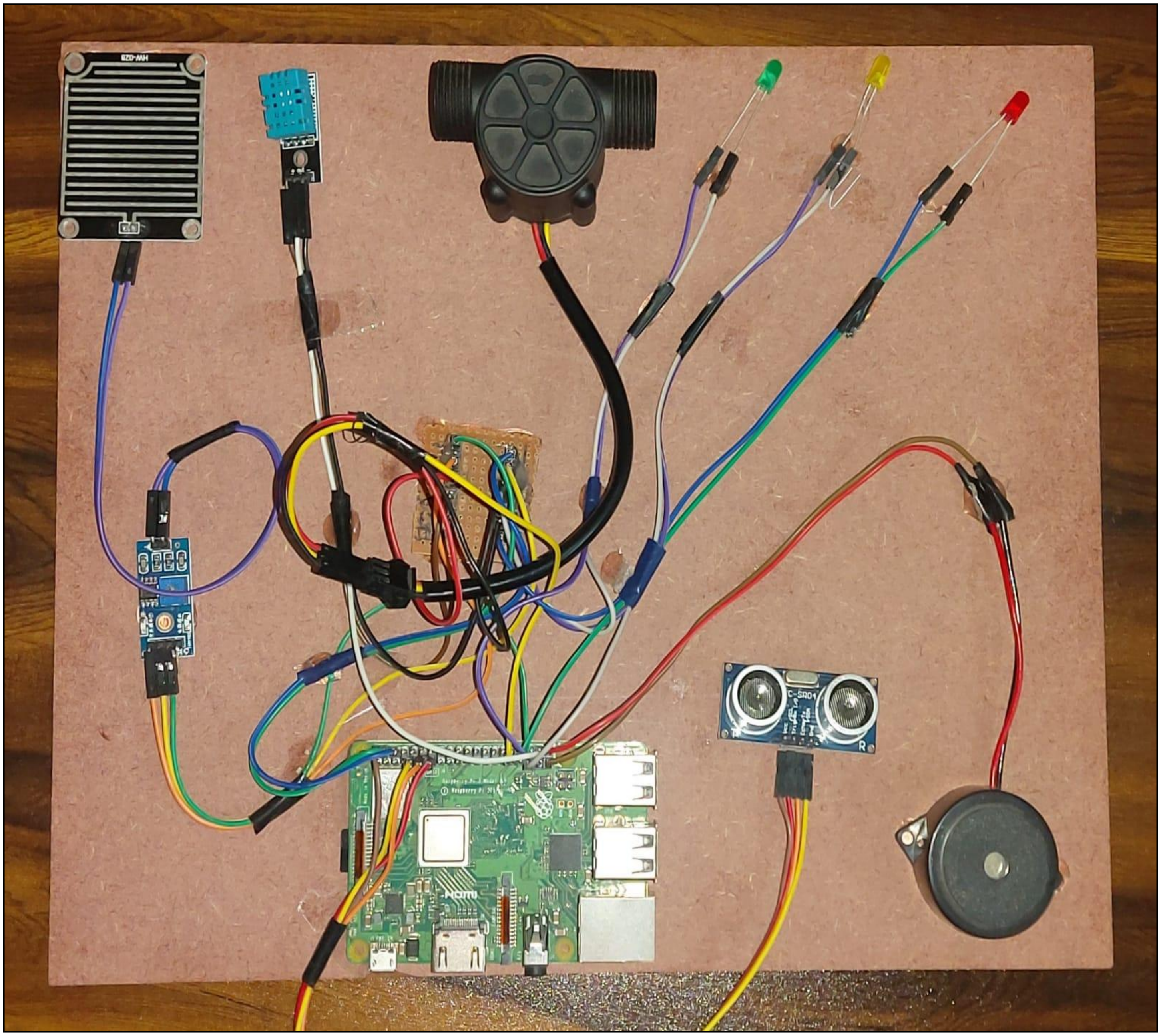


Figure 11: Hardware Setup

9.2 SENSOR READINGS

Figure 12 shows Waterflow Sensor Readings that can be seen on the screen when we run WaterFlow Sensor Program Code.

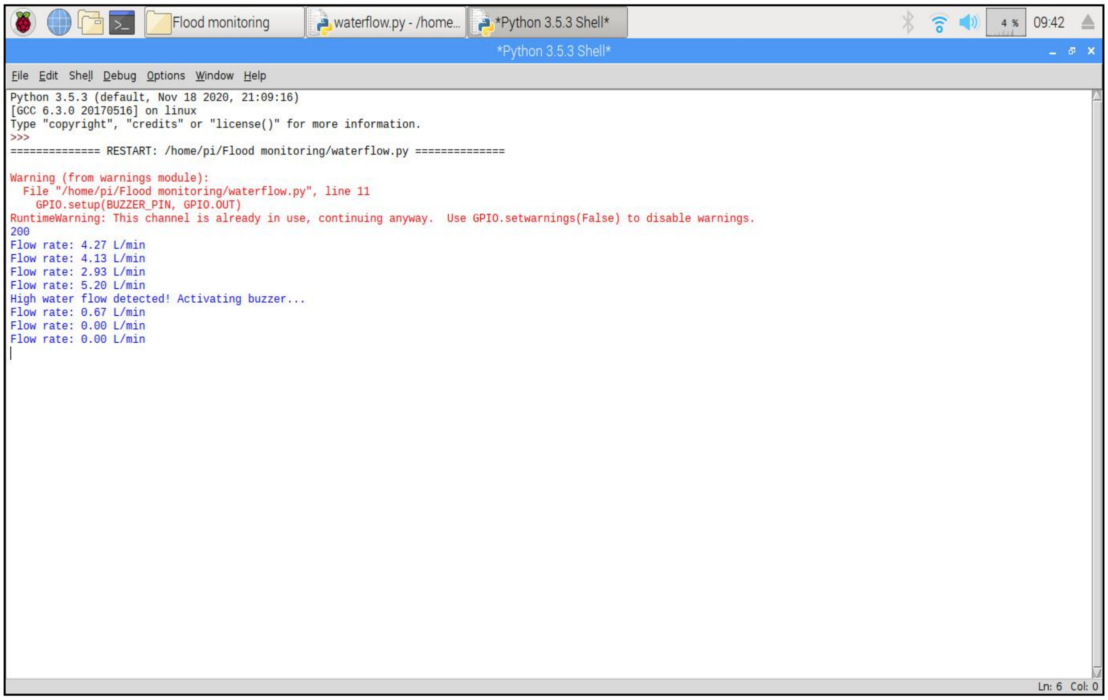


Figure 12: WaterFlow Sensor Readings

Figure 13 shows Ultrasonic Sensor Readings that can be seen on the screen when we run Ultrasonic Sensor Program Code.

