PLANT IRRIGATION SYSTEM

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BONAFIDE CERTIFICATE

This is to certify that this project report entitled "PLANT IRRIGATION SYSTEM" is a bonafide work of by ***Loura Shiny M*** **(19BCE1524),** ***Prayasi Gopi*** **(19BCE1719)** and ***Shreyaas K*** **(19BCE1800)** who carried out the Project work under my supervision and guidance for the course **CSE2006-MICROPROCESSOR AND INTERFACING**.

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ABSTRACT

Civilization began with agriculture, and though humanity has changed significantly, agriculture still remains very important. Irrigation plays a vital role in agriculture. Besides, kitchen gardens are of a great interest to people. Although these gardens exist, people don't get the time to water their plants and end up leaving their plants dry or pouring excessing water all at once. This can be overcome with a smart soil moisture sensor which can sense the moisture level in the soil and provide water accordingly. Hence, water use will be optimal and plant growth will also be efficient. By implementing this project, the concept of microcontrollers and sensors were understood and practically experimented.

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CHAPTER 1
Introduction

Water scarcity is on the rise and addressing to the alarming situation is a need of the hour. Our project on plant irrigation can directly support the cause as its scope extends to Agriculture as well, where water plays a very crucial role. Our project focuses on the idea of using resources in a sustainable manner, so that some resources are also left for the future generations. When resources are used according to the requirements, the quality of crop produce will also be better and lesser are the chances of crop damage.

1.1 Purpose

Our project; soil moisture sensor, can be deployed in a soil surface so that the moisture content in the soil can be sensed and the plants can be watered according to the water level of the soil. The chances of spoiling plants by pouring excessive water on gloomy and humid days when water is already present in the soil are high and lack of awareness is a major reason. Such situations can be avoided if we know how much water is to be given to the soil for the plants to grow in a healthy manner.

Moisture content of the soil is one of the factors based on which the water requirement of a plant can be regulated. Here the moisture content of the soil is sensed with the help of a soil moisture detector and the presence of moisture is indicated with the help of LED Bulbs. This indication will help the user to understand if water is to be provided to the plant or not. Other factors which can also play an important role in calculating the accurate water level requirement of a plant includes soil temperature, humidity level, intensity of irrigation, type of crop, etc. These factors can also be monitored with other devices and can later be integrated with our project to increase the accuracy of the indication of water requirement. This project is economically feasible and implementing it results in a lot of positive results *viz* optimization of water usage, effective nurturing of plants and crops and saving quality time which can be utilized in other productive works. This way our project can indeed demonstrate the fact how technology can actually result in the welfare of mankind if used in the right direction.

1.2 Scope

Our project can be deployed in terrace gardens, mini gardens in balconies, plantations with steps of land designed for terrace farming, etc. This project can be effectively tested in our terrace gardens and neighborhoods and later be made commercial as a kit for aiding gardeners, gardening enthusiasts and farmers. As the future scope of our project, it can be integrated with multiple sensors to sense multiple factors affecting the water requirement of the soil *viz* temperature, humidity level, crop type, etc. The accuracy of the irrigation system will be more advanced on integrating these factors. The method of indication can also be developed into smarter and more efficient ways. We are living in the era of technology where things can be done anywhere and anytime just with a single touch on the mobile. Hence, the users can be directly notified and updated with the water level of the plant directly on their mobile phones. This way they need not be around the system to wait for the signal for watering plants. Moreover, the idea of automatic watering of the plants with the help of a pump, will be very useful to people who stay outdoors and don't get time to maintain their plants. This way their plants can be watered according to the water level as and when required and they need not worry or compromise their time for watering their plants. This idea can be proposed to Agriculture -based industries as well who are keenly interested in looking out for ways to conserve resources. Furthermore, the pump-based provision of water can also be modified as a drip irrigator mechanism where water is provided in a more conservative and sustainable manner.

