IOT BASED

PLANT WATERING SYSTEM

USING ESP-32

A PROJECT REPORT

Submitted by

DEEPAK RAJ S	**513121106301**
GOKUL R	**513121106701**
JANA K	**513121106703**

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THANTHAI PERIYAR GOVERNMENT INSTITUTE OF TECHNOLOGY, VELLORE-02.

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report **"IOT BASED PLANT WATERING SYSTEM USING ESP-32"** is the bonafide work of **"DEEPAK RAJ S – 513121106301, GOKUL R – 513121106701, JANA K – 513121106703"**who carried out the project work under my supervision.

SIGNATURE	**SIGNATURE**
Dr. S. LETITIA, M.E., Ph.D.,	**Mrs. S.SABARI RAJAN, M.E.,**
HEAD OF THE DEPARTMENT,	**PROJECT GUIDE,**
PROFESSOR,	**ASSISTANT PROFESSOR,**
Department of Electronics and	Department of Electronics and
Communication Engineering,	Communication Engineering,
ThanthaiPeriyar Govt. Institute	ThanthaiPeriyar Govt. Institute
of Technology,Vellore-632002.	of Technology,Vellore-632002.

Project work viva voce held on ________________

INTERNAL EXAMINER **EXTERNAL EXAMINER**

ABSTRACT

To accomplish In-Memory Computing (IMC) by implementing all fundamental two-input Boolean functions, a hybrid memory architecture based on a novel array of SRAM and Resistive Random-Access Memory (RRAM) cells is proposed. It is possible to set up the SRAM array as a dual-purpose component. The Proposed architecture can be utilized as an SRAM array to store data for high-performance applications. It can also be set up to read data from RRAMs and carry out In-memory computations as a sense amplifier (SA-SRAM). TheIndependent gate FINFETwhose channel is controlled by two separate gates, is used in the circuit design to increase design flexibility.The proposed 11T cell's leakage power consumption is also decreased by 67.05% and 35.15%, respectively, when compared with 6T and 10T SRAM cells. In addition, to address security concerns, the proposed polymorphic circuit primitive to prevent reverse engineering or integrated circuit (IC) counterfeiting. Furthermore, the energy consumption of our design in application areas like image processing is significantly less than the well-known comparative in-memory architecture solution.

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INTRODUCTION

Water scarcity and inefficient irrigation practices pose significant challenges to modern agriculture, threatening food security and environmental sustainability. With the global population projected to reach nearly 10 billion by 2050, the demand for food production is expected to increase substantially, placing greater pressure on already strained water resources. In this context, there is an urgent need for innovative solutions that optimize water usage while maximizing crop yields.

Traditional irrigation methods, such as flood irrigation or manual watering, often result in overwatering or underwatering, leading to water wastage, soil erosion, and reduced crop productivity. To address these challenges, the integration of Internet of Things (IoT) technology with agricultural practices offers promising opportunities for smart, automated water management systems.

This paper introduces an IoT-based plant watering system designed to enhance water efficiency and optimize irrigation processes in agriculture. By leveraging IoT sensors, microcontrollers, and actuators, this system enables real-time monitoring of soil moisture levels and precise delivery of water to plants based on their specific requirements. The integration of remote monitoring and control capabilities further enhances the system's functionality, allowing farmers to manage irrigation operations efficiently from anywhere, at any time.

The remainder of this paper will delve into the design, implementation, and benefits of the IoT-based plant watering system. It will discuss the key components of the system, its operational principles, and its potential impact on sustainable agriculture. Additionally, it will explore the implications of this technology for water conservation, resource optimization, and the future of smart farming practices. Through this examination, we aim to highlight the significance of IoT-enabled solutions in addressing the complex challenges facing modern agriculture and fostering a more resilient and sustainable food production system.

