IoT-Based Decision Support System for Slurry and Manure Application in Agriculture

Project Category

Farming

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Description

The aim of this project is to create an IoT-based decision support system that assists farmers in determining the optimal time to spread slurry or manure on their fields. The system leverages various environmental sensors to gather real-time data on atmospheric and soil conditions, such as air temperature, humidity, air pressure, and soil temperature. This data is processed and analyzed using a Raspberry Pi and then transmitted over the internet to a centralized platform for evaluation.

Motivation

Our project team is motivated by the need to support farmers in making more efficient and sustainable decisions when applying slurry and manure to their fields. By leveraging IoT technology, we aim to provide real-time, data-driven insights that help farmers optimize the timing of their spreading activities, ultimately saving resources and enhancing crop productivity. Additionally, our system promotes environmentally responsible farming by reducing the risk of nutrient runoff and soil degradation, ensuring that natural fertilizers are used effectively. Through this project, we strive to make agricultural practices more sustainable, cost-effective, and environmentally friendly.

Approach

The IoT-based Decision Support System leverages sensor devices to optimize slurry and manure application in agriculture. Key sensors monitor critical environmental factors such as temperature and air humidity, while a GPS ensures precise location tracking to incorporate a accurate weather forecast. This sensor data is transmitted to the cloud, where it is stored and managed. The users can check optimal conditions are met for manure spreading on a website.

Techniques

The system will use a range of IoT devices, including the RHT03 or BME I2C/SPI sensors to monitor temperature and humidity, a soil moisture sensor to assess soil conditions

and the Adafruit Ultimate GPS Breakout for precise geolocation. The sensor data is transmitted to a cloud server, which stores the data. The user can access the information via a website.

Parts

Sensor Devices

- 3x Raspberry Pico
- 3x Pico LoRa LoRa device for Raspberry Pico (https://www.bastelgarage.ch/pico-lora-node-modul-fur-raspberry-pi-pico-sx1262?search=lora%20raspberry)
- 3x Adafruit IoT Sensor T/H/P/L
- 3x Soil Moisture

Gateway

- 1x Lora Gateway

Cloud

- 1x Linux VM in Labservices or RaspberryPi 4

Evaluation

To assess the effectiveness of our IoT-based decision support system, we plan to conduct both controlled and field-based evaluations. Our approach involves testing the sensors and the system's overall performance in real agricultural environments to ensure accuracy, reliability, and usability.

Sensor Accuracy:

We will test each sensor (e.g., temperature, humidity, soil moisture) in field conditions to verify their precision and consistency.

System Reliability:

The system's ability to collect, process, and transmit data without interruption will be evaluated by deploying it in real-world settings. We will monitor the data flow from the sensors to the cloud platform and assess whether the system functions reliably across different environmental conditions and distances.

User Feedback:

The web interface will be tested by potential end-users, such as farmers, to evaluate the ease of use, accessibility of information, and the clarity of the insights provided by the system. Feedback will be gathered to refine the user experience and improve the platform's practical applicability.

Field Testing:

The complete system will be tested on a farm to ensure that the decision support insights align with the optimal conditions for slurry and manure application. We will compare the system's recommendations with traditional methods to determine if it can optimize the timing of spreading while minimizing environmental impact.

By conducting these evaluations, we aim to refine the system, ensuring it is both technically robust and practically beneficial for farmers.