LESSON-11
Automatic Plant Watering System

Gardening is a beautiful hobby that allows you to design your garden by adding a variety of beautiful flowers and different species of plants. The experience of being in your garden in the early hours of the morning is truly wonderful. However, it is important to properly take care of your plants, including watering them and treating any flowers affected by insects with pesticides.

Now, let's imagine a scenario where you need to visit another town for a couple of days during the hot summer season with strong gusts of wind.

As the sole person living in your home, you have a garden that you truly cherish and take care of.

The question arises: How will you manage to hydrate your plants when you are out of town?

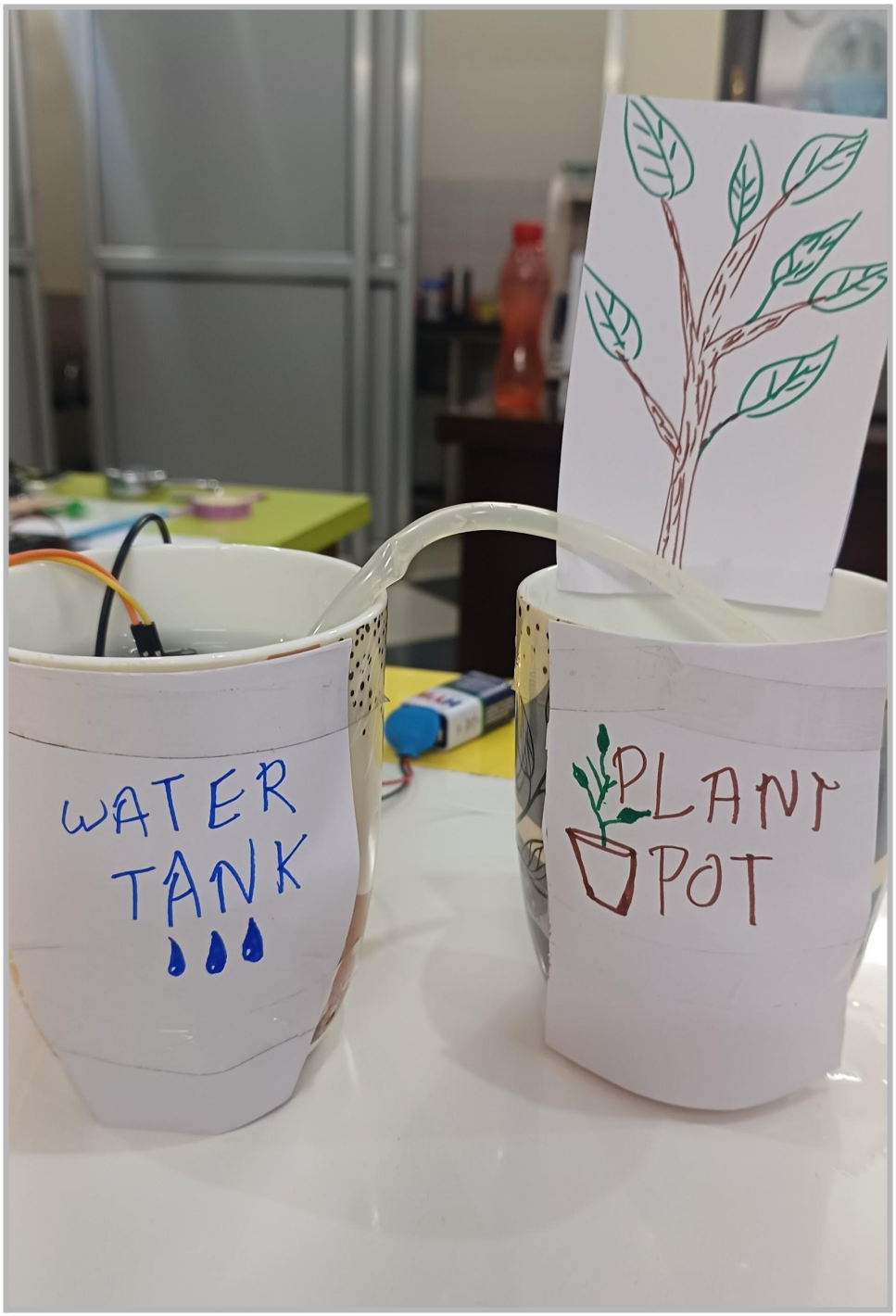
This is where the need for an automatic watering system comes into play. Such a system can detect moisture percent in the soil and water the plants automatically when the moisture is low.

This will be the project that we are going to work on now.

Project: Automatic watering System

Working project video link:
https://drive.google.com/file/d/1T7u6Z5nWgNcKew_UNTTa8uDF3gK5a6H3/view?usp=sharing
In the video, the probes are inserted into the water tank cup instead of the plant pot cup because there is no soil in the plant pot water cup. If the probes are not in moist soil, the pump will start working. So, we are using the water tank cup to keep the soil moisture sensor wet. This way, the pump will not turn on unnecessarily.

Aim: To make an automatic plant watering system that can detect moisture percent in the soil and can turn ON the water supply to water the plants when the moisture percentage is low.



Working project pic

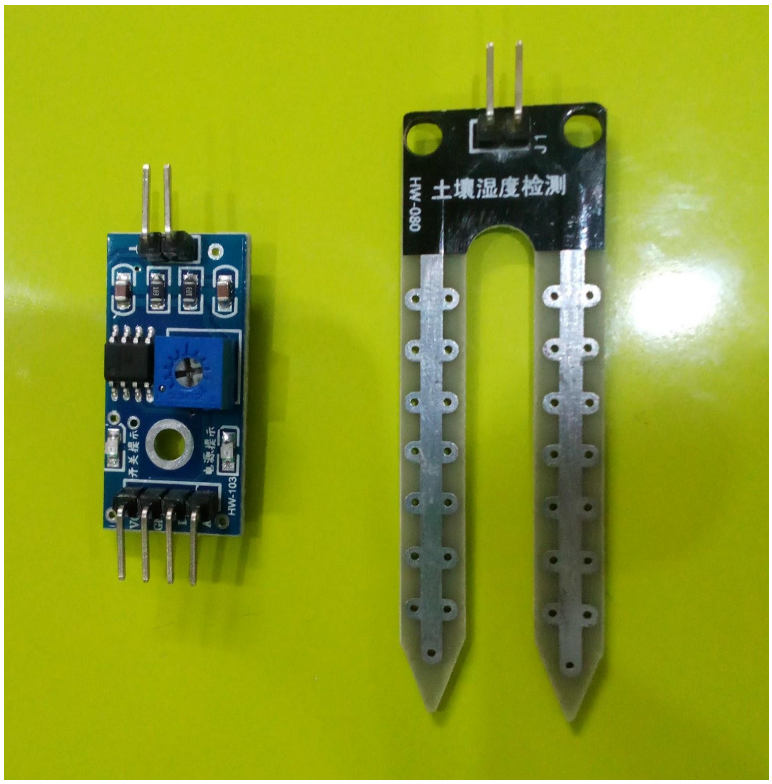
What is Needed:

- UNO
- Soil moisture sensor module
- Water pump
- Relay Module
- Jumper wires (male to female) * 1 set

- Breadboard
- Paper cup * 2 (1 to be filled with water and 1 to be dry)
- Small tube or pipe for water delivery
- USB cable
- 9V battery
- Battery cap

Quick knowledge:
Let us first understand what a soil moisture sensor module is:

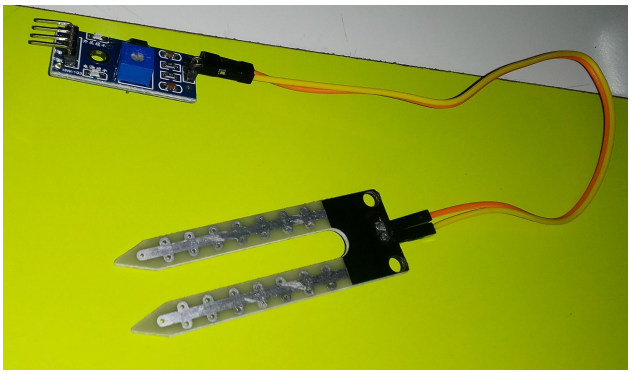
A soil moisture sensor module is a special device that helps us understand how much water is in the soil where plants grow. The soil moisture sensor module has two parts called probes that we stick into the soil.



The two long pointed legs that you see on the right are called probes

These probes are like little detectives that can sense if the soil is wet or dry. They can do this because they can detect how well electricity can pass through the soil. When the ground is wet, it allows electricity to flow

easily. So, in wet ground the moisture sensor gives a reading that indicates to us that the soil has a lot of water. But when the soil is somewhat dry, it doesn't allow electricity to pass through that well. The moisture sensor, in this case, tells us that the ground needs more water by giving a different reading.



By using this sensor, we can make sure to water our plants at the right time and keep them happy and healthy. It's like having a special friend that tells us when our plants are thirsty!

Soil moisture sensor module provides analog output based on the moisture level in the soil. The output voltage of the sensor changes with the soil moisture content. This analog signal is then read by the analog-to-digital converter (ADC) in the microcontroller of UNO.

The Arduino Uno's ADC converts the analog voltage into a digital value ranging from 0 to 1023.

The value when there is no moisture is 1023. As the moisture keeps getting higher, the value keeps getting low.

We have used the value 512 in the code. So, if the value is greater than that, we consider the plant pot dry and we start the water pump, else the water pump remains off.

Relay:

Imagine you have a switch that can turn on or off something really big, like a big light bulb or a motor. But instead of using your hands to flip the switch, you are using a signal to control that switch.

A relay is an electrically operated switch that listens to your commands (the signal that you give to it) and acts as ON switch or OFF switch.

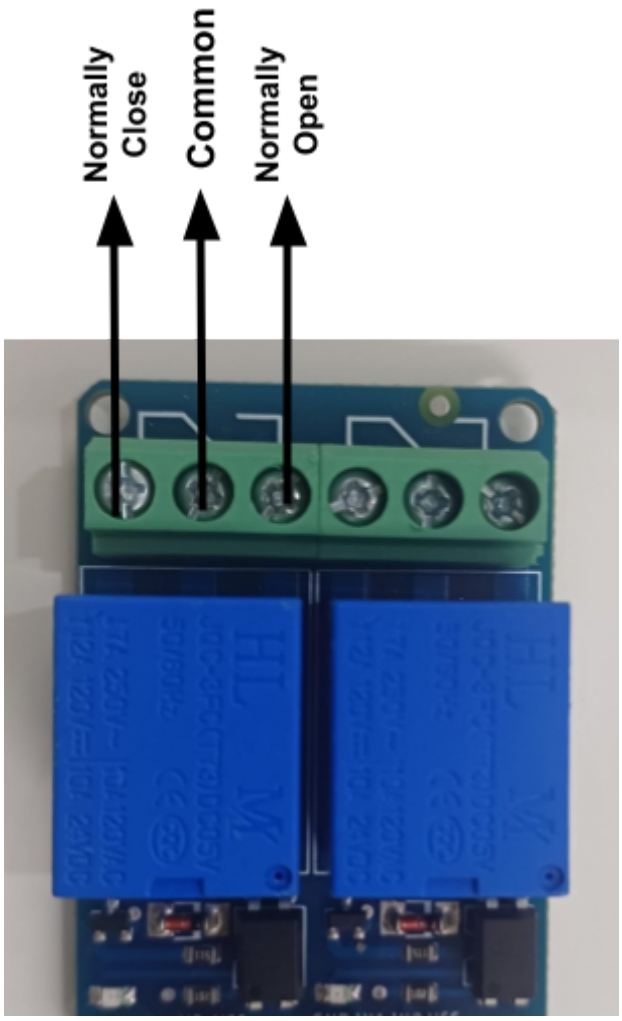
So, let's say you want to turn on a lamp. You send a signal from the UNO to the relay and so, the relay acts as ON switch. Now, the lamp turns on!

Relays are useful because they allow us to control big things with smaller and safer signals. They help us automate and control all sorts of devices like lights, fans, and even machines. It's like having a helper that can control the world of electricity for us!

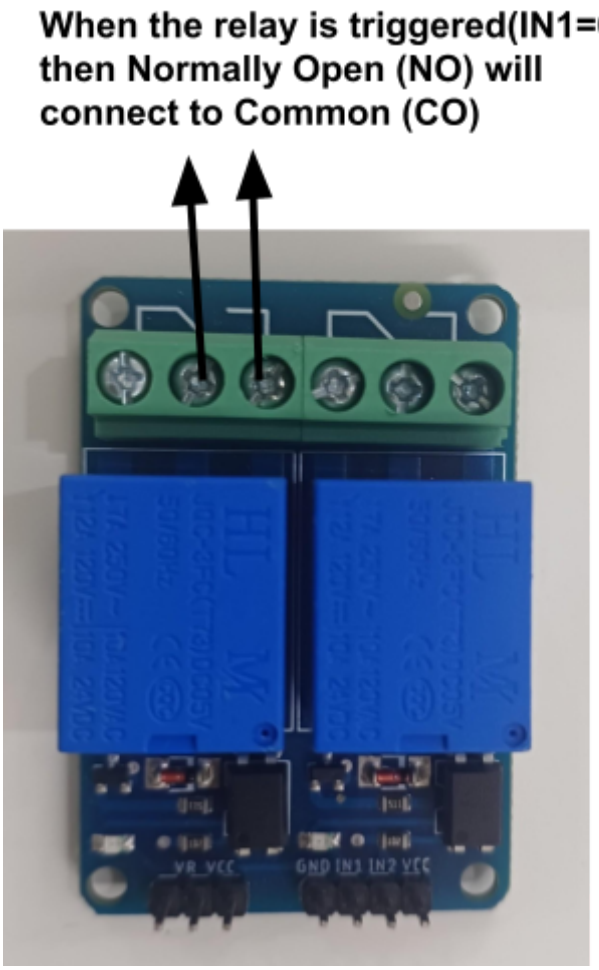
Please watch this video to get more familiar with the relay. A single-channel relay module has been shown in this video:
https://youtu.be/MAu-51a_MIQ

The relay module used in this lesson is a two-channel relay module. There are two relays being used in this one so as to work with two circuits, But, we only need to use one of the relays, so ignore the relay to the right. We will use the relay on the left:

The pin IN1 on the relay module will be connected to the UNO. The signal will be given by the UNO to control the relay through this pin. IN1 will get either 0 or 1 as the value of the signal from the UNO.
Let us see what will happen when the relay gets 0 and 1.


