Iot based smart agriculture using esp32

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Abstract: Water plays a crucial role in human life, with around 80% to 90% of it being utilized in agriculture. However, with the increasing effects of globalization and population growth, water consumption is on the rise. This poses a challenge for every country to reduce agricultural water consumption while still providing fresh and healthy food. Automation has become essential in modern life, offering not just convenience but also energy efficiency and time-saving benefits. In today's world, changes in temperature, humidity, and rainfall are significant factors affecting agricultural processes. Sensors are employed to detect these changes and send signals to devices like the ESP32 microcontroller. However, traditional automation and control machines used in industries are often expensive and not well-suited for agricultural settings. To address this gap, we propose a smart irrigation technology based on IoT using Raspberry Pi. This system can automatically control water motors and monitor plant growth using a webcam. With the Raspberry Pi serving as the central component, users can access live farm streaming on their mobile phones via a suitable application and Wi-Fi network. By leveraging IoT and affordable hardware like Raspberry Pi, this solution offers a cost-effective and efficient way to manage water resources in agriculture while ensuring optimal plant growth

Keywords :- esp32, soil moisture sensor, pir sensor, temperature sensor, lcd display, relay, 9v dc motor, buzzer, battery.

I. INTRODUCTION

This paper aims to provide insights into constructing a robust framework for field operations that is simple for farmers to use. One of the primary areas of ongoing IoT-based research and product development, contributing to smarter and more efficient activities for better agricultural production, is agriculture itself. The agricultural sector holds significant importance globally for ensuring food security. In India, farmers face considerable challenges, including farm size, access to technology, trade issues, government policies, and climate conditions. To address these challenges, innovative solutions are essential. One such solution involves leveraging IoT technology to enhance irrigation systems. By implementing wireless sensor networks, farmers can monitor their crops and automate irrigation processes. These sensor nodes continuously collect data from the crop fields and transmit it to a coordinator node, which then makes decisions regarding irrigation based on field conditions. This approach has shown promising results, with a significant reduction in water usage compared to traditional and other modern irrigation methods. Additionally, security measures can be implemented using effective key management mechanisms within the IoT application. Overall, by integrating IoT technology into agriculture, farmers can improve irrigation efficiency, reduce crop wastage, and increase crop productivity

II. OBJECTIVES

1. An agricultural monitoring system displays soil moisture levels, temperature, and humidity levels.
2. Phone notifications alert users to temperature changes, pest detection, soil moisture levels, and humidity.
3. Pump automation is triggered based on these alerts.
4. The system minimizes the need for human intervention

III. BLOCK DIAGRAM

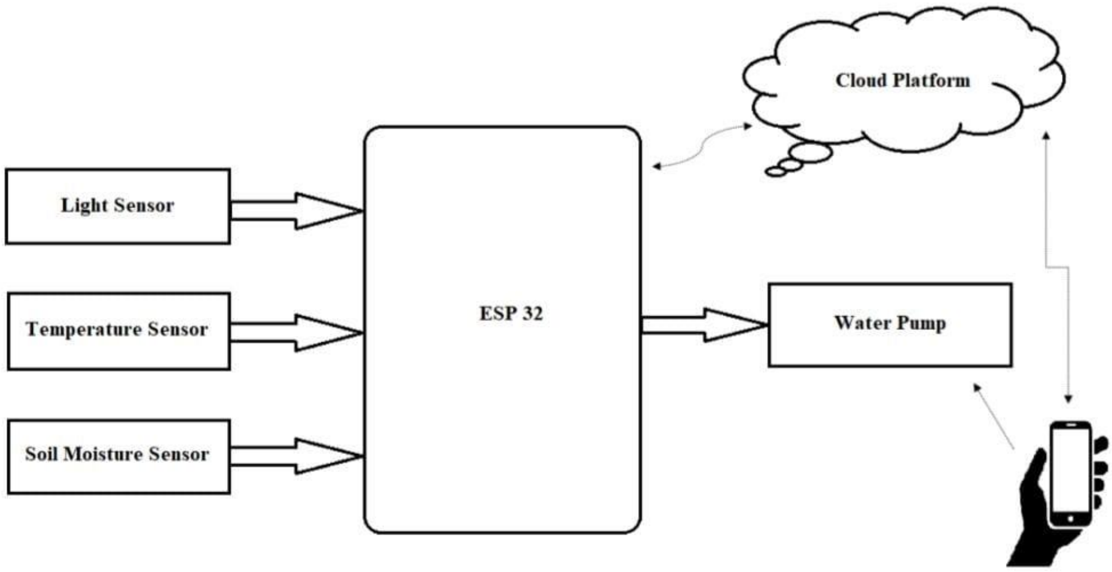

Fig- block diagram

The proposed model integrates both hardware and software components to create a smart irrigation system. Hardware components include various sensors such as DHT22, soil moisture sensor, and pH sensor, along with an ESP32 microcontroller for processing. These sensors enable live monitoring of farmland conditions, while a water pump powered by a 9V battery facilitates smart irrigation, conserving water resources.