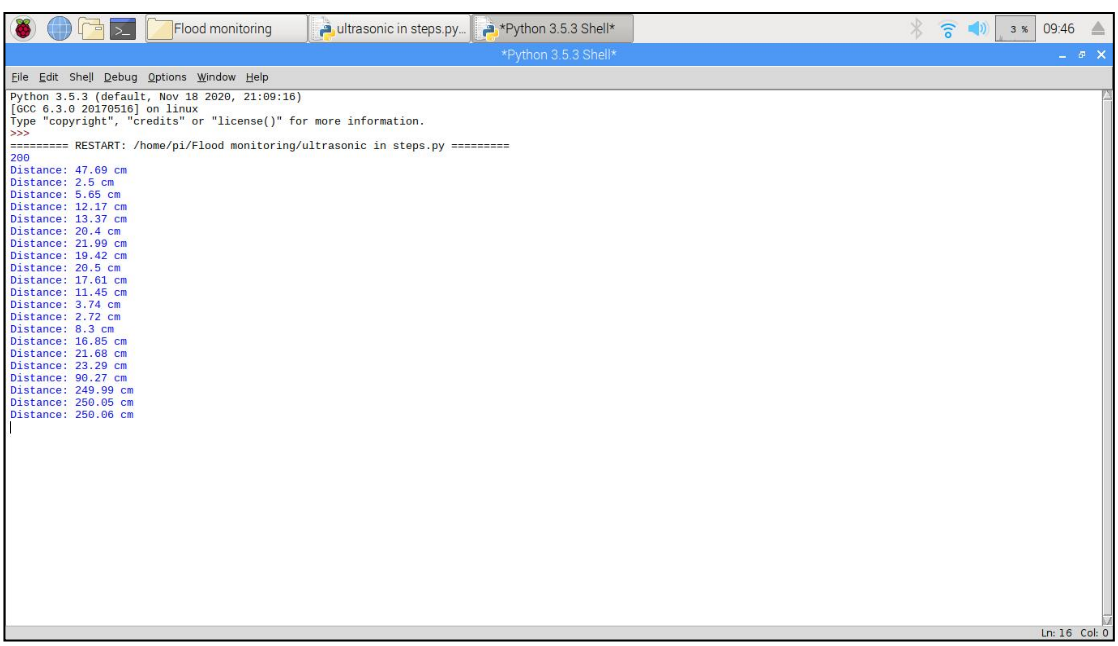


Figure 13: Ultrasonic Sensor Readings

Figure 14 shows DHT-11 Sensor Readings that can be seen on the screen when we run DHT-11 Sensor Program Code.

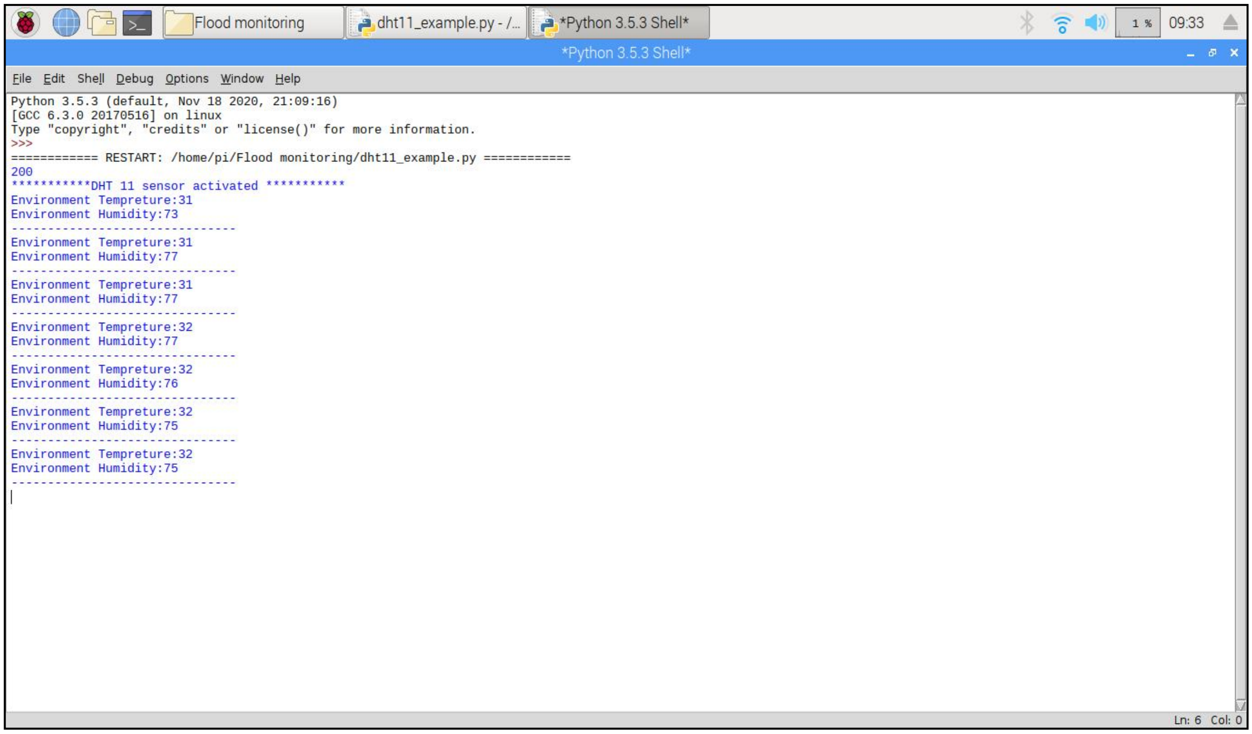


Figure 14: DHT-11 Sensor Readings

Figure 15 shows Rain Sensor Readings that can be seen on the screen when we run Rain Sensor Program Code.