CHAPTER 2

Design/Implementation

2.1 Introduction

Our project is an assembly of multiple components which are used in almost all microcontroller-based projects. It is a combination of Arduino UNO, Sensors, LEDs and some wires. The design has been setup with a motive of detecting the soil moisture and providing water accordingly. The entire setup can hence be deployed on a plant or on a mini garden with multiple plants positioned besides each other in a container. The approach chosen for the system hence worked on the idea that after deployment, whenever the moisture content of the soil went below the minimum required moisture value, it was sensed by the soil moisture detector and indicated to the user by means of an LED. Besides the indication, the motor was activated, water was drawn by the pump and provided to the plants till the minimum soil moisture requirement was surpassed and the appropriate state of soil moisture was regained. If adequate water is given to the soil and there is no requirement of any more water considering other factors such as the climate, humidity, weather, temperature, etc, then the moisture won't give indication for water to be supplied. It will instead give indication in terms of the Red LED Bulb.

2.2 Design Approach

The entire system works on the setup such that when the soil moisture detector is positioned in the soil at a considerable depth, the moisture of the soil is detected. The detector detects the moisture level and communicates to the user if water is required or not. The code with all the instructions is loaded from the system to the Arduino UNO Board and it operates based on the written algorithm. The input to the Arduino board is given by the soil moisture detector and the output of the Arduino is connected to a motor which will be providing water to the soil. The output will be indicated with the help of two LED bulbs, red and green. Green refers to the state when water is not required to be given to the soil while red refers to the state where provision of water to maintain the specific moisture content of that soil. The motor is activated with the glow of the red LED Bulb and water is provided accordingly to the soil. If moisture is detected, signal is sent to the bulb and the bulb glows. Jump cables both male and female were used for the purpose.

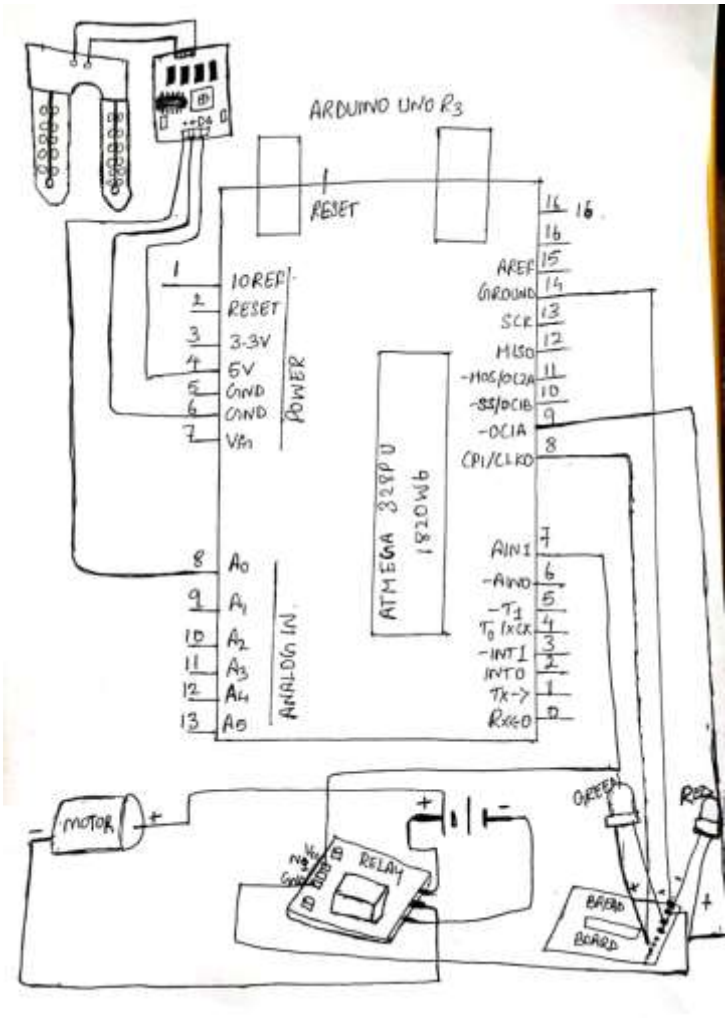

Fig 2.1 Circuit Diagram

2.3 Proposed System

2.3.1 Economic Feasibility

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The tools we used in this project were economically feasible. We dint use any parts which were very expensive. We estimated a particular amount initially and we were successful in finishing the project at that amount itself. We dint use any tools which were very expensive and the whole project was done at an expense of 2000 Rs approximately. The design of the project is very simple and dint require much tools and mostly the tools we used were available in hardware shops such as mercy electronics. The rest were ordered through online. The pandemic made us work hard as we couldn't meet to assemble the parts. But somehow, we managed everything online with the available technologies. This project can be considered as economically-friendly by the users as it has less complexity and cost. As college students, this

project made us spend the nominal amount which generally any project would take. When we started planning for the project itself, we put an excel sheet and calculated the amount this idea would take and we saw the areas where the cost can be cut down. The parts that were ordered from amazon were also equally less expensive when compared to the ones bought from hardware shops. Therefore, the above-mentioned factors clearly show that this project is economically feasible in other words cost-effective.

