Harnessing IOT to solve underpass flooding Challenges

Mid-Review 2

GITAM
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Major Project
Project ID: C4

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INTRODUCTION:

The integration of **Internet of Things (IoT)** technology offers a smart and effective approach to tackling this issue. By deploying **sensors, real-time data analytics, and automated control systems**, IoT enables early detection of water accumulation, proactive warning systems, and efficient drainage management. IoT-powered solutions can monitor water levels, activate drainage pumps automatically, and provide real-time alerts to authorities and commuters, ensuring safer and more resilient urban infrastructure

ABSTRACT:

Urban flooding in underpasses poses significant risks to **public safety, traffic flow, and infrastructure** in Bengaluru. This project presents an **IoT-based solution** for **real-time flood monitoring, automated drainage, and intelligent traffic management** to mitigate these challenges effectively.

The system utilizes **wireless sensor networks, weather forecasting models, and water level sensors** to detect rainfall patterns and predict flood risks in underpasses. An **LCD** showcases real-time **moisture and humidity readings**, along with system status updates such as **"Water Detected"** or **"System Normal."**

A **microcontroller-based automation system** processes real-time data and autonomously activates **drainage pumps** when water levels exceed predefined thresholds, ensuring efficient water redirection. An **LCD** provides instant **moisture and humidity readings**, along with status updates such as **"Water Detected"** or **"System Normal."**

Objective and Goals

Objective

1. To predict weather conditions, monitor rainfall and water levels in underpasses to enable early flood risk
2. To deploy automated drainage and traffic management systems that redirect vehicles during underpass flooding to minimize traffic congestion and accidents.
3. To establish a low-latency communication network that links IoT devices, sensors, control systems, and public alert systems for effective flood management.

Goals

Main Goals

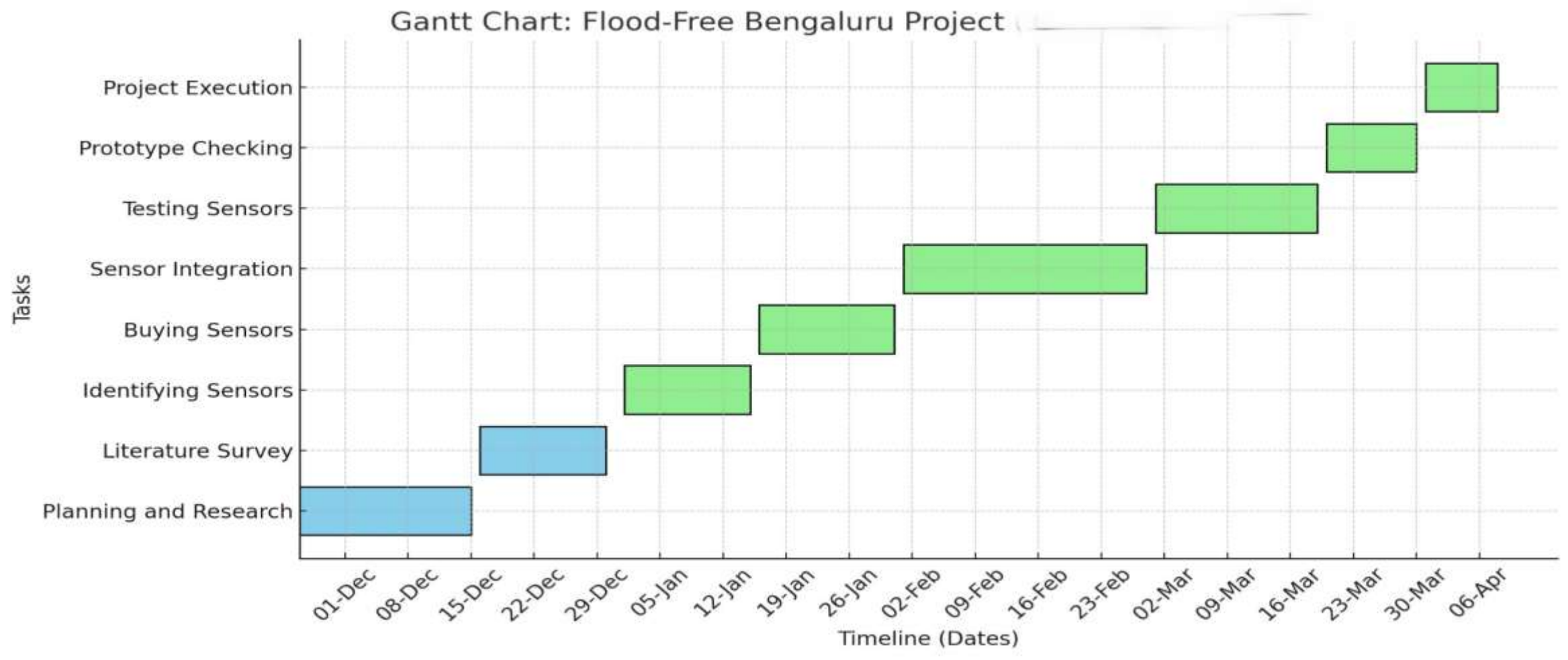
- Utilize **wireless sensor networks** to continuously monitor **rainfall, humidity, and water levels** for **accurate flood prediction**.
- Create a **low-latency network** that links **IoT sensors, municipal authorities, and public alert systems** for quick decision-making and emergency response
- Prevent accidents and disruptions by providing **real-time flood alerts** and **automated response mechanisms** in underpasses.

