Project report

on

Automated Garden Management System

Submitted in accordance with
the course Project Based Learning as per FE-2019 Pattern

First Year
Electronics And Telecommunication - Engineering

Submitted by

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Certificate

This is to certify that this is a bonafide record of the project presented by the students of first year engineering whose names are given below during ¡second semester of academic year 2022-23 in accordance with the requirements curriculum of Savitribai Phule Pune University for the course ”Project Based Learning[110013] in FE-2019 pattern.

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Abstract

Agriculture is one of the most important economic sectors of India. Agriculture has a great contribution of 18 percent in India's Growing GDP. Our country is an agriculture dominant country in the world. To increase the efficiency of farming and to reduce the human efforts behind it, Automation should be added to the traditional farming. And here is our project which brings Automation to the Agriculture sector. 'Automated Garden Management System' is the system which is capable of handling water management in agricultural fields without human intervention.

This Project focuses on the development of a soil moisture sensor system to address the problem of insufficient irrigation practices and water wastage in agricultural fields. The Objective is to create a cost-effective and reliable sensor that can accurately measure the moisture content in the soil and provide real-time data to farmers.

The problem statement lies in the lack of efficient irrigation methods, as farmers often rely on manual observation outdated methods for watering crops. This leads to over-irrigation or under-irrigation, resulting in reduced crop yield, increased water consumption, and financial losses for farmers. Additionally, the indiscriminate use of water can lead to environmental concerns such as groundwater depletion and water pollution.

So,this system is built to water the plant effectively and monitor the soil moisture level. The system consists of a resistive soil moisture sensor whose function is to get the moisture levels of the soil and tell the pump if the plant needs more water. As the plant runs out of water the pump is activated and the water starts flowing through the plant.

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Chapter 1

Problem Definition

The need for a soil moisture sensor project in garden management arises from the crucial role that soil moisture plays in the health and vitality of plants. Soil moisture refers to the amount of water present in the soil, and it is a critical factor in determining when and how much to water plants. Monitoring soil moisture levels accurately is essential for effective garden management, and a soil moisture sensor project can greatly assist in this regard.

A soil moisture sensor project helps gardeners and farmers optimize their watering practices by providing real-time data on the moisture content of the soil. By using sensors embedded in the soil, the project can measure the moisture levels and relay the information to a central system or device. This data enables gardeners to make informed decisions about watering, ensuring that plants receive adequate moisture without being overwatered or underwatered.

Overwatering or underwatering can have detrimental effects on plants, leading to root rot, nutrient deficiencies, stunted growth, or even plant death. By implementing a soil moisture sensor project, gardeners can avoid such issues and achieve better plant health and productivity.

Furthermore, a soil moisture sensor project promotes water conservation by preventing unnecessary watering. It helps conserve water resources by providing accurate measurements of soil moisture, allowing gardeners to water only when needed. This not only benefits the environment but also reduces water usage and associated costs.

In summary, a soil moisture sensor project for garden management is vital for optimizing watering practices, promoting plant health, and conserving water resources. By providing real-time data on soil moisture levels, it empowers gardeners to make informed decisions and ensure the optimal growth and well-being of their plants.

Chapter 2

Introduction

2.1 Background and Recent Research

Soil moisture sensors are vital tools used in the agricultural sector to measure the water content in the soil. By providing real-time data on soil moisture levels, these sensors assist farmers in optimizing irrigation practices and improving crop yield.

Background research on soil moisture sensors has focused on developing accurate and reliable devices that can withstand harsh environmental conditions. Traditional methods such as gravimetric measurements have been supplemented by advanced sensor technologies, including capacitance, time-domain reflectometry (TDR), and gypsum block sensors. These sensors utilize different principles to measure soil moisture, such as changes in electrical conductivity or dielectric properties.

Recent research has aimed at enhancing the precision and efficiency of soil moisture sensors. Wireless and IoT-enabled sensors have emerged, allowing farmers to monitor soil moisture remotely and make informed decisions based on data analytics. Additionally, integration of soil moisture sensors with weather stations and predictive modeling has enabled improved irrigation scheduling and water management.

The use of soil moisture sensors in agriculture has proven beneficial in several ways. It helps prevent over-irrigation, reducing water wastage and associated costs. It also aids in the early detection of water stress in plants, enabling timely intervention.