Normally Close
Common
Normally Open

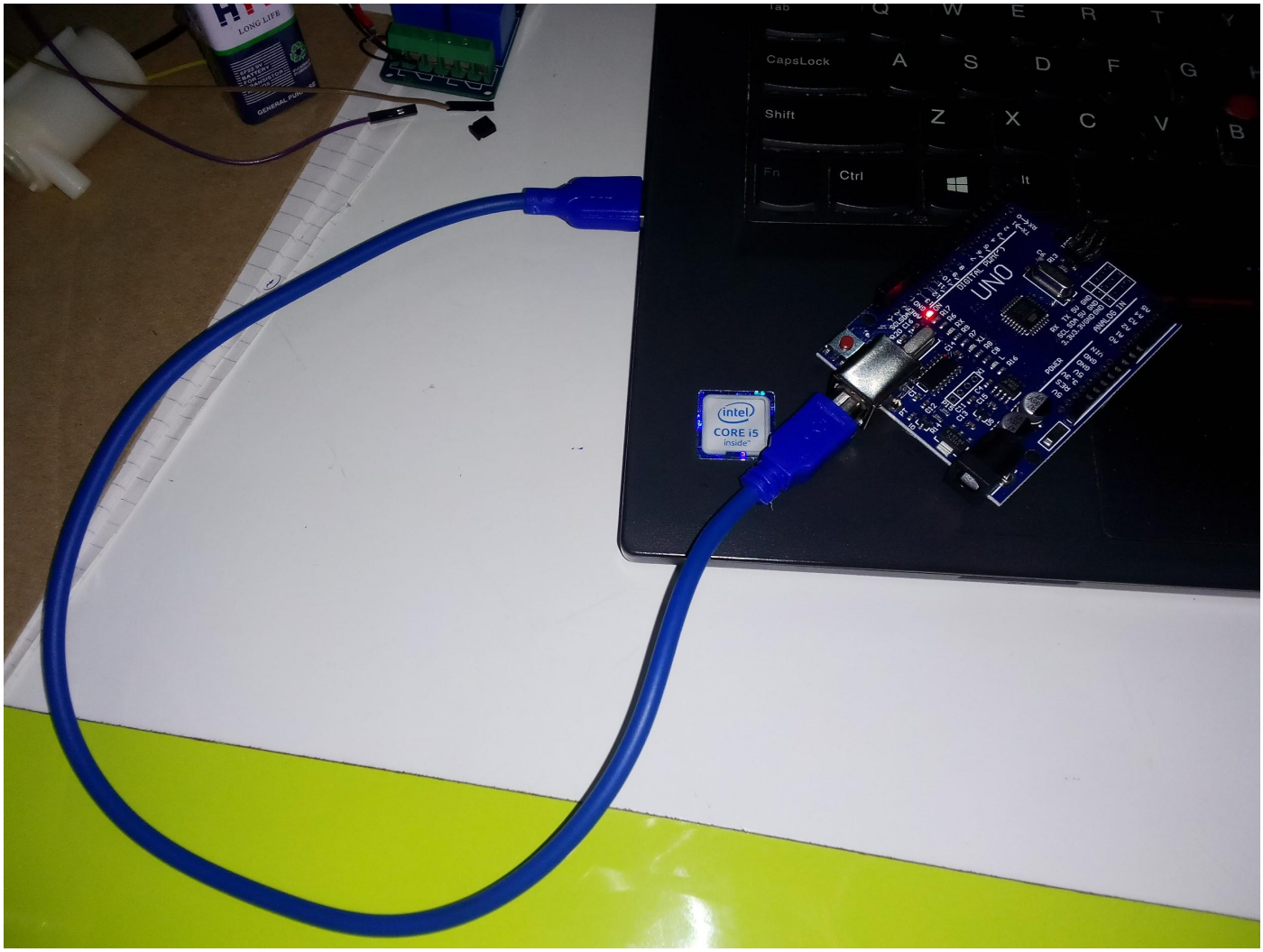
When relay is not triggered(IN1=1), the Common (CO) is connected to the Normally Close(NC)



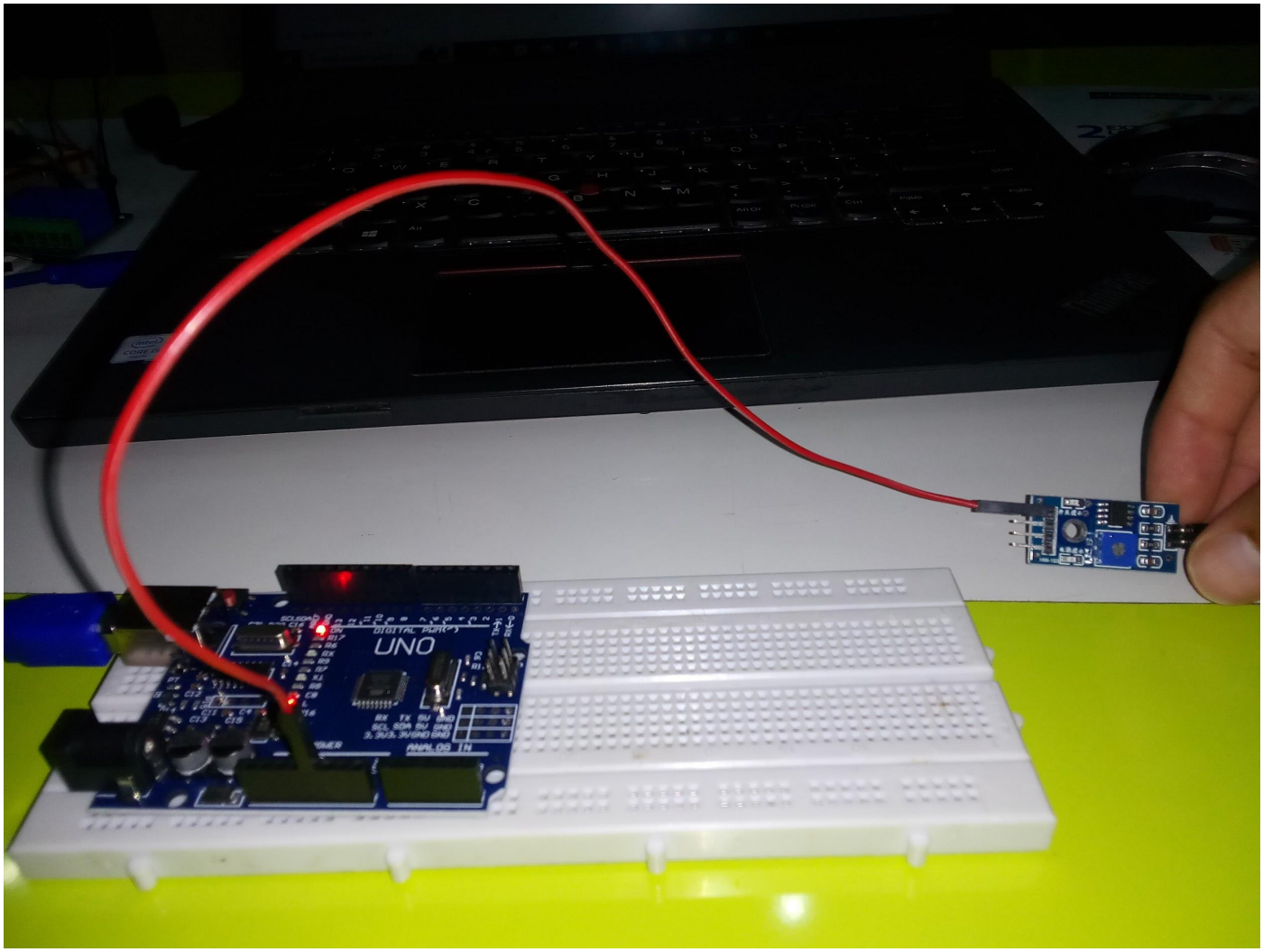
Procedure:

Video help for making connections:
https://drive.google.com/file/d/17mnA94VrQJf465VZpmVJ4FrN_2ZWTXZW/view?usp=sharing

Step 1: Setting up connections
- Connect the UNO board to your computer using the USB cable as shown below:

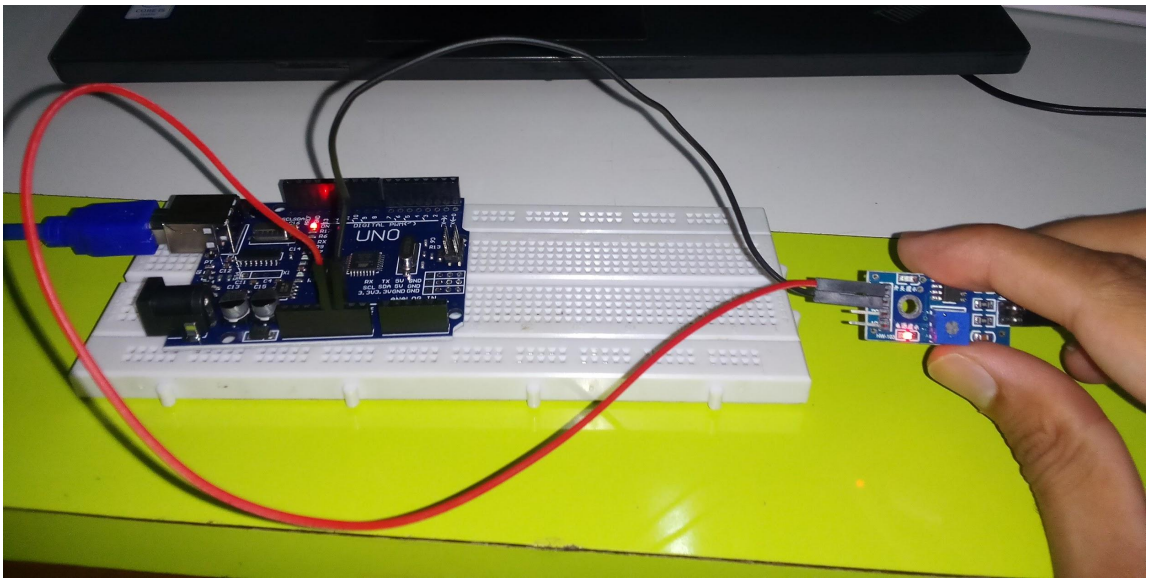


- Connect the VCC pin of the soil moisture sensor module to the 5V pin on the UNO as shown below: (see the red wire)

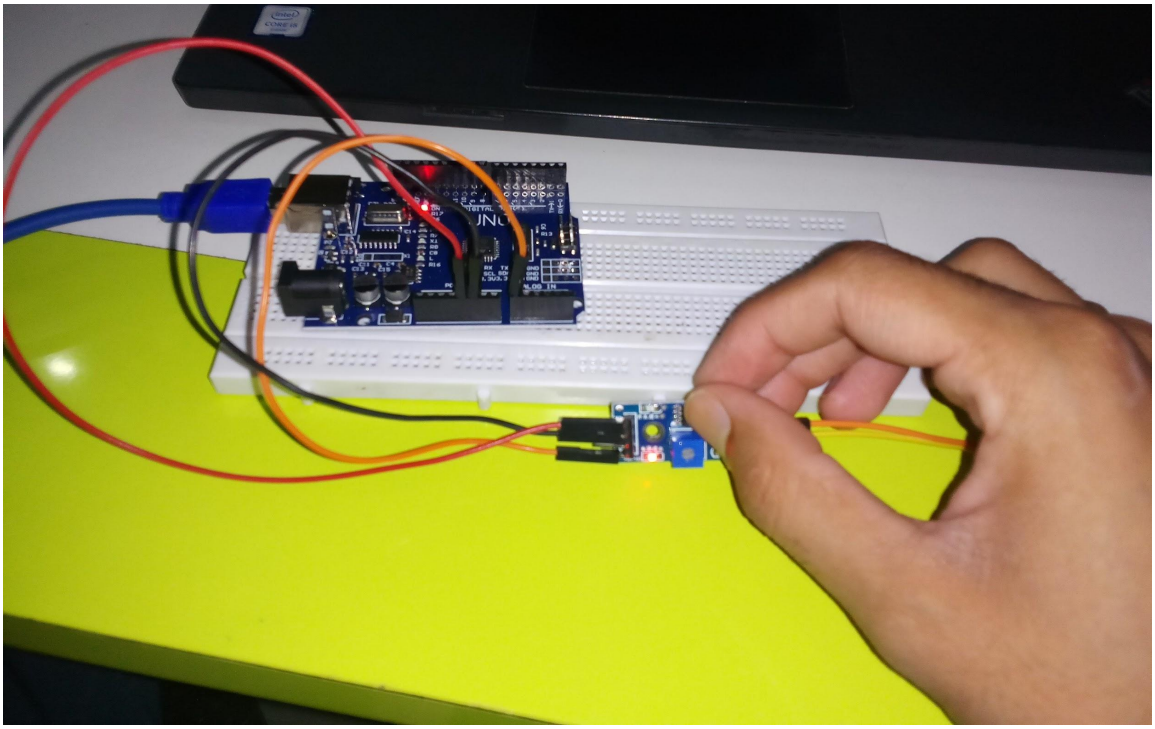


- Connect the GND pin of the soil moisture sensor module to the GND pin on the UNO as shown below: (see the black wire)

The red and black wire is used for supplying power to the soil moisture sensor module.

