IoT-Based Temperature and Humidity Monitoring System Report

Project Title: IoT-Based Temperature and Humidity Monitoring System

Presented By: **Group 31**

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1. Project Overview

Problem Statement:
If humidity and temperature levels in classrooms and laboratories are not kept in check, students' comfort and health may be compromised, which decreases their productivity and overall wellness.

Objectives:

- Develop an IoT-based system to monitor temperature and humidity.
- Trigger alerts when values exceed set thresholds.
- Store and visualize data using cloud platforms.

Solution Explanation:

Why This IoT-based technology is chosen?

- *Wokwi(Simulation Platform):-* No need for real hardware, making testing and debugging faster and cost-free.
- *ESP32 (Microcontroller) :-* Built-in WiFi, low power consumption, and better processing power than Arduino.
- *DHT22 (Sensor) :-*More accurate and stable than DHT11, measuring temperature and humidity.
- *ThingSpeak (IoT Cloud) :-* Free for basic use, real-time data monitoring, and easy ESP32 integration without extra libraries

A DHT22 sensor is used to obtain temperature and humidity readings as well as activate things when set parameters are met. Processed by the microcontroller (ESP32) the data is uploaded to ThingSpeak(cloud-based platform) for real time data retrieval. If temperature or humidity exceeds predefined limits, the system activates alerts via LEDs and a buzzer.An alert is sent via email to indicate limits exceeded.

2. Design & Implementation

Components Used:

- Temperature and humidity sensor (DHT22)
- Microcontroller (ESP32)
- Cloud platform: ThingSpeak for real-time data logging and alert generation
- Open-source simulators: Wokwi
- Additional components: LEDs, buzzer
- Resistor: 10kΩ
- Jumper Wires: For circuit connections.

Circuit Design:

➢ The circuit is implemented using Wokwii
➢ ThingSpeak API is used for real-time data logging.

A circuit is designed to integrate the DHT sensor with the microcontroller. The sensor reads temperature and humidity values, which are then sent to the cloud. If the readings exceed the threshold, LEDs change color, and a buzzer sounds an alarm.

The circuit consists of the following connections:

DHT22 Sensor

VCC → 3.3V (ESP32)
GND → GND (ESP32)

DATA → GPIO4 (ESP32)

Pull-up Resistor (10kΩ) connected between VCC and DATA

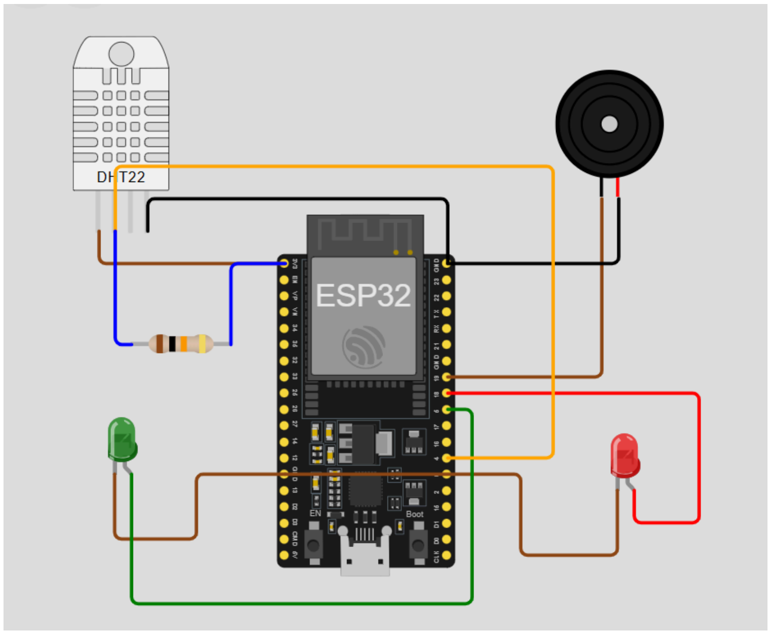
LEDs

Green LED (Normal Condition) → GPIO5
Red LED (Alert Condition) → GPIO18
Both LEDs' cathodes are connected to GND

