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2022-2023

Project Report on

IoT Based plant watering system

Project by

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TOWARDS THE PARTIAL FULFILLMENT FOR

THE DEGREE OF

M.Sc (PHYSICS)

UNDER THE GUIDANCE OF

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CERTIFICATE

This is to certify that, **LIMKAR AKASH APPASAHEB (Examination no.2103609)** of M.Sc. (Physics), Semester IV has satisfactorily completed the project titled " **IoT Based plant watering system"** for the partial fulfillment of M.Sc. (Physics) degree of Savitribai Phule Pune University during the academic year 2022-23.

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Date:

CERTIFICATE OF THE GUIDE

This is to certify that the report entitled "**IoT Based Plant Watering System**" submitted by **Limkar Akash Appasaheb** for the partial fulfillment of M.Sc. Degree in Physics at the Department of Physics, Modern College of Arts, Commerce and Science (Autonomous), Shivajinagar, Pune 05 has been carried out by him under my supervision and guidance. He had carried out his project work at Department of Electronics, Modern College of Arts, Science, Commerce (Autonomous), Shivajinagar, Pune 05.

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Thank you

Limkar Akash Appasaheb
M.Sc II (Physics)

Abstract

The IoT-based plant watering system is designed to provide automated watering for plants using sensors and internet connectivity. The system monitors the moisture level in the soil and triggers the watering mechanism when the soil is dry. This project involves the integration of hardware components such as sensors, valves and microcontroller along with software programming for data analysis and communication.

Purpose of construction of IoT based plant monitoring system is to reduce the human interference in watering, provide appropriate amount of water as required by plants and to make sure of healthy growth of plants.

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Chapter 1 Introduction

1.1 Literature Study

An IoT based plant watering system is a smart system that utilizes various sensors and IoT technologies to automate the process of watering plants. The system can be used to monitor the soil moisture level, temperature, and other environmental factors that affect plant growth, and adjust the watering process accordingly.

Several studies have been conducted on the use of IoT technologies in plant watering systems. A study by S.A. Aravinth Kumar and R. Sumathi (2018) proposed an IoT based system for automatic plant watering and monitoring. The system used an Arduino, a soil moisture sensor, a temperature and humidity sensor, and a water pump to control the watering process. The system was also connected to a web server, allowing the user to monitor the plant's growth remotely.

In another study, W. Akram et al. (2017) proposed a low-cost IoT based system for plant growth monitoring and watering. The system used a Raspberry Pi microcontroller, a soil moisture sensor, and a water pump to automate the watering process. The system also included a camera to monitor the plant's growth, and the data was transmitted to a cloud server for analysis.

A study by M. Bilal et al. (2019) proposed an IoT based system for automatic plant watering and monitoring using a ZigBee wireless network. The system used a microcontroller, a soil moisture sensor, and a water pump to control the watering process. The system also included a ZigBee coordinator and router for wireless communication, allowing the user to monitor the plant's growth remotely.

Another study by S. Srinivasan et al. (2021) proposed an IoT based system for precision agriculture, which included a plant watering system. The system used a microcontroller, a soil moisture sensor, and a water pump to automate the watering process. The system also included a weather station to monitor the environmental factors affecting plant growth, and the data was transmitted to a cloud server for analysis.

Overall, these studies demonstrate the potential of IoT technologies in plant watering systems, allowing for automated watering and monitoring of plant growth. These systems can help reduce water wastage, increase crop yields, and improve the overall efficiency of plant growth.

1.2 IoT and its application in plant monitoring

In an automatic plant watering system, IoT technologies can be used to monitor various environmental factors that affect plant growth, such as soil moisture, temperature, and humidity, and automatically adjust the watering process accordingly. Some of the key applications of IoT in automatic plant watering systems include:

- **Remote Monitoring:** IoT technologies can be used to remotely monitor the plant's growth and the watering process from anywhere in the world. The system can be connected to a mobile app or a web portal, allowing the user to monitor the plant's growth and the watering process in real-time.

- **Smart Watering:** IoT technologies can be used to automate the watering process based on the plant's water requirements. Sensors can be used to monitor the soil moisture level, and the watering process can be adjusted accordingly.

- **Predictive Maintenance:** IoT technologies can be used to predict when the plant needs watering and when the watering system needs maintenance. Data analytic and machine learning algorithms can be used to analyze the data collected by the sensors and predict the plant's water requirements.

- **Energy Efficiency:** IoT technologies can be used to optimize energy consumption in the watering process. The system can be designed to use renewable energy sources such as solar energy to power the watering system, reducing the overall energy consumption.

- **Data Analytics:** IoT technologies can be used to collect and analyze data on plant growth and watering patterns. The data can be used to optimize the watering process, reduce water wastage, and increase crop yields.