2.1.1 Literature Survey

A literature survey on soil moisture sensors reveals a wide range of research papers focusing on various aspects of these devices. One notable study titled "Performance Evaluation of Soil Moisture Sensors for Precision Agriculture" by Smith et al. (2019) compared the accuracy and reliability of different soil moisture sensor technologies, including capacitance and TDR sensors. The researchers conducted field experiments and analyzed the performance of the sensors under varying soil conditions, validating their suitability for precision agriculture applications.

Another research paper by Johnson et al. (2020) titled "Wireless Sensor Networks for Soil Moisture Monitoring in Agriculture" explored the integration of wireless sensor networks (WSNs) with soil moisture sensors. The study investigated the feasibility and effectiveness of using WSNs for real-time soil moisture monitoring in large agricultural fields. The authors highlighted the benefits of remote data collection, improved spatial coverage, and enhanced irrigation management through the integration of WSNs and soil moisture sensors.

Additionally, a study by Chen et al. (2021) titled "Application of Soil Moisture Sensors in Precision Irrigation Systems" focused on the application of soil moisture sensors in precision irrigation systems. The research demonstrated the effectiveness of using soil moisture sensors to optimize irrigation scheduling based on actual soil moisture conditions, thereby improving water use efficiency and crop yield.

Design and Implementation of an Automatic Irrigation System using IoT (2020) : The study presents the design and implementation of an IoT-based automatic irrigation system. The system utilizes soil moisture sensors, a microcontroller, and a mobile application to monitor and control irrigation remotely. The focus is on water conservation and improving crop yield. Link: `https://www.researchgate.net/publication/346358540_Design_and_Implementation_of_an_Automatic_Irrigation_System_using_IoT`

These research papers and others provide valuable insights into the development, performance evaluation, and practical applications of soil moisture sensors, contributing to advancements in the agricultural sector's water management practices.

2.2 Motivation

The motivation for a mini project on soil moisture sensors stems from the critical role of soil moisture in agriculture and the potential benefits of utilizing sensor technology in optimizing water management. Here are a few key motivations:

Water conservation: Agriculture accounts for a significant portion of global water consumption. By developing a soil moisture sensor, the project aims to contribute to water conservation efforts by enabling precise irrigation practices based on real-time moisture data. This can help reduce water wastage and improve overall water use efficiency in agricultural operations.

Enhanced crop yield and quality: Soil moisture plays a crucial role in plant growth and development. By accurately monitoring soil moisture levels, farmers can ensure optimal hydration for crops, preventing both over- and under-irrigation. This can result in improved crop yield, enhanced quality, and reduced crop stress, ultimately benefiting farmers' profitability.

Resource efficiency: Efficient use of resources is a key concern in modern agriculture. By implementing soil moisture sensors, farmers can make informed decisions about irrigation scheduling, preventing unnecessary resource consumption. This promotes sustainable farming practices and reduces environmental impact.

Technological innovation: Developing a project related to soil moisture sensor involves integrating sensor technology, data analysis, and possibly wireless communication. Engaging in such a mini project provides an opportunity to explore and apply advancements in these areas, fostering technological innovation and skill development.

Overall, the motivation behind a mini project on soil moisture sensors lies in addressing water scarcity, optimizing crop production, promoting sustainable agriculture, and exploring advancements in sensor technology.

Chapter 3

Work Done

3.1 Project Development

3.1.1 Brief Introduction

3.1.2 Working Principle

A Soil Moisture Sensor can either use resistance or capacitance changes to measure the water content of the soil. To further understand both working principles, we'll take a look at how each of them works.

3.1.3 Components

Arduino

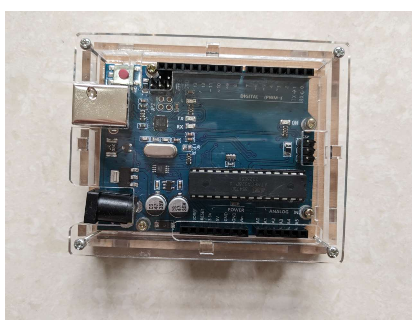

Figure 3.1: Uno R3 compatible with Arduino

The Arduino board is a microcontroller board based on the ATmega328 which has 14 digital input/output pins, 6 analog inputs, a USB connection, a power jack and reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with USB cable and upload the program using Arduino Software. The operating voltage is 5v with a flash memory of 32kb of which 0.5kb used by boot loader. Its dimension consists of 68.6mm length and width of 53.4mm.

