FLOOD WATER MONITERING AND EARLY WARNING

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

OVERVIEW :

Human based resistive mechanisms towards flood control open up multitude problems like dynamic reactions of prior alen about the risky situations and stage of current water level. The growth of Internet of Things (IOT) paved the significant aiiention in all fields. Today, droughts and floods arc a common feature and their co-cjustcuce poses a potent threat, which cannot be eradicated but has to be managed. Transfer of the surplus monsoon water to areas of water deficit is a potential possibility. This would aho help create additional irrigaiional potential, the generation of hydropower, as well as ovcrcomi ng regional imbalances. From the rcccnl floods in Kolhapur, satara. etc we observed the severe conditions people bad to face due to improper management of the Almatti dam situated on the Maharashtra • Kamalaka border. Ample people and animals lost lheir life's, all the living standard was disturbed. Generally, local people lose «heir important contact with the river once a dam comes up on it. They are scared U> go near it fearing for their lives. Dams can easily become a weapon of terror unlike the temple of development they are projected to be as they have the capacity to suddenly release a lot of water downstream. Keeping this scenario and recent incident in mind, there is a need to develop some proper dam management system. An 1OT bued dam management system ii being developed in this ptojecl Io avoid floods occurring due Io improper management of opening and c l<KU>g of doors of dam. An attempt Io make a system to *en»e the Icmperaturc, humidity, watri lew I and rain prcjicncc is made, depending on which the opening door percentage will be decided.

Node MCU is an IOT bawd platform <hs ploy» an important role in the project. UlirMonic censors measure distance by using ultrasonic waves. The sensor head emits an ultrasonic wave arid receives the wave reflected back from the target. Firebase is a mobile and web application developmeDt plaifonn developed by Firebue. Inc. in 2011.

Servo niotoc used LO control lhe opening and closing of doors of dam. Node MCU is an open

MXirce roT platform, whose firmware i.t developed for ESP8266 wifi chip. This is uxed to interface lhe ultrasonic seniors the data from these senwn is .tent on cloud for decision making stage that is designed using machine learning algorithm using python. The output of machine learning algonthm will be sent back to node MCU which then will decide how much extent the doots of lhe dam should be opened, n. LITERATURE REVIEW As India f»ced recenl devasuting flood in Kerila, there arise a need of efHcienl flood monitoring <cysiemc. Flood forecasting and the iswing of flood warnings are effective way* to reduce damage. The proposed system will be efficient because it has belter cooed in ati on of monitoring, communication and transmission techoologira which are adaptable to background condition. The proposed systrm in [1| also ensures increased accessibility for assessment of emergency situaiions and enhances effectiveness and efficiency in rta ponding to catastrophic inc ideni». In summary, the proposed sy?tfetn would be beneficial lo the comm unity for decision making and evacuation planning purposes.Flooding is a natural phenomenon which has attxacted global altcntion BA a reaull of its negative impact on the wdety. Developing nations such as Nigeria have beta predicted to experience increased flood occurrenceJ in the coming decade. The events of flooding arc unlikely to change, however, its impact on our society can be very well reduced. Paper [2] focuses on providing early »arning& lo aieas likely to be ravaged by flood even» using Wirele,s SensM Network (WSN). The system iniolves the deployment of sensor nodes al npecific flood vulnerahk locations fo< reduime flood monitoring and detection. Flood events relating to flash flooding and rum-off water or overflow are succeufully monilored in real time which uves individuals plenty of time to prepare against predicted flood occurrence, saving them from the aftermath of flood disaster. The system was tested via simulation of different flood scenarios, and

ABSTRACTION :

Waler plays an importani role in our day to day life in various fields. Iiuroduction of new methods to solve the water related problems includes adaptive management, remote sensing with the new concepts such as water security, global integration of information, etc. Recently, we can sec an increasing amount of dam damage or failure due to aging, earthquakes occurrence and unusual changes in weather. For this reason, dam safety is gaining marc importance than ever before in terms of disaster management at a naikxul level. Therefore, the government is trying to come up with an array of legal aciions to secure consistent dam safety. Other dam management organizations are also taking various institutional and technical measures for the same purpose.what should be the standard operating procedure in case sudden release is required. This project proposes an IOT based When it comes to dam safety issues, there is hardly *a* set of rules for how and when water can be released and dam management system. In this, four ultrasonic sensors namely, temperaiure sensor, humidiiy sensor, water level sensor and rain sensor are used to monitor the state of dam. Node MCU is used to interface all the sensors a^d send the data to the cloud. Machine learning algorithm is designed to control the opening of doors of dam via a servo motor.

Keyword: Flood detection. !oT, Python. Embedded C. Node MCU. DNN

SYSTEM ANALYSIS :

EXISTING SYSTEM:

METHOLOGY:

After going through literature survey and various research papers we finalized our hardware and software requirements. Various natural factors, which includes humidity, temperature, water level and flow level are observed by system to detect flood. Our system consists of different sensors which helps to collect data for individual parameters.

1. For detecting changes in humidity and temperature the system has a DHT11 Digital Temperature Humidity Sensor. It is a sensor which detects humidity and temperature.

2. The water level is always under observation by an Ultrasonic sensor, which works by constantly monitoring as water levels rise and fall. Once the water level increases beyond threshold, a trigger is generated which sends an Email Alert indicating the rise of Water and possibility of Flood.

3. The Flow sensor on the system keeps eye on the flow of water. The speed changes when water falls on rotor which makes it to rotate. After the successful completion of hardware setup, we move towards software setup and using Arduino IDE and Visual Studio Code. We created a Project Email for sending Email Alerts. Using Python Scripting and interfacing the Arduino outputs with Python, the program reads the inputs from the sensors via Arduino. We set a threshold value for the water level, once the water crosses the threshold level, a trigger causes the program to send an Email Alert notifying people regarding rise in water level and possibility of flood.

PROPSED SYSTEM :

MODELING AND ANALYS

Flood is a huge threat to humanity as it is also considered one of the most devastating natural disasters in the world. Since flooding results in great damage to agricultural land, residential area, and the economy of the country. In a country like India,with extreme weather and climatic conditions, the occurrence of heavy rainfall.We are not just monitoring the water level using Ultrasonic Sensor, but also monitoring the flow of water using Flow Sensor which gives an upper hand for immediate alerting the danger. We are using advance Temperature and Humidity Sensor for getting more accurate and correct values of temperature and humidity of surrounding, this sensor works in all extreme conditions. We are using a Wi-Fi module which can send data over the internet. We have used Python for sending Email Alerts interfacing it water.

