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IoT Based Smart Agriculture Monitoring System

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Abstract: *The rapid advancement of Internet of Things (IoT) technology has revolutionized the field of agriculture by enabling efficient and intelligent monitoring systems. This paper proposes an IoT-based smart agriculture monitoring system that incorporates sensors to measure soil quality, temperature, air moisture, and soil moisture. The system utilizes an ARM Cortex microcontroller to gather data from these sensors and performs predictive analysis. The system is designed to address the challenges faced by farmers in monitoring crucial parameters for optimal crop growth. In conclusion, the proposed IoT-based smart agriculture monitoring system offers an efficient and comprehensive solution for monitoring essential parameters in agricultural environments.*

Keywords *– DHT11 Temperature and Humidity sensor, Arm Cortex Rp2040, LCD, pH sensor, Moisture sensor, Predictive analysis, Blynk IOT.*

I.INTRODUCTION

The agricultural sector plays a critical role in sustaining human civilization by providing food, feed, and fiber. In recent years, there has been a growing demand for innovative technologies that can enhance agricultural productivity while ensuring the sustainable use of resources. The Internet of Things (IoT) has emerged as a transformative technology that can revolutionize the way farming is practiced. By integrating IoT devices and sensors into agricultural systems, farmers can monitor various environmental parameters in real-time, make data-driven decisions, and optimize their farming practices. This paper presents an IoT-based smart agriculture monitoring system that incorporates multiple sensors, including a pH sensor for soil quality, a temperature sensor for monitoring temperature, a humidity sensor for measuring air moisture, and a moisture sensor for assessing soil moisture. These sensors are strategically placed in agricultural fields to capture key environmental data. The collected data is then processed and analyzed using an ARM Cortex microcontroller, which enables predictive analysis and generates valuable insights for farmers.

II. MONITORING

Sensors are deployed throughout the agricultural field or greenhouse to collect various types of data. These sensors can measure parameters such as temperature, humidity, soil moisture, light intensity, pH levels, nutrient levels, and more. The sensors continuously collect data from their respective environments. They may be connected to a central gateway or directly to the internetusing wireless protocols like Wi-Fi, Bluetooth, Zigbee, or cellular networks. The collected data is then transmitted to a central serveror cloud platform.

The collected data is transmitted from the sensors to the central server or cloud platform using wireless communication protocols. This allows for real-time or near real-time monitoring of the agricultural environment.

The data received from the sensors is processed and analyzed to extract meaningful insights. This can be done either at the edge (locally, on the device or gateway) or in the cloud, depending on the system architecture and requirements. Data processing techniques like machine learning algorithms or statistical analysis can be applied to identify patterns, anomalies, and trends.

The processed data is presented in a user-friendly format through software applications or web-based dashboards. Farmers or agricultural experts can access these interfaces to monitor the agricultural parameters and make informed decisions. They can also set up alerts or notifications to be notified when certain conditions are met or if any anomalies are detected.

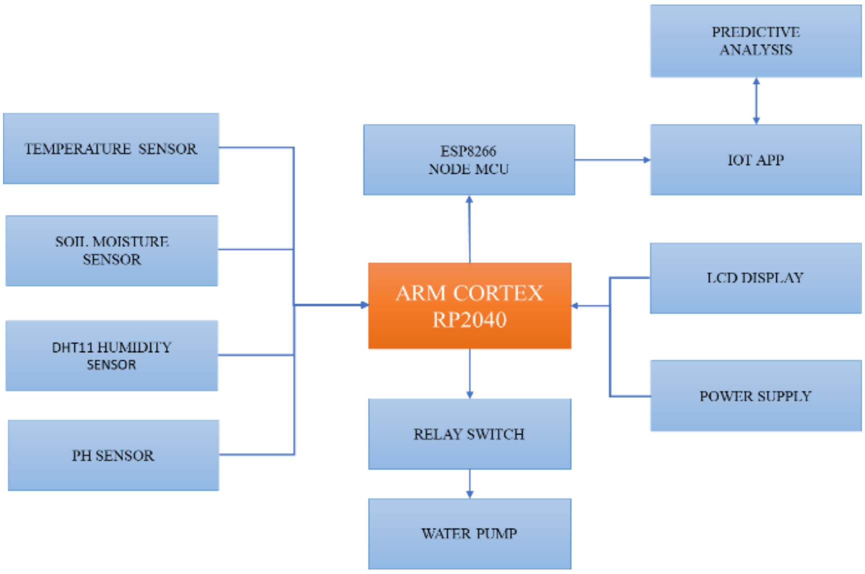
In some cases, the smart agriculture monitoring system may include control and automation capabilities. Based on the collected data and analysis, the system can trigger actions or send commands to actuators or devices. For example, it can automatically adjust irrigation systems, turn on or off certain equipment, or activate shading mechanisms.

