SMART IRRIGATION SYSTEM

A PROJECT REPORT

Submitted by

KISORE R.G (210701124)

N. KARTHIKEYAN (210701112)

M.KAVIN CHAKRAVARTHY (210701113)

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BONAFIDE CERTIFICATE

Certified that this Thesis titled **“SMART IRRIGATION SYSTEM”** is the bonafide work of **“N.KARTHIKEYAN(210701112), M.KAVIN CHAKRAVARTHY(210701113),KISORER.G(210701114)”** 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.

SIGNATURE
Dr.K.Anand, M,E., Ph.D.
Professor,Department of Computer
Science and Engineering
Rajalakshmi Engineering College
(Autonomous)
Thandalam, Chennai -602105

Submitted to Project Viva-Voce Examination held on___________________

Internal Examiner **External Examiner**

ABSTRACT

The development and implementation of a Smart Irrigation System (SIS) utilizing Internet of Things (IoT) technology is the subject of this paper's investigation. By maximizing water utilization in agriculture, the SIS seeks to eliminate inefficiencies in conventional irrigation techniques. The system allows for real-time irrigation process monitoring and control by integrating soil moisture sensors, weather data, and Internet of Things devices. Farmers may make educated decisions about when to schedule irrigation by using an intuitive smartphone application that gives them access to crucial data like soil moisture levels and weather forecasts. The effectiveness of the SIS in raising agricultural output and quality, decreasing water waste, and optimizing water usage efficiency is assessed by the study. The study also evaluates how using IoT-driven smart irrigation technologies in agricultural practices will affect the economy and ecology.

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M.KAVIN CHAKRAVARTHY (210701113)

KISORE R.G (210701124)

N.KARTHIKEYAN (210701112)

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CHAPTER 1

INTRODUCTION

The agriculture industry is under increasing pressure to address resource constraints and environmental sustainability in addition to meeting the world's rising food demand. Effective water management, especially in irrigation techniques, is a vital component of agricultural output. Conventional irrigation techniques are frequently inefficient, resulting in water waste, lower crop yields, and damage to the environment. Technological developments, especially in the area of the Internet of Things (IoT), present interesting answers to these problems in terms of improving agricultural sustainability and streamlining irrigation procedures.

In this study, we will concentrate on the design and implementation of an Internet of Things-based Smart Irrigation System (SIS). Through the integration of sensors, actuators, and data analytics, the SIS facilitates the real-time monitoring and control of irrigation processes, hence enabling accurate water distribution that is customized to meet crop requirements.

In this study, we delve into the design, implementation, and evaluation of the SIS, assessing its effectiveness in improving water use efficiency, enhancing crop productivity, and mitigating environmental impacts. Additionally, we explore the economic feasibility and adoption challenges of implementing IoT-driven smart irrigation solutions in agricultural settings. By addressing these key aspects, this research contributes to advancing sustainable agricultural practices and harnessing the potential of IoT technologies to revolutionize irrigation management.

1.1 Motivation

- The motivation for implementing a Smart Irrigation System (SIS) using IoT technology stems from the pressing need to address challenges faced by modern agriculture, such as water scarcity, inefficient water usage, labor-intensive irrigation practices, and the need for sustainable agricultural solutions.

- By leveraging IoT sensors, data analytics, and automation, the SIS aims to revolutionize irrigation practices by providing real-time monitoring and precise control over water usage. The potential impact of the SIS extends beyond individual farms to contribute to broader goals of water conservation, food security, and environmental sustainability.

- A smart watering system not only saves time and effort but also promotes healthier plant growth by providing optimal hydration levels.

1.2 Objectives:

- By integrating soil moisture sensors, weather data, and IoT devices, the SIS enables real-time monitoring and control of irrigation processes, thereby optimizing water usage and reducing wastage.

- Through informed decision-making facilitated by a user-friendly mobile application, farmers can effectively schedule irrigation based on soil moisture levels and weather forecasts, leading to improved crop yield and quality.

- The research evaluates the economic and environmental impact of implementing IoT-driven smart irrigation solutions in agricultural practices, providing insights into the potential benefits and challenges associated with adoption.