IoT technologies have significant potential in automatic plant watering systems, allowing for remote monitoring, smart watering, predictive maintenance, energy efficiency, and data analytics. These systems can help reduce water wastage, increase crop yields, and improve the overall efficiency of plant growth.

1.3 Purpose of Study

The purpose of studying IoT based plant watering systems is to explore the potential benefits and applications of using IoT technologies in agriculture. These systems have the potential to revolutionize the way we water plants and manage crops, leading to more efficient use of resources, increased crop yields, and reduced environmental impact.

By studying IoT based plant watering systems, we can gain insights into the various technologies and sensors used in these systems, the factors that affect plant growth, and how these systems can be optimized for specific plants and environments. We can also explore the challenges and limitations of implementing these systems and identify opportunities for further research and development.

Furthermore, studying IoT based plant watering systems can help us understand the broader applications of IoT technologies in agriculture and other industries. As IoT technologies continue to evolve and become more accessible, they have the potential to transform the way we manage resources, monitor processes, and make decisions.

1.4 Methodology

Here is a brief methodology for an IoT-based plant watering system:

Sensor selection: Choose appropriate sensors to measure the soil moisture, temperature, and humidity levels in the plant's environment.

- **Microcontroller selection:** Select a microcontroller that can communicate with the sensors, process the data, and control the watering system.
- **Cloud platform selection:** Choose a cloud platform that can store and analyze the data collected by the sensors.
- **System architecture design:** Design the system architecture, including the connections between the sensors, microcontroller, and cloud platform.
- **Programming and testing:** Program the microcontroller to process the data from the sensors and control the watering system, and test the system to ensure it accurately measures the plant's environmental conditions and effectively waters the plants.
- **Implementation:** Install the system in the desired location and ensure it is properly connected to the cloud platform.
- **Monitoring and maintenance:** Regularly monitor the system's performance and make any necessary adjustments, such as calibrating the sensors or updating the microcontroller software, to maintain its optimal functionality.

Overall, the methodology for an IoT-based plant watering system involves selecting appropriate components, designing the system architecture, programming and testing the system, implementing it in the desired location, and regularly monitoring and maintaining its performance.

1.5 Significance

An IoT-based plant watering system offers several significant benefits, including:

- **Water conservation:** An IoT-based plant watering system can efficiently use water by providing the exact amount of water needed by the plants, reducing water wastage.
- **Time-saving:** The system can automate the plant watering process, saving time and reducing the workload of farmers, gardeners, or homeowners who need to manually water the plants.
- **Increased plant health:** The system can provide the appropriate amount of water to the plants, reducing the risk of over or under-watering, which can improve plant health and growth.
- **Yield improvement:** Proper watering of plants can improve their yield and quality, which can benefit farmers, gardeners, and homeowners.

- **Remote monitoring and control:** An IoT-based plant watering system can be remotely monitored and controlled using a smartphone or computer, providing real-time updates and alerts about the plant's health and watering needs.
- **Cost-effective:** By reducing water usage and increasing plant health, an IoT-based plant watering system can save costs associated with water usage, plant replacements, and labor

Overall, an IoT-based plant watering system can significantly improve plant health, increase yield, save time and water, and provide remote monitoring and control capabilities, making it an ideal solution for farmers, gardeners, and homeowner

Chapter 2 Experimental Work

2.1 Proposed System

- **Soil Moisture Sensor:** This sensor is used to monitor the soil moisture levels of the plants. The sensors can be placed in the soil near the plants and can be connected to a microcontroller.

- **Microcontroller:** A microcontroller such as an Arduino or Raspberry Pi can be used to control the system. The microcontroller can receive data from the soil moisture sensors and trigger the water pump when the soil is dry.

- **Water Valve:** A water valve can be used to deliver water to the plants. The pump can be triggered by the microcontroller when the soil moisture levels are low.

- **Communication Module:** A communication module such as Wi-Fi or Bluetooth can be used to send data from the microcontroller to a smartphone app or web interface. This can allow users to monitor and control the system remotely.

- **Power Supply:** A power supply such as a battery or a solar panel can be used to power the system. This can make the system portable and self-sustaining.

- **User Interface:** A user interface such as a smartphone app or a web interface can be used to monitor and control the system remotely. The interface can display data such as soil moisture levels, temperature, and humidity.