IOT BASED PLANT WATERING SYSTEM FOR SMART AGRICULTURE

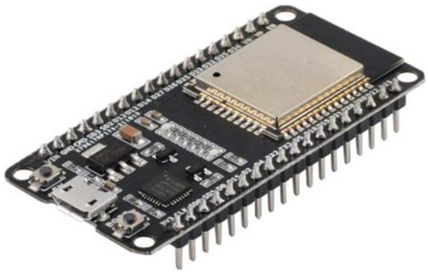
The objective of this paper is to introduce and explore the implementation of an IoT-based plant watering system designed to enhance water efficiency and optimize irrigation processes in agriculture. By discussing the system's design, implementation, and benefits, this paper aims to highlight the significance of IoT technology in addressing the challenges of water scarcity and inefficient irrigation practices. Additionally, the paper will examine the implications of this technology for sustainable agriculture, emphasizing its potential to improve crop productivity while minimizing environmental impact. Through this exploration, we seek to underscore the importance of embracing IoT-enabled solutions to meet the growing demands of modern agriculture and foster a more resilient and sustainable food production system.

COMPONENTS REQUIRED

1. ESP32 microcontroller
2. Relay module
3. Water pump motor
4. Soil moisture sensor
5. LCD display (16x2 or similar)
6. Jumper wires
7. Breadboard
8. Power supply (battery or adapter)

ESP32 microcontroller:

The ESP32 is a popular microcontroller developed by Espressif Systems. It's widely used in IoT (Internet of Things) projects due to its versatility and capabilities. The ESP32 features a dual-core processor, Wi-Fi and Bluetooth connectivity, various digital and analog I/O pins, and support for a range of protocols and interfaces, making it suitable for a wide range of applications including home automation, sensor networks, wearable devices, and more.



Relaymodule:

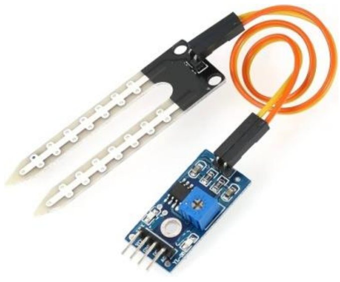
A relay module is an electronic device that acts as a switch controlled by an external signal. It typically consists of a relay, which is an electromechanical switch, and supporting circuitry like a transistor or optocoupler. The relay module is used to control high-power or high-voltage devices using a low-voltage signal, such as from a microcontroller or sensor.

Water pump motor:

A water pump motor is an electric motor specifically designed to power water pumps. These motors are engineered to provide the necessary torque and power to drive the impeller or other mechanisms within the pump to move water from one place to another.

Soil moisture sensor:

A soil moisture sensor is a device used to measure the moisture content of soil. It typically consists of two or more conductive probes that are inserted into the soil. As the moisture level in the soil changes, the electrical conductivity between the probes also changes. This change in conductivity is then measured by the sensor and converted into a moisture level reading.



LCD display:

An LCD (Liquid Crystal Display) with a 16x2 configuration is a common type of alphanumeric display used in various electronic devices, such as digital clocks, appliances, and DIY projects. The "16x2" refers to the dimensions of the display, with 16 characters per line and 2 lines of text.These displays are popular because they are relatively inexpensive, easy to interface with microcontrollers and other electronic circuits, and offer a simple way to display information in a compact format. They typically feature a backlight for improved visibility in different lighting conditions.

WORKING:

1. Soil Moisture Sensing:

• The soil moisture sensor (connected to pin A0 of the ESP32) measures the moisture level in the soil.

• The moisture level is read using the analogRead() function, which returns a value between 0 and 1023.

2. Displaying Moisture Level:

• The moisture level is mapped to a percentage value using the map() function.

• The percentage value is then displayed on the 16x2 LCD display.

3. Controlling the Watering System:

•If the moisture level falls below a certain threshold (50% in this example), the relay (connected to pin 2 of the ESP32) is activated.

•The relay, in turn, controls the water pump motor.

