Module Code & Module Title
CC5068NI– Cloud Computing & IoT

Smart Plant Care

Assessment Type
40% Main Report

Semester
2024 Spring

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Assignment Due Date: 10th May 2024
Assignment Submission Date:
Submitted to: Mr. Sugat Man Shakya
Word Count:2279

I confirm that I understand my coursework needs to be submitted online via Google Classroom under the relevant module page before the deadline in order for my assignment to be accepted and marked. I am fully aware that late submissions will be treated as non-submission and a mark of zero will be awarded.

Acknowledgement

We are very grateful for Islington College for providing us such a great opportunity to work on the Internet of Things project work. We would also love to express our sincere gratitude towards our module leader, Mr Sugat Man Shakya, for giving us this possibility and for his vital guidance through the project. Furthermore, we extend our utmost thank to our fellow classmates who offered their help whenever possible and guided us through our mistake. Finally, we want to express our deepest gratitude towards our parents for their financial support and motivation.

Abstract

The Smart Plant Care project has successfully made a prototype that uses an Arduino Uno microcontroller and a soil moisture sensor to automate plant watering. This prevents both overwatering and underwatering, promoting healthy plant growth. This system offers a convenient solution for plant owners which leads to not having to worry about watering their plants.

Table of Contents

Table of Figures

Table of Table

1.Introduction

The Internet of Things (IoT) is the network of devices, vehicles, buildings, and other things integrated with sensors, software, electronics, circuits, and network connection that allows these objects to collect and exchange data. The Internet of Things allows objects to be monitored and controlled from anywhere in the world using the internet (Gokhale, et al., 2018).

Smart Plant Care is an IoT device that provides plants with the right amount of water to nourish them and promote healthy growth. This technology frees people from the worry of either overwatering or underwatering their plants, which can damage them internally. It implements a **soil moisture sensor** that checks the moisture level of the soil and delivers right amount of water needed for healthy growth.

1.1 Current Scenario

Growing a healthy plant can be challenging for many of the plant owners. Watering them daily even when life gets busy, becomes a chore. This has led to many plant lovers to abandon growing plants in their home and have started preferring artificial plants as a home décor. The constant worry about overwatering or underwatering, both of which can be harmful for a plant’s health.

Figure 1: Watering plants.

Figure 2: Choosing artificial plants over real plants.

Even when the plant owners provide the right amount of nutrients, improper watering can damage the plant. Underwatering causes leaves to scorch, while overwatering leads to root rot.

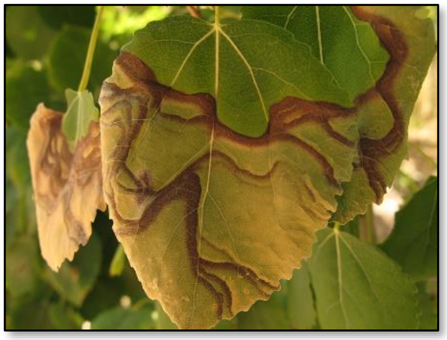


Figure 3: Leaves scorching due to insufficient water.

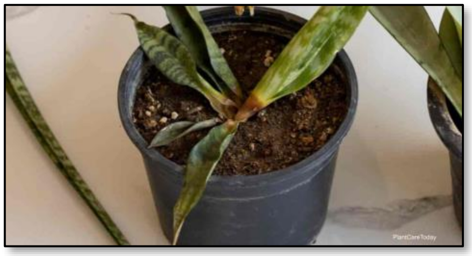


Figure 4: Roots rotting, due to over watering.

1.2 Problem Statement and Project as a Solution

People love having plants in their home or offices, either for decorating or to create a sense of well-being. However, many people eventually switch to artificial plants when caring for real plants become a burden. The most common reason for this switch is the lack of time for watering and general maintenance.

Plant lovers often face a watering dilemma. Unsure of how much, how often or when to water, they risk underwatering, which leads to yellow leaves and dry soil. In the other hand, overwatering can cause root rot and soggy soil. Both causing extreme damages to the plant. Busy plant devotee, specifically, struggle to monitor soil moisture and provide the optimal amount of water.

Smart Plant Care is an automated watering system that uses sensors to monitor soil moisture and water plants according to their needs. By monitoring moisture levels and providing water as needed, it prevents both overwatering and underwatering, promoting healthy growth in plants. Therefore, it frees plant owners from worrying about damaging their plants.

1.3 Aim and Objectives

Aim

Smart Plant Care aims to promote healthy plant growth by providing the right amount of water.

Objectives

- Developing a system that will free owners from the worry of overwatering or underwatering, which can damage their plants.
- To help users to use precise amount of water, ensuring efficient water uses to promote healthy plant growth.
- To help users to have a healthy plant to decorate their home.

2.Background

2.1 System Overview

Understanding the problem of plant owner, we have created prototype called Smart Plant Care. This prototype is used for providing plant with right amount of water to make them healthier. The soil moisture sensor checks the amount of moisture available in the soil and waters the plant accordingly.

In this project total seven devices are used and connected to make the prototype work. The soil moisture sensor and relay module are connected directly to the Arduino UNO via jumper wires. The battery is connected to water to the water pump and relay module via jumper wires as well. The Arduino UNO is connected to computer through a USB cable.

The system is automated by the code uploaded to the Arduino UNO microcontroller. The code allows for watering plants based on their moisture levels. When the soil is very damp, the microcontroller does not water the plant. In contrast, when the soil is very dry, it triggers watering.

2.2 Design Diagrams

2.2.1 System Architecture

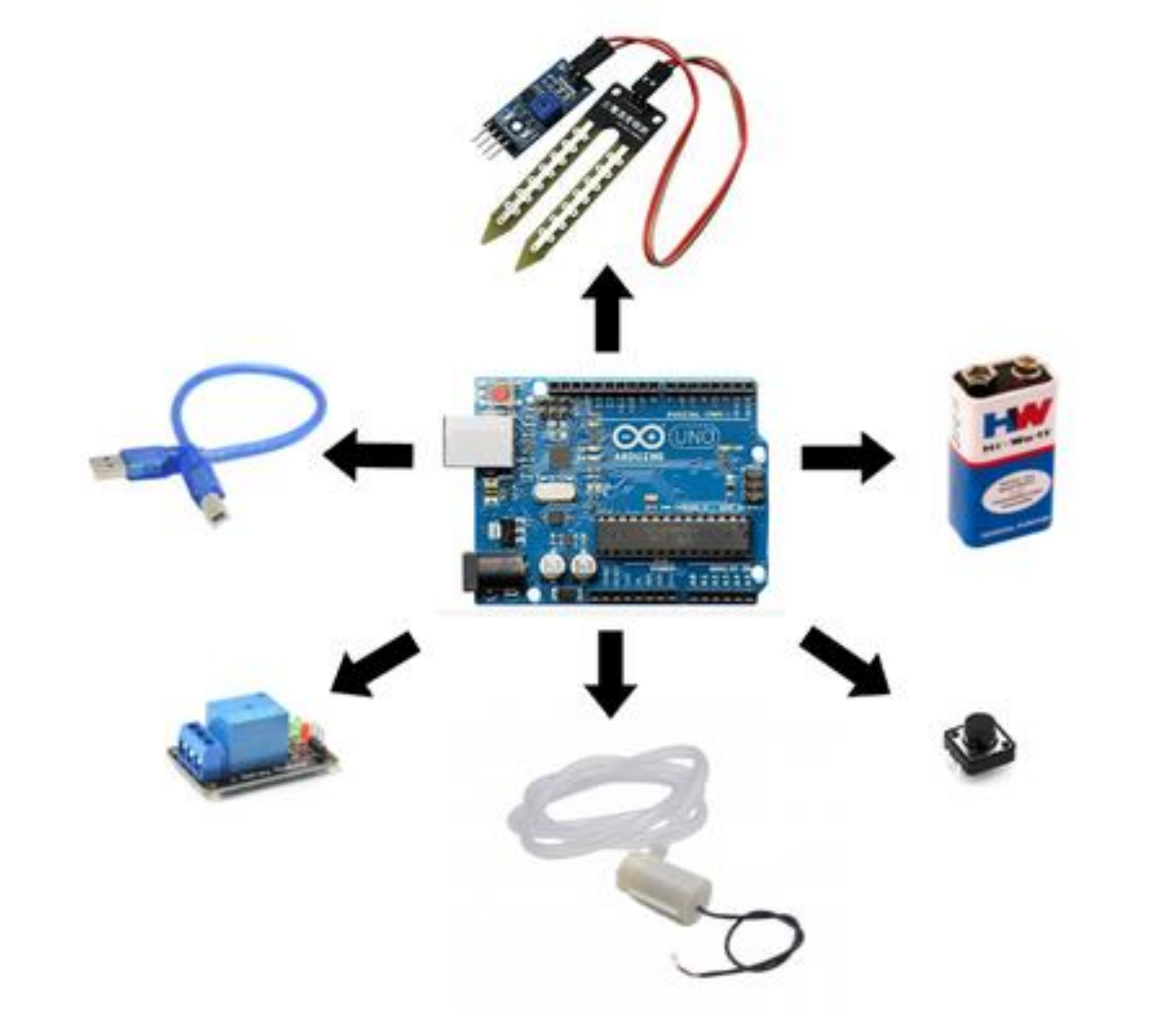


Figure 5: System Architecture.

