Department of Electronic and Telecommunication Engineering
University of Moratuwa

EN3251-Internet of Things

Smart Agricultural System
Project Proposal

Team PulseLink

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1. Introduction

The world's economy is largely dependent on agriculture. Among the world's most developed nations are those with thriving agricultural economies. In addition to reducing the cost of importing food and groceries, the government can boost national revenue through advanced agriculture. Thus, the major goal of our project is to use modern technology to improve agriculture in our nation. Our project closes the gap between local farmers and technological advancement through bringing IoT technology to them. In order to enhance the agriculture industry, we are developing a smart agricultural system that collects data from farms and integrates it with technology.

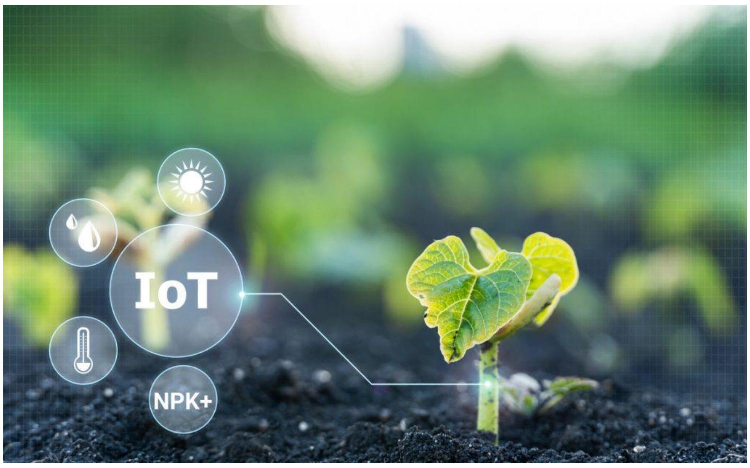

Figure 1: Smart agriculture

2. Problem Description

Large-scale agricultural landscape-owning farmers are facing substantial challenges in monitoring their cultivation and maintaining the necessary nutrients and optimal conditions for their crops. This often leads to wastage of resources and money, as they struggle to identify the nutritional requirements of specific plants and choose the right crops for particular pieces of land. Consequently, food production is reduced, and agricultural sustainability is impaired. To address these issues, a solution is needed to efficiently monitor large-scale

Figure 2: A large-scale agricultural landscape

agricultural landscapes and accurately track the nutritional needs of plants throughout their growth cycle.

3. Our Solution

The purpose of our solution is to provide guidance to farmers for making informed decisions regarding precise fertilisation and irrigation. Our goal is to help them increase crop yields, improve soil health, and enable efficient monitoring of their entire land. To achieve this, our team has developed an IoT based soil monitoring device equipped with various sensors. This device measures critical soil parameters, including NPK values, pH levels, soil temperature, soil moisture content, and other specifications crucial for plant growth. Several of these devices are placed in different locations of the land to cover the entire landscape. Sensor data received from each device is published via MQTT and this real-time data is displayed on a single Node-red dashboard.

