Smart Plant Watering System

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***Abstract*—This paper presents the design and implementation of a smart plant watering system using NodeMCU and Internet of Things (IoT) technologies. The system integrates soil moisture sensors, a water level sensor, a pump, and cloud-based monitoring to optimize water usage for plant care. The system supports both automatic and manual watering modes, with real-time data monitoring via a mobile application. This project aims to reduce water wastage while ensuring healthy plant growth, providing a practical and sustainable solution for modern agriculture and gardening.**

I. Introduction

Efficient water management is critical in agriculture and gardening due to increasing water scarcity and environmental concerns. Traditional irrigation methods often lead to over-watering or underwatering, wasting both water and resources. Modern IoT-based systems, such as the proposed smart plant watering system, provide a solution by enabling real-time monitoring of soil moisture levels and automating the irrigation process.

This paper explores a soil moisture-based watering system that utilizes NodeMCU, IoT technology, and a water level sensor to provide a cost-effective, scalable solution for plant care. The system supports both automatic and manual watering modes, making it versatile for different use cases. The design focuses on integrating sensors, microcontrollers, and cloud-based platforms to ensure accurate data collection and real-time monitoring.

II. System Design

The system comprises four main components:

A. Hardware

1. **NodeMCU (ESP8266)**: The microcontroller acts as the central unit, processing sensor data and controlling the pump. 2. **Soil Moisture Sensor**: Measures the water content in the soil and sends data to the NodeMCU. The data is used to determine when irrigation is needed. 3. **Water Level Sensor**: Monitors the water level in the reservoir or tank to ensure that there is sufficient water available for the plants. If the water level drops too low, the system sends an alert or stops watering until the reservoir is refilled. 4. **Water Pump**: A submersible or peristaltic pump is used to supply water to the plants. The pump is controlled by the NodeMCU based on the soil moisture readings or manual user input. 5. **Power Supply**: Provides the necessary voltage and current to the hardware components.

B. Software

1. **Arduino IDE**: Used to program the NodeMCU, read sensor inputs, and control the pump. 2. **Cloud Platform**: A cloud service (e.g., Firebase or ThingSpeak) stores and visualizes data from the sensors. It also sends alerts based on soil moisture or water level conditions. 3. **Mobile Application (Blynk)**: The Blynk app is used as the companion app that allows users to monitor soil moisture levels and water levels, and control the watering system manually or automatically. Blynk provides an easy-to-use interface for users to toggle between the automatic and manual modes and receive real-time notifications.

C. Modes of Operation

The system operates in two main modes:

1) Automatic Mode:: In automatic mode, the system automatically controls the watering process based on soil moisture levels. When the soil moisture falls below a preset threshold, the NodeMCU activates the pump to water the plants. The water level sensor ensures there is enough water in the reservoir before the pump is activated. Once the soil moisture is sufficient, the pump is turned off.

2) Manual Mode:: In manual mode, the user can control the watering system through the Blynk mobile application or a physical switch. The user can turn the pump on or off regardless of the soil moisture readings. This mode is useful for situations where the user needs to manually water the plants or perform maintenance tasks.

III. How to Connect

The circuit diagram shown in Fig. 1 illustrates the connections between the NodeMCU, soil moisture sensors, water level sensor, water pump, and other components.

Steps to connect the components: 1. Connect the soil moisture sensors' output pins to the analog input pins (A0, A1) of the NodeMCU. 2. Connect the water level sensor to a digital input pin (D5) of the NodeMCU. 3. Connect the water pump to the motor driver (L293D), and control it through digital pins (D6, D7) on the NodeMCU. 4. Power the NodeMCU through the VIN pin using a 7.4V supply or USB power. 5. Ensure all grounds (GND) of the sensors, motor driver, and NodeMCU are connected.

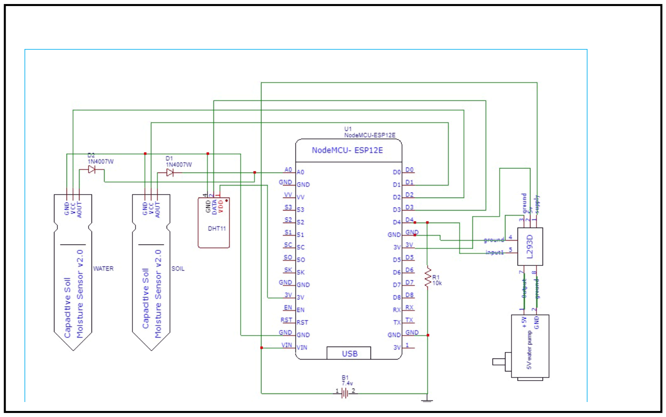

Fig. 1. Circuit Diagram for the Smart Plant Watering System

IV. Methodology

The implementation of the smart plant watering system follows these steps:

1. **Sensor Calibration**: The soil moisture sensor is calibrated to ensure accurate readings across various soil types. The water level sensor is also calibrated to detect low water levels in the reservoir. 2. **System Integration**: The NodeMCU is programmed to read sensor data, control the pump, and transmit data to the cloud platform. 3. **Cloud Setup**: A cloud database is configured to store incoming sensor data, generate real-time analytics, and trigger alerts when the soil is dry or the water level is low. 4. **Mobile App Development**: The Blynk app is used to fetch data from the cloud, display it to the user, and allow the user to toggle between automatic and manual modes.

V. Results and Discussion

Preliminary tests indicate that the system provides reliable soil moisture readings with an error margin of less than 5%. The water level sensor ensures that the pump only operates when there is enough water in the reservoir. The automatic mode helps reduce water wastage, while the manual mode offers flexibility to the user. Table I compares traditional watering methods with the proposed system in terms of water efficiency and ease of use.

TABLE I
Comparison of Traditional and IoT-Based Watering Methods

Parameter	Traditional Methods	Proposed System
Water Usage	High	Optimized
User Control	Manual	Automatic / Manual
Real-Time Monitoring	No	Yes

VII. Conclusion

The proposed smart plant watering system demonstrates the practical application of IoT in efficient water usage. By using real-time data and supporting both automatic and manual modes, the system optimizes plant watering while minimizing water waste. Future work will focus on integrating additional environmental sensors, such as temperature and humidity, to further enhance the system's capabilities.

Acknowledgments

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References

[1] IoT-Based Smart Agriculture Monitoring System - Discusses the integration of sensors and IoT for agriculture.
[2] Automatic Plant Irrigation System Using IoT - Explores soil moisture monitoring and water pump automation.
[3] Arduino Project Hub: Self-Watering Plant Using Arduino.
[4] Instructables: DIY Smart Plant Watering System.
[5] Circuit Digest: IoT Plant Monitoring System.
[6] YouTube tutorials on "Smart Plant Watering System using Arduino and IoT."
[7] Online forums like Stack Overflow or Reddit's r/IOT for troubleshooting.

GitHub

The full project code and implementation details can be found on the GitHub: https://github.com/3lidandan/Project-of-Mobile-and-Wireless-Networks