•The pump runs for 5 seconds (delay(5000)) to water the plant.

4. Looping:

•This process repeats in the loop() function.

•The moisture level is continuously monitored, and the plant is watered as needed.

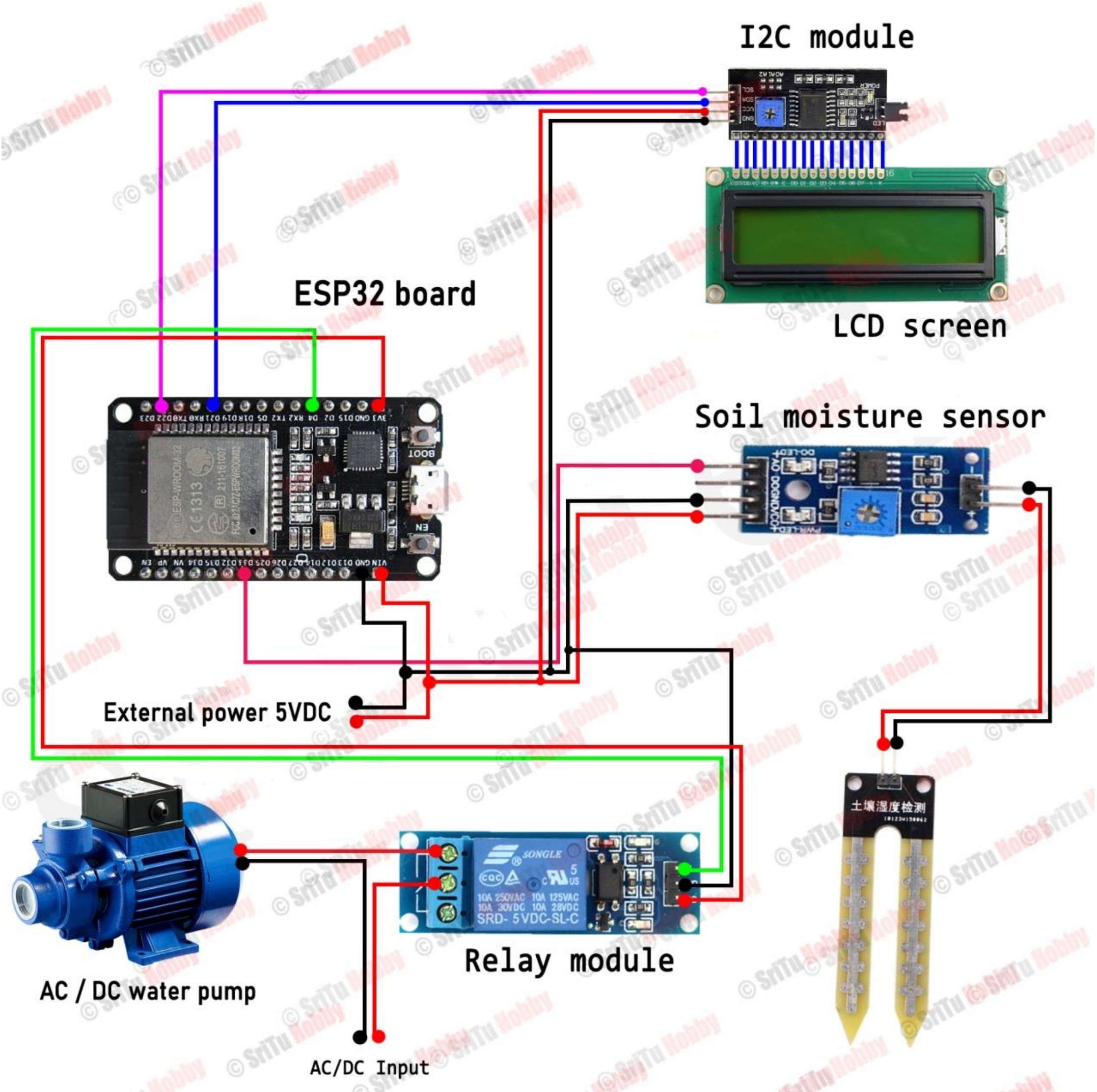
5. LCD Display:

•The LCD display is initialized in the setup() function and shows the current soil moisture level in percentage.

