PROJECT REPORT FOR

SMART AGRICULTURAL SOLUTION

DEVELOPED DURING COURSE

CS724: SENSING, COMMUNICATIONS AND NETWORKING FOR SMART WIRELESS DEVICES

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1. Introduction

Agricultural Smart Solution aims to revolutionize traditional farming practices by integrating cutting-edge technology to optimize crop growth. The primary goal is to develop a comprehensive system that monitors soil conditions and efficiently supplies necessary nutrients. This innovative approach targets precision agriculture, enabling farmers to make informed decisions for better crop health and yield.

2. Background

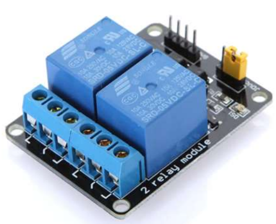
Traditional agricultural methods often lack precision in addressing specific soil nutrient deficiencies, leading to suboptimal crop growth and yield. This solution addresses these limitations by harnessing smart technology to precisely detect and address nutrient deficiencies in real time. The need for such a system arises from the imperative to improve agricultural productivity sustainably.

3. Hardware Components

The project utilizes a sophisticated set of components:

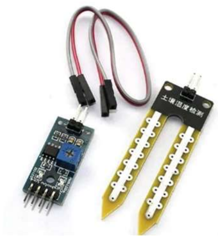
Arduino: This serves as the central control unit, orchestrating data processing and controlling mechanisms.

Relay Module: Facilitates the control of pumps for nutrient supply based on instructions from the Arduino.

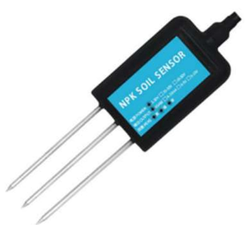


Pumps: Dispense water and nutrients as directed by the system.

Moisture Sensor: Monitors soil humidity levels.



NPK Sensor: Detects nitrogen, phosphorus, and potassium levels in the soil.



Jumper Wires: Essential for seamless connections between various components.

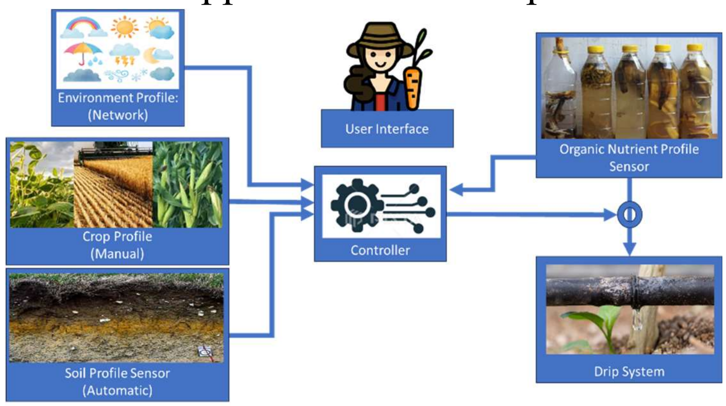
Soil: The target for precise nutrient supplementation based on detected deficiencies.

Organic manure solution: Kitchen waste, when composted or processed into organic manure, contains varying amounts of essential nutrients such as nitrogen (N), phosphorus (P), and potassium (K), which are crucial for plant growth. The exact NPK values of kitchen waste organic manure can vary based on the types and proportions of waste materials used, the composting process, and the duration of decomposition. In our project we have used solution of Banana Peels and water left out for a week in Sun in a closed bottle.

Bluetooth Module: Bluetooth module in integrated with Arduino to allow communication over mobile phone.

4. Methodology

The system operates by utilizing sensors to collect critical soil data. The Arduino serves as the core processing unit, analyzing this data and interfacing with the MIT App Inventor-developed mobile application.