Buzzer
Positive Terminal → GPIO19
Negative Terminal → GND

WiFi Connection

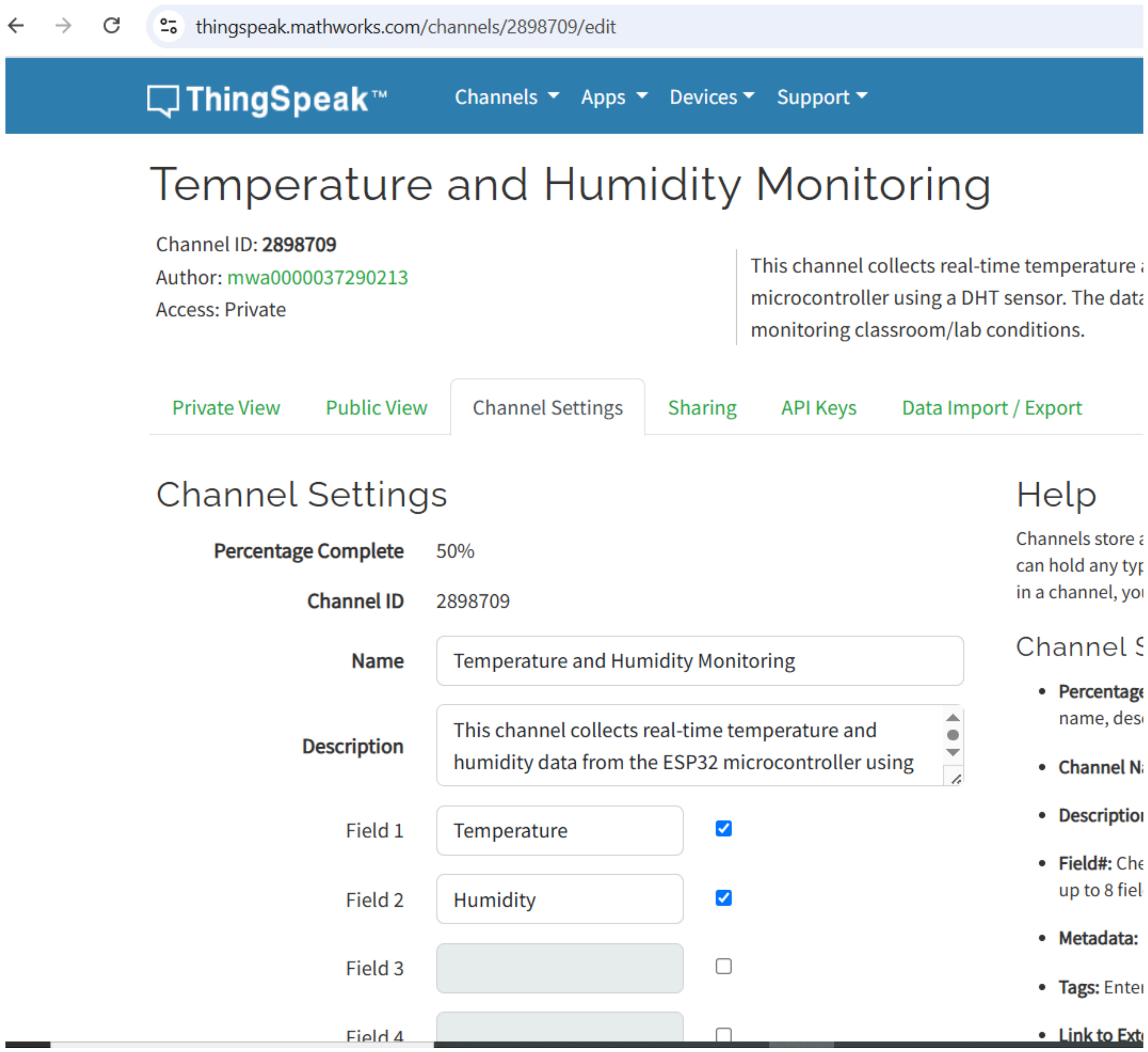
ESP32 connects to the **Wokwi-GUEST** WiFi network
Data is sent to **ThingSpeak** cloud



Implementation Steps:

1. Connect the DHT22 sensor to the microcontroller.
2. Establish a Wi-Fi connection for data transmission.
3. Read temperature and humidity values from the sensor.
4. Send the collected data to ThingSpeak.
5. Define threshold values for temperature and humidity.
6. Trigger alerts (LED and buzzer) when limits are exceeded.
7. Visualize data through ThingSpeak dashboards.
8. Email sent on exceeding limit as an Alert!

Configurations on ThingSpeak :



thingspeak.mathworks.com/channels/2898709/edit

Temperature and Humidity Monitoring

Channel ID: **2898709**
Author: mwa0000037290213
Access: Private

This channel collects real-time temperature
microcontroller using a DHT sensor. The data
monitoring classroom/lab conditions.

Channel Settings

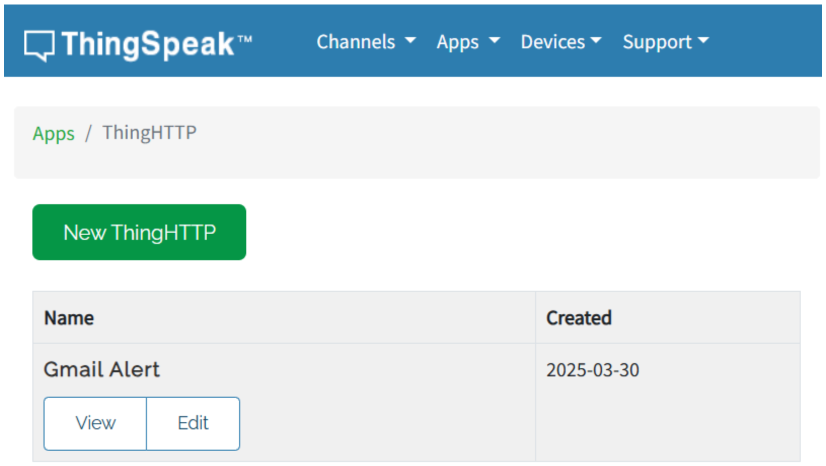
Percentage Complete	50%	
Channel ID	2898709	
Name	Temperature and Humidity Monitoring	
Description	This channel collects real-time temperature and humidity data from the ESP32 microcontroller using	
Field 1	Temperature	✓
Field 2	Humidity	✓
Field 3		☐
Field 4		☐

Help

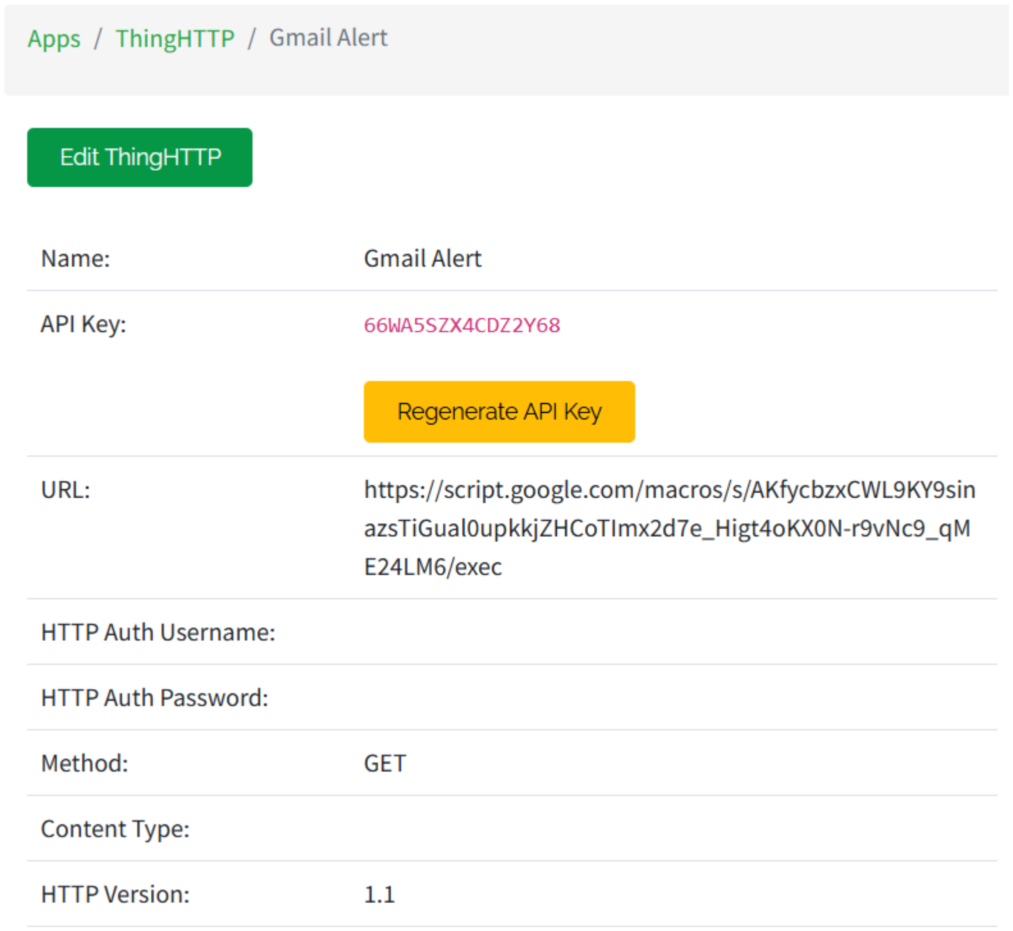
Channels store a
can hold any typ
in a channel, yo