6. Power Supply:

•The system can be powered using a battery or an adapter connected to the ESP32.

CIRCUIT DIAGRAM



PROGRAM

```
#include <Wire.h> // Include I2C library for communication

#include <LiquidCrystal_I2C.h> // Include I2C LiquidCrystal library


const int I2C_ADDRESS = 0x27; // Replace with your I2C LCD address (check datasheet)

LiquidCrystal_I2C lcd(I2C_ADDRESS, 2, 3); // Initialize I2C LCD object


int pump = 13;

int LED = 12;

int buz = 11;

int d = 0;


int ledState = LOW;

int pumpState = LOW;

unsigned long previousMillis = 0;

const long interval = 200;

unsigned long previousMillis2 = 0;

const long interval2 = 30000;


void setup() {

  lcd.init(); // Initialize I2C LCD communication

  lcd.backlight(); // Turn on backlight (optional)

  pinMode(LED, OUTPUT);

  pinMode(buz, OUTPUT);

  pinMode(pump, OUTPUT);
```

```
  Serial.begin(9600);
}

void loop() {
  d = Serial.read();

  if (d == 'p') {
    lcd.clear();
    lcd.print(" Fire Detected ");

    Blink();

    digitalWrite(pump, HIGH);
    delay(800);
  }

  if (d == 's') {
    lcd.clear();
    lcd.print("Capturing Video...");
    digitalWrite(LED, LOW);
    digitalWrite(buz, LOW);
    unsigned long currentMillis2 = millis();
    if ((unsigned long)(currentMillis2 - previousMillis2) >= interval2) {
      digitalWrite(pump, LOW);
```

```
      previousMillis2 = currentMillis2;
    }
    delay(5);
  }
}

void Blink() {
  unsigned long currentMillis = millis();
  if (currentMillis - previousMillis >= interval) {
    previousMillis = currentMillis;
    if (ledState == LOW) {
      ledState = HIGH;
    } else {
      ledState = LOW;
    }
    digitalWrite(LED, ledState);
    digitalWrite(buz, ledState);
  }
}
```

OUTPUT

CONCLUSION

The IoT-based plant watering system, incorporating components like the ESP32 microcontroller, relay, water pump motor, soil moisture sensor, and LCD display, marks a significant advancement in the realm of smart agriculture. This convergence of technology and plant care offers an automated solution for maintaining optimal soil moisture levels, crucial for plant health. Through the seamless integration of these components, the system automates the watering process, eliminating the risks associated with manual watering practices such as over or under watering. By accurately monitoring soil moisture levels in real-time, the system ensures that plants receive the right amount of water at the right time, promoting healthy growth and maximizing yield. The inclusion of an LCD display provides users with easily accessible information on soil moisture levels, system status, and potential alerts. Moreover, the system's potential for further enhancement through Wi-Fi connectivity opens up avenues for remote monitoring and control, enhancing convenience and enabling proactive maintenance. This connectivity also facilitates data logging and analysis, allowing users to gain deeper insights into plant health and environmental conditions. Furthermore, the system's modularity and open-source nature encourage community collaboration and innovation, driving advancements in precision agriculture. As interest in sustainable living and urban gardening grows, technologies like the IoT-based plant watering system have the potential to empower individuals and communities to cultivate their own food in a resource-efficient manner, contributing to food security and self-sufficiency efforts. In conclusion, the IoT-based plant watering system represents a promising marriage of technology and agriculture, offering an efficient, automated, and customizable solution for nurturing healthy plants while conserving water and empowering users to become more resilient in their gardening endeavors.