EXP.No.13: INTERFACING DHT11, SOIL MOISTURE SENSOR, AND ULTRASONIC SENSOR WITH ESP8266 TO MONITOR ENVIRONMENTAL PARAMETERS

OBJECTIVES:

1. To interface DHT11, soil moisture sensor, and ultrasonic sensor with the ESP826 NodeMCU board.
2. To measure temperature, humidity, soil moisture, and distance using the respective sensors.
3. To display the sensor readings on the Blynk IoT app.

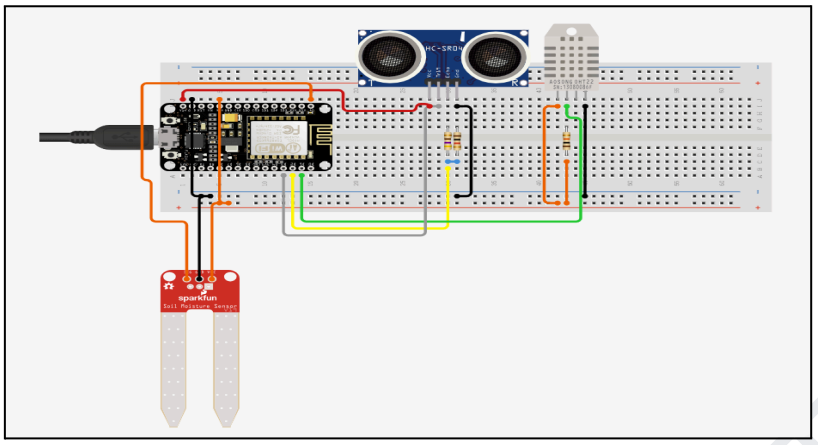
MATERIALS REQUIRED:

- ESP8266 NodeMCU board
- DHT11 temperature and humidity sensor
- Soil moisture sensor module
- Ultrasonic sensor module (HC-SR04)
- Breadboard
- Jumper wires
- USB cable
- Computer with Arduino IDE installed
- Blynk app installed on a smartphone or tablet

THEORY:

- **DHT11 Sensor:** Measures temperature and humidity. It outputs a digital signal proportional to the temperature and humidity levels.
- **Soil Moisture Sensor:** Measures the volumetric water content in soil by acting as a variable resistor.
- **Ultrasonic Sensor (HC-SR04):** Measures distance by emitting ultrasonic waves and calculating the time it takes for the waves to return after hitting an object.
- **ESP8266 NodeMCU:** A low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability.
- **Blynk:** A platform with iOS and Android apps to control Arduino, Raspberry Pi, and similar devices over the Internet.

CIRCUIT DIAGRAM:



DHT11 Pin Configuration:

- V_{CC}: 3.3V
- GND: GND
- Data: D1 on ESP8266

Soil Moisture Sensor Pin Configuration:

- V_{CC}: 3.3V
- GND: GND
- Analog Output: A0 on ESP8266

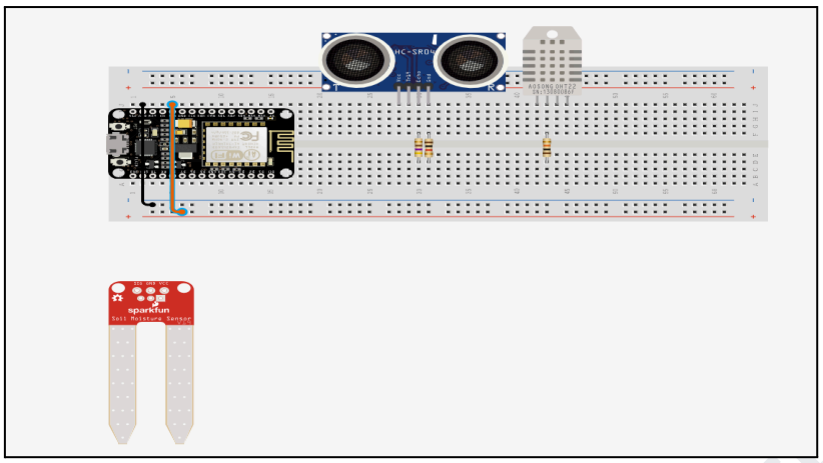
Ultrasonic Sensor Pin Configuration:

- VCC: 5V
- GND: GND
- Trig: D3 on ESP8266
- Echo: D2 on ESP8266

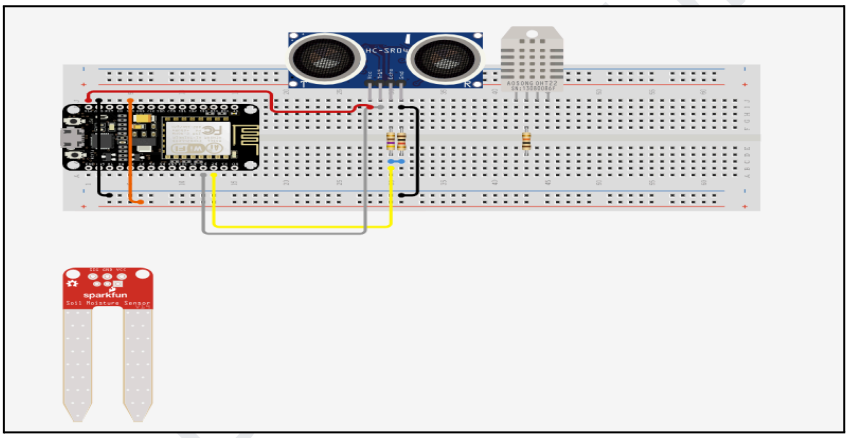
PROCEDURE:

1. Hardware Setup:

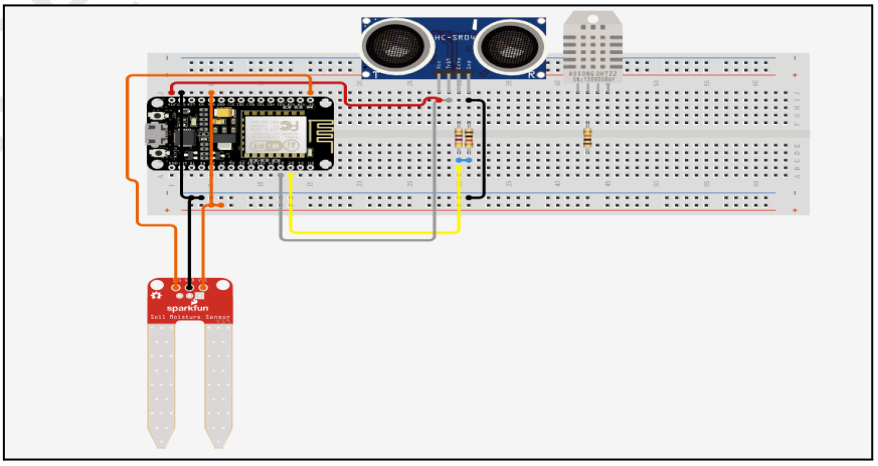
- Connect the VCC pin of the DHT11 to the 3.3V pin on the ESP8266.
- Connect the GND pin of the DHT11 to a GND pin on the ESP8266.



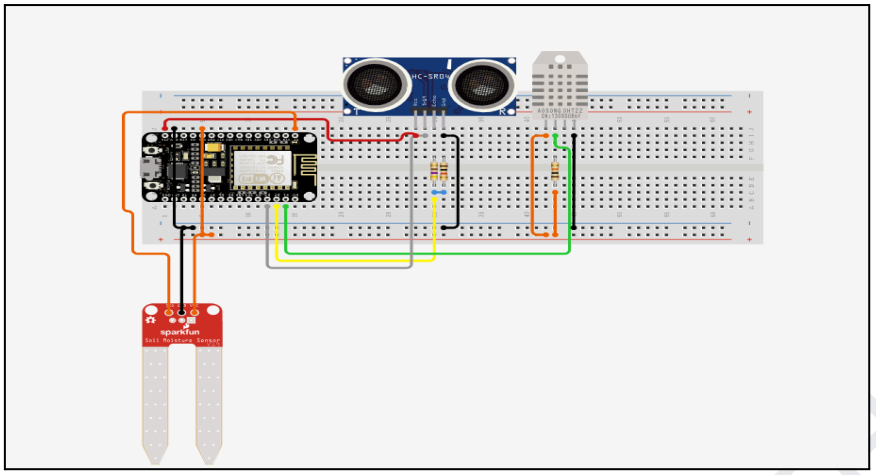
- Connect the Data pin of the DHT11 to the D1 pin on the ESP8266.
- Connect the VCC pin of the soil moisture sensor to the 3.3V pin on the ESP8266.