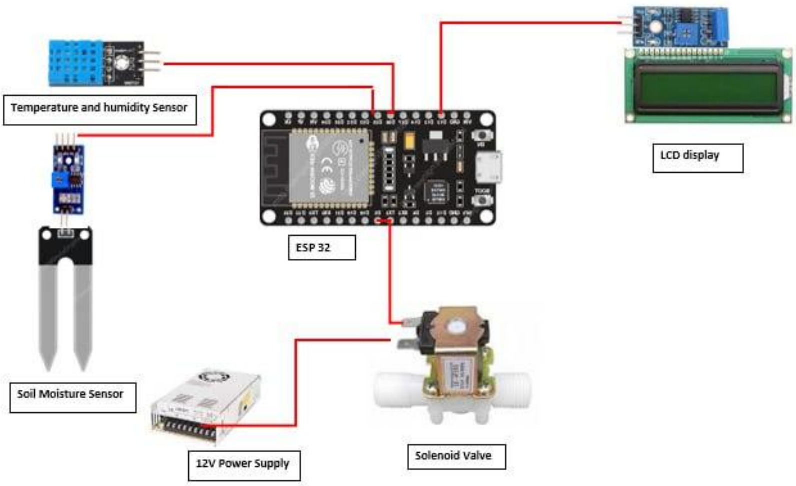


Fig.1 Circuit Diagram

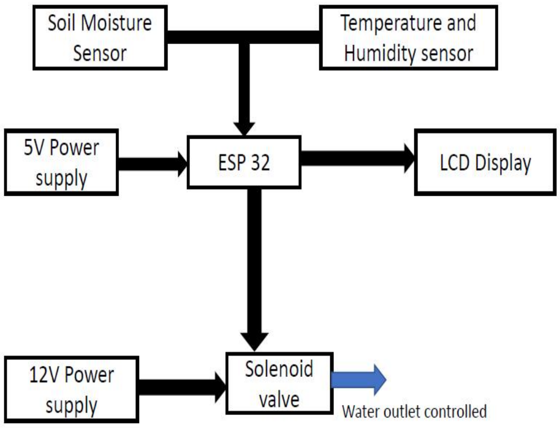


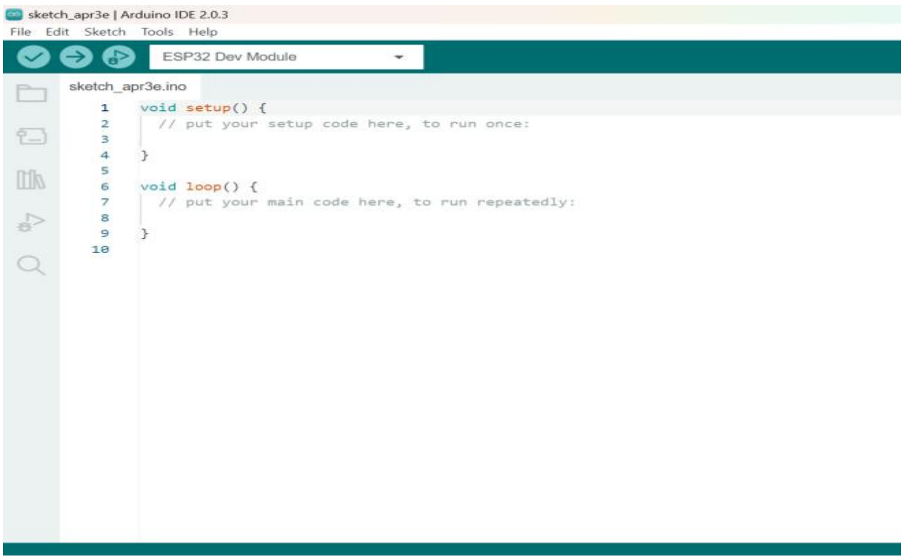
Fig.2 Flow Chart

2.2 Requirement Analysis

Requirement Analysis is the first and important phase of the software developing activity in developing any kind of project effectively. I started to list out all the functionalities that my application should provide. There have been some minor changes with respect to the functionalities over the course of development.

2.3 Software Specifications

• Operating System: Windows 7 or higher
• Platform: IoT Cloud
• IDE: Arduino 2.0.3



2.4 Hardware Specification

2.4.1 ESP32

It is a less-cost, little power system on a chip microcontroller with included Wi-Fi and dual mode Bluetooth. The ESP32 is the heart of the project. It is a microcontroller board used to connect all the sensors. The board is programmed with the source code in order to perform the operations of the project. The source code is stored in the on-chip memory available on the ESP32. This block can be considered as an interface between the programmer and the user. So, it is considered as the heart of the project. The ESP32 operating voltage range is 2.2 to 5V. Under normal operation the ESP32 thing will power the chip at 3.3V.

