

FLOOD MONITORING AND EARLY WARNING SYSTEM

INTRODUCTION:

Floods are among the most devastating natural disasters, causing loss of lives, property damage, and economic disruptions worldwide. Flood monitoring and early warning systems are crucial tools for minimizing the impact of floods by providing timely information and alerts to vulnerable communities. This paper explores the key concepts and components of flood monitoring and early warning systems, their significance, and the technologies involved in their implementation.

Understanding Floods:

Floods occur when an excessive amount of water accumulates in an area, often due to heavy rainfall, snowmelt, storm surges, or dam failures. These events can have catastrophic consequences, including inundation of homes and infrastructure, contamination of water sources, and displacement of populations. Floods can be slow-onset or flash floods, making timely warnings essential for preparedness and response.

The Importance of Early Warning:

Early warning systems for floods serve as a lifeline, providing advance notice of impending disasters. They enable communities to take proactive measures to protect lives and property, evacuate if necessary, and mitigate the economic and environmental impact of floods. Effective early warning can significantly reduce the loss of life and damage associated with floods. Solving the problem of flood monitoring and early warning involves a multifaceted approach that integrates technology, data analysis, community engagement, and infrastructure development. Here is a step-by-step process for addressing this challenge.

- **Needs Assessment:** Begin by conducting a comprehensive assessment of the region's flood risk and vulnerability. Identify flood-prone areas, historical flood data, and potential hazards.
- **Establish Data Collection Infrastructure:** Install and maintain a network of weather stations, river gauges, and remote sensing technologies to continuously collect meteorological and hydrological data.

- **Early Warning System Setup:** Implement an early warning system that integrates data analysis and modelling results. This system should include automated alert triggers, communication channels, and community outreach strategies.
- **Infrastructure Investment:** Invest in infrastructure improvements to mitigate flood risks, such as levees, flood barriers, and stormwater drainage systems. Regular maintenance is essential to ensure their effectiveness.
- **Integration of Technology:** Leverage advanced technologies like satellite imagery, IoT sensors, and geographic information systems (GIS) to enhance data accuracy and real-time monitoring.

HARDWARE REQUIRED:

- NODE MCU
- 16*2 LCD DISPLAY (12 CM MODULE)
- CSM 900A MODULE
- ULTRASONIC SENSOR
- FLOAT SENSOR
- ZERO PCB
- 5V 2A DC POWER SUPPLY

STEP 01:

1. Visit the Wok Wi website (<https://wokwi.com/>).
2. Create an account if you don't have one already.
3. Once logged in, click on "Create a new simulation".
4. Select "ZERO PCB" as your board

STEP 02: (Connecting the Hardware in Wok Wi)

1. In the Wok Wi simulator, you can add components like the ZERO PCB, ULTRASONIC SENSOR and FLOAT SENSOR by dragging them from the components panel onto the virtual breadboard.

2. Connect the components using virtual jumper wires. Connect the power and ground pins appropriately.
3. Connect the Ultra Sonic Sensor to an analog input pin on the ZERO PCB.
4. Connect the 5V 2A DC POWER SUPPLY to a digital output pin on the ZERO PCB

STEP 03:

(Writing the Arduino Code)

Step 04: (Simulate the Flood Monitoring)

1. In the Wok Wi simulator, click on the "Start Simulation" button to run your project.
2. Simulate the water level sensor by clicking on it and changing its value to simulate rising water levels.
3. Observe how the 5V 2A DC POWER SUPPLY activates when the water level exceeds the threshold

STEP 05: (Features of Flood Monitoring and Early Warning)

1. Timely Alerts and Early Warning: - One of the most critical aspects of flood monitoring systems is their ability to provide timely alerts and early warnings to communities at risk. By detecting rising water levels and extreme weather patterns in real-time, these systems can issue warnings promptly, allowing residents to evacuate and take necessary precautions before the situation escalates.
2. Data-Driven Decision Making: - Flood monitoring systems rely on accurate data collected from various sensors. Analysing this data helps authorities make informed decisions. By understanding historical patterns and current conditions, officials can deploy resources effectively, plan evacuations, and allocate emergency funds where they are most needed.
3. Community Engagement and Education: - Engaging communities in the monitoring process is crucial. Educating the public about flood risks, safety protocols, and evacuation routes enhances their preparedness. Informed communities are better equipped to respond to warnings, follow evacuation

plans, and assist others during emergencies, reducing the overall impact of floods.

4. Integration of Technology: - Modern flood monitoring systems integrate advanced technologies such as Geographic Information Systems (GIS), remote sensing, and data analytics. These technologies provide comprehensive insights into flood-prone areas, enabling precise mapping of risks. Integrating weather forecasts into the system enhances predictive capabilities, allowing for proactive measures before a flood occurs.

5. Continuous Improvement and Adaptability: - Flood monitoring systems must undergo continuous improvement based on feedback, post-event analysis, and advancements in technology. Regular assessments help identify weaknesses and areas for enhancement. Additionally, these systems need to be adaptable to changing climate patterns, ensuring they remain effective in the face of evolving environmental challenges.