ADVANTAGE :

- Timely detection of possible flood risks and floods.
- Highly reliable and available real-time data.
- Tailored solution that can be integrated with external developments at any level (device, connectivity, cloud or user application).
- Total adaptation and integration with emergency plans.
- Creation of historic data for Administrations.
- Low energy consumption.
- An unlimited number of devices can be included in future extensions.
- Far-reaching bidirectional communications.
- Long working life of the equipment.

DISADVANTAGES :

- Inability to produce highly accurate results,
- If there is no sufficient data flood prediction cannot be done.
- It saves the data into the database but doesn't use it
- hence wasting the space. -It cannot predict the flood with its historic data.
- GPS module track is not upgraded in the system
- Hyper pipes algorithm considered as having the lowest accuracy percentage.

SYSTEM SPECIFICATION :

➢ HARDWARE SPECIFICATION :

- Raspberry Pi 3
- Wifi Module
- LCD Display

- Water Sensor
- Rain Drop Sensor
- Resistors
- Capacitors
- Transistors
- Cables and Connectors
- Diodes
- PCB and Breadboards
- LED
- Transformer/Adapter
- Push Buttons
- Switch
- IC
- IC Sockets

➢ SOFTWARE SPECIFICATION :

- Linux
- Programming Language: Python

➢ SOFTWARE DESCRIPTION :

A software specification for flood monitoring and early warning typically involves the following components:

➢ User Requirements:

Define the user requirements, such as government agencies, emergency responders, and the general public.Specify the geographical scope and areas to be covered by the system.

➢ System Overview:

Provide an overview of the software system, including its purpose and main functions.
Define the scope of the system, including the types of floods it will monitor (e.g., riverine, flash floods).

➢ Data Sources:

Identify the sources of data to be used, such as weather data, river level sensors, and satellite imagery.
Specify data acquisition methods and data formats.

- Data Processing:

  Describe how raw data will be processed and transformed into meaningful information. Explain algorithms for flood prediction and early warning.

- User Interface:

  Define the user interface design, including maps, dashboards, and alerts.
  Specify user roles and permissions for accessing the system.

- Alerting and Notification:

  Detail how warnings and alerts will be generated and delivered to users.
  Specify communication channels (e.g., SMS, email, mobile app notifications).

- Geospatial Mapping:

  Describe the mapping components, including GIS integration, mapping layers, and geospatial data visualization.

- Historical Data:

  Include a database for storing historical flood data for analysis and future planning.

- System Performance:

  Define performance metrics, such as response time and accuracy of flood predictions.
  Specify hardware and software requirements.

- Testing and Validation:

  Describe the testing procedures, including unit testing, integration testing, and user acceptance testing.
  Specify validation criteria for the accuracy of flood predictions.

- Maintenance and Support:

  Detail the procedures for ongoing maintenance and updates.
  Specify support channels for users to report issues and request assistance.
  Security.Outline security measures to protect data and the system from unauthorized access or breaches.

- Compliance and Regulations:

  Ensure that the system complies with relevant environmental and safety regulations.

- Documentation:

  Provide documentation for users, administrators, and developers, including user manuals and system architecture documentation.

- Deployment and Scalability:

  Describe how the system will be deployed, scaled, and managed over time.

- Budget and Resources:

  Estimate the budget required for software development, hardware, and ongoing operations.

- Timeline:

  Create a timeline for the development, testing, and deployment phases of the system.

- Risk Assessment:

  Identify potential risks and mitigation strategies, such as data inaccuracies, system failures, and user adoption challenges.

- Integration:

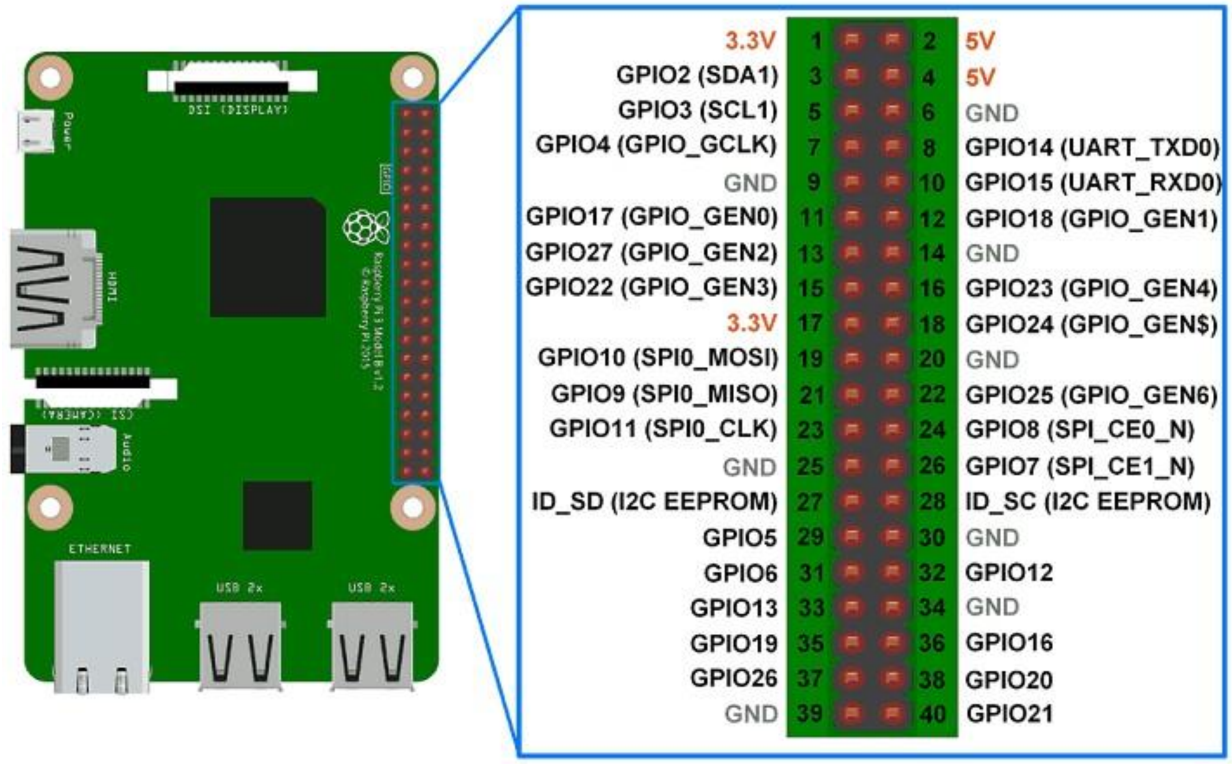
  Specify how theA software specification for flood monitoring and early warning typically involves the following components:

- User Requirements:

  Define the user requirements, such as government agencies, emergency responders, and the general public.
  Specify the geographical scope and areas to be covered by the system.

