Department of Electronic and Telecommunication Engineering
University of Moratuwa

EN3251 – Internet of Things

Project Report : BotaniBuddy
Team Enigma

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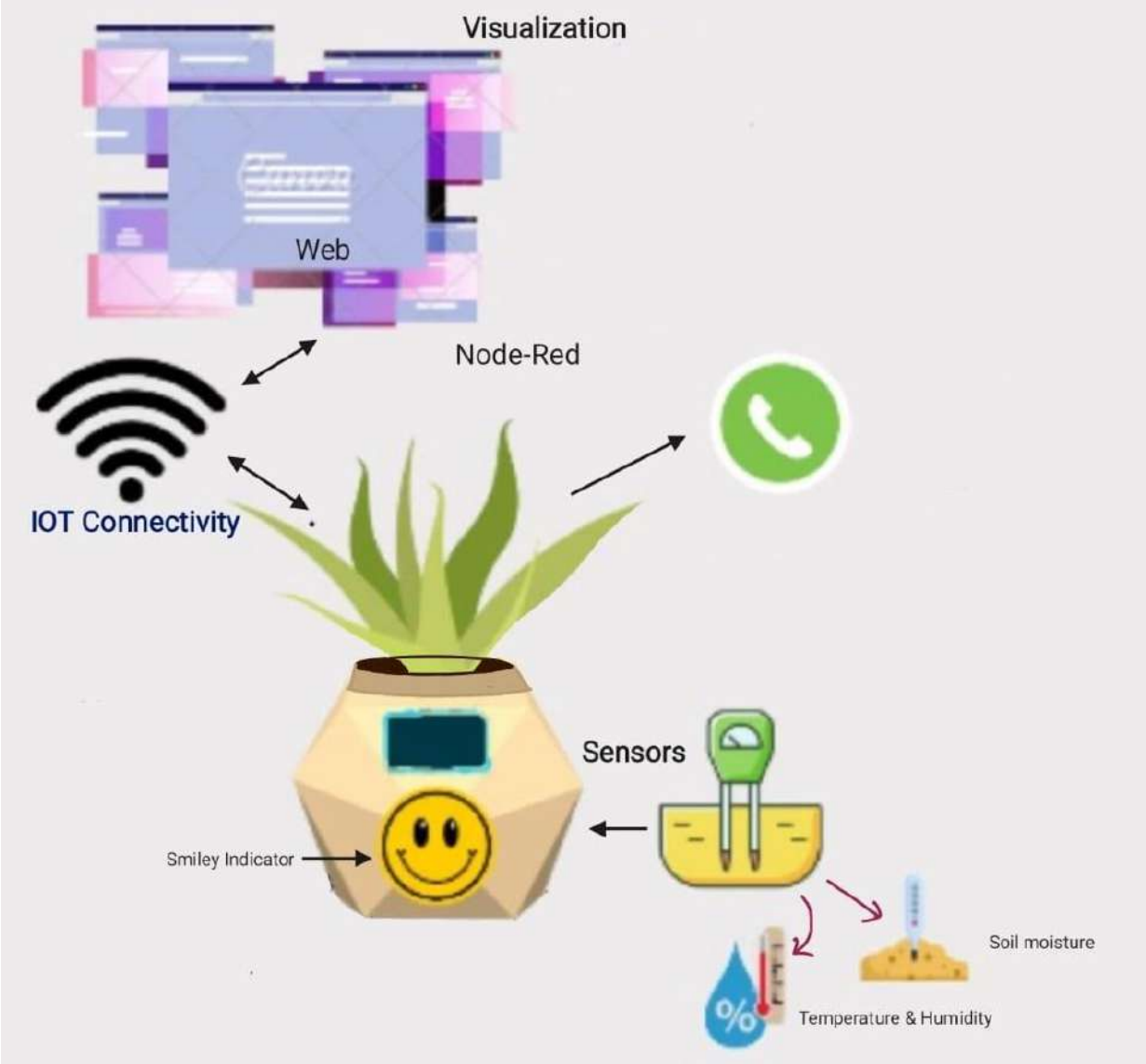
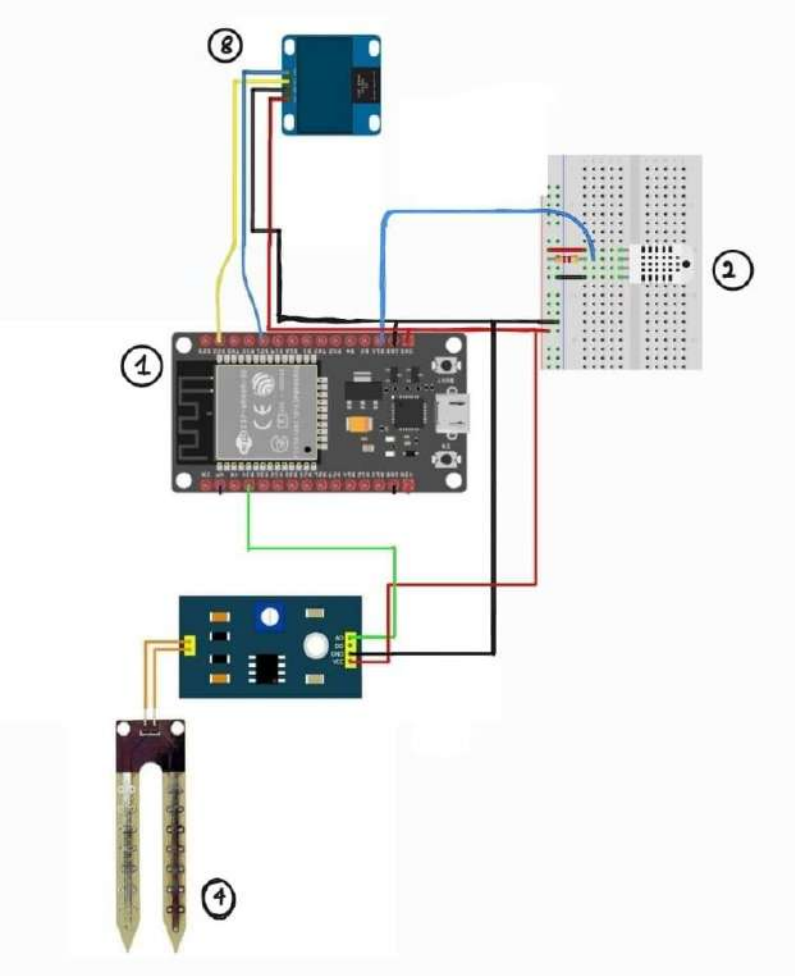
Project Architecture