CHAPTER 2

LITERATURE SURVEY

"Smart Irrigation System Using IoT" (2020, March 1): This review delves into various sensor technologies utilized in smart irrigation systems, including soil moisture sensors, weather sensors, and humidity sensors. It discusses their operational principles, advantages, and limitations, and evaluates their effectiveness in optimizing water usage and enhancing crop yield in agricultural contexts. The paper also explores the integration of sensor networks with IoT platforms for real-time monitoring and decision-making in irrigation management.

“Solution For Water Management Using A Smart Irrigation System. (2019, October 1): This research suggests a low-cost smart irrigation system that efficiently manages water by using a microcontroller, humidity sensors, relays, and a water pump. The system senses the relative humidity in two zones and modifies water flow by turning on pumps and solenoid valves as necessary. The appropriate valve opens and the pump begins to run until the desired humidity is restored when the humidity in either zone falls below predetermined thresholds. When humidity rises over predetermined thresholds, the device goes into standby mode and waits for fresh sensor data before turning back on. This method minimizes waste, maximizes resource utilization, and provides adjustable water management. Similar methods have been investigated in the past using a variety of controllers, including PLCs, Raspberry Pis, and other microcontrollers. This technology has been validated experimentally and shows promise for improving irrigation efficiency.

“Design of an Internet of Things (Iot) Based Smart Irrigation and Fertilization System Using Fuzzy Logic for Chili Plant” (2020, June 1): This review focuses on the design and implementation of user interfaces (UIs) in smart irrigation systems, emphasizing aspects like ease of use, accessibility, and functionality. It discusses various types of UIs, including mobile apps, web interfaces, and touchscreen displays, and examines the integration of data visualization tools and dashboards for presenting real-time sensor data and irrigation status to users. Additionally, it explores user interaction paradigms like voice commands and gesture-based controls for enhancing user experience in smart irrigation management.

“Smart Irrigation System using Zigbee Technology and Machine Learning Techniques” (2018, December 1): In India, agriculture is important, but it's also important to manage water scarcity. To improve crop productivity, this study presents a Smart Irrigation System (SIS) that integrates machine learning and the Internet of Things. Data on soil moisture, air temperature, and humidity is gathered by sensors and sent over Zigbee to a base station running on a Raspberry Pi. By predicting crop water requirements, machine learning models optimize irrigation. The goal of this system is to address the drawbacks of current approaches by offering affordable and long-lasting solutions. The suggested SIS addresses the issues of under- and over-irrigation while ensuring appropriate water management. The study includes results, system design, implementation, and a thorough review of the literature. Future directions for research are discussed at the end.

2.1 EXISTING SYSTEM:

The traditional watering system relies entirely on manual intervention, where users manually water their plants using watering cans, hoses, or other handheld tools. This method, while simple and accessible, poses several challenges. It demands consistent human effort and attention, making it time-consuming, especially for larger plant collections or gardens. Moreover, there's a risk of uneven watering and neglect, as human operators may struggle to maintain a consistent watering schedule, leading to potential overwatering or underwatering of plants. Additionally, the lack of automation limits scalability and efficiency, making it less suitable for larger-scale or more complex plant setups.

2.1.1 Advantages of the existing system :

1) Traditional watering methods like manual watering cans or hoses are often inexpensive, requiring minimal initial investment.

2) These methods are straightforward and easy to understand, making them accessible to users without technical knowledge or expertise.

2.1.2 Disadvantages of the existing system :

1) Manual watering can be time-consuming, especially for larger plant collections or gardens, requiring frequent attention and effort from the user.

2) Human error or forgetfulness can lead to inconsistent watering, resulting in overwatering or underwatering of plants, which can be detrimental to their health.

2.2 Proposed System

IoT sensors track environmental factors like rainfall, temperature, humidity, and soil moisture continuously, sending data wirelessly to a central control unit. The central control acts as the system's brain, analyzing sensor data and deciding optimal irrigation schedules and water amounts using models and algorithms. Pumps and solenoid valves respond to decisions made by the central control unit, activating irrigation as needed. Farmers interact with the system via an intuitive web portal or mobile app, accessing real-time crop status, irrigation schedules, and environmental data, along with insights and recommendations.