SYSTEM DESIGN

DHT11:



DSI (DISPLAY)
Power
HDMI
CSI (CAMERA)
Audio
ETHERNET
USB 2x
USB 2x
3.3V 1 2 5V
GPIO2 (SDA1) 3 4 5V
GPIO3 (SCL1) 5 6 GND
GPIO4 (GPIO_GCLK) 7 8 GPIO14 (UART_TXD0)
GND 9 10 GPIO15 (UART_RXD0)
GPIO17 (GPIO_GEN0) 11 12 GPIO18 (GPIO_GEN1)
GPIO27 (GPIO_GEN2) 13 14 GND
GPIO22 (GPIO_GEN3) 15 16 GPIO23 (GPIO_GEN4)
3.3V 17 18 GPIO24 (GPIO_GEN$)
GPIO10 (SPI0_MOSI) 19 20 GND
GPIO9 (SPI0_MISO) 21 22 GPIO25 (GPIO_GEN6)
GPIO11 (SPI0_CLK) 23 24 GPIO8 (SPI_CE0_N)
GND 25 26 GPIO7 (SPI_CE1_N)
ID_SD (I2C EEPROM) 27 28 ID_SC (I2C EEPROM)
GPIO5 29 30 GND
GPIO6 31 32 GPIO12
GPIO13 33 34 GND
GPIO19 35 36 GPIO16
GPIO26 37 38 GPIO20
GND 39 40 GPIO21

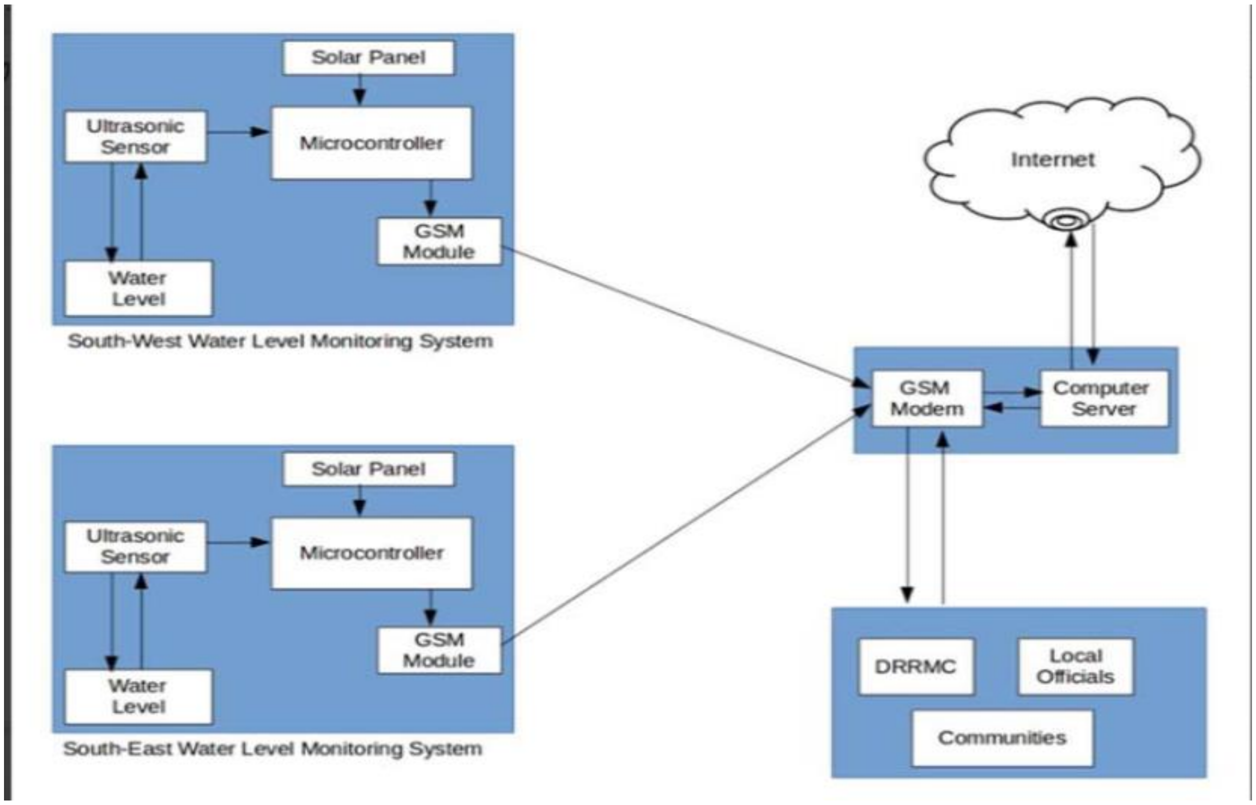


Fig 1.1 system architecture.

