SMART PLANT WATERING SYSTEM

A Remote-Controlled IoT Approach to Plant Care

A PROJECT REPORT

submitted by

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in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

in

COMPUTER SCIENCE AND ENGINEERING

RAJALAKSHMI ENGINEERING COLLEGE,

ANNA UNIVERSITY: CHENNAI 600 025

MAY 2025

RAJALAKSHMI ENGINEERING COLLEGE, CHENNAI

BONAFIDE CERTIFICATE

Certified that this project report titled "**SMART PLANT WATERING SYSTEM"** is the bonafide work of "**DHIVYA SHREE K (230701079), FARHEEN TABASSUM (230701088)"** who carried out the work under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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ABSTRACT

Efficient plant care is essential for promoting sustainable living and environmental conservation. However, traditional manual watering methods are often inconsistent and resource-intensive. This study proposes the development of a Smart Plant Watering System using Internet of Things (IoT) technology to automate irrigation based on real-time soil moisture monitoring. The system utilizes sensor data, a microcontroller, and a mobile application for real-time monitoring with automated irrigation based on soil moisture. Through the integration of hardware components and IoT platforms, the project aims to demonstrate an efficient and sustainable solution for automated plant care.

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ACKNOWLEDGEMENT

First, we thank the almighty God for the successful completion of the project. Our sincere thanks to our chairman **Mr. S. Meganathan, B.E., F.I.E.,** for his sincere endeavor in educating us in his premier institution. We would like to express our deep gratitude to our beloved Chairperson **Dr. Thangam Meganathan, Ph.D.,** for her enthusiastic motivation which inspired us a lot in completing this project, and Vice-Chairman **Mr. Abhay Shankar Meganthan**, **B.E., M.S.,** for providing us with the requisite infrastructure. We also express our sincere gratitude to our college principal, **Dr.S.N.Murugesan M.E., PhD.,** and **Dr. P. Kumar M.E., Ph.D., Head of the Department of Computer Science and Engineering,** and our project guide **Ms. S. Ponmani M.E.,MBA,** for her encouragement and guiding us throughout the project. We would like to thank our parents, friends, all faculty members, and supporting staff for their direct and indirect involvement in the successful completion of the project for their encouragement and support.

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CHAPTER 1

INTRODUCTION

Water management is a critical factor in promoting plant health and supporting sustainable agriculture and gardening practices. With increasing environmental awareness and the need for resource conservation, traditional manual irrigation methods are often found to be inefficient, leading to water wastage and inconsistent plant growth. As urbanization and lifestyle changes limit the time individuals can dedicate to plant care, the need for efficient, automated systems has become more pronounced.

Advancements in emerging technologies, particularly the Internet of Things (IoT), have enabled the development of smart solutions for real-time monitoring and automation. IoT-based systems can leverage sensor networks, cloud platforms, and mobile applications to optimize resource use and enable remote management of environmental conditions. By automating irrigation based on soil moisture levels, these systems can significantly enhance water efficiency and ensure better plant health with minimal human intervention.

This study focuses on the development of an IoT-based Smart Plant Watering System designed to automate the irrigation process using real-time soil moisture data. The system incorporates a NodeMCU ESP8266 microcontroller, soil moisture sensors, a relay module, and the Blynk IoT platform for monitoring and control. By adopting a structured methodology involving system design, prototype development, and performance evaluation, the study aims to demonstrate the feasibility and effectiveness of intelligent plant care solutions.

1.1 Motivation

Promoting Sustainable Water Use: Water is a vital and limited natural resource. Inconsistent or excessive watering not only harms plants but also contributes to water wastage. This project aims to promote responsible water use by developing an automated system that delivers water only when the plant needs it, based on real-time soil moisture data.

Simplifying Plant Care: Many individuals, especially in urban areas, struggle with maintaining a consistent watering routine due to busy schedules or lack of gardening knowledge. The Smart Plant Watering System offers a hands-free solution that ensures proper care for plants, enhancing convenience for users and improving plant health.

Utilizing IoT for Smart Gardening: The project leverages Internet of Things (IoT) technology, integrating sensors, microcontrollers, and cloud-based platforms to create a connected and intelligent plant care system. This enables real-time monitoring, automatic irrigation, and remote access through a mobile app, reflecting the growing trend toward smart home solutions.

1.2 Objectives

Develop a Smart Plant Watering System: The primary objective is to design and implement a fully functional IoT-based watering system that monitors soil moisture levels and automatically activates irrigation when needed, ensuring optimal plant hydration.