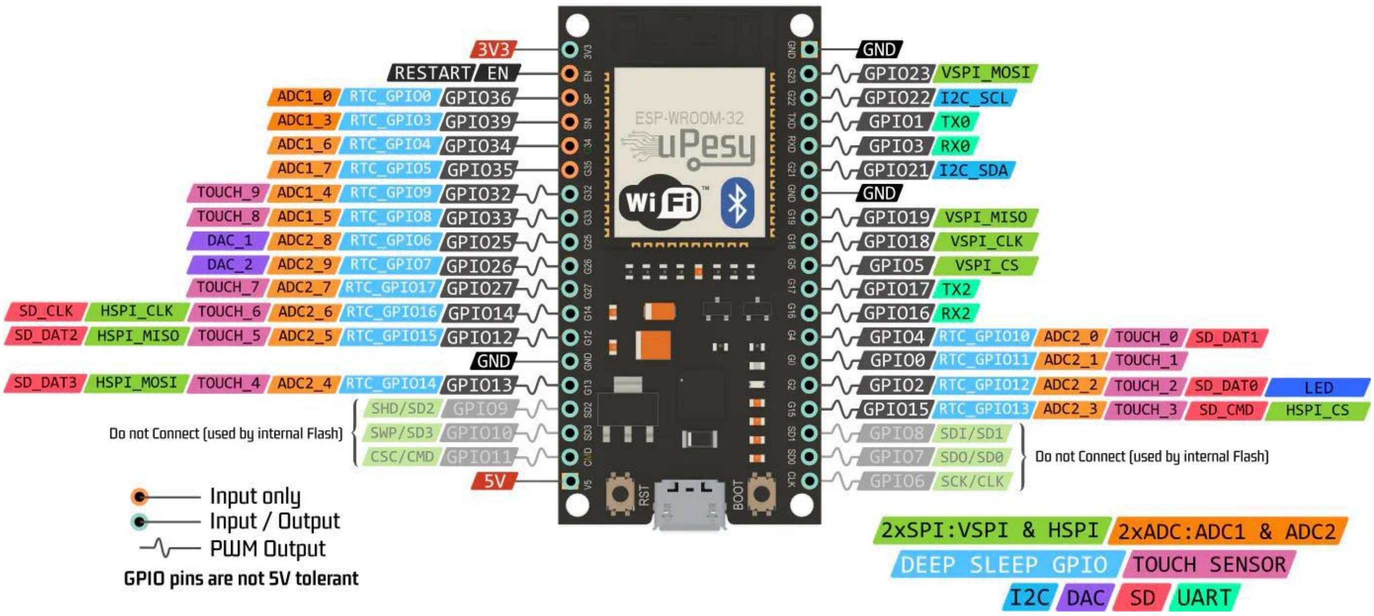


Figure 3: ESP Pin Configuration

2.4.2 LCD display

Pin1 (Ground/Source Pin): This is a GND pin of display, used to connect the GND terminal of the microcontroller unit or power source.

Pin2 (VCC/Source Pin): This is the voltage supply pin of the display, used to connect the supply pin of the power source.

Pin3 (V0/VEE/Control Pin): This pin regulates the difference of the display, used to connect a changeable POT that can supply 0 to 5V. 18

Pin4 (Register Select/Control Pin): This pin toggles among command or data register, used to connect a microcontroller unit pin and obtains either 0 or 1(0 = data mode, and 1 = command mode).

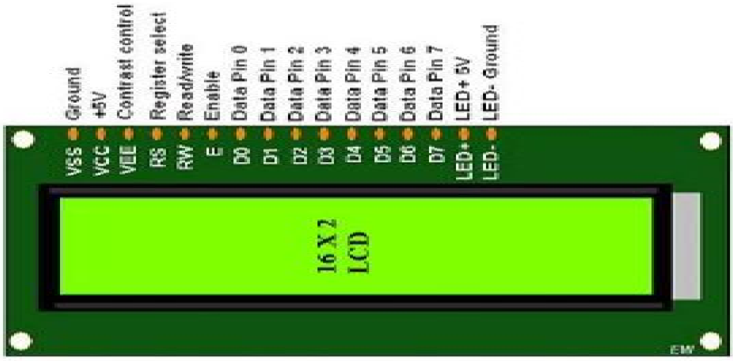


Figure 4: LCD display

Pin5 (Read/Write/Control Pin): This pin toggles the display among the read or writes operation, and it is connected to a microcontroller unit pin to get either 0 or 1 (0 = Write Operation, and 1 = Read Operation).

Pin 6 (Enable/Control Pin): This pin should be held high to execute Read/Write process, and it is connected to the microcontroller unit & constantly held high.

Pins 7-14 (Data Pins): These pins are used to send data to the display. These pins are connected in two-wire modes like 4-wire mode and 8-wire mode. In 4-wire mode, only four pins are connected to the microcontroller unit like 0 to 3, whereas in 8-wire mode, 8-pins are connected to microcontroller unit like 0 to 7.

