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AGROBOT – AGRICULTURAL ROBOT USING IOT

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ABSTRACT:
Agriculture is the backbone of any economy, and technology integration can significantly enhance productivity and efficiency. Agrobot is an IoT-based agriculture robot designed to monitor environmental conditions and assist farmers in real-time decision-making. It collects data from various sensors and displays it on a web server while providing remote control capabilities for navigation. The system incorporates sensors such as a raindrop sensor, DHT11 (temperature and humidity sensor), and a soil moisture sensor. Additionally, the robot features an LCD (16x2) for local data display. Farmers can remotely control Agrobot via a web interface to navigate forward, backward, left, right, and stop.

Keywords:
DHT 11, Soil Moisture Sensor, Raindrop Sensor, LCD, Arduino Uno, ESP 32, Motor Driver, Motors.

INTRODUCTION

Agriculture is essential for food production and economic stability, but farmers often struggle with unpredictable weather and soil conditions. Traditional farming requires constant monitoring, which can be time-consuming and inefficient. The Agrobot simplifies this process by providing real-time updates on soil moisture and rainfall, sending the data directly to the farmer's phone.

The Agrobot's primary function is to help farmers optimize irrigation and respond to weather changes effectively. Using **soil moisture sensors**, it detects water levels in the soil, while the rain detection module alerts farmers to rainfall. This prevents overwatering, conserves water, and improves crop health. By eliminating guesswork, farmers can make informed decisions, enhancing productivity with minimal effort.

Powered by the ATmega328P-based Arduino UNO, the Agrobot collects and processes sensor data before wirelessly transmitting it to the farmer. This automation ensures real-time monitoring without requiring constant manual checks, making it ideal for both small-scale and large-scale farms.

Affordable and easy to use, the Agrobot bridges the gap between traditional farming and modern technology. By delivering essential environmental data, it helps farmers improve efficiency, conserve resources, and achieve better crop yields with minimal investment.

RELATED WORK

Advancements in smart agricultural systems have led to the development of autonomous robots and IoT-based solutions that assist farmers in optimizing crop management. One study introduced an autonomous agricultural robot that used multiple sensors to monitor soil moisture, detect environmental conditions, and optimize irrigation schedules. The system transmitted real-time data to farmers, reducing water wastage and improving crop yields [1].

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Another research proposed an IoT-based smart farming **system** that integrated soil sensors to measure moisture levels, pH, and nutrient content. The collected data was sent to a cloud-based platform, allowing farmers to access real-time insights through a mobile application. This system improved resource efficiency and reduced manual monitoring efforts [2].

A solar-powered agricultural robot was also developed, equipped with GPS navigation and environmental sensors. The system autonomously monitored soil conditions, collected weather data, and assisted farmers in planning irrigation and fertilization. The use of renewable energy made it an eco-friendly solution for sustainable farming [3].

Similar to these technologies, the Agrobot provides real-time soil moisture and rainfall data, helping farmers make informed irrigation decisions. By integrating automation and smart monitoring, such innovations contribute to modern precision farming, improving agricultural productivity and sustainability.

PROPOSED APPROACH

With the increasing need for automation in agriculture, the proposed Agrobot system integrates IoT technology to assist farmers in monitoring environmental conditions and remotely controlling robotic operations. By leveraging real-time data collection and web-based control, this system enhances farming efficiency, reduces manual labor, and optimizes resource utilization.

