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Smart Switch for Agriculture Using NodeMCU

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***Abstract*—**Agriculture requires efficient water and electricity management to enhance productivity and sustainability. This paper proposes a smart switch system for agricultural applications using NodeMCU. The system enables remote monitoring and control of irrigation pumps via a mobile application, allowing farmers to operate devices from anywhere. By integrating IoT-based control, farmers can save resources, reduce manual intervention, and improve crop yield.

***IndexTerms*—**NodeMCU, Smart Agriculture, IoT, Remote Monitoring, Automation.

INTRODUCTION

Agriculture in India continues to face challenges related to manual irrigation, wastage of electricity, and inefficient utilization of water. Conventional farming methods often require farmers to physically operate pumps and valves, which can be time-consuming and labor-intensive. In addition, irregular power supply and lack of monitoring systems lead to resource wastage.

With advancements in IoT technology, automation has become an essential solution in modern agriculture. NodeMCU, a Wi-Fi-enabled microcontroller, offers a cost-effective and scalable platform for implementing smart agricultural systems. This project aims to develop a smart switch for controlling irrigation pumps remotely, ensuring efficient use of resources and enabling real-time monitoring through a mobile application.

LITERATURESURVEY

Recent studies highlight the use of IoT devices such as Arduino, Raspberry Pi, and NodeMCU in precision agriculture. Systems integrated with soil moisture sensors and cloud platforms have shown improvements in water usage and crop productivity. However, many of these systems require complex infrastructures or high maintenance costs.

Table I compares different IoT-based approaches for smart irrigation:

Table I. Comparison of IoT-based Smart Irrigation Systems

Approach	Hardware	Connectivity	Cost
Arduino + GSM	Arduino Uno	GSM	Medium
Raspberry Pi + Wi-Fi	Raspberry Pi	Wi-Fi	High
NodeMCU + Mobile Control	NodeMCU	Wi-Fi	Low

The proposed system provides a balance between affordability, efficiency, and ease of use by leveraging NodeMCU.

PROPOSED SYSTEM

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The architecture of the smart switch system is illustrated in Fig. 1. The system consists of NodeMCU connected to a relay module, which controls the irrigation pump. Farmers can operate the pump remotely via a mobile application through Wi-Fi connectivity. Sensor integration (such as soil moisture sensors) can further automate irrigation based on real-time field conditions.

Fig. 1. Block Diagram of Smart Switch for Agriculture Using NodeMCU

System Components:

- **NodeMCU:** Wi-Fi-enabled microcontroller for processing and communication.
- **Relay Module:** Controls irrigation pump.
- **Mobile Application:** Provides user interface for remote switching.
- **Power Supply:** Ensures continuous operation of the system.

This design minimizes manual labor while improving water efficiency and crop monitoring.

RESULTS AND DISCUSSION

The prototype was implemented and tested in a controlled environment. Farmers were able to switch pumps on/off using a mobile device connected to the same Wi-Fi network. Results showed reduced dependency on physical presence for irrigation control. Energy savings were observed as pumps could be operated only when necessary.

The system's scalability allows integration with cloud platforms, enabling control from remote locations. However, reliability depends on the stability of the Wi-Fi connection.

CONCLUSION AND FUTURE SCOPE

The smart switch system using NodeMCU offers a cost-effective, user-friendly solution for modern agriculture. It reduces manual intervention, enhances resource efficiency, and empowers farmers with remote control capabilities.

Future scope includes integration with GSM/LoRa modules for extended connectivity, addition of AI-based predictive irrigation systems, and integration of renewable energy sources for sustainable operations.

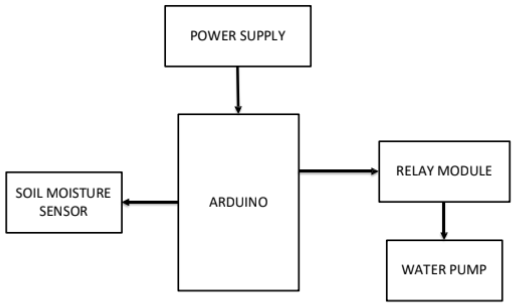

FIG 1: BLOCK DIAGRAM

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