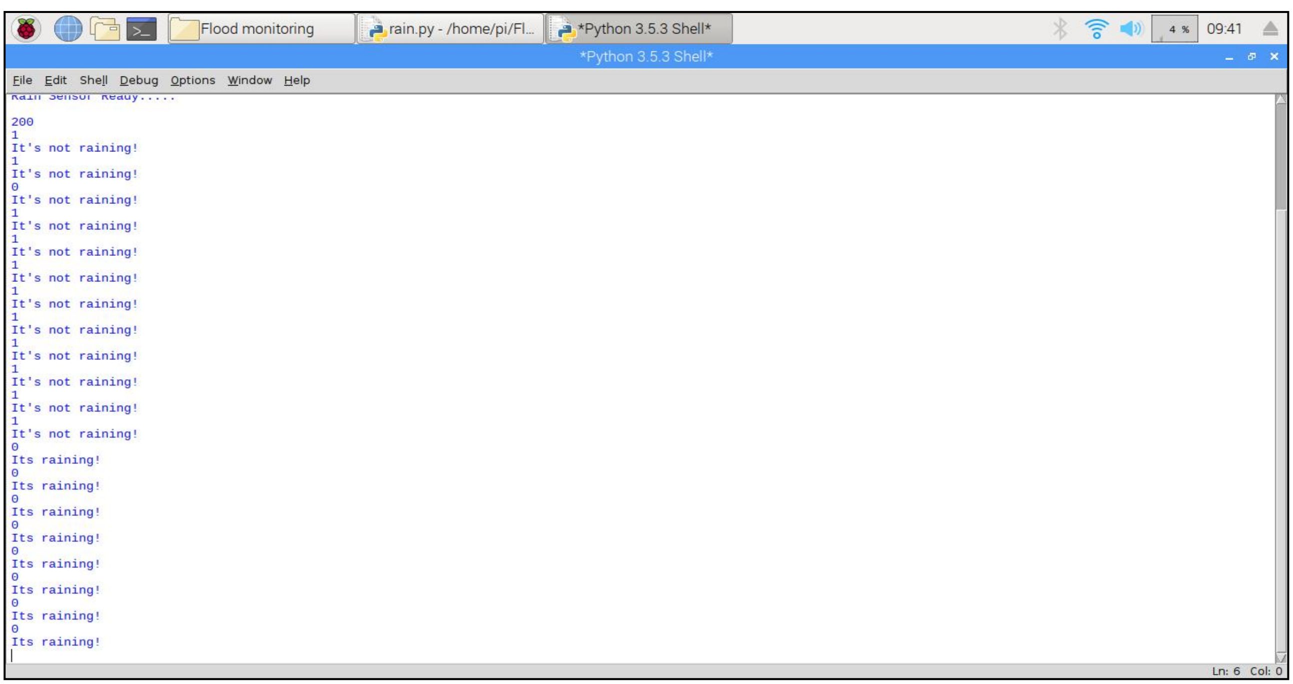
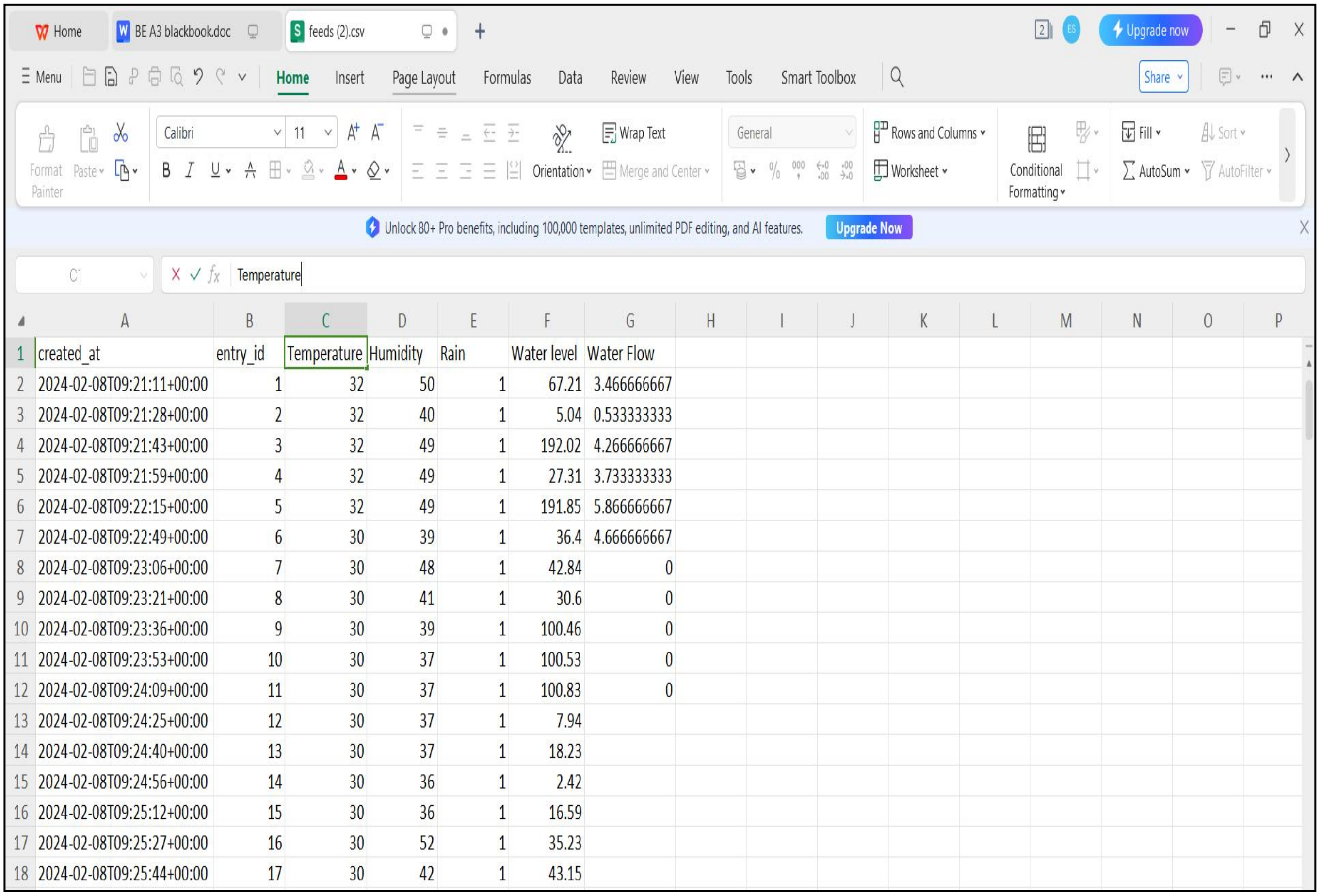