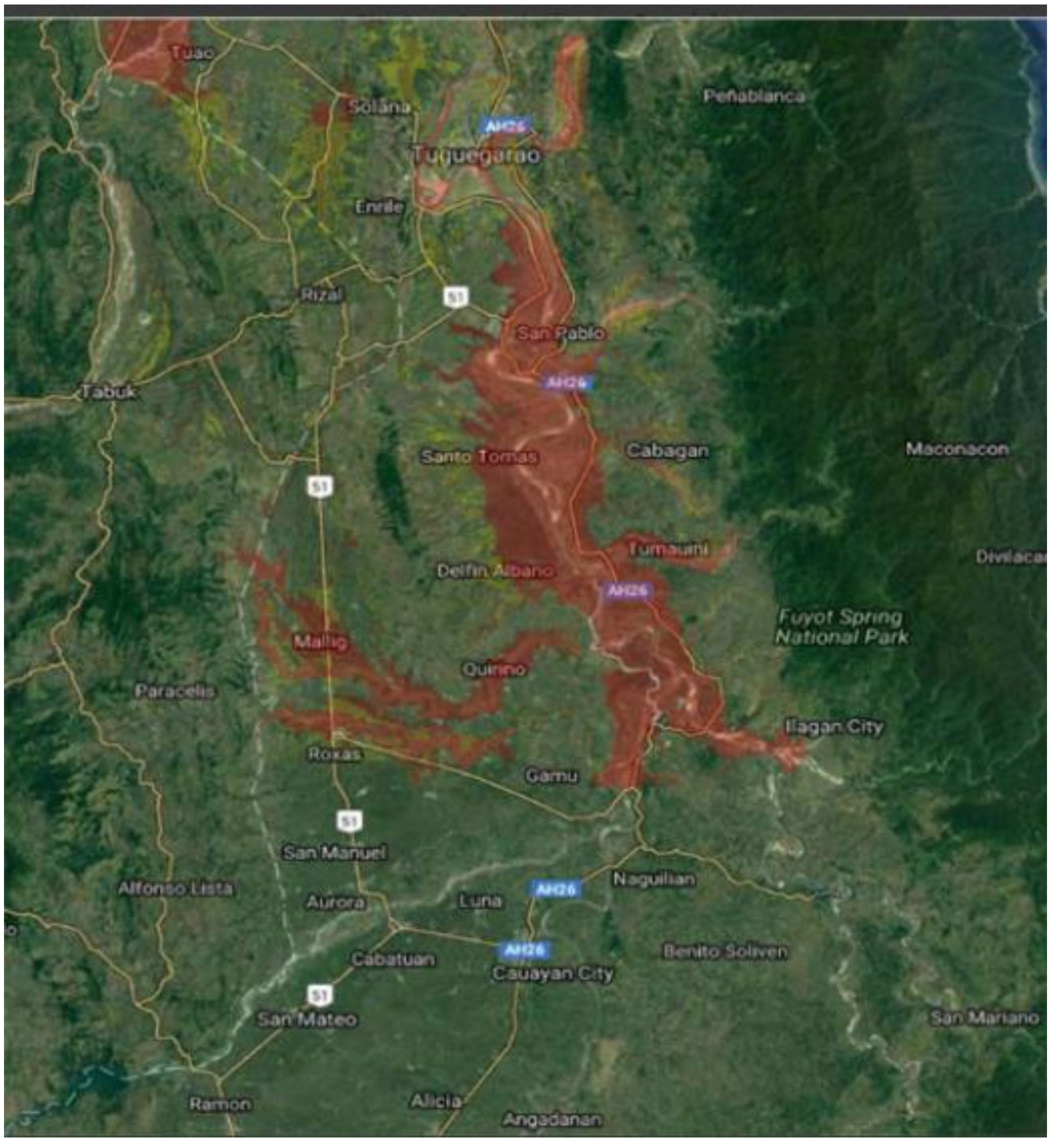
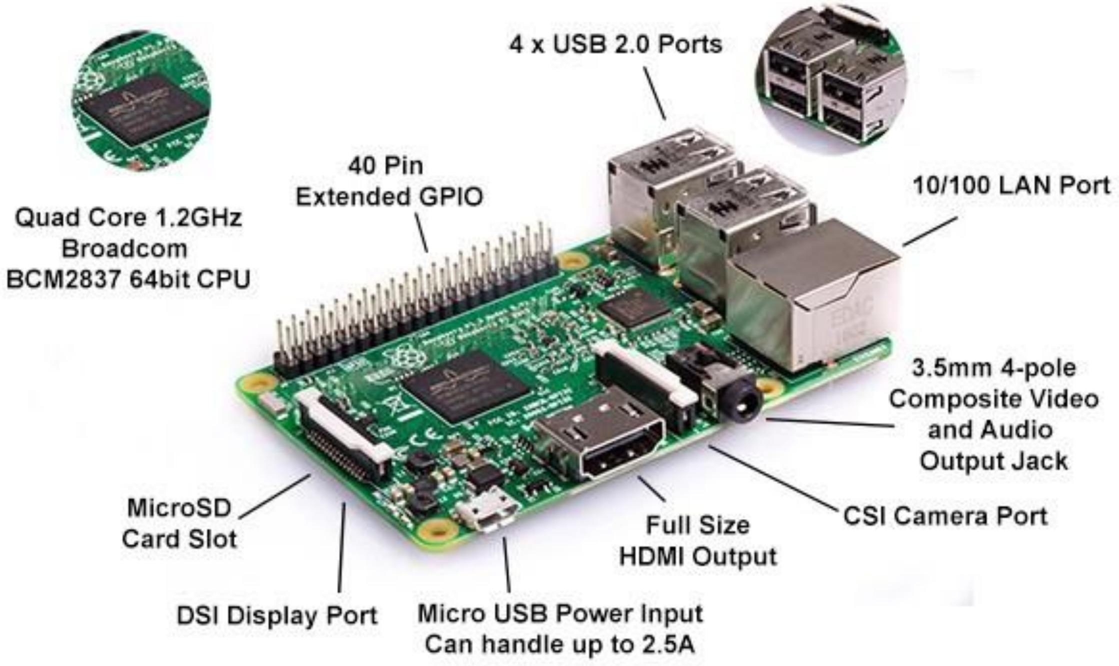


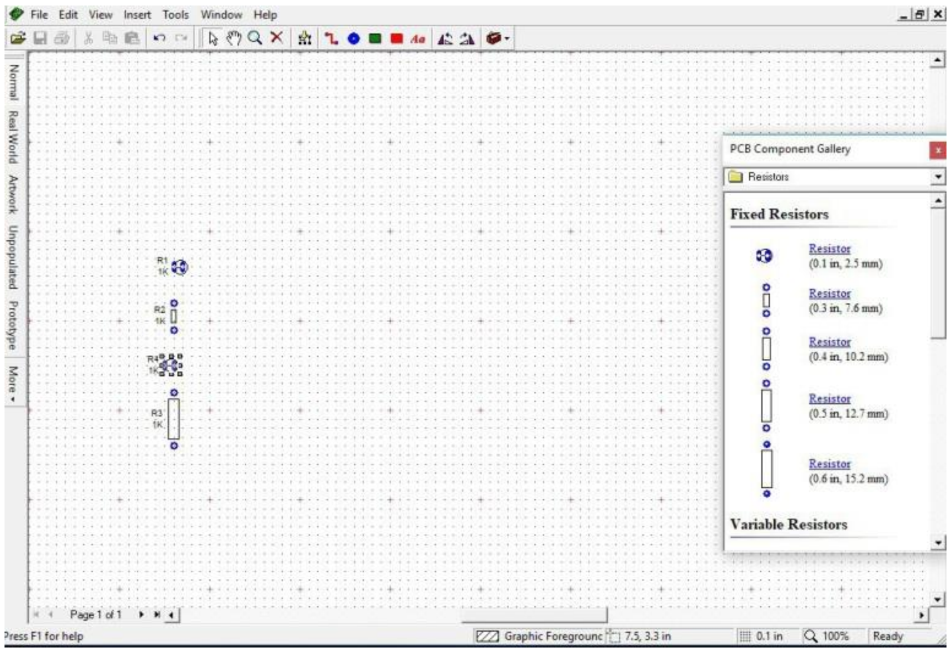
Fig 1.2 . Geographical Map of Flooded Areas in the Northern Protion of Isabela.