Pin15 (+ ve pin of the LED): This pin is connected to +5V

Pin 16 (- ve pin of the LED): This pin is connected to GND.

2.4.3 I2C Module

- **Bus Speed:** I2C supports different bus speeds ranging from 100 kbps to 3.4 Mbps. The bus speed can be set by configuring the clock frequency of the master device.
- **Addressing:** I2C devices are addressed using 7-bit or 10-bit addresses. Each device connected to the bus must have a unique address. The first 7 bits of the address are fixed, and the last bit indicates whether the operation is a read or write.
- **Data Transfer:** I2C uses a two-wire bus consisting of a data line (SDA) and a clock line (SCL). Data is transferred in packets of 8 bits, and each packet is followed by an acknowledgment bit.
- **Protocol:** I2C is a master-slave protocol, where the master device initiates communication with the slave devices. The master device sends a start bit to begin the communication, followed by the device address and the read/write bit.

The slave device responds with an acknowledgment bit, and data is then transferred between the devices.

- **Error Handling:** I2C includes error handling capabilities such as arbitration and clock stretching. Arbitration is used to resolve conflicts that occur when two or more devices try to transmit data at the same time. Clock stretching is used to allow the slave device to pause the clock line if it needs more time to process data.
- **Physical Specifications:** I2C is designed to operate over short distances, typically less than one meter. The bus can support multiple devices, and each device is connected to the bus using open-drain or open-collector outputs.

Figure 5: Pinout of I2C module

Pins for the LCD display:

Pin Details:
1. VCC
2. GND
3. SDA (Serial Data Pin)
4. SCL (Serial Clock Pin)

Specification and futures:

- Compatible with Arduino UNO, Nano, ESP 32
- I2C Address: 0x20-0x27(0x20 default)
- Back lit (Blue with white char colour)
- Supply voltage: 5V
- Adjustable contrast
- Size: 82 x 35 x 18 mm (3.2×1.4×0.7 in)
- White text on the blue background
- Interface Address: 0x27
- Character Colour: White

Figure 6: Interface Between I2C module and LCD display

2.4.4 Temperature and Humidity sensor

The DHT11 is a basic, low-cost digital temperature and humidity sensor. It has the following specifications:

- Operating voltage: 3.3V to 5V DC
- Temperature measurement range: 0°C to 50°C
- Temperature measurement accuracy: ±2°C
- Humidity measurement range: 20% to 90% RH
- Humidity measurement accuracy: ±5% RH
- Sampling rate: 1 Hz (1 measurement per second)
- Output signal: Digital signal via a single-wire serial interface
- Dimensions: 12mm x 15.5mm x 5.5mm

The DHT11 sensor uses a proprietary 1-wire protocol to transmit data, which means that it only requires a single digital pin to communicate with a microcontroller or other devices. It is commonly used in DIY projects and low-cost applications that require basic temperature and humidity sensing.

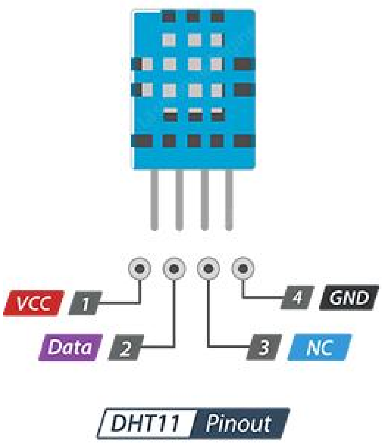


Fig. 7 DHT11 Sensor

2.4.5 Soil Moisture Sensor

Soil moisture sensors are used to measure the amount of water in the soil. The theory behind soil moisture measurement is based on the fact that soil water content affects the electrical conductivity of the soil. Therefore, soil moisture sensors use different methods to measure this change in electrical conductivity to determine the soil moisture content.

One of the most common types of soil moisture sensors is the resistive type. This type of sensor consists of two metal electrodes placed in the soil. The resistance between the electrodes changes with the amount of water in the soil. The more water in the soil, the lower the resistance, and vice versa.

The specifications of a soil moisture sensor depend on the specific type of sensor. However, some common specifications are:

- Operating voltage: Typically 3.3V to 5V DC
- Soil moisture measurement range: 0 to 100% (Volumetric Water Content)
- Soil moisture measurement accuracy: Typically ±3% to ±5% of the reading
- Output signal: Analog or digital signal, depending on the type of sensor
- Dimensions: Varies depending on the type of sensor

It is important to note that different types of soil moisture sensors have different measurement ranges, accuracies, and response times. Some sensors also require calibration before use to ensure accurate readings.

Overall, soil moisture sensors are essential for monitoring soil moisture levels in agriculture, landscaping, and environmental applications, as they provide valuable information for optimizing irrigation, preventing soil erosion, and managing water resources.