- **Additional Goal**
- Integrate **mobile alerts, sirens, and public announcement systems** to **notify commuters and authorities** before flooding occurs.

Project Plan (Clearly mention milestone for objectives under each reviews)

Gant Chart - Milestones and Activities

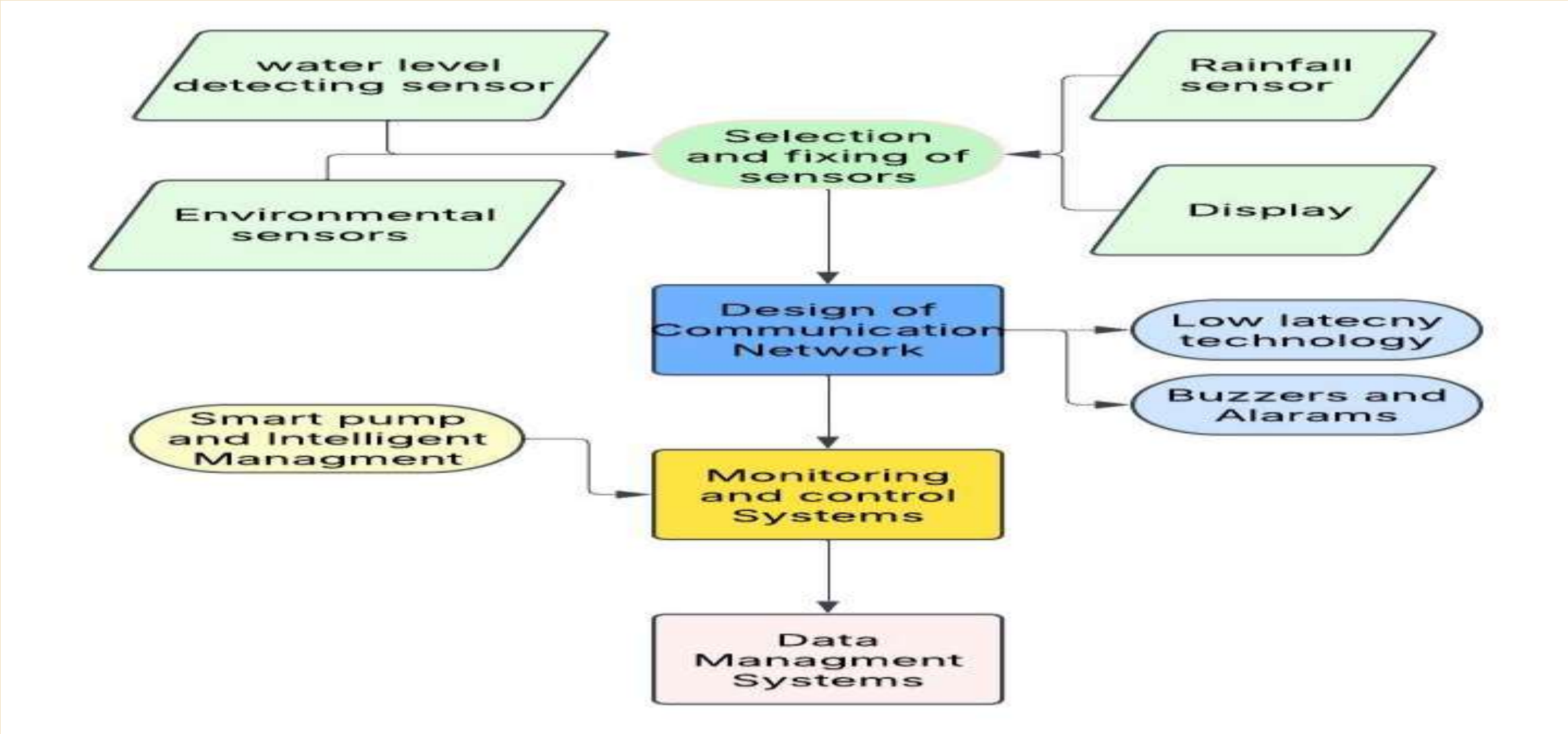
Resources : https://www.officetimeline.com/gantt-chart/how-to-make/excel & https://www.teamgantt.com/