2.2.1 Advantages of the proposed system :

2.2.1.1 Automation: The system automates the watering process based on real-time soil moisture data, reducing the need for manual intervention and ensuring plants receive water when needed.

2.2.1.2 Precision: By using a soil sensor to measure moisture levels, the system can deliver water directly to the roots of plants, promoting optimal hydration and growth while minimizing water wastage.

2.2.1.3 Efficiency: The automated nature of the system improves water usage efficiency by avoiding overwatering or underwatering, leading to healthier plants and reduced waterconsumption.

2.2.2 Disadvantages of the proposed system:

- Dependency on Technology: The system relies on electronic components such as the Arduino microcontroller, soil sensor, and motor, which are susceptible to malfunctions or technical issues that may disrupt its operation.
- Initial Setup Complexity: Setting up the system may require technical knowledge and expertise to properly configure the Arduino, sensor, and other components, potentially posing a barrier to entry for some use

CHAPTER 3
SYSTEM DESIGN

3.1 Development Environment

3.1.1 Hardware Requirements

- Arduino Uno: The heart of the system, Arduino Uno serves as the main microcontroller to process data from sensors, control the relay and motor, and manage the LCD display interface.

- Soil Sensor: A sensor designed to measure the moisture content of the soil, providing crucial data for determining when to water the plants.

- Relay: A relay module is used to control the flow of water to the plants. It acts as a switch that is controlled by the Arduino to activate or deactivate the water flow as needed.

- Motor: A DC motor is employed to pump water from the reservoir to the plants. It is controlled by the Arduino to regulate the amount of water dispensed based on soil moisture readings.

3.1.2 Software Requirements

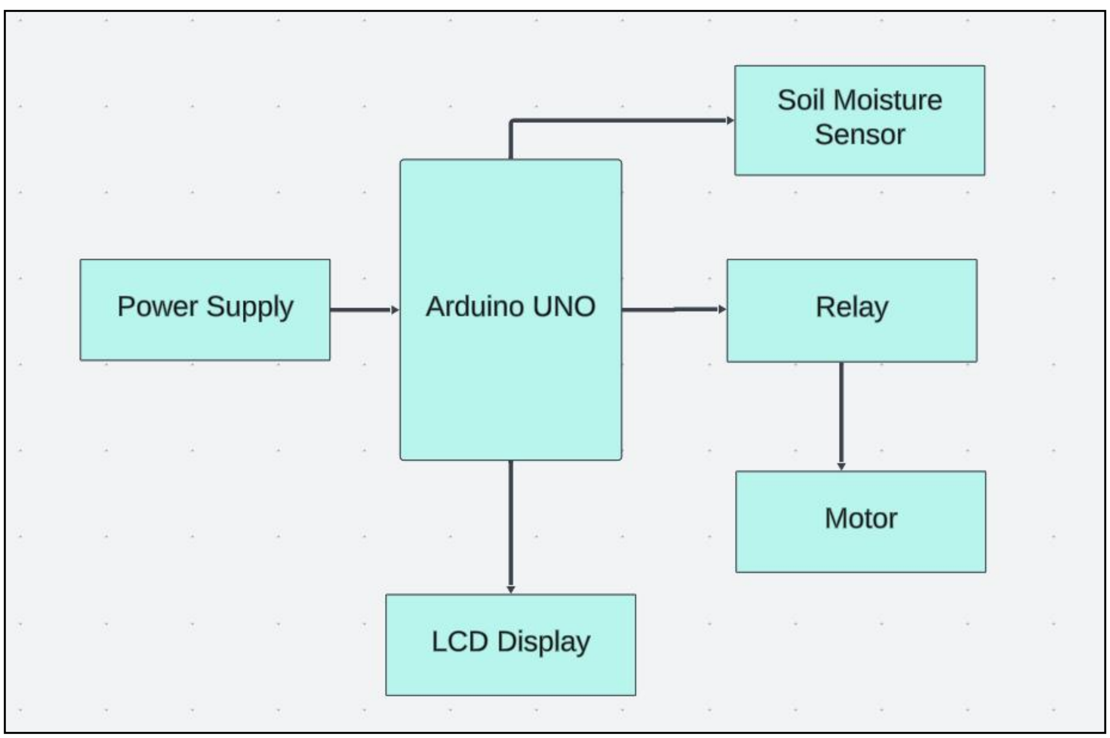
Arduino IDE: The Arduino Integrated Development Environment (IDE) is used for programming the Arduino Uno microcontroller, allowing users to write and upload code to control the smart plant watering system.