2.2.2 Flowchart

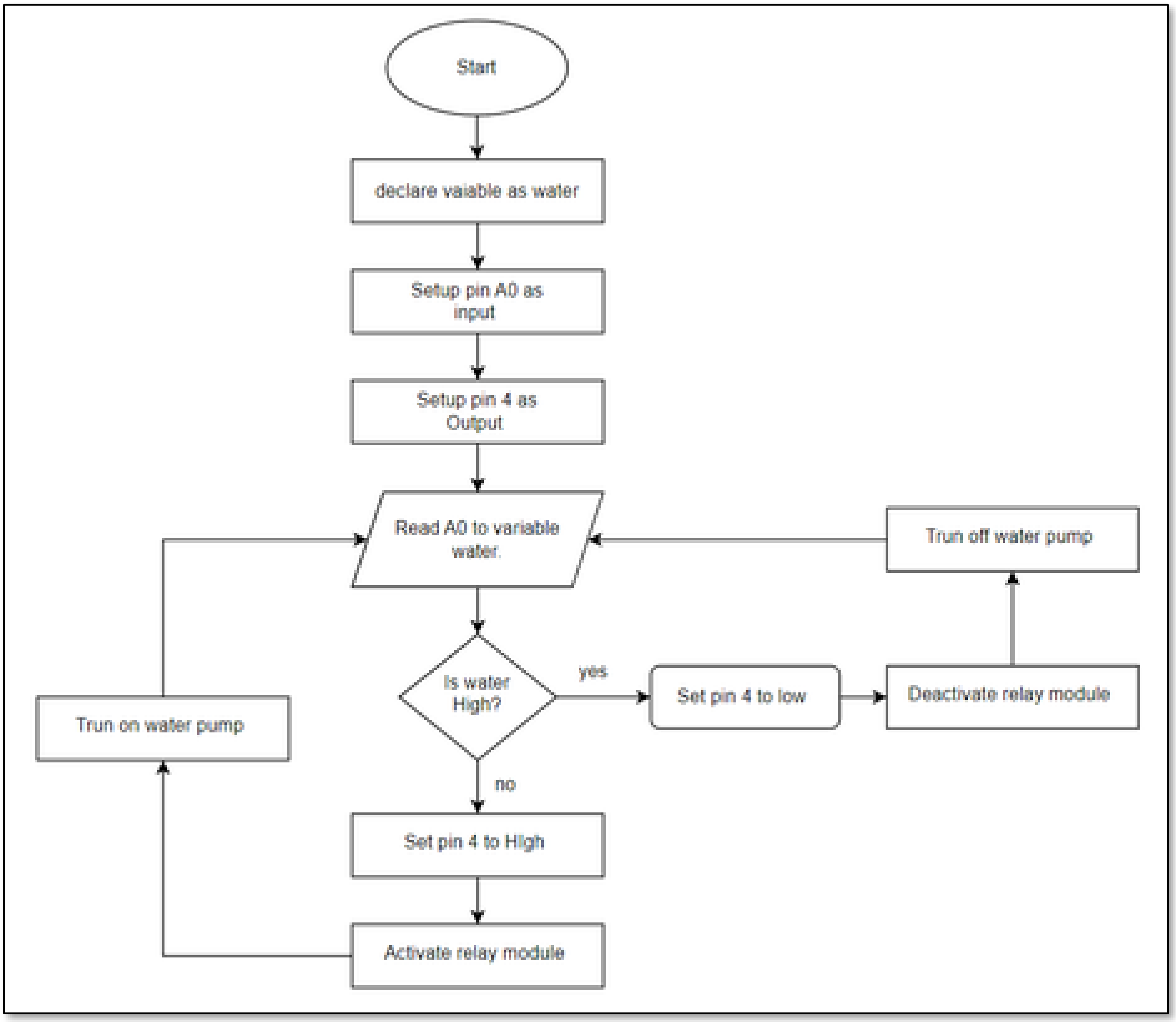


Figure 6: Flowchart.

2.2.3 Block Diagram

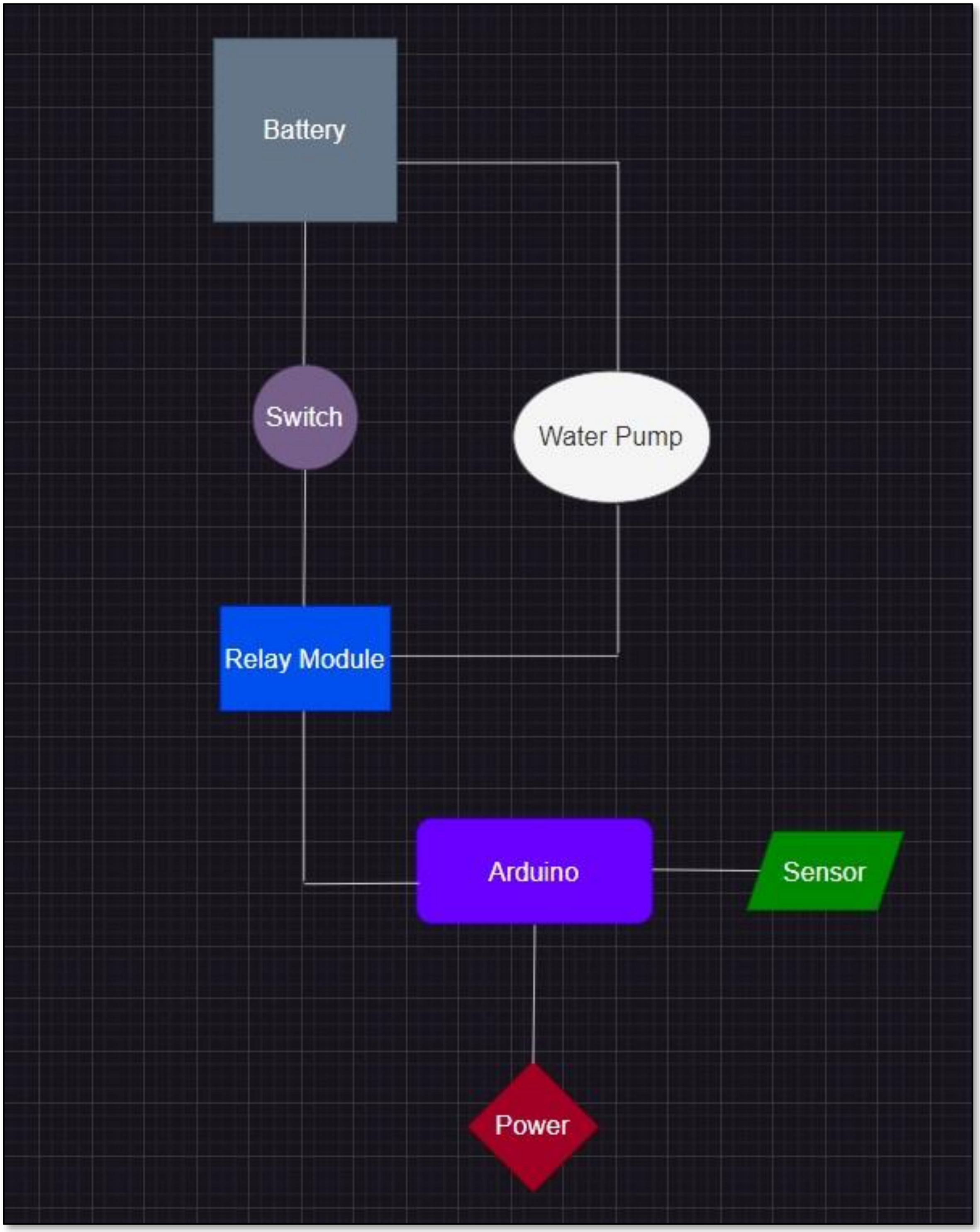


Figure 7: Block Diagram.