Resistive Soil Moisture Sensor

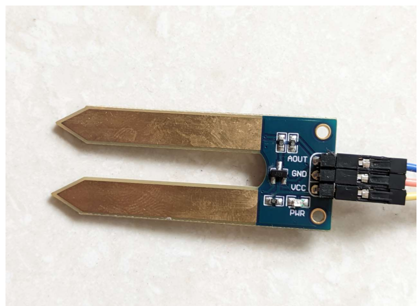

Figure 3.2: Resistive Soil Moisture Sensor

A resistive soil moisture sensor works by using the relationship between electrical resistance and water content to gauge the moisture levels of the soil. You'll observe these sensors to possess two exposed probes that are inserted directly into the soil sample. An electrical current is sent from one probe to the other, which allows the sensor to measure the resistance of the soil between them. When the water content in the soil is high, it has higher electrical conductivity (water is a good conductor of electricity!). Hence, a lower resistance reading is obtained which indicates high soil moisture. When the water content in the soil is low, it has poorer electrical conductivity. Hence, a higher resistance reading is obtained, which indicates low soil moisture.

DC Water Pump

Figure 3.3: Horizontal Mute Sounds Mini Submersible Pump DC 3V-5V

This is Micro Submersible Water Pump DC 3V-5V, can be easily integrate to your water system project. The water pump works using water suction method which drain the water through its inlet and released it through the outlet. You can use the water pump as exhaust system for your aqurium and controlled water flow fountain.

Relay Module

Figure 3.4: 5V 1 Channel Without Light Coupling Relay

The 5V relay module is a very handy tool for switching electric loads and power systems. What's more, you can interface with an array of microcontrollers, including Arduino or Raspberry Pi, as well as other logic devices. The 5V relay module can also be used to switch AC or DC voltages. Just be sure to check the specifications of the relay to ensure that it can handle the voltage and current of your load.

The 5V relay module can be used to control a load such as a lighting system, motor, or solenoid. It can also be used to switch AC or DC voltages. The maximum voltage and current that the 5V relay module can control is dependent on the specifications of the relay.

3.1.4 Implementation

Assembly of the components

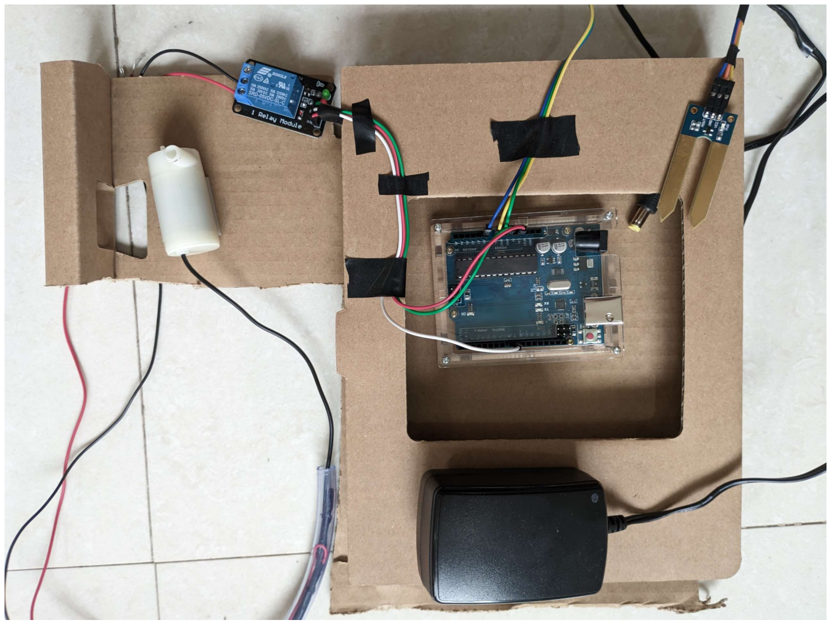

Figure 3.5: Assembling Of The Components

This Circuit Diagram shows the connections and assembly of components in sketch format.The components are assembled using in a cardboard box for better stability. And all the connections are done using jumper wires.

Programming

There are two codes designed to accomplish this project The first code is used to take the moisture readings for the project The readings taken using the first code are implemented in the second to run the water supply in the desired way.