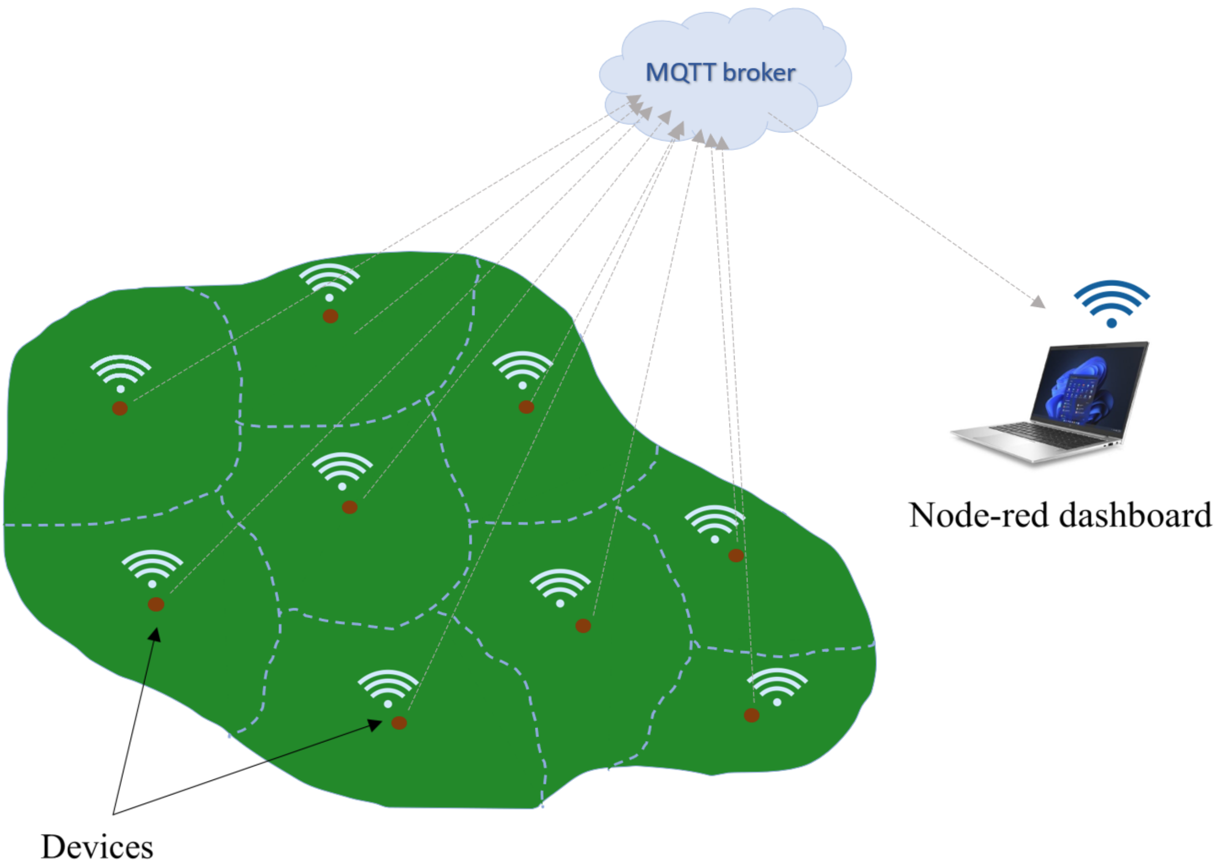

Figure 3: Mechanism overview

4. Device Features

- Integrated sensors
  - NPK sensor

    The device has a NPK sensor to quantify the levels of nitrogen (N), phosphorus (P), and potassium (K) in the soil. This data is crucial for determining the nutrient composition of the soil.
  - pH sensor

    A pH sensor is integrated into the device to measure the acidity or alkalinity of the soil.
  - DHT 11

    To measure humidity and temperature of the surrounding air.
  - Moisture Sensor

    To measure the soil moisture level. This data enables farmers to follow effective irrigation practices.
  - LDR

    To measure the sunlight intensity.
- ESP8266 NodeMCU : For Wi-Fi communication
- Rechargeable battery