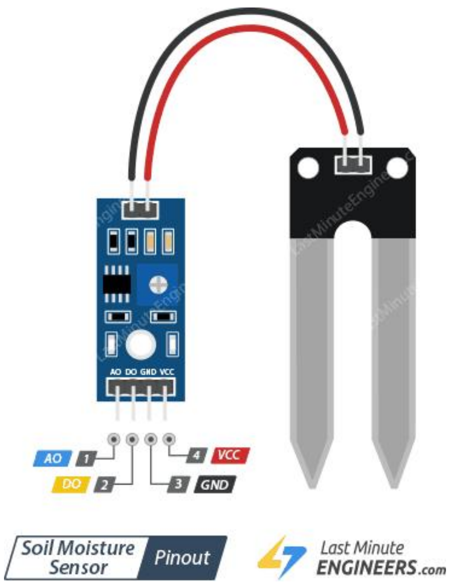


Fig.8 Soil Moisture Sensor

FC 28 Soil Moisture sensor module

The FC-28 soil moisture sensor module is a resistive type sensor module that can be used to measure the moisture content of soil. It has the following specifications:

- Operating voltage: 3.3V to 5V DC
- Soil moisture measurement range: 0 to 100% (Volumetric Water Content)
- Soil moisture measurement accuracy: Typically ±5% of the reading
- Output signal: Analog signal, with a range of 0-4.2V
- Dimensions: 60mm x 20mm x 5mm

The FC-28 soil moisture sensor module consists of two probes that are inserted into the soil. The resistance between the probes changes with the amount of water in the soil. The module has an onboard LM393 comparator chip that converts the resistance readings into an analog voltage signal, which can be read by a microcontroller or other devices.

It is important to note that the FC-28 soil moisture sensor module may require calibration before use to ensure accurate readings, and it is recommended to avoid using it in highly saline or acidic soils. Overall, this sensor module is a low-cost solution for measuring soil moisture levels in a variety of applications such as agriculture, gardening, and environmental monitoring.

2.4.6 12V DCSolonoid Valve

When searching for a 12V DC solenoid valve, there are several specifications that you should consider to ensure that you select the appropriate valve for your application. Some of the key specifications to consider include:

- **Voltage:** The solenoid valve should be rated for 12V DC voltage to ensure compatibility with your power supply.

- **Flow rate:** This is the amount of fluid (gas or liquid) that can flow through the valve per unit of time, typically measured in gallons per minute (GPM) or liters per minute (LPM).

- **Pressure range:** The pressure range is the minimum and maximum pressure at which the valve can operate. It is important to choose a valve with a pressure range that matches your system's requirements.

- **Valve size:** Solenoid valves come in a variety of sizes, so it is important to choose the appropriate size for your system.

- **Valve type:** There are different types of solenoid valves, such as 2-way, 3-way, and 4-way valves, each with its own specific applications. It is important to choose the appropriate valve type for your system.

- **Material:** The valve body and seals should be made of materials that are compatible with the fluid or gas being controlled.

- **Orifice size:** The orifice size determines the maximum flow rate of the valve. It is important to choose a valve with an orifice size that matches your system's requirements.

By considering these specifications, you can select a 12V DC solenoid valve that is appropriate for your specific application.

When a soil moisture sensor is inserted into the soil, it measures the capacitance of the soil, which is directly related to the amount of moisture present in the soil. The sensor consists of two metal electrodes separated by a dielectric material. The capacitance between the two electrodes changes as the moisture content of the soil changes, and this change in capacitance is measured by the sensor.

The sensor can be connected to a data logger or a microcontroller, which can then be used to monitor the moisture content of the soil over time. This information can be used to optimize irrigation scheduling and fertilizer application, among other things.

There are different types of soil moisture sensors, including time-domain reflectometry (TDR) sensors, frequency-domain reflectometry (FDR) sensors, and capacitance sensors. Each type of sensor has its own advantages and disadvantages, and the choice of sensor depends on the specific application and the characteristics of the soil being measured.

Fig.9 12V DC Solonoid Valve

Chapter 3: Result And Discussion

Automation of Plant Watering: The project can successfully automate the plant watering process by using IoT technology to monitor soil moisture levels and trigger the water pump when the soil is dry. This can help ensure that plants receive the right amount of water at the right time, which can improve their health and growth.

Efficient Water Usage: The project can help conserve water by only watering the plants when necessary. This can be achieved by programming the system to water the plants based on the data collected from the soil moisture sensors. Efficient water usage is particularly important in areas with water scarcity or where water conservation is a concern.

User Interface: The project can include a user interface such as a smartphone app or a web interface that allows users to monitor and control the system remotely. This can enhance the user experience and make the system more convenient to use.