Figure 15:Rain Sensor Readings

Figure 16 shows CSV File that we can download from Thingspeak that can be used for data Analysis.



created_at	entry_id	Temperature	Humidity	Rain	Water level	Water Flow
2024-02-08T09:21:11+00:00	1	32	50	1	67.21	3.466666667
2024-02-08T09:21:28+00:00	2	32	40	1	5.04	0.533333333
2024-02-08T09:21:43+00:00	3	32	49	1	192.02	4.266666667
2024-02-08T09:21:59+00:00	4	32	49	1	27.31	3.733333333
2024-02-08T09:22:15+00:00	5	32	49	1	191.85	5.866666667
2024-02-08T09:22:49+00:00	6	30	39	1	36.4	4.666666667
2024-02-08T09:23:06+00:00	7	30	48	1	42.84	0
2024-02-08T09:23:21+00:00	8	30	41	1	30.6	0
2024-02-08T09:23:36+00:00	9	30	39	1	100.46	0
2024-02-08T09:23:53+00:00	10	30	37	1	100.53	0
2024-02-08T09:24:09+00:00	11	30	37	1	100.83	0
2024-02-08T09:24:25+00:00	12	30	37	1	7.94	
2024-02-08T09:24:40+00:00	13	30	37	1	18.23	
2024-02-08T09:24:56+00:00	14	30	36	1	2.42	
2024-02-08T09:25:12+00:00	15	30	36	1	16.59	
2024-02-08T09:25:27+00:00	16	30	52	1	35.23	
2024-02-08T09:25:44+00:00	17	30	42	1	43.15	

Figure 16: Sensor Readings CSV File

9.3 THINGSPEAK SNAPSHOTS

Figure 17(a) and Figure 17(b) shows Thingspeak view of DHT-11 Sensor Readings Showing Temperature and Humidity

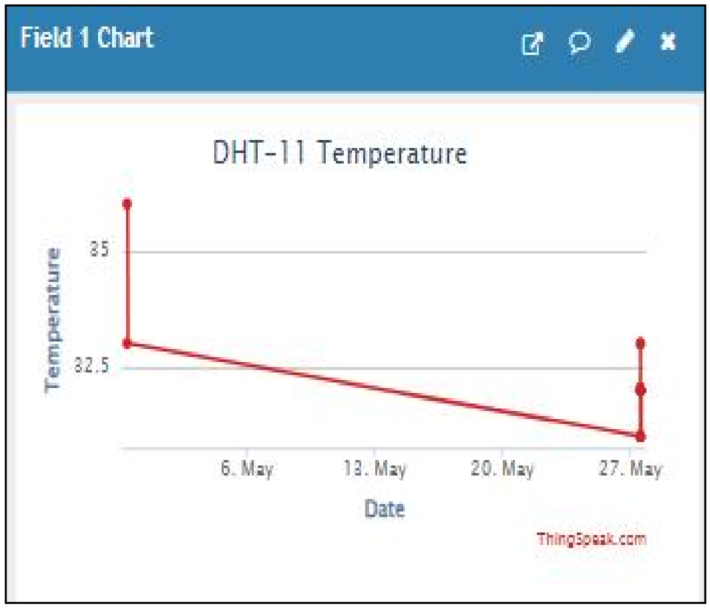


Figure 17(a):DHT-11 Temperature Thingspeak view

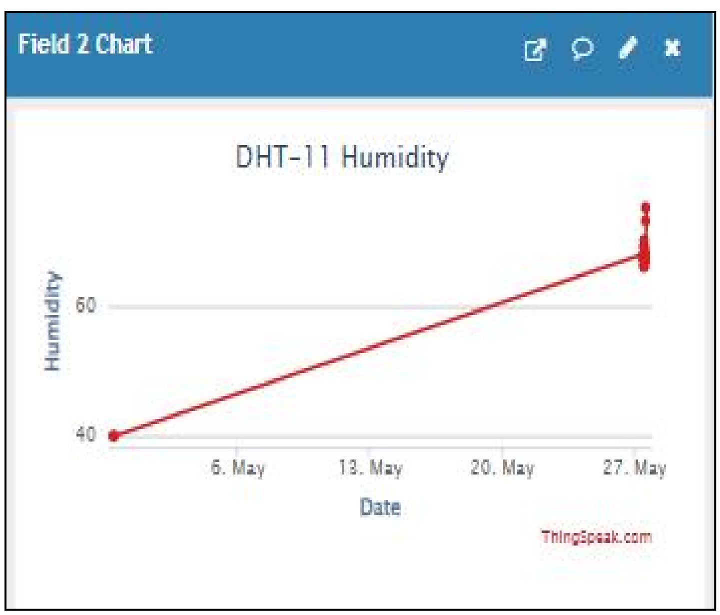


Figure 17(b):DHT-11 Humidity Thingspeak view

Figure 18 shows Thingspeak view of Rain Sensor Readings Showing detection of rain.

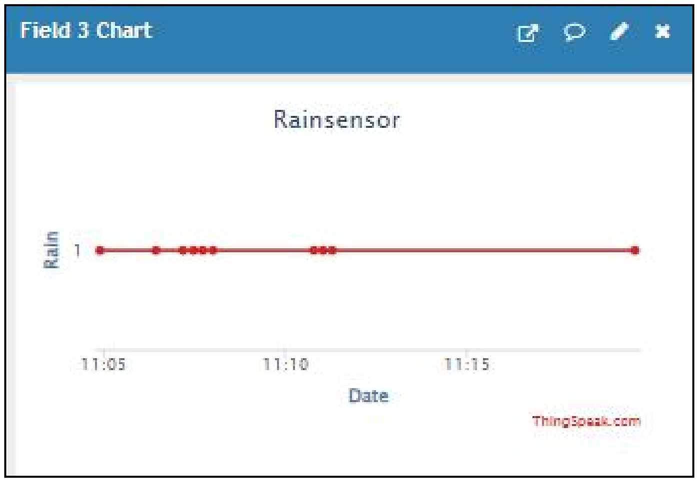


Figure 18:Rain Sensor Thingspeak view

Figure 19 shows Thingspeak view of Ultrasonic Sensor Readings Showing Water level distance from ultrasonic sensor.

