AUTOMATIC IRRIGATION SYSTEM USING ARDUINO UNO

ABSTRACT:

The project is designed to develop an automatic irrigation system which switches the pump motor ON/OFF on sensing the moisture content of the soil. In the field of agriculture, use of proper method of irrigation is important. The advantage of using this method is to reduce human intervention and still ensure proper irrigation. The project uses an 8051 series microcontroller which is programmed to receive the input signal of varying moisture condition of the soil through the sensing arrangement. This is achieved by using an op-amp as comparator which acts as interface between the sensing arrangement and the microcontroller. Once the controller receives this signal, it generates an output that drives a relay for operating the water pump. An LCD display is also interfaced to the microcontroller to display status of the soil and water pump. The sensing arrangement is made by using two stiff metallic rods inserted into the field at a distance. Connections from the metallic rods are interfaced to the control unit.

I. INTRODUCTION:

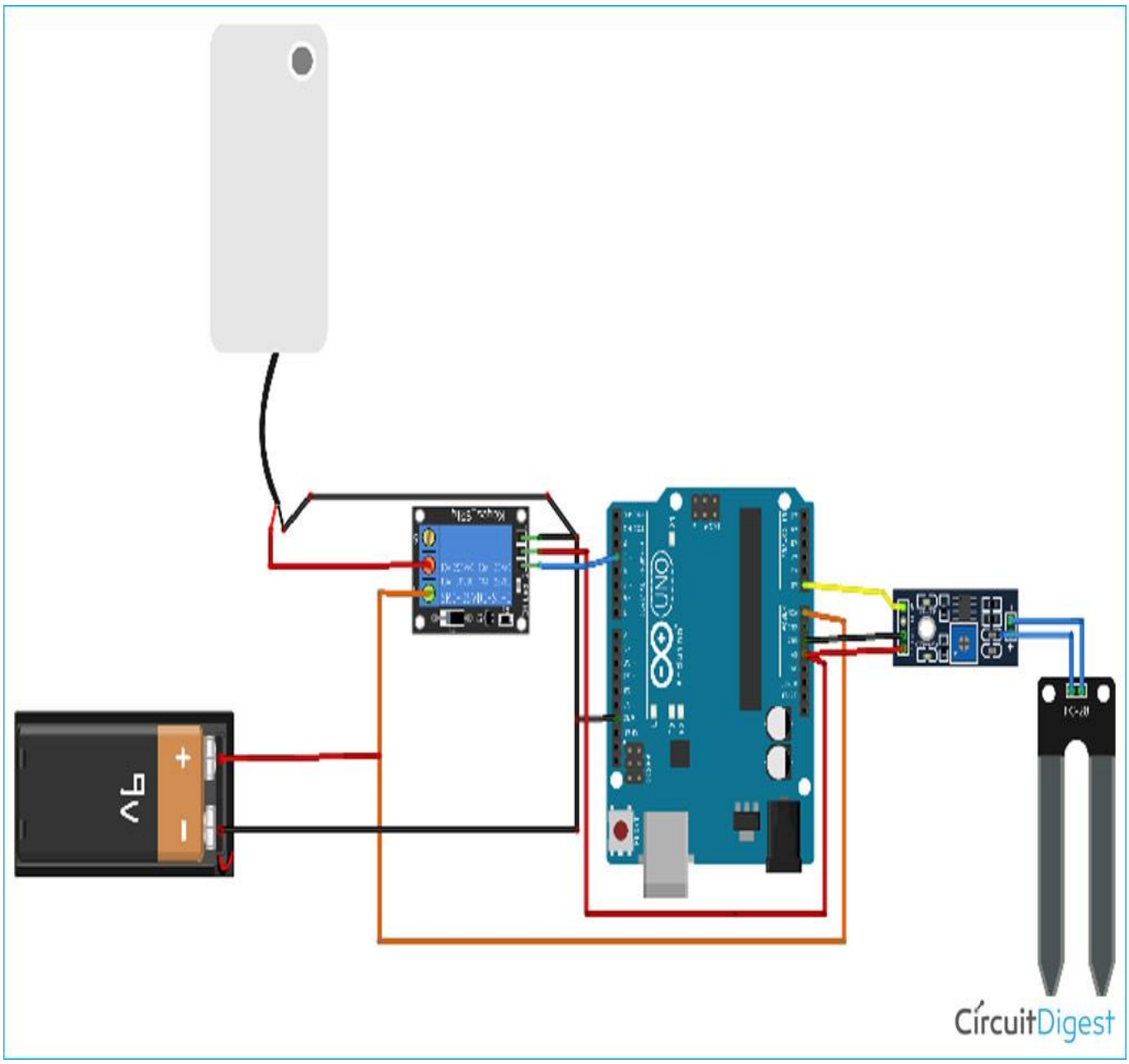
In the fast paced world human beings require everything to be automated. Our life style demands everything to be remote controlled. Apart from few things man has made his life automated. In the world of advance electronics, life of human beings should be simpler. Hence to make life simpler and convenient, we have made “AUTOMATIC IRRIGATION SYSTEM”. A model of controlling irrigation facilities to help millions of people. This model uses sensing arrangement technology with microcontroller to make a smart switching device. The continuous increasing demand of food requires the rapid improvement in food production technology. In a country like India, where the economy is mainly based on agriculture and the climatic conditions are isotropic, still we are not able to make full use of agricultural resources. The main reason is the lack of rains & scarcity of land reservoir water. Irrigation has always been an ancient practice which has evolved through so many stages over the years. Our ancestral farmers in a bid to irrigate their farm sought for various methodologies. Manual irrigation using buckets and watering cans, flood irrigation, drip irrigation, sprinkler irrigation were and are still being used today. The existing system has several limitations; leaching off of soil nutrients, erosion due to flooding, loss of water from plant surfaces through evaporation, water wastage which can result to water scarcity in drought areas and production of unhealthy crops. This problem can be rectified if we use microcontroller based automated irrigation system in which the irrigation will take place only when there will be acute requirement of water