2.3.2 Technical feasibility:

The proposed idea of our project is technically feasible and our group have implemented the proposed idea of plant irrigation system using Arduino. The hardware requirements used in our project are Arduino uno board with cable, relay module, jump wires, resister, LEDs, soil moisture sensor, motor, tube and battery. Most of the parts were available in market as they were common tools and the few parts which we dint get in hardware shops were ordered online from online shopping cart such as amazon. Though initially it was hard for us to implement in this pandemic situation as we couldn't sit together and work, we somehow managed with the available technologies with video calls and implemented the project. The parts we used were easy to use and we also learnt a lot while doing the project. We used LEDs to depict whether the soil requires water or not which makes people understand the basic working of the system easily. Using Arduino was new to our team, but through this project we got to know it's working, process and uses. We dint have any complex parts which required any extensive searching and with the available sources itself we managed completing the project. Thereby, our project was technically feasible according to us and will also be to the users who use this.

2.3.3 Operational feasibility

The project that we choose which is plant irrigation system using Arduino is a very helpful project for people who have gardens and find it hard to maintain. For any plant, the primary requirement is water and this requirement should be provided accordingly only when the soil requires. Like, pouring a huge amount of water can result in rotting of the plant as it doesn't get the amount of oxygen and at the same time pouring less amount of water can lead to the destruction of the plant turning its leave pale. Our project helps to overcome this problem as it

provides water to the soil only when the soil requires it. A soil moisture sensor is placed in the soil which detects the moisture content in the soil and indicates whether the soil requires water or not through LEDs which glow accordingly. When the soil requires water, with the help of pump and motor, the water is produced to the soil. We have executed our project on the soil multiple times and found it to be working well and giving effective results. Use of Arduino made the project more effective. Relay was used to get the power supply of 5 volts and we have programmed it in a way such that the water is sent to the plant with the help of motor and pump when there is a need. This project can be helpful at cases where people having gardens go on long vacations as this project will take care of the plants making it operationally feasible.

2.4 Overview of software

In the implementation of the idea of Plant Irrigation System, the software was involved in the detection of soil moisture. It was required to monitor the soil moisture content such that when the level of moisture content in the soil dropped, indication had to be provided. The open-source Arduino Software (IDE) was used in our project for this purpose. This software can be used with any Arduino board. The code can easily be written on this software and can later be uploaded to the board. The Arduino UNO board is a microcontroller board which works on the instructions loaded and produces output according to the code. It is an Integrated Development Environment, hence working on this software would be very easy for the users. It is a cross platform application and the functions are written in C and C++ languages. The Arduino board is connected to a computer via USB, where it connects with the Arduino development environment (IDE). The written Arduino code in the IDE is referred to as sketches. It is uploaded to the microcontroller which executes the code, interacting with inputs and outputs such as sensors, motors, and lights.

2.5 Hardware Specification

Following are the hardware specifications for the design setup of the smart Plant Irrigation System:

- Arduino UNO

  Arduino/ Genuino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog

inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button.

- 1 Channel 5V Relay Module for Arduino

  Provides the needed power for the motor or any other device that requires more power than what the Arduino UNO can supply. A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal.

- Green, Red LED Bulbs

  Light emitting Diodes were used to signify if the motor is on or off or if moisture is enough or not. This will act as a visual representation in our project.

- Water Motor - 9V and Tube

  A 9V water motor is used to pump water. The Arduino board cannot supply this power. Thus, using a relay module, power is given to the motor from the external battery. This motor will be switched on when there isn't enough moisture in the soil and switched off when there is enough water. Water will be pumped out via tube.

- 9V External Battery

  Here a 9V battery is used as an external source of power for motor. As Arduino cannot supply enough power to the motor. Power from the battery is given to the motor through a relay module.