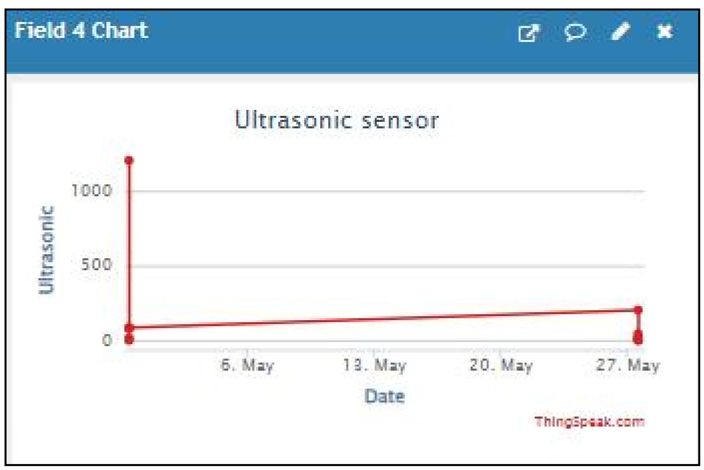


Figure 19:Ultrasonic Sensor Thingspeak view

Figure 20 shows Thingspeak view of Water Flow Sensor Readings Showing Water Flow.

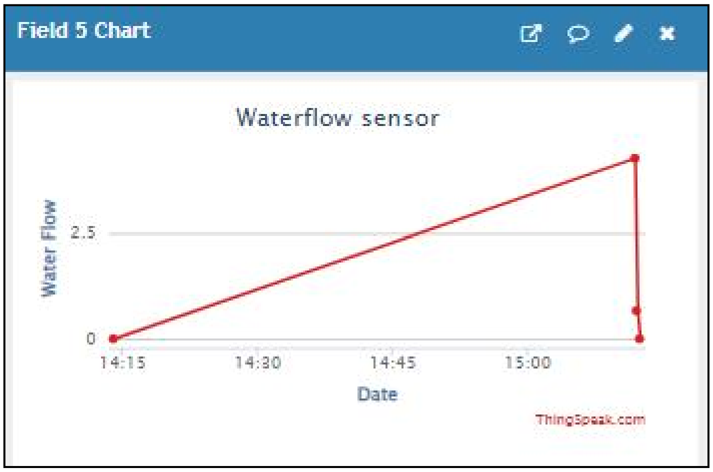


Figure 20:WaterFlow Sensor Thingspeak view

9.4 SMS ALERTS SNAPSHOTS

Figure 21 shows SMS alert that is received when rainfall is detected by rain sensor.

Figure 21:Rain sensor SMS alert

Figure 22 shows SMS alert that is received when Ultrasonic sensor detects rise in water level exceeding predefined threshold value.

Figure 22:Ultrasonic sensor SMS alert

Figure 23 shows SMS alert that is received when Waterflow sensor detects rise in water flow exceeding predefined threshold value.

Figure 23:Water Flow sensor SMS alert

9.5 DISCUSSION

IoT-based flood monitoring and alerting systems offer significant potential in mitigating the impact of flooding events by providing real-time data collection, analysis, and early warning capabilities. Here's a discussion on various aspects of such systems:

1. Data Collection:

- IoT sensors deployed in flood-prone areas can collect a wide range of data, including water levels, rainfall intensity, temperature, and humidity.
- These sensors can be integrated with existing infrastructure such as river gauges, weather stations, and urban drainage systems to enhance data collection accuracy and coverage.

2. Real-time Monitoring:

- By continuously monitoring environmental parameters, IoT-based systems can detect changes indicative of imminent flooding events.
- Real-time data transmission to a central monitoring platform allows for immediate analysis and decision-making by authorities and emergency responders.

3. Early Warning Systems:

- Advanced data analytics and machine learning algorithms can process incoming sensor data to identify flood patterns and trigger early warning alerts.
- These alerts can be disseminated through various communication channels, including SMS, mobile apps, social media, and sirens, to reach affected communities in a timely manner.

4. Community Engagement:

- IoT-based flood monitoring systems can engage local communities in disaster preparedness and response efforts.

- Public access to flood risk maps, real-time data visualizations, and educational resources can increase awareness and encourage proactive measures to mitigate flood risks.

5. Integration with Disaster Management:

- Seamless integration with existing disaster management systems allows for coordinated response efforts during flood events.
- Decision support tools based on IoT data can assist emergency responders in resource allocation, evacuation planning, and infrastructure protection.

6. Resilience and Adaptation:

- Continuous monitoring of flood-prone areas enables the identification of vulnerable infrastructure and communities.
- Data-driven insights from IoT systems can inform urban planning, infrastructure development, and climate adaptation strategies to enhance resilience against future flood events.

7. Challenges and Considerations:

- Despite their benefits, IoT-based flood monitoring systems face challenges such as network connectivity issues, sensor maintenance requirements, data privacy concerns, and scalability.
- Ensuring the reliability, accuracy, and security of sensor data is crucial for the effectiveness of these systems.

IoT-based flood monitoring and alerting systems hold great promise in improving flood resilience and enhancing disaster preparedness and response capabilities. However, addressing technical, operational, and regulatory challenges is essential to realize their full potential in safeguarding communities and infrastructure against the impacts of flooding.

CHAPTER 10

CONCLUSION

10.1 CONCLUSION

- An IoT-based flood monitoring and alerting system is a critical technological solution that can help mitigate the devastating impact of floods on communities and the environment. This system leverages the power of interconnected devices, sensors, and data analysis to provide real-time information, early warnings, and effective response mechanisms. By harnessing these technologies, it enables timely and informed decision-making that can significantly reduce the risks and damages associated with flooding events.

- In conclusion, an IoT-based flood monitoring and alerting system is a vital tool for improving flood preparedness, response, and mitigation. It can save lives, reduce property damage, and help safeguard the environment. However, its success depends on the effective integration of technology, data management, and collaboration among various stakeholders, including government agencies, emergency services, and the public.

- Furthermore, the implementation of such systems brings about multiple advantages, such as enhancing community resilience, informing infrastructure development, and optimizing water resource management. Despite these benefits, challenges such as environmental impacts, forecast uncertainty, and infrastructure limitations need to be addressed to maximize the system's efficacy.

- Looking ahead, advancements in artificial intelligence, intelligent warning systems, and resilient infrastructure design promise to further refine and enhance these monitoring systems. Additionally, integrating these systems into broader frameworks for disaster management and climate adaptation will ensure a more holistic approach to tackling the challenges posed by floods.
- Ultimately, the ongoing evolution and improvement of IoT-based flood monitoring systems will play a crucial role in building more resilient societies capable of withstanding and recovering from the adverse effects of flooding, thereby ensuring the safety and well-being of future generations.