This paper presents a project that is more localized to help the communities affected by flood in the province of Isabela particularly in the northern area by providing an interactive and real-time information on the current water level in the two majors portion of the province. This project also widens the coverage of people that can receive the information to improve the emergency measures during floods.

Furthermore, this study builds a prototype that detects the current water level across the watershed of Cagayan River and its surrounding areas through ultrasonic sensors. The geographical area was sub-divided into two, where monitoring devices were installed. Specifically, the objectives of this study .

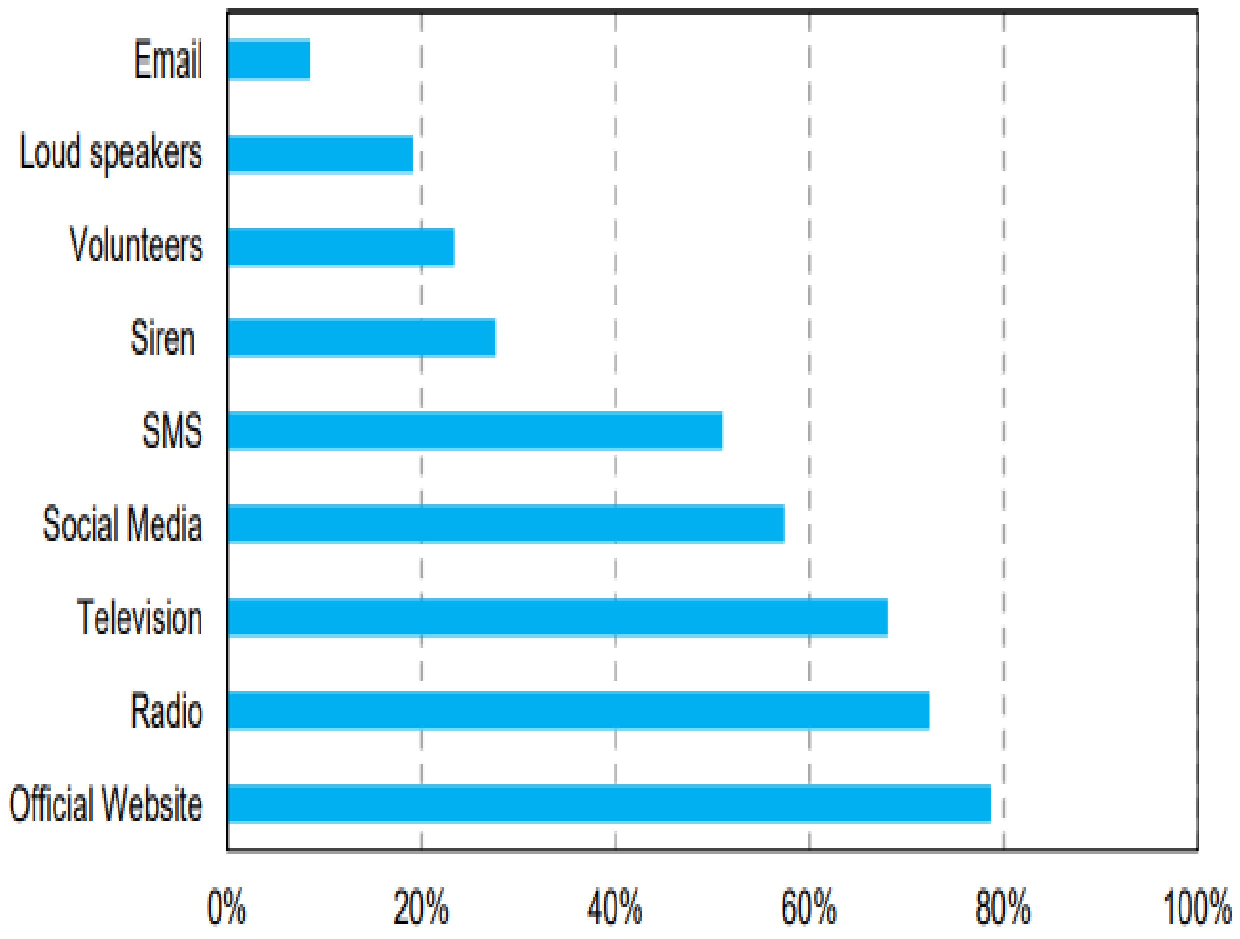

Quad Core 1.2GHz Broadcom BCM2837 64bit CPU
40 Pin Extended GPIO
4 x USB 2.0 Ports
10/100 LAN Port
3.5mm 4-pole Composite Video and Audio Output Jack
CSI Camera Port
Full Size HDMI Output
Micro USB Power Input Can handle up to 2.5A
DSI Display Port
MicroSD Card Slot

Ultrasonic sensor

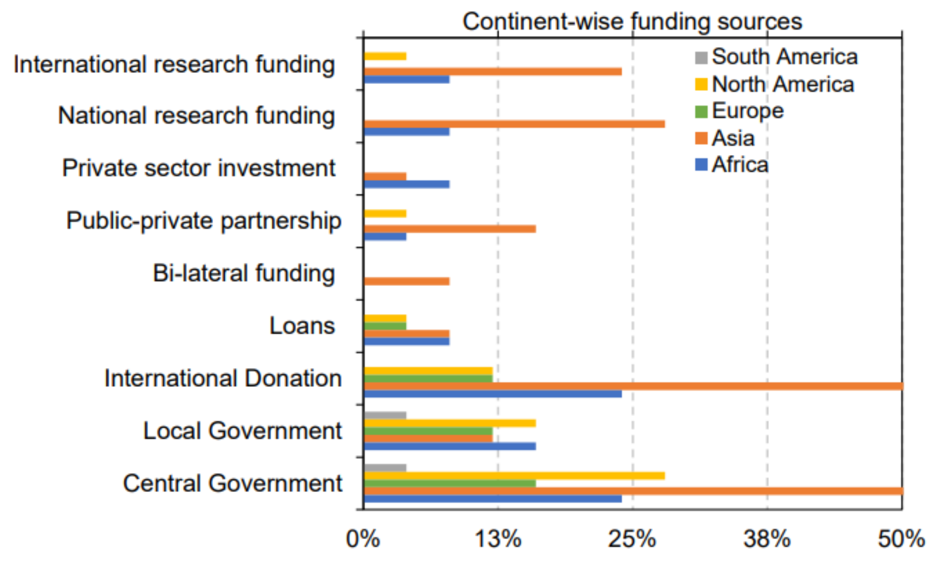

File Edit View Insert Tools Window Help
Normal Real World Artwork Unpopulated Prototype More
R1 1K
R2 1K
R4 1K
R3 1K
PCB Component Gallery
Resistors
Fixed Resistors
Resistor (0.1 in, 2.5 mm)
Resistor (0.3 in, 7.6 mm)
Resistor (0.4 in, 10.2 mm)
Resistor (0.5 in, 12.7 mm)
Resistor (0.6 in, 15.2 mm)
Variable Resistors
Page 1 of 1
Press F1 for help
Graphic Foreground
7.5, 3.3 in
0.1 in
100%
Ready