Channel S

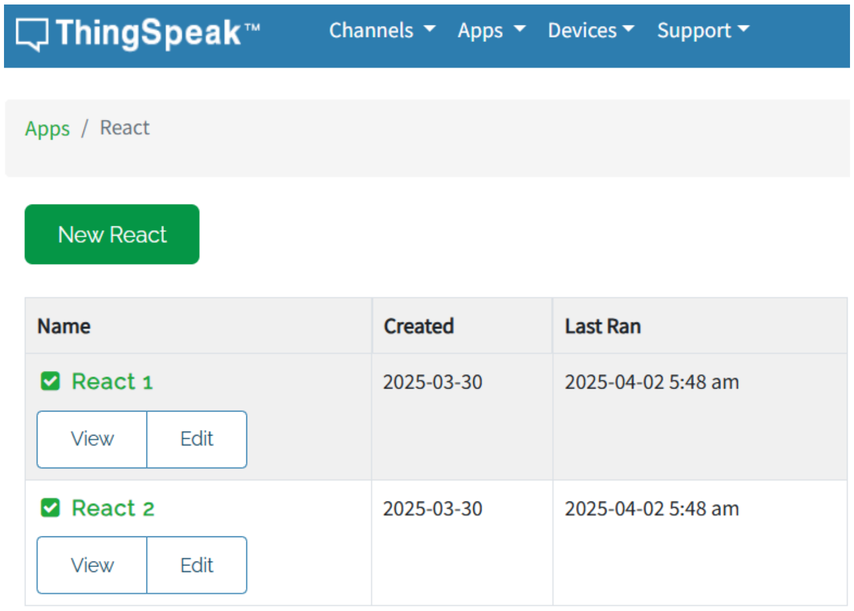
- **Percentage**
  name, desc
- **Channel Na**
- **Descriptio**
- **Field#:** Che
  up to 8 fiel
- **Metadata:**
- **Tags:** Enter
- **Link to Ext**



Name	Created
Gmail Alert	2025-03-30

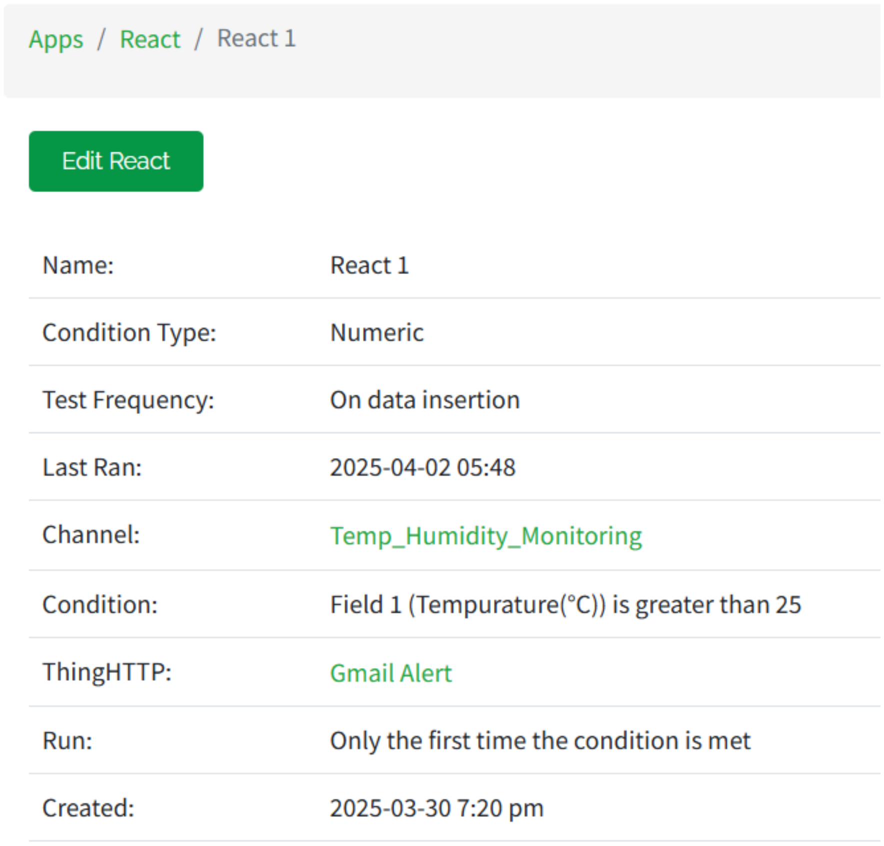


Name:	Gmail Alert
API Key:	66WA5SZX4CDZ2Y68
URL:	https://script.google.com/macros/s/AKfycbzxCWL9KY9sinazsTiGual0upkkjZHCoTImx2d7e_Higt4oKX0N-r9vNc9_qME24LM6/exec
HTTP Auth Username:	
HTTP Auth Password:	
Method:	GET
Content Type:	
HTTP Version:	1.1