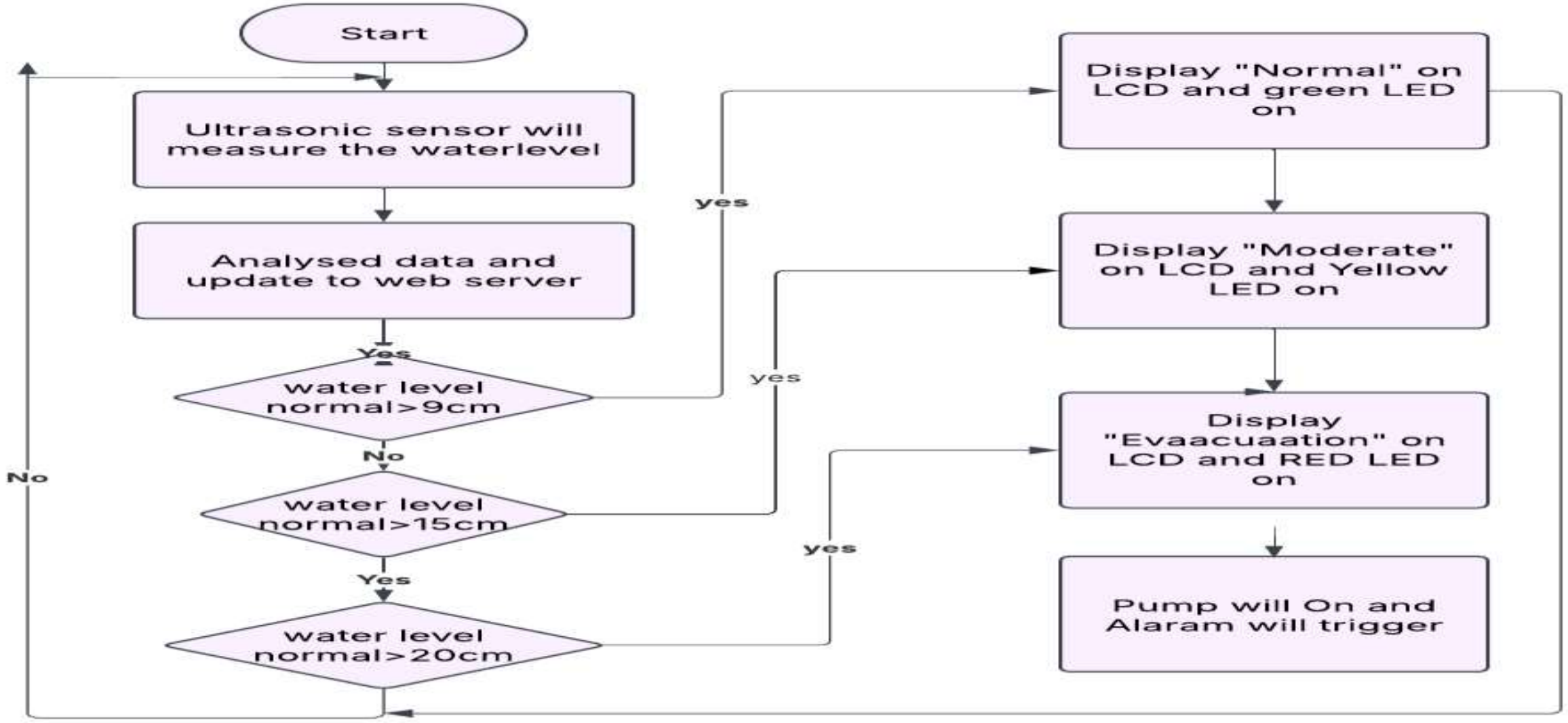
Literature Survey (Improved post minor project)