II. DESIGN METHODOLOGY:

This project on "Automatic Irrigation System" is intended to create an automated irrigation mechanism which turns the pumping motor ON and OFF on detecting the damspness content of the earth. In the domain of farming, utilization of appropriate means of irrigation is significant. The continuous extraction of water from earth is reducing the water level due to which lot of land is coming slowly in the zones of un-irrigated land. The benefit of employing this technique is to decrease human interference and still make certain appropriate irrigation. The circuit comprises of sensing arrangement parts built using op-amp IC LM358. Op-amp's are configured here as a comparator. Two stiff copper wires are inserted in the soil to sense whether the soil is wet or dry. The Microcontroller is used to control the whole system by monitoring the sensing arrangement and when sensing arrangement senses the dry condition then the microcontroller will send command to relay driver IC the contacts of which are used to switch on the motor and it will switch off the motor, if the sensing arrangement senses the soil to be wet. The microcontroller does the above job as it receives the signal from the sensing arrangement through the output of the comparator, and these signals operate under the control of software which is stored in ROM of the Microcontroller. The condition of the pump i.e., ON/OFF is displayed on a 16X2 LCD. The power supply consists of a step down transformer, which steps down the voltage to 12V AC. This is converted to DC using a Bridge rectifier. The ripples are removed using a capacitive filter and it is then regulated to +5V using a voltage regulator which is required for the operation of the microcontroller and other components. The figure below shows the block diagram of Microcontroller

based irrigation system that proves to be a real time feedback control system which monitors and controls all the activities of the irrigation system efficiently.

BLOCK DIAGRAM



In this section, I will explain all the details with the help of the schematic diagram. The **Arduino UNO** is the brain of this whole project. It controls the motor pump according to the moisture in the soil which is given by the moisture sensor.

To power the circuit, I am using an external Battery. You can use any 9v or 12-volt battery. The battery is connected to the Vin and ground pins of Arduino and we can also connect the motor to this battery via a relay. Moisture sensor output is connected to the analog pin of Arduino. Do remember to use the Arduino's 5volt pin to power the sensor and relay module.

