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IOT Based Crop Management System: A Review

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Abstract: The IoT-Based crop monitoring System is a cutting-edge solution designed to enhance agricultural productivity and efficiency by utilizing sensor technology and automation. The core objective is to automate the irrigation process based on real-time soil moisture data. The systememploysanESP8266 module to facilitate the seamless exchange of data between various sensors and Firebase, a real-time cloud database. This interconnected system comprises two primary fields, each equipped with soil and soil moisture sensors, temperature sensors, smoke detectors, UV light, buzzer, solenoid valves, and mini water pump. The ESP8266 module serves as the central hub for collecting data from the sensors and transmitting it to the Firebase database. The data includes crucial information such as soil moisture levels, temperature, smoke detection, and UV light intensity. Furthermore, the system integrates alarm functionality through the buzzer and precise irrigation control via the solenoid valve and mini water pump. The data stored in Firebase is accessible through a web application built using React.js and Node.js. This web interface provides users with a graphical representation of the gathered data, allowing them to monitor the agricultural conditions in real-time. Users can view historical data trends, set thresholds, and receive alerts in case of unfavorable conditions, such as low soil moisture levels or unusual temperature fluctuations. The main key features are Data Visualization in which users can remotely monitor soil moisture levels and receive real-time updates on crop conditions through a web application. User Control in this the system allows users to adjust moisture thresholds and irrigation schedules, providing flexibility and customization. Resource Efficiency by automating irrigation, this model optimizes water usage, reducing waste and improving water conservation. This paper not only showcases the integration of IoT technology in agriculture but also serves as a practical and environmentally responsible solution for modern farming practices.

Keyword: IoT(Internet Of Things), Automation Sensor, Data Visualization.

I. Introduction

Agriculture has been the backbone of human civilization for millennia, and its sustainability and efficiency are critical for ensuring food security in an ever-growing global population. To address the challenges faced by modern agriculture, there is a pressing need to integrate cutting-edge technology and data-driven approaches. The "IoT-Based Agriculture Management System with ESP8266 and Firebase Integration" project emerges as a groundbreaking solution to enhance agricultural productivity and resource management. The ESP8266 module serves as the central hub for collecting data from the sensors and transmitting it to the Firebase database. The data includes crucial information such as soil moisture levels, temperature, smoke detection, and UV light intensity. Furthermore, the system integrates alarm functionality through the buzzer and precise irrigation control via the solenoid valve and mini water pump. This project focuses on harnessing the power of the Internet of Things (IoT) to create a smart and efficient agricultural ecosystem. At its core, the system utilizes the ESP8266 module as a bridge between various sensors and Firebase, a real-time cloud database. The integration of multiple sensors, including soil moisture, temperature, smoke, and UV light, along with actuators like buzzers, solenoid valves, and mini water pump, forms the foundation of an intelligent agricultural infrastructure. The system operates in two distinct agricultural fields, each equipped with a suite of sensors and actuators tailored to the specific needs of the crops grown. By continuously monitoring key environmental parameters such as soil moisture, temperature, and UV light intensity, the system enables precision agriculture practices. This includes automated irrigation control, real-time alerts for adverse conditions, and the ability to take immediate corrective actions. The heart of this project lies in the seamless connectivity between the ESP8266 module and Firebase. All data collected by the sensors is transmitted in real-time to the Firebase database, which serves as the central repository for agricultural information. This data is then made accessible through a web application developed using React.js and Node.js. The web application provides an intuitive graphical interface for users to visualize and analyze the data, enabling informed decision-making and proactive management.

II. LITERATURE

Crop monitoring system serves as a crucial means of analysis and control for cultivation of crops in proper manner. As advancements in technology and education continue, there is a growing interest in developing farming systems where software and hardware merged together to maximize the crop growing methodology. The crop monitoring system is an IOT based method which is a combination of various sensors integrated with mobile application software. ESP8266 is a microcontroller which read the data from sensors and transmit it to the mobile application with the help of Wi-Fi module. This literature review focuses on examining existing research that explores the application of IOT based method which is a combination of various sensors integrated with web application software. The process involves utilizing IOT to maximize better crop growing techniques, with many studies automation sensors, including data visualization to analyse the statistical data in the web application. These studies aim to assign appropriate data visualization techniques for visualizing the data from the automation sensors, although it often face challenges in accurate visualization of data. To build robust and accurate crop monitoring module, a substantial amount of data is essential. Addressing the complex problem of monitoring system, various research methods can be categorized into two groups: visualization- based techniques and sensor-based techniques.

1. “Integration of Farm Financial Accounting and Farm Management Information Systems for Better Sustainability Reporting” by Krijin Poppe states that how the increasing need for sustainability reporting could be met by better use and integration of data flows at the farm. A dashboard with key performance indicators on the sustainability performance of a farm integrates farm financial accounting and farm management information. FFAs and FMISs operate on different levels of granularity.
2. “A comparative study of deep learning and Internet of Things for precision agriculture” by T. Saranya. The work describes the IoT architecture and analyzes sensor categorization, agriculture sensors, and unmanned arial vehicles (UAVs) used in recent research. Besides that, data acquisition, annotation, and augmentation for agriculture datasets were covered, and a few widely

used datasets were listed. This work also discusses some challenges and issues that DL and IoT face.

3. "Smart Agricultural Management using IoT Based Automation Sensors" by T. Veeramakali, predict and measure the necessary values our suggested model is collaborated with different sensors including humidity, temperature etc. Our model supports smart irrigation and warehouse management. Monitoring all the stocks becomes our system's major responsibility

III. METHODOLOGY

1. **Project Initiation:**
   - Define the project scope and objectives, including the specific agricultural fields to be covered and the types of crops to be monitored.
   - Identify the stakeholders, including farmers, agricultural experts, and technical team members.
   - Establish a project timeline and budget.

