SECURITY SYSTEM USING SENSORS

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19Z604 – EMBEDDED SYSTEMS

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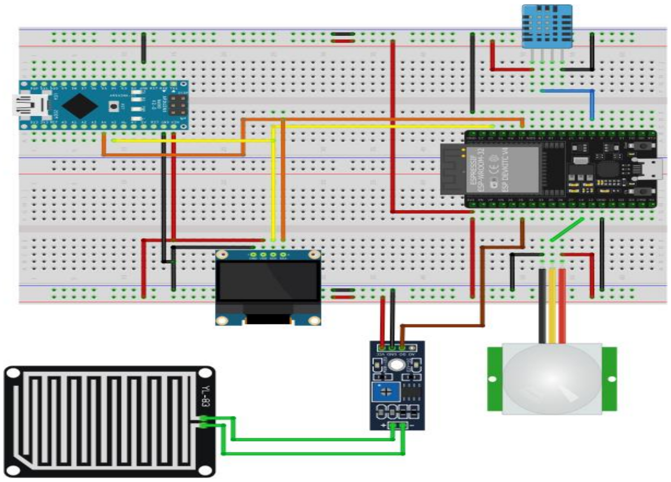
PROBLEM STATEMENT:

The objective of this project is to develop a comprehensive security monitoring system using an ESP32 microcontroller integrated with motion, temperature, humidity, and rain sensors. The primary challenge addressed is ensuring the system's reliability and robustness against potential failures or coding errors. To achieve this, we aim to design a rigorous testing framework that includes both positive and negative test cases to validate the system's functionality under various scenarios. In the event of detecting anomalous activities or environmental changes, such as unauthorized motion or extreme weather conditions, the system should promptly trigger an alert through a buzzer. Moreover, the system will be equipped with WiFi connectivity to transmit real-time sensor data to a local server. Users can access this data via a dedicated port on a webpage when connected to the system's WiFi network. This project aims to enhance security monitoring capabilities while ensuring seamless user accessibility and system reliability.

COMPONENTS USED:

- Arduino Nano
- Esp32-Wroom (8mb flash - 38 pins)
- OLED 128x64
- DHT 11
- PIR Sensor
- Rain Sensor
- Bread Board
- Jumper Wires

SCHEMATIC DIAGRAM:



EMBEDDED C CODE:

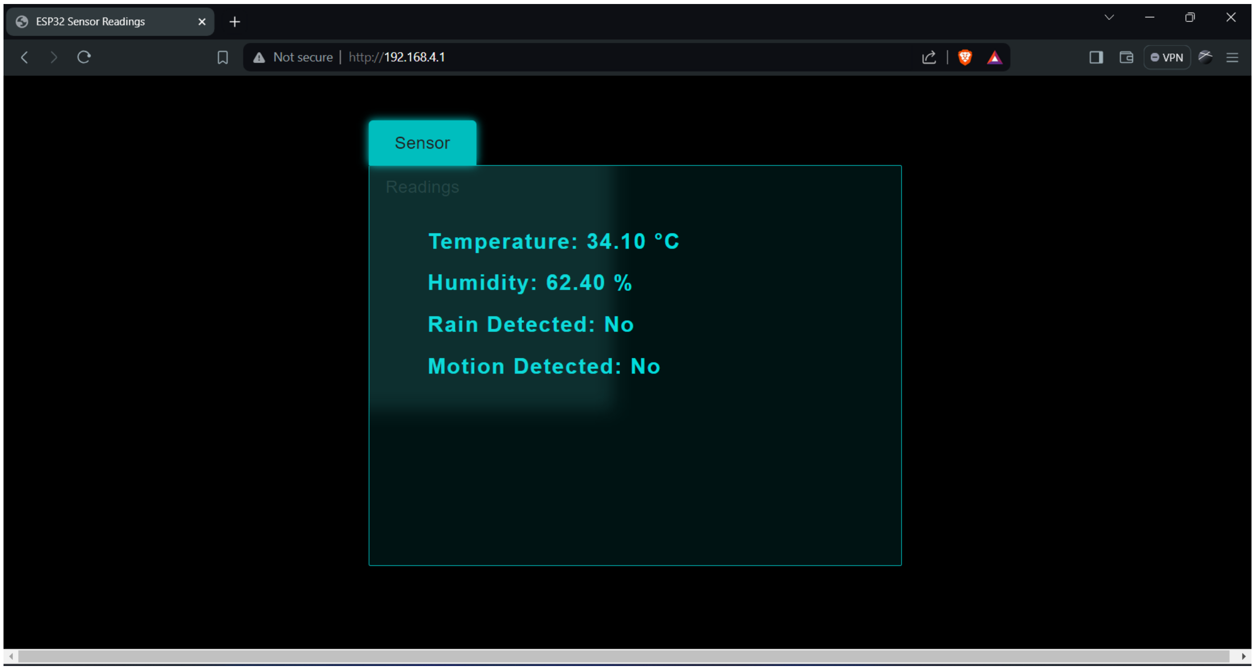
```
#include <WiFi.h>
#include <WebServer.h>
#include <DHT.h>
#include <Adafruit_SSD1306.h>

// Define DHT sensor pin and type
#define DHTPIN 4
#define DHTTYPE DHT11

int _moisture, sensor_analog;  // Variables to store soil moisture and sensor analog value

// WiFi AP credentials
const char *ssid = "Agriculture";
const char *password = "password123";

// Define PIR sensor pin and OLED display settings
#define PIR_PIN   14
#define OLED_SDA 21
#define OLED_SCL 22
#define OLED_WIDTH 128
#define OLED_HEIGHT 32

// Initialize DHT sensor, OLED display, and WebServer
DHT dht(DHTPIN, DHTTYPE);
Adafruit_SSD1306 display(OLED_WIDTH, OLED_HEIGHT, &Wire, -1);
WebServer server(80);

// Define pins for soil and rain sensors
int sensor_pin = 34;
int rainSensorPin = 35;
int soilMoisture = 0;
int rainSensor = 0;

// Handle root endpoint request
void handleRoot() {
  // Read temperature, humidity, and PIR sensor state
  float temperature = dht.readTemperature();
  float humidity = dht.readHumidity();
  int pirState = digitalRead(PIR_PIN);

  // Generate HTML webpage with sensor readings
  String webpage = "<!DOCTYPE html><html lang=\"en\"><head><meta charset=\"UTF-8\"><meta name=\"viewport\" content=\"width=device-width, initial-scale=1.0\"><title>ESP32 Sensor Readings</title>";
  // Add CSS styles to the webpage
  webpage += "<style>";
  // ... (CSS styles)
  webpage += "</style>";
  // JavaScript for auto-refresh every 3 seconds
  webpage += "<script>setTimeout(function(){location.reload();}, 3000);</script>";
  webpage += "</head><body>";
  // Create sensor readings section on the webpage
  webpage += "<ul class=\"scifiUI\">";
  webpage += "  <li>";
  webpage += "    <input type=\"radio\" name=\"tab\" id=\"tab1\" checked>";
  webpage += "    <label for=\"tab1\">Sensor Readings</label>";
  webpage += "    <div class=\"blurred-box section\">";
  // Display temperature and humidity readings
  webpage += "<h2>Temperature: " + String(temperature) + " °C</h2>";
  webpage += "<h2>Humidity: " + String(humidity) + " %</h2>";
  // Check if rain and motion are detected
  if (rainSensor == LOW) {
    webpage += "<h2>Rain Detected: Yes</h2>";
  } else {
    webpage += "<h2>Rain Detected: No</h3>";
  }
  if (pirState == HIGH) {
    webpage += "<h2>Motion Detected: Yes</h2>";