Components Required for the Automatic Irrigation System

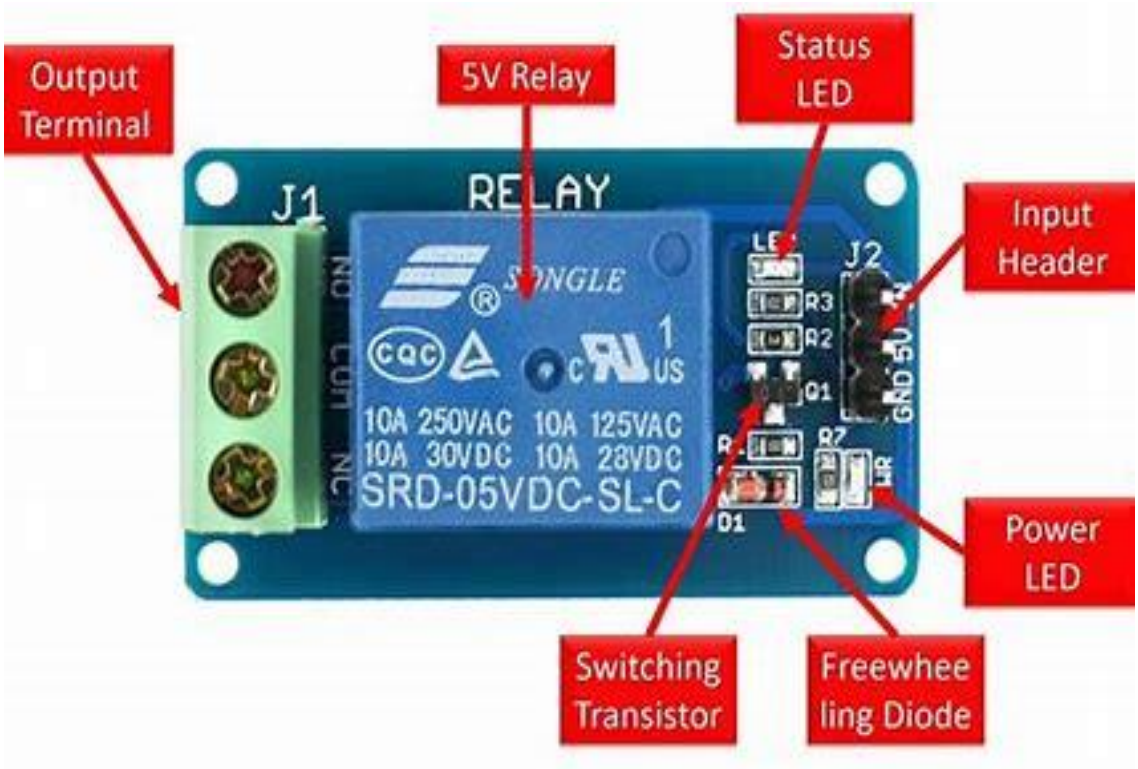
The project requires very few components and the connection is also very simple. The components are listed below:

- Arduino * 1
- moisture sensor * 1
- 5v relay module * 1
- 6v Mini water pump with small pipe * 1
- Connecting wires
- 5v battery * 1

Working of the Automatic Irrigation System

5V Relay Module

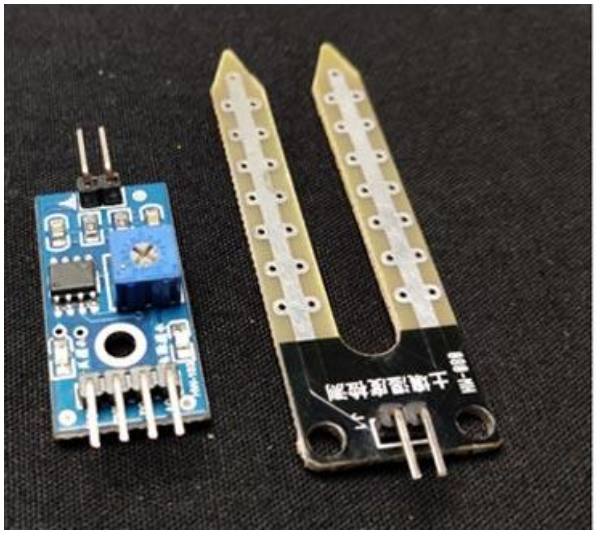
The relay module with a single channel board is used to manage high voltage, current loads like solenoid valves, motor, AC load & lamps**. This module is mainly designed to interface through different microcontrollers like PIC, Arduino, etc. 5V Relay Module Pin Configuration**

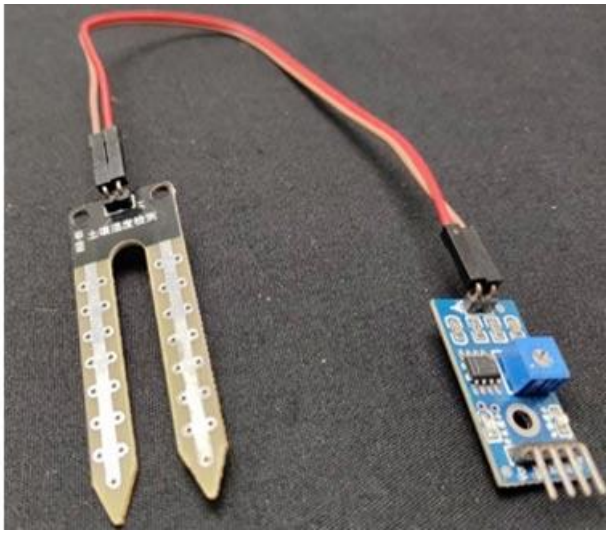


Soil Moisture Sensor

The working of the soil moisture sensor is very easy to understand. It has 2 probes with exposed contacts that act like a **variable resistor** whose **resistance varies** according to the water content in the soil. This resistance is inversely proportional to the soil moisture which means that higher water in the soil means better conductivity and hence a lower resistance. While the lower water in the soil means poor conductivity and will result in higher resistance. The sensor produces an analog voltage output according to the resistance.