Our project architecture combines hardware and software elements for effective plant care. The ESP32 microcontroller manages sensors measuring soil moisture, environmental temperature and humidity, providing real-time data. This information is sent via MQTT to Node-RED, where a dashboard visualizes the data in an accessible format. The Node-RED flow also integrates with a WhatsApp notification API, triggering alerts when the plant's environment undergoes changes. Additionally, the plant's mood is shown as an interactive emoji on the pot. In summary, our architecture seamlessly connects the physical monitoring hardware with a display for plant emotions, data visualization through Node-RED, and instant notifications, offering a comprehensive solution for smart and responsive plant care.

Hardware Design



In our hardware setup, we've employed an **ESP32 microcontroller (1)** to manage the operations of various sensors. This includes a **resistive soil moisture sensor (4)** that assesses soil wetness, providing analog data to the ESP32, which interprets and converts it into a percentage for system use. An **OLED display (8)** acts as a visual interface, presenting soil moisture levels as emojis to represent the emotions. The **DHT22 sensor (2)** continuously tracks environmental temperature and humidity, offering comprehensive environmental insights to the ESP32. The entire system communicates via MQTT, allowing the ESP32 to share sensor data with external systems. Notably, the code incorporates functions that respond to different soil moisture scenarios, indicating potential actions or alerts based on the readings. Together, these components form an integrated system for real-time monitoring and control.

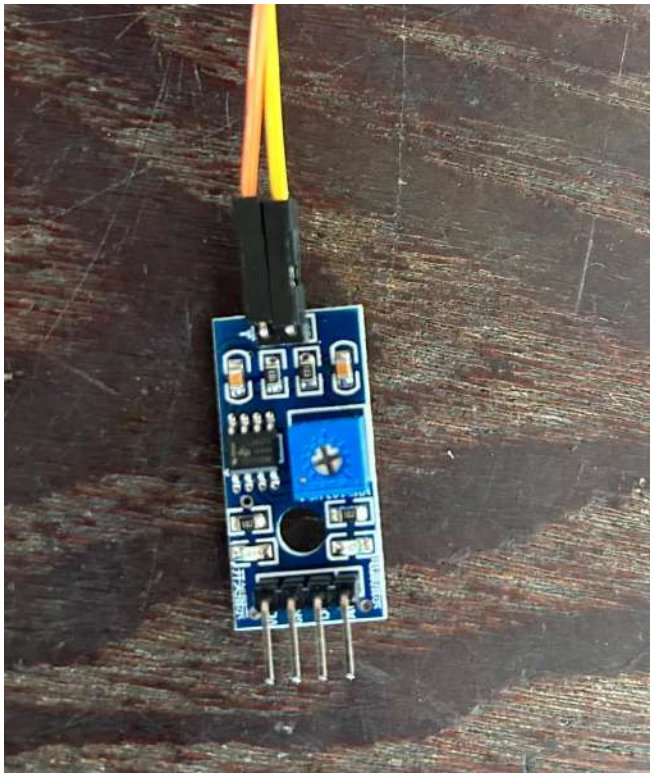
Hardware Components

1.Microcontroller: ESP 32

Sensors:

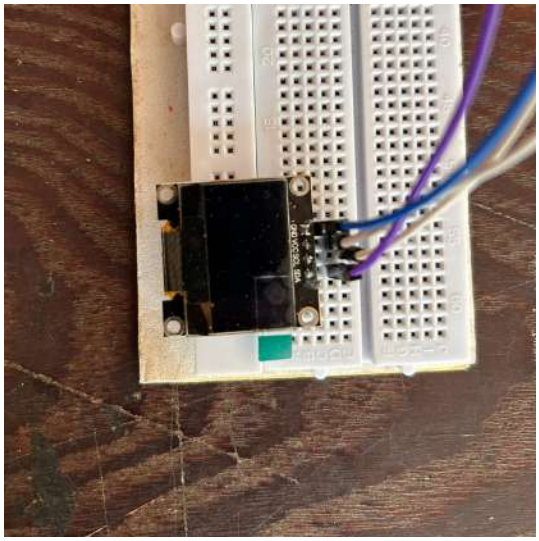
2.Temperature and humidity: DHT22 sensor

3.Soil moisture: Resistive soil moisture sensor

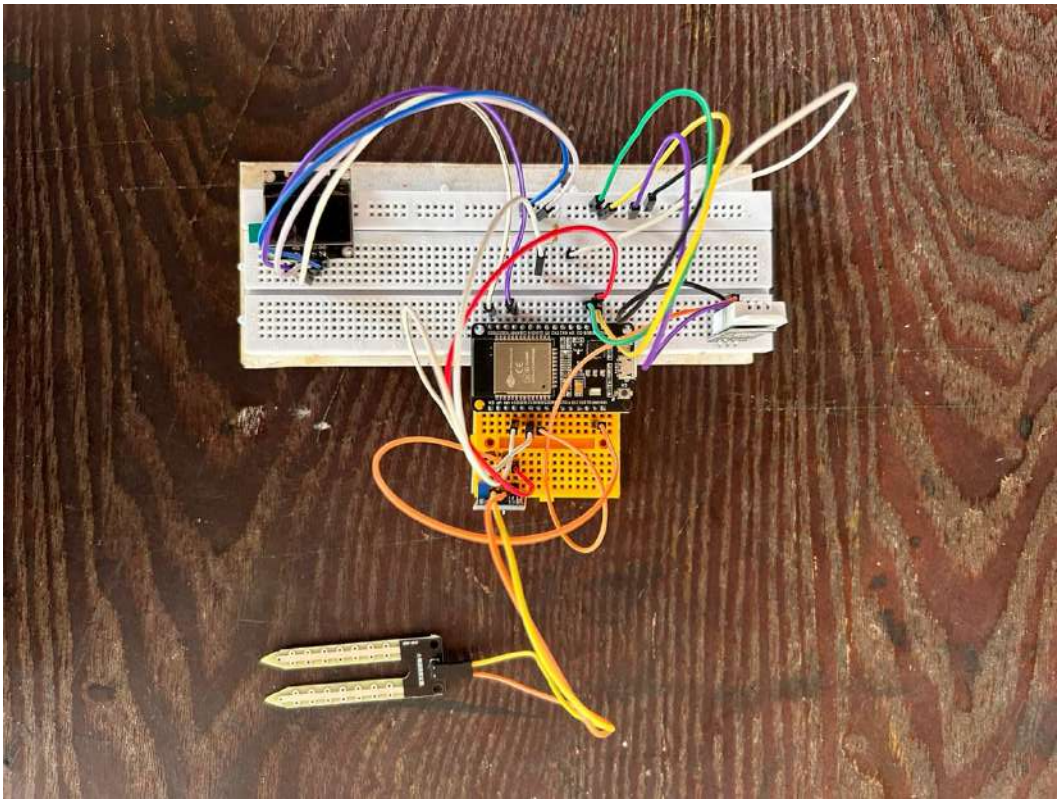


Output:

4.OLED Display



Breadboard Implementation



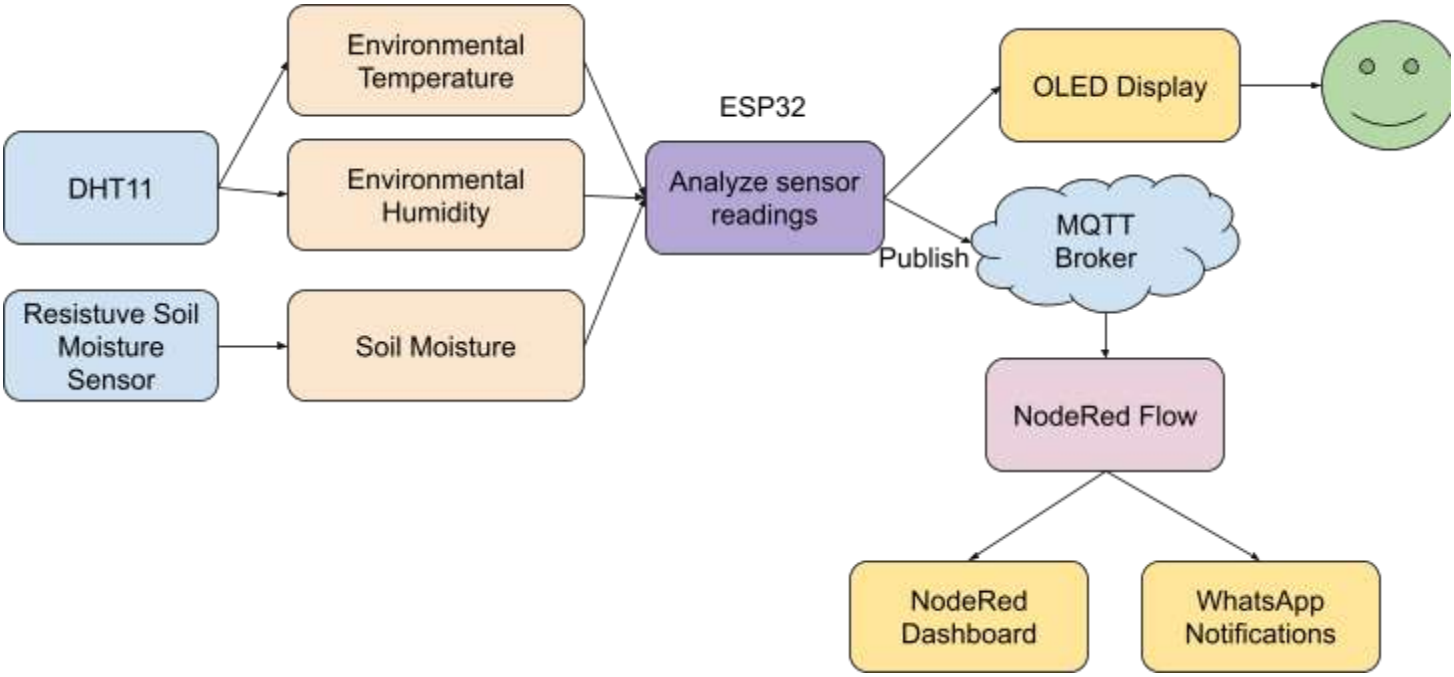
Additional Hardware

Sand

Pot

Plant

Functionalities



The functionality block diagram illustrates a streamlined process where an ESP32 microcontroller serves as the central hub, interfacing with various sensors such as resistive soil moisture sensor, and environmental humidity and temperature. This data is seamlessly transmitted to a Node-RED dashboard through MQTT as JSON objects for user-friendly visualization.

Simultaneously, the system is equipped to generate real-time WhatsApp notifications when the plant's mood changes while showcasing its emotions as emojis on the OLED display. The integration of these components forms an efficient and fun-interactive system that empowers users with valuable insights into the plant's health and facilitates timely interventions for optimal care.

Deliverables

- An animated emoji on OLED display according to the plant status
- WhatsApp notifications to users to plant controls remotely
- A node-red dashboard visualizing plant status

Animated emoji

An animated emoji will be displayed on the pot indicating the current status of the plant. This animated emoji is driven by the soil moisture threshold, which indicates high, low or excess soil moisture. By observing this emoji, users can understand the plant's current well-being.

Node-red Dashboard

The node-red dashboard displays both environmental and plant conditions. Under environmental conditions, we present the current temperature and humidity, along with a graph illustrating the last 24 hours variations of those parameters. Additionally, heat index is displayed.

In the plant conditions tab the soil moisture value alongside its last 24 hours variations graph is shown. The system indicates whether the moisture level is classified as low, optimal or high. Based on this information, users receive advice on whether to water the plant or refrain from doing so.

Whatsapp Notification

Messages are being sent to the whatsapp via a whatsapp node with a user preferred delay value. The published MQTT messages are classified to 3 stages according to a specific function into 3 message types according to the soil moisture levels.

