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Smart Irrigation System using IoT

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ABSTRACT: The increasing demand for sustainable agriculture and efficient water usage has driven the innovation of smart irrigation systems. This paper presents a Smart Irrigation System powered by Internet of Things (IoT) technology, aimed at automating the irrigation process using real-time soil moisture and weather data. The system leverages a combination of sensors, microcontrollers, cloud services, and mobile applications to monitor and control irrigation activities remotely. It ensures efficient water management, reduces manual intervention, and improves crop yield. The proposed system demonstrates the potential of IoT in transforming traditional farming into a data-driven, eco-friendly process.

KEYWORDS: Smart Irrigation, IoT, Soil Moisture Sensor, Automation, Agriculture, Water Conservation.

I. INTRODUCTION

Agriculture consumes nearly 70% of global freshwater resources. Traditional irrigation systems, which often rely on fixed schedules or human intuition, lead to overwatering or underwatering, contributing to water wastage and lower crop productivity. Climate change and water scarcity have made efficient irrigation an urgent priority.

This paper presents a Smart Irrigation System based on IoT technologies that monitors soil moisture and environmental parameters in real time. The system automates the irrigation process, ensuring that water is supplied only when necessary, thereby promoting water conservation and improved crop health.

II. LITERATURE SURVEY

Several IoT-based irrigation systems have been proposed:

1. IoT-Based Smart Irrigation System – Shweta Potdar et al. demonstrated integration of soil moisture sensors with cloud systems for automated control.
2. Automated Irrigation Using GSM and Arduino – S.K. Nayak et al. used GSM communication; this can be improved with Wi-Fi-based IoT systems for better range and scalability.
3. Real-time Agricultural Monitoring – T. Rajkumar et al. focused on live monitoring and decision-making using sensors.

Our system builds on these approaches by incorporating cloud analytics, mobile alerts, and modular design.

III. PROPOSED SYSTEM

The system is composed of:

- Sensor Node: Soil moisture, temperature, and humidity sensors collect environmental data.
- Controller Node: An ESP32 microcontroller processes sensor data and controls actuators.
- Communication Module: Wi-Fi-based connectivity transmits data to the cloud.

- Cloud Platform: Firebase stores data and supports remote control logic.
- Mobile Application: Allows real-time monitoring and manual overrides.

Features:

- Real-time soil and weather monitoring
- Automated and remote irrigation control
- Mobile notifications
- Cloud data storage and analytics

IV. METHODOLOGY

The irrigation system operates in the following flow:

1. Sensors gather data on soil moisture and weather.
2. ESP32 microcontroller processes the readings and decides whether irrigation is needed.
3. If moisture is below threshold, the water pump is activated.
4. Data is uploaded to Firebase, and mobile app alerts the farmer.
5. Actuation and control history is logged for analysis.

UML diagrams, flowcharts, and data flow diagrams illustrate the architecture and operational logic in detail (see Appendix).