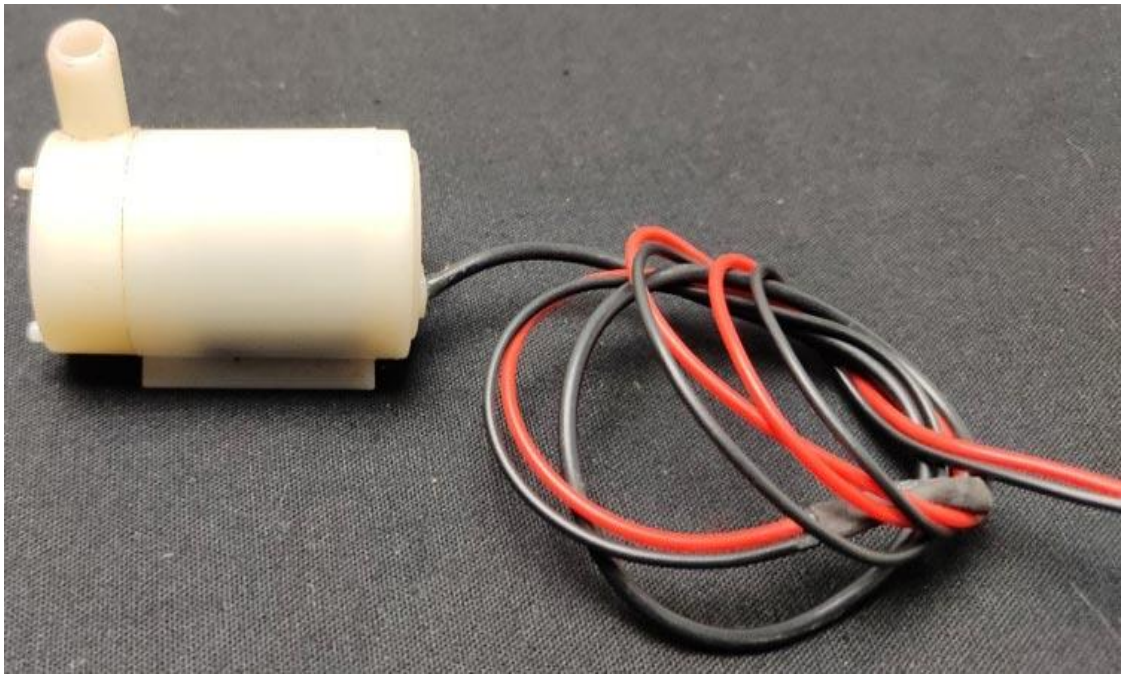
The sensor comes with an electronic module that connects the probe to the Arduino. The module has an **LM393 High Precision Comparator** which converts the analog signal to a Digital Output which is fed to the microcontroller.





Pump

We need a small pump to irrigate the plant, but in the case of a garden, we need to drive a larger pump that can provide a higher volume of water depending on the size of your garden which can’t be directly powered by an Arduino. So in case you need to operate a larger pump, a driver is necessary to provide enough current for the pump, to show that I am using a 5v relay. You can also use an AC-powered pump and use a suitable relay. The working will remain the same as shown in this project, you just have to replace the DC power input connected to the relay with an AC power input and have to power your Arduino with a separate DC power source.



Arduino

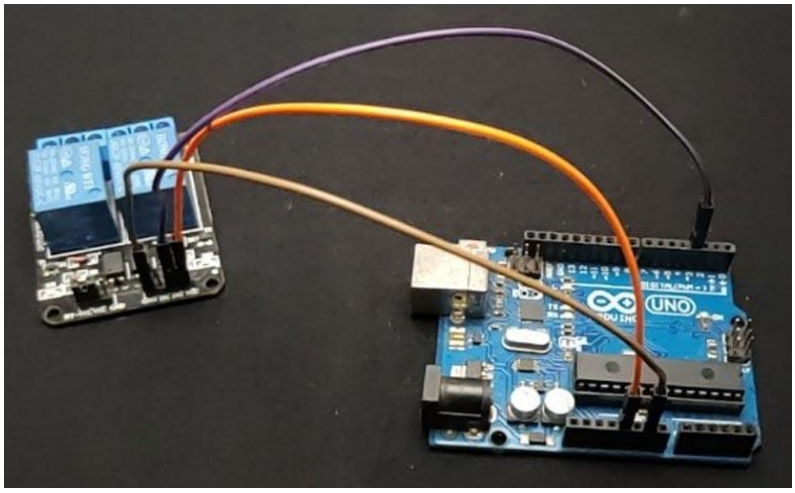
Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software. It consists of a circuit board, which can be programed (referred to as a microcontroller) and a ready-made software called Arduino IDE (Integrated Development Environment), which is used to write and upload the computer code to the physical board.