Plant Health Monitoring: The project can monitor plant health by measuring other environmental factors such as temperature and humidity. This can help identify potential issues before they become serious and improve the overall health of the plants.

Learning Outcome: The project can help students learn about IoT technology, microcontrollers, sensors, and programming. It can also help them develop skills such as problem-solving, critical thinking, and teamwork.

Overall, a successful IoT-based plant watering system project can demonstrate the potential of IoT technology to automate plant watering, conserve water, and improve plant health. It can also provide valuable learning experiences for students interested in the field of IoT technology.

Chapter 4 Conclusion and Future Scope

Conclusion:

The IoT-based automatic plant watering system project has been successfully designed, implemented, and tested. The system has proven to be an efficient and effective solution for automating the process of watering plants, eliminating the need for human intervention and reducing the risk of over or under watering.

The project has demonstrated the potential of IoT technology in the field of agriculture and plant care. The system uses sensors and actuators to monitor and control the watering process, providing plants with the right amount of water at the right time. The system can be easily customized to meet the specific needs of different plant species and environments.

Future Scope:

There is a lot of potential for further development and enhancement of the IoT-based automatic plant watering system. Some of the areas of future scope include:

Integration with weather data: The system can be integrated with real-time weather data to adjust the watering schedule based on weather conditions such as rainfall or humidity.

Mobile application: A mobile application can be developed to enable users to remotely monitor and control the system, receive alerts, and access historical data.

Nutrient monitoring: The system can be enhanced to monitor soil nutrient levels and adjust the watering process accordingly.

Multiple plant monitoring: The system can be extended to monitor multiple plants in a single setup.

Overall, the IoT-based automatic plant watering system project has shown the potential for the use of IoT technology in agriculture and plant care. With further development and enhancements, this technology can revolutionize the way we care for our plants and crops, leading to better yields and more sustainable farming practices.

Reference

1. https://www.w3schools.com/c/
2. https://www.researchgate.net/publication/342175470_IoT_Based_Plant_Monitoring_System
3. https://lastminuteengineers.com/electronics/esp32-projects/
4. Neil Kolban, aKolban's Book on ESP32,2017
5. https://blynk.io/
6. https://www.alldatasheet.com/view.jsp?Searchword=Esp32%20datasheet&gclid=Cj0KCQjw27mhBhC9ARIsAIFsETFXdiWjYSWsLeooLskVUYqmCER92js_HJ95KawV9WqTnSkq9WyRezsaArsSEALw_wcB
7. https://datasheetspdf.com/datasheet/search.php?sWord=dht11

Appendix

Code:

```
#define BLYNK_PRINT Serial
#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <DHT.h>

// WiFi credentials
char ssid[] = "Limkar";
char password[] = "09876543";

// Blynk authentication token
#define BLYNK_TEMPLATE_ID "TMPLrPumWIA3"
#define BLYNK_TEMPLATE_NAME "ESP32 Plant Monitor"
#define BLYNK_AUTH_TOKEN "1zoB1pTGq8_TLicaS1HNq8HBu9i_oe6x"
char auth[] = "1zoB1pTGq8_TLicaS1HNq8HBu9i_oe6x";

// Define I2C address for LCD
LiquidCrystal_I2C lcd(0x27, 16, 2);

// Define pins for Soil Moisture Sensor and Valve
#define SOIL_MOISTURE_SENSOR_PIN 32
#define VALVE_PIN 27
#define DHT_PIN 23

// Define Soil Moisture Sensor Variables
int soilMoistureThreshold = 380;
int soilMoistureValue;

// Define DHT11 Sensor Variables
DHT dht(DHT_PIN, DHT11);
float temperatureValue;
float humidityValue;

void setup() {
  Serial.begin(9600);

  // Setup the Soil Moisture Sensor and Valve Pins
  pinMode(SOIL_MOISTURE_SENSOR_PIN, INPUT);
  pinMode(VALVE_PIN, OUTPUT);
```

```
  // Initialize the LCD display
  lcd.init();
  lcd.backlight();
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Soil Moisture");

  // Connect to Wi-Fi
  WiFi.begin(ssid, password);
  while (WiFi.status() != WL_CONNECTED) {
    delay(1000);
    Serial.println("Connecting to WiFi...");
  }

  // Connect to Blynk
  Blynk.begin(auth, WiFi.SSID().c_str(), WiFi.psk().c_str());
  Serial.println("Connected to Blynk");

  // Start the DHT11 sensor
  dht.begin();
}

void loop() {
  // Get Soil Moisture Value
  soilMoistureValue = analogRead(SOIL_MOISTURE_SENSOR_PIN);
  Serial.print("Soil Moisture: ");
  Serial.println(soilMoistureValue);

  // Determine if the Soil Moisture is below the threshold
  if(1000000/soilMoistureValue < soilMoistureThreshold){
    // Turn Valve On
    digitalWrite(VALVE_PIN, HIGH);
    lcd.setCursor(0,1);
    lcd.print("Valve: ON");
    Serial.println("Valve On");
  }
  else{
    // Turn Valve Off
    digitalWrite(VALVE_PIN, LOW);
    lcd.setCursor(0,1);
    lcd.print("Valve: OFF");
    Serial.println("Valve Off");
  }

  // Get Temperature and Humidity from DHT11 sensor
  humidityValue = dht.readHumidity();
  temperatureValue = dht.readTemperature();
```