Experimental Results

Fig 1.2

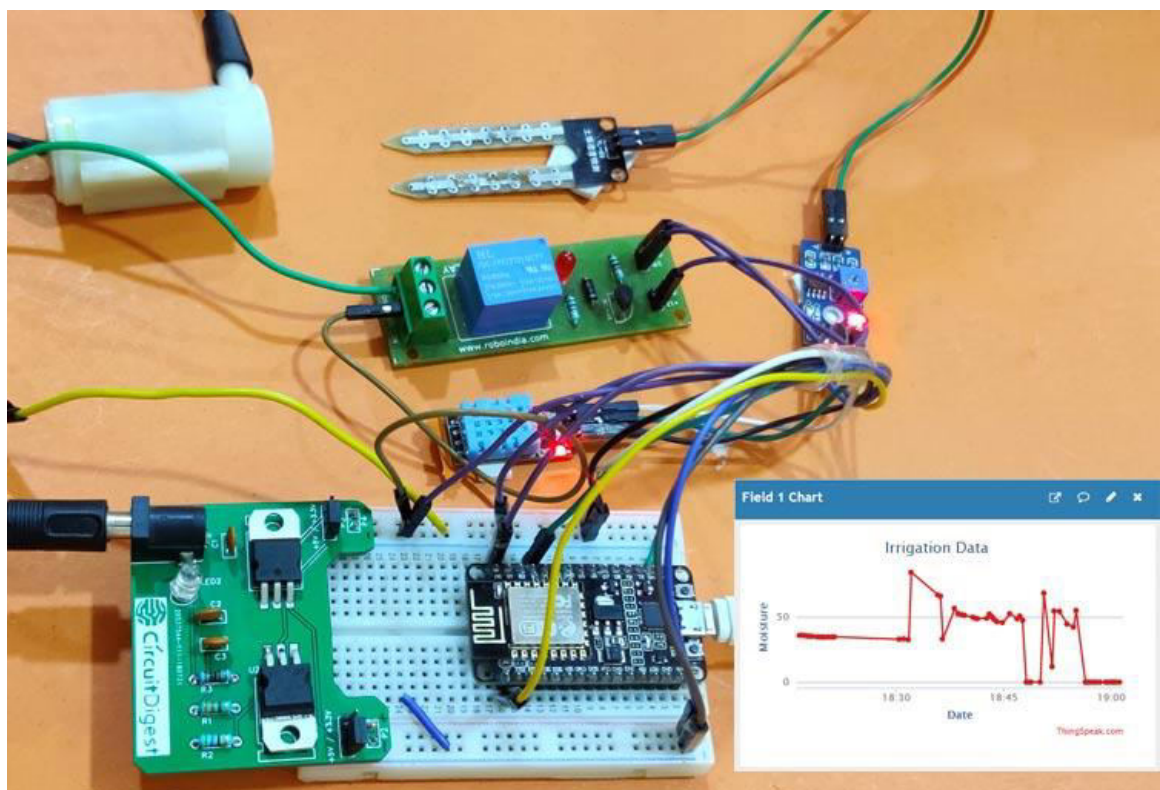
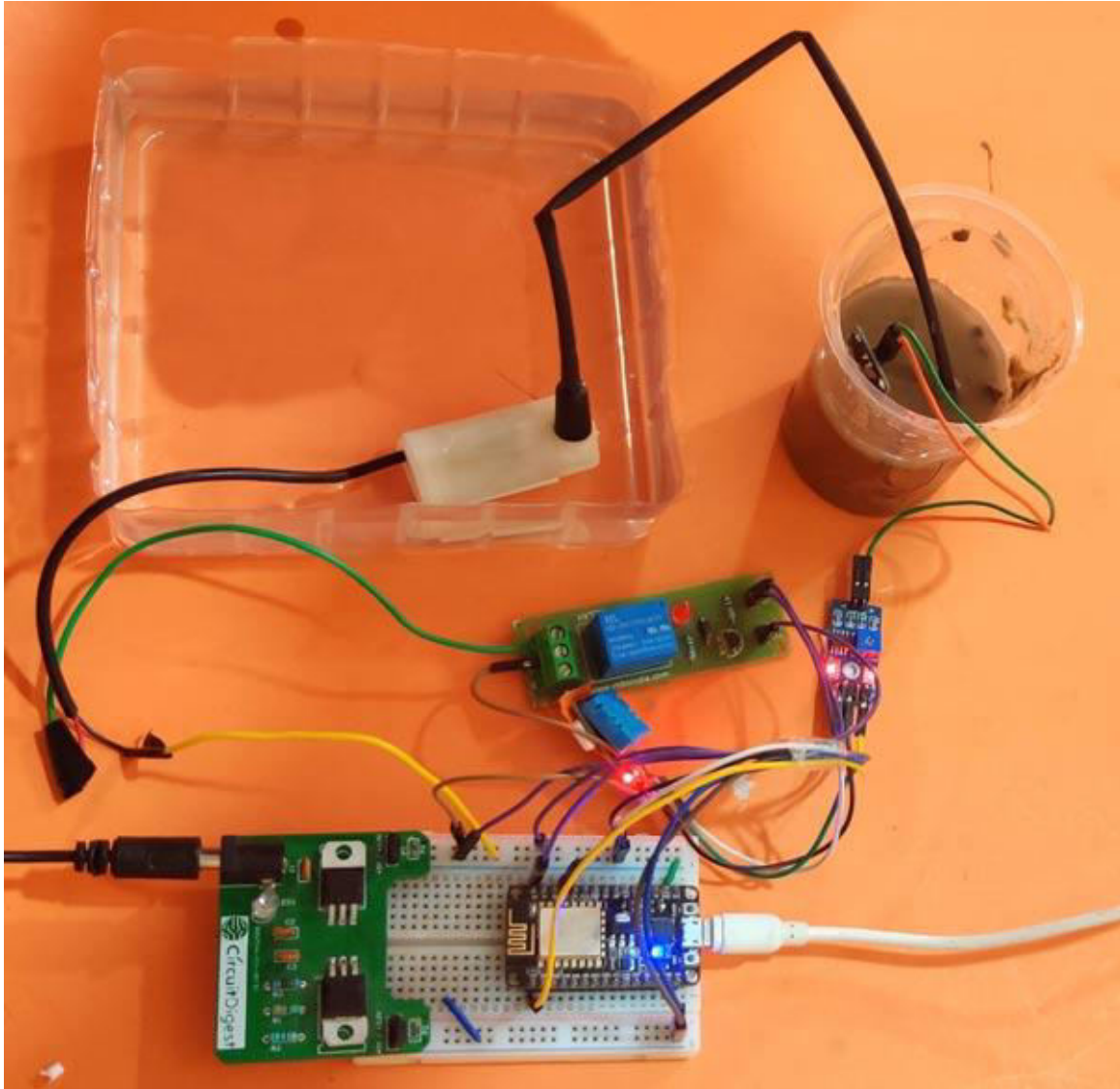


Fig 1.2



V. RESULTS AND DISCUSSION

- Performance: The system successfully automated irrigation based on moisture levels.
- Water Savings: Preliminary tests showed up to 30% water savings.
- Crop Health: Improved consistency in watering led to better crop condition.
- User Feedback: Farmers appreciated remote control and notifications.

VI. CONCLUSION

The Smart Irrigation System using IoT achieves significant efficiency in water use while reducing manual labor. The modular and scalable design makes it suitable for small to medium farms. Integration with AI for weather prediction and solar-powered modules are potential areas for future development.

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