Software description

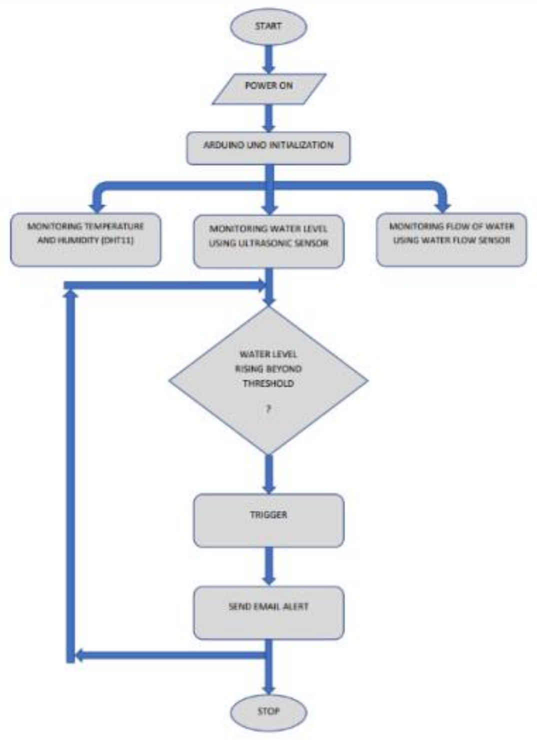
GRAPH REPRESENTATION:



Warning dissemination methods used by survey respondents (%)



Global (top) and continental (bottom) distribution of investments in FEWS


START
POWER ON
ARDUINO UNO INITIALIZATION
MONITORING TEMPERATURE AND HUMIDITY (DHT11)
MONITORING WATER LEVEL USING ULTRASONIC SENSOR
MONITORING FLOW OF WATER USING WATER FLOW SENSOR
WATER LEVEL RISING BEYOND THRESHOLD ?
TRIGGER
SEND EMAIL ALERT
STOP

Flow Chart of the System

Overview of the project :

Ideally, the collected hydroclimatic data are stored in a database and processed in real time by hydrologic/hydraulic models. Not all countries have a centralized database that is fed continually up to date. The data are sometimes temporarily in spreadsheets to undergo quality control before being fed in the central database days or months later. One of the significant challenges faced by operational systems is the lack of technical expertise and human resources. Trained personnel with flood forecasting expertise and adequate forecast group staffing are required by the FFCs to issue timely warnings effectively. However, 74% of the flood forecasting personnel confirm that their centers do not have the experts and staff capable of integrating data, performing forecasts, and disseminating information [1].

SYSTEM IMPLEMENTATION :

PROJECT DESCRIPTION ;

- Frontend python code :

```
import time
import machine
import dht

# Define GPIO pins
TRIG_PIN = machine.Pin(2, machine.Pin.OUT)
ECHO_PIN = machine.Pin(3, machine.Pin.IN)
BUZZER_PIN = machine.Pin(4, machine.Pin.OUT)
DHT_PIN = machine.Pin(5)
LED_PIN = machine.Pin(6, machine.Pin.OUT)

def distance_measurement():
    # Trigger ultrasonic sensor
    TRIG_PIN.on()
    time.sleep_us(10)
    TRIG_PIN.off()

    # Wait for echo to be HIGH (start time)
    while not ECHO_PIN.value():
        pass
    pulse_start = time.ticks_us()

    # Wait for echo to be LOW (end time)
    while ECHO_PIN.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():
    d = dht.DHT22(DHT_PIN)
    d.measure()
    return d.temperature(), d.humidity()

buzz_start_time = None  # To track when the buzzer started

while True:
    dist = distance_measurement()
    temp, humidity = read_dht_sensor()

    # Check if the distance is less than a threshold (e.g., 50 cm)
    if dist < 50:
        # Turn on the buzzer and LED
        BUZZER_PIN.on()
        LED_PIN.on()
        status = "Flooding Detected"
        buzz_start_time = time.ticks_ms()
    elif buzz_start_time is not None and time.ticks_diff(time.ticks_ms(), buzz_start_time) >=
60000:  # 1 minute
```

```
        # Turn off the buzzer and LED after 1 minute
        BUZZER_PIN.off()
        LED_PIN.off()
        status = "No Flooding Detected"
    else:
        status = "No Flooding Detected"

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

    time.sleep(2)
```