Arduino provides a standard form factor that breaks the functions of the micro-controller into a more accessible package.

Assembling the Automatic Irrigation System

Let's start with connecting the relay to the Arduino board. Connect the VCC of the relay module to the 5v pin of the Arduino and connect the ground of the relay to the ground of Arduino. Now connect the relay signal pin to any digital pin of Arduino except pin 13. Here I have connected it to pin 3 as shown in the image below.

The next step is to connect the soil moisture sensor with the Arduino. Connect the VCC and gnd of the sensor to the 5volt and ground pin of the Arduino. The analogue output of the sensor connects to any analogue pin of the Arduino, here I’ve connected it to pin A0 (according to our program).



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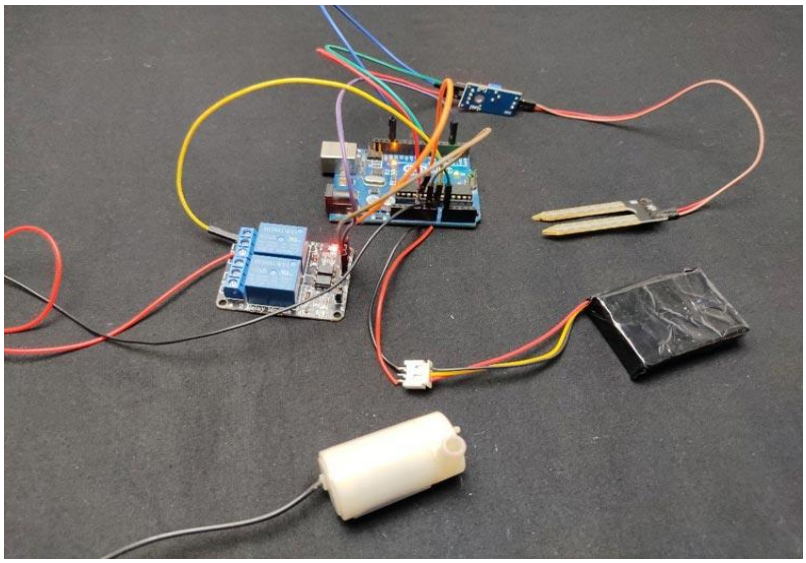


Finally, connect the pump to the relay module. A relay module has 3 connection points which are common, normally closed, and normally open. We have to connect the pump positive to common and connect the normally open pin to the positive of the battery. You have to select the battery as per your pump. The next step is to connect the ground of the pump to the ground of the Arduino and finally, connect the small hose to the water pump.

Now connect the battery to the circuit and if the pump starts working then your circuit is okay. Now let's upload code to Arduino.

Explanation of the code for The Automatic Irrigation System

For this project, we are not using any library we are just using the basic functions for programming. The code is very simple and easy to use. The explanation of the code is as follows.

We start by defining all the required integers here I used two integers for storing the soil moisture and the converted moisture percentage.

```
int soilMoistureValue = 0;

int percentage=0;
```

Now, we define the pin mode, here I have used pin 3 as an output and in the next line, I have initialised Serial Monitor for debugging.

```
void setup() {

  pinMode(3,OUTPUT);

  Serial.begin(9600);

}
```

I started the *loop* section by reading the soil moisture. I used the analogRead function of Arduino to read the soil moisture and I stored that in soilMoistureValue. This value varies from 0 to 1023

```
void loop() {

soilMoistureValue = analogRead(A0);
```

In the below line, I have converted the sensor values from 0-100 percent for that we use the map function on Arduino. That means that if the soil is dry then the output moisture percentage is 0% and if the soil is extremely wet then the moisture percentage is 100%.

```
percentage = map(soilMoistureValue, 490, 1023, 0, 100);

Serial.println(percentage);
```