TITLE	YEAR	AUTHOR	TECHNOLOGY	RESEARCH GAP
https://www.researchgate.net/publication/356419431_Smart_IoT_Flood_Monitoring_System	2019	Shahirah Binti Zahir, Phaklen Ehkan, Thennarasan Sabapathy, Muzammil Jusoh	**wireless sensor networks** (Ultrasonic sensors, pressure sensors) ThingSpeak MicrocontrollerESP8266 Wi-Fi module	1. Inefficient Early Warning Mechanisms 2.Inefficient Early Warning Mechanisms
file:///C:/Users/chowd/Downloads/Performance_Analysis_of_IOT_based_Flood_Monitoring_Framework_in_Sub-urban.pdf	2021	Annisa Jamali, Jonathan Peter Giman	**Node-RED software**, **ultrasonic sensors**, and **Arduino UNO microcontroller**	No alerting system
https://www.ijraset.com/research-paper/review-on-iot-based-flood-monitoring-and-alerting-system	2024	Nalini Tiwari, Prajakta Khairnar, Divya Salunke, Prajakta Chavan, Vaishnavi Pabalkar	ThingSpeak cloud SMS and mobile applications	No Low latency technology

Structural Diagram



Behavioural Diagram



Water level detecting

These are the devices used to measure the level of water

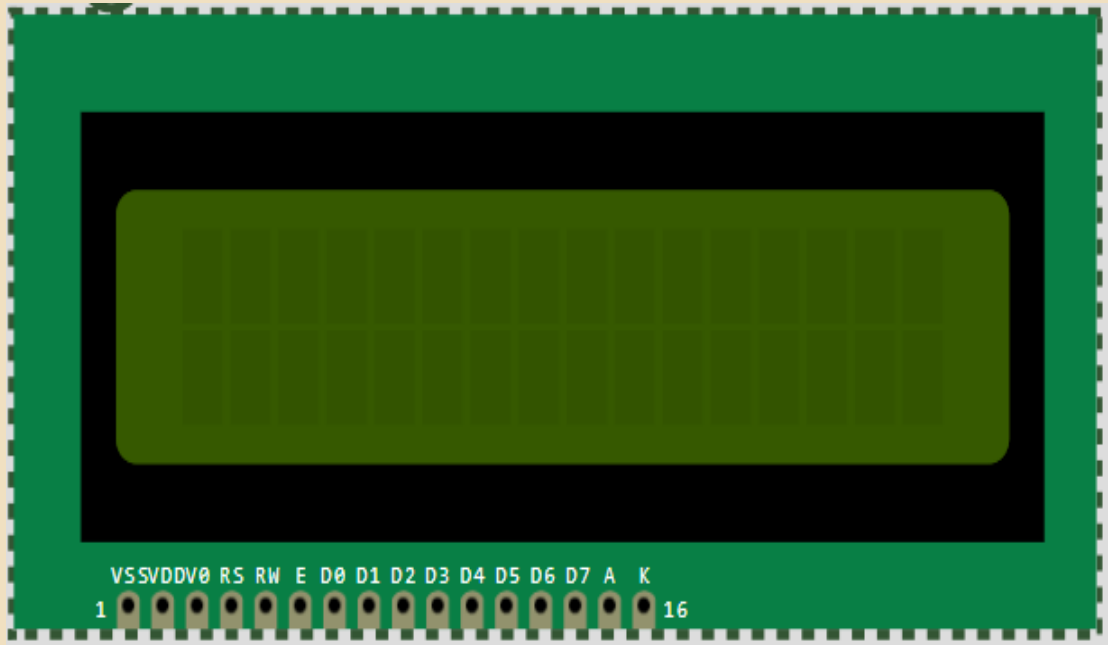
Rainfall Sensor

This senor is used to detect the rainfall

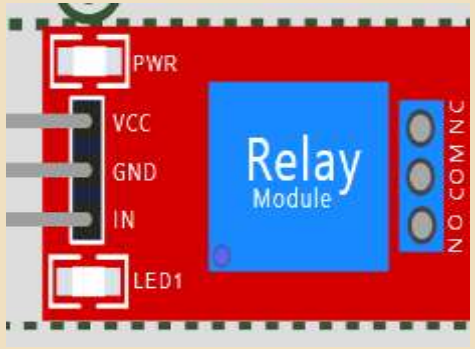
Environmental Sensor

A DHT22 sensor is used to measure both temperature and humidity in the surrounding air

