ENGINEERING CLINICS

VIT-AP UNIVERSITY

Fully Automated Hydroponic Garden Using Arduino

Guidance of Prof. Rajamohan R

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1. INTRODUCTION

The most basic need for humans to survive is food, water and living space. As everyone knows the human population is increasing day by day, and this results in a need for more food, space and water. Hence the method of the automated hydroponic system has been introduced. Hydroponics is proliferating in this modern world, as it helps to grow plants with less time and space. It is a developing automated system, that provides the opportunity to grow high-grade crops with rich nutrients. The most advantageous thing is the production of the crop can be increased 4 to 10 times in the same place. Most crops can be grown twice as fast in a hydroponic system.

There are different types of hydroponic systems, to get more knowledge about this smart farming many authors have researched and published many papers about hydroponics, as per the research the NFT (nutrient film technique) is the most popular method in hydroponic. In this NFT method, the root of the plant will be in contact with a flowing nutrient solution. To grow the small plants the water required is around ½ gallon and large plants require around 2 gallons. Hydroponic is the process of growing plants with enriched nutrients with or without soil by saving time and space and also water. It uses the internet of things to transfer data to the system about the condition of the plant. India is encouraging the hydroponic method; there is no need of growing plants or crops using soil. Earlier due to less knowledge of hydroponics many countries didn't encourage this smart farming, after a lot of research people got to know the value and importance of the land.

Embedded C is software used in hydroponic systems, a set of language extensions for C programming; it is the most popular programming language in the software field. Humidity measurement indicates the concentration of water vapour present in the air. And also, it is referred to as hygrometers, as it provides the accurate or actual humidity condition within the air.

Temperature sensor: temperature sensor is an electronic device which is used to measure the temperature. These sensors are used in medical devices, environmental control etc.

PH sensor: a pH sensor is an important tool used for water measurements. This pH sensor can measure acidity in water. It is an electrical device used to measure alkalinity in water

2. BACKGROUND

This method takes traditional soil-based plant growth in an effective and innovative twist.

Unlike conventional growing, in a hydroponic system, the plant is never in contact with soil. Instead, the roots of the plants are in contact with a nutritional water solvent. Research suggests that soil-less growing can result in crops growing faster, can take up 1/5th of the space and need 1/20th of the water compared to growing in soil. Soil-less growing also has a more negligible risk of diseases and pests, which allows the use of fewer pesticides. In a society where the demand for farming is rising every year due to a growing world population, hydroponic farms form a possibility to make growing crops more efficient.

3. OBJECTIVES

The project will be centred around the creation of a small-scale automated hydroponics system with the use of mechatronics. The system itself shall be designed to house and maintain six medium-sized plants. The system is intended to keep track of the following parameters:

1. Pumping direct water to the plants eradicating the traditional method of soil-based planting
2. Temperature optimum watering system includes the system watering the plant when the room temperature rises and discarding the already existing water in the container.
3. Wifi modules for monitoring the system as a whole
4. LED-based inspect lights to check on the plants

4. PROCEDURE:

Stage 1: Arduino to Breadboard

- Connect GND of Arduino to Breadboard.
- Connect 5V of Arduino to Breadboard.
- COnnect 3.3V of Arduino to Breadboard.

Stage 2: Connect DHT11 Sensor to Arduino

- Connect VCC of DHT11 to 5V of Breadboard.
- Connect GND of DHT11 to GND of Breadboard.
- Connect the Data of DHT11 to any digital pin.
- Upload the code to Arduino.

Stage 3: Connect Temperature Sensor to Arduino

- Connect VCC(red wire) of DS18B20 Temperature Sensor to 3.3V of Breadboard.
- Connect GND(black wire) of DS18B20 to GND of Breadboard.
- Connect Data(yellow wire) to any digital pin of Arduino.
- Upload the code to Arduino.

Stage 4: Connect 4-Channel Relay to Arduino

- Connect GND of Relay to GND of Breadboard.
- Connect VCC of Relay to 5V of Breadboard.

Stage 5: Connect Motors to Relay

- Connect input 1 of Relay to any digital pin of Arduino.
- Connect the positive wire of the first motor to the 5V of Breadboard.
- Connect the negative wire to the second port of K1 of Relay.
- Connect the GND of Arduino to the third port of K1 of Relay.
- Connect input 2 of Relay to any digital pin of Arduino.
- Connect the positive wire of the second motor to the 5V of Breadboard.
- Connect the negative wire to the second port of K2 of Relay.
- Connect the GND of Arduino to the third port of K2 of Relay.

Stage 6: Connect LED Strips to Relay

- Cut the positive wire of the LED Strip into two.
- Connect Input 3 of Relay to any digital pin.
- Connect one positive wire of the LED Strip to the second port of K3 of Relay and another positive wire of the LED Strip to the third port of K3 of Relay.
- Plug the adapter of the LED Strip.
- Upload the code to Arduino.

Stage 7: Connect pH Sensor

- Connect the positive output pin to any analog pin.
- Connect the positive wire to the 5V.
- Connect the negative wire to GND.