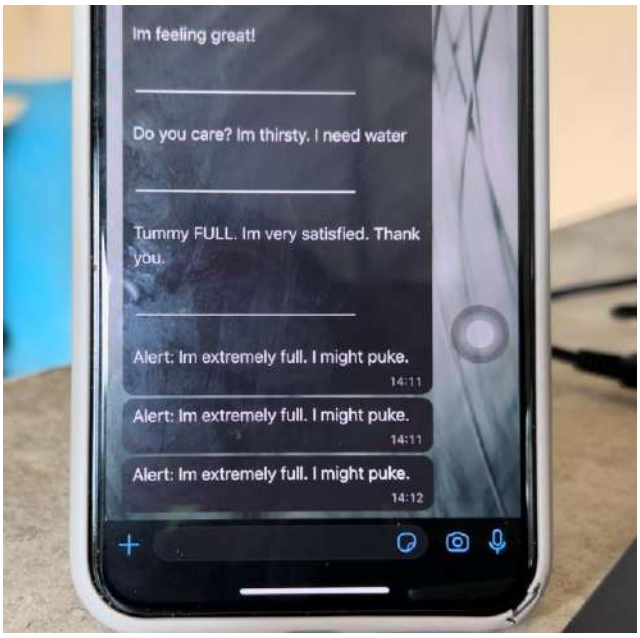
Photographs

Final Setup

Hungry Emotion

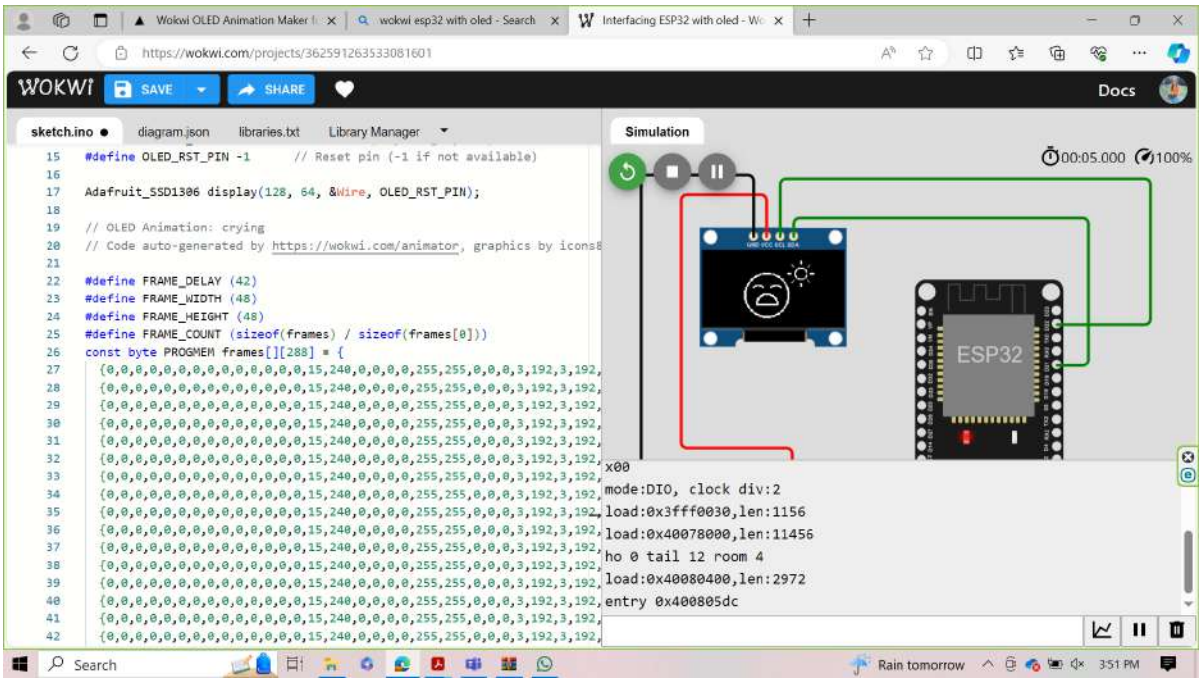
Happy emotion

Tummy Full emotion



WhatsApp Notifications when too full

Simulations



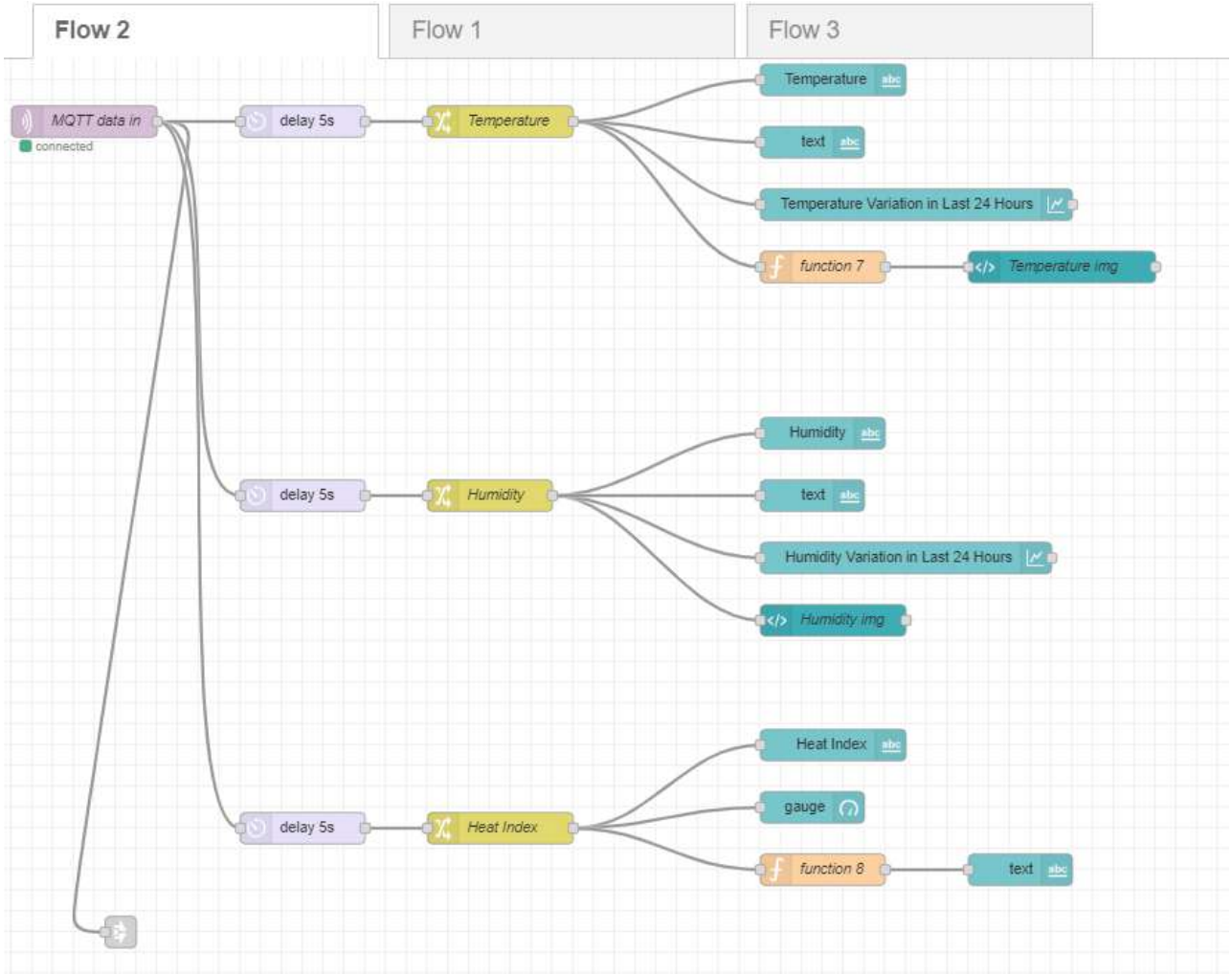
NodeRed Flow

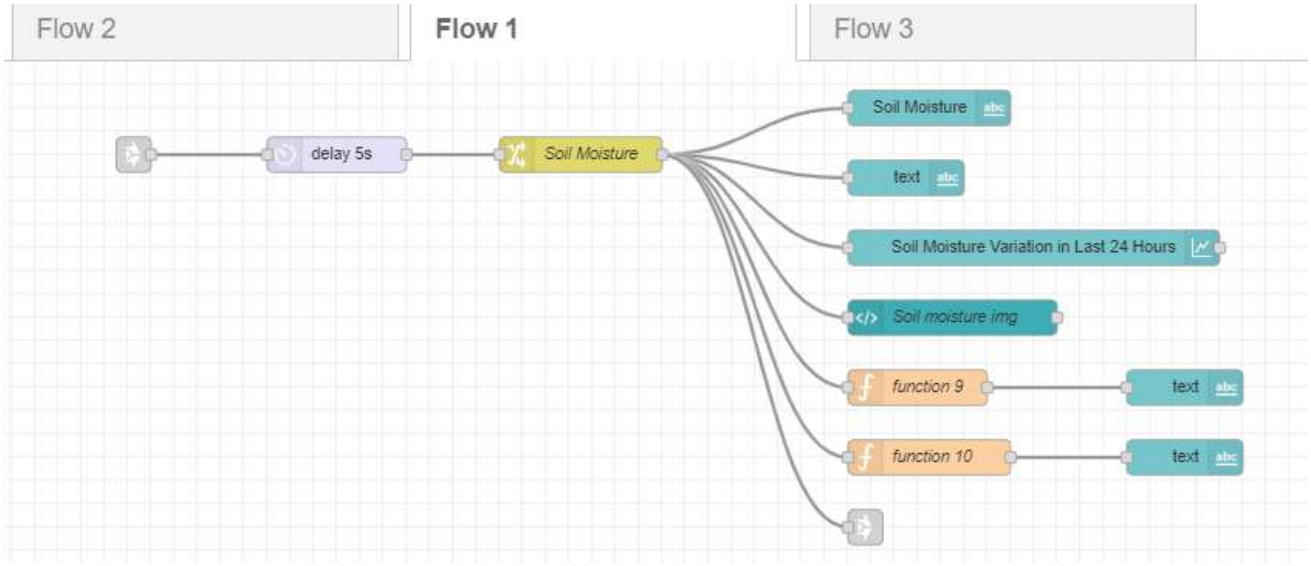
In the Node-RED flow, the flow begins with an MQTT node to retrieve data. Delay nodes are used to update the data displayed on the dashboard at 5-second intervals. The JSON object obtained from MQTT is passed through change nodes to separate key-value pairs, specifically for temperature, humidity, soil moisture, and heat index.