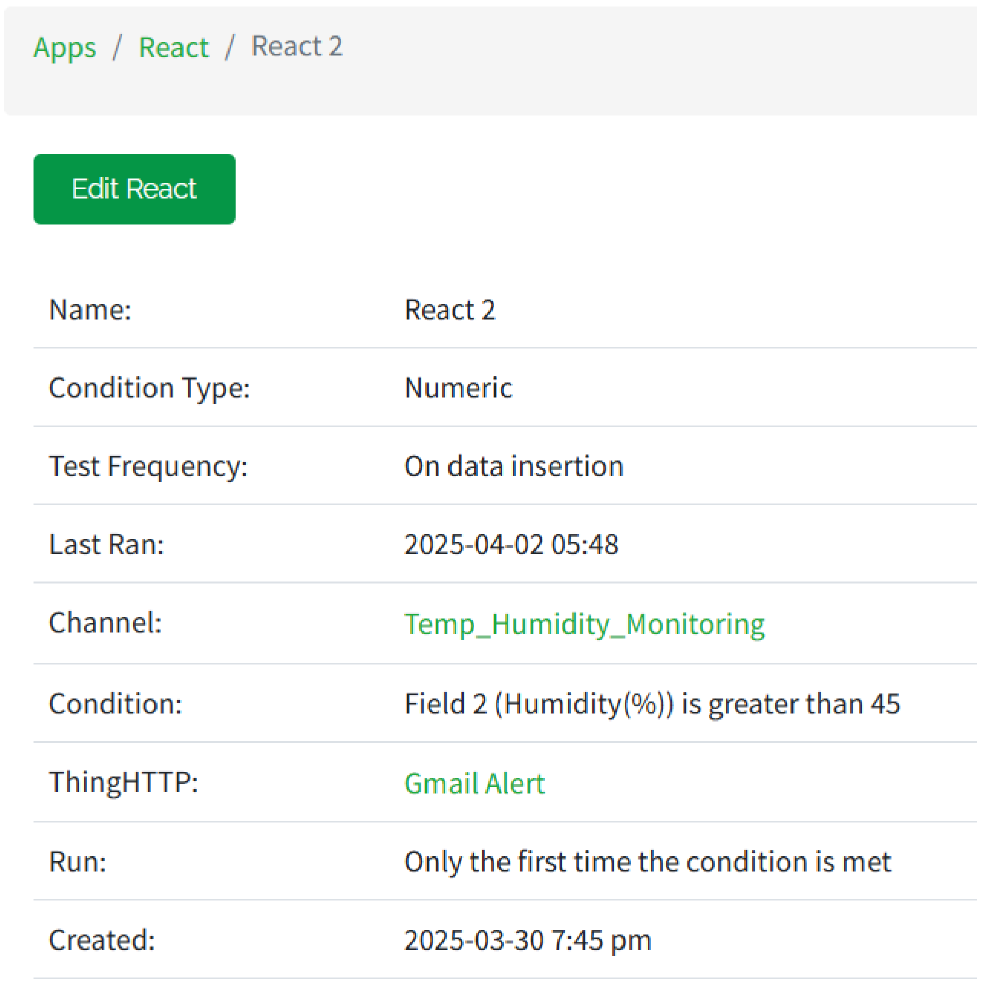
Apps / React

Name	Created	Last Ran
✓ React 1	2025-03-30	2025-04-02 5:48 am
✓ React 2	2025-03-30	2025-04-02 5:48 am



Apps / React / React 1

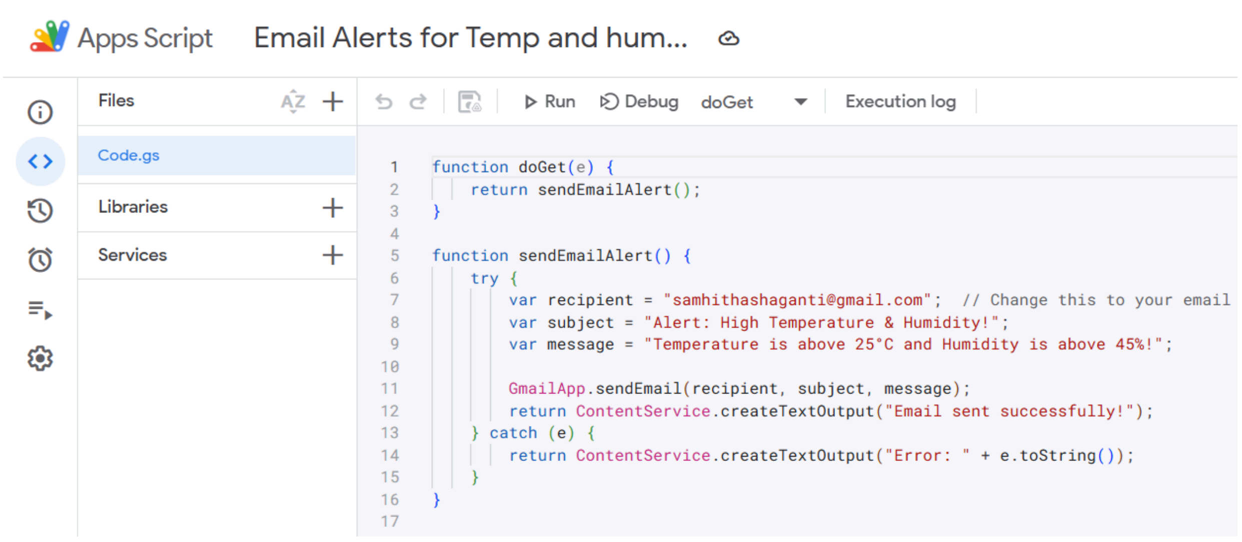
Name:	React 1
Condition Type:	Numeric
Test Frequency:	On data insertion
Last Ran:	2025-04-02 05:48
Channel:	Temp_Humidity_Monitoring
Condition:	Field 1 (Tempurature(°C)) is greater than 25
ThingHTTP:	Gmail Alert
Run:	Only the first time the condition is met
Created:	2025-03-30 7:20 pm