LCD 16*2

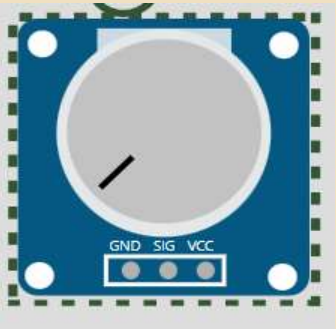


Shows the Moisture and water level



This device allows a low-power signal to control a high-power circuit. It's used to switch devices on and off

This module is a variable resistor that allows you to adjust the voltage output by rotating the knob.



Arduino code for LEDS

Moisture level ≤ 500:
•**Green LED ON**
•LCD shows **"System Normal"**

500 < Moisture level ≤ 750:
•**Yellow LED ON**
•**Relay (pump) ON**
•LCD shows **"Water Detected! Pumping Water...“**

Moisture level > 750:
•**Red LED ON, Buzzer ON**
•**Relay (pump) ON**
•LCD shows **"Critical Water! Pump Activated!"**

PIN ASSIGNMENT

MOISTURE_SENSOR A0
RELAY 7
DHTPIN 8
DHTTYPE DHT11
RED_LED 9
GREEN_LED 10
BUZZER 11
YELLOW_LED 12
TRIG 12
ECHO 13

COMPONENTS USED

DHT11 Sensor (Digital Input - D8)
•Measures humidity levels

Buzzer (Digital Output - D11)
•Sounds an alarm when the moisture level is **above 750**.

Ultrasonic Sensor (Trig - D12, Echo - D13)
•Measures the water level or distance of the water source.

Relay Module (Digital Output - D7)
•Controls the water pump.
•Turns **ON** when moisture is above **500**.

LCD Display (I2C)
Displays moisture level, water distance, and system status.

LED Indicators (Digital Outputs)
•**Green LED (D10):** Indicates normal system operation (moisture ≤ 500).
•**Yellow LED (D12):** Indicates water is being pumped (moisture between 500 - 750).
•**Red LED (D9):** Indicates critical moisture level (> 750).

