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Smart Plant Monitoring System

1. Abstract:

The **Smart Plant Monitoring System** leverages Raspberry Pi devices equipped with sensors and motors, coupled with MQTT protocol for seamless communication. This system offers users an intuitive Web Dashboard for efficient plant care management.

Monitor Conditions:
1. Soil Moisture Level.
2. UV Level.
3. Temperature & Humidity Level.

DashBoard Features:
1. Real-time insights into plant environment.
2. Perform action such as watering & lighting control.
3. Convenient user interface for task execution.

2. Objective:

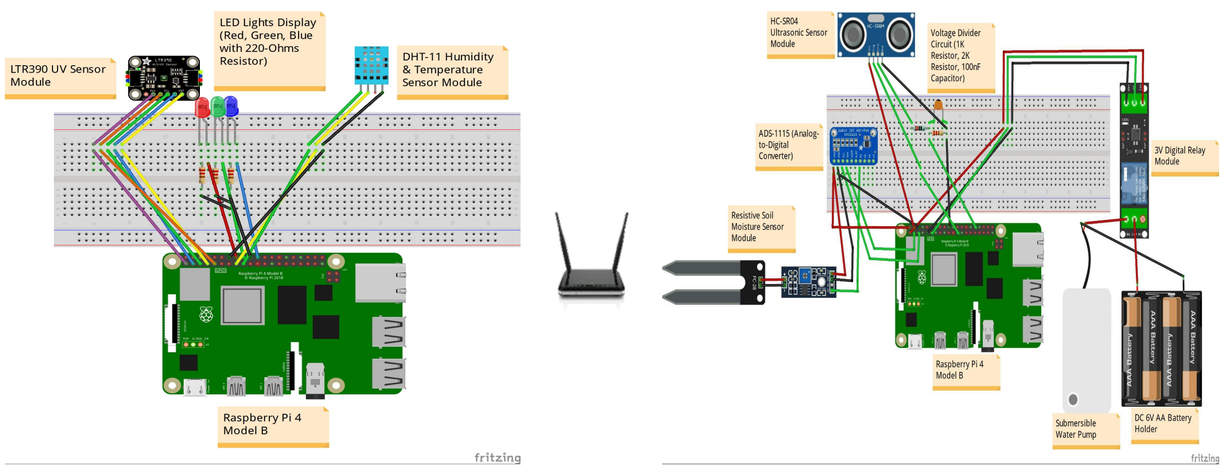
1. Provides users with a Web Dashboard using Node-RED to monitor their plants & enable them to perform actions.
2. Have 2x Paho-MQTT Client (Mosquitto Broker) Raspberry Pis equipped with sensors & motors respectively to monitor the plants & perform actions such as automated watering and light intensity controller.
3. Have 1x MQTT Server (Mosquitto & Node-Red) Raspberry Pi to receive & display the data on the Dashboard & send actions to Client.

3. Methodology:

To make this project flexible & scalable,**four major parts** of IoT Technology are applied.
They are as followed:
1. **Sensors** & **Microcontroller**
2. **Gateway** & **Network**
3. **Management Service**
4. **Application**