Apps / React / React 2

Edit React

Name:	React 2
Condition Type:	Numeric
Test Frequency:	On data insertion
Last Ran:	2025-04-02 05:48
Channel:	Temp_Humidity_Monitoring
Condition:	Field 2 (Humidity(%)) is greater than 45
ThingHTTP:	Gmail Alert
Run:	Only the first time the condition is met
Created:	2025-03-30 7:45 pm

Project code in Google Apps Script :



```
function doGet(e) {
  return sendEmailAlert();
}

function sendEmailAlert() {
  try {
    var recipient = "samhithashaganti@gmail.com";  // Change this to your email
    var subject = "Alert: High Temperature & Humidity!";
    var message = "Temperature is above 25°C and Humidity is above 45%!";

    GmailApp.sendEmail(recipient, subject, message);
    return ContentService.createTextOutput("Email sent successfully!");
  } catch (e) {
    return ContentService.createTextOutput("Error: " + e.toString());
  }
}
```

3. Code & Simulation Files(Uploaded on GClassroom)

Source Code:
The following C++ code collects temperature and humidity data, sends it to ThingSpeak, and triggers alerts when thresholds are exceeded

****

```
#include <WiFi.h>

#include "DHT.h"

#include "ThingSpeak.h"

#define DHTPIN 4

#define DHTTYPE DHT22

DHT dht(DHTPIN, DHTTYPE);

#define GREEN_LED 5

#define RED_LED 18

#define BUZZER 19

#define TEMP_THRESHOLD 25.0

#define HUM_THRESHOLD 45.0

const char* WIFI_NAME = "Wokwi-GUEST";

const char* WIFI_PASSWORD = "";

const int channelNumber = 2898709;

const char* myApiKey = "3J5Z4E94VE6YQO2U";

const char* server = "api.thingspeak.com";

WiFiClient client;

void connectWiFi() {

   Serial.print("Connecting to WiFi: ");
```

```
    Serial.println(WIFI_NAME);
    WiFi.mode(WIFI_STA);
    WiFi.begin(WIFI_NAME, WIFI_PASSWORD);
     int attempt = 0;
    while (WiFi.status() != WL_CONNECTED && attempt < 20) {
        delay(1000);
        Serial.print(".");
        attempt++;
    }    if (WiFi.status() == WL_CONNECTED) {
        Serial.println("\nWiFi Connected!");
        Serial.print("Local IP: ");
        Serial.println(WiFi.localIP());
    } else {
        Serial.println("\nWiFi Connection Failed! Restarting...");
        ESP.restart();
    }
}void setup() {
    Serial.begin(115200);
    dht.begin();
    pinMode(GREEN_LED, OUTPUT);
    pinMode(RED_LED, OUTPUT);
    pinMode(BUZZER, OUTPUT);
    connectWiFi();
```

```
  ThingSpeak.begin(client);

  digitalWrite(GREEN_LED, HIGH);

  digitalWrite(RED_LED, LOW);

  digitalWrite(BUZZER, LOW);

}

void loop() {

  float temp = dht.readTemperature();

  float hum = dht.readHumidity();

    if (isnan(temp) || isnan(hum)) {

    Serial.println("Failed to read from DHT sensor!");

    return;

  }   Serial.print("Temperature: ");

  Serial.print(temp);

  Serial.print(" °C  |  Humidity: ");

  Serial.print(hum);

  Serial.println(" %");

  if (temp > TEMP_THRESHOLD || hum > HUM_THRESHOLD) {

    digitalWrite(GREEN_LED, LOW);

    digitalWrite(RED_LED, HIGH);

    Serial.println("ALERT! High Temperature or Humidity!");

    for (int i = 0; i < 5; i++) {

      digitalWrite(BUZZER, HIGH);

      delay(200);
```

```
          digitalWrite(BUZZER, LOW);
          delay(200);
        }
    } else {
        digitalWrite(GREEN_LED, HIGH);
        digitalWrite(RED_LED, LOW);
        digitalWrite(BUZZER, LOW);
    }    ThingSpeak.setField(1, temp);
    ThingSpeak.setField(2, hum);
    int check = ThingSpeak.writeFields(channelNumber, myApiKey);
        if (check == 200) {
        Serial.println("Data pushed successfully");
    } else {
        Serial.println("Push error: " + String(check));
    }
      delay(2000);
}
```