2.2.4 Circuit Diagram

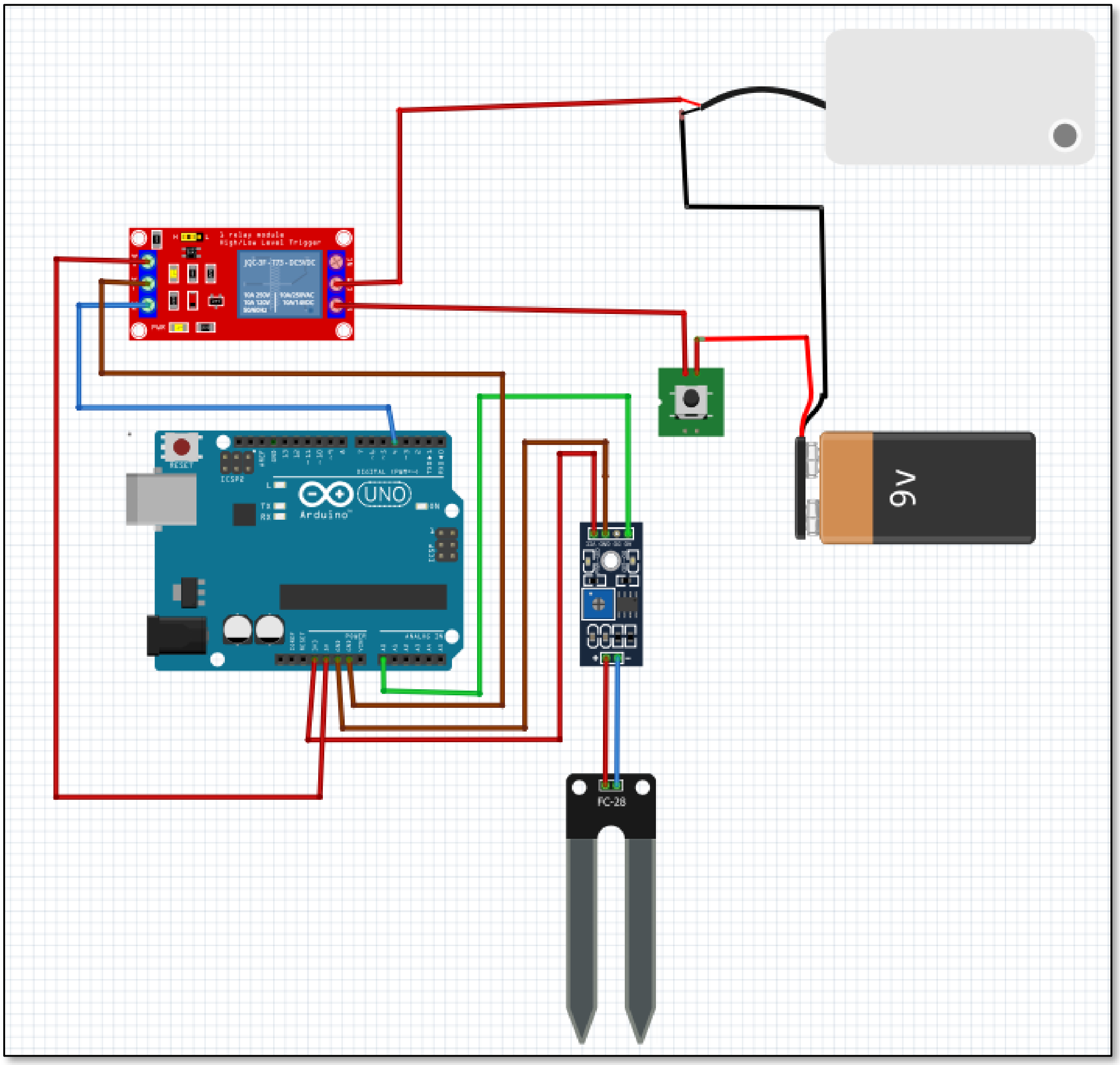


Figure 8: Circuit Diagram.

2.2.5 Logic Diagram

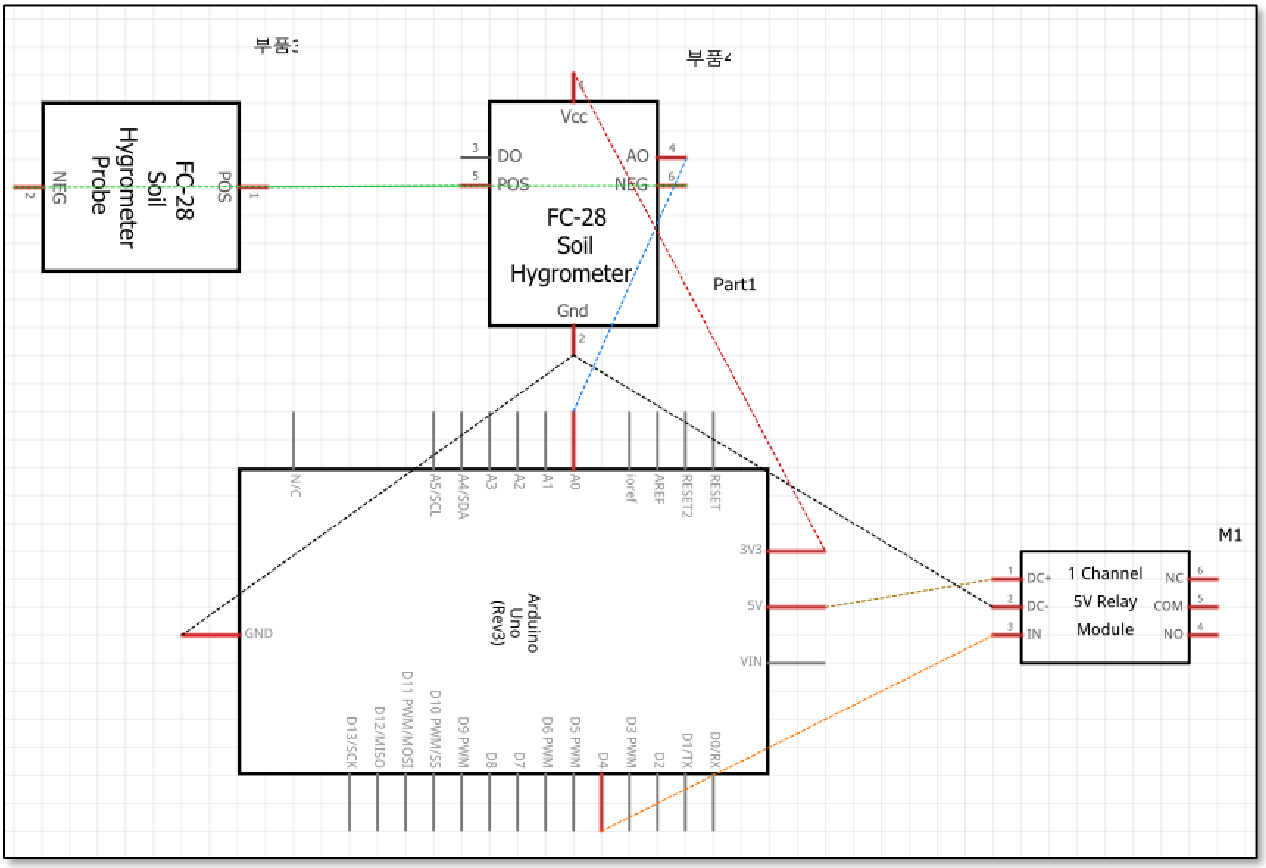


Figure 9: Logic Diagram

2.3 Requirement Analysis

2.3.1 Software

- **Arduino IDE**

  Arduino Integrated Development Environment connects to Arduino hardware to upload programs and communicate with it. The software offers a user-friendly interface with a text editor for writing code, message window, text console, a toolbar with easy-access buttons for common functions and a series of menus (Arduino, 2024).

- **Microsoft Word**

  Word lets a user create and format document with different themes. In this project, we have used Microsoft word to write report .

- **Draw.io**

  Draw.io is a diagram software and a flowchart maker. It was developed by Gaudenz Alder, founder of JGraph a company registered in England and draw.io is registered in Switzerland (geeksforgeeks, 2020). Draw.io is used to create different types of diagrams and flowchart. It also allows user to create and share the diagrams for free. It does not only create diagrams and flowcharts it also creates class diagrams, wireframes, ERD (Entity Relation Diagram), network diagrams and UML diagrams and many more.

2.3.2 Hardware

- **Arduino UNO**

Arduino UNO is microcontroller based on the ATmega328P, which consist of :

1. a USB connection,
2. 14 digital input/output pin,
3. 6 analogues inputs, a 16mhz resonator,
4. power jack,
5. In Circuit Serial Programming (ICSP) header
6. a reset button.

This microcontroller features a barrel plug connector which is suitable with 9V battery (Arduino UNO, 2022). This microcontroller is beginner-friendly and very affordable.

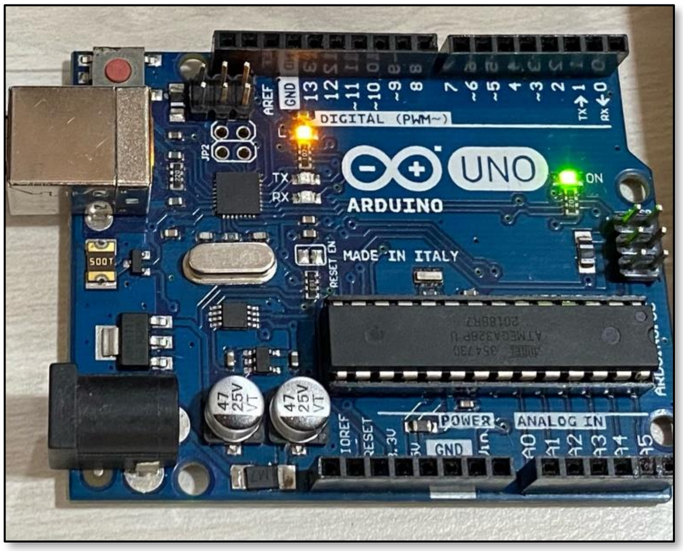


Figure 10: Arduino UNO.

- **Soil Moisture Sensor**

  The sensor we used in our project is an Analogue sensor that acquires real-time signals, such as checking the moisture of soil. Also, it is an active sensor which utilizes external power sources. [More about soil moisture sensor.]

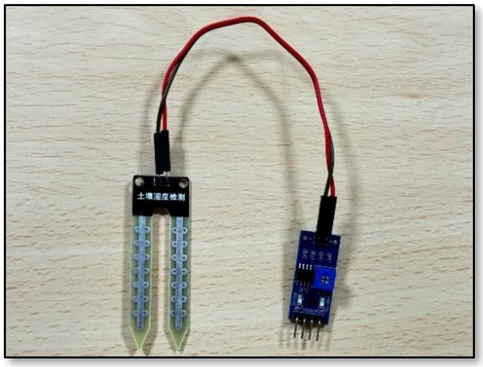


Figure 11: Soil moisture sensor.

- **Voltage Relay Module**

  The voltage relay module high voltage, current loads, motor, AC load and lamps. This relay module is designed to interface through different microcontrollers. In this project this module is used with Arduino UNO. This module consists of 6 pins:

  1. Normally Open
  2. Common Contact
  3. Normally Closed
  4. Signal PIN
  5. VCC PIN
  6. GND PIN

  This relay operated at 5 volts (5V), also commonly known as 5V relay and is encased in blue plastic (Electronics|Projects|Focus, 2022).