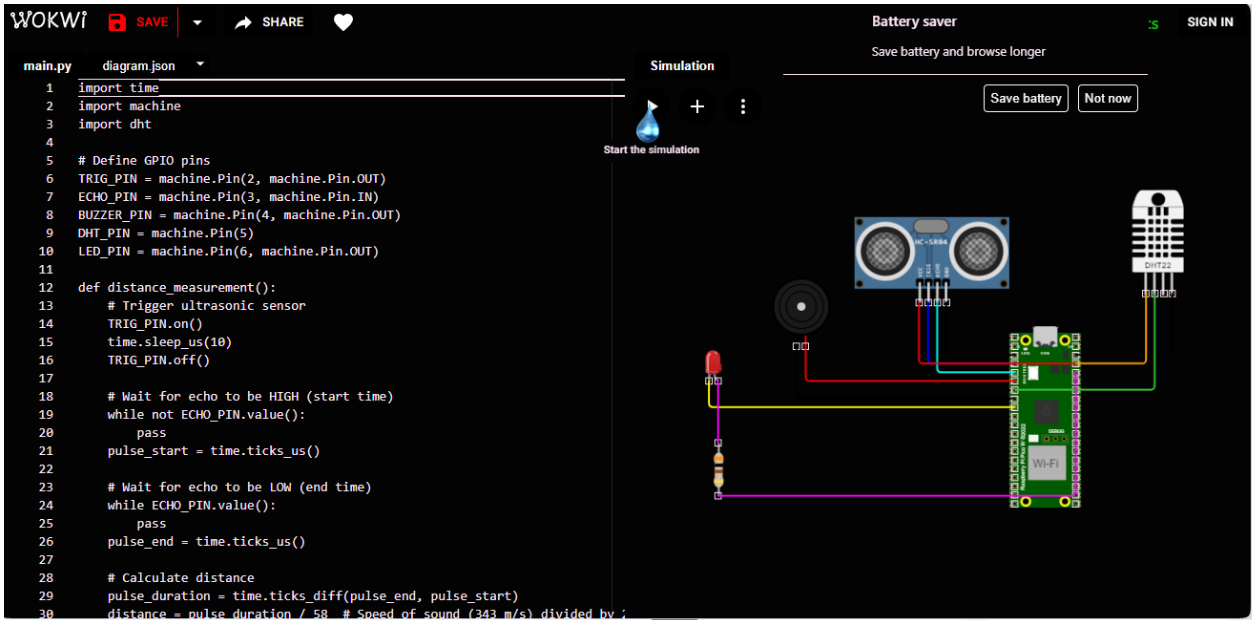
BACKEND SOURCE CODE :

```
{
"version": 1,
"author": "Anonymous maker",
"editor": "wokwi",
"parts": [
{
"type": "board-pi-pico-w",
"id": "pico",
"top": -118.45,
"left": 32.35,
"attrs": { "env": "micropython-20231005-v1.21.0" }
},
{
```

```
"type": "wokwi-hc-sr04",
"id": "ultrasonic1",
"top": -238.5,
"left": -138.5,
"attrs": { "distance": "257" }
},
{
"type": "wokwi-buzzer",
"id": "bz1",
"top": -180,
"left": -228.6,
"attrs": { "volume": "0.1" }
},
{ "type": "wokwi-dht22", "id": "dht1", "top": -268.5, "left": 167.4, "attrs": {} },
{ "type": "wokwi-led", "id": "led1", "top": -99.6, "left": -313, "attrs": { "color": "red" } },
{
"type": "wokwi-resistor",
"id": "r1",
"top": 33.6,
"left": -317.35,
"rotate": 90,
"attrs": { "value": "300" }
}
],
"connections": [
[ "ultrasonic1:TRIG", "pico:GP2", "blue", [ "v0" ] ],
[ "ultrasonic1:ECHO", "pico:GP3", "cyan", [ "v0" ] ],
[ "ultrasonic1:GND", "pico:GND.1", "black", [ "v0" ] ],
[ "bz1:2", "pico:GP4", "red", [ "v0" ] ],
[ "bz1:1", "pico:GND.2", "black", [ "v0" ] ],
[ "dht1:GND", "pico:GND.8", "black", [ "v0" ] ],
[ "dht1:SDA", "pico:GP5", "limegreen", [ "v0" ] ],
[ "ultrasonic1:VCC", "pico:3V3_EN", "red", [ "v0" ] ],
[ "dht1:VCC", "pico:3V3_EN", "orange", [ "v0" ] ],
[ "led1:C", "pico:GP6", "yellow", [ "v0" ] ],
[ "led1:A", "r1:1", "magenta", [ "v0" ] ],
[ "r1:2", "pico:3V3", "magenta", [ "h0" ] ]
],
"dependencies": {}
}
```

SAMPLE CODE OUTPUT :

Screenshort image:



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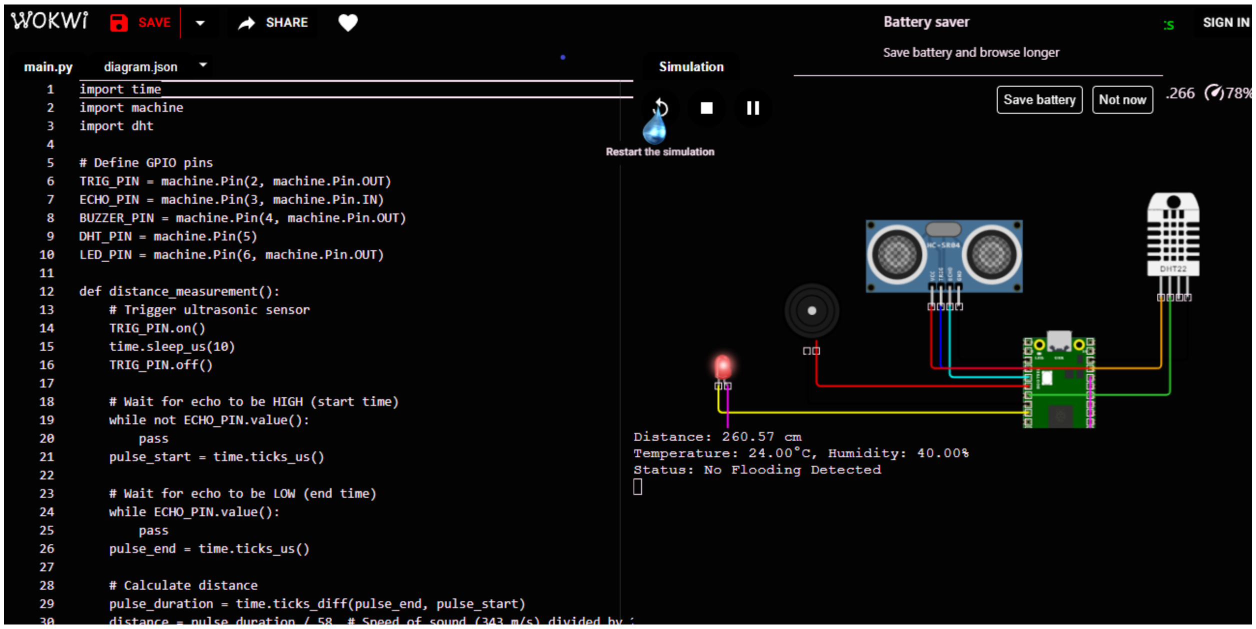
    pulse_start = time.ticks_us()