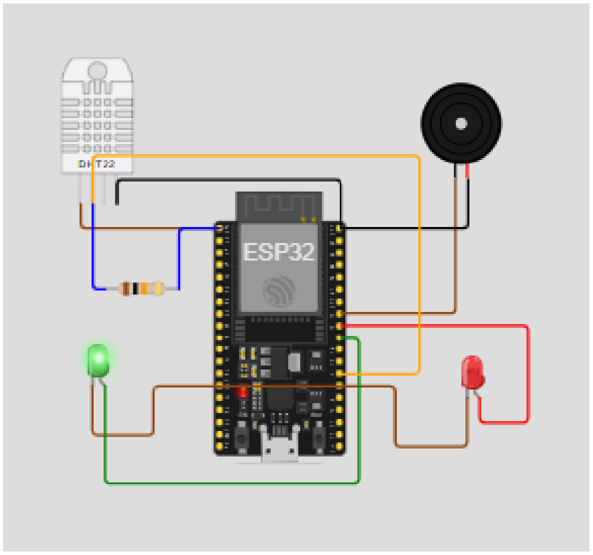
****

---

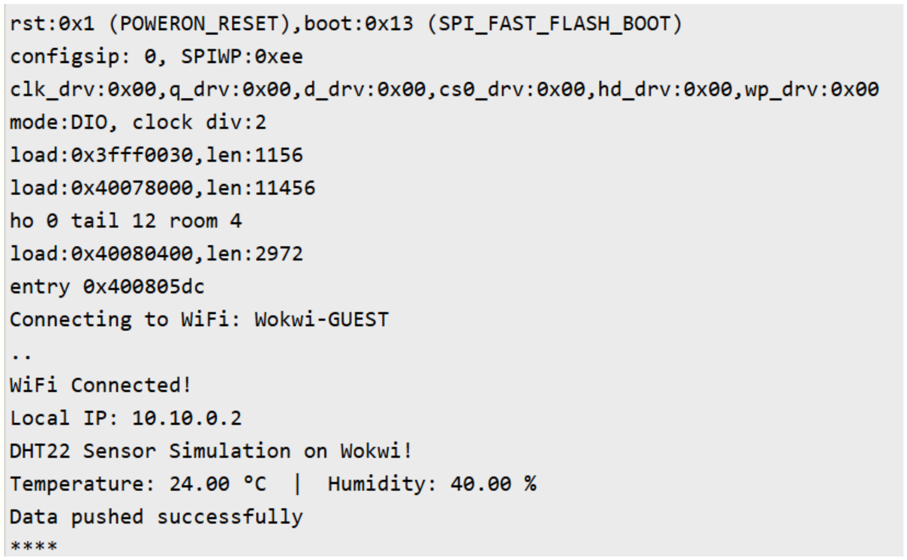
4. Results & Testing

<u>Simulator Results:</u>

Case 1: When the Temperature and Humidity levels<= Threshold



Green LED ‘**ON**’, Red LED ‘**OFF**’ ,Buzzer ‘**OFF**’

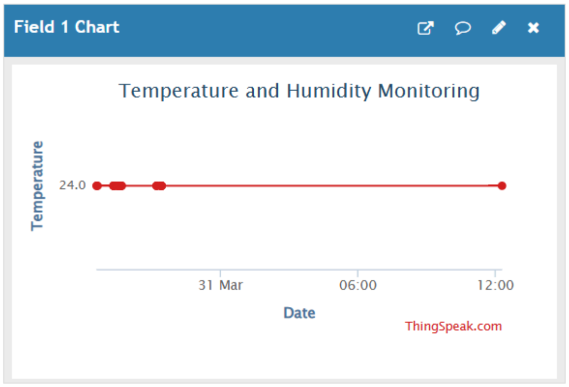


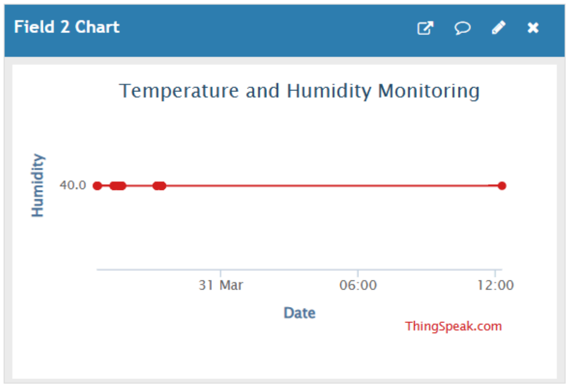
```
rst:0x1 (POWERON_RESET),boot:0x13 (SPI_FAST_FLASH_BOOT)
configsip: 0, SPIWP:0xee
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_drv:0x00
mode:DIO, clock div:2
load:0x3fff0030,len:1156
load:0x40078000,len:11456
ho 0 tail 12 room 4
load:0x40080400,len:2972
entry 0x400805dc
Connecting to WiFi: Wokwi-GUEST
..
WiFi Connected!
Local IP: 10.10.0.2
DHT22 Sensor Simulation on Wokwi!
Temperature: 24.00 °C  |  Humidity: 40.00 %
Data pushed successfully
****
```

ThingSpeak Results:

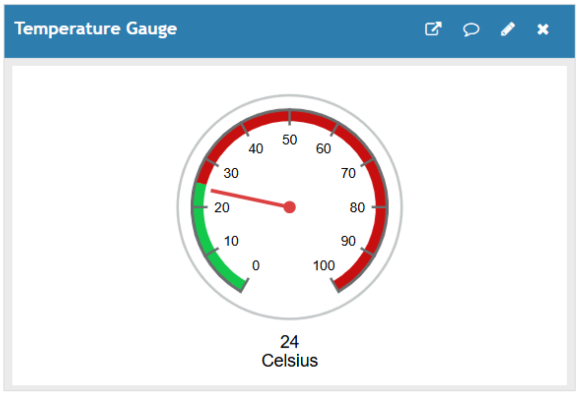
Case 1: When the Temperature and Humidity levels<= Threshold