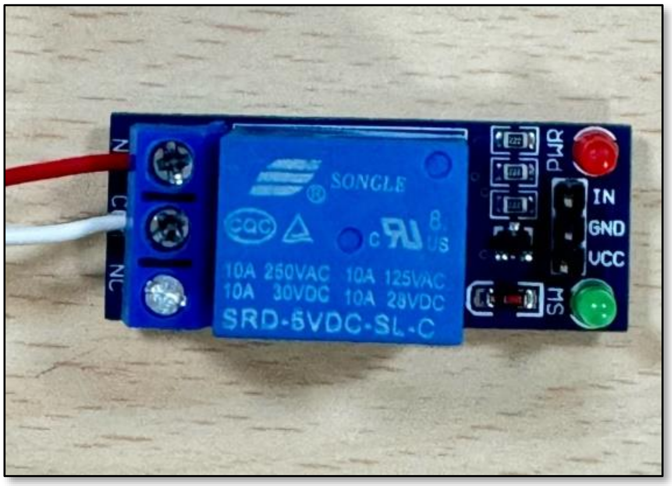


Figure 12: Voltage Relay Module.

- **Water pump**

The actuator in our project is the water pump, which is a rotary actuator. Rotary actuator is actuator that moves in circular direction and are controlled by electrically or mechanically in a specific degree. [More about water pump.]()

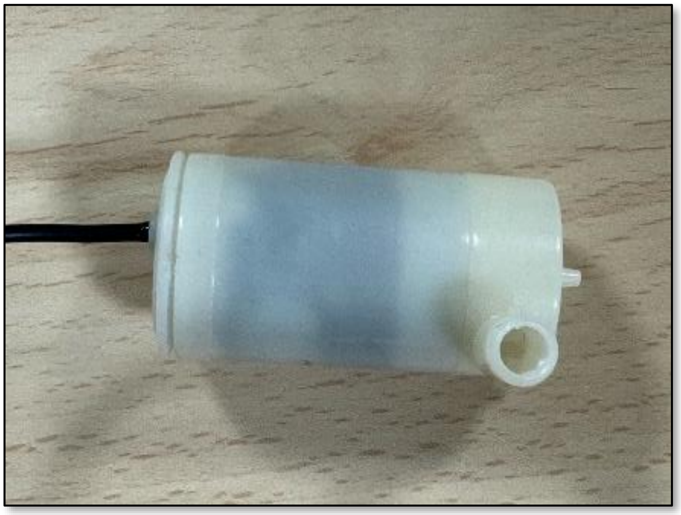


Figure 13: Water Pump.

- **Jumper wires**

  Jumper wires allow to easily connect and disconnect components without soldering, making them ideal for experimenting and prototyping circuits. It is the perfect wire to connect sensors and modules to microcontroller. The jumper wires have 3 different types:

  1. Male to Male
  2. Male to Female
  3. Female to Female

  Where, male connector is also known as plug and female connector is known as jack (Wiltronics, 2022).

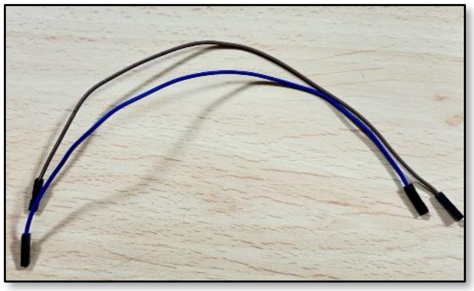


Figure 15: Jumper wires: Female to Female

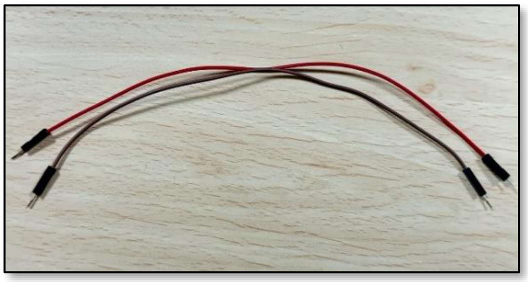


Figure 14: Jumper wires: Male to Male.

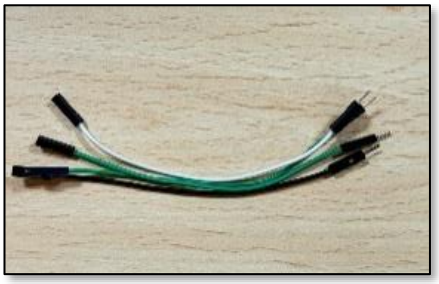


Figure 16: Jumper wires: Male to Female.

- **Battery**
- **USB Cable**

3.Development

Step 1 : Planning and Design

We researched for various ideas, and all four of us agreed on this design. It is simple and has potential usefulness for our home making it a perfect choice.

Step 2 : Resource Collection

The resources to develop this IOT project are Arduino UNO, relay module, jumper wires, soil moisture sensors, battery, and water pump. Some of the components like Arduino UNO, jumper wires, soil moisture sensors were given by the Resource department of the college, while relay module, water pump , battery and some stuffs for the outer decoration were bought by team members.

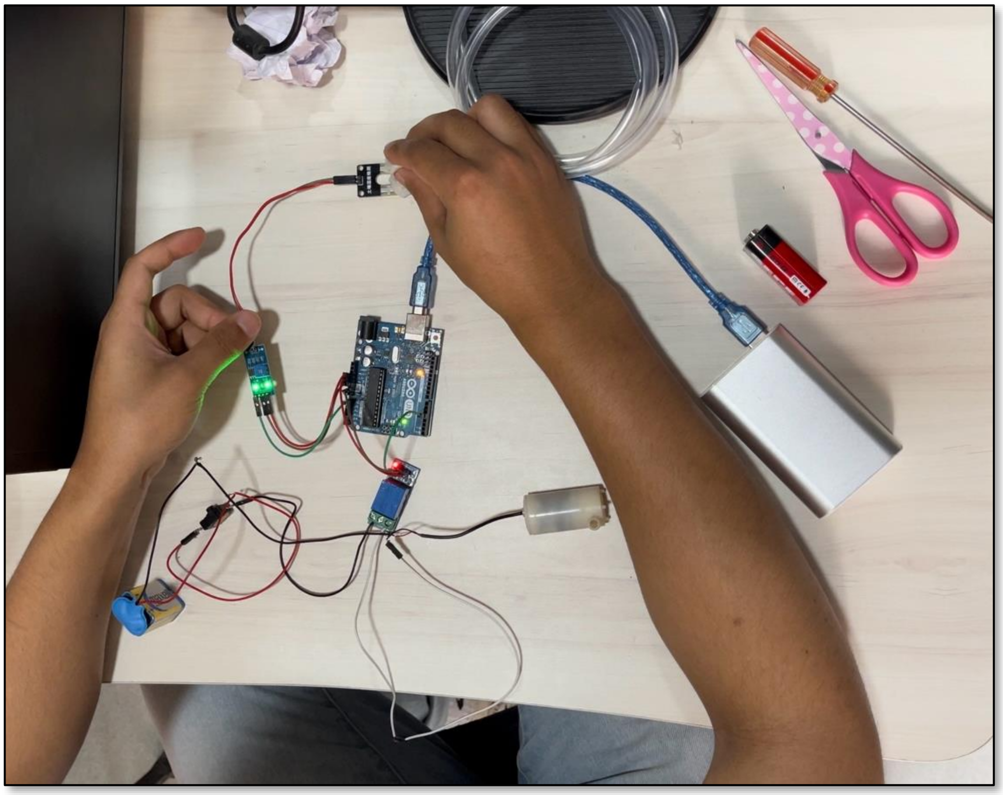


Figure 17: Resources used.

Step 3: System development

Phase 1: After collecting our resources from the resource department, we started our project from connecting relay module to Arduino UNO.

Relay module – Arduino UNO

VCC pin – 5-volt output pin

Group pin – Ground pin.

IN pin – PIN no 4

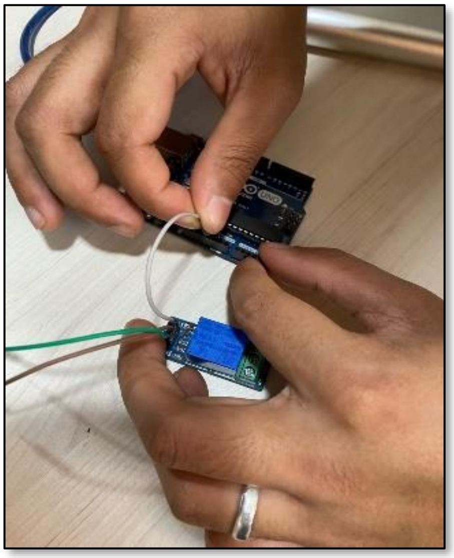


Figure 18: Connecting Relay Module and Arduino UNO.

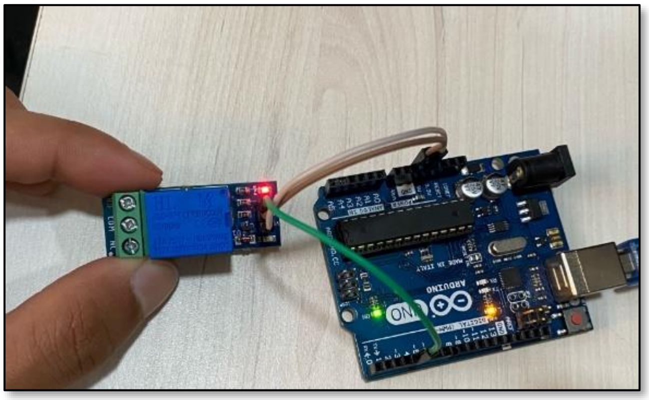


Figure 19: Successful connection between Relay module and Arduino Uno.