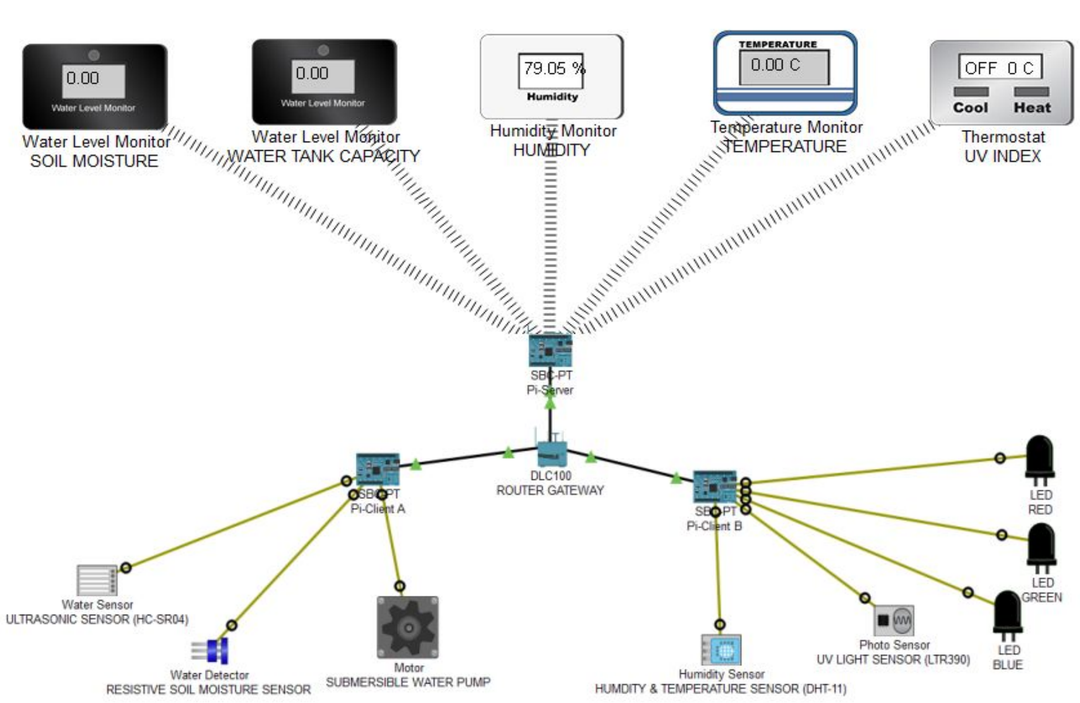
Sensors & Microprocessor	Gateway & Network	Management Service	Application
1. **Raspberry Pi** connected via LAN for easy IoT node setup. 2. **Efficient** resource usage & **scalable** architecture. 3. **Sensors:** • **Soil Moisture:** for irrigation control. • **Water Pump:** automated watering. • **Relay:** high-power device control. • **ADC:** precise analog data reading. • **Temp & Humidity:** ambient condition monitoring. • **UV Light:** intensity detection. • **RGB LEDs:** simulates plant growth lighting. 	1. Both **IBM Node-Red** & **Python** handle gateway functions, processing MQTT data. 2. **JSON** is utilized for formatting the data for the Node-Red Dashboard. 3. **MQTT** ensures seamless data forwarding from collection to Node-Red.     	1. **MQTT** for Device Communication. 2. **Z-score** for Sensor Data Collection. 3. **GPIO pins** for Device Control. 4. **Multi-Threading** for Thread Management. 5. **Exceptions** for Error Handling. 6. **Data Processing:** outlier detection & sensor data conversion. 	1. **Smart Agriculture.** 2. **Urban/Rural farming.** 3. **Crop Monitoring & Management.** 4. **Precision Farming.**   

4. Connection Circuit Layout:



Client A Client B

5. Network Diagram:



6. Resources:

3x Raspberry Pi 4 Model B, 1x Router, Online documentation for Paho-MQTT, Mosquitto Broker & Node-RED,4x Sensors (UV Light, Temperature & Humidity, Ultrasonic, Moisture), 1x Motors (Submersible Water Pump), 3x LEDs (Light Intensity controller), Electrical Components (Breadboard, Jumper Wires, Resistors, ADC, etc.)

7. Conclusion:

Currently 3 Pis have been deployed with 2 as client and 1 as server. Cost price is about $50 SGD for the sensor modules excluding the Pis.

Future expansion for this project is shown below:
1. Adding **live feed** features.
2. Explore integrating it with **Amazon Alexa, SQLite3, Azure AI.**
3. Explore integrating it with **LoRa.**

8. References:

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[3]G. Journals, “IoT Based Agriculture and Transportation Surveillance,” *www.academia.edu*, May 22, 2018. https://www.academia.edu/36632828/IoT_Based_Agriculture_and_Transportation_Surveillance?email_work_card=view-paper