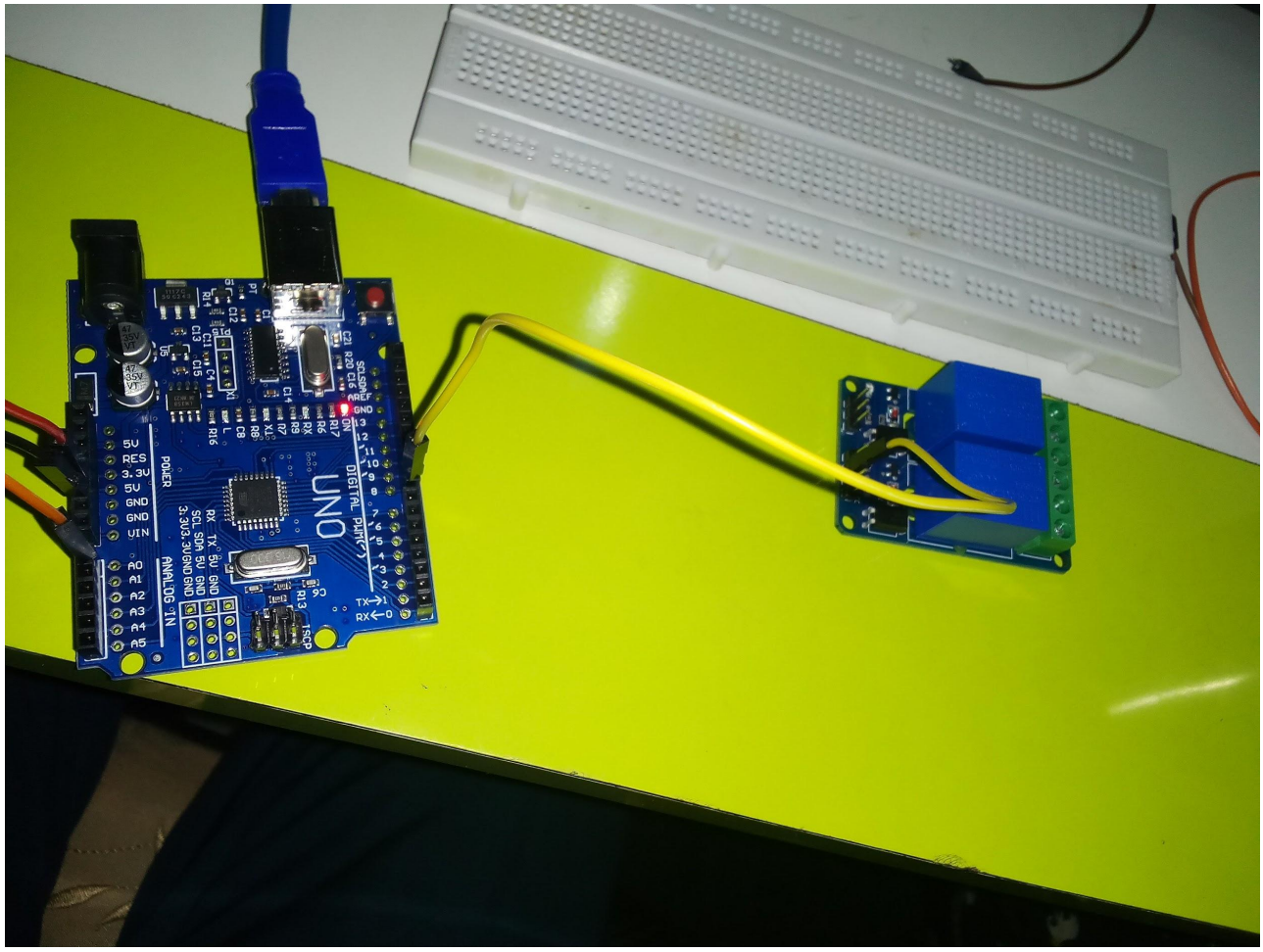


- As the soil moisture sensor is giving analog output, we will not use a digital pin. Here, we have to use an analog input pin on the UNO [anyone from A0 to A5] so that the microcontroller can read the analog signal coming from the soil moisture sensor.
- So, connect the Analog output pin AO of the soil moisture sensor module to any analog input pin on the UNO (let us choose A0).(observe the orange wire in the image below). From this pin AO, the analog signal (which gives information of moisture content in the soil) goes to the UNO.

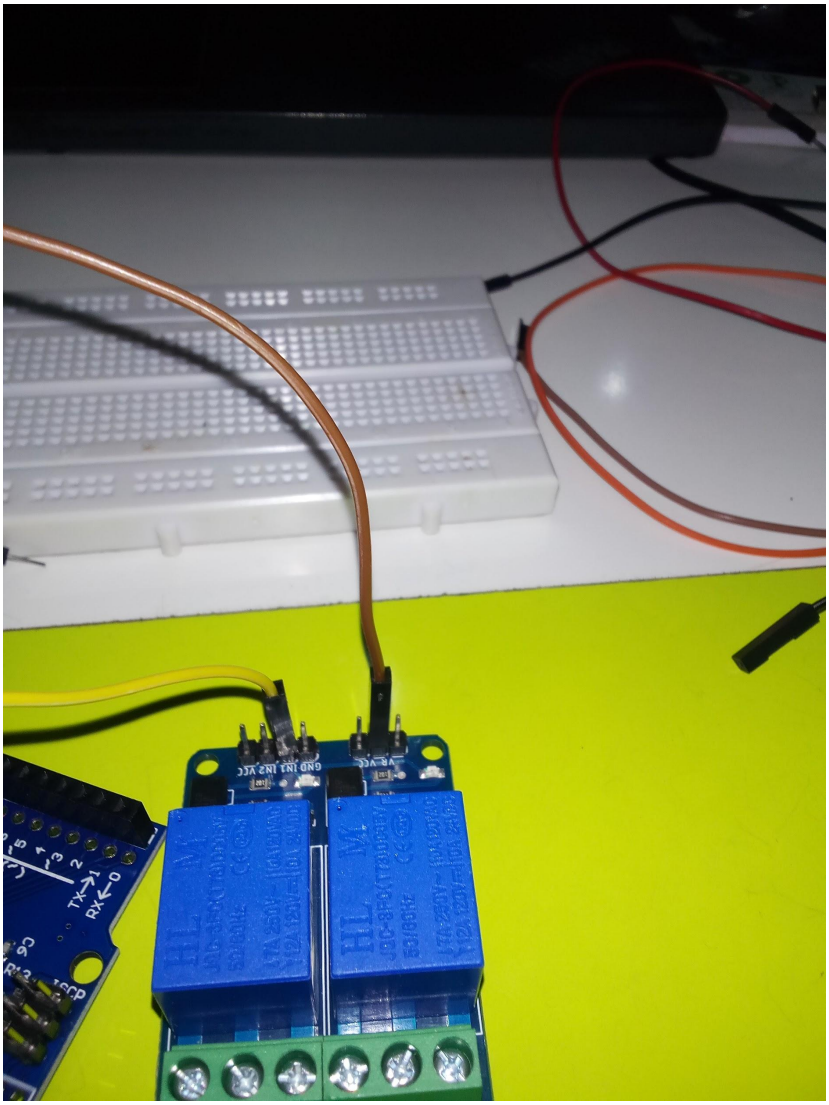


- Connect one end of the jumper wire to the digital pin on the UNO (let us connect it to pin 9).