Phase 2: After the successful connection between relay module and Arduino UNO, we start connecting Soil moisture sensor to Arduino.

Soil moisture sensor – Arduino UNO

VCC pin – 3.3-volt output pin

Group pin – Ground pin.

Analog Output (AO) pin – A0 pin

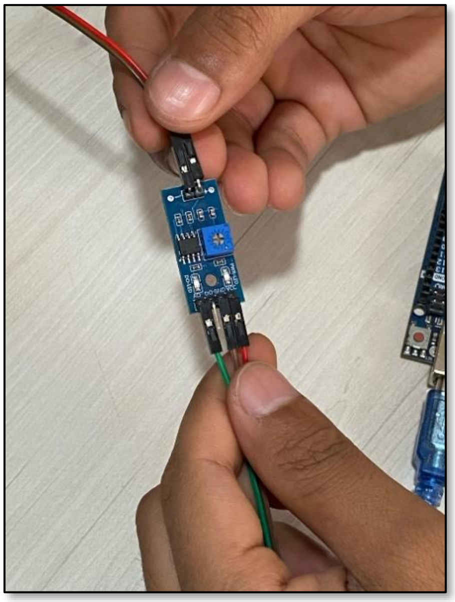


Figure 20: Securing the connection on sensor side.

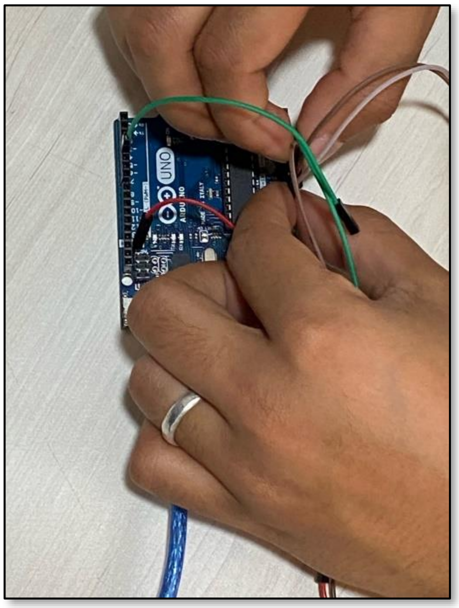


Figure 21: Securing the connection on Arduino side.

Phase 3: Connecting water pump and battery to relay module.

Negative – terminal of water pump – Negative – terminal battery

Positive + terminal of water pump – Common pin (COM) of relay module

Positive + terminal of battery – 1 terminal of switch and another terminal switch to Normally Open (NO)

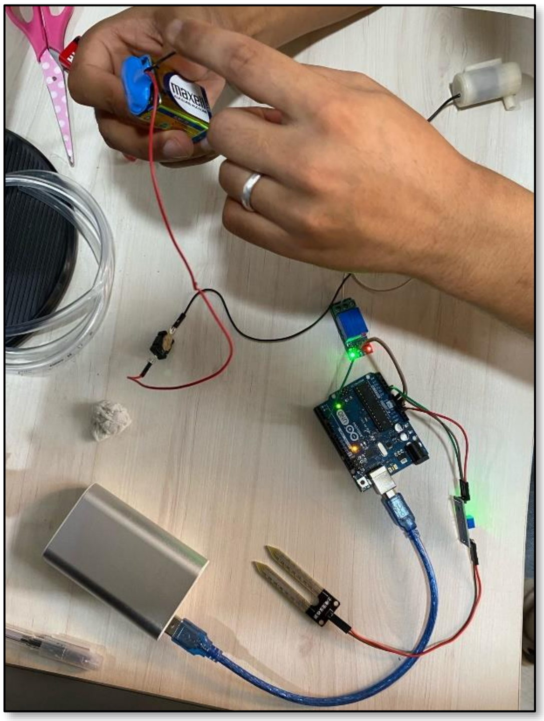
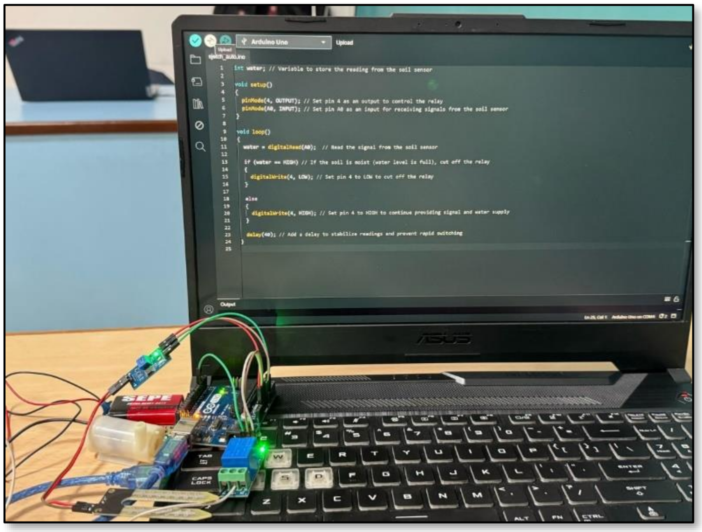


Figure 22: Successful connection between water pump, battery, and relay module.

Phase 4:

Compiling and uploading code to Arduino UNO.



```
int water; // Variable to store the reading from the soil sensor

void setup()
{
  pinMode(4, OUTPUT); // Set pin 4 as an output to control the relay
  pinMode(A0, INPUT); // Set pin A0 as an input for receiving signals from the soil sensor
}

void loop()
{
  water = digitalRead(A0);  // Read the signal from the soil sensor

  if (water == HIGH) // If the soil is moist (water level is full), cut off the relay
  {
    digitalWrite(4, LOW); // Set pin 4 to LOW to cut off the relay
  }

  else
  {
    digitalWrite(4, HIGH); // Set pin 4 to HIGH to continue providing signal and water supply
  }

  delay(40); // Add a delay to stabilize readings and prevent rapid switching
}
```

Figure 23 Uploading the code to Arduino UNO.

Step 5: Completing the project.

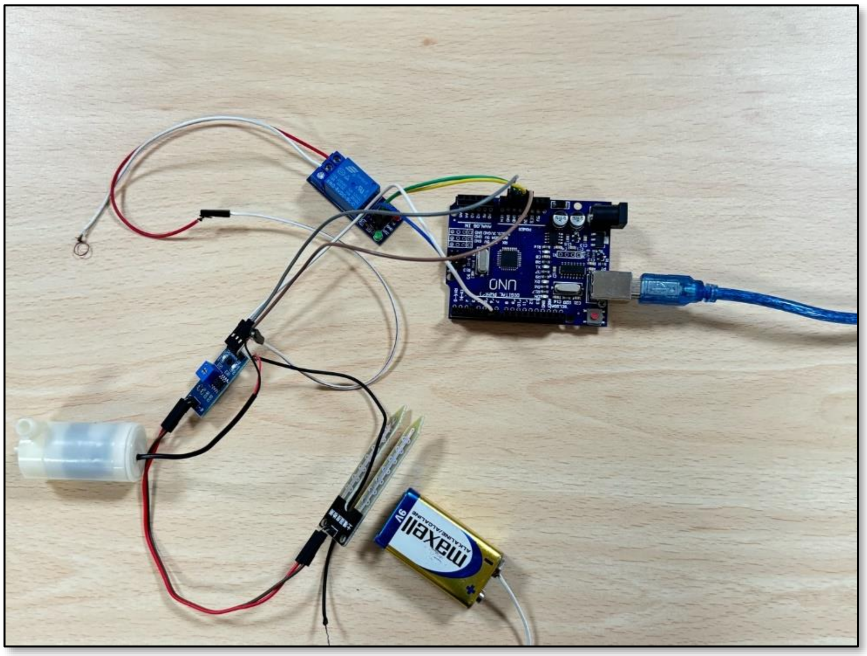


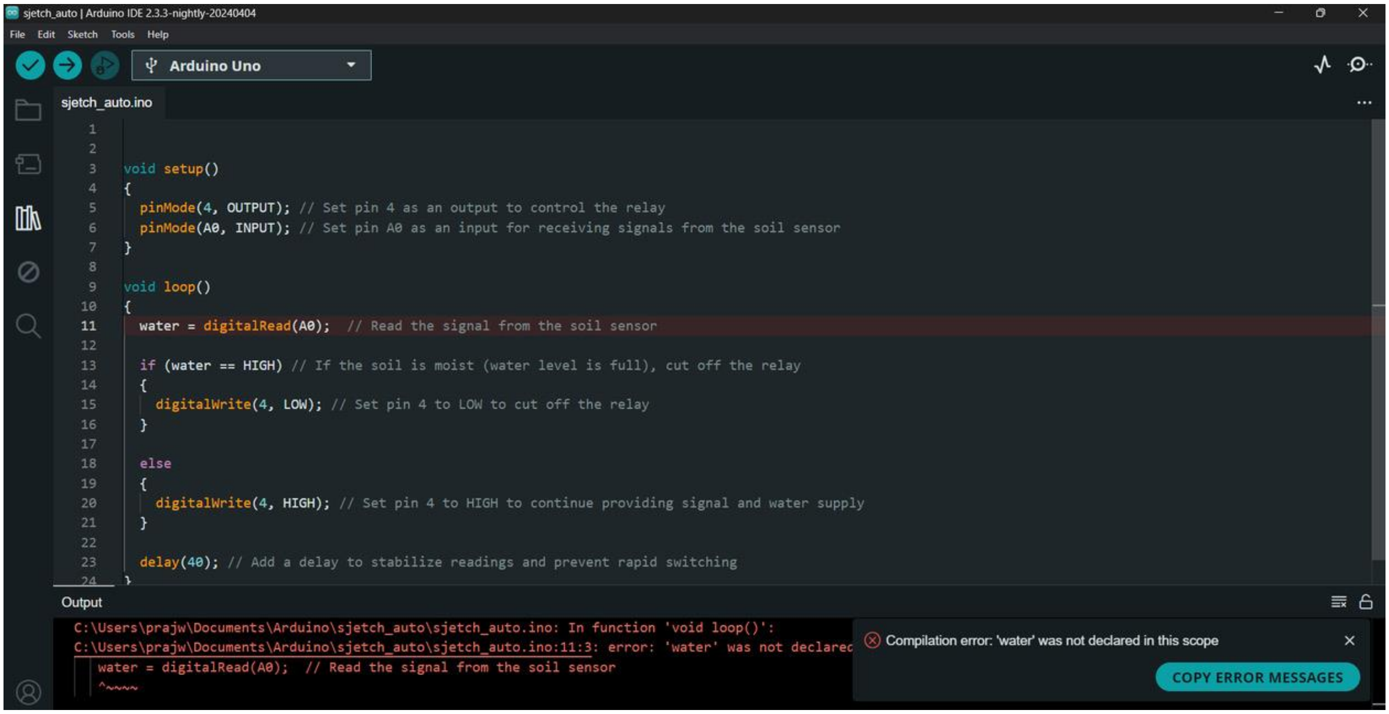
Figure 24 Completion of development.