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IoT Based Flood Monitoring and Alerting System

Nalini Tiwari[1], Prajakta Khairnar[2], Divya Salunke[3], Prajakta Chavan[4], Vaishnavi Pabalkar[5]
[1, 2]*Professor,* [3,4,5]*UG Student, Department of ECE, Ajeenkya D Y Patil School of Engineering Pune, Maharashtra, India*

Abstract: In the era of rapid technical advancements, the convergence of Internet of Things (IOT) technology and environmental monitoring has paved the way for groundbreaking solutions that address critical challenges faced by communities worldwide. Among these challenges, the increasing frequency and severity of flooding events have spurred the development of advanced flood monitoring and alerting systems. One such cutting-edge solution is the IOT based Flood Monitoring and Alerting System, a trans-formative approach that harnesses the power of interconnected devices and real-time data analysis to mitigate the impact of flooding and enhance disaster preparedness. Floods pose a significant threat to lives, property, and the environment. Timely detection and rapid response are essential to mitigate the impact of floods.

In this context, we present an IOT based Flood Monitoring and Alerting System designed to provide early warning, real-time monitoring, and data-driven insights for effective flood management. Our system leverages Internet of Things (IOT) technologies to collect data from various sensors distributed across flood-prone areas. These sensors continuously monitor environmental conditions and transmit data securely to a central server or Thing speak cloud platform. Through advanced data analytic and predictive modeling, our system forecasts potential flood events, assesses their severity, and triggers automated alerts when predefined thresholds are exceeded. The alerts generated by our system are delivered through multiple communication channels, such as SMS, mobile apps, ensuring that residents, emergency services, and local authorities receive timely and accurate information. This enables proactive decision-making and coordinated responses, including evacuation and asset protection measures.

Keywords: Floods, IOT, Thing speak, Water levels, SMS, Alerts

I. INTRODUCTION

One of the most destructive natural disasters is flooding, especially in areas like India where monsoonal rains can cause abrupt and sharp rises in water levels. Floods can have severe impacts, especially on people in low- to middle-income countries who don't have the infrastructure to properly protect and respond, or are already vulnerable. Understanding the incidence, severity, and aftereffects of natural disasters is essential if the goal is to improve preparedness and protect people's lives and means of subsistence.We describe a prototype flood monitoring system based on the Internet of Things (IoT) with the goal of early identification and avoidance in response to this persistent menace. The system collects real-time environmental data via a network of sensors set up in flood-prone areas, with an emphasis on variables including soil moisture, rainfall intensity, and water level.The Raspberry Pi gateway, which is attached to these sensors, gathers and processes the data before sending it to the cloud-based Thing Speak platform for additional examination. Users of Thing Speak can access the gathered data using a smart phone application, giving them insight into the conditions in the area in which they stand right now.

The system's capacity to immediately send out warnings when water levels cross crucial thresholds is one of its main advantages. This is made possible by highly developed algorithms that monitor incoming data continuously for patterns that point to impending flooding. The device automatically sends out SMS alerts to authorities and communities when it detects such conditions, giving them time to take preventative action to lessen the effects of the approaching flood.The technique makes sure that alerts are received by a large number of people, even those who live in distant or under served areas and lack access to traditional communication infrastructure, by taking use of the widespread use of mobile phones. This is especially important in areas like India, where dense populations are frequently located near riverbanks that are vulnerable to flooding.

Our Internet of Things (IoT)-based flood monitoring system exemplifies a proactive approach to disaster management by utilizing technology to enable communities to take preventative measures and deliver early warnings. The system's objectives are to minimize the socioeconomic impact of floods in susceptible places like India and reduce casualties by targeted notifications, real-time data processing, and ongoing monitoring.

II. LITERATURE REVIEW

Kiran Jadhav, Aniket Patil, Ajay Yamkar, Mrunmai Nagtodege [1] proposed a system that indicates the water level and movement in riverbeds using an Arduino Uno, sensors, and a Wi-Fi module, in case of the level reaching the threshold, system generates early email alerts making everyone aware of the flood possibilities.

Harshali S. Mali, Ashwini R. Marathe, Priyanka K. Patil, Mr. Harshad Patil[2] suggested a system that uses the Arduino Mega 2560 as the primary microcontroller and the Blynk Application for notification, specifically for parking places, to inform and warn the vehicle owner.

Bhushan Moundekar1, Nitish Halde1, Priyanka Waghulkar1, Sunakshi Ganvir, Prof. S.D. Kakde [3] proposed a system that uses an ultrasonic sensor and an ATMEGA328P microcontroller to automatically detect the water level in reservoirs and cannels. It then uses the Wi-Fi module to relay these values to the control room and the GSM module to send an SMS alarm.

K. R. Jaware, D. S. Chavan, and P. M. Mane[4] proposes a system that gathers information on flood-related characteristics using a range of sensors, such as humidity, rainfall, and water level sensors. An Arduino microcontroller is used by the system to process sensor data and provide email and SMS flood notifications to authorities and residents.

A. Kumar and S. Kaur [5] provides a comprehensive overview of IoT-based flood prediction and alerting systems. The paper also discusses the use of machine learning techniques to improve the accuracy of flood predictions.

k Subramanya Chari, Maturi Thirupathi2, Hariveena. Ch [6] proposed a system that uses rain and water sensor along with Raspberry Pi as main controller when surpasses the threshold limit value, the algorithm calculates how long it would take for flooding to occur in the area and notify the villagers.

Wahidah MdShah,Fahmi Arif, A.A.Shahrin, Aslinda Hassan[7] proposed a system that can measure the water level's rising rate and notify the resident in addition to simply detecting the water level.The waterfall model is used as the methodology. Data from the water sensor is gathered by Raspberry Pi and sent to a GSM module so that an SMS alarm can be sent.

Anisha Daniel P J , Abhishek M L, Frelbin Nazeer, Ann Johny[8] proposed a system in which Arduino Mega and water/rain sensors are used in the development of a flood monitoring and alerting system. Because this method gives authorities real-time data on changes in river stages, they can quickly analyze concerns. It forecasts the impacted areas and sends out immediate IoT alerts on detection of flood.

Garima Singh, Nishita Bisht, Pravesh Bisht, Prajjwal Singh [9] proposed the development strategies for a flood alerting and monitoring system based on the Internet of Things that uses open weather API for weather forecasting.