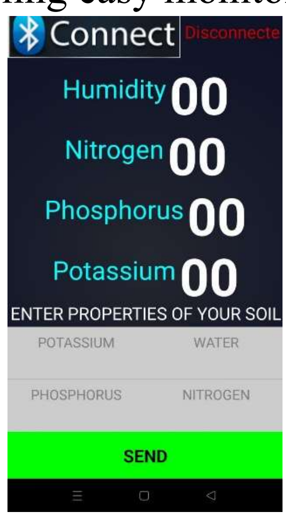


The application empowers users to:

Access real-time soil condition data, including humidity and NPK levels.
Identify specific nutrient deficiencies.
Initiate nutrient supply with ease through an intuitive user interface.

5. Features and Functionalities

MIT App Inventor Interface: Developed to provide an intuitive and user-friendly platform, enabling easy monitoring of soil conditions.



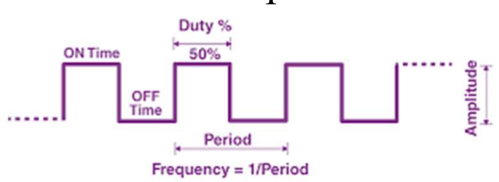
Real-time Monitoring: Users can access current soil humidity and NPK values, aiding in informed decision-making.

Nutrient Supply Control: Allows users to take immediate action by initiating nutrient supply to address identified deficiencies, directly from the app.

6. Data Flow and Control Law

The system's data flow involves the sensors gathering soil data, which is processed by the Arduino. The Arduino communicates bidirectionally with the mobile application, providing soil condition data and receiving instructions to control nutrient supply based on user inputs.

The control law running in Arduino is designed as dwell time based automaton to handle the feedback delay caused by dissemination of water and nutrients in soil. It also takes care of the time variant nutrient contents in the organic manure solution. Arduino sends PWM signal to pumps via relays to realize this solution. Duty cycle as of now is kept at 50%. It can be tried with multiple values to reach the optimum point.



7. Challenges and Solutions

Following are some of the salient challenges that we faced during the development.

- Interfacing the pumps with Arduino didn't go as planned. Arduino could drive small device with about 20mili-ampere current rating. But our pumps required around 220 mili-ampere of current. Therefore we deployed external power source in form of 9V cells for every pump.
- All sensors and devices were working individually but when put together, unexpected behavior was observed. For example we could achieve only one way communication between phone and Arduino over bluetooth in integrated setup.
- Formulation of an optimal control law was our desired goal. Had to balance out different requirements to reach a solution with minimum silicon footprint.

- System is made up of jumper wires, breadboards, water and nutrient liquid. Hence it is neither portable not robust. Further efforts can be put in to make it more efficient in all dimensions.

8. Results and Impact

Improved Nutrient Management: The system's precision in addressing nutrient deficiencies is expected to yield better soil health and improved crop growth.

Interactive User Interface: Farmers can see real time nutrient contents in soil and set the thresholds based on desired crop profile and weather forecasts.

9. Limitations

- Unidirectional communication over Bluetooth.
- As of now the system works on static crop profile. All enablers, except full duplex Bluetooth communication, are in place.
- Due to availability of only two pumps, we could integrate nourishment for water and one nutrient (Nitrogen).
- Robustness, reliability, and portability
- This is a battery dependent setup. Electrical interfaced need to be modified to facilitate AC/DC power sources.

10. Future Scope

- Energy Efficiency Enhancement: Explore methods to optimize energy consumption, considering low-power modes or alternative energy sources like solar power.
- Mobile App Optimization: Refine the mobile app's user interface and experience for better control and data visualization.
- Data Logging and Analysis: Implement a data logging system to store historical sensor data, enabling informed decision-making and trend analysis.
- Connectivity Upgrades: Investigate additional connectivity options such as Wi-Fi or GSM to extend the range and accessibility of the system.

11. Conclusion

The Agricultural Smart Solution demonstrates the transformative potential of technology-driven approaches in agriculture. By empowering farmers with real-time soil data and precise nutrient supply controls, the project exemplifies how technology can significantly enhance agricultural practices for sustainable and efficient crop production.