Stage 8: Connect Real-Time Clock (RTC)

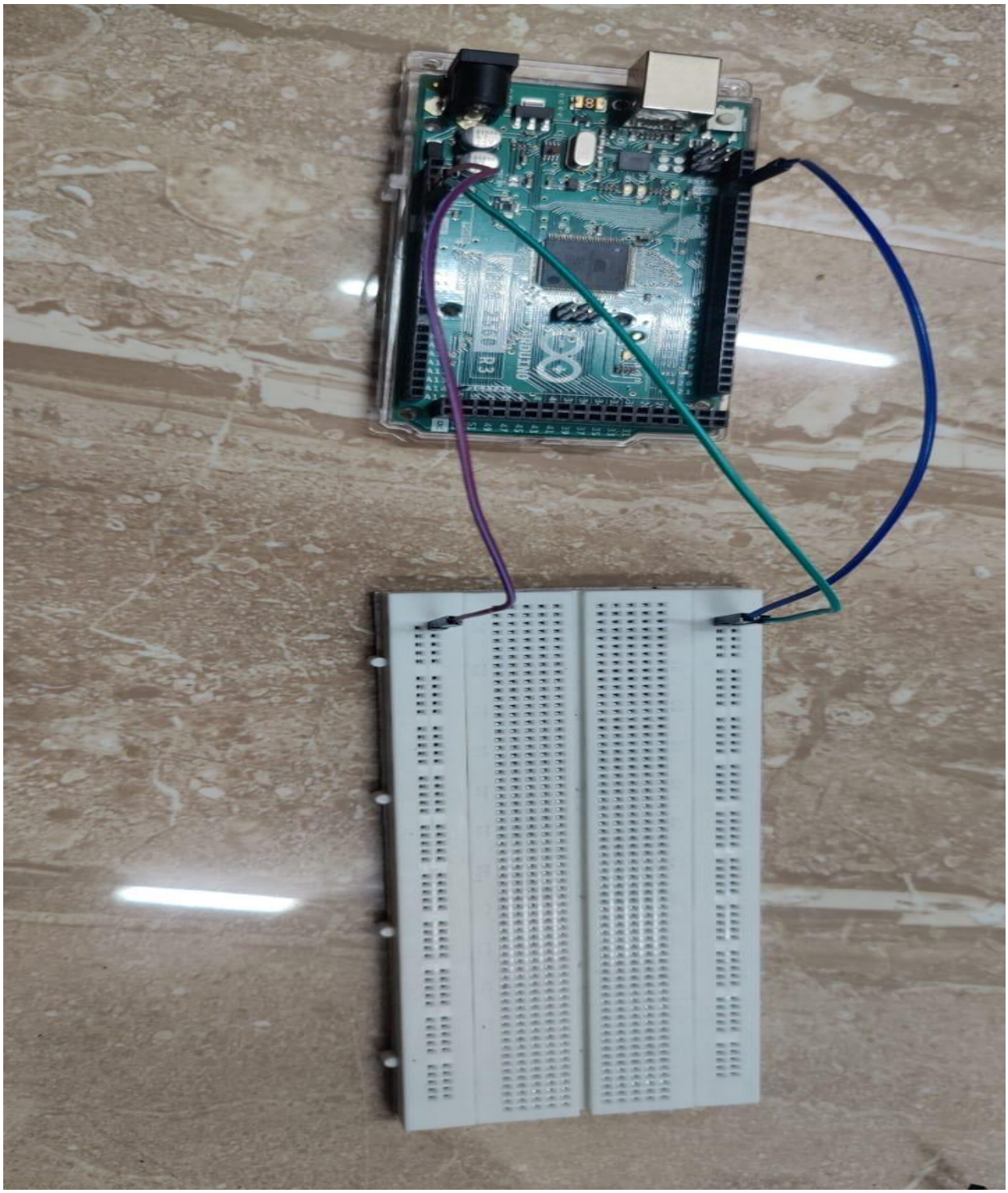
- Connect VCC of RTC to 5V of Arduino.
- Connect GND of RTC to GND of Arduino.
- Connect SDA of RTC to SDA1 of Arduino.
- Connect SCL of RTC to SCL1 of Arduino.
- Upload the code to Arduino.