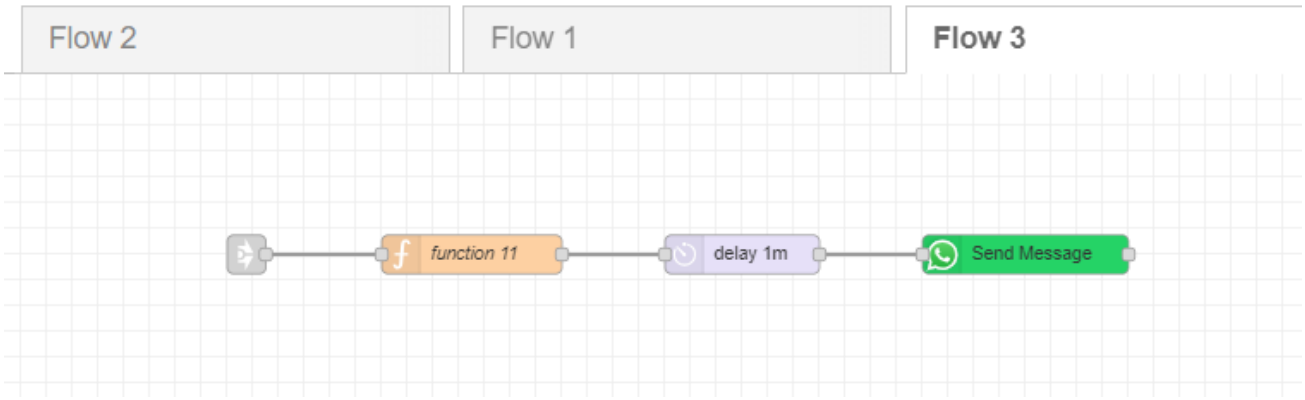
JSON object: {"EnvTemp":32, "EnvHum": 78, "HeatIndex":45, "SoilMoisture":67}

These values are then flowed to their respective text or graph nodes for display on the dashboard. Additionally, functions are used to categorize the values into ranges, which are important for indicating various scenarios related to the plant or the environment.

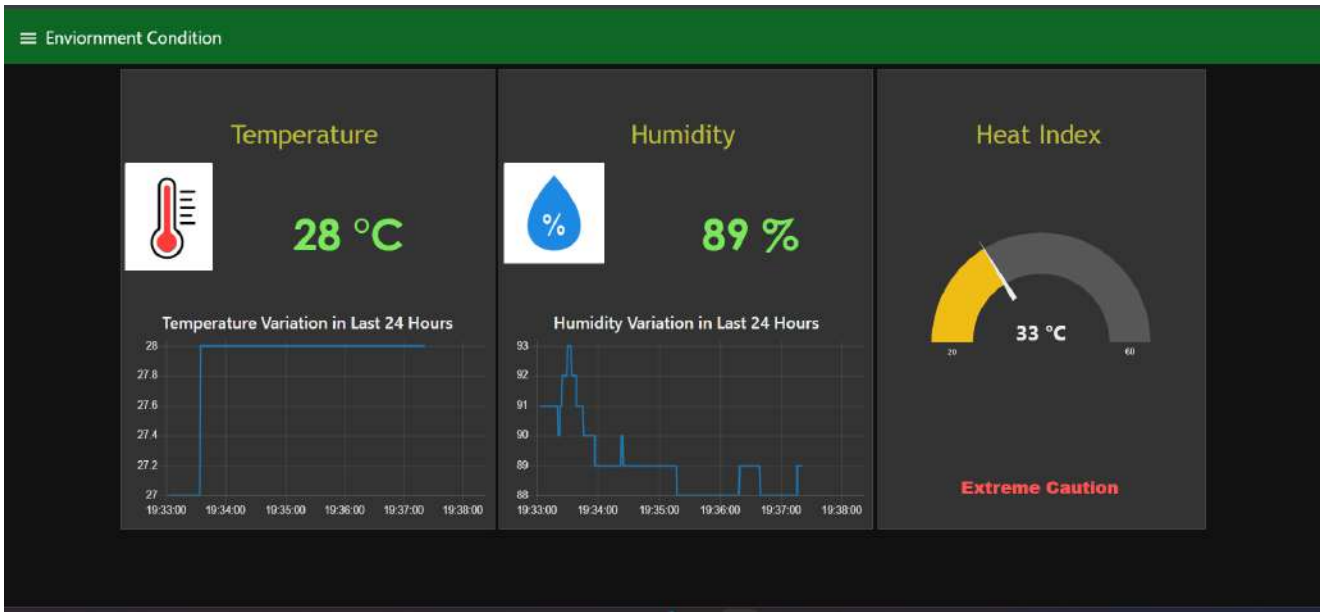
WhatsApp node is incorporated into the flow, which uses the WhatsApp API to send messages to a specified phone number using an API key.



