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IOT Based Low Cost and Intelligent Module for Smart Irrigation

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ABSTRACT:

Agriculture is pivotal for food production and economic development in India. With the growing concern of water scarcity due to climate change, irrigation becomes crucial. This paper presents an IoT-based smart irrigation system designed to address these challenges. The system utilizes microcontrollers for remote operation, enabling precise control over irrigation timing based on soil and crop conditions. Sensors monitor soil moisture, temperature, and air humidity, with decision-making controlled by the user. Data collected from sensors are transmitted wirelessly to a server database, automating irrigation when necessary and notifying farmers of field conditions. This low-cost, intelligent system is particularly beneficial in water-scarce regions, enhancing efficiency and crop yield.

Keywords: *IOT, Smart irrigation system, control system, monitoring a Sensors's control system, Smart irrigation, Machine learning, Internet of Things, Agriculture*

1. Introduction

Agriculture forms the backbone of India's economy, providing livelihoods for millions. However, water management is critical, especially in water-stressed regions. This project focuses on developing an IoT-based smart irrigation system to optimize water usage and crop growth. By integrating sensors and microcontrollers, the system can automate irrigation based on real-time data, offering farmers greater control and efficiency.

Literature Review:

Prior studies have explored smart irrigation systems using IoT technology. Chang et al. (2019) proposed a system utilizing machine learning and LoRa P2P networks for automated irrigation. However, the reliance on costly components like LoRa gateways limits scalability. Goldstein et al. (2018) emphasized data-driven approaches for irrigation management, employing regression and classification algorithms for predictive modeling

Shekhar, Yuthika, et.al [Shekhar2017] developed an Intelligent IoT-based Automated Irrigation system which captured soil moisture and temperature sensor data. This is completely machine controlled wherever devices communicate and apply the knowledge of irrigation to one another. It was created to victimize embedded devices such as Arduino Uno, Raspberry Pi3, that are low price. The Intelligent IoT-based Automated Irrigation System is developed using M2M, a part of IoT that allows devices to communicate with other devices where moisture and temperature sensors are deployed in the field of agriculture to capture field watering information.

The principle that we've used is very simple and easy to implementBut it has various drawbacks and limitations and the system which is available in the market has only on and off automation . Proposed system is based on following research questions on iot based irrigation

Proposed System:

Our system utilizes sensor nodes equipped with LoRa technology for data transmission and processing. Soil moisture, temperature, and weather forecast data are collected to inform irrigation decisions. Each node represents different crop yields, enabling tailored irrigation management. The low-power, long-range communication capabilities of LoRa ensure efficient data transmission across farm locations.

Sensors Control System:

The sensor control system consists of microcontrollers that receive data from soil moisture, temperature, and humidity sensors. Raspberry Pi microcontrollers serve as both master and slave controllers, facilitating data exchange and decision-making processes. Remote sensing technologies enable real-time monitoring and adjustments, enhancing irrigation efficiency.

Master Control System:

The master control system orchestrates the entire irrigation process, utilizing scheduling databases and sensor data for precise irrigation management. Plant selection and irrigation/fertilization processes are automated based on predefined schedules and real-time sensor inputs. Arduino C programming ensures seamless integration and operation of master and slave microcontrollers.

Software Design:

The system's intelligence is augmented by web and mobile applications, enabling remote monitoring and control. Weather forecasting APIs provide accurate real-time weather data for informed decision-making. Users can visualize field conditions and adjust irrigation schedules through intuitive interfaces, enhancing user experience and system usability.

System Description:

Our system integrates smart irrigation technologies into existing irrigation infrastructure, offering real-time monitoring and control capabilities. Mobile and web applications provide user-friendly interfaces for seamless interaction and management. A block diagram illustrates the system's components and interactions, ensuring clarity and understanding.

Existing System:

Previous research has explored various approaches to smart irrigation, focusing on soil moisture sensing and automated watering. However, existing systems often rely on expensive components or lack comprehensive monitoring and control capabilities. Our system builds upon these foundations, offering cost-effective solutions with enhanced functionality and scalability.

Design and Development:

The hardware design incorporates sensors, microcontrollers, and water pumps to create an automated irrigation system. Soil moisture, temperature, and humidity sensors provide real-time data for irrigation decision-making. The system's low-cost design and wireless connectivity ensure accessibility and scalability, making it suitable for a wide range of agricultural applications.

Hardware Design:

The system's hardware components include sensors, microcontrollers, and water pumps, interconnected to form an integrated irrigation system. Soil moisture sensors trigger water pumps based on soil moisture levels, ensuring precise and efficient irrigation. The use of NodeMCU ESP8266 microcontrollers enables seamless communication and control, enhancing system performance and reliability.

Advantages and Disadvantages:

The proposed system offers numerous advantages, including cost-effectiveness, user-friendliness, and enhanced accuracy compared to traditional methods. By leveraging IoT technology, the system optimizes water usage and improves crop yield, benefiting farmers and the environment. However, challenges such as the initial cost and installation complexity need to be addressed to ensure widespread adoption and usability.

Results and Conclusion:

The developed smart irrigation system demonstrates the feasibility and effectiveness of IoT technology in agriculture. By integrating sensors, microcontrollers, and web/mobile applications, the system offers real-time monitoring and control capabilities, enhancing irrigation efficiency and crop productivity. Future research should focus on addressing implementation challenges and optimizing system performance for broader adoption and impact.

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