- Connect the Analog Output pin of the soil moisture sensor to the A0 pin on the ESP8266.
- Connect the GND pin of the soil moisture sensor to a GND pin on the ESP8266.



- Connect the VCC pin of the ultrasonic sensor to the 5V pin on the ESP8266.
- Connect the GND pin of the ultrasonic sensor to a GND pin on the ESP8266.



- Connect the Trig pin of the ultrasonic sensor to the D3 pin on the ESP8266.
- Connect the Echo pin of the ultrasonic sensor to the D2 pin on the ESP8266.

2. Software Setup:

- Open the Arduino IDE on your computer.
- Install the necessary libraries: DHT sensor library, NewPing library, and Blynk library.
- Install the Blynk library by navigating to Sketch -> Include Library -> Manage Libraries and searching for “Blynk”.

3. Blynk App Setup:

- Open the Blynk app on your smartphone/tablet.
- Create a new project and note the Auth Token.
- Add the following widgets:
- Value Display for Temperature (C) on Virtual Pin V0
- Value Display for Temperature (F) on Virtual Pin V1
- Value Display for Humidity on Virtual Pin V2
- Value Display for Distance on Virtual Pin V3
- Value Display for Soil Moisture on Virtual Pin V4

4. Programming:

- Connect the ESP8266 to your computer using a USB cable.
- In the Arduino IDE, write the following code:

```
#define BLYNK_TEMPLATE_ID "TMPL39Ex6jAwk"
#define BLYNK_TEMPLATE_NAME "cha"
#define BLYNK_AUTH_TOKEN "pi5bfneDmML4Av6lREdZ813y6CpWsDf8"

#define BLYNK_PRINT Serial

#include <ESP8266WiFi.h>
```

```
#include <BlynkSimpleEsp8266.h>
#include <DHT.h>
#include <NewPing.h>

// Your WiFi credentials
const char* ssid = "Porapoo";
const char* password = "88888888";

// DHT sensor settings
#define DHTPIN D1
#define DHTTYPE DHT11
DHT dht(DHTPIN, DHTTYPE);

// Ultrasonic Sensor settings
#define TRIGGER_PIN D3
#define ECHO_PIN D2
#define MAX_DISTANCE 200

// Initialize NewPing library for ultrasonic sensor
NewPing sonar(TRIGGER_PIN, ECHO_PIN, MAX_DISTANCE);

// Soil moisture sensor settings
#define SOIL_MOISTURE_PIN A0

// Timer for scheduling sensor readings
BlynkTimer timer;

void sendSensorData() {
  // Read and send DHT11 data
  float tC = dht.readTemperature();
  float tF = dht.readTemperature(true);
  float humidity = dht.readHumidity();

  if (isnan(tC) || isnan(tF) || isnan(humidity)) {
    Serial.println("Failed to read from DHT sensor!");
  } else {
    Blynk.virtualWrite(V0, tC);
```

```
  Blynk.virtualWrite(V1, tF);
  Blynk.virtualWrite(V2, humidity);
 }

 // Read and send ultrasonic distance data
 unsigned int distance = sonar.ping_cm();
 Blynk.virtualWrite(V3, distance);

 // Read and send soil moisture data
 int soilMoistureValue = analogRead(SOIL_MOISTURE_PIN);
 Blynk.virtualWrite(V4, soilMoistureValue);

 // Print values to Serial Monitor for debugging
 Serial.print("Temperature (C): ");
 Serial.print(tC);
 Serial.print(" | Temperature (F): ");
 Serial.print(tF);
 Serial.print(" | Humidity: ");
 Serial.print(humidity);
 Serial.print(" | Distance: ");
 Serial.print(distance);
 Serial.print(" cm | Soil Moisture: ");
 Serial.println(soilMoistureValue);
}

void setup() {
 Serial.begin(115200);
 Blynk.begin(BLYNK_AUTH_TOKEN, ssid, password);
 dht.begin();
 timer.setInterval(2000L, sendSensorData);
}

void loop() {
 Blynk.run();
 timer.run();
}
```

- Replace `BLYNK_AUTH_TOKEN`, `ssid`, and `password` with the actual values.

- Upload the code to the ESP8266.