2. **Requirement Analysis:**
   - Conduct a thorough analysis of the agricultural requirements, considering factors such as soil type, crop varieties, and local climate conditions.
   - Determine the types and quantities of sensors required for each field.
   - Collect input from farmers and agricultural experts to tailor the system to their needs.

3. **Hardware Selection and Acquisition:**
   - Select appropriate sensors for soil moisture, temperature, UV light, smoke detection, and other relevant parameters.
   - Choose an ESP8266 module or microcontroller for data collection and transmission.
   - Procure actuators like solenoid valves and mini water pumps.
   - Ensure the selected hardware components are compatible and meet project requirements.

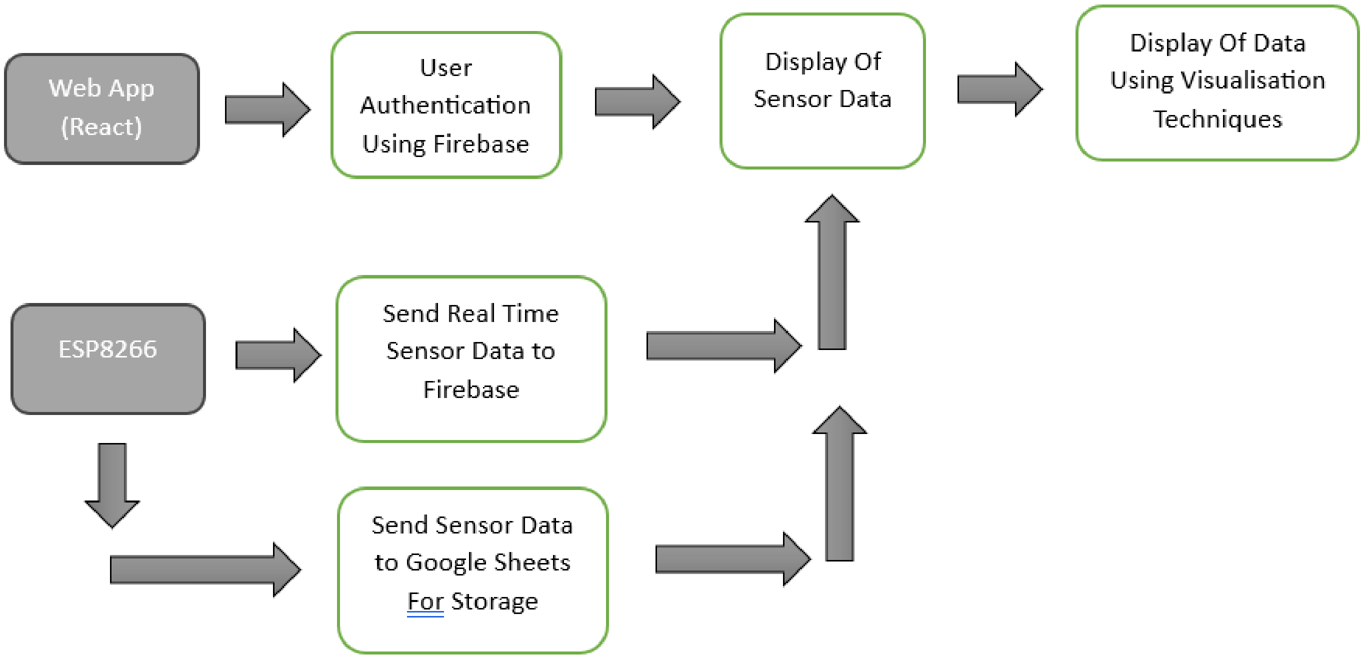
4. **Sensor Deployment:**
   - Install sensors in the designated agricultural fields, taking into account their optimal placement for accurate data collection.
   - Establish a reliable power source for the sensors, considering solar panels or battery options for remote locations.
   - Connect sensors to the ESP8266 module, ensuring proper wiring and communication protocols.
5. **Software Development:**
   - Develop firmware for the ESP8266 module to collect data from sensors and transmit it securely to Firebase.
   - Create a Firebase project and set up the database structure to store sensor data.
   - Build a web application using React.js and Node.js to provide a user interface for data visualization and control.
   - Implement data visualization components, including graphs and charts, for users to monitor agricultural conditions.

6. **Data Integration:**
   - Establish communication between the ESP8266 module and Firebase to ensure seamless data transmission.
   - Develop mechanisms to synchronize sensor data with the cloud database in real-time.
   - Implement security measures to protect sensitive data during transmission and storage.

7. **User Interface Development:**
   - Design an intuitive and user-friendly web interface for the agriculture management system.
   - Incorporate features for setting thresholds, customizing alerts, and controlling actuators.
   - Ensure responsive design for access on various devices, including smartphones and tablets.

8. **Testing and Validation:**
   - Conduct rigorous testing of the entire system, including sensors, data transmission, Firebase integration, and the web application.
   - Verify that sensor readings accurately reflect the field conditions.
   - Test the system's ability to send alerts and control actuators based on predefined thresholds.

9. **User Training:**
   - Provide training to farmers and agricultural stakeholders on how to use the system effectively.
   - Educate users on interpreting sensor data and making informed decisions for irrigation and crop management.



System Process

IV. CONCLUSION

Our Farming Management System represents a groundbreaking solution that addresses the dual challenges of electricity efficiency and Moisture management in Farms. By seamlessly integrating IoT automation for energy conservation and tracking into a unified web application, we have streamlined operations and enhanced the Farming and Croping experience. This project embodies our commitment to modernizing Farming while maintaining a strong focus on ensuring a responsible and sustainable approach to the implementation of Modern Farming.

V. Acknowledgment

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