III.EXISTING SYSTEM

The existing system described in the provided information utilizes various components and sensors to create an IoT-based agricultural monitoring and irrigation system. The system consists of the following key components: Node MCU ESP8266: This microcontroller is specifically designed for IoT projects and serves as the main control unit for the system. It integrates the ESP8266WiFi SoC software and ESP-12 module's hardware. Soil Moisture Sensor (YL-38): The sensor measures the moisture content in the soil by detecting changes in resistance. It consists of two probes and provides data through its data pin and analog pin. Waterproof Temperature Sensor (DS18B20): This sensor is used to measure the temperature of the soil. It is sealed with stainless steel for protection and communicates temperature data through its data pin. DHT11 Sensor: This sensor measures both temperature and humidity of the surrounding environment. It has three pins (VCC, data, and ground) and collects data related to temperature and humidity. LDR Light Sensor: The light sensor measures the amount of light received by the plants. It changes its resistivity based on light intensity, allowing the system to determine if the plants are receiving sufficient light. SIM800L GSM Module: This module enables the system to send messages to a phone for irrigation control. It operates at a voltage range of 3.4V to 4.4V. Buck-Boost Converter (LM-2587): This converter is used to convert the 9V power supply from an adapter to 5V, providing power to the system. LCD I2C 16x2 Display: The display is used to show the output results of the sensors. It can display 16 characters in 2 lines. Two- Channel 5V Relay Module: This module enables remote control of the water pump and light source over the internet. It can turn them on or off as required. DC Submersible Water Pump: This water pump is utilized to implement the irrigation system in the proposed work.

IV.PROPOSED SYSTEM

Arm Cortex RP2040: This microcontroller serves as the central processing unit of the system. It integrates the Arm Cortex RP2040. ESP8266 Node MCU: This microcontroller serves as the central processing unit of the system. It integrates the ESP8266 WiFi SoC for data processing and wireless connectivity. Temperature Sensor: The temperature sensor measures the ambient temperature of the farm field. It provides real-time temperature data to monitor environmental conditions.



Block Diagram for proposed system

Soil Moisture Sensor: The soil moisture sensor measures the moisture content in the soil. It helps in determining the irrigation needs of the plants by detecting changes in soil moisture levels. Humidity Sensor: The humidity sensor measures the humidity levels in the surrounding environment. It provides valuable data for understanding the moisture content in the air, which can impact plant growth and irrigation requirements. pH Sensor: The pH sensor measures the acidity or alkalinity of the soil. It helps in monitoring the soil's pH level, which is essential for maintaining optimal conditions for plant growth. IoT App with Predictive Analysis: The system includes a smartphone application that allows users to monitor and control the agricultural parameters remotely. The app incorporates predictive analysis capabilities to forecast temperature, humidity, soil moisture, and pH levels, aiding in decision-making for irrigation and crop management. Relay Switch: The relay switch is used to control the water pump. It enables the automation of the irrigation process by turning the water pump on or off based on the sensor readings and user-defined thresholds. Water Pump: The water pump is responsible for delivering water to the plants when irrigation is required. It is controlled by the relayswitch and can be remotely activated or deactivated through the IoT app.