Integration of Sensor and Control Technologies: Incorporate soil moisture sensors to detect water content in the soil and a NodeMCU ESP8266 microcontroller to process the data. Use a relay module and water pump to physically control the irrigation process.

Remote Monitoring and User Interaction: Implement the Blynk IoT platform to allow users to view real-time moisture levels and monitor the watering system remotely while it automatically waters based on soil moisture, enhancing flexibility and user engagement.

Encourage Efficient Resource Management: Demonstrate how automated irrigation based on actual plant needs can conserve water, reduce human effort, and contribute to sustainable living practices.

CHAPTER 2

LITERATURE REVIEW

[1] An IoT-Based Smart Irrigation System Using Soil Moisture and Weather Prediction

The paper outlines an open-source IoT-based smart irrigation system that monitors soil parameters such as moisture and temperature, combined with weather forecast data. By integrating sensor nodes and cloud platforms, the system ensures optimized irrigation schedules, aiming to conserve water resources and promote sustainable agricultural practices.

[2] IoT-Based Plant Monitoring System Using NodeMCU
This paper presents a plant monitoring system utilizing soil moisture and environmental sensors connected to a NodeMCU microcontroller. Data is transmitted to a mobile application via the Blynk platform, enabling real-time monitoring and remote control. The system focuses on reducing human intervention while ensuring proper plant care and maintenance.

[3] Design and Implementation of Soil Moisture Monitoring and Irrigation System Based on ARM and IoT

The study proposes a soil monitoring and irrigation management system built using ARM architecture and IoT technologies. It integrates various sensors to capture soil humidity and environmental data, relays information to a cloud platform, and automates irrigation control, thereby enhancing efficiency in agricultural practices.

[4] IoT-Based Smart Irrigation with Tracking System Using NodeMCU ESP8266

The paper introduces a smart irrigation and crop monitoring system that uses NodeMCU ESP8266 with various environmental sensors. The system enables users to monitor soil moisture, temperature, and humidity remotely through mobile devices, optimizing irrigation practices and protecting crops against adverse conditions.

[5] Smart Sensors and NodeMCU ESP8266-Based Automated Irrigation System for Effective Water Management in Agriculture

This paper develops an automated irrigation system using smart sensors and the NodeMCU ESP8266 microcontroller, integrated with the ThingSpeak platform. The system allows for real-time monitoring of soil conditions and automates the watering process based on data-driven analysis, aiming to achieve effective water resource management in agriculture.

2.1 Existing System

Traditional plant watering systems typically rely on manual or fixed-time irrigation methods, unlike the automated control in our system. Manual systems require gardeners to evaluate moisture levels and water plants accordingly, which can be inconsistent and labor-intensive. Fixed-time systems water plants at scheduled intervals, regardless of the actual soil moisture. While these systems are easy to set up and cost-effective, they often result in water wastage or insufficient watering, depending on changing weather conditions or plant needs. Additionally, these systems do not offer real-time monitoring or adaptability, leading to inefficiency in water use and potential plant health issues.

2.1.1 Advantages of the existing system

Traditional systems are simple, cost-effective, and easy to implement. They don't require advanced technology or technical expertise, making them suitable for a wide range of users.

2.1.2 Drawbacks of the existing system

The major drawbacks include water wastage, as the systems water plants irrespective of the actual need, and the lack of real-time monitoring. This results in inefficient water use and potentially poor plant health due to inconsistent watering.

2.2 Proposed System

The proposed Smart Plant Watering System uses IoT technology and soil moisture sensors to monitor real-time soil moisture levels and adjust watering accordingly. Unlike fixed-time systems, it adapts to the actual needs of the plants, ensuring efficient water use. The system is controlled by a NodeMCU microcontroller, and users can monitor and manage it remotely through a mobile app. This automation eliminates the need for manual intervention, as the system makes decisions autonomously, making it more efficient and convenient. The system can be customized to suit different plant needs, ensuring optimal growth while conserving water.

2.2.1 Advantages of the proposed system

The proposed system offers better water efficiency by watering only when necessary, reducing waste. It automates the process, eliminating the need for manual intervention, as the system makes decisions autonomously,
and provides remote monitoring, making it more convenient for users.

CHAPTER 3

SYSTEM DESIGN

3.1Development Environment

3.1.1 Hardware Requirements

NodeMCU ESP8266

Soil Moisture Sensor

Relay Module

Mini Water Pump

Breadboard

Jumper Wires

9V Battery and Clip

NodeMCU ESP8266

The NodeMCU ESP8266 is a low-cost microcontroller board with built-in Wi-Fi capabilities. It serves as the brain of the system, collecting data from the soil moisture sensor and sending commands to the relay to control the water pump. It also connects to the Blynk app via Wi-Fi to allow real-time monitoring and auto-control.

