

Design of a Multipurpose Autonomous Robot for Intelligent Agricultural Systems

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ABSTRACT: This project proposes an automated system for both seeding and irrigation in agriculture to reduce labour cost and improve efficiency without affecting soil quality. The system uses an Arduino Uno as the main control unit, with ultrasonic sensors for obstacle detection and soil moisture sensors to monitor soil conditions. A robotic mechanism with a funnel-like arrangement is used to perform accurate and efficient seeding operations. Additionally, the system is enhanced with IoT technology, enabling real-time monitoring of soil moisture levels and system status through a cloud platform or mobile application. This allows farmers to control irrigation remotely and receive updates, ensuring optimal water usage and improved crop productivity. Overall, the proposed system provides a smart, cost-effective, and scalable solution for modern agriculture.

KEYWORDS: Arduino UNO, Soil Moisture Sensor, Digital Humidity And Temperature, Agriculture Robot

1. INTRODUCTION

With the rapid growth of the global population, the demand for food production is expected to increase significantly, with estimates suggesting a 70% rise by 2050. At the same time, challenges such as shrinking agricultural land, limited freshwater resources, and declining crop yields are putting pressure on the farming sector. Additionally, the reduction in agricultural labor in many regions has made traditional farming practices less sustainable. To address these issues, the adoption of IoT-based solutions in agriculture has become essential. These

technologies help farmers improve productivity, profitability, and sustainability by enabling precision agriculture. Through the use of sensors, smart devices, and wireless communication, farmers can efficiently monitor soil conditions, optimize the use of water and fertilizers, and automate farming operations, thereby reducing costs and minimizing reliance on manual labor.



Fig 1. IoT based smart agriculture will be the future

Smart farming using IoT technologies improves agricultural productivity by reducing waste and optimizing the use of resources such as water, fertilizers, and energy. It utilizes sensors to monitor key environmental factors like soil moisture, temperature, humidity, and crop health in real time. Farmers can access field data remotely and choose between manual or automated control for irrigation and other operations. When soil moisture drops, the system can automatically trigger irrigation to maintain optimal crop conditions. Advanced technologies such as drones, robotics, crop monitoring, spraying, and field management. Data collected from sensors helps in predicting yield, improving planning, and enhancing overall farm efficiency. Overall, IoT-based smart farming transforms traditional agriculture into a more intelligent, efficient, and data-driven system.

2.LITERATURE SURVEY

Williams and Brown (2020) developed an open-source energy monitoring platform

utilizing ESP-32 microcontrollers and cloud-based analytics, demonstrating the feasibility of low-cost, DIY approaches to residential energy management. Their platform has been adopted by thousands of users worldwide, validating the democratization potential of accessible IoT technologies.

Ibrahim and Abdullah (2021) explored DHT11 sensor applications in smart home climate control systems, validating measurement accuracy and response characteristics for temperature and humidity monitoring in residential environments. Their calibration methodologies and error analysis provided practical guidelines for sensor deployment and data interpretation.

3. PROPOSED SYSTEM

The farm monitoring system integrates both hardware and software components to enable efficient agricultural management. The hardware includes an Arduino Uno microcontroller along with sensors such as temperature, humidity, and soil moisture sensors, which continuously collect environmental data. This data is processed by the Arduino and can be monitored through the Arduino IDE. An ESP8266 Wi-Fi module is connected to provide IoT functionality, allowing the collected data to be transmitted to a cloud platform or mobile application. The system updates farmers at regular intervals (e.g., every 10

seconds) about field conditions, enabling real-time monitoring. Overall, this system combines sensors, a microcontroller, and wireless communication to support smart and automated farming practices.

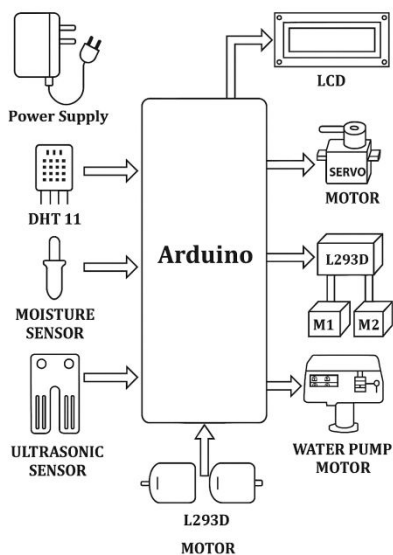


Fig 2: Block Diagram

The proposed system uses Arduino, sensors, and IoT modules to continuously monitor soil moisture, temperature, and humidity for smart agricultural automation. Based on real-time sensor data, the system automatically controls the water pump to ensure efficient drip irrigation and water conservation. It also integrates an autonomous seeding robot that navigates using ultrasonic sensors to perform uniform seed distribution without human intervention. IoT connectivity enables remote monitoring and alerts, making the system more efficient, user-friendly, and suitable for precision farming.