  } else {
    webpage += "<h2>Motion Detected: No</h2>";
  }
  webpage += "    </div>";
  webpage += "  </li>";
  webpage += "</ul>";
  webpage += "</body></html>";
  // Send webpage as response to client
  server.send(200, "text/html", webpage);
}
```

```
void setup() {
  // Initialize serial communication
  Serial.begin(115200);
  // Initialize I2C communication for OLED display
  Wire.begin(OLED_SDA, OLED_SCL);

  // Initialize OLED display
  if (!display.begin(SSD1306_SWITCHCAPVCC, 0x3C)) {
    Serial.println(F("SSD1306 allocation failed"));
    while (1);
  }
  // Initialize DHT sensor
  dht.begin();

  // Set pin modes for PIR sensor and LED
  pinMode(PIR_PIN, INPUT);
  pinMode(18, OUTPUT);

  // Set up WiFi AP
  WiFi.softAP(ssid, password);
  IPAddress IP = WiFi.softAPIP();
  Serial.println("AP IP address: " + IP.toString());

  // Configure pin modes for soil and rain sensors
  pinMode(sensor_pin, INPUT);
  pinMode(rainSensorPin, INPUT);

  // Define web server route for root endpoint
  server.on("/", handleRoot);

  // Start web server
  server.begin();
}

// Function to generate beep sound
void beep(){
  digitalWrite(18, HIGH);
  delay(3000);
  digitalWrite(18, LOW);
}
```

```
void loop() {
  // Read temperature and humidity from DHT sensor
  float temperature = dht.readTemperature();
  float humidity = dht.readHumidity();

  // Read soil moisture and rain sensor values
  sensor_analog = analogRead(sensor_pin);
  _moisture = ( 100 - ( (sensor_analog / 4095.00) * 100 ) );

  // Read PIR sensor state
  int pirState = digitalRead(PIR_PIN);

  // Clear OLED display
  display.clearDisplay();
  display.setTextSize(1);
  display.setTextColor(SSD1306_WHITE);
  display.setCursor(0, 0);

  // Display temperature and humidity on OLED
  display.println("Temperature: " + String(temperature) + " C");
  display.println("Humidity: " + String(humidity) + " %");

  // Display rain and motion detection status on OLED
  if (rainSensor == LOW) {
    display.println("Rain Detected: Yes");
    beep();
  } else {
    display.println("Rain Detected: No");
  }
  if (pirState == HIGH) {
    display.println("Motion Detected: Yes");
  } else {
    display.println("Motion Detected: No");
  }

  // Update OLED display
  display.display();
  // Handle web server client requests
  server.handleClient();
}
```