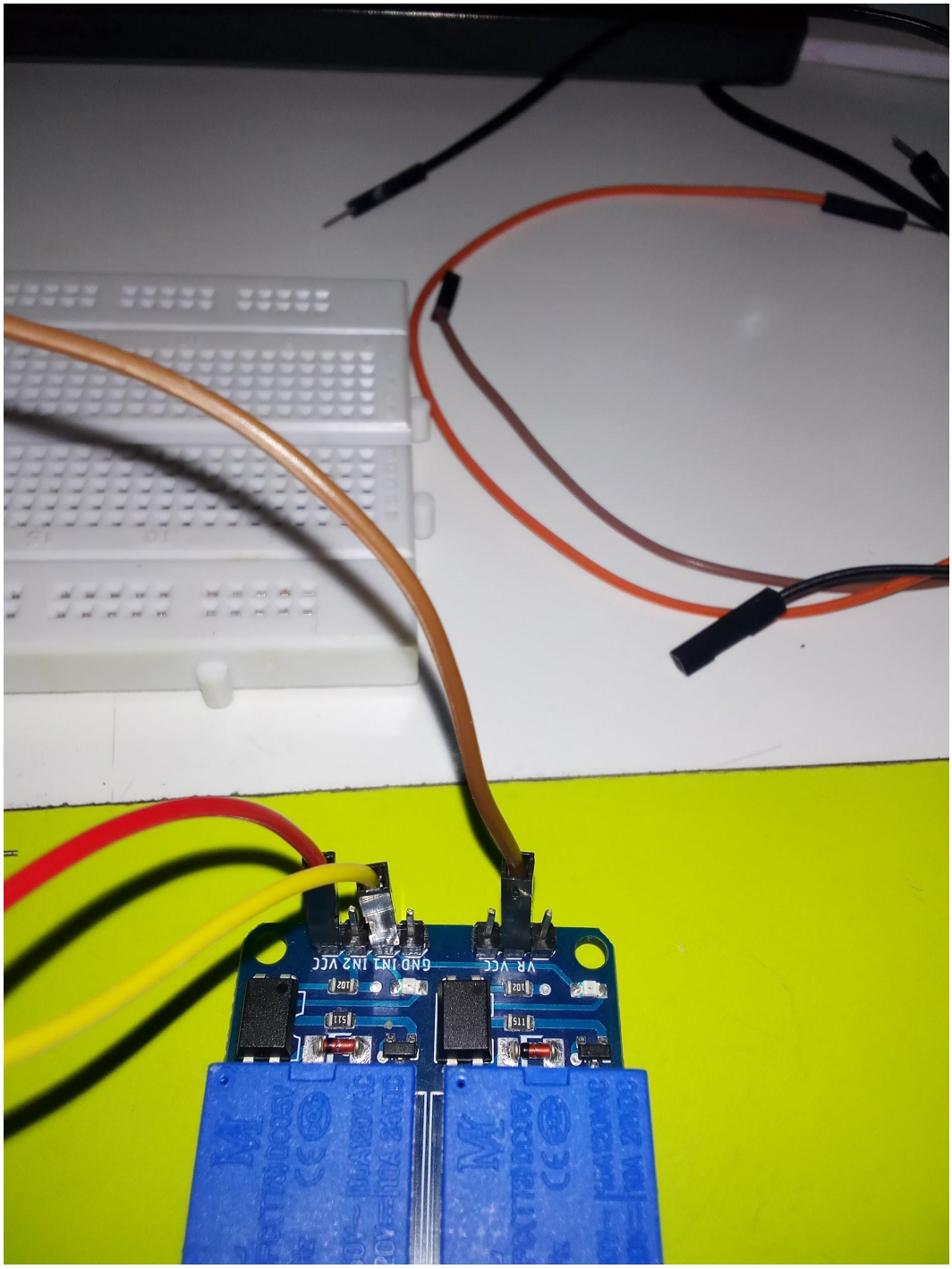
- Connect the other end of the jumper wire to the IN1 pin of the relay module. (observe the yellow wire). From the IN1 pin, the signal will be given to the relay to control it.



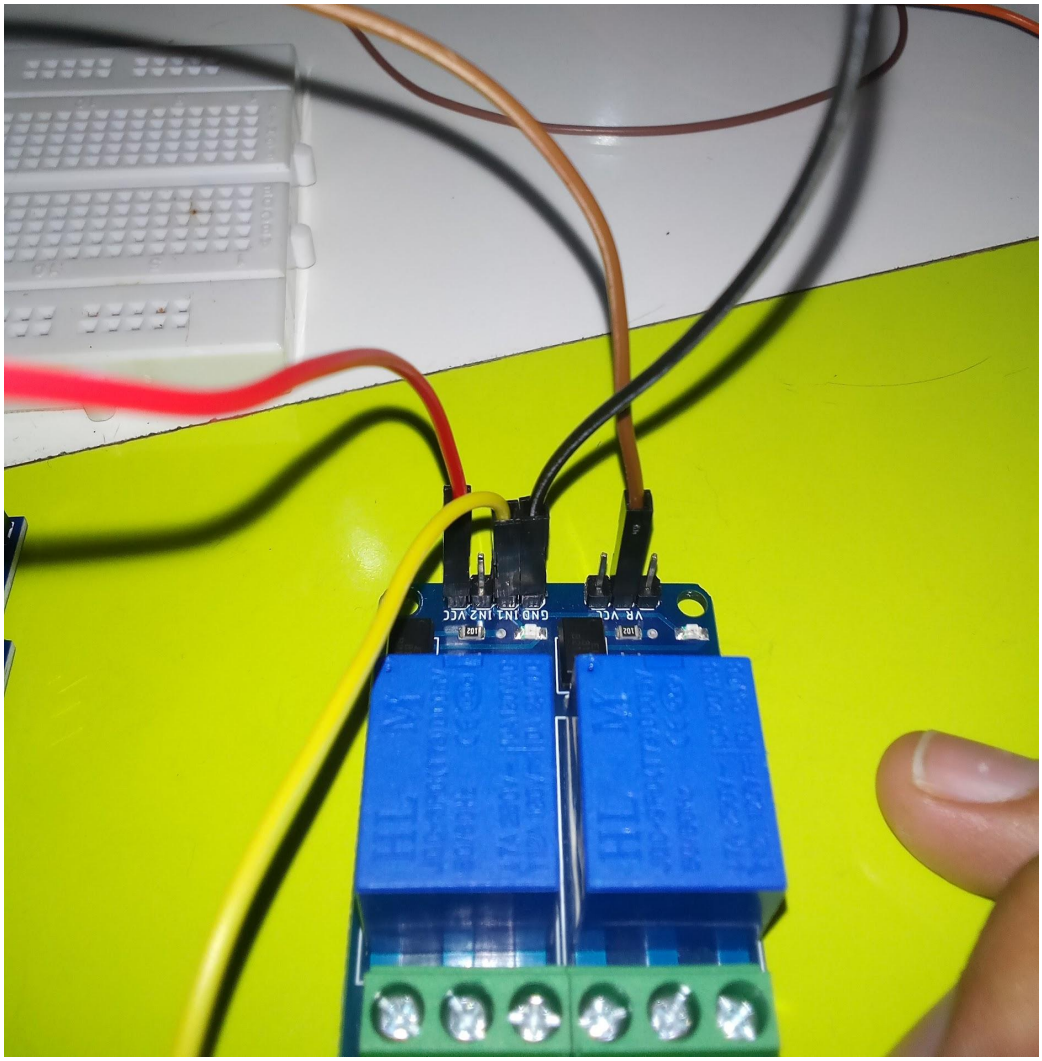
- Connect the VCC on the right side of the relay to the 5V of the UNO board using male-to-female jumper wires. (observe the brown wire in the image below)