- Soil Moisture Sensor

  The Soil Moisture Sensor is used to measure the volumetric water content of soil. This sensor gives an analogy input to the Arduino board. It proves to be a very useful sensor when it comes to domains such as agriculture, plantations, etc. This is the main component as the soil moisture sensor determines if water needs to be supplied or not.

- Jump Wires

  These are also referred to as the connecting wire. Both male and female jump wires were used.

- Resistors for LEDs

Resistor were used here to make sure the current given the LEDs didn't fuse it. The current went through the resisters, having them in control and giving it to the LEDs.

- ❖ Plant pot - Two experimental plants were taken for the experiment. One with dry soil and another with moisture soil.

STATE\COMPONENT	MOTOR	LED GREEN	LED RED	RELAY
Well moisture soil	OFF	ON	OFF	RED
Dried soil	ON	OFF	ON	GREEN & RED

Comparison of the two states of the plant irrigation system

2.6 Software Requirements

The Plant Irrigation System is an Arduino UNO based model. Input to the board is given from the soil moisture sensor and output from the board is given to the LEDs and the motor. It is a hardware-based model. Hence no specific software is required. Arduino IDE was used to run the below mentioned pseudo code. Output from the soil moisture sensor can be seen on the Serial Monitor. If the generated moisture values were less than 500, it implied that there was no moisture in the soil. Whereas, the generated value greater than 500 implied the presence of moisture in the soil. The output values were displayed with a delay of 1 second.

Pseudo code/ Algorithm of the code

1. Get the required variables for input and output pins.

2. Here, resval is used to hold the value of the soil moisture sensor, respin holds A0, the input pin. MOTOR =7, holds the output pin for motor, LED_GREEN_PIN = 8 holds output pin for Green LED,
LED_RED_PIN = 9 holds output pin for Red LED.

3. Next define the setup() fo r the plan irrigation system. Set Serial.begin(9600).

4. Now define the mode of the output pins

```
pinMode(LED_RED_PIN, OUTPUT);
pinMode(LED_GREEN_PIN, OUTPUT);
pinMode(MOTOR, OUTPUT);
```

5. Define loop() for the functionality of the LED s and the MOTOR. Here resval holds the analog value from the pin and stores it resval.

6. Now print the value of resval in the serial monitor.

```
Serial.println(resval);
```

7. Give a of 1 second between each display.

```
delay(1000);
```

8. if rescal is less than 500 then

It means not enough moisture is present in the soil. To indicate this visually, Red LED is turned ON and the Motor is ON to supply water.

else

It means enough moisture is present in the soil. To indicate this visually, Green LED is turned ON and the Motor is OFF, no water is supplied to the plant.

2.7 Summary

The idea and prime motive of our project is to develop a smart Plant Irrigation System which will detect the moisture content in the soil and provide water to the soil automatically as per the bare minimum requirement of the moisture content of the soil. Our setup was designed to equally support the idea such that it can be deployed at any plant pot or mini garden trench and implemented so that the user need not be bothered about looking after the plants. The water will be provided at a regular basis and other external factors such as weather, temperature, humidity and climate play a role in the level of moisture content in the soil. The moisture content in the soil will be affected and reduced depending on these factors and for an instance is the fact that a gloomy day requires less water provision because of less transpiration and

water requirement. On building this system, in the most economical way possible with the easily available parts make this project an idea which can be seen in almost every house in the near future especially in this era where environmental concerns are a big issue. Environmentalists, water conservatives and eco enthusiasts are already playing their roles in conserving resources and using them in a sustainable manner. With the addition of this system to the cause, by deploying it in our households, and nearby gardens, a considerable amount of water can be saved as water need not be provided to the plants unnecessarily, thus saving them from being damaged due to excess water or water shortage. Hence our project can eventually help in saving resources as every drop counts and every step matters.

CHAPTER 3

Result and Analysis / Testing

The live demonstration of the project is been depicted here as picture in a step-by-step manner such that a run through to all the images will give a clear idea on the working of the project and the implementation of the setup.

