Smart Garden Campus Monitoring System

Objective

The aim of this project was to implement a Smart Garden Monitoring System that automates irrigation and monitors plant health in real-time. The system helps maintain healthy plant growth while reducing manual watering and unnecessary water consumption.

Software and Frameworks

- **Arduino IDE** – Used for programming the ESP32 sensor nodes.
- **Node-RED** – Used to process data, apply automation rules, and display the dashboard.

System Overview

The setup consisted of 9 ESP32-based sensor nodes, each placed near individual garden plots. These nodes measured soil moisture, surrounding temperature, and humidity. A central dashboard system in Node-RED collected and displayed data from all nodes.

A separate ultrasonic sensor was used to monitor the water level in the main irrigation tank to avoid running the pump without sufficient water.

Each node included:

- Soil Moisture Sensor
- DHT11 Temperature & Humidity Sensor
- Servo Motor for irrigation valve control

Data Communication

The system used the MQTT protocol for communication. Each ESP32 node published sensor readings to MQTT topics. Node-RED subscribed to these topics and displayed the real-time data on the dashboard.

Monitoring and Working (5 Hour Observation)

During the 5-hour monitoring period, the system ran continuously:

- Each node transmitted moisture and climate data regularly.
- Tank water level was monitored and updated continuously.
- The dashboard displayed all sensor values and watering status live.

Automation Rule

A rule-based condition was implemented:

> *When soil moisture drops below a defined threshold and temperature exceeds 20°C, the system activates irrigation for that specific plot.*

This triggered an MQTT command that rotated the servo motor, opening the irrigation valve. Irrigation stopped automatically once the soil moisture returned to normal.

Predictive Analytics

A simple linear regression model was used to estimate soil drying rate. Based on this, the system provided a prediction of the next watering time, helping plan irrigation more efficiently.

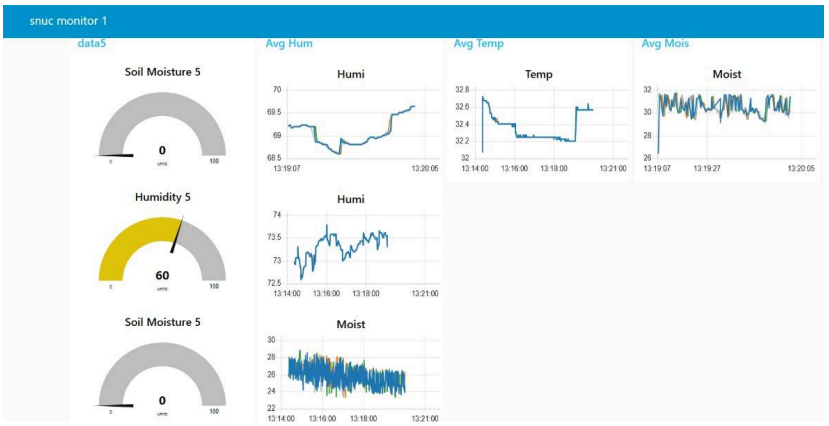
Dashboard Visualization

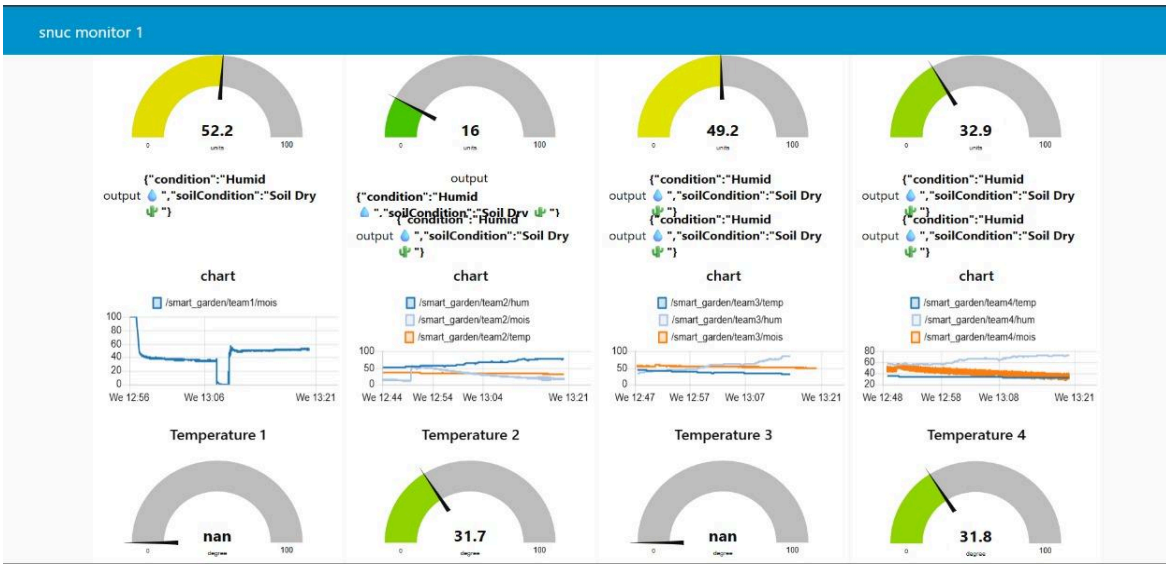
The Node-RED dashboard displayed:

- Real-time moisture values from all 9 nodes
- Temperature and humidity readings
- Water tank level status
- Irrigation activity logs and predictions

Conclusion

The system performed effectively during the 5-hour observation period. Sensor data remained stable, the automatic irrigation logic responded correctly, and the dashboard provided clear real-time insights. The system shows potential for scalable green campus or agricultural automation, promising water conservation and reduced manual effort.





By (registration numbers):

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