Automatic Irrigation System



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**ABSTRACT**

**Title: Automatic Irrigation System**

**Abstract:**

This project focuses on the design and implementation of an automatic irrigation system aimed at enhancing water efficiency and promoting optimal plant growth. The system utilizes a combination of soil moisture sensors, weather data, and a microcontroller to monitor and control the irrigation process. By dynamically adjusting watering schedules based on real-time conditions, the system ensures that plants receive adequate moisture without wasteful over-irrigation.

**Keywords:**

* Automatic irrigation system
* Water efficiency
* Plant growth
* Soil moisture sensors • Weather data, microcontroller.

i

## TABLE OF CONTENTS

Sample is given below:

Abstract ................................................................................................ ………...i

Chapter I: Introduction ................................................................................... 1

Introduction of Project

1.1: Statement of the Problem ........................................................ 1

1.2: Objectives ................................................................................ 3

Chapter II: Project Design/ Implementation.……………………….……...4

2.1: Overview of Hardware & Software Components

2.2: Design Diagram

2.3: Detail of Implementation Steps

2.4: Any Circuit Diagrams or Code Snippets

Chapter III: Testing/ Results.……………………………………..……...4

3.1: Assessment of system performance and effectiveness

Any Detail regarding Final Product and its functions + applications

Chapter IV: Conclusion & Recommendations…….……................................4 References

CHAPTER 1

# Introduction

**1.1 Introduction of the Project:**

The project focuses on developing an automatic irrigation system that utilizes advanced technologies to optimize plant watering. By integrating soil moisture sensors, weather data, and a microcontroller, the system ensures efficient water usage and promotes healthy plant growth.

**1.1.1 Statement of Problem:**

Inefficient manual irrigation methods hinder water conservation and compromise plant health, necessitating the development of an automatic irrigation system for improved water efficiency and optimal plant growth.

**1.1.2 Objectives:**

* Develop a reliable and accurate soil moisture sensing system to monitor the moisture levels in the soil.
* Design an automated control mechanism that adjusts irrigation schedules based on real-time data from soil moisture sensors and weather forecasts.
* Enhance water efficiency by delivering precise amounts of water tailored to the specific needs of plants.
* Improve plant health and growth by ensuring optimal soil moisture levels and preventing under or over-watering.
* Minimize water wastage by reducing manual intervention and utilizing automated irrigation processes.
* Provide a user-friendly interface for easy monitoring and management of the irrigation system.
* Evaluate the performance and effectiveness of the automatic irrigation system in comparison to traditional manual methods.
* Identify opportunities for further enhancements and potential integration with smart irrigation technologies.

CHAPTER 2

# Project Design/Implementation

**2.1 Overview of Hardware and Software Components:**

* **ESP 32:**

ESP32 is a widely used microcontroller module. The ESP32 module integrates a dual-core processor, Wi-Fi and Bluetooth connectivity, a variety of digital and analog inputs/outputs.