STEP 06: (Description of Flood Monitoring and Early Warning)

Flood monitoring system uses NODE MCU, 16x2 LCD, CSM 900A module, ultrasonic sensor, float sensor, and ZERO PCB. It detects water levels via sensors and displays warnings on the LCD if levels rise, ensuring timely alerts for potential floods. Powered by a 5V 2A DC supply, it aids in early flood detection



FLOOD MONITORING AND EARLY WARNING SYSTEM USING ULTRASONIS SENSOR

SYSTEM FLOWCHART:

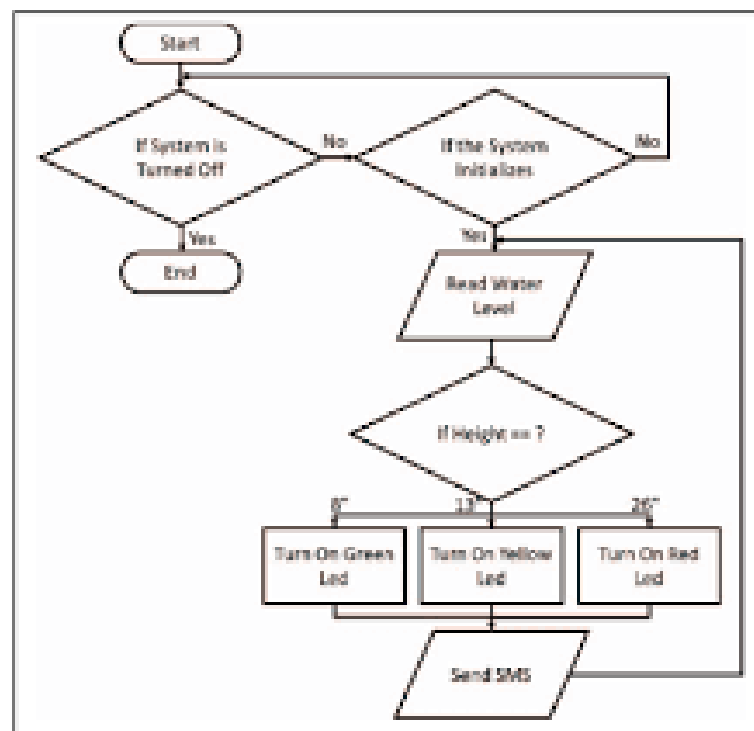


Fig. 2. System Flowchart

PROGRAM:

```
import time

import dht

import urequests

import network

from machine import Pin


# Define GPIO pins

TRIG_PIN = 2

ECHO_PIN = 3

BUZZER_PIN = 4

DHT_PIN = 5

LED_PIN = 6


# Define your Wi-Fi SSID and password

WIFI_SSID = "LIBIN"

WIFI_PASSWORD = "4651232960"


# Define your ThingSpeak API Key and Channel ID

THING_SPEAK_API_KEY = "GYZTW85RNGCZSLE9"

THING_SPEAK_CHANNEL_ID = "2316433"


# Function to establish a Wi-Fi connection

def connect_wifi(ssid, password):

    wlan = network.WLAN(network.STA_IF)

    wlan.active(True)
```

```
if not wlan.isconnected():  
    print("Connecting to Wi-Fi...")  
    wlan.connect(ssid, password)  
    while not wlan.isconnected():  
        pass  
print("Connected to Wi-Fi:", wlan.ifconfig())
```

```
def distance_measurement():  
    # Trigger ultrasonic sensor  
    trigger = Pin(TRIG_PIN, Pin.OUT)  
    trigger.on()  
    time.sleep_us(10)  
    trigger.off()  
  
    # Wait for echo to be HIGH (start time)  
    echo = Pin(ECHO_PIN, Pin.IN)  
    while not echo.value():  
        pass  
    pulse_start = time.ticks_us()  
  
    # Wait for echo to be LOW (end time)  
    while echo.value():  
        pass  
    pulse_end = time.ticks_us()  
  
    # Calculate distance
```

```
pulse_duration = time.ticks_diff(pulse_end, pulse_start)
distance = pulse_duration / 58 # Speed of sound (343 m/s) divided by 2
```

```
return distance
```

```
def read_dht_sensor():
    dht_sensor = dht.DHT22(Pin(DHT_PIN, Pin.IN))
    dht_sensor.measure()
    return dht_sensor.temperature(), dht_sensor.humidity()
```

```
buzz_start_time = None # To track when the buzzer started
```

```
# Connect to Wi-Fi
connect_wifi(WIFI_SSID, WIFI_PASSWORD)
```

```
while True:
    dist = distance_measurement()
    temp, humidity = read_dht_sensor()
    status = "No Flooding Detected"
```

```
if dist < 50:
    # Turn on the buzzer and LED
    Pin(BUZZER_PIN, Pin.OUT).on()
    Pin(LED_PIN, Pin.OUT).on()
    status = "Flooding Detected"