3.1 Experiment Plants (Well moisture v/s Dried)

Fig 3.1

3.2 Soil Moisture Sensor placed in well moistured plant

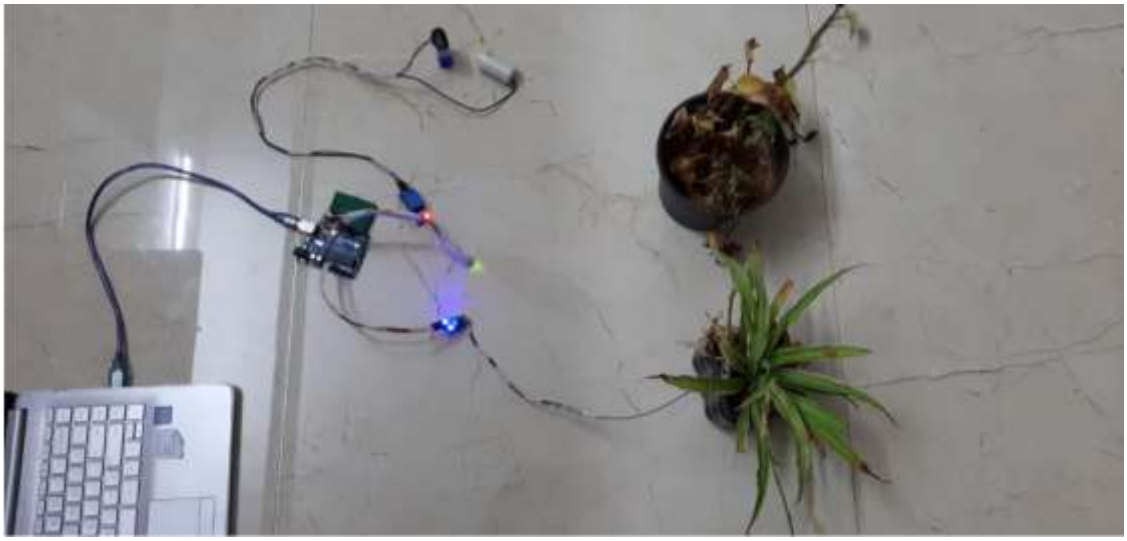

Fig 3.2

The Green LED is glowing because of the presence of moisture in the soil. The relay is turned off as no power is required for the motor and no water is to be provided as the soil is already moist.

3.3 Soil Moisture Sensor placed in not a well moistured plant

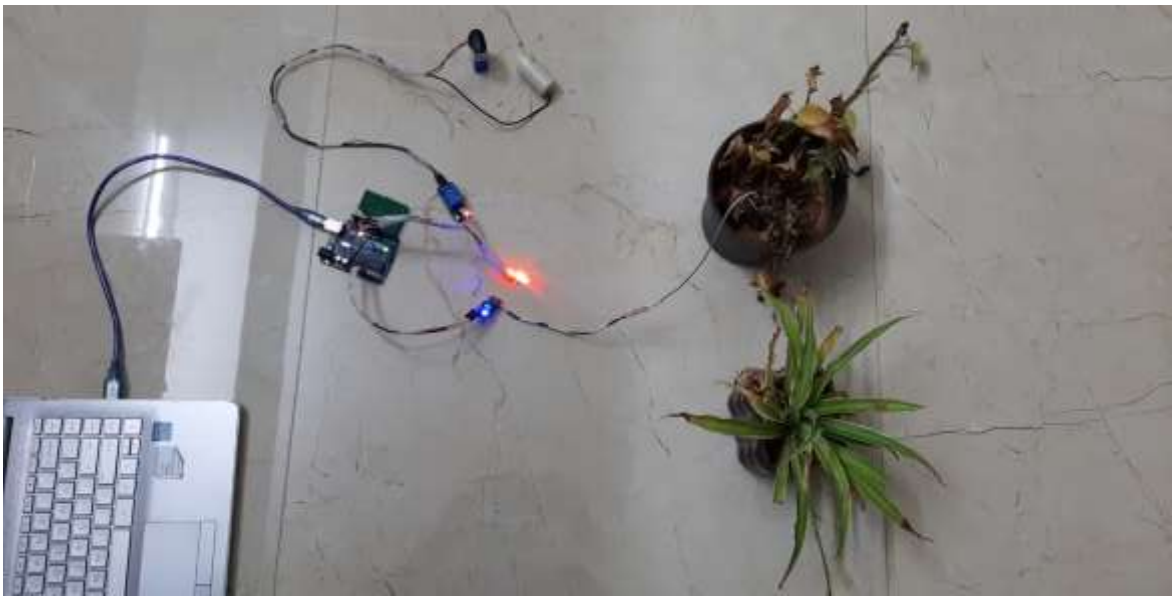

Fig 3.3

The Red LED is glowing because of the absence of moisture in the soil. The relay is turned on by the indication of the green light on the relay module as power is required for the motor and water is to be provided as the soil is not moist.