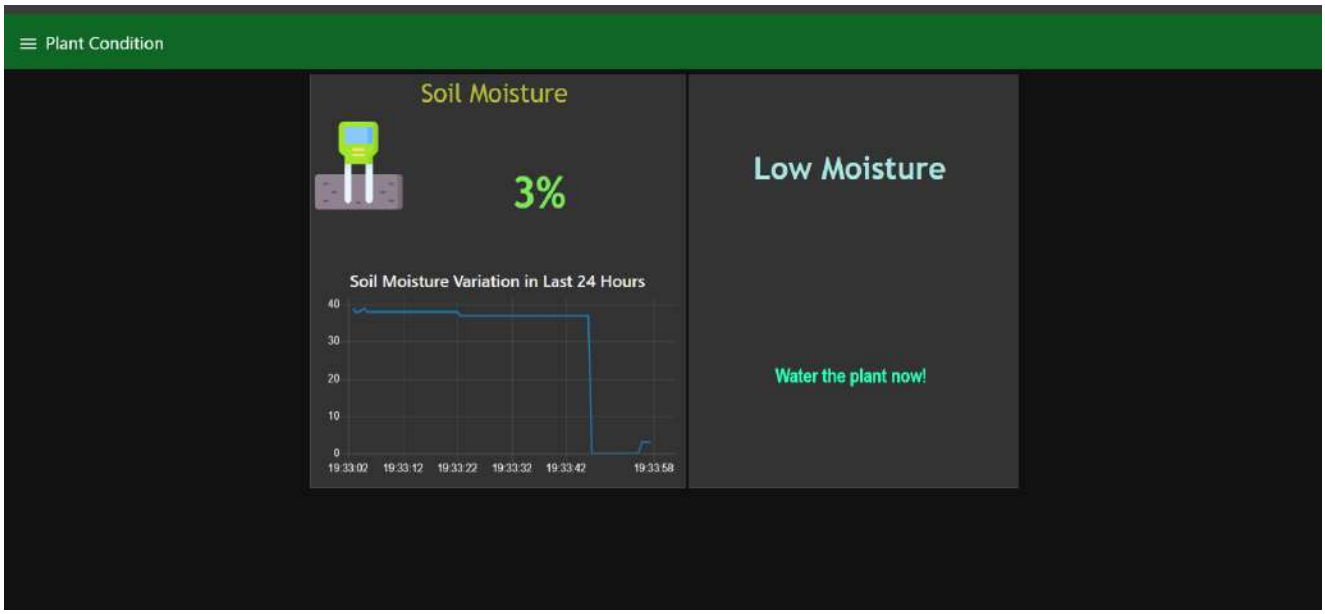

Flow 2
Flow 1
Flow 3
delay 5s
Soil Moisture
Soil Moisture
text
Soil Moisture Variation in Last 24 Hours
Soil moisture img
function 9
text
function 10
text


Flow 2
Flow 1
Flow 3
function 11
delay 1m
Send Message

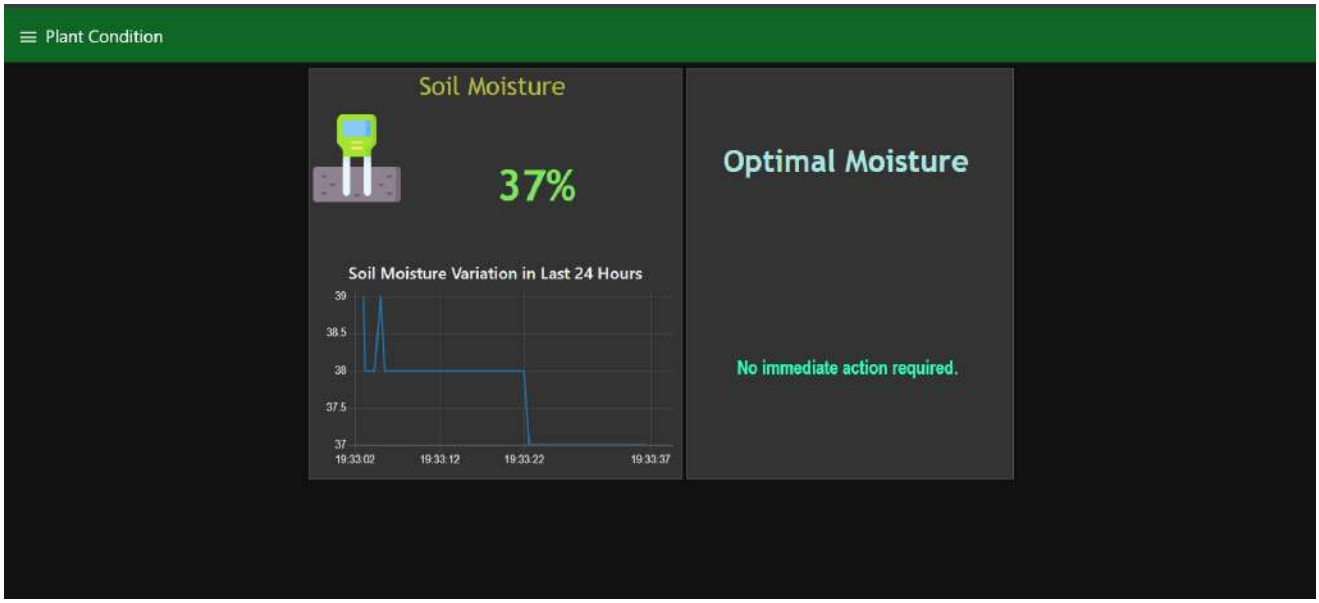
Environment conditions tab on the dashboard.



Plant conditions tab - low moisture



Plant conditions tab - optimal moisture



Plant conditions tab - excess moisture