WATER IRRIGATION SYSTEM USING ARDUINO (BECE352E)

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ABSTARCT:

In this project, we propose an IoT-based soil nutrient monitoring and analysis system using Arduino and ESP32. Soil health is crucial for agriculture, as it directly impacts crop yield. Monitoring soil properties such as moisture, temperature, and nutrient content (nitrogen, phosphorous, and potassium) is essential for efficient farming practices.

The system consists of the following components:

1. **Sensors:**
    - **Capacitive Soil Moisture Sensor: Measures soil moisture levels.**
    - **DS18B20 Waterproof Temperature Sensor: Monitors soil temperature.**
    - **Soil NPK Sensor: Determines nitrogen, phosphorous, and potassium levels.**
2. **Arduino Nano Board: Interfaces with the sensors and collects data.**
3. **ESP32 Board: Acts as the gateway to transmit data to the cloud.**
4. **NR24L01 PA+LNA Module: Wirelessly transmits data from sensor nodes to the gateway.**
5. **Thingspeak Server: Displays data in graphical and numerical formats.**

The farmer can wirelessly monitor soil parameters on a mobile phone or PC. The NRF2401 wireless transceiver module extends the range, allowing data transmission from sensor nodes to the gateway. The ESP32, connected to Wi-Fi, uploads data to the Thingspeak server.

By combining IoT, Arduino, and wireless sensors, this system enables real-time soil nutrient content analysis, monitoring, and testing. It empowers farmers to make informed decisions for sustainable agriculture.

Bill of Materials:

1. **Arduino Nano Board**
2. **ESP32 Board**
3. **NR24L01 PA+LNA Module**
4. **NPK Sensor**
5. **Capacitive Soil Moisture Sensor**
6. **DHT 11 Temperature Sensor**
7. **Resistor (4.7K)**
8. **9V Power Supply**
9. **Connecting Jumper Wires**
10. **Breadboard**

INTRODUCTION:

In this project, we propose an IoT-based soil nutrient monitoring and analysis system using Arduino and ESP32. The goal is to empower farmers with real-time insights into soil properties, including moisture, temperature, and nutrient content (specifically nitrogen, phosphorous, and potassium). By wirelessly transmitting data to mobile phones or PCs, farmers can make informed decisions for sustainable agriculture. The usability of a soil monitoring device built with Arduino depends on several factors, including its accuracy, reliability, ease of use, and the specific needs of the user. Here are some points to consider regarding its usability:

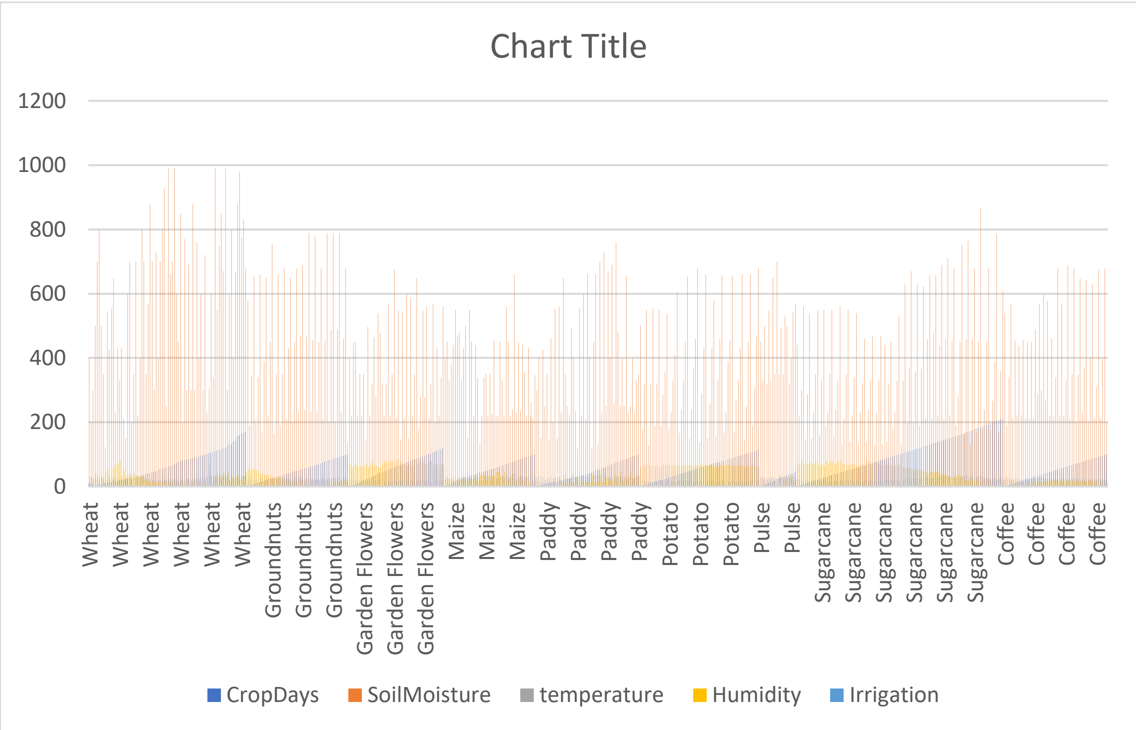
1. **Accuracy and Reliability: The accuracy of the device in measuring soil moisture and temperature is crucial. Users rely on accurate data to make informed decisions about watering schedules, soil health, and plant growth. Calibrating the sensors properly and ensuring they are of good quality can enhance accuracy and reliability.**
2. **Ease of Use: A user-friendly interface is essential for usability. If the device includes a display, it should present data in a clear and understandable format. Users should be able to interpret the readings easily without technical expertise.**
3. **Accessibility: The device should be accessible to users with different levels of technical knowledge. This includes easy setup and operation instructions, as well as troubleshooting guidance in case of issues.**
4. **Remote Monitoring Capabilities: Adding remote monitoring capabilities, such as wireless connectivity, can enhance usability by allowing users to access real-time data from anywhere. This is especially beneficial for users who need to monitor multiple locations or those who cannot physically access the device regularly.**
5. **Customization: The ability to customize the device to suit specific needs is valuable. Users may want to adjust parameters, such as moisture threshold levels or data logging intervals, to match their unique requirements.**
6. **Durability and Weather Resistance: For outdoor use, durability and weather resistance are essential considerations. The device should be able to withstand environmental factors such as rain, sunlight, and temperature fluctuations without compromising its functionality.**
7. **Power Efficiency: Optimizing power consumption is important, especially for devices deployed in remote locations or off-grid settings. Using low-power components and implementing sleep modes can prolong battery life and reduce the need for frequent maintenance.**
8. **Scalability: Users may want to expand their monitoring system over time. Designing the device with scalability in mind allows for easy integration of additional sensors or features as needed.**