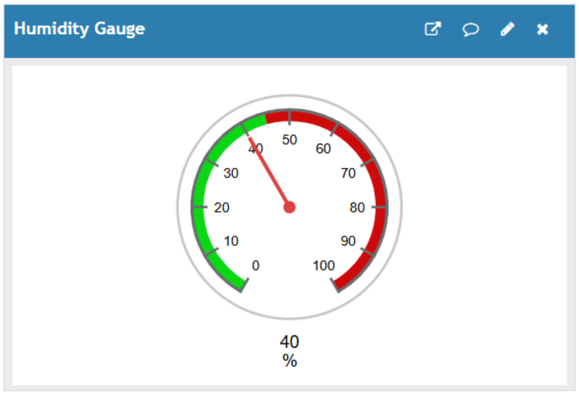
Line Charts



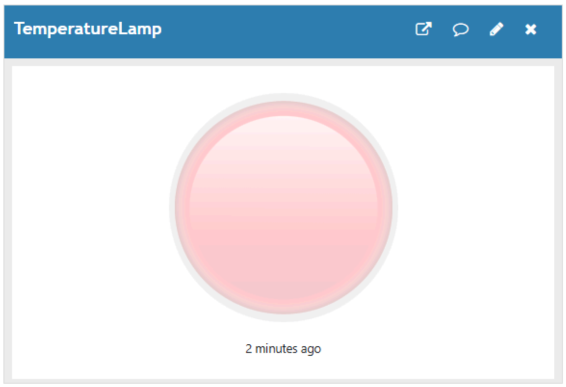


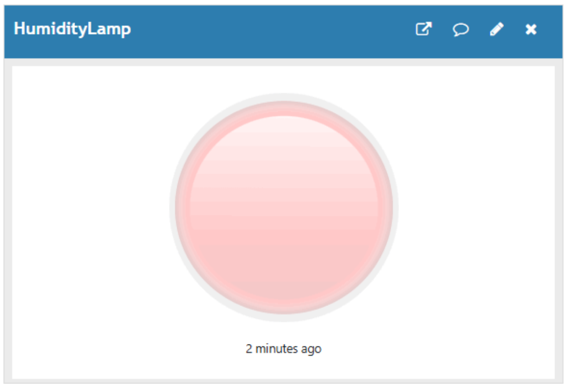
Gauge Readings





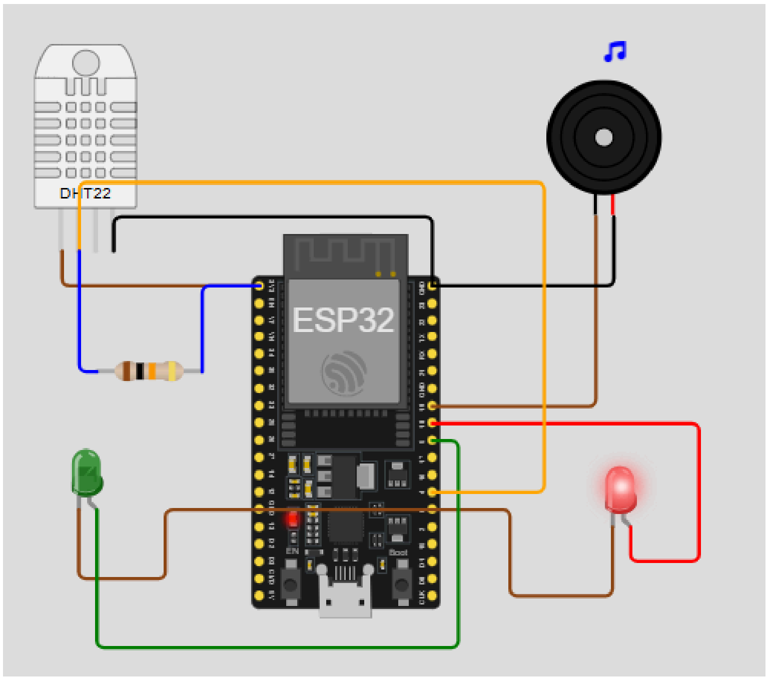
Lamp Readings(OFF here as threshold NOT exceeded)





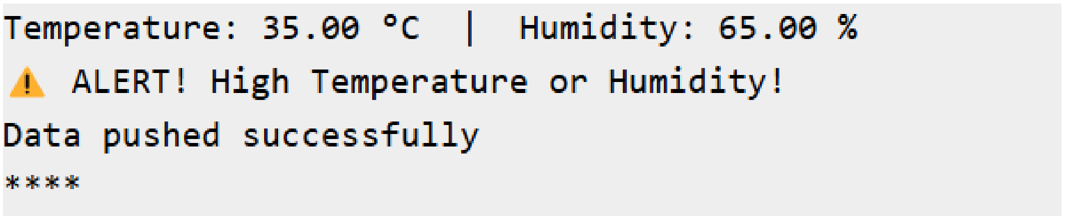
Case 2: When the Temperature and Humidity levels> Threshold

Simulator Results:



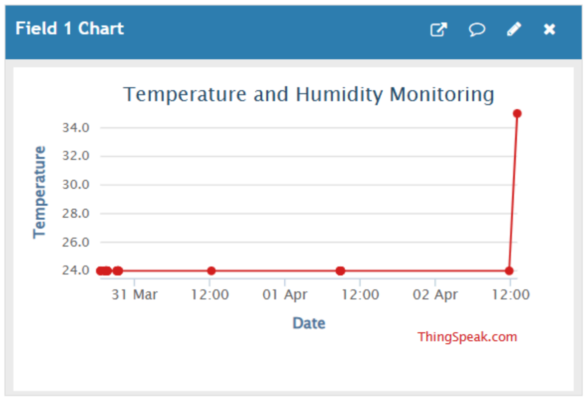
Green LED ‘**OFF**’, Red LED ‘**ON**’ ,Buzzer ‘**ON’**

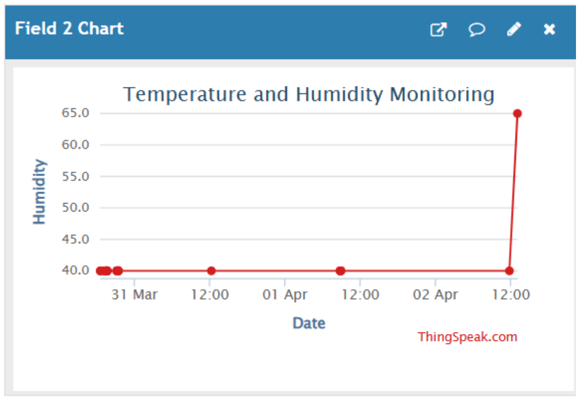
->As Wokwi is a Visual Simulator, we cannot hear the buzzer beeping, but the music notes emerging out of it showcase that it is on.