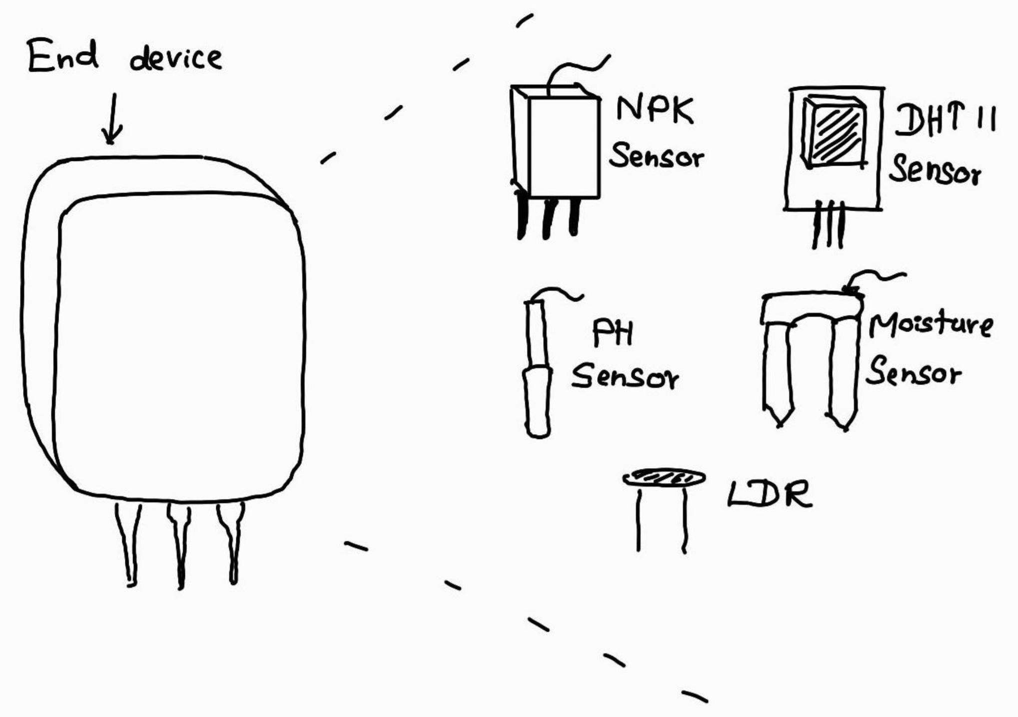

Figure 4: End-device rough sketch

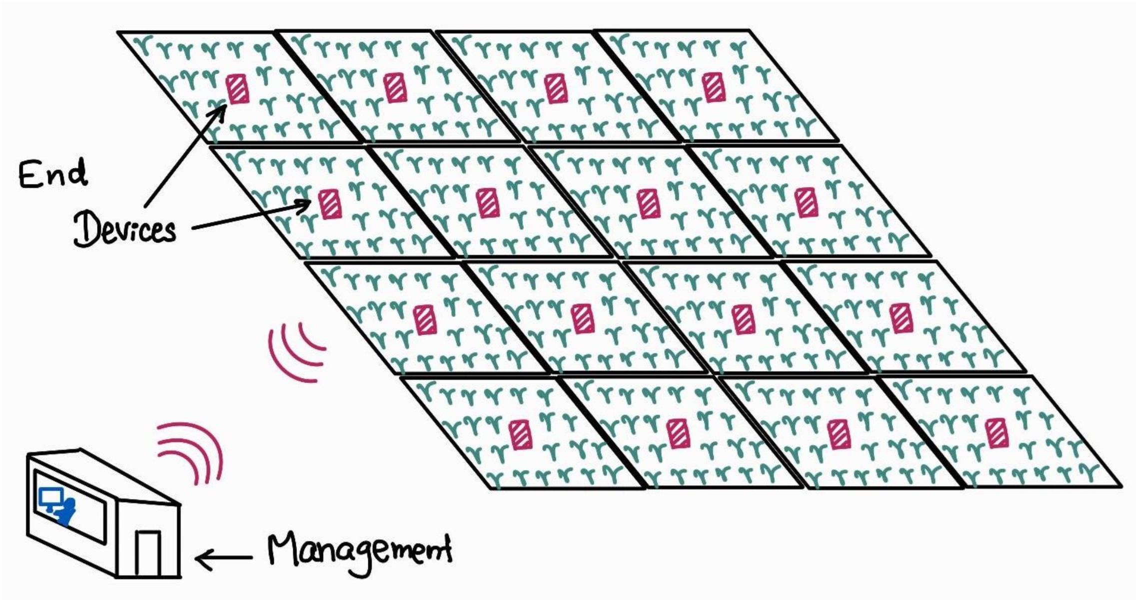

Figure 5: Final setup

5. Node-red Platform

The information which is gathered by the sensors from each land section will be published to a MQTT broker, and then we subscribe to the broker using Node-red. Our Node-red dashboard has several tabs within it. Additionally, the preferred limits of environmental parameters for different types of crops is included in a csv database and that is used for analysis purposes in our Node-red dashboard.

- **Overview tab:**

  This tab contains a summary about the real time information of each land section. Here we represent the current state of each crop in each land section using several groups in the Node-red dashboard. The user can easily inspect if there are any problems with a land section using the visual representation. Then he can take necessary solutions to overcome the problem by moving to the tab which is reserved for that land section. Additionally, the user can observe the water amount used by each land section using this tab. By that the user can identify which land section uses more water and take necessary actions to reduce the usage and reduce the overall cost of production.

- **Separate tabs for each land section:**

  After the user observes any defect in a land section, he can examine it using these tabs. The information gathered using the sensors are available for each land section, with a visual representation of the variation of those factors for the past days. The ideal amounts of environmental factors will be available for the manager for the planted crop type. Additionally, the user will be given the most suitable crop type for the land section. This is done by comparing the ideal values for each crop with the current state of the landscape. Apart from that, the user can insert the crop amount from each land section for each month to the database. After that the user can get a visual representation about the history of the land section in order to make future decisions.

- **Crop types:**

  If the user wants to plant a specific crop type, and if he wants to find the most suitable land action for that crop type, the user can move to this tab. Here, the user can select the desired crop using a dropdown menu. Then the most suitable land sections will appear with the history of environmental factors in those land sections. Then the user can compare and choose the best land section accordingly.

6. Impact on the Community

Our project greatly impacts both the local farmers and the farm managers.

- Farmer:
  - Easily communicate with the manager.
  - Observe the state of each land section without having to physically be there.

- Manager:
  - Observe the entire land from one place.
  - Identify the activity of each farmer using the state of their land sections.
  - Increase the profit by choosing the most suitable plant for each section.
  - Reduce the cost by maintaining the water usage of each land section.

7. Conclusion

In conclusion, our IoT-based smart agricultural system enhances productivity and decision-making for large-scale farming, providing real-time data on soil conditions and crop status. This technology empowers farmers to optimise their practices and improve crop yields.