III. METHODOLOGY

Nowadays, there is no idea about when flood will occur, so there is need to prepare such system for people who are near the flood prone area. Therefore, the purpose of this system's design is to send out alert signals to individuals about the approaching flood.. The basic working of project consists monitoring of water levels and values of other sensors used against predefined threshold values and if collected sensor values exceed threshold values potential flood is detected and alerts are sent through SMS.After thorough literature survey we decided to use

1) Raspberry Pi board as main controller instead of Arduino board because in Arduino board we will have to connect GSM module externally to create SMS alerts via internet based SMS gate service whereas in Raspberry Pi we can create SMS alerts via internet based SMS gate service without need to connect GSM module externally.
2) DHT11 (Temperature and Humidity Sensor) to detect real-time temperature and humidity of environment.
3) HC-SR04 (Ultrasonic Sensor) to check rise or fall in water level.Once the water level increases beyond threshold, a trigger is generated that causes an SMS Alert warning about the potential for flood.
4) Water Flow Sensor to check real-time water flow.
5) Buzzer to give alert when it gets triggered.

For software setup we have used Raspbian which is Operating system of Raspberry Pi and Python IDLE for writing Python program. The Raspberry Pi is used by the application to read the sensor inputs. We set a threshold value in the ultrasonic sensor program for the water level in three levels: normal water level causes the green LED to turn on; at medium water level, the yellow LED glows on; and once the water level reaches the highest threshold level, the red LED and buzzer turn on. In other words, if the water level is at the closest distance from the ultrasonic sensor, a trigger instructs the program to send out an SMS alert warning people about the potential for flooding and rising water levels. We have also written program for rain sensor and water flow sensor for getting SMS alert regarding Rain and high water flow respectively.

Furthermore, we also created channel on Thing Speak Platform for displaying real-time sensor values in graphical form which makes it easier to study sensor values time to time.

IV. RESULTS

Fig.1 shows a Hardware Setup using a Raspberry Pi 3B+, we were able to create a flood monitoring and alerting system, DHT11 (Temperature and Humidity Sensor), HC-SR04 (Ultrasonic Sensor), Water Flow Sensor and buzzer. Along with real-time readings on the Thing Speak Platform, we have also added SMS alerts.

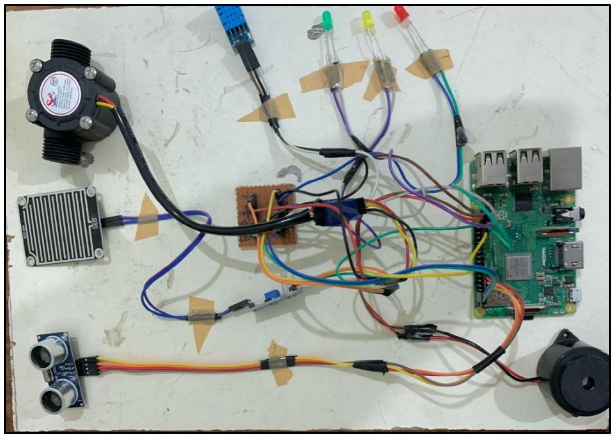

Fig. 1 Hardware Setup

Fig.2 shows snapshot of SMS alert that is received when rainfall is detected by rain sensor.

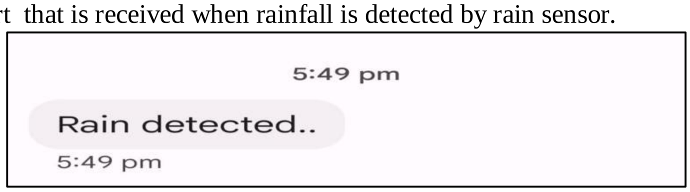

Fig. 2: Rain sensor SMS alert

Fig.3 shows snapshot of SMS alert that is received when water level more than predefined threshold value is detected by ultrasonic sensor.

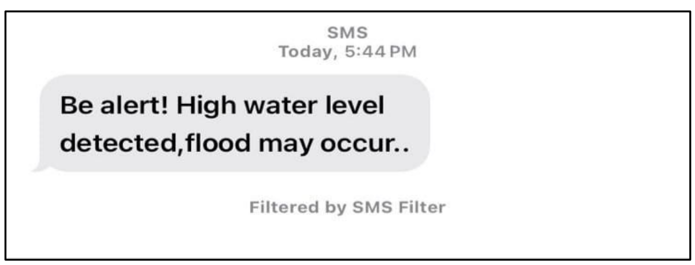

Fig. 3: ultrasonic sensor SMS alert

Fig.4 shows snapshot of SMS alert that is received when water flow detected by water flow sensor exceeds predefined threshold

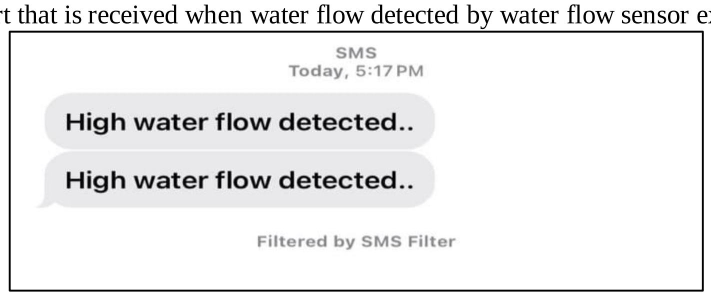

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Fig.4: Water flow sensor SMS alert

Fig.5 shows snapshot of Real-time sensor values that can be seen on Thing Speak platform in graphical form.