4.Result and Findings

4.1 Test 1: To compile and upload the code.

Test	**1**
Objective	To compile the code and upload it.
Activity	1. Connecting Arduino with laptop. 2. Compiling the code.
Expected Result	The code would be complied and run successfully.
Actual Result	There was error while compiling the code.
Conclusion	The test was unsuccessful.

Table 1: To compile and upload the code.


sjetch_auto | Arduino IDE 2.3.3-nightly-20240404
File Edit Sketch Tools Help
Arduino Uno
sjetch_auto.ino
Output
COPY ERROR MESSAGES

```


void setup()
{
  pinMode(4, OUTPUT); // Set pin 4 as an output to control the relay
  pinMode(A0, INPUT); // Set pin A0 as an input for receiving signals from the soil sensor
}

void loop()
{
  water = digitalRead(A0);  // Read the signal from the soil sensor

  if (water == HIGH) // If the soil is moist (water level is full), cut off the relay
  {
    digitalWrite(4, LOW); // Set pin 4 to LOW to cut off the relay
  }

  else
  {
    digitalWrite(4, HIGH); // Set pin 4 to HIGH to continue providing signal and water supply
  }

  delay(40); // Add a delay to stabilize readings and prevent rapid switching
}
```

```
C:\Users\prajw\Documents\Arduino\sjetch_auto\sjetch_auto.ino: In function 'void loop()':
C:\Users\prajw\Documents\Arduino\sjetch_auto\sjetch_auto.ino:11:3: error: 'water' was not declared
   water = digitalRead(A0);  // Read the signal from the soil sensor
   ^~~~~
```

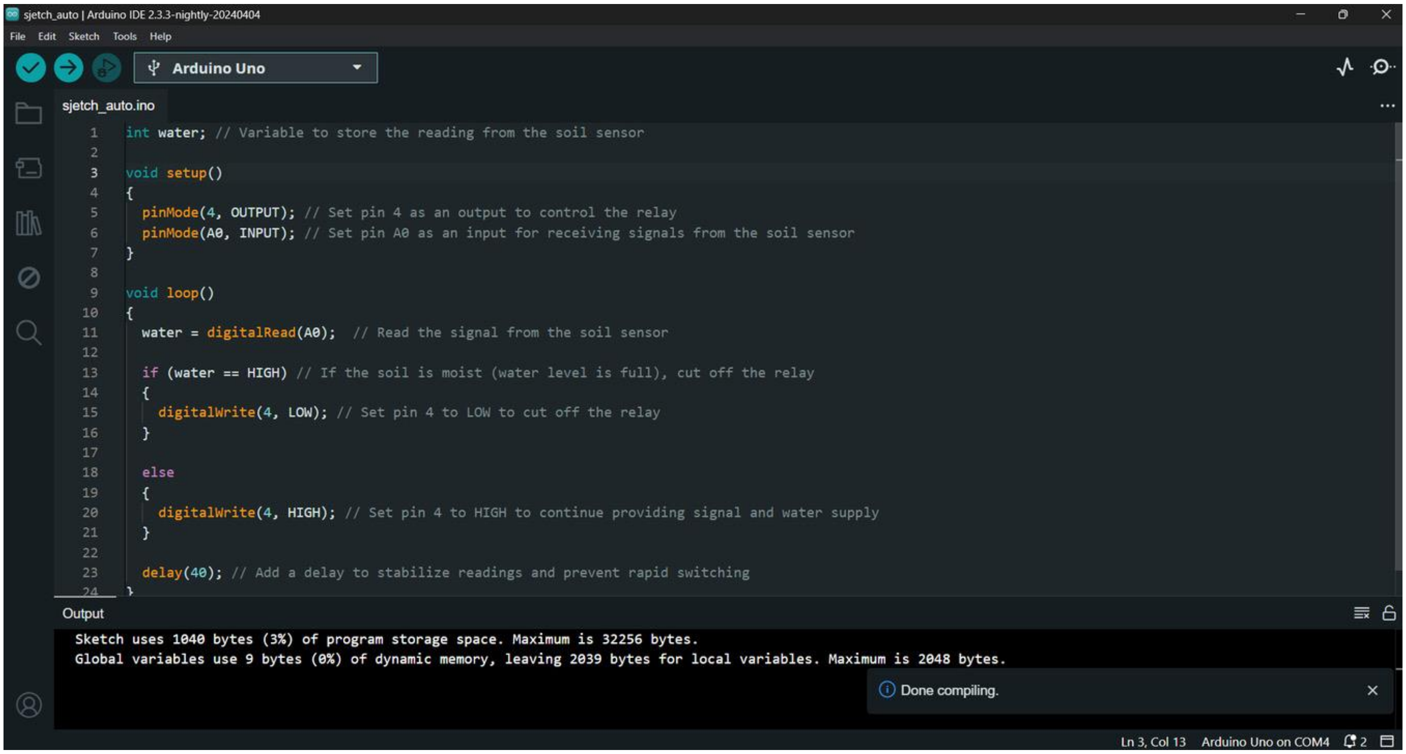
Compilation error: 'water' was not declared in this scope

Figure 25: An error occurred when compiling.

4.2 Test 2: To compile and deploy the code.

Test	**2**
Objective	To compile the code and upload it.
Activity	1. Connecting Arduino with laptop. 2. Compiling the code.
Expected Result	The code would be complied and run successfully.
Actual Result	The code is compiled.
Conclusion	The test is successful.

Table 2: To compile and deploy the code.


sjetch_auto | Arduino IDE 2.3.3-nightly-20240404
File Edit Sketch Tools Help
Arduino Uno
sjetch_auto.ino
Output

```
int water; // Variable to store the reading from the soil sensor

void setup()
{
  pinMode(4, OUTPUT); // Set pin 4 as an output to control the relay
  pinMode(A0, INPUT); // Set pin A0 as an input for receiving signals from the soil sensor
}

void loop()
{
  water = digitalRead(A0);  // Read the signal from the soil sensor

  if (water == HIGH) // If the soil is moist (water level is full), cut off the relay
  {
    digitalWrite(4, LOW); // Set pin 4 to LOW to cut off the relay
  }

  else
  {
    digitalWrite(4, HIGH); // Set pin 4 to HIGH to continue providing signal and water supply
  }

  delay(40); // Add a delay to stabilize readings and prevent rapid switching
}
```

```
Sketch uses 1040 bytes (3%) of program storage space. Maximum is 32256 bytes.
Global variables use 9 bytes (0%) of dynamic memory, leaving 2039 bytes for local variables. Maximum is 2048 bytes.
```

Done compiling.

Ln 3, Col 13 Arduino Uno on COM4

Figure 26: The code is compiled.

4.3 Test 3: To check if the soil moisture detects water.

Test	**3**
Objective	To test if the soil moisture works.
Activity	1. Connecting UCC pin of soil moisture to the 3.3-volt output pin of Arduino. 2. Connecting the GND pin to the GND pin of Arduino. 3. Connecting analogue out pin (AO) to the analogue out pin (AO) of Arduino.
Expected Result	The soil moisture is expected to detect water.
Actual Result	The soil moisture detects water.
Conclusion	The test is successful.

Table 3: To check if the soil moisture sensor detects water.

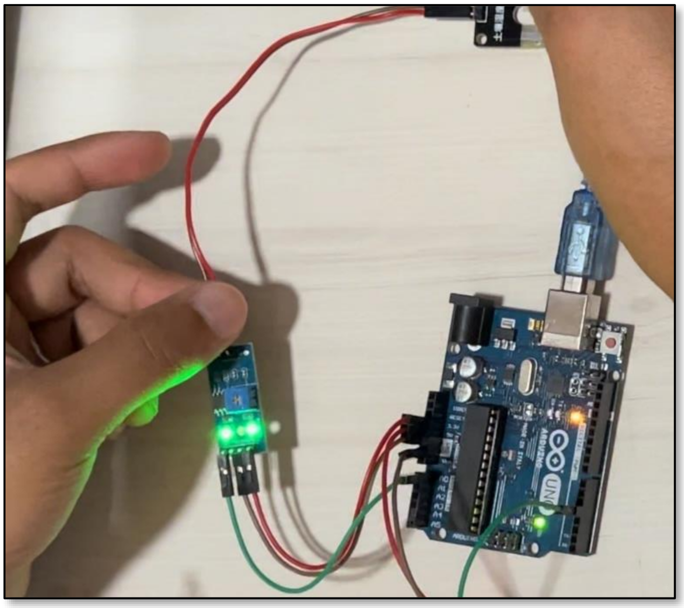


Figure 27: Sensor detects water.