PROCEDURE:

1. **Sensor Interfacing:**
   - **Connect the capacitive soil moisture sensor, DS18B20 temperature sensor, and soil NPK sensor to the Arduino Nano board.**
   - **Use appropriate pins for each sensor (refer to their datasheets).**
2. **Calibration:**
   - **Calibrate the soil moisture sensor by embedding it into the soil.**
   - **Pour water into the soil slowly and observe the sensor readings.**
   - **Note down the value when the soil changes from dry to wet; this value is your threshold.**
3. **Wireless Communication:**
   - **Use the NRF2401 wireless transceiver modules to transmit data wirelessly from the sensor nodes to the gateway (ESP32).**
   - **The ESP32 is connected to Wi-Fi and uploads data to the Thingspeak server.**
4. **Programming:**
   - **Write Arduino code to read data from the sensors.**
   - **Implement wireless communication using the NRF2401 modules.**
   - **Upload the code to both the Arduino Nano and ESP32.**
5. **KAGGLE Integration:**
   - **Set up a Thingspeak account and create a channel.**
   - **Configure the ESP32 to send data to the Thingspeak channel using Wi-Fi.**
6. **Data Visualization:**
   - **Access the Thingspeak dashboard to view real-time data in graphical and numerical formats.**
   - **Monitor soil moisture, temperature, and NPK values remotely.**
7. **Testing and Deployment:**
   - **Deploy the system in the field (agricultural area).**
   - **Ensure that the NRF2401 wireless communication works within the desired range.**
   - **Monitor the data on your mobile phone or PC.**

8. **Maintenance:**
    - **Regularly check the system for any issues.**
    - **Replace sensors if needed.**
    - **Keep the system powered and connected to the Wi-Fi network.**
9. **Further Enhancements:**
    - **Explore additional features, such as sending alerts when soil conditions deviate from optimal levels.**
    - **Consider integrating more sensors for comprehensive soil analysis.**

RESULTS:



INFERENCE:

1. **Wheat:**
    - Wheat tends to have a moderate growth period, neither too short nor too long.
    - It may show sensitivity to soil moisture levels, with optimal growth occurring within a specific range.
    - Irrigation frequency could significantly impact wheat yield, with careful management potentially leading to improved outcomes.
2. **Groundnuts:**
    - Groundnuts might have a relatively longer growth period compared to some other crops.
    - They may prefer higher soil moisture levels, especially during certain stages of growth.
    - Groundnuts could benefit from consistent irrigation, particularly during critical growth phases such as flowering and pod development.
3. **Maize:**
    - Maize growth period could vary depending on the variety, but it typically falls within a moderate range.
    - It might exhibit sensitivity to both temperature and soil moisture levels, with optimal growth conditions requiring a balance of these factors.
    - Adequate irrigation, especially during the early stages of growth, could be essential for achieving optimal maize yields.
4. **Paddy:**
    - Paddy rice may have one of the longer growth periods among the crops in the dataset.
    - It likely prefers high soil moisture levels throughout its growth cycle, reflecting its aquatic nature.

- Effective irrigation management, including water level control, could be crucial for successful paddy cultivation.

5. **Potato:**
   - Potatoes might have a relatively short to moderate growth period.
   - They could show sensitivity to soil moisture levels, with excessive moisture possibly leading to issues like rotting.
   - Irrigation management might need to be carefully calibrated to avoid waterlogging while ensuring adequate moisture for tuber development.

6. **Pulse:**
   - Pulses may have a shorter growth period compared to some other crops.
   - They might exhibit tolerance to variations in soil moisture levels, but consistent moisture during critical growth stages could enhance yield.
   - Moderate irrigation levels may suffice for optimal pulse cultivation, but excessive water might lead to issues like root rot.

7. **Sugarcane:**
   - Sugarcane could have one of the longer growth periods among the crops in the dataset.
   - It likely requires consistently high soil moisture levels, especially during the initial growth stages and during cane development.
   - Proper irrigation management, along with soil fertility management, could be essential for maximizing sugarcane yield.

8. **Coffee:**

    - Coffee plants may have a longer growth period, particularly in regions with cooler climates.
    - They might be sensitive to both temperature and soil moisture levels, with optimal growth conditions requiring moderate temperatures and consistent moisture.
    - Coffee cultivation could benefit from precise irrigation management to maintain soil moisture levels within the ideal range for plant health and productivity.

REFERENCES:

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- **https://www.instructables.com/Smart-Irrigation-System-Using-Arduino-Uno-Soil-Moi/**