    # Wait for echo to be LOW (end time)
    while ECHO_PIN.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
```



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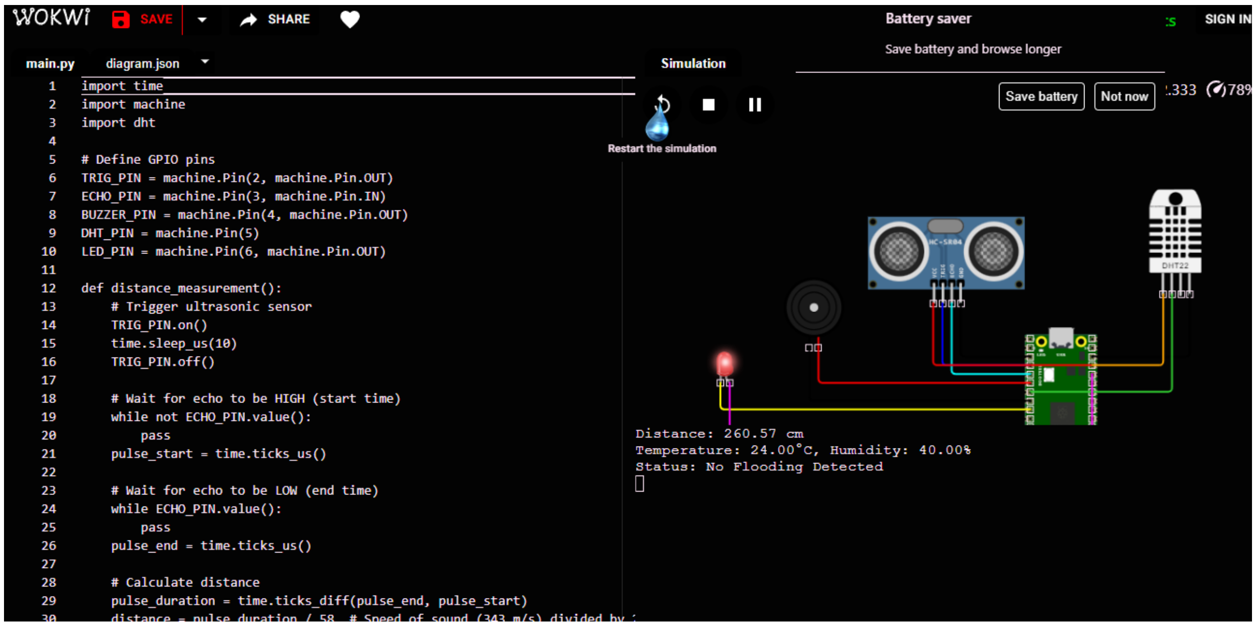
```

```
Distance: 260.57 cm
Temperature: 24.00°C, Humidity: 40.00%
Status: No Flooding Detected
```



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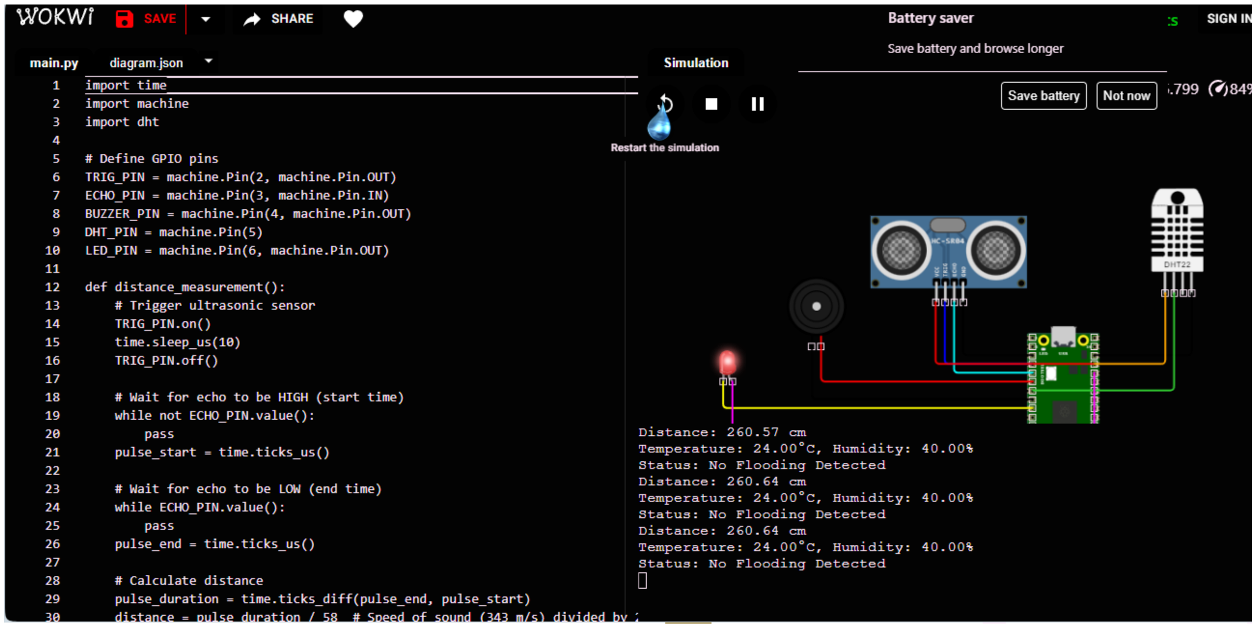

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Status: No Flooding Detected
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Temperature: 24.00°C, Humidity: 40.00%
Status: No Flooding Detected
```

CONCLUSION AND FUTURE ENHANCENGMENT:

IoT sensors-based flood monitoring systems tend to be lower cost, consistent and portable. However, when there are large areas, these systems are not recommended due to the fact that every sensor is generally invigorated by a vitality restricted battery. This paper reviewed and clarified different ecological and flood monitoring systems and various communication technologies that support enhancing the detection of viable floods and identifying cautioning issues. Further, these systems that are having highly reliable sensors with powerful IoT cloud platforms can be fundamentally utilized for large-scale environmental monitoring, and flood prediction and prevent damage caused by it. Even though the methodology of utilizing IoT in flood monitoring is not extensively explored at this point, we will see a colossal utilization of IoT and some new advancements in the near future. For example, AI and 5G techniques meet up for the prediction of floods as well as other natural calamities. The use of satellite images could be very helpful in flood monitoring as they help to keep an eye on the water bodies and the change in their behaviour from above. Some researchers have utilized data based on Google Maps to build a detection model. GSM modules also have been used in different ways similarly. Close consultation with hydrologists and learning machine-learning algorithms can further support building efficient monitoring and alert system. In the future, the usage of SAR data from the Sentinal-1 satellite is an added advantage in handling rescue operations and damage assessments based on data before and after floods. The wireless sensors can help in gathering flood related data by creating a database for further analysis. As a recommendation, there is a tremendous opportunity to explore the combination of IoT systems and SAR data to classify the images from floodprone areas and develop robust and secure Flood monitoring and early warning system

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