V.WORKING METHODOLOGY

Sensor Deployment: Various sensors are strategically deployed throughout the agricultural field or greenhouse to monitor differentparameters such as temperature, humidity, soil moisture, light intensity, pH levels, nutrient levels, and more. The number and typesof sensors used depend on the specific requirements of the farming operation.

Data Collection: The deployed sensors continuously collect data from their respective environments. The sensors are connected to a central gateway or directly to the internet using wireless communication protocols like Wi-Fi, Bluetooth, Zigbee, or cellular networks. The collected data is transmitted to a central server or cloud platform.

Data Transmission: The collected data from the sensors is transmitted to the central server or cloud platform via the established wireless connectivity. This data transmission can occur in real-time or at regular intervals, depending on the system requirements and the frequency of data updates.

Data Processing and Analysis: Once the data is received, it undergoes processing and analysis. This can take place either at the edge (on the device or gateway) or in the cloud. Data processing techniques such as statistical analysis, machine learning algorithms, or predictive models may be applied to extract meaningful insights and identify patterns, anomalies, or trends.

Visualization and Reporting: The processed data is presented in a user-friendly format through software applications or web-based dashboards. This allows farmers or agricultural experts to monitor and analyze the agricultural parameters in real-time. The system may provide visualizations, charts, graphs, and reports to help users understand the data more effectively.

Alerts and Notifications: The smart agriculture monitoring system can be configured to generate alerts or notifications based on specific conditions or thresholds. For example, farmers can receive alerts when the soil moisture drops below a certain level, the temperature exceeds a specified range, or there is a deviation from the optimal conditions.

Decision-Making and Automation: The collected data and insights enable farmers and agricultural professionals to make informed decisions. They can take actions based on the monitored parameters, such as adjusting irrigation schedules, applying fertilizers, managing pests, or initiating preventive measures. In some cases, the system may also support automation, where it can trigger actions or send commands to actuators or devices to control irrigation systems, ventilation, lighting, or other equipment.

VI.PREDICTIVE ANALYSIS

Predictive analysis is a powerful tool in an IoT-based smart agriculture monitoring system, enabling farmers to make informed decisions and plan for the future. By analyzing historical and real-time data, the system can uncover valuable insights and predict future outcomes. Through the use of machine learning algorithms and statistical models, the system can identify patterns, correlations, and trends in crop performance, weather patterns, soil conditions, and other relevant factors. This allows for accurate yield predictions, helping farmers plan harvesting, storage, and distribution activities. Additionally, predictive analysis aids in disease and pest outbreak detection, enabling early intervention and minimizing crop damage. By optimizing irrigation practices based on predicted water needs, farmers can ensure efficient water usage and crop health. Moreover, nutrient management can be enhanced by predicting the optimal timing and dosage of fertilizers. Risk assessment and management are also improved, as the system can predict potential risks such as droughts or market fluctuations, allowing farmers to implement mitigation strategies. Overall, predictive analysis empowers farmers with actionable insights, enhancing productivity, sustainability, and profitability in smart agriculture.

VII.ADVANTAGES

- Real-time monitoring
- Data-driven Insights
- Optimal Resource Management

- Automation and Efficiency
- Remote Access and Control
- Flexibility and scalability

VIII.APPLICATIONS

- Crop Monitoring
- Environmental Monitoring
- Irrigation Management
- Pest and Disease Management
- Livestock Monitoring
- Yield Prediction and Planning
- Supply Chain Management
- Decision Support and Analytics

IX.CONCLUTION

IoT will help to enhance smart farming. Using IoT the system can predict the soil moisture level and humidity so that the irrigation system can be monitored and controlled. IoT works in different domains of farming to improve time efficiency, water management, crop monitoring, soil management and control of insecticides and pesticides. This system also minimizes human efforts, simplifies techniques of farming and helps to gain smart farming. Besides the advantages provided by this system, smart farming can also help to grow the market for farmer with single touch and minimum effort.

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