SNAPSHOTS OF OUTPUT:

SCENARIO 1: NO MOTION AND NO RAIN



Sensor

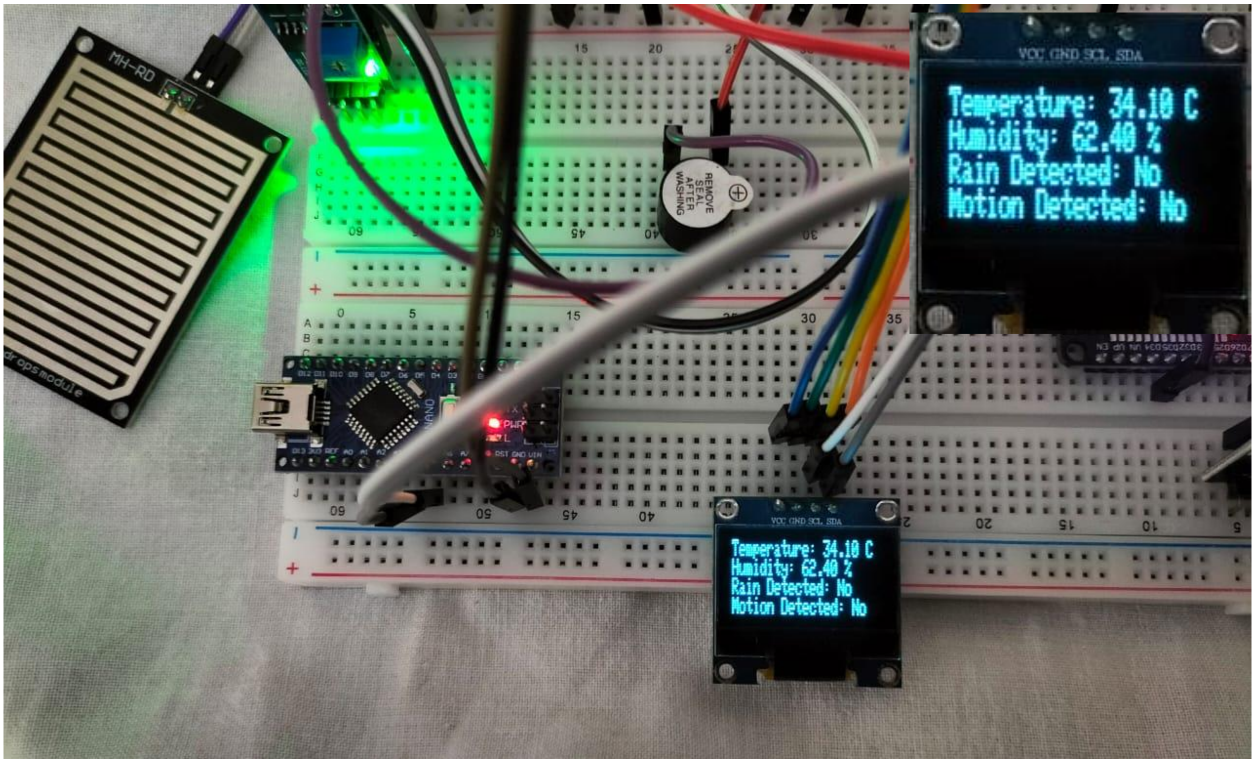
Readings

Temperature: 34.10 °C

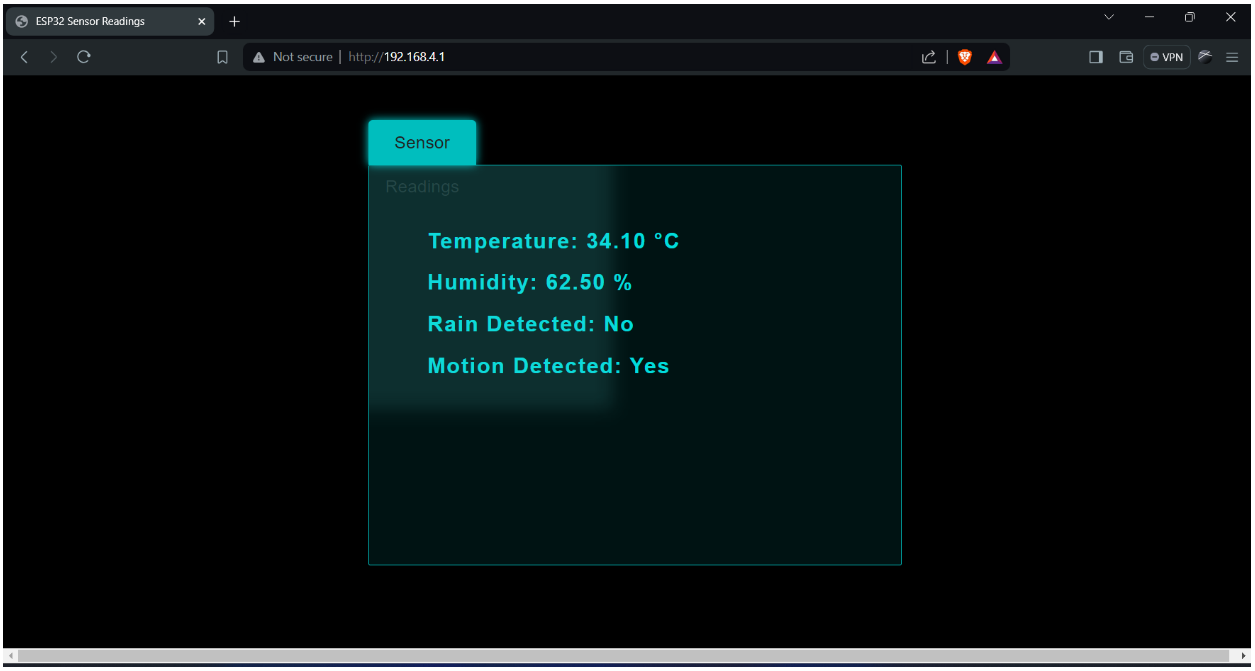
Humidity: 62.40 %