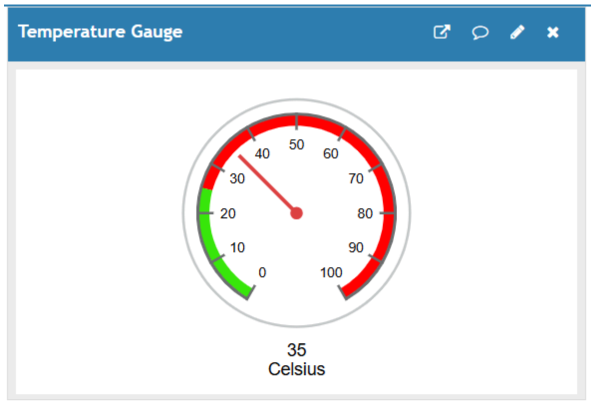


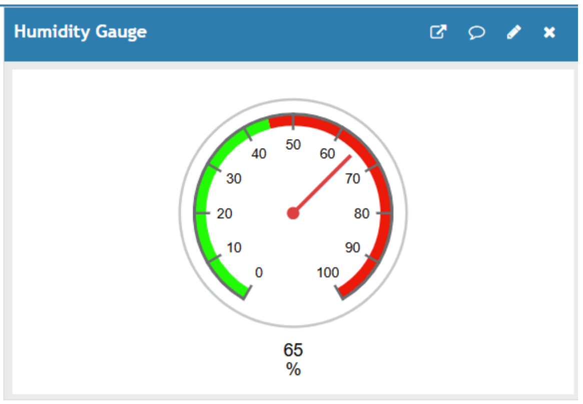
```
Temperature: 35.00 °C  |  Humidity: 65.00 %
⚠️ ALERT! High Temperature or Humidity!
Data pushed successfully
****
```

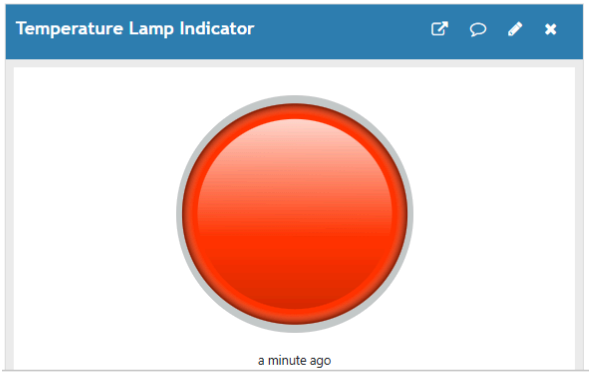
ThingSpeak Results:

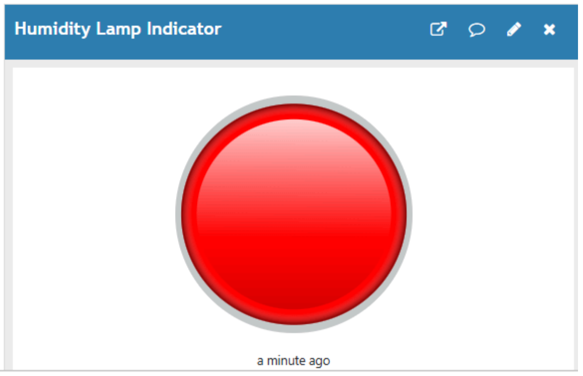






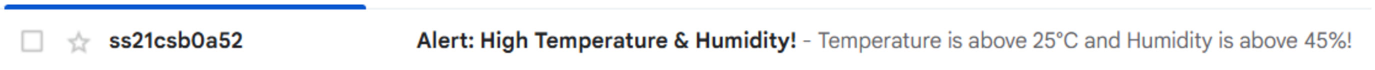




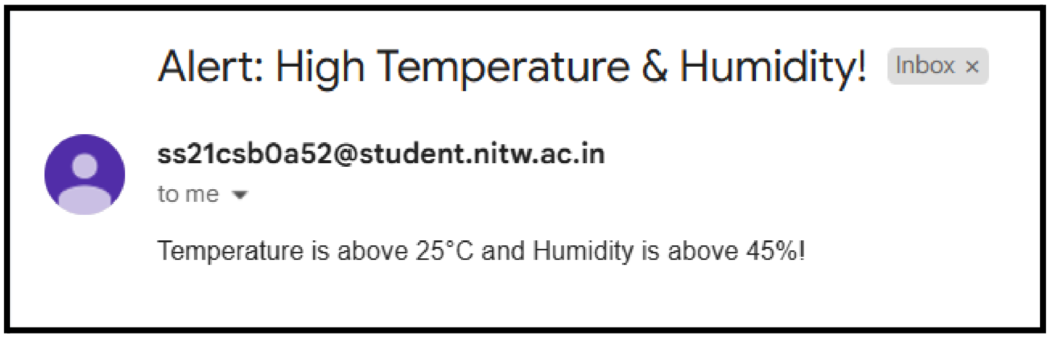


Lamp Readings(ON here as threshold exceeded)

Email Alert Screenshot:



ss21csb0a52 **Alert: High Temperature & Humidity!** - Temperature is above 25°C and Humidity is above 45%!


Alert: High Temperature & Humidity! Inbox ×

ss21csb0a52@student.nitw.ac.in

to me

Temperature is above 25°C and Humidity is above 45%!

5. Conclusion

This IoT-based system provides a simple yet effective solution for monitoring classroom temperature and humidity. It ensures comfort and safety by triggering real-time alerts when thresholds are exceeded. Future enhancements may include:

- Integration with mobile notifications.
- Predictive maintenance using data analytics.
- AI-based temperature control mechanisms.

6. Group Contributions & Peer Review

Samhitha Shaganti(21CSB0A52)

- Worked on Arduino Code(.ino) for exceeding Thresholds .
- Setting up thingHTTP and React apps in ThingSpeak .
- Connected thingHTTP to Google Apps Script for sending email alerts.
- Observing the alerts and respective readings due to exceeding thresholds on ThingSpeak.
- Worked on PPT(Approach and Results)
- Worked on Report(Design and Implementation,Results part)

Savvy Jain (21CSB0F15)

- Connected the components in Wokwi platform.
- Worked on arduino code(.ino)
- Connecting wokwi with thingspeak
- Creating channels on ThingSpeak and observing the graphs and gauge readings and lamp indicators.
- Worked on PPT(Design and Implementation)
- Worked on Report(Design and Implementation,Results part)

Yashsvini Katare (21CSB0A67)

- Part of report and ppt
- Tried code also

7.Resources:

- https://iotdesignpro.com/projects/temperature-humidity-monitoring-over-thingspeak-using-arduino-esp8266
- https://www.youtube.com/watch?v=8JdOLIxw9Yc