5. Running the Experiment:

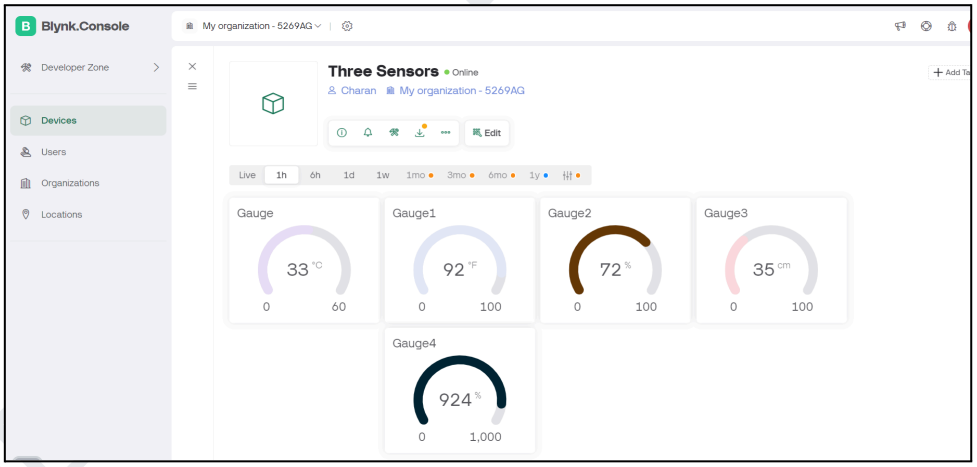
- Open the Serial Monitor in the Arduino IDE to observe the sensor readings.
- Open the Blynk app to view the live sensor data on the Value Display widgets.

Observations:

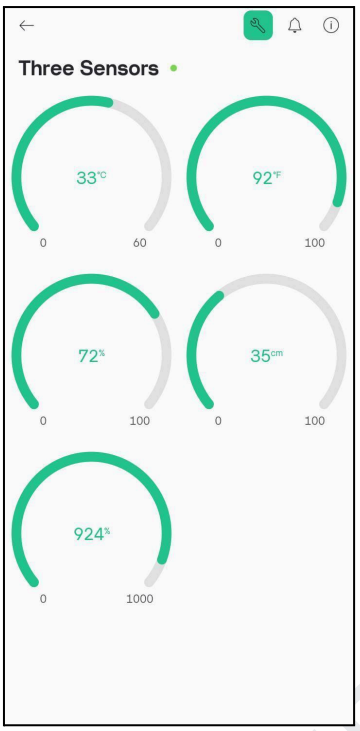
Record the sensor readings displayed on the Blynk app at different intervals.

S.No.	Time (HH:MM)	Temperature (°C)	Temperature (°F)	Humidity (%)	Distance (cm)	Soil Moisture (%)

Observation in Blynk website:



Observation in Blynk IoT mobile app:



Result:

The temperature, humidity, soil moisture levels, and distance were successfully measured using the respective sensors and displayed on the Blynk app.

Conclusion:

This experiment demonstrates how to interface the DHT11, soil moisture sensor, and ultrasonic sensor with the ESP8266 board and use the Blynk IoT platform to remotely monitor environmental parameters. The successful implementation confirms the practicality of using ESP8266 and Blynk for IoT applications.

Appendix:

A. Symbols, Units, and Abbreviations:

- °C: Degrees Celsius (Temperature)
- °F: Degrees Fahrenheit (Temperature)
- %: Percent (Humidity)
- cm: Centimetres (Distance)
- VCC: Voltage Common Collector
- GND: Ground
- GPIO: General Purpose Input/Output

B. Tools Required:

- ESP8266 NodeMCU board
- DHT11 temperature and humidity sensor

- Soil moisture sensor module
- Ultrasonic sensor module (HC-SR04)
- Breadboard
- Jumper wires
- USB cable
- Computer with Arduino IDE installed
- Blynk app installed on a smartphone or tablet

C. Additional Resources:

- ESP8266 Documentation
- Arduino IDE Installation Guide
- Blynk Documentation
- DHT11 Sensor Guide
- Soil Moisture Sensor Guide
- Ultrasonic Sensor Guide

D. Reference link with QR code

https://www.youtube.com/watch?v=gnplPonzGAI

This format provides a clear and comprehensive guide for conducting the experiment, ensuring students can follow along and achieve the desired outcomes.