Rain Detected: No

Motion Detected: No



SCENARIO 2: MOTION DETECTED AND NO RAIN



Sensor

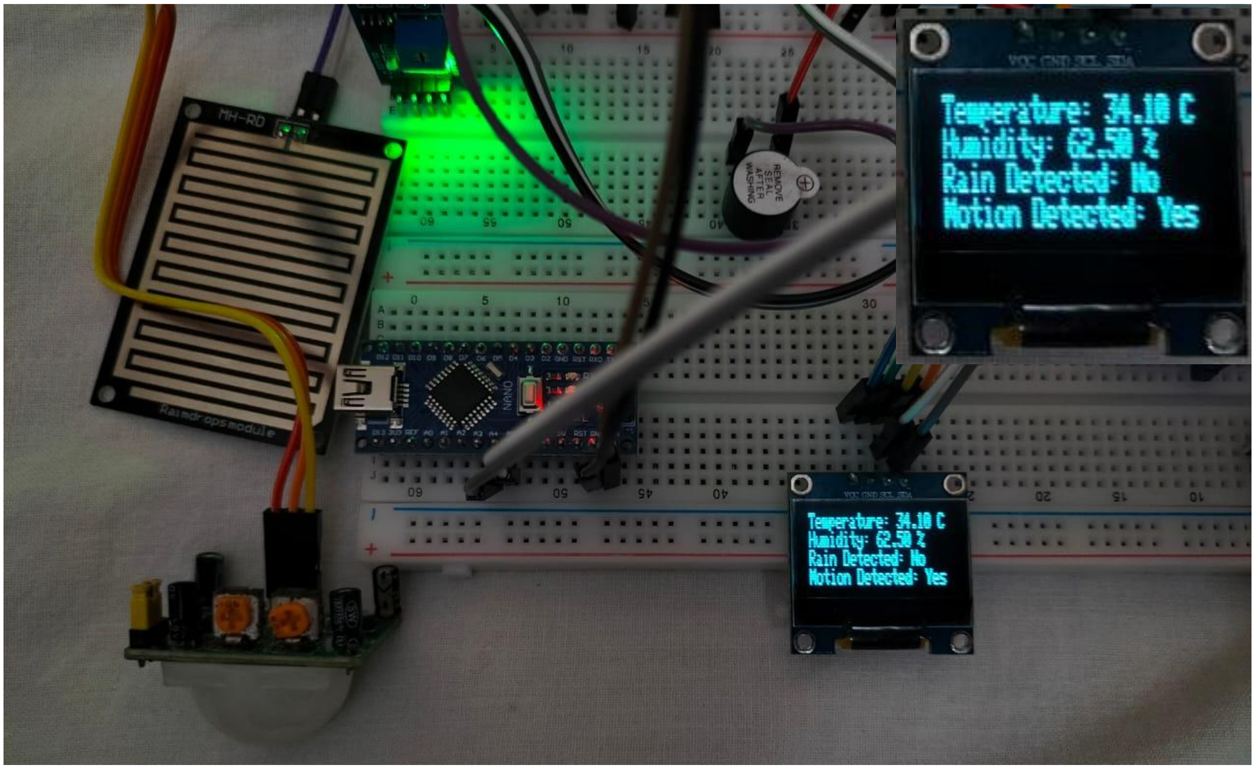
Readings

Temperature: 34.10 °C

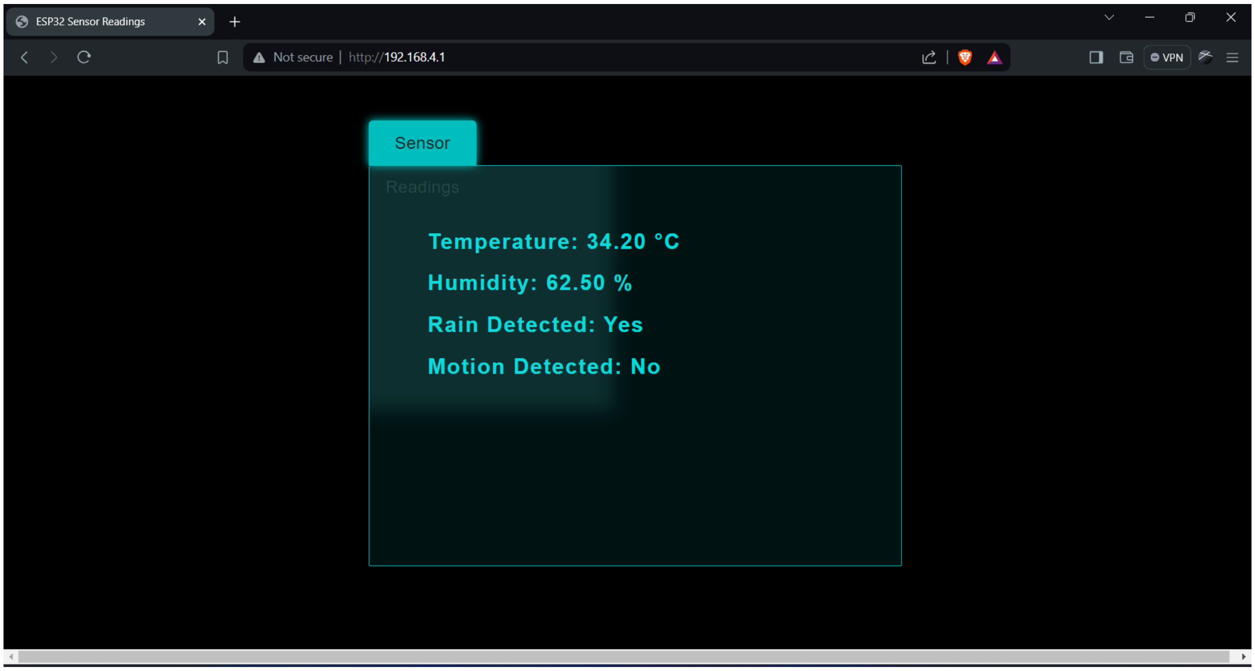