4.4 Test 4: To check if the relay module is functioning.

Test	**4**
Objective	To check if the relay module works.
Activity	1. Pin 4 of the Arduino with the IN pin of the relay module. 2. Connecting GND pin of Arduino with GND of relay module. 3. Connecting 5-volt power output of Arduino to VCC pin of the relay module.
Expected Result	The relay module is expected to function.
Actual Result	The relay module works.
Conclusion	The test was successful.

Table 4: To check if the relay module is functioning.

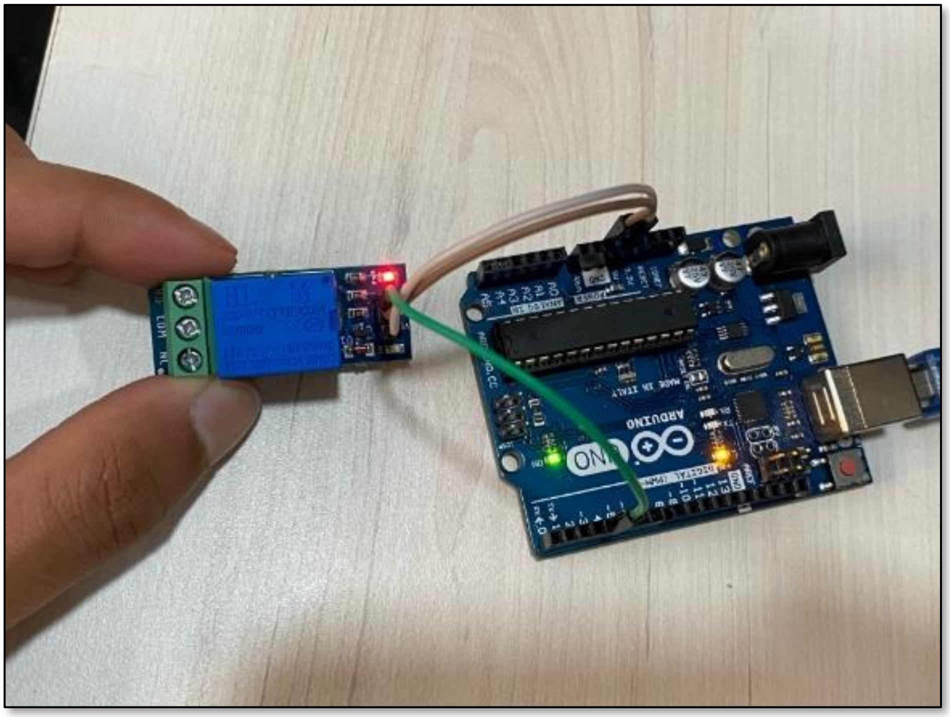


Figure 28 Relay module functions.

4.5 Test 5: To verify if the water pump is functioning properly.

Test	**5**
Objective	To test if the water pump works.
Activity	1. Connecting negative terminal of water pump with relay module on NC. 2. Connecting positive terminal of water pump with battery.
Expected Result	The water pump is expected to function properly.
Actual result	The water pump does not function.
Conclusion	The test was unsuccessful.

Table 5: To verify if the water pump is functioning properly.

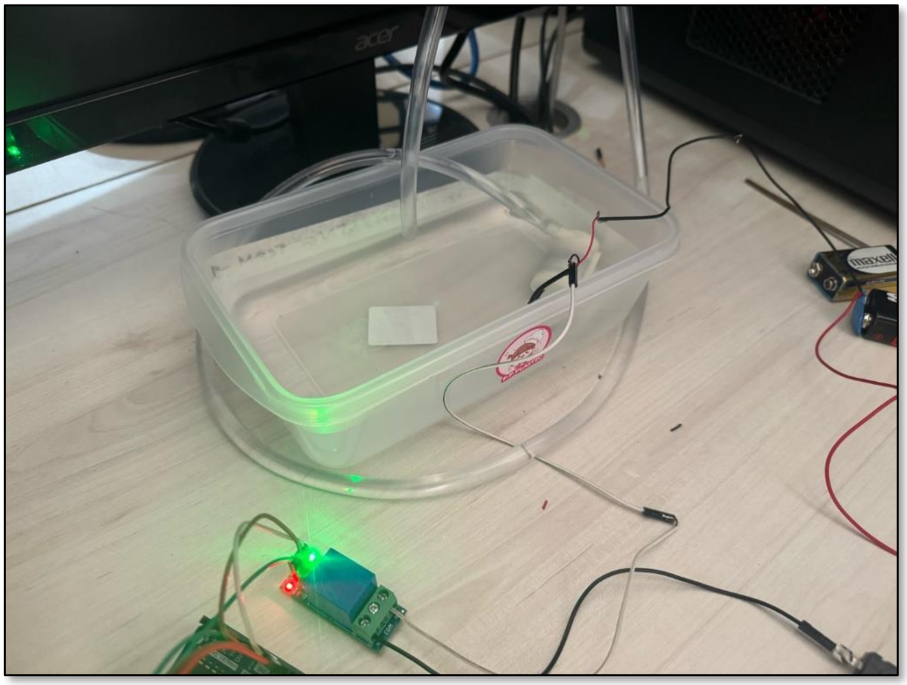


Figure 29: Water pump does not move water.

4.6 Test 6: To see if the water pump is moving water.

Test	**6**
Objective	To test if the water pump works.
Activity	1. Connecting negative terminal of water pump with relay module on COM. 2. Connecting positive terminal of water pump with battery.
Expected Result	The water pump is expected to move water.
Actual Result	The water pump moves water.
Conclusion	The test was successful.

Table 6: To see if the water pump is moving water.

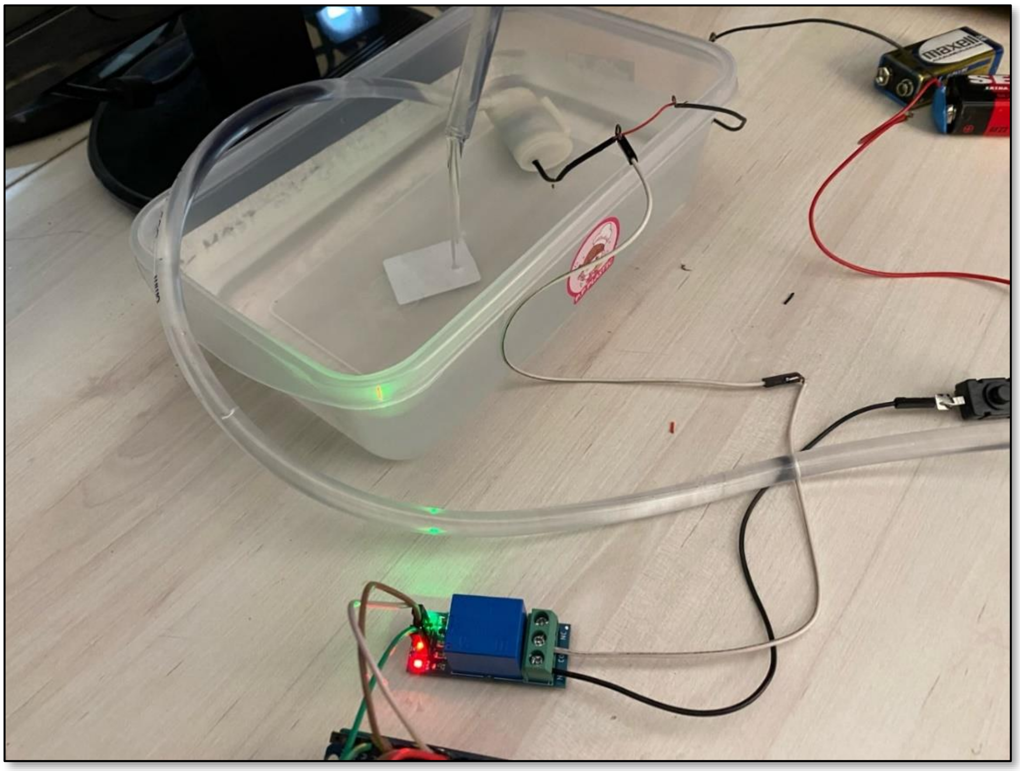


Figure 30 The water pump moves water.

5.Future Works

Our project has a lot of room for improvement. Currently, the prototype can only sense the water level, and the user still need to manually activate the system to water the plan. As our project only senses the water level and human have to go and turn on the prototype to water the plant.

We can simply add a light sensor to measure light levels to determine water needs of the plants. For instance, we can implement red light when the moisture is very dry and green when the water level is good.

We can combine Arduino Uno with a timer and create an automatic watering based on sensor data and advance watering schedules. For example, in summer, we can set the timer to a 6-hour difference. Since it’s hot, and the soil dries quickly, the system will automatically water the plant every 6 hours.

We can develop a mobile application , so that users can monitor sensor information, modify water schedules, and manage system remotely. For instance, if a someone is away, on a vacation and needs to water their plants, they can easily do so by using the application on their phone.

6.Conclusion

The Smart Plant Care project utilizes an Arduino Uno microcontroller and a soil moisture sensor to automate plant watering. This prototype aims to solve the common issue of plant owners overwatering and underwatering their plant. One consequence of this overwatering or underwatering is that plant owners, fearing damage to their plants, have increasingly opted for artificial plants. This project directly addresses this concern. This report details various tests conducted to demonstrate the projects successful functionality. Finally, it proposes recommendations for further improvement.