3.4 Water provision to the dried plant.

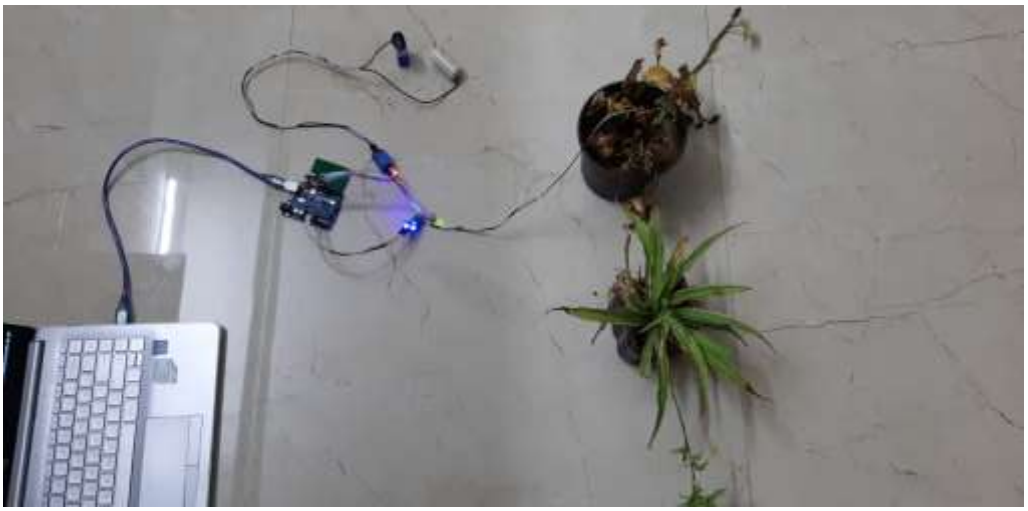

Fig 3.4

The green LED is glowing instead of red because of the presence of moisture in the soil by the addition of water. The relay is turned off by the indication of the red light on the relay module as power is not required for the motor and water is to not be provided as the soil is moist.

3.5 Arduino Board Setup

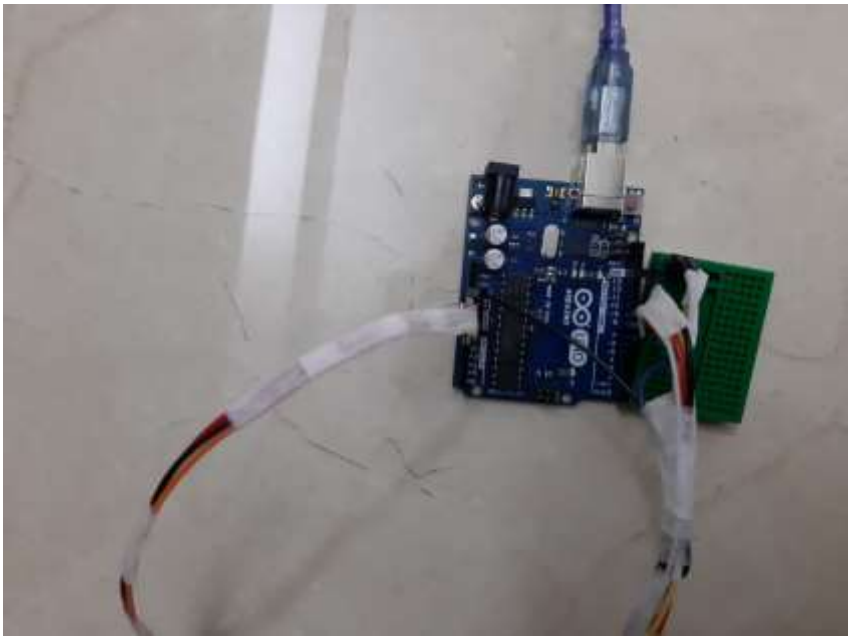

Fig 3.5

The input to the Arduino board is given by the soil moisture detector and the output of the Arduino is connected to a motor which will be providing water to the soil.