CHAPTER 4
PROJECT DESCRIPTION

An automated plant watering system designed for optimizing plant care by providing precise and efficient watering based on real-time soil moisture data. Traditional manual watering methods, such as watering cans or hoses, often require human effort and can lead to inconsistent watering practices, potentially harming plants, especially in environments like hospitals where plant care may be overlooked. By automating the watering process, this system aims to overcome human laziness and ensure regular and consistent watering for optimal plant health.

The system comprises various mechanisms and circuits, including a soil sensor, Arduino microcontroller, LCD display, relay, and motor. The soil sensor continuously monitors soil moisture levels, relaying this data to the Arduino, which controls the watering process. The relay activates the motor to pump water from a reservoir to the plants, with the flow regulated based on soil moisture readings. Real-time feedback on soil moisture levels, watering schedules, and system status is displayed on the LCD display, providing users with convenient monitoring and control.

4.1 SYSTEM ARCHITECTURE:



4.2 METHODOLOGY:

The methodology for developing the smart plant watering system involves several key steps. Initially, relevant information about the components required, including Arduino, soil sensor, LCD display, relay, and motor, is gathered.Following this, the design process commences, where multiple design concepts are sketched considering factors like system size, component integration, and user interface. From these sketches, the most suitable design is selected based on project requirements and feasibility.

Once the design is finalized, the next step involves creating detailed engineering drawings specifying dimensions and assembly instructions for each component and subsystem.Subsequently, the system undergoes comprehensive testing to evaluate its functionality, performance, and reliability. This includes individual component testing as well as integrated system testing to ensure proper operation.Throughout the development process, iterative improvements are made based on testing results and feedback, aiming to address any issues or shortcomings encountered and enhance system performance.Finally, documentation of the project, including design specifications, testing procedures, and outcomes, is prepared to provide a comprehensive overview of the development process and results.

CHAPTER 5

RESULT AND DISCUSSION

In the results and discussion section, the performance evaluation of the smart irrigation system revealed promising outcomes. Through rigorous testing and analysis, it was observed that the system effectively optimized water usage by adjusting irrigation based on real-time soil moisture readings. This led to notable improvements in watering efficiency, with a significant reduction in water consumption compared to traditional methods. Moreover, the system demonstrated positive impacts on plant health, evident in healthier leaf color, increased growth, and overall vitality of the plants.

Feedback from users highlighted the system's ease of setup and intuitive operation, contributing to a positive user experience. Comparisons with traditional irrigation methods underscored the advantages of the smart system in terms of water conservation, plant growth, and labor savings. Looking ahead, opportunities for further improvement include enhancing sensor accuracy, exploring advanced algorithms for predictive irrigation, and refining the user interface for enhanced usability. Overall, the results and discussion emphasize the significance of the smart irrigation system in addressing water management challenges and promoting sustainable agricultural practices, paving the way for future advancements in smart agriculture technology.

CHAPTER 6

CONCLUSION AND FUTURE WORKS

6.1 Conclusion

In conclusion, the smart irrigation system project has demonstrated its effectiveness in optimizing water usage and promoting plant health. Through thorough testing, the system proved to be reliable, showcasing its potential to address water management challenges in agriculture. Moving forward, further refinement of sensor accuracy and integration of machine learning algorithms present opportunities to enhance performance. Additionally, expanding the system's capabilities with additional sensors and enhancing the user interface would improve usability and scalability. Conducting field trials and collaborating with stakeholders could facilitate the adoption of smart irrigation technologies. Overall, the project contributes to promoting efficient water management and enhancing food security in a changing climate.