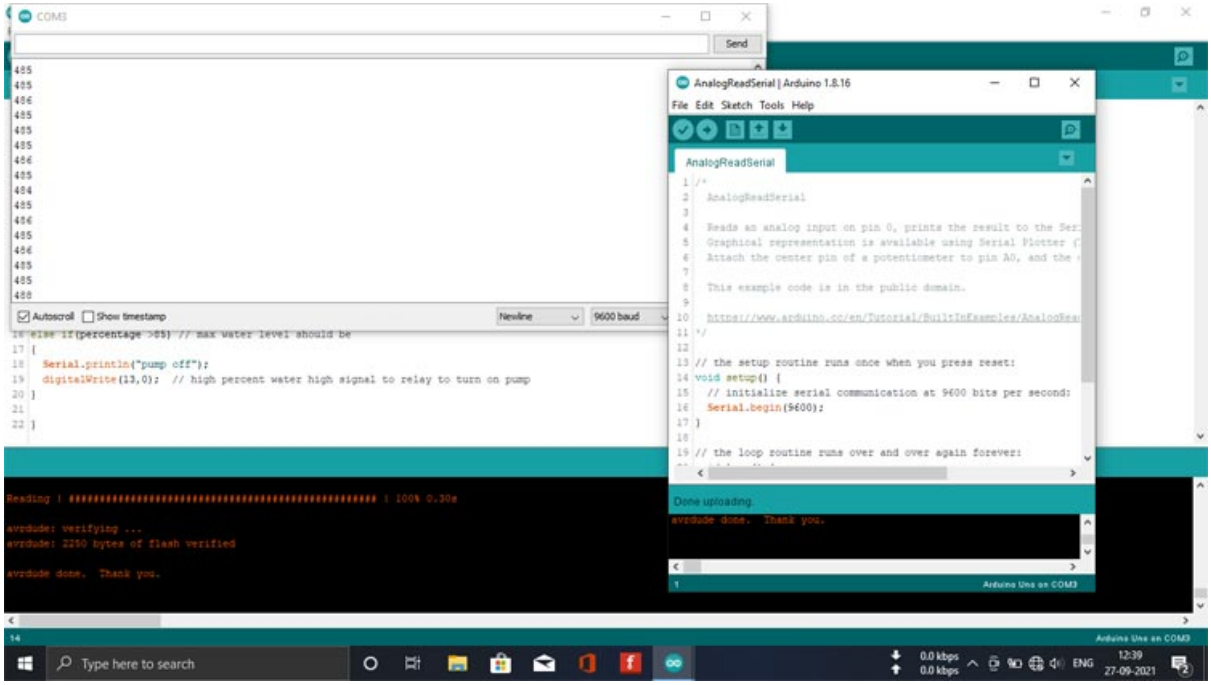
Calibrating our Moisture Sensor

In the **map function,** we need to assign the dry value and wet value. To do that we need to monitor that values. You can read that values using the following code:

```
void setup() {

  Serial.begin(9600);

}

void loop() {

 int sensorValue = analogRead(A0);

  Serial.println(sensorValue);

  delay(1);
```

Upload the above code to your Arduino and open the serial monitor. Then place your soil moisture sensor in dry soil or just hold the sensor in the air and read the value. now put that value in place of 490(second term of map function).