Humidity: 62.50 %

Rain Detected: No

Motion Detected: Yes



SCENARIO 3: NO MOTION AND RAIN DETECTED

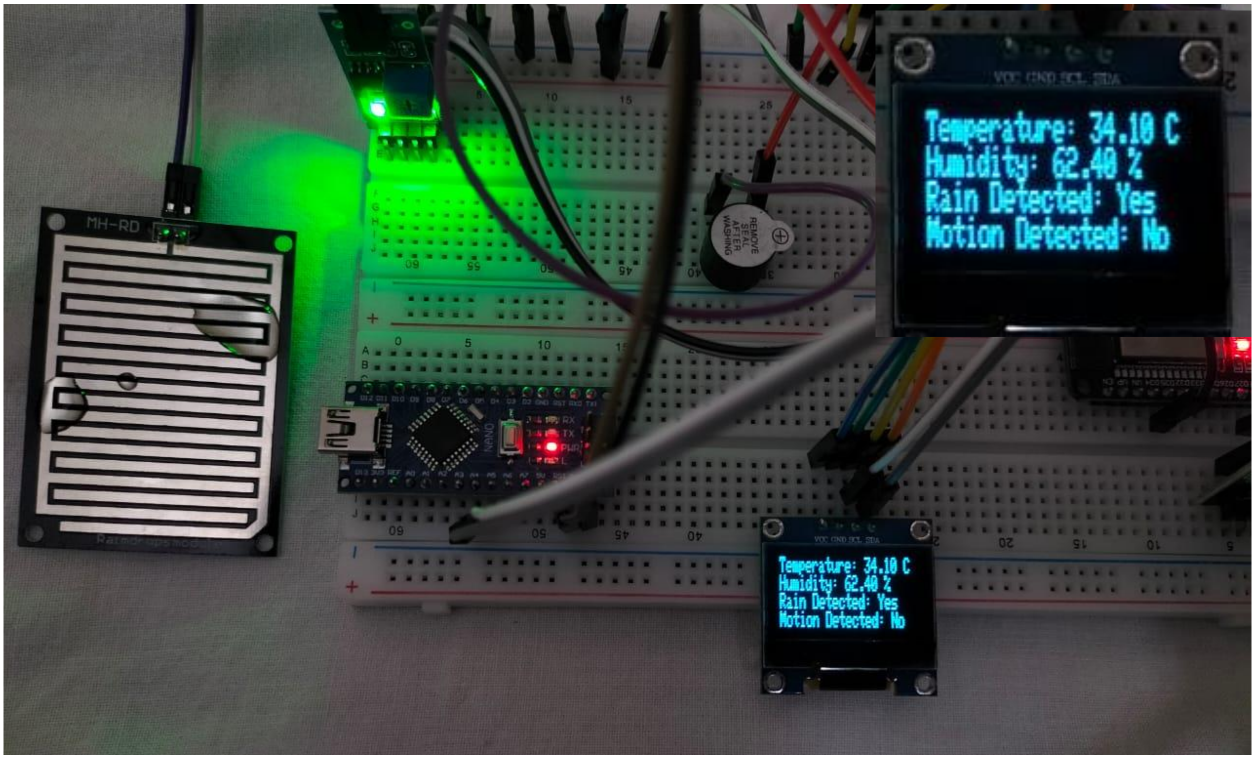


Temperature: 34.20 °C

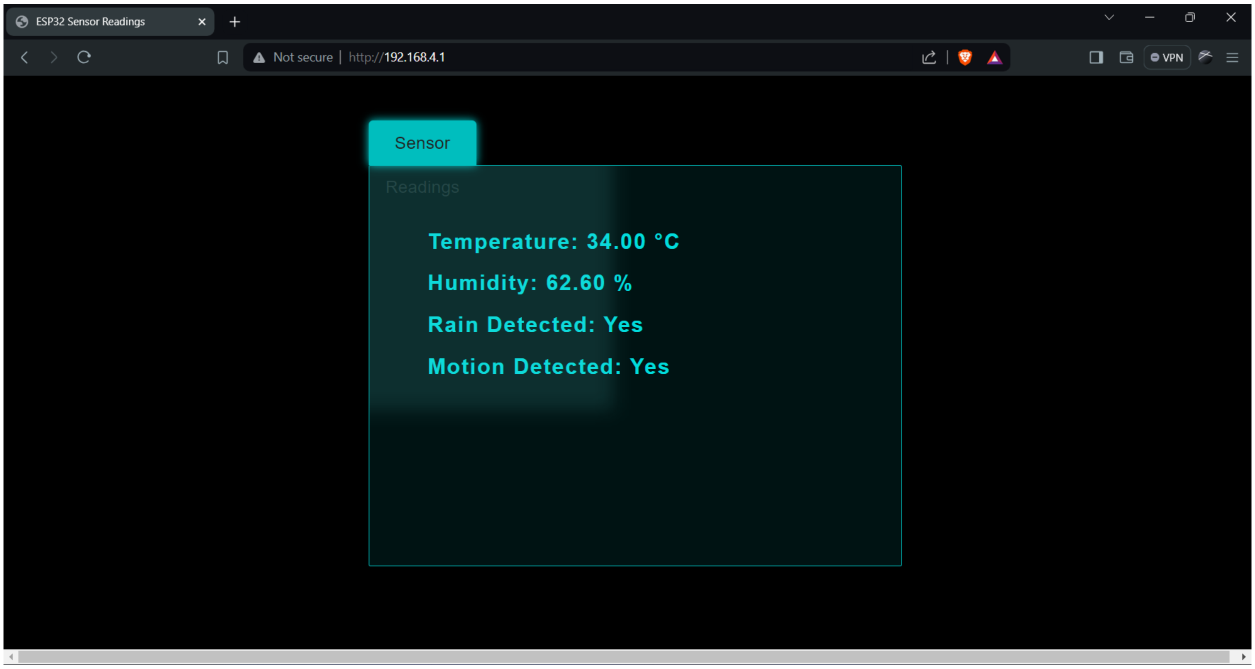
Humidity: 62.50 %

Rain Detected: Yes

Motion Detected: No



SCENARIO 4: BOTH MOTION AND RAIN DETECTED



Sensor

Readings

Temperature: 34.00 °C

Humidity: 62.60 %

Rain Detected: Yes

Motion Detected: Yes