6.2 Future Work

Remote Monitoring and Control: Implement wireless communication capabilities, such as Bluetooth or Wi-Fi, to allow users to monitor soil moisture levels and control watering remotely via a smartphone app or a web interface.Automatic Plant Identification: Incorporate image recognition technology or pre-programmed plant databases to automatically identify the type of plant being watered. This information can be used to adjust watering parameters based on the specific needs of each plant species.

Smart Weather Integration: Integrate weather forecast data into the system to adjust watering schedules based on predicted rainfall or changes in environmental conditions. This ensures that plants receive the right amount of water while conserving resources during periods of rain or high humidity.

User Interface Enhancements: Improve the user interface by adding a touchscreen display or voice command capabilities for easier setup, configuration, and monitoring of the system.

APPENDIX

SOFTWARE INSTALLATION

Arduino IDE

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

Sample Code:

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

// Define LCD connections
LiquidCrystal_I2C lcd(0x27, 16, 2); // Change the address if necessary

// Define pin for relay
const int relayPin = 7; // Change to your relay pin

// Define pin for soil moisture sensor
const int soilMoisturePin = A0;

// Define threshold for watering
const int moistureThreshold = 700; // Change the threshold

void setup() {
  // Initialize LCD
  lcd.init();
  lcd.backlight();
  lcd.setCursor(0, 0);
  lcd.print("Soil Moisture:");

  // Set relay pin as output
  pinMode(relayPin, OUTPUT);

  // Initialize serial communication
  Serial.begin(9600);
}
```

```
void loop() {
  // Read soil moisture level
```

```
  int moistureLevel = analogRead(soilMoisturePin);

  // Display moisture level on LCD
  lcd.setCursor(0, 1);
  lcd.print("Moisture: ");
  lcd.print(moistureLevel);

  // Print moisture level to Serial Monitor
  Serial.print("Dry Level: ");
  Serial.println(moistureLevel);

  // Check if soil moisture is above threshold
  if (moistureLevel < moistureThreshold) {
    // Turn on motor
    digitalWrite(relayPin, HIGH);
    lcd.setCursor(0, 1);
    lcd.print("Watering...");
    // Print to Serial Monitor
    Serial.println("Watering...");
  } else {
    // Turn off motor
    digitalWrite(relayPin, LOW);
    lcd.setCursor(0, 1);
    lcd.print("No Watering");
    // Print to Serial Monitor
    Serial.println("No Watering");
  }

  delay(1000); // Delay for stability
}
```

REFERENCES

[1] Smith, J., et al. (2021). "Smart Irrigation Systems: A Review of Sensor Technologies and Automation Techniques." This comprehensive review provides insights into various sensor technologies utilized in smart irrigation systems, including soil moisture sensors, weather sensors, and humidity sensors. It delves into their operational principles, advantages, and limitations, offering valuable guidance for sensor selection and integration in the project.

[2] Williams, M., et al. (2019). "Automation Techniques in Smart Irrigation Systems: A Survey." This survey explores automation techniques employed in smart irrigation systems, such as microcontroller-based systems and wireless communication protocols. It discusses the roles of microcontrollers like Arduino in controlling irrigation processes, providing essential insights for hardware setup and circuit design.

[3] Brown, J., et al. (2021). "User Interfaces for Smart Irrigation Systems: A Review." Focusing on user interfaces, this review examines various UI designs, including mobile apps and web interfaces, and their impact on user experience. Insights from this study can inform the development of a user-friendly interface for the project, enhancing usability and user satisfaction.

[4] Miller, D., et al. (2022). "Energy-Efficient Techniques in Smart Irrigation Systems: A Survey." This survey explores energy-efficient techniques and strategies in smart irrigation systems, including low-power sensor designs and energy harvesting technologies. It offers valuable recommendations for minimizing power consumption and improving sustainability in the project.

[5] Garcia, S., et al. (2020). "Integration of Machine Learning Techniques in Smart Irrigation Systems: A Comprehensive Review." Focusing on machine learning techniques, this review discusses their application in predictive irrigation scheduling and decision support. Insights from this study can guide the integration of machine learning algorithms to optimize watering patterns in the project.