3.6 Soil Moisture Detector

Fig 3.6

3.7 Relay Module

Fig 3.7

Provides the needed power for the motor or any other device that requires more power than what the Arduino UNO can supply. A relay is an electrically operated switch.

3.8 Arduino IDE

Fig 3.8

Serial Monitor view when moisture is not present in the soil

3.9 Arduino IDE

Fig 3.9

Serial Monitor view when moisture is present in the soil.

3.10 Summary

The Plant Irrigation System is an Arduino UNO based model. Input to the board is given from the soil moisture sensor and output from the board is given to the LEDs and the motor. The board receives input from pin A0. It has three output pins - one for motor and two for two LEDs (red and green). The motor used requires 9 V power and since Arduino board cannot provide with that much power, an external battery is used to supply power. The output from the Arduino is connect to a relay module via which a motor is connected. The soil moisture sensor is used to detect moisture in the soil. When there is moisture in the soil, i.e., value read by the soil moisture sensor is greater than 500 then it means there is moisture in the soil. Thus, the Green LED glows and the motor is off. Now when the value in the sensor reads less than 500 then it means that there isn't enough moisture, thus the motor starts and water is given to the plant. Here the Red LED glows. So, this automates the water supply by switching the motor ON and OFF whenever necessary by the relay. The project has many ways to be developed in the future. We can make this a full-fledged irrigation system for a terrace garden. We can add a Wi-Fi/ Bluetooth module to the system so that we can control the system from a device. We can include multiple factors such as temperature sensor, light sensor, humidity sensor to give a more informed irrigation to the plants.

CHAPTER 4
CONCLUSION AND FUTURE ENHANCEMENT

Plants are the bases on which life exits. There are many ways in which technology is advancing and they can also help nourish the environment. People have acquainted to growing plants in the recent past but all of their busy schedules don't give them enough time to water their plants whenever needed. Thus, an irrigation system like this will prove to provide easy to a lot of plant owners. Since the system is automated, the owner will not have to regularly remember to water plants. This way their precious time can effectively be used in a productive way and at the same time their plants are also taken care of without much investment of their time. This Arduino based Plant Irrigation System is a great way to begin learning about Arduino boards. This hardware model will prove to be very useful in many households and especially mini gardens setup in small containers which has the capability of accommodating a few plants. On deploying this system in such places, the entire set of plants in that container can be taken care of. Hence, we can conclude on a positive note that we have brought an idea which by all means saves resources, time and can be a potential solution for water conservation. As the future scope of this project, we can computerize the setup even further with the help of Wi-Fi and Bluetooth such that the user can be notified directly in their mobile phones in this era where mobiles have become a necessity. Moreover, the method of providing water to the plants can be made even more conservative by means of drip or sprinkler irrigation.

APPENDIX

Code used on the software side

This code is written and run-on Arduino IDE, a very easy to use and compile environment for the execution of the code.

```
int resval = 0;   // holds the value
int respin = A0; // sensor pin used for input
int MOTOR = 7;  //output pin for motor
int LED_GREEN_PIN = 8;  //output pin for Green LED
int LED_RED_PIN = 9;  //output pin for Red LED

void setup()
{
  // start the serial console
  Serial.begin(9600);
  pinMode(LED_RED_PIN, OUTPUT);
  pinMode(LED_GREEN_PIN, OUTPUT);
  pinMode(MOTOR, OUTPUT);
}

void loop()
{
  resval = analogRead(respin); // Read data from analog pin and store it to resval variable
  Serial.println(resval); //print on serial monitor
  delay(1000);
  if (resval < 500)
  {
//not enough moisture, turn on Red LED and Motor is ON
    digitalWrite(LED_RED_PIN, HIGH);
    digitalWrite(LED_GREEN_PIN, LOW);
    digitalWrite(MOTOR, HIGH);
  }
  else
  {
```

```
//enough moisture, turn on Green LED and Motor is OFF
    digitalWrite(LED_RED_PIN, LOW);
    digitalWrite(LED_GREEN_PIN, HIGH);
    digitalWrite(MOTOR, LOW);
  }
}
```

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