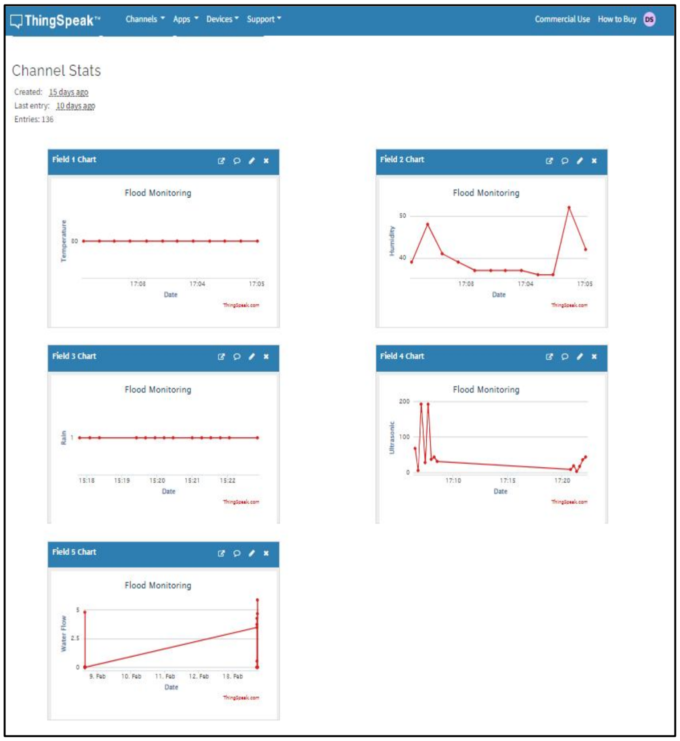

Fig.5: Sensor Data on Thing Speak

V. FUTURE SCOPE

The integration of flood monitoring and alerting systems with other disaster management systems is becoming more and more important. This covers systems including transportation management systems, emergency response systems, and early warning systems. We can increase the efficacy and coordination of our flood response by integrating these systems.

Artificial intelligence (AI)-driven flood forecasting systems**:**Artificial intelligence (AI)-driven flood forecasting systems are able to anticipate flood inundation areas and water depths in real time. Plans for evacuation and early warning systems can be updated with this knowledge.

Intelligent flood warning systems: Alerts can be tailored to each community's specific needs by use of intelligent flood warning systems.A warning system for a heavily populated urban area might differ from one for a rural community, for instance.

Infrastructure that is resistant to flooding: Bridges, roads, and buildings that are resistant to flooding can be developed with the help of flood monitoring and alerting systems. Sensors, for instance, can be used to track the health of infrastructure and spot possible flaws.

For example, a warning system for a rural community might be different from a warning system for a densely populated urban area.

Flood insurance: Flood monitoring and alerting systems can be used by insurance companies to assess the risk of flooding in different areas and set premiums accordingly.

VI. CONCLUSIONS

IOT **-** based flood monitoring and alerting systems have the potential to improve our ability to detect and respond to floods. By using a network of interconnected sensors and devices, these systems can provide real-time information on water levels, rainfall, and other environmental factors like temperature, humidity etc. This data can then be used to generate accurate flood forecasts and warnings, which can be disseminated to nearby inhabitants and authorities in real time.

Overall, IOT **-** based flood monitoring and alerting systems have the potential to play a highly significant role in reducing the loss of life and property damage brought on by floods. By providing early warning and supporting other aspects of flood management, these systems can help communities to better prepare for and respond to floods.

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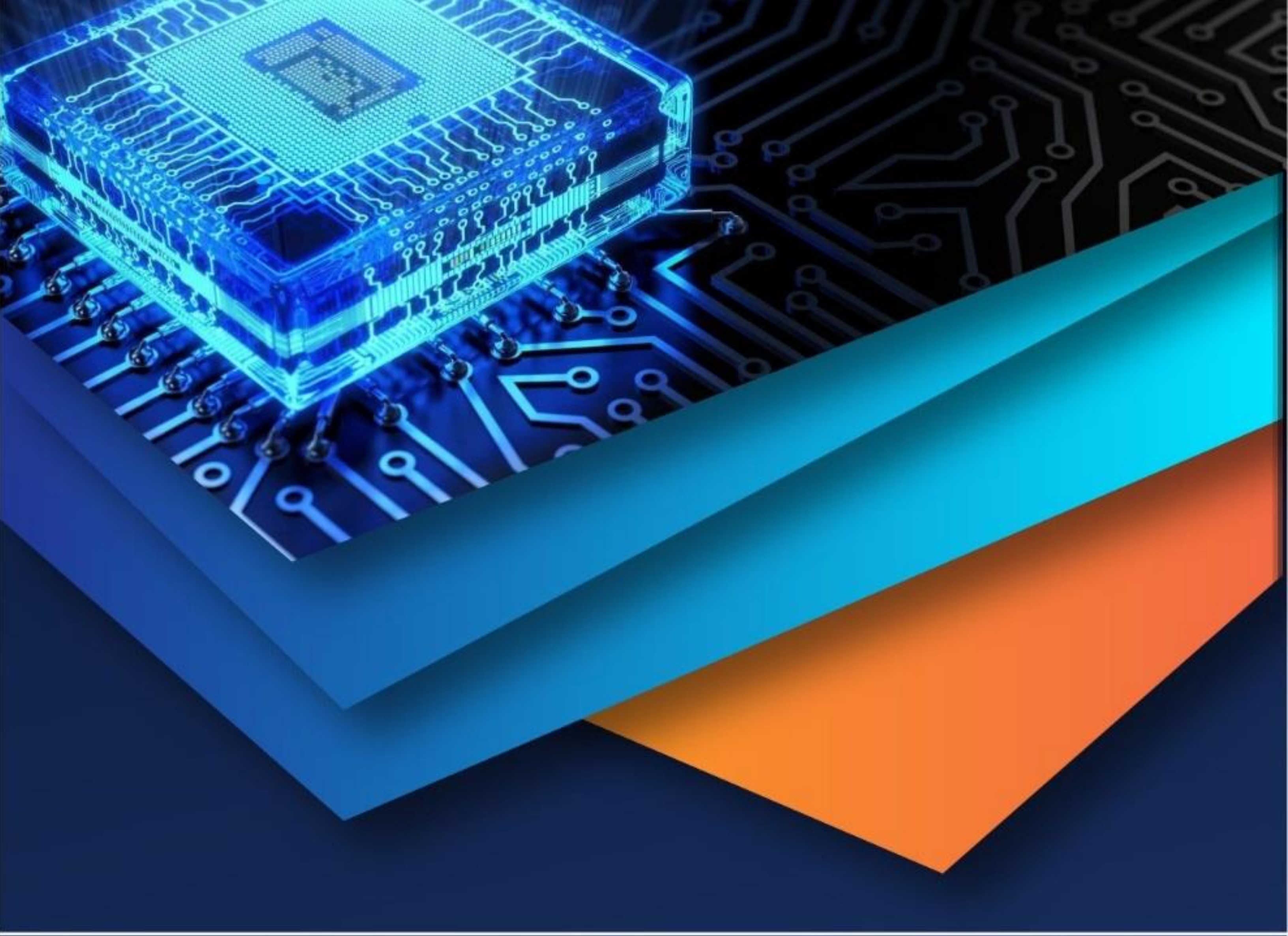

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