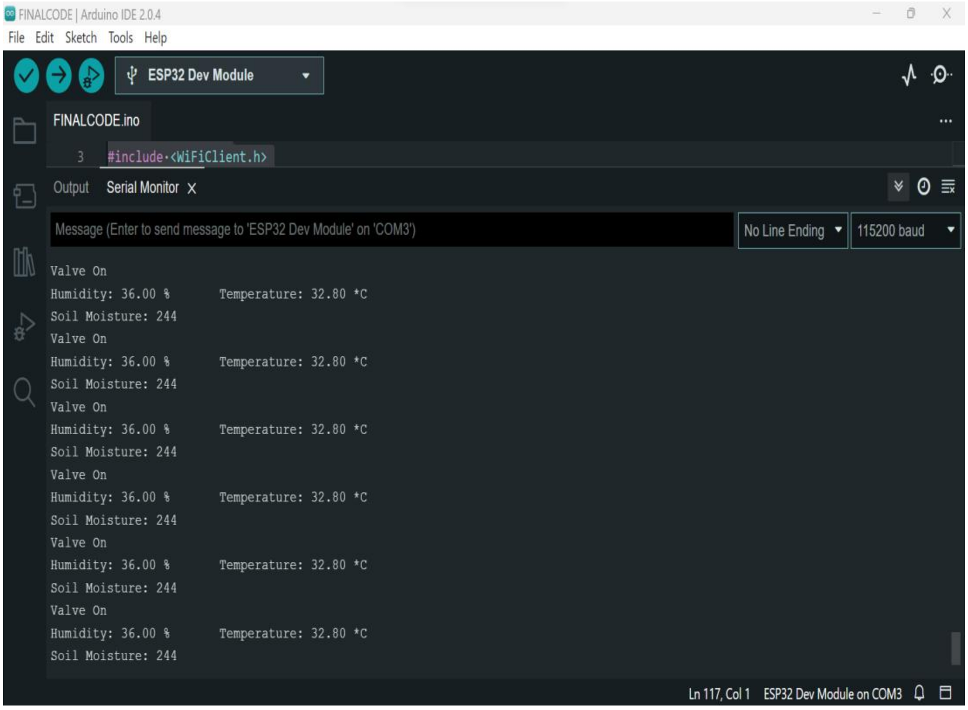
```
  // Check if the sensor is reading correctly
  if (isnan(humidityValue) || isnan(temperatureValue)) {
    Serial.println("Failed to read from DHT sensor!");
    return;
  }


  Serial.print("Humidity: ");
  Serial.print(humidityValue);
  Serial.print(" %\t");
  Serial.print("Temperature: ");
  Serial.print(temperatureValue);
  Serial.println(" *C");

  // Send Temperature and Humidity values to Blynk
  Blynk.virtualWrite(V5, humidityValue);
  Blynk.virtualWrite(V6, temperatureValue);
  Blynk.virtualWrite(V4, 1000000/soilMoistureValue );


  delay(1000);
}
```

Output



FINALCODE | Arduino IDE 2.0.4
File Edit Sketch Tools Help
ESP32 Dev Module
FINALCODE.ino
3 #include<WiFiClient.h>
Output Serial Monitor X
Message (Enter to send message to 'ESP32 Dev Module' on 'COM3')
No Line Ending
115200 baud
Valve On
Humidity: 36.00 % Temperature: 32.80 *C
Soil Moisture: 244
Valve On
Humidity: 36.00 % Temperature: 32.80 *C
Soil Moisture: 244
Valve On
Humidity: 36.00 % Temperature: 32.80 *C
Soil Moisture: 244
Valve On
Humidity: 36.00 % Temperature: 32.80 *C
Soil Moisture: 244
Valve On
Humidity: 36.00 % Temperature: 32.80 *C
Soil Moisture: 244
Valve On
Humidity: 36.00 % Temperature: 32.80 *C
Soil Moisture: 244
Ln 117, Col 1 ESP32 Dev Module on COM3