Soil Moisture Sensor

This sensor detects the moisture content in the soil. It provides analog signals based on the water level in the soil. When the moisture level falls below a set threshold, the NodeMCU activates the pump to water the plant.

Relay Module

The relay module works as an electronic switch. It receives a signal from the NodeMCU and controls the power to the water pump, turning it ON or OFF based on the soil moisture levels.

Mini Water Pump

This component is responsible for the actual watering of the plant. It pumps water from a container to the soil when triggered by the relay module.

Breadboard

The breadboard is used for assembling and testing the circuit without soldering. It helps to connect all components easily for prototyping purposes.

Jumper Wires

Jumper wires are used to make the necessary electrical connections between the NodeMCU, sensors, relay, and other components on the breadboard.

9V Battery and Clip

The 9V battery powers the mini water pump independently. It is connected through a clip, ensuring the pump runs without drawing power from the NodeMCU board.

3.1.1 Software Requirements

- Arduino IDE
- Blynk App(New Version)
- Blynk Version

CHAPTER 4

PROJECT DESCRIPTION

4.1 SYSTEM ARCHITECTURE

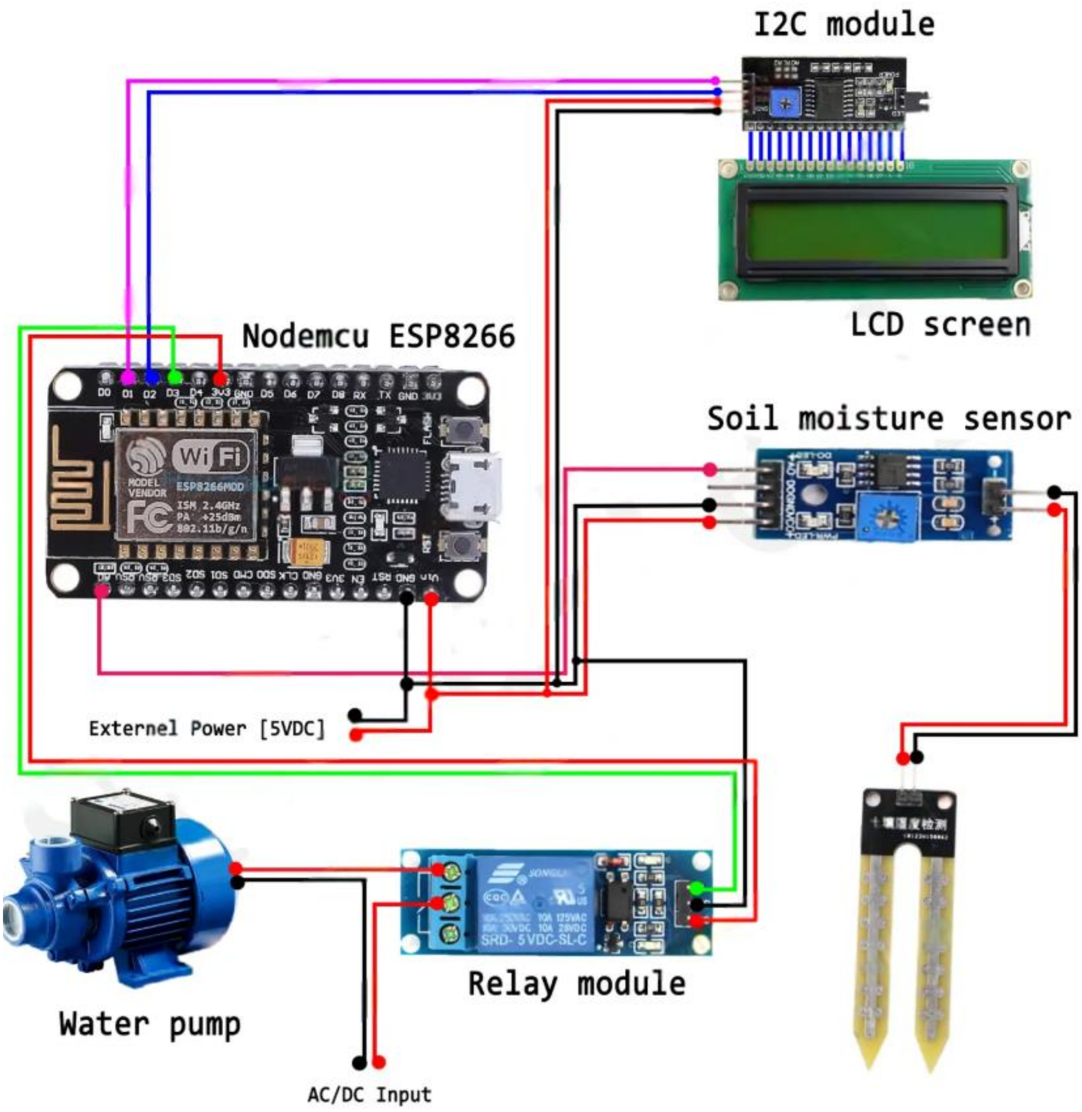

Fig 4.1 System Architecture

4.2 METHODOLOGY

Problem Definition: The methodology begins with identifying the problem of water wastage and inefficient irrigation in agriculture. The objective is to develop an IoT-based smart irrigation system using the NodeMCU ESP8266 microcontroller, which can monitor soil moisture in real-time and automatically automatically control a water pump when the moisture falls below the threshold, ensuring efficient water usage.

Literature Review: A comprehensive review of existing research and technologies was conducted, focusing on IoT-based agricultural systems, soil moisture sensing techniques, wireless communication modules, and automation in irrigation. Various open-source platforms and similar prototypes were studied to determine the best practices for system design, component selection, and integration strategies for real-time monitoring and control.

Requirements Analysis: The functional requirements include real-time soil moisture monitoring, automatic water pump control, data display on an LCD screen, and wireless communication capability. Non-functional requirements focus on system reliability, low power consumption, affordability, and ease of use. Components such as the NodeMCU ESP8266, soil moisture sensor, relay module, and LCD display with I2C interface were selected based on their compatibility, efficiency, and cost-effectiveness.

System Design: The system architecture includes a soil moisture sensor connected to the ESP8266 for continuous moisture data collection. The data is processed by the microcontroller, and based on predefined threshold levels, the relay module is activated to switch the water pump on or off. An LCD screen with an I2C module is used to display moisture levels and pump status. External 5V DC power is supplied to run the components efficiently. The ESP8266 also provides Wi-Fi capability for future extension to cloud-based monitoring.