Library Imports & Pin Definitions

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <dht.h>
```

Wire.h is required for I2C communication with LCD

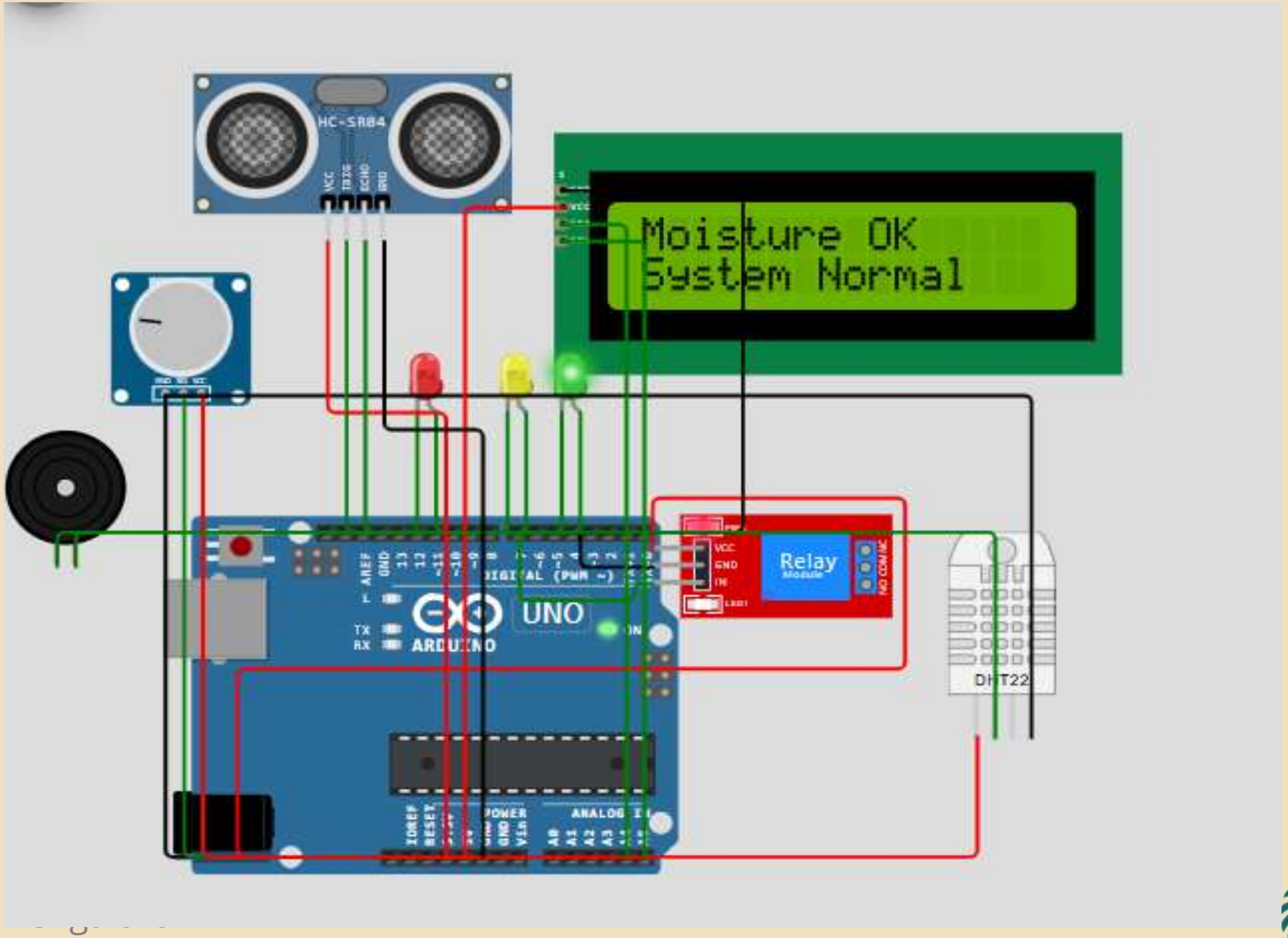
LiquidCrystal_i2C.h is used for controlling a 16*2 LCD screen

Dht.h is included for using the DHT22 sensor

Key features

monitoring and water distance
Automatic pump control based on moisture level.
Visual and audio alerts using LEDs and buzzer
LCD for instant system status updates

Implementation of Harnessing IOT using WOKWI



Conclusion

This project successfully implements an **IoT-based flood monitoring and mitigation system** to address underpass flooding challenges. Integrating moisture and ultrasonic sensors continuously monitors water levels and provides **real-time alerts** through LEDs, a buzzer, and an LCD display. When moisture levels exceed predefined thresholds, the system **automatically activates a water pump** to drain excess water, ensuring timely flood prevention.

The system classifies flood risk levels using a **multi-stage alert mechanism**:
Green Light → Normal conditions, system operational.
Yellow Light → Water detected, pump activated.
Red Light & Buzzer → Critical water level, emergency response required.

By **automating flood detection and response**, this solution minimizes waterlogging risks, improves **urban safety**, and reduces traffic disruptions. Future enhancements, such as **IoT cloud integration, mobile alerts, AI-based flood prediction, and solar power implementation**, can further enhance its reliability and effectiveness

FUTURE WORK is implementation of Hardware

Hardware Integration: We will work on implementing the **pump system** for real-world flood mitigation.

Alert System Enhancement: We plan to integrate **SMS notifications** to alert concerned authorities when water levels exceed the threshold.

Water Pump Integration: A pump will be added to automatically drain excess water when moisture levels reach a critical threshold

Power Backup System: To ensure continuous operation during power failures, we will integrate a **battery backup or solar panel system**.

Additional Sensors for Better Monitoring
Water Level Sensor (Float Sensor): To measure the precise water level and provide an extra layer of validation.
Flow Sensor: To monitor water drainage speed and detect pump efficiency (YF – S201 water flow sensor)
Rain Sensor: To predict potential flooding by detecting rainfall intensity

THANK YOU

Have a Great Day !