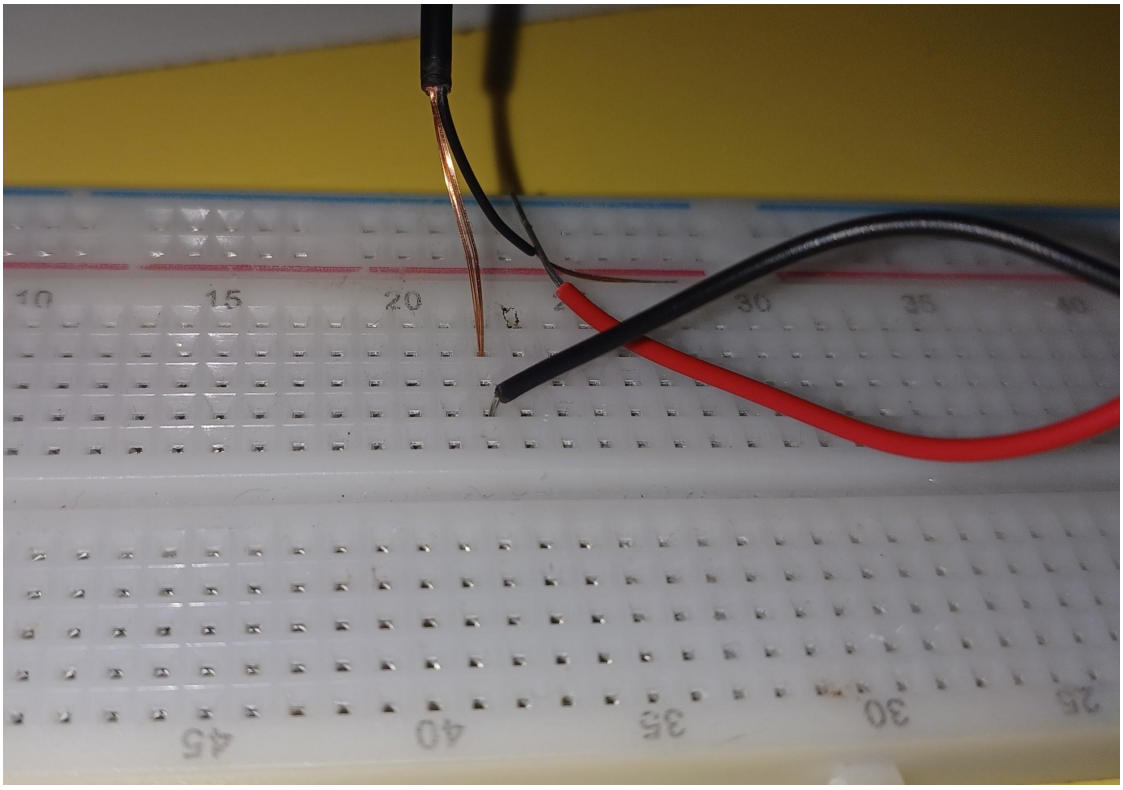
- Connect the left side VCC to the 3.3 V pin of UNO. (observe the red wire)


GND IN1 IN2 VCC
VR VCC

- Connect the ground pin (GND) of the relay module to the GND of the UNO. (observe the black wire)

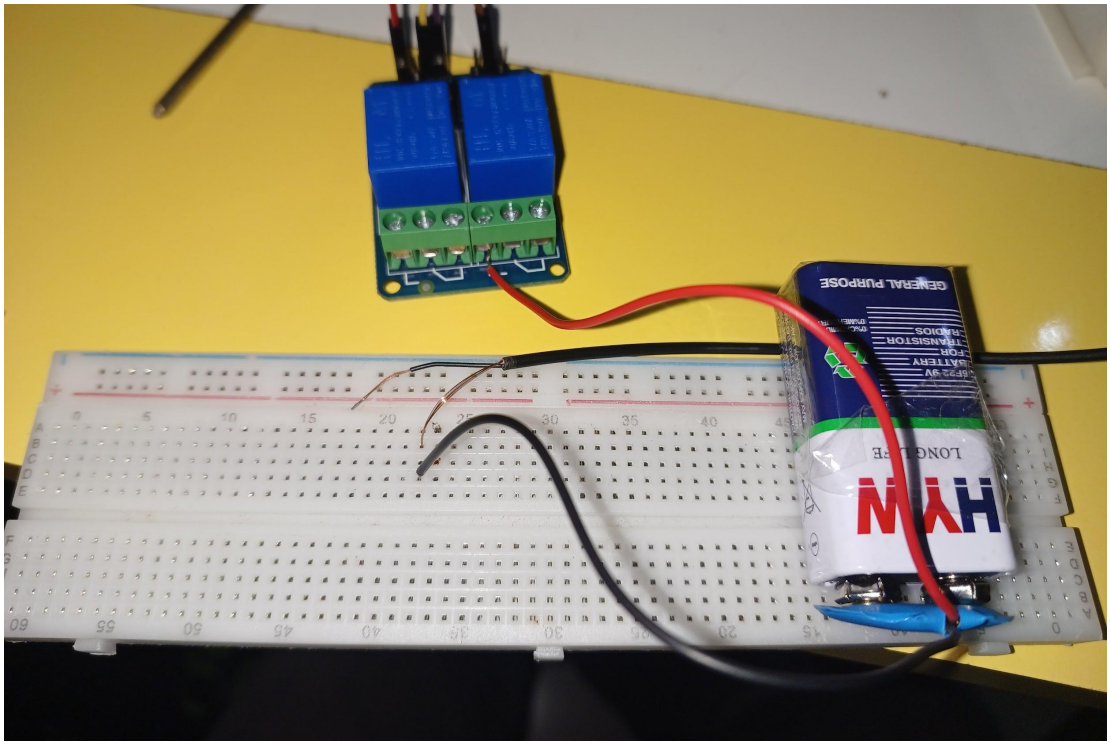


- Connect one water pump wire (there are two wires with the water pump) to the black wire of the battery clip (which is connected to the negative terminal).