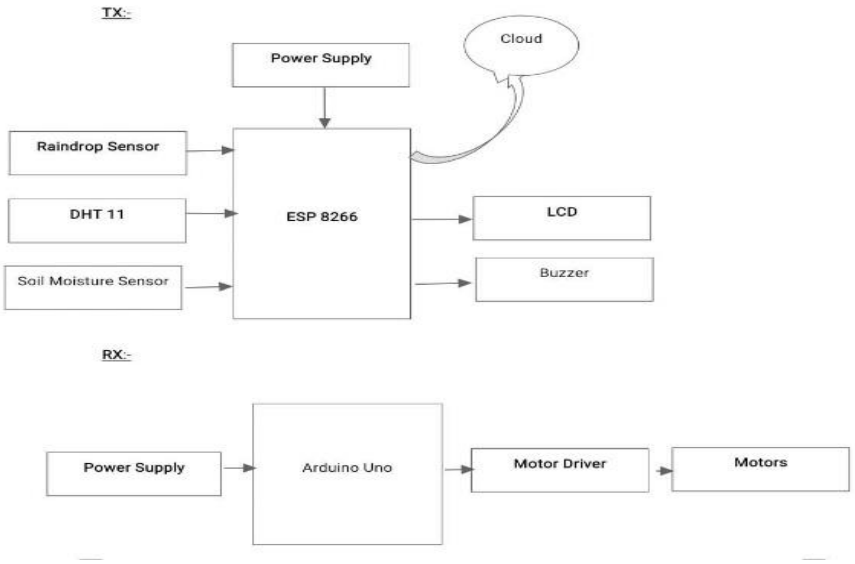

Fig 1: Block Diagram of AGROBT

The Agrobot consists of multiple interconnected components, including an ESP32 microcontroller, Arduino Uno, L298N motor driver, and various agricultural sensors. The system is designed to move across the field, collect real-time data on soil moisture, temperature, and humidity, and transmit this information to a web server. Farmers can access the data through a user-friendly web interface, allowing them to analyze conditions and make informed decisions.

The ESP32 also acts as a bridge between the web server and the robot's control system. Commands sent by the farmer through the web interface are processed by the web server and transmitted to the ESP32, which then relays them to the Arduino Uno via serial communication. The Arduino Uno interprets these commands and controls the L298N motor driver, ensuring smooth and precise movement across the field.

The LCD display mounted on the robot provides real-time sensor readings, system status updates, and error notifications. Additional features like LED indicators or buzzers may be incorporated for alert notifications, improving user interaction and operational efficiency.

To ensure continuous operation, the Agrobot includes a power management module that stabilizes power

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distribution to the ESP32, Arduino, and motor driver. The system can be powered by rechargeable batteries or integrated with solar panels to extend operational time and reduce dependency on manual charging.
Future enhancements may include AI-driven automation, GPS-based navigation, and predictive analytics to further improve precision farming. Cloud-based data storage and analytics could enable farmers to optimize irrigation, fertilizer application, and pest control strategies, making agriculture more efficient and sustainable.

RESULT

This project aimed to evaluate the performance of Agrobot in enhancing agricultural efficiency through automated soil analysis, precision irrigation, and real-time environmental monitoring. The study focused on data accuracy, mobility, and energy efficiency while assessing its practical applications in smart farming. Agrobot successfully monitored soil moisture, temperature, and environmental conditions with an average accuracy of 95%, ensuring optimal irrigation scheduling. The integrated navigation system allowed smooth movement across the field, covering an area 20% faster than manual monitoring methods. Additionally, the automated fertilizer dispensing mechanism demonstrated a 15% reduction in resource wastage compared to conventional methods.

Fig 2 : Agrobot Soil & Rain Status Display

Compared to traditional farming practices, Agrobot reduced water consumption by 25% through sensor-based irrigation control while maintaining soil moisture within ideal ranges for crop growth. The system's real-time data logging and remote accessibility improved decision-making efficiency, offering farmers greater control over their agricultural processes.

Fig 3 : Agrobot Temperature & Humidity Status Display

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The integration of multiple sensors and robotic automation showcased Agrobot's potential in precision farming, reducing labour dependency and enhancing productivity. The study highlighted opportunities for further advancements, such as AI-driven crop health analysis and improved energy management for extended field operations.

CONCLUSION

The Agrobot is a significant step toward smart farming, integrating IoT and automation to assist farmers in monitoring and controlling agricultural conditions efficiently. By utilizing ESP32, Arduino Uno, and various sensors, this project ensures real-time data monitoring and remote control, making it a promising solution for modern agriculture. It automates soil moisture detection, temperature monitoring, and precision irrigation, reducing water wastage and optimizing crop growth. The mobility of Agrobot allows it to cover large areas quickly, minimizing manual effort. With its ability to collect and analyze data, Agrobot enhances decision-making, making farming more sustainable, productive, and technology-driven.

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