On the software side, the ESP-IDF platform on VS Code is used to implement desired functionalities, while Thing Speak cloud service enables viewing sensor data on smartphones. The system architecture, depicted in Figure 1, encompasses all these components.

To facilitate communication between devices, a master-slave configuration is employed using two ESP32s. One ESP32 acts as a client (master), while the other serves as a server (slave). Utilizing the ESP-BLE-Mesh vendor model, wireless BLE communication is established between the two ESP32s. Sensors are connected to the slave ESP32, which collects sensor data and transmits it to the client ESP32 via BLE. The client ESP32 then uploads this data to the Thing Speak cloud, providing graphical representation for easy analysis.

The implementation of the smart irrigation system allows for automatic activation of the water pump based on soil moisture content. Threshold values are set based on the specific crop planted, and when sensor readings fall below these thresholds, the pump is activated to irrigate the field. Once the desired moisture level is reached, the pump is automatically switched off, enabling efficient water usage.

The combination of sensor and wireless networks creates a complex yet effective system. The BLE connectivity between master and slave ESP32s enables bidirectional data transmission, creating a full-duplex communication model. Additionally, the master ESP32's Wi-Fi connectivity facilitates data transfer to the Thing Speak cloud, enabling remote access to farmland conditions via smartphones, utilizing IoT technology.

IV. FLOW CHART

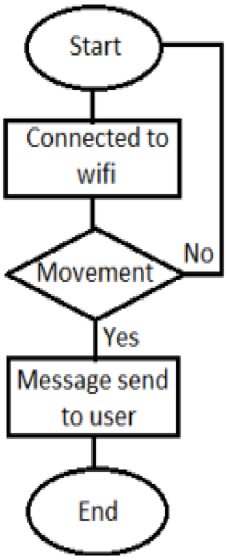

Fig-flow chart

STEP 1: start the process;
STEP 2: connected to wi fi;
STEP 3: read temperature, humidity, soil and ph;
STEP 4: get temperature, humidity, soil and ph values from analog pins;
STEP 5: send data to cloud;
STEP 6: delay to 10 seconds;
STEP 7: repeat step 4, 5 & 6 until the process end;
STEP 8: end;

V. HARDWARE MODEL

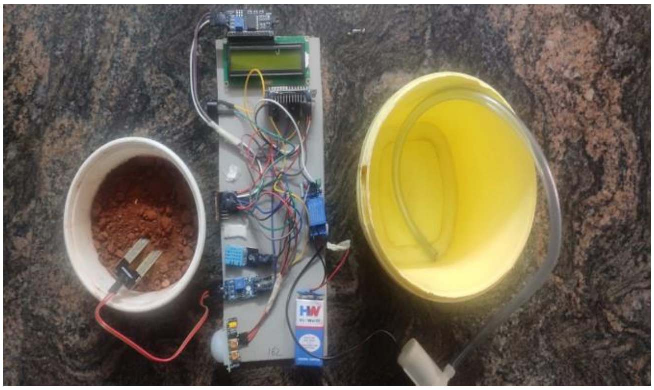

Fig - prototype of the proposed system

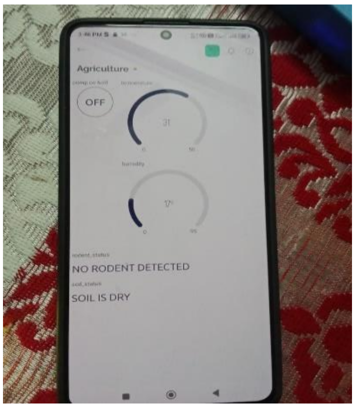

Fig 7.2 notifications received in phone

1. Accurate data regarding light intensity, soil moisture percentage, and temperature based on current environmental conditions are presented individually.
2. Data feeds are showcased on Adafruit IO dashboards and can also be monitored on subscribed smartphones.
3. The motor activates and deactivates automatically according to pre-set threshold values programmed based on soil moisture percentages in the source code.
4. Results obtained during experimentation align satisfactorily with prevailing environmental conditions.
5. The IoT-based Smart Irrigation System utilizing ESP32 offers several advantages over existing systems, particularly due to its low implementation cost. Additionally, integration with Raspberry Pi can enhance its capabilities, enabling monitoring of larger cultivatable areas.

VI. CONCLUSION

IoT plays a crucial role in advancing smart farming practices. By leveraging IoT technology, the system can accurately predict soil moisture levels and humidity, enabling precise monitoring and control of the irrigation system. IoT implementation spans various domains within farming, enhancing time efficiency, optimizing water management, facilitating crop monitoring, improving soil management, and enabling precise control of insecticides and pesticides. Additionally, this system reduces human labor, simplifies farming techniques, and fosters the transition to smart farming practices. Beyond its direct advantages, smart farming initiatives can expand market opportunities for farmers by streamlining processes with minimal effort and a single touch interface.

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