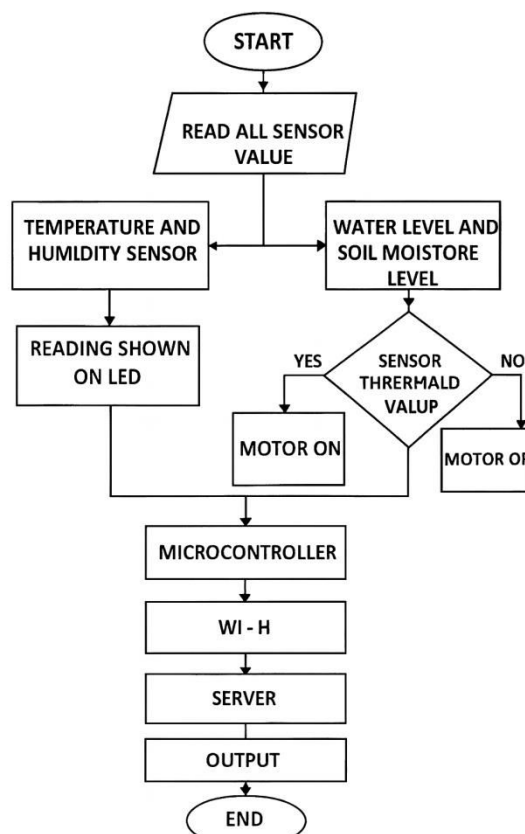


Fig 3: Flow Chart

4. RESULTS AND DISCUSSION

The developed system effectively monitored soil moisture, temperature, and humidity to enable accurate automated irrigation decisions. The drip irrigation and seeding mechanisms worked efficiently, ensuring proper water usage and uniform seed placement with minimal human intervention. Overall, the system improved precision agriculture by enhancing resource efficiency, reducing wastage, and increasing crop productivity.

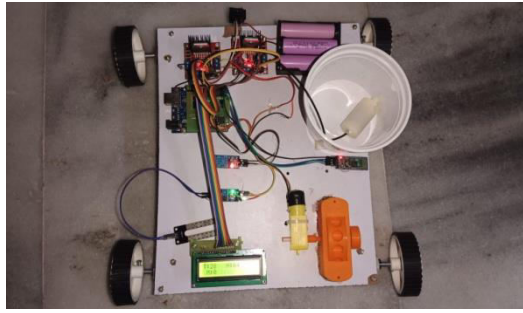


Fig 4 : Hardware Implementation

The agriculture robot uses Arduino Uno to control DC motors, seeding mechanism, and soil moisture sensors for automated farming tasks. It monitors soil conditions and automatically activates irrigation when needed, while the LCD displays real-time system status and sensor data.

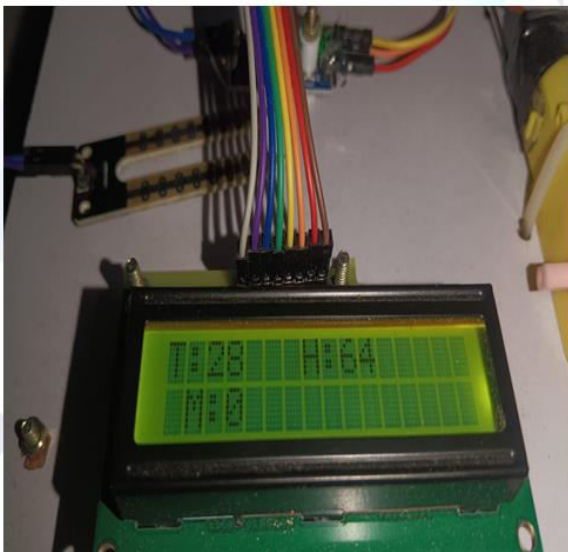


Fig 5: Display the Values on LCD

The Liquid Crystal Display is used in this project to display information to the user. It shows important data such as sensor readings and system status. The LCD is connected to the Arduino Uno to receive and display the output.

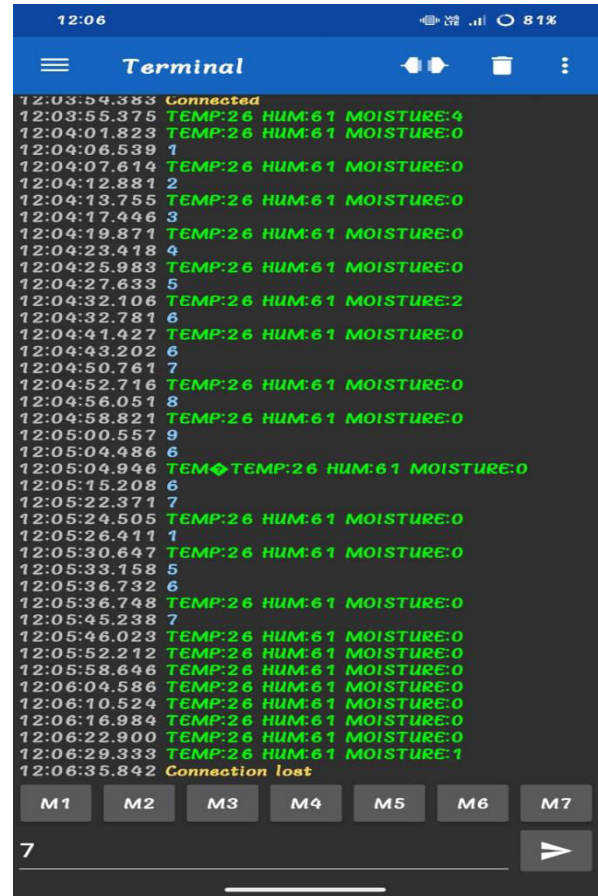


Fig 6: Upload IoT Data

5. CONCLUSION

The developed Agrobot significantly reduces human effort and dependency on manual labor, addressing issues such as labor shortage and high costs in traditional farming. It improves agricultural efficiency by enabling accurate and uniform seed planting while simplifying complex farming tasks. Being cost-effective and eco-friendly, the robot produces no pollution and is well-suited for small and medium-scale farming, with the possibility of deploying multiple units for larger fields.

FUTURE SCOPE:

The system can be enhanced by integrating advanced sensors, Artificial Intelligence, and image processing to improve accuracy and performance on uneven terrains. Additionally, incorporating GSM or IoT technology can enable real-time monitoring and notifications, allowing farmers to track the robot's operational status remotely.

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