Stage 9: Connect ESP8266 to Arduino

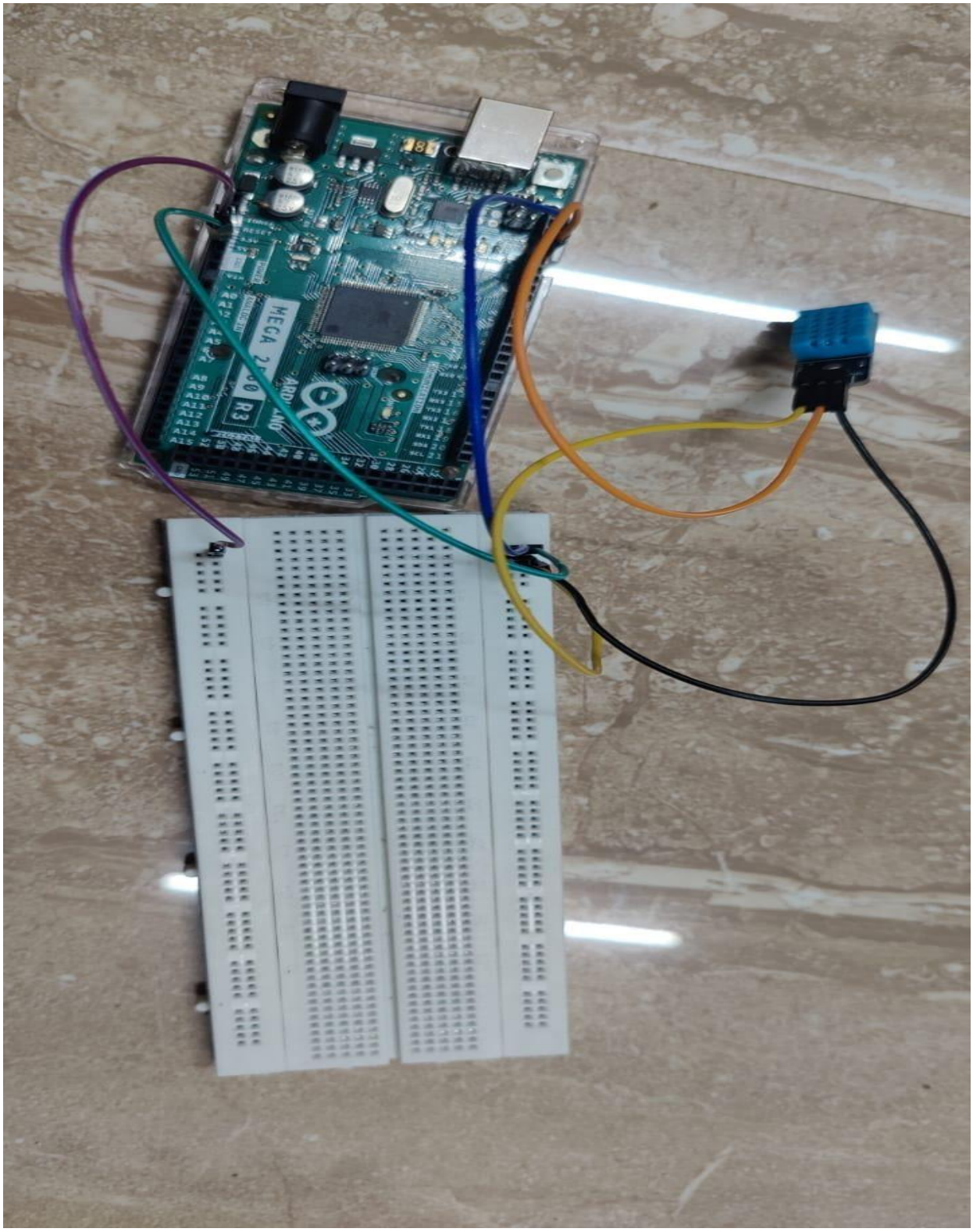
- Connect TX of the ESP2866 to TX of Arduino.
- Connect RX of the ESP2866 to RX of Arduino.
- Connect EN of the ESP2866 to 3.3V of Arduino.
- Connect 3V3 of the ESP2866 to 3.3V of Arduino.
- Connect GND of the ESP2866 to GND of Arduino.