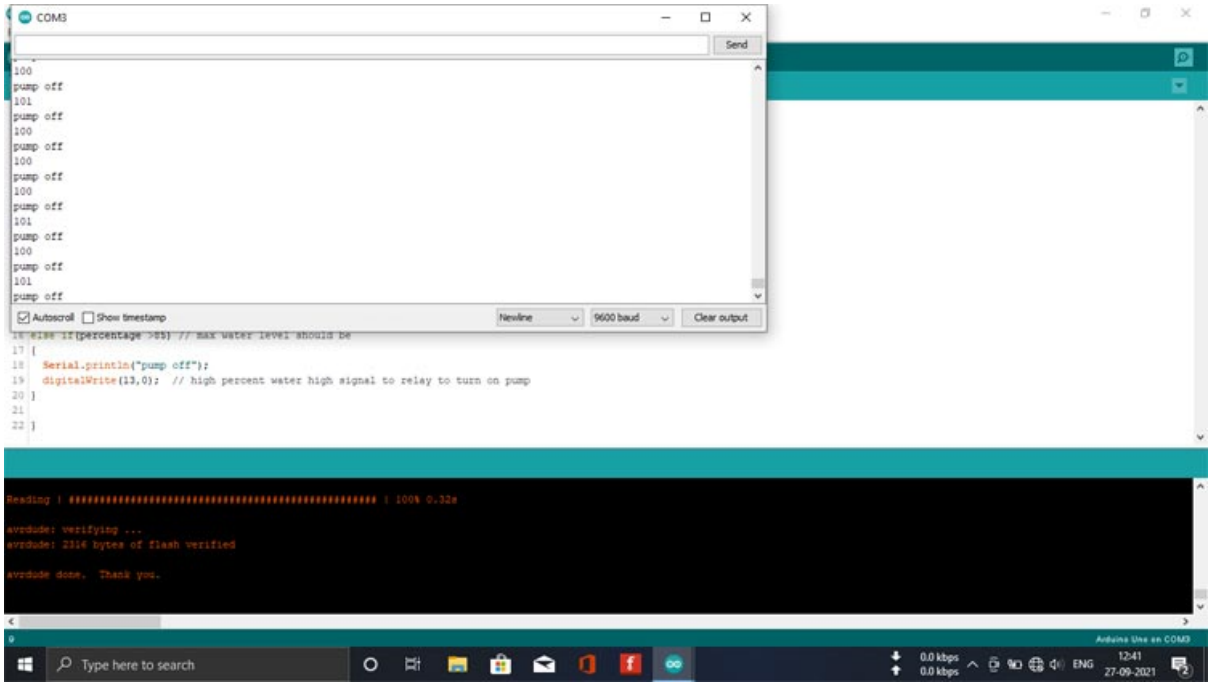
The next step is to place the sensor in wet soil or submerge it in water and read the value and assign that value in place of 1023 (third term of map function). These values will calibrate your sensors correctly to get better results.



After converting the values we can control the pump according to the soil moisture percentage. With the help of '**If condition**', I write the first condition, if the moisture percentage goes below 10, then the Arduino will turn pin 3 to LOW and the pump will turn

on (our relay module uses the **active low signal to trigger**) and the Arduino will print pump on message in the serial monitor.

```
If (percentage < 10)

{

  Serial.println(" pump on");

  digitalWrite(3,LOW);

}
```

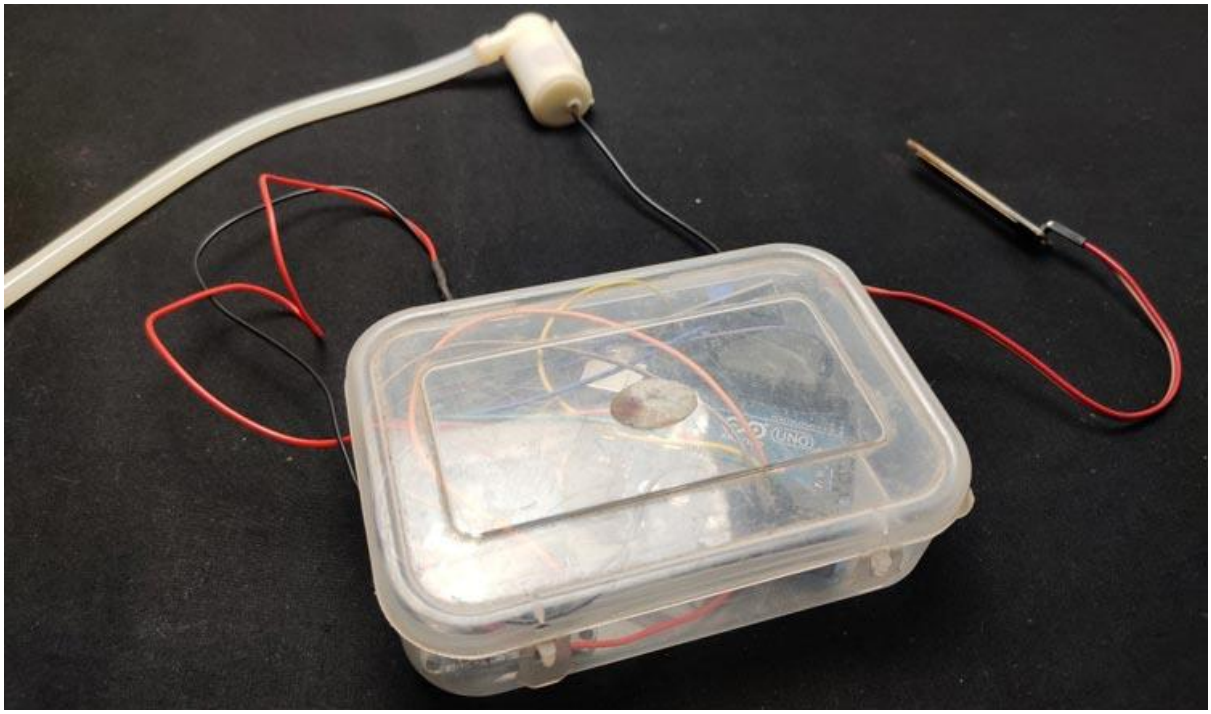


When the moisture percentage goes above 80 percent (indicating soil is filled with water) the Arduino will turn off the pump and print the ‘pump off’ on the serial monitor.