    buzz_start_time = time.ticks_ms()
```



```

    elif buzz_start_time is not None and time.time() - buzz_start_time >= 60000: # 1 minute
        # Turn off the buzzer and LED after 1 minute
        Pin(BUZZER_PIN, Pin.OUT).off()
        Pin(LED_PIN, Pin.OUT).off()

    print("Distance: {:.2f} cm".format(dist))
    print("Temperature: {:.2f}°C, Humidity: {:.2f}%".format(temp, humidity))
    print("Status:", status)

# Send data to ThingSpeak
try:
    data = {
        "api_key": THING_SPEAK_API_KEY,
        "field1": dist,
        "field2": temp,
        "field3": humidity,
    }

    response = urequests.post("https://api.thingspeak.com/update.json",
                              json=data)
    response.close()
except Exception as e:
    print("Error sending data to ThingSpeak:", e)

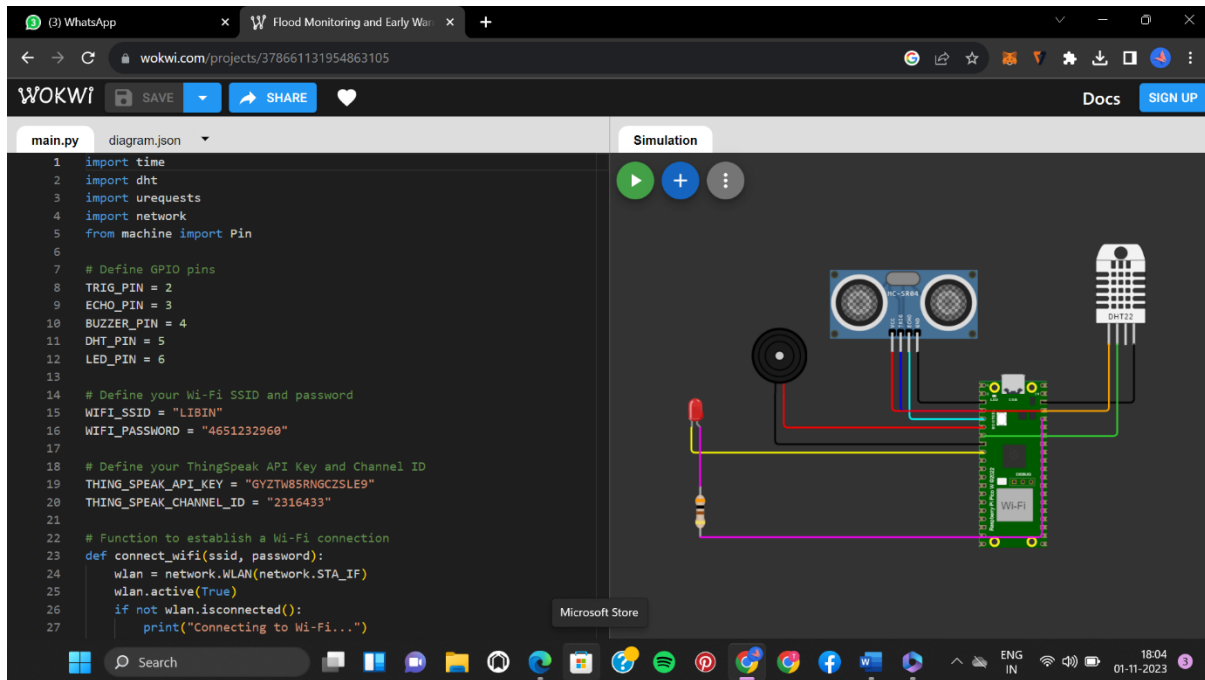
time.sleep(2)

```

LINK:

<https://wokwi.com/projects/378661131954863105>

SIMULATION:



CONCLUSION:

In conclusion, the implementation of a comprehensive flood monitoring and early warning system is crucial in safeguarding communities against the devastating impacts of floods. By integrating advanced technologies such as remote sensing, GIS mapping, and real-time data analysis, these systems offer a proactive approach to disaster management. Timely and accurate information enables authorities to anticipate flood events, assess potential risks, and issue timely warnings to residents, allowing them to take necessary precautions and evacuate if needed.

Furthermore, the effectiveness of a flood monitoring and early warning system lies not only in its technological capabilities but also in the establishment of robust communication channels between authorities, local communities, and relevant stakeholders. Public awareness and education initiatives play a pivotal role in ensuring that residents understand the warnings and know how to

respond appropriately, thereby reducing the loss of life and property during flood incidents.

As climate change continues to exacerbate the frequency and intensity of extreme weather events, investing in and expanding flood monitoring and early warning systems is paramount. Governments, organizations, and communities worldwide must collaborate to enhance these systems, ensuring their accessibility, accuracy, and reliability. By doing so, we can significantly mitigate the impact of floods, protect vulnerable populations, and build more resilient societies capable of facing the challenges of an uncertain future.