5. RESULTS AND DISCUSSION:

Stage 1: Arduino to Breadboard



Stage 2: Connect DHT11 Sensor to Arduino



```
DHTxx test!
Humidity: 78.00%  Temperature: 26.10C 78.98F  Heat index: 27.77C 81.99F
Humidity: 78.00%  Temperature: 26.20C 79.16F  Heat index: 27.96C 82.33F
Humidity: 78.00%  Temperature: 26.10C 78.98F  Heat index: 27.77C 81.99F
Humidity: 78.00%  Temperature: 26.00C 78.80F  Heat index: 27.59C 81.66F
Humidity: 78.00%  Temperature: 25.90C 78.62F  Heat index: 27.41C 81.34F
Humidity: 78.00%  Temperature: 26.00C 78.80F  Heat index: 27.59C 81.66F
Humidity: 78.00%  Temperature: 26.00C 78.80F  Heat index: 27.59C 81.66F
Humidity: 78.00%  Temperature: 26.10C 78.98F  Heat index: 27.77C 81.99F
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Humidity: 78.00%  Temperature: 26.00C 78.80F  Heat index: 27.59C 81.66F
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Humidity: 78.00%  Temperature: 26.10C 78.98F  Heat index: 27.77C 81.99F
Humidity: 78.00%  Temperature: 26.10C 78.98F  Heat index: 27.77C 81.99F
Humidity: 78.00%  Temperature: 26.00C 78.80F  Heat index: 27.59C 81.66F
Humidity: 78.00%  Temperature: 25.90C 78.62F  Heat index: 27.41C 81.34F
Humidity: 78.00%  Temperature: 26.10C 78.98F  Heat index: 27.77C 81.99F
Humidity: 78.00%  Temperature: 26.10C 78.98F  Heat index: 27.77C 81.99F
Humidity: 79.00%  Temperature: 26.10C 78.98F  Heat index: 27.82C 82.07F
Humidity: 79.00%  Temperature: 26.20C 79.16F  Heat index: 28.01C 82.42F
Humidity: 80.00%  Temperature: 26.10C 78.98F  Heat index: 27.86C 82.15F
Humidity: 80.00%  Temperature: 26.20C 79.16F  Heat index: 28.06C 82.50F
Humidity: 80.00%  Temperature: 26.50C 79.70F  Heat index: 28.67C 83.60F
Humidity: 81.00%  Temperature: 26.50C 79.70F  Heat index: 28.73C 83.72F
Humidity: 80.00%  Temperature: 26.60C 79.88F  Heat index: 28.88C 83.98F
Humidity: 80.00%  Temperature: 26.70C 80.06F  Heat index: 29.09C 84.36F
Humidity: 79.00%  Temperature: 26.80C 80.24F  Heat index: 29.22C 84.60F
Humidity: 78.00%  Temperature: 26.90C 80.42F  Heat index: 29.35C 84.82F
Humidity: 78.00%  Temperature: 26.90C 80.42F  Heat index: 29.35C 84.82F
Humidity: 77.00%  Temperature: 26.90C 80.42F  Heat index: 29.26C 84.67F
Humidity: 77.00%  Temperature: 27.00C 80.60F  Heat index: 29.46C 85.03F
Humidity: 76.00%  Temperature: 27.00C 80.60F  Heat index: 29.37C 84.87F
Humidity: 76.00%  Temperature: 27.10C 80.78F  Heat index: 29.57C 85.23F
Humidity: 76.00%  Temperature: 27.00C 80.60F  Heat index: 29.37C 84.87F
Humidity: 75.00%  Temperature: 27.10C 80.78F  Heat index: 29.48C 85.06F
Humidity: 75.00%  Temperature: 27.10C 80.78F  Heat index: 29.48C 85.06F
Humidity: 75.00%  Temperature: 27.10C 80.78F  Heat index: 29.48C 85.06F
```
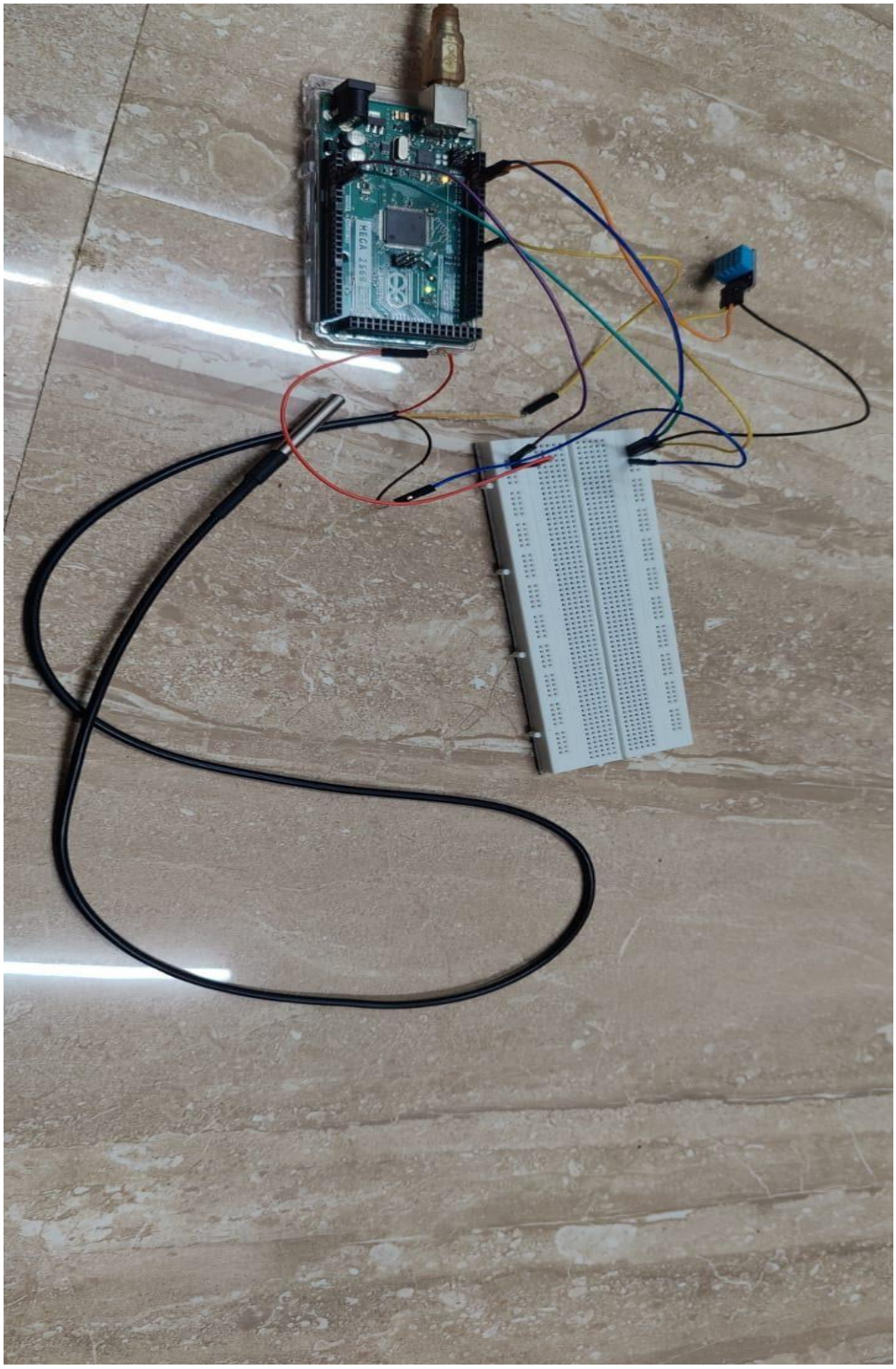