Prototype Development: The prototype was developed by assembling the hardware components according to the circuit diagram. The NodeMCU was programmed using the Arduino IDE with logic for reading sensor values, comparing them to threshold levels, and triggering the pump via the relay. The LCD was programmed to display real-time moisture readings and system status. The system was tested using different moisture conditions to ensure it responded correctly.

Evaluation and Testing: The prototype system was evaluated through multiple test scenarios simulating dry and wet soil conditions. Key performance metrics such as response time, pump activation accuracy, and display readability were analyzed. The system demonstrated reliable performance and efficient water usage, with consistent activation of the pump when the soil was dry and deactivation when sufficient moisture was detected. Feedback was collected to identify potential improvements, such as adding remote monitoring via a web interface.

CHAPTER 5

RESULTS AND DISCUSSION

The prototype of the IoT-based smart irrigation system was successfully implemented and tested in various soil conditions. The soil moisture sensor effectively measured the moisture level, and the data was accurately processed by the NodeMCU ESP8266. When the soil moisture dropped below the preset threshold, the relay module activated the water pump automatically. The LCD screen displayed the current moisture level and pump status in real-time, allowing easy monitoring. The system operated reliably using 5V DC external power and demonstrated quick responsiveness to changes in soil moisture.

The results indicate that the system can significantly reduce water wastage by ensuring irrigation occurs only when necessary. The automation eliminates the need for manual intervention, as the system makes decisions autonomously, making it ideal for use in agricultural fields, gardens, or greenhouses. The discussion also highlighted areas for future improvement, such as integrating Wi-Fi-based data logging or smartphone alerts. Overall, the project successfully met its objective of designing an efficient, low-cost, and reliable smart irrigation solution using IoT technology.

CHAPTER 6

CONCLUSION AND FUTURE WORK

6.1 Conclusion

The development of the IoT-based Smart Plant Watering System represents a significant advancement in automating plant care and optimizing water usage. By leveraging IoT technologies, such as soil moisture sensors, NodeMCU, and the Blynk app, the system provides real-time monitoring of soil conditions and ensures that plants are watered only when necessary, preventing both overwatering and underwatering. This smart solution not only conserves water but also ensures that plants receive consistent care, promoting healthy growth. The integration of the Blynk app further enhances the user experience by enabling real-time monitoring and auto-control, making plant care more convenient and efficient.