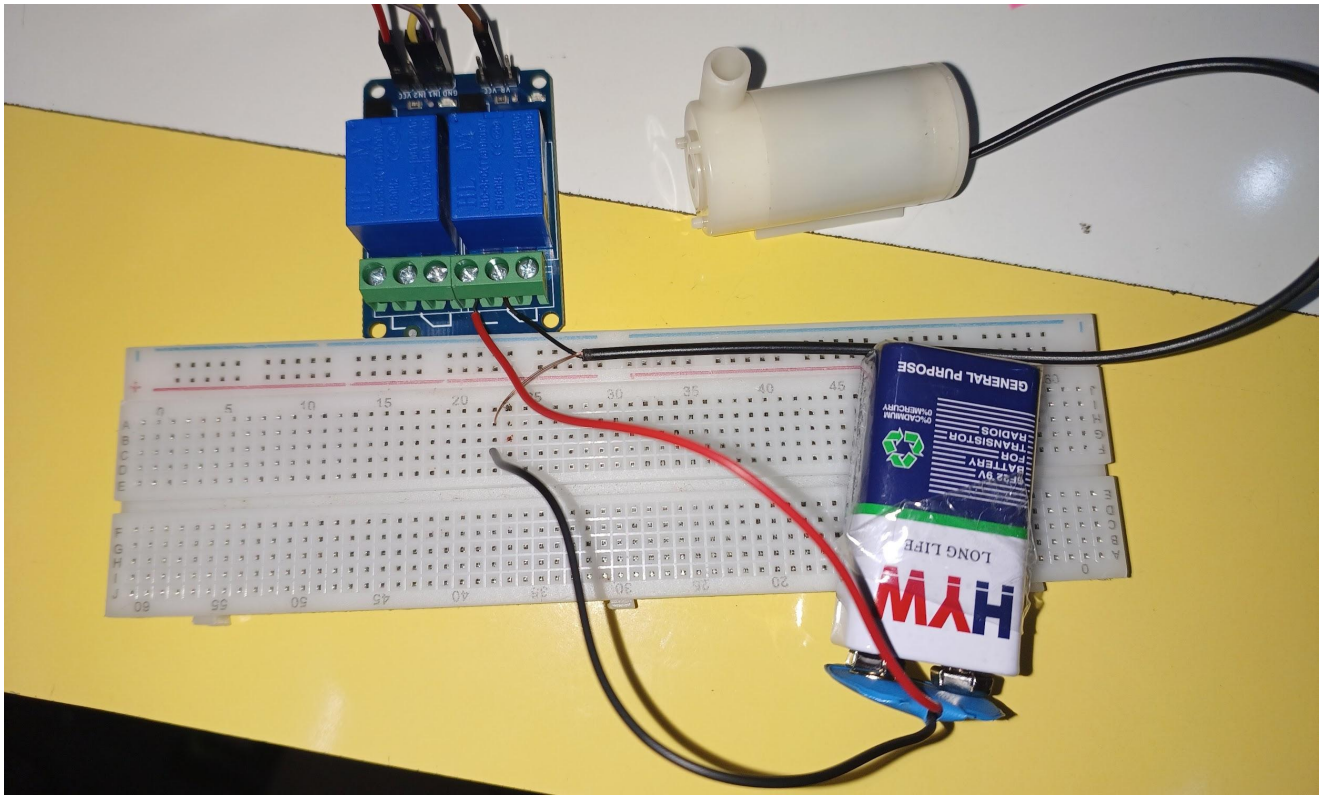
Here a breadboard has been used to connect these wires, we can also use tape to connect the wires

- Connect the RED wire of the battery clip(that connects to the positive terminal) to the NO (normally open) of 1st Relay in the relay module.



Observe the RED wire from the battery clip going to the green part (called the terminal block) of the relay. We use screws to attach wires. We can tighten the screws so that it holds the wire.

- Connect the other wire from the water pump to the CO(common) of the same relay in the relay module.



Observe the black wire from the water pump going to the green part of the relay, it has been attached to the CO (common) of the relay.

This circuit that we have made using a battery clip, pump, wires, and the relay, is for making the water pump work when the relay is triggered by the UNO. Generally, the Normally Open and Common are not connected to each other so the water pump will not work. When the moisture in the soil gets low, the UNO will switch on the water pump by triggering the relay (in this case the Normally Open NO and Common CO get connected to each other, completing the circuit for the water pump with the battery).

Step 2: Prepare the Plant Pot

- Fill the small container or pot with soil and plant in it.
- Insert the soil moisture sensor probes into the soil, ensuring they are deep enough to reach the roots of the plant.

Step 3: Write the UNO Code

- Open the Arduino IDE software on your computer.
Below is a program that reads the moisture from the soil moisture sensor using the analog input pin.

- Set a threshold value, above which the soil is considered dry and the plant needs watering. Let us choose 512. If the value is greater than that, we will make the UNO turn ON the water pump, else, the water pump won't work.

Before going to step 4, let us first understand the program written below:
The UNO is taking the readings from the soil moisture sensor inserted into the soil.
If the moisture is less, then the UNO will trigger the relay by writing LOW value to the pin connected to the relay. When the relay is triggered, the water pump is activated.
And on the other hand, if the moisture is greater, the relay will not get triggered so water pump will not work.

Step 4: Upload the Code to UNO:

```
const int moistureSensorPin = A0;              // Analog pin for moisture sensor
const int waterPumpPin = 9;                    // Digital pin for water pump

void setup() {
  pinMode(waterPumpPin, OUTPUT);      // Set water pump pin as output
}

void loop() {

  int moistureLevel = analogRead(moistureSensorPin);  // Read moisture level from
//the sensor. We are using an analog pin so we will use the analogRead() function

  if (moistureLevel > 512)
```

```
 {
   digitalWrite(waterPumpPin, LOW);   //  triggering the relay to activate water pump
  }

  else                                    // when the moisture is greater than threshold
    {
  digitalWrite(waterPumpPin,HIGH);     // relay not triggered so water pump off
    }

  delay(1000);                          // Wait for a moment before taking the next reading
}
```

- Select the correct board and port in the Arduino IDE.
- Click the "Upload" button to upload the code to the UNO.

Step 5: Test the System

- Place the plant pot with the moisture sensor and the water pump setup in an appropriate location.
- Ensure the water pump is dipped in the water source.
- Power up the UNO board.
- If the moisture level falls, the water pump should activate and water the plant.

Conclusion:

With the completion of this experiment, you have successfully built an automatic plant watering system using a UNO, relay, water pump, a soil moisture sensor module. You have learned how to activate the water pump when the plant needs watering. Remember, proper watering is essential for the healthy growth of plants, and this automated system can

help ensure they receive the right amount of water. Keep experimenting and exploring the world of electronics and plant care!