Stage 3: Connect Temperature Sensor to Arduino



```
Celsius temperature: -127.00 - Fahrenheit temperature: -196.60
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Celsius temperature: -127.00 - Fahrenheit temperature: -196.60
```
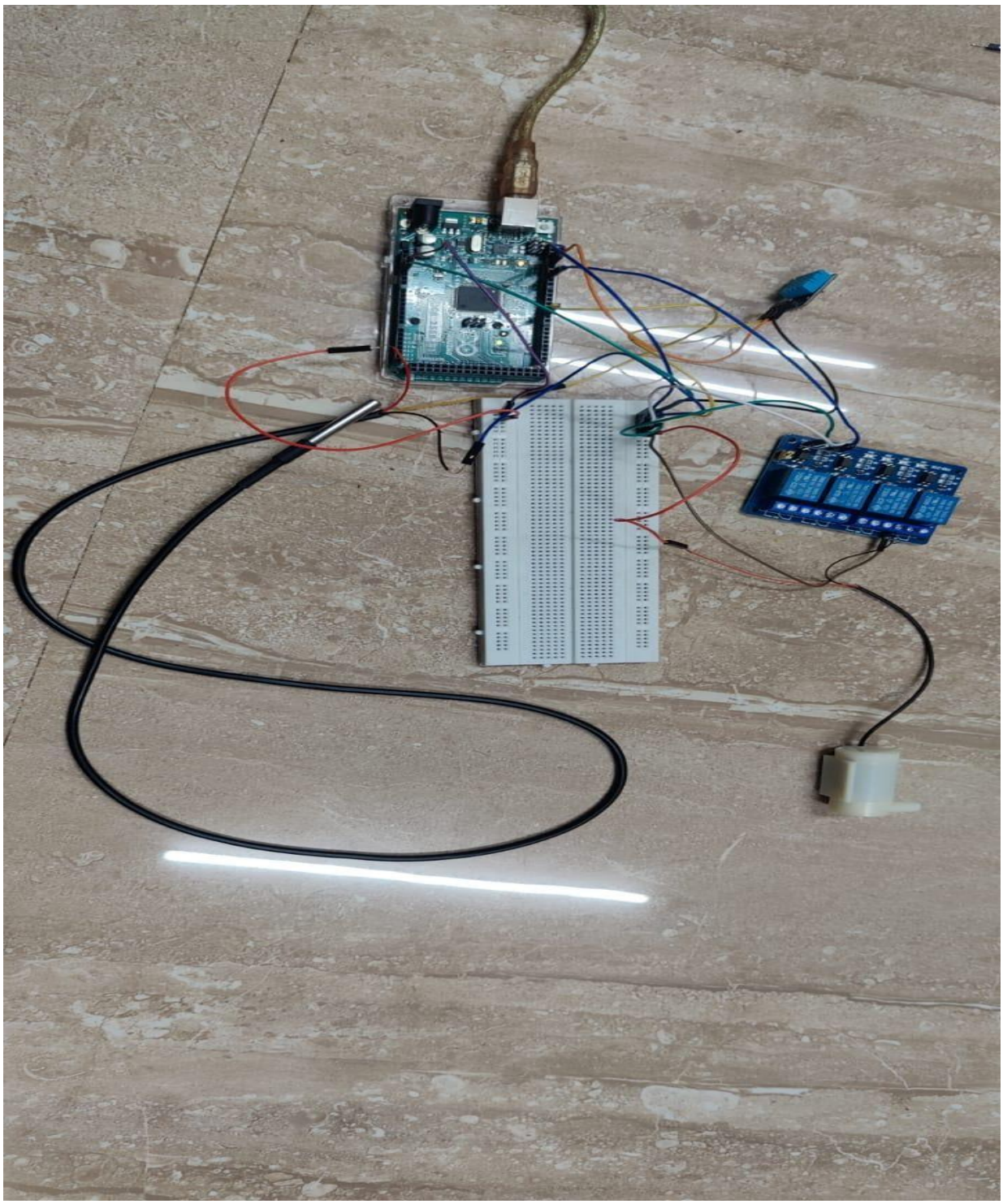
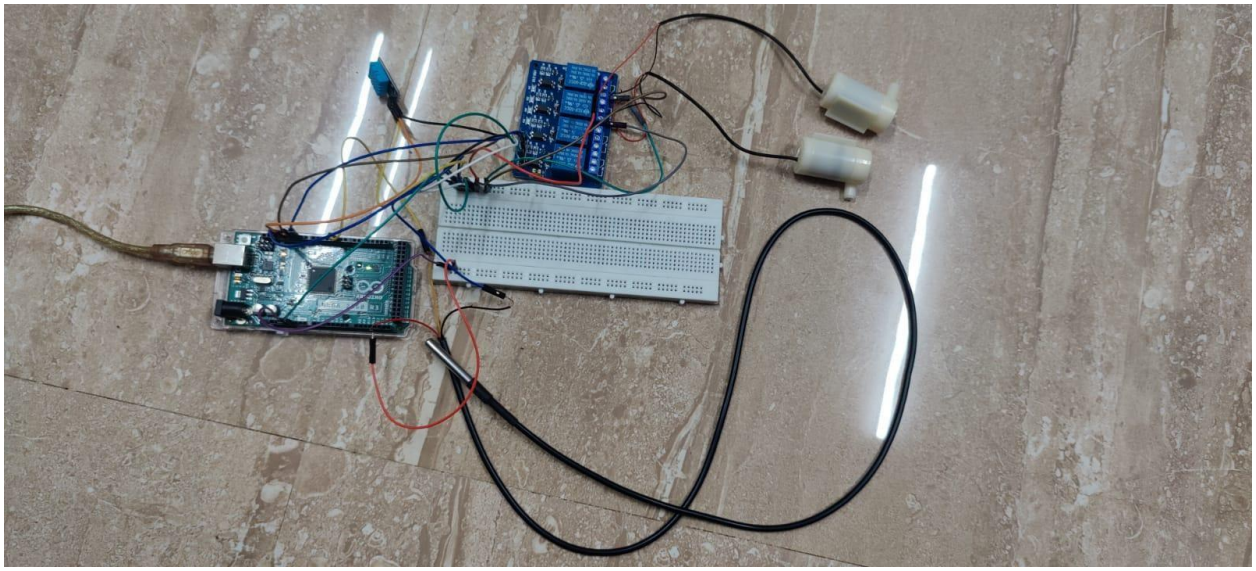
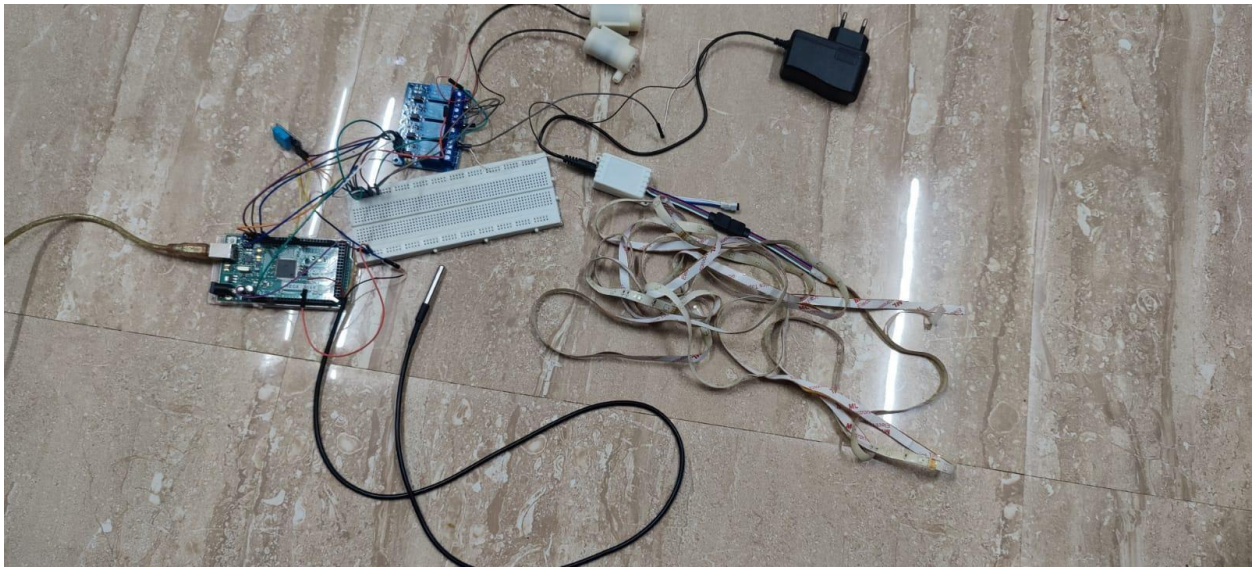