6.2 Future Work

In the future, we aim to enhance the Smart Plant Watering System by exploring more advanced sensor technologies and refining the control algorithms. This includes the development of next-generation soil moisture sensors that offer higher accuracy and durability, ensuring more reliable performance in various environmental conditions. We also plan to integrate additional sensors, such as temperature and humidity sensors, to create a more comprehensive environmental monitoring system for plants. Furthermore, we aim to improve the system's scalability by enabling multi-plant support, allowing users to manage multiple plants simultaneously through the Blynk app. Lastly, we will explore the use of machine learning algorithms to analyze plant care data and provide intelligent recommendations for optimal watering schedules based on plant types and environmental conditions.

APPENDIX

SOFTWARE INSTALLATION

Arduino IDE

To run and mount code on the Arduino NANO, we need to first install the Arduino IDE. After running the code successfully, mount it.

Sample code

```
#define BLYNK_TEMPLATE_ID "TMPL357TbotXz"
#define BLYNK_TEMPLATE_NAME "Plant Watering System"

#define BLYNK_PRINT Serial
#include <Blynk.h>
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include <LiquidCrystal_I2C.h>

// Initialize the LCD display
LiquidCrystal_I2C lcd(0x27, 16, 2);

// Blynk and WiFi credentials
char auth[] = "s2J9v7RyKjq4heoV5xRQcaX_jC0_giLc";
char ssid[] = "Farheen";
char pass[] = "Farheen250705";

BlynkTimer timer;

// Define component pins
#define sensor A0
#define waterPump D3

void setup() {
  Serial.begin(9600);
  pinMode(waterPump, OUTPUT);
  digitalWrite(waterPump, HIGH); // pump initially off
```

```
  lcd.init();
  lcd.backlight();

  Blynk.begin(auth, ssid, pass, "blynk.cloud", 80);

  // Wait for WiFi connection
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }

  Serial.println("\nWiFi connected!");
  Serial.print("IP Address: ");
  Serial.println(WiFi.localIP());

  lcd.setCursor(1, 0);
  lcd.print("System Loading");
  for (int a = 0; a <= 15; a++) {
    lcd.setCursor(a, 1);
    lcd.print(".");
    delay(100);
  }
  lcd.clear();

  // Set timer to read soil moisture regularly
  timer.setInterval(1000L, soilMoistureSensor);
}

// Automatically control pump based on soil moisture
void soilMoistureSensor() {
  int value = analogRead(sensor);
  value = map(value, 0, 1024, 0, 100);
  value = (value - 100) * -1;

  Blynk.virtualWrite(V0, value); // Update moisture level in app

  lcd.setCursor(0, 0);
  lcd.print("Moisture: ");
  lcd.print(value);
  lcd.print(" %   ");

  if (value < 30) {
```

```
    digitalWrite(waterPump, LOW); // Turn pump ON
    lcd.setCursor(0, 1);
    lcd.print("Auto: Pump ON ");
    Blynk.virtualWrite(V1, 1);    // Sync app button
  } else {
    digitalWrite(waterPump, HIGH); // Turn pump OFF
    lcd.setCursor(0, 1);
    lcd.print("Auto: Pump OFF");
    Blynk.virtualWrite(V1, 0);     // Sync app button
  }
}

void loop() {
  Blynk.run();
  timer.run();
}
```

REFERENCES

[1] S. Velmurugan, V. Balaji, T. M. Bharathi, and K. Saravanan. *An IoT-Based Smart Irrigation System Using Soil Moisture and Weather Prediction*. International Journal of Engineering Research & Technology (IJERT), 2020.

[2] R. Bhattacharya, S. Shrivastava, and A. Ojha. *IoT-Based Plant Monitoring System Using NodeMCU*. International Journal on Future Revolution in Computer Science & Communication Engineering, 2019.

[3] *Design and Implementation of Soil Moisture Monitoring and Irrigation System Based on ARM and IoT*. Procedia Computer Science, 2022.

[4] N. E. M. Shawky. *IoT-Based Smart Irrigation with Tracking System Using NodeMCU ESP8266*. International Journal of Scientific Research in Computer Science and Engineering, 2021.

[5] S. Althaf, S. J. Hussain, and L. S. Dendukuri. *Smart Sensors and NodeMCU ESP8266-Based Automated Irrigation System for Effective Water Management in Agriculture*. International Journal for Research in Applied Science and Engineering Technology (IJRASET), 2023.