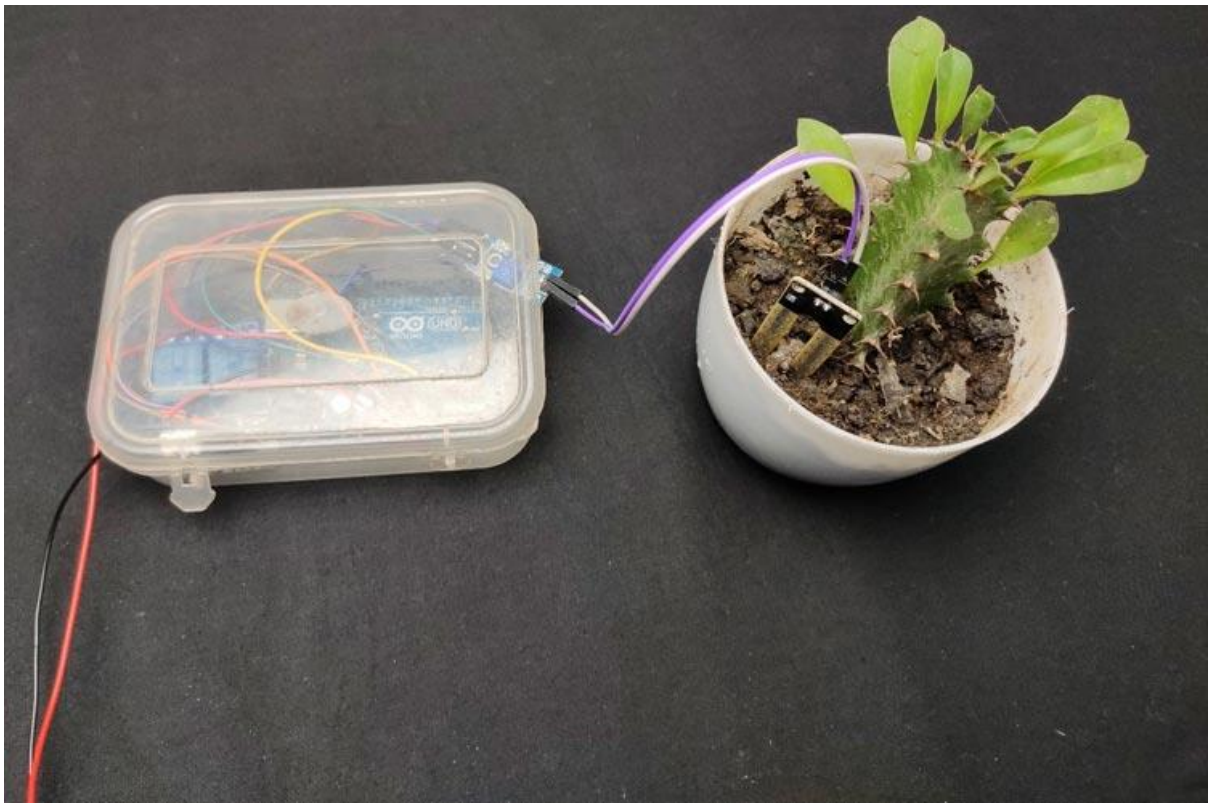
```
if(percentage >80)

{

  Serial.println("pump off");

  digitalWrite(3,HIGH);

}

}
```

Testing the Automatic Irrigation System

After uploading the code to the Arduino, I placed the whole circuit except the pump and sensor probe in a plastic box as shown in the figure below.



Now place the moisture sensor into the soil. Place the sensor as close to the roots of the plants as possible for higher accuracy.



The final step is to place your motor in a container filled with water and your automatic irrigation is ready to take care of your lovely plants when you are not around.

You might have to change the moisture percentage to start and stop the pump as different plants have different water requirements. Hope you enjoyed the project and are ready to build your own automatic irrigation system using Arduino. If you have any questions, you can leave them in the comment section below.

Applications

•The circuit can be used to measure the loss of moisture in the soil over timedue to evaporation and intake.

•Minimizes water waste and improves plant growth.

•The circuit is designed to work automatically and hence, there is no need forany human intervention.

•The project is intended for small gardens and residential environment.