Stage 5: Connect Motors to Relay

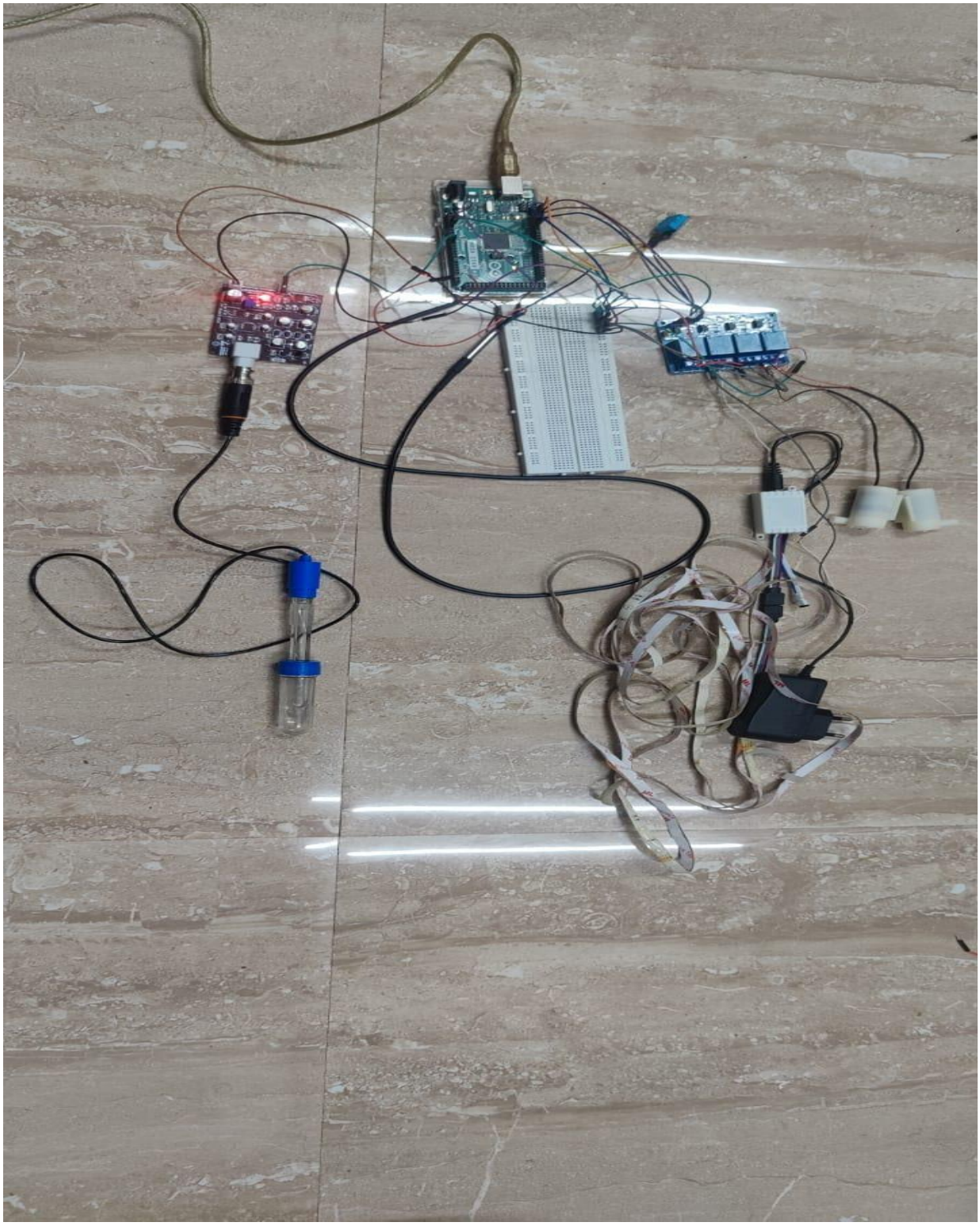




Stage 6: Connect LED Strips to Relay

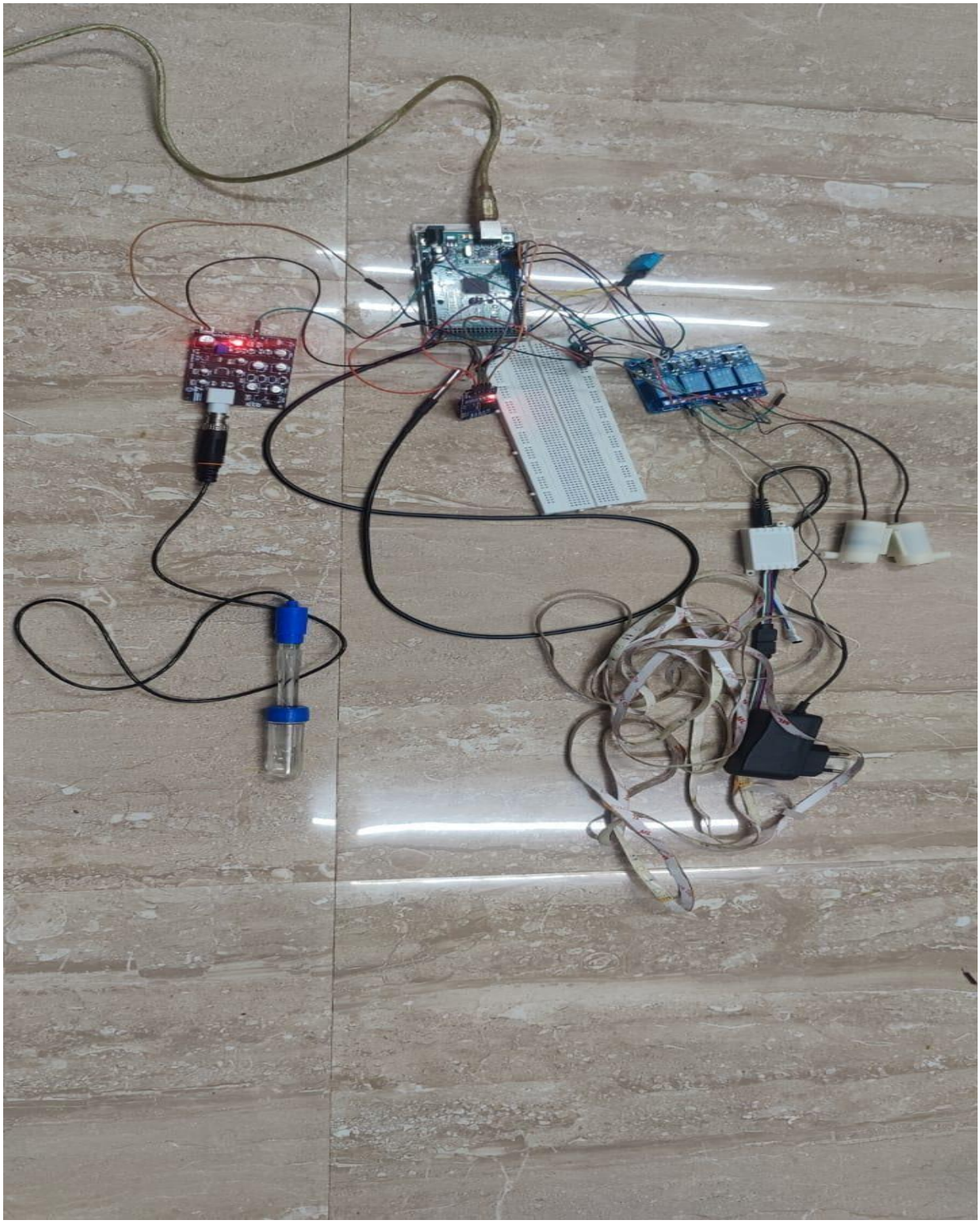


Stage 7: Connect pH Sensor



pH Value = 3.97
pH Value = 4.01
pH Value = 3.97
pH Value = 4.00
pH Value = 4.00
pH Value = 3.99
pH Value = 4.00
pH Value = 4.00
pH Value = 3.98
pH Value = 3.96
pH Value = 3.99
pH Value = 3.99
pH Value = 4.01
pH Value = 3.97
pH Value = 4.00
pH Value = 3.98
pH Value = 4.01
pH Value = 4.00
pH Value = 4.00
pH Value = 3.99
pH Value = 3.98
pH Value = 3.99
pH Value = 4.01
pH Value = 4.00
pH Value = 3.97
pH Value = 3.99
pH Value = 3.99

Stage 8: Connect Real-Time Clock (RTC)



Stage 9: Connect ESP8266 to Arduino

6. CONCLUSION:

Through this project, we aimed to prove that hydroponics farming is much more efficient and time-saving than traditional farming. Using embedded C software and various sensors, we successfully created a real-time environment for the plant to grow with enough light and nutrients. The automated hydroponic system maintains the parameters required for the plants to thrive and with an IoT network incorporated for remote monitoring and control. In addition, the system has an important use which allows the user to control the measurement of light, pH level, temperature and humidity. There is complete control over the aspects that allows a plant to grow. It can be customised to fit the need of different plants, and it does not rely on the outside atmosphere or environment to do so. The results were more than satisfactory and the applications are vast. In the near future, this system will be developed to have more versatile related devices. Data mining techniques will be applied to analyse and predict information about the quantity, quality and time aspects.

7. REFERENCES:

a) https://journals.resaim.com/ijresm/article/view/2228/2166
b) https://create.arduino.cc/projecthub/luisantoniomartinnuez/arduino-controlled-smart-hydroponic-modular-system-0d65ad
c) https://www.arduino.cc/

8. APPENDIX:

Arduino Code:

DHT11:

```
#include "DHT.h"
#define DHTPIN 2
#define DHTTYPE DHT11

DHT dht(DHTPIN, DHTTYPE);
void setup() {
  Serial.begin(9600);
  Serial.println(F("DHTxx test!"));
  dht.begin();
}
void loop() {
  delay(2000);
  float h = dht.readHumidity();
  float t = dht.readTemperature();
  float f = dht.readTemperature(true);
  if (isnan(h) || isnan(t) || isnan(f)) {
        Serial.println(F("Failed to read from DHT sensor!"));
        return;
  }
  float hif = dht.computeHeatIndex(f, h);
  float hic = dht.computeHeatIndex(t, h, false);
  Serial.print(F(" Humidity: "));
  Serial.print(h);
  Serial.print(F("% Temperature: "));
  Serial.print(t);
```

```
  Serial.print(F("C "));
  Serial.print(f);
  Serial.print(F("F Heat index: "));
  Serial.print(hic);
  Serial.print(F("C "));
  Serial.print(hif);
  Serial.println(F("F"));
}
```

DS18B20:

```
#include <OneWire.h>
#include <DallasTemperature.h>
#define ONE_WIRE_BUS 7
OneWire  oneWire(ONE_WIRE_BUS);
DallasTemperature sensors(&oneWire);
void setup(void)
{
  Serial.begin(9600);
  sensors.begin();
}
void loop(void){
  sensors.requestTemperatures();
  Serial.print("Celsius temperature: ");
  Serial.print(sensors.getTempCByIndex(0));
  Serial.print(" - Fahrenheit temperature: ");
  Serial.println(sensors.getTempFByIndex(0));
  delay(1000);
}
```

Relay Motors and LEDs:

```
int D10=10;
int D11=11;
int D12=12;
```

```
void setup(){
  pinMode(D10,OUTPUT);
  pinMode(D11,OUTPUT);
  pinMode(D12,OUTPUT);

}
void loop(){
  digitalWrite(D10,HIGH);
  digitalWrite(D11,HIGH);
  digitalWrite(D12,HIGH);
  delay(5000);
  digitalWrite(D10,LOW);
  digitalWrite(D11,LOW);
  digitalWrite(D12,LOW);
  delay(5000);
}
```

RTC DS3231

```
#include <DS3231.h>
DS3231 rtc(SDA, SCL);
void setup()
{
  Serial.begin(9600);
  rtc.begin();
  rtc.setDOW(WEDNESDAY);
  rtc.setTime(12, 0, 0);
  rtc.setDate(1, 1, 2020);
}

void loop()
{
  Serial.print(rtc.getDOWStr());
  Serial.print(" ");
  Serial.print(rtc.getDateStr());
  Serial.print(" -- ");
  Serial.println(rtc.getTimeStr());
```

```
  delay (1000);
}
```