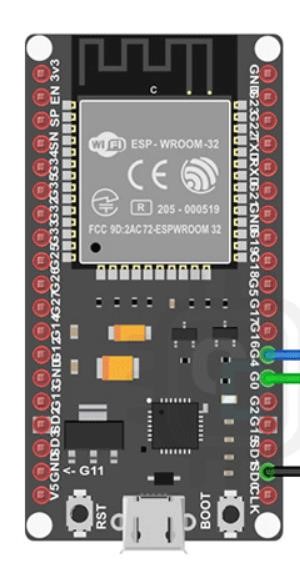


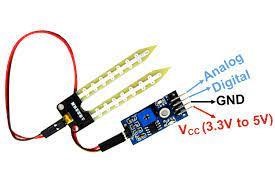
Fig 2.1**:** ESP 32 High Level Overview

* **Water Pipe:**



Fig 2.2: Water Pipe to spray water

* **Soil Moisture Sensors:**

 Fig 2.3: Soil Moisture Sensors

* **Water Storage Tank:**



Fig 2.3: Water Storage Tank

* **Power Supply:**



Fig 2.4: Power Supply

* 1. **Design Diagram:**

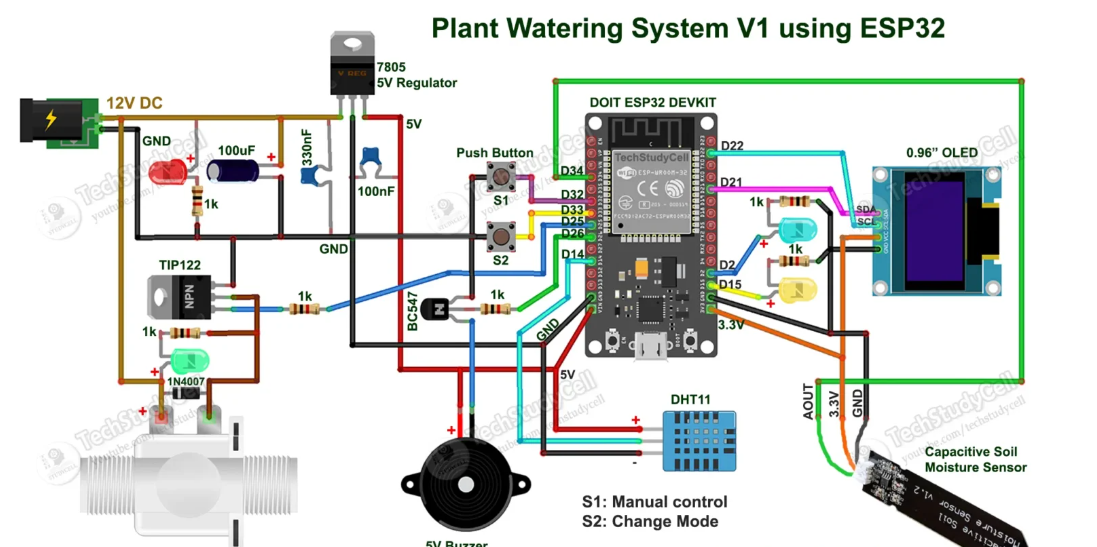


Fig 2.5: Design Diagram of Automatic Irrigation System

* 1. **Details of Implementation Steps:**

1. System Design and Planning:

* + - Define irrigation system requirements and objectives.
    - Select ESP32 microcontroller for control and data processing.

1. Sensor Installation:

* + - Determine optimal locations for soil moisture sensors.
    - Install soil moisture sensors in the ground and connect them to the ESP32.

1. ESP32 Programming:

* + - Set up the ESP32 programming environment.
    - Develop code to read soil moisture sensor data and integrate it with weather data.
    - Program the control logic to determine watering schedules and control solenoid valves.

1. Water Supply and Distribution:

* + - Set up water supply system, including a water source, pump, and storage tank.
    - Connect the water pump and solenoid valves to the ESP32.

1. Weather Data Integration:

* + - Integrate weather data API or use a weather station with the ESP32.
    - Develop code to retrieve and process real-time weather data for adjusting watering schedules.

1. User Interface Development:

* + - Design and develop a user-friendly interface using ESP32 web server capabilities.
    - Implement features for setting schedules and monitoring system status.

1. Testing and Calibration:

* + - Perform thorough testing of the system components and control logic.
    - Calibrate the system to optimize watering schedules and ensure accuracy.

1. Installation and Deployment:

* + - Install the automatic irrigation system in the target area, ensuring proper connections.
    - Test the system under real-world conditions to validate performance.

1. Monitoring and Maintenance:

* + - Regularly monitor the system's performance, including sensor readings and valve operations.
    - Perform maintenance tasks as needed, such as replacing sensors or updating software.

1. Documentation and Reporting:

* + - Document system design, component specifications, and programming details.
    - Prepare a final report summarizing the project objectives, implementation steps, and system evaluation.

**2.4 Code:**

#include <WiFi.h>

// WiFi credentials const char\* ssid = "Your\_WiFi\_SSID"; const char\* password = "Your\_WiFi\_Password";

// Server details const char\* serverIP = "Server\_IP\_Address"; const int serverPort = 80;

// Pins const int soilMoisturePin = A0; // Analog pin for soil moisture sensor const int solenoidValvePin = 2; // Digital pin for solenoid valve

// Thresholds and delays const int moistureThreshold = 500; // Adjust the value according to your soil and sensor const int wateringTime = 5000; // Time in milliseconds to water the plants

// Global variables bool isWatering = false;

// Establish WiFi connection void connectWiFi() { WiFi.begin(ssid, password);

while (WiFi.status() != WL\_CONNECTED) { delay(1000);

Serial.print(".");

}

Serial.println("");

Serial.println("WiFi connected");

Serial.print("IP address: ");

Serial.println(WiFi.localIP());

}

// Send watering command to server void sendWateringCommand() {

WiFiClient client; if (client.connect(serverIP, serverPort)) { client.print("GET /wateringCommand HTTP/1.1\r\n"); client.print("Host: "); client.print(serverIP); client.print("\r\n"); client.print("Connection: close\r\n"); client.print("\r\n"); delay(1000);

} client.stop();

}

// Start watering the plants void startWatering() { digitalWrite(solenoidValvePin, HIGH); isWatering = true; delay(wateringTime);

}

// Stop watering the plants void stopWatering() { digitalWrite(solenoidValvePin, LOW); isWatering = false;

}

// Setup function

void setup() { Serial.begin(115200); pinMode(solenoidValvePin, OUTPUT); connectWiFi();

}

// Main loop void loop() { int moistureValue = analogRead(soilMoisturePin);

if (!isWatering && moistureValue < moistureThreshold) { startWatering(); sendWateringCommand();

}

else if (isWatering && moistureValue >= moistureThreshold) { stopWatering();

}

delay(1000); // Adjust the delay based on your requirements

}

CHAPTER 3

# Testing/Results

**3.1 Assessment of System performance and Effectiveness:**

* Conduct extensive testing to validate the accuracy of soil moisture readings and control logic.
* Measure the impact of the automatic irrigation system on plant growth, yield, and water savings.
* Compare the system's performance with traditional manual irrigation methods to showcase its benefits.

**3.1.1 Final Product and its Functions/Applications:**

* The automatic irrigation system utilizing ESP32 provides precise watering based on soil moisture and weather data.
* Functions include real-time monitoring, automated control, and customizable watering schedules.
* Applications range from residential gardens to commercial agriculture, promoting water conservation and healthy plant growth.

CHAPTER 4

# Conclusion and Recommendations

**4.1 Conclusion:**

The implementation of the automatic irrigation system using ESP32 has shown promising results in enhancing water efficiency and promoting healthy plant growth. Through real-time monitoring of soil moisture and integration with weather data, the system effectively adjusts watering schedules, minimizing water waste and optimizing resource usage. The evaluation of system performance indicates improved plant health and substantial water savings compared to manual irrigation methods.

**4.2 Recommendations:**

1. Further refine and optimize the control logic of the system to accommodate specific plant requirements and environmental conditions for different regions and crops.
2. Explore the integration of additional sensors, such as pH and nutrient sensors, to enable comprehensive plant health monitoring and precise fertilization control.
3. Enhance the user interface by developing a mobile application for convenient remote monitoring and control of the irrigation system.
4. Conduct long-term field trials to evaluate the system's performance across different seasons and climates, considering variations in water requirements and environmental factors.
5. Collaborate with water management authorities and agricultural organizations to promote the adoption of automatic irrigation systems, highlighting the potential for water conservation and sustainable agriculture practices.
6. Continuously update and maintain the system to ensure reliable and accurate operation, including periodic calibration of sensors and software updates.

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