

# **Weather Monitoring**

## **Station**

### **Members**

<b>23-NTU-SC-1054</b>	<b>M. Umair</b>
<b>23-NTU-SC-1067</b>	<b>M. Hanzala Zahid</b>
<b>23-NTU-SC-1080</b>	<b>M. Zohaib Warrach</b>

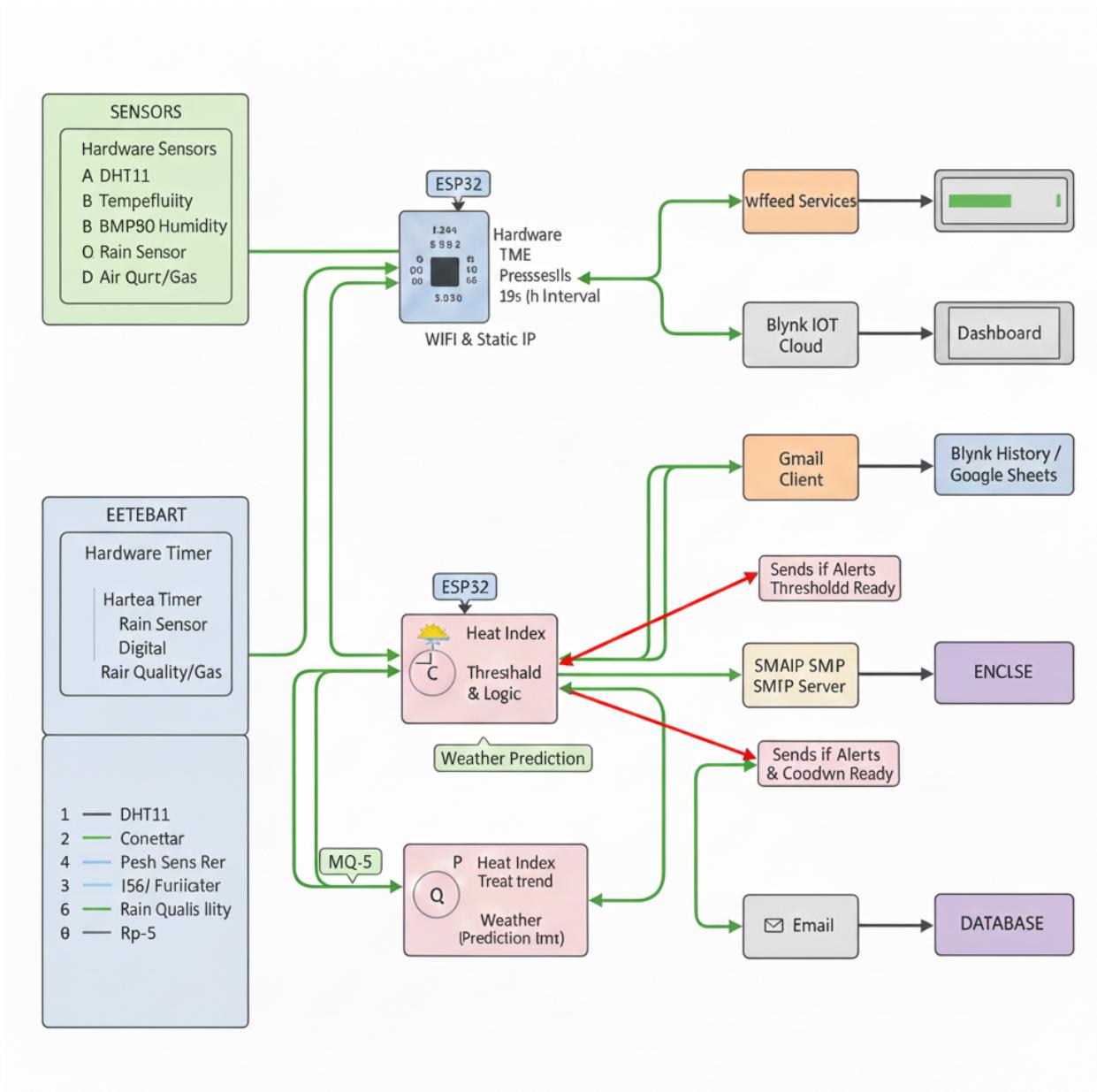
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## 1. Project Overview

The **Smart Weather Monitoring Station** is an ESP32-powered IoT system designed for real-time environmental data acquisition and predictive analysis. It integrates multiple sensors to track air quality, pressure, and precipitation, pushing live data to the **Blynk IoT Cloud** while providing automated emergency alerts via **Gmail SMTP**.

## 2. Flow Diagram:



### 3. Sensor Definitions

- ❖ **DHT11:** This is your primary climate sensor; it tracks how hot it is and how much moisture is in the air.
- ❖ **BMP280:** A precision instrument that measures atmospheric pressure—essential for "feeling" changes in the weather before they actually happen.
- ❖ **MQ-5:** This acts as a safety guard, sniffing the air for combustible gases or smoke to ensure the environment is safe.
- ❖ **Rain Sensor:** A simple but effective pad that detects the very first drop of rain, letting you know the moment the weather turns wet.

### 4. Communication & Cloud Services

#### Blynk IoT Configuration

The system uses the Blynk IoT platform for remote monitoring and data visualization.

- **Template ID/Name:** Used to identify the project on the Blynk server.
- **Auth Token:** The unique key used by the ESP32 to securely connect to your specific Blynk dashboard.
- **Data Mapping:**
  - ❖ **V0 (Double):** For Temperature.
  - ❖ **V1 (Double):** For Humidity.
  - ❖ **V2 (Double):** For Pressure.
  - ❖ **V3 (Integer):** For Rain (0 for dry, 255 for rain).
  - ❖ **V4 (Integer):** For Air Quality %.
  - ❖ **V5 (String):** For the Weather Prediction text.
  - ❖ **V6 (Double):** For the Heat Index ("Feels Like").

## SMTP Service (Gmail)

The **ESP\_Mail\_Client** library facilitates automated email alerts.

- ❖ **SMTP Host:** smtp.gmail.com (Port 465 for SSL).
- ❖ **Authentication:** Uses a **Google App Password**, bypassing standard login requirements for higher security.
- ❖ **Rate Limiting:** A 5-minute cooldown (managed by an ESP32 hardware timer) prevents the system from spamming the recipient during a persistent critical event.

## 5. System Logic & Data Flow

### The Data Pipeline

1. **The Loop:** Every 1 second, a hardware timer triggers the `sendSensorData` function.
2. **Processing:**
  - ❖ **Heat Index:** Calculated using a complex polynomial formula to determine the "Feels Like" temperature.
  - ❖ **Forecasting:** The system compares the current pressure against the value from 10 minutes ago; a sharp drop predicts a storm, while rising pressure indicates clearing skies.
3. **Transmission:**
  - ❖ Data is written to **Blynk Virtual Pins** for real-time mobile/web dashboard updates.
  - ❖ **Alert Verification:** If any sensor crosses a "**Critical Threshold**" (e.g., Temp > 40°C or Rain Detected), the system checks the `canSendEmail` flag.

- ❖ If the flag is **true**, an email is dispatched and the flag is locked for **5 minutes**.

## 6. Network Configuration

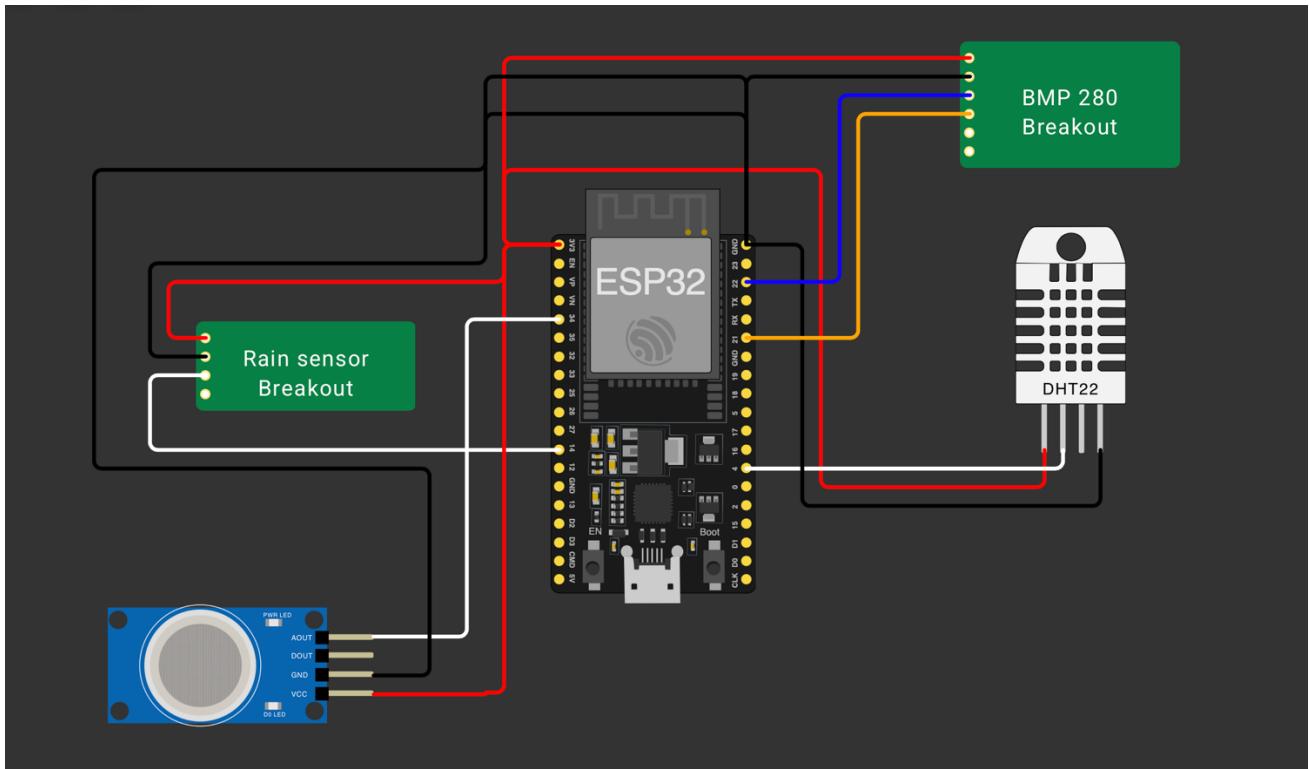
The device uses a **Static IP Configuration** (10.153.74.17). This ensures that the weather station maintains a fixed address within the local network, which is critical for stability and troubleshooting in industrial or home automation environments.

## 7. Pin Diagram:

Components	ESP32 Pin	Signal Type
DHT11	GPIO 4	Digital Input
Rain Sensor	GPIO 14	Digital Input
MQ-5 Gas Sensor	GPIO 34	Analogue Input
BMP280 (SDA)	GPIO 21	I2C Data
BMP280 (SCL)	GPIO 22	I2C Clock
Power (VCC)	VCC 3.3/5	Power
Ground (GND)	GND	Ground

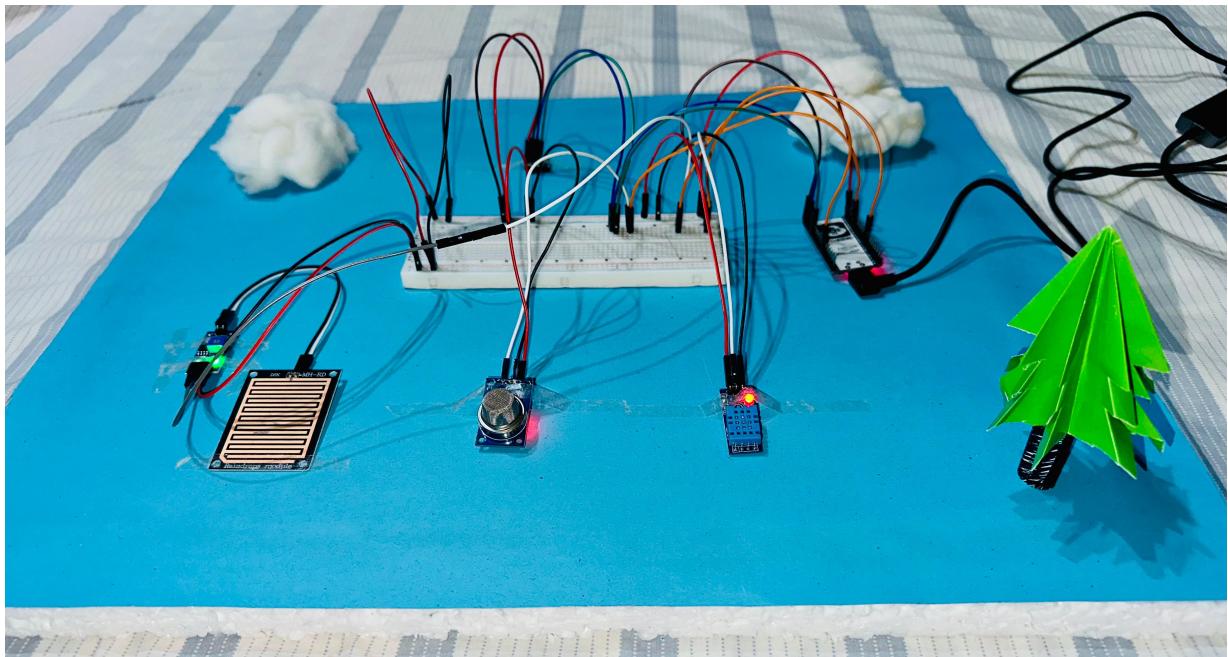
*Pin-Map Diagram*

## 8. Circuit Diagram