7.References

Amazon, 2022. *4Pcs DC 3-5V Micro Submersible Mini Water Pump with 2pcs Clear Vinyl Tubing Flexible PVC Tubing(1M) for Aquariums Fish Tank Pond Fountain Hydroponics Garden.* [Online]
Available at: https://www.amazon.com/Sipytoph-Submersible-Flexible-Aquariums-Hydroponics/dp/B097F4576N
[Accessed 04 04 2024].

Arduino UNO, 2022. *UNO R3.* [Online]
Available at: https://docs.arduino.cc/hardware/uno-rev3/#tech-specs
[Accessed 04 04 2024].

Arduino, 2024. *Arduino Integrated Development Environment (IDE) v1.* [Online]
Available at: https://docs.arduino.cc/software/ide-v1/tutorials/arduino-ide-v1-basics/
[Accessed 04 04 2024].

Britannica, 2024. *battery.* [Online]
Available at: https://www.britannica.com/technology/poison-nuclear-physics
[Accessed 04 04 2024].

Electronics|Projects|Focus, 2022. *What is a 5V Relay Module : Working & Its Applications.* [Online]
Available at: https://www.elprocus.com/5v-relay-module/
[Accessed 04 04 2024].

geeksforgeeks, 2020. *About diagrams.net.* [Online]
Available at: https://diagrams.net/about
[Accessed 17 01 2023].

Gokhale, P., Bhat, O. & Bhat, S., 2018. Introduction to IOT. *International Advanced Research Journal in Science, Engineering and Technology,* 5(1), pp. 41-44.

Wiltronics, 2022. *What Are Jumper Wires: Know by Colour, Types and Uses.* [Online]
Available at: https://www.wiltronics.com.au/wiltronics-knowledge-base/what-are-jumper-wires/
[Accessed 04 04 2024].

8.Appendix

8.1 Source Code

```
int water; // Variable to store the reading from the soil sensor


void setup()
{
  pinMode(4, OUTPUT); // Set pin 4 as an output to control the relay
  pinMode(A0, INPUT); // Set pin A0 as an input for receiving signals from the soil sensor
}


void loop()
{
  water = digitalRead(A0);  // Read the signal from the soil sensor


  if (water == HIGH) // If the soil is moist (water level is full), cut off the relay
  {
    digitalWrite(4, LOW); // Set pin 4 to LOW to cut off the relay
  }


  else
  {
    digitalWrite(4, HIGH); // Set pin 4 to HIGH to continue providing signal and water supply
  }


  delay(40); // Add a delay to stabilize readings and prevent rapid switching
}
```

8.2 Individual Contribution

Members name	Task
Prajwal Ghising (25%)	- Formatting and reviewing of the project. - Idea and research of the project - System Architecture, circuit diagram and flowchart - Background (System overview) - Testing - Presenting about the system.
Bishesh Thapa Balal (25%)	- Appendix - Doing overall project - Bringing material required for the project. - Abstract and Acknowledgment - Presenting about the problem and project as solution.
Sonam Dhendhup Gurung (25%)	- Circuit diagram and Block diagram - Review of the report - References - Introduction - Ending the presentation with conclusion
Kasis Shrestha (25%)	- Doing overall documentation. - Future works - Development - Bringing material required for the project. - Problem statement - Background (Requirement analysis) - Starting the presentation with a introduction of project.

Table 7: Individual Contribution Plan.

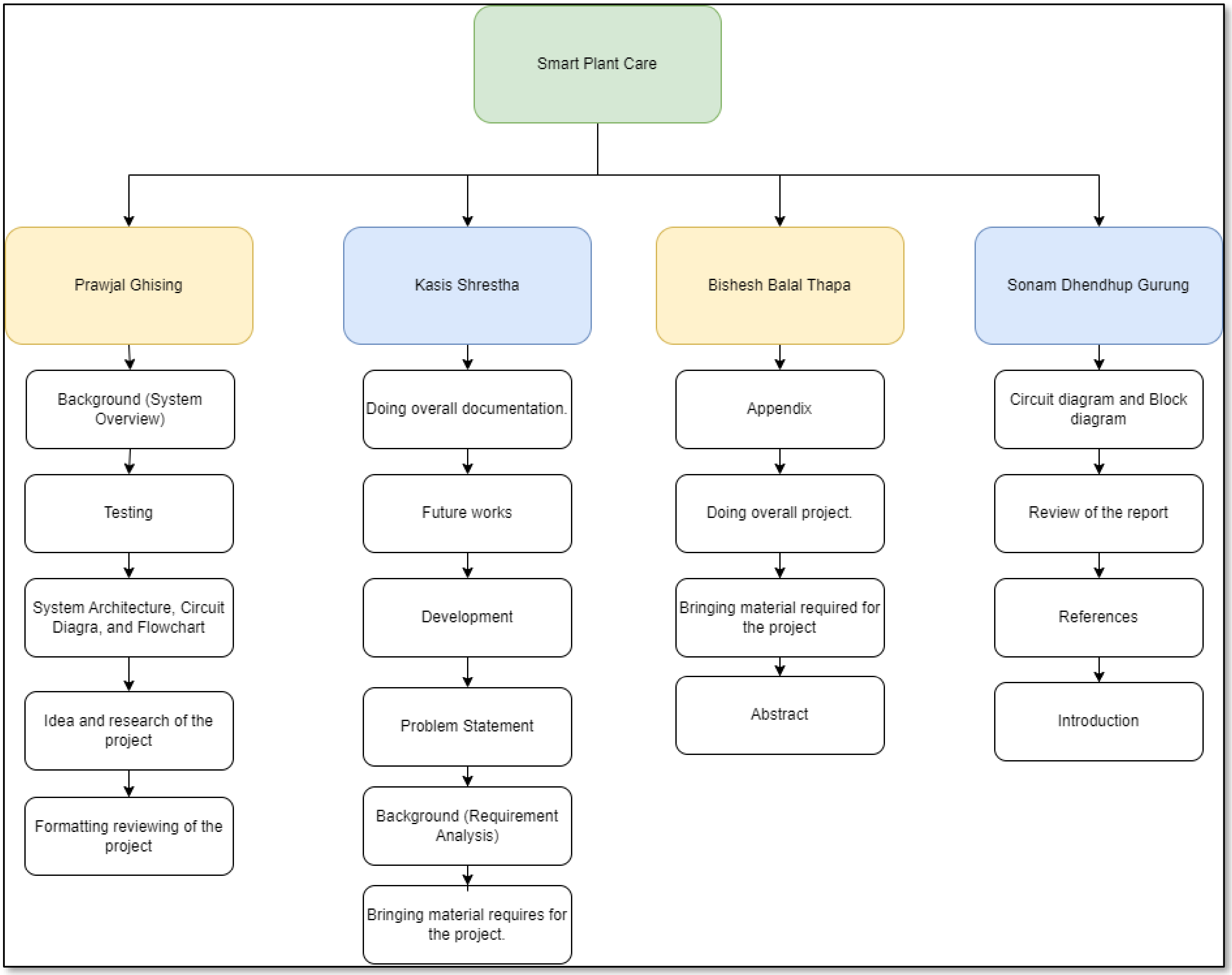

Smart Plant Care
Prawjal Ghising
Kasis Shrestha
Bishesh Balal Thapa
Sonam Dhendhup Gurung
Background (System Overview)
Testing
System Architecture, Circuit Diagra, and Flowchart
Idea and research of the project
Formatting reviewing of the project
Doing overall documentation.
Future works
Development
Problem Statement
Background (Requirement Analysis)
Bringing material requires for the project.
Appendix
Doing overall project.
Bringing material required for the project
Abstract
Circuit diagram and Block diagram
Review of the report
References
Introduction

Figure 31: Work Breakdown Structure.

8.3 Soil moisture sensor

By using Soil moisture sensors, we can accurately measure amount of water in the soil. The There are two main categories:

1. Stationary sensors are fixed in a place at a specific location and depths within a land.

2. Portable sensors are handheld devices that can be used to check moisture at various locations within a filed. This project is created using **Portable soil moisture sensors.**

8.4 Water pump

This machine transfers water from one location to another. This machine can use voltage of DC 3V or 4.5V. current. It does not produce much noise and can load water discharge of capacity of 100 L. It is used for small size aquarium, fish tank, pond and hydroponic systems (Amazon, 2022).

8.5 Battery

In electricity, batter is a device that converts chemical energy directly into electrical energy (Britannica, 2024). Due to the help of battery, we can run **motor** in this project.

Figure 32: Battery.

8.6 USB Cable

USB 2.0 Cable Type A and Type B is used to connect Arduino UNO and laptop to upload the code.

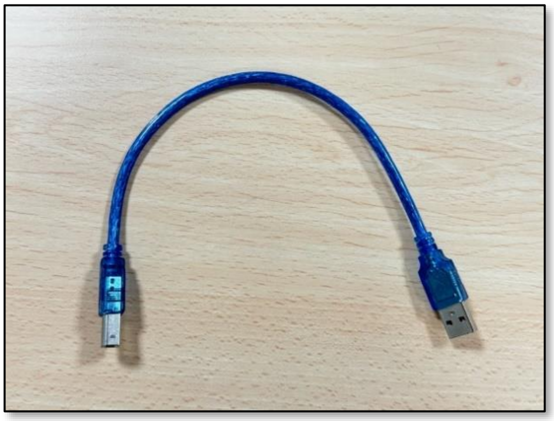


Figure 33: USB Cable.