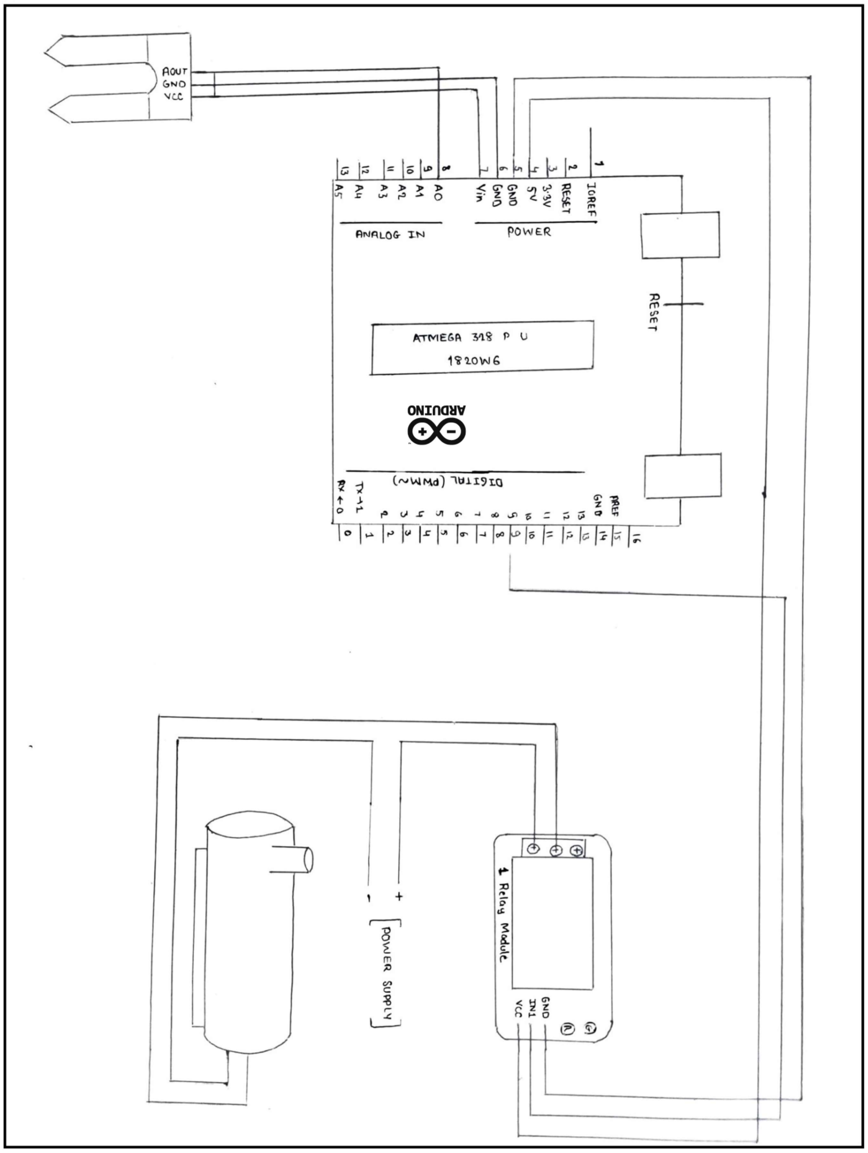

Figure 3.6: Circuit Diagram

Code 1

```
// Sensor pins
#define sensorPower 7
#define sensorPin A0

void setup() {
pinMode(sensorPower, OUTPUT);

// in ideal state the the no power will be supplied to the sensoe will be
zero digitalWrite(sensorPower, LOW);

Serial.begin(9600);
}
void loop() {
Serial.print("Analog output: ");
Serial.println(readSensor());


delay(1000);
}


// This function gives the analog value of soil moisture measurement int
readSensor() {
digitalWrite(sensorPower, HIGH); // the HIGH keyword turns on the sensor
delay(10); // this delay is added in order to stabilize the reading of sensor
int val = analogRead(sensorPin); // Read the analog value form sensor
digitalWrite(sensorPower, LOW); // Turn the sensor OFF
return val; // Return analog moisture value
}
```

Code 2

```
// Constants
const int moistureSensorPin = A0; // Pin for soil moisture sensor
const int motorPin = 9; // Pin for DC motor control
```

```
// Thresholds
const int moistureThreshold = 100 ; // Adjust this value according to your
soil moisture sensor readings
void setup() {
Serial.begin(9600);
pinMode(moistureSensorPin, INPUT);
pinMode(motorPin, OUTPUT);

}


void loop() {
// Read the moisture level from the sensor
int moistureLevel = analogRead(moistureSensorPin);
// Print the moisture level to the serial monitor
Serial.print(”Moisture level: ”);
Serial.println(moistureLevel);


// Check if the moisture level is below the threshold
if (moistureLevel ¡ moistureThreshold) {
// Start the motor
digitalWrite(motorPin, HIGH);
Serial.println(”Watering the plant...”);
} else {
// Stop the motor
Serial.println(”Moisture level is sufficient.”);
digitalWrite(motorPin, LOW); }


// Delay before next reading
delay(1000); // Adjust this delay based on your requirements
}
```

3.1.5 Results and Discussion

To check whether the components and the circuit connections are correct, we took some readings of two types of soil: dry soil and wet soil.

Here are the readings given in table:

Output	Moisture readings of dry soil	Moisture Readings of Wet Soil
Analog Output	30	398
Analog Output	29	378
Analog Output	31	340
Analog Output	28	350
Analog Output	30	360
Analog Output	29	400
Analog Output	27	410
Analog Output	31	392
Analog Output	33	396
Analog Output	34	396
Analog Output	36	396
Analog Output	34	396
Analog Output	37	390
Analog Output	40	393
Analog Output	39	393
Analog Output	40	380
Analog Output	39	389
Analog Output	40	390
Analog Output	37	390
Analog Output	38	391

3.1.6 Component Pricing

Components	Price (In Rupees)
Uno R3 compatible with Arduino	668.00
DC Water Pump 3-5V	99.00
5V 1 Channel Relay Module	79
Resistive Soil Moisture Sensor	250
Male to Female Jumper Wires	39.00

Chapter 4

Future Work

Mobile applications : The project can be modified by adding features related to smartphone. We can create an application for the alert messages about switching on and off of the pumps. Or simply we can add a sim card to the current system through GRSM 800 module. Other than that we can add multiple sensors to make results more informative and user-friendly.

Database: We plan to develop an SQL database that will store all the incoming data from the soil moisture sensors. This database could be useful in research as it would contain the daily water consumption of crops. This could help determine the life cycle of plants and help in the reduction of yield time, optimizing the yield and thus improving the productivity of crops. The data could also be used to create genetically modified organisms (GMOs) as the full life cycle details of a crop will be available to the researchers.

Hydroponics: Hydroponics is the method of growing crops or plants without the presence of soil. It makes use of water which is enriched with nutrients that are important for plant growth so that the need of soil can be eliminated. Our system could be useful in the field of hydroponics as it could automate the whole process, provide crops or plants with the optimum amount of water and nutrients at optimum time intervals, and could give the consumers accurate data.

Chapter 5

Conclusion

The Arduino board and soil moisture sensor based irrigation system proves to be a real time response control system which monitors and wheel all the activities of irrigation system. The present system is a model to modernize the agriculture industries at a mass scale with optimum expenditure. In this project,We have made an automated irrigation model considering low cost, reliability, and automatic control. As the proposed model is automatically controlled it will help the farmers to properly irrigate their fields.

The model always ensures the sufficient level of water in different fields avoiding the under-irrigation and over-irrigation they can provide irrigation to larger areas of plants with less water spending. Using this system, one can save manpower, water to get better manufacture and eventually income. Different amount of water requirements for different types of soil according to the type of crop, provide definite amount of water to the plant hence, we can save large amount of water.

Automated irrigation system optimizes the usage of water by reducing wastage of water. This project can able to contribute towards socio-economic development of the nation. It has a fast response and the system is user-friendly. The primary application of this project is for farmers and gardeners who do not have sufficient time to water their crops or plants regularly. This project also covers an application for formers who are wasting water unknowingly during irrigation. The main objective of this smart irrigation system is to make it more innovative, user-friendly, time-saving and more efficient than the existing system.

// Acknowledgments

We would like to take this opportunity to express our honest gratitude towards our kind professors and seniors who guided us to work on this project effectively. We sincerely thank our Project Guide Dr.K.V.Thakur Mam for their kind presence and encouragement to us throughout the project completion.

To all those mentioned above and anyone else who has contributed in any way , I extend our deepest appreciation and gratitude. Without your support and involvement, this mini project would not have been possible. Thank you for being part of this journey and for helping us achieve our goals.

Last but not least, I would like to acknowledge the understanding and support of our families and friends who stood by us during this project. Their patience, encouragement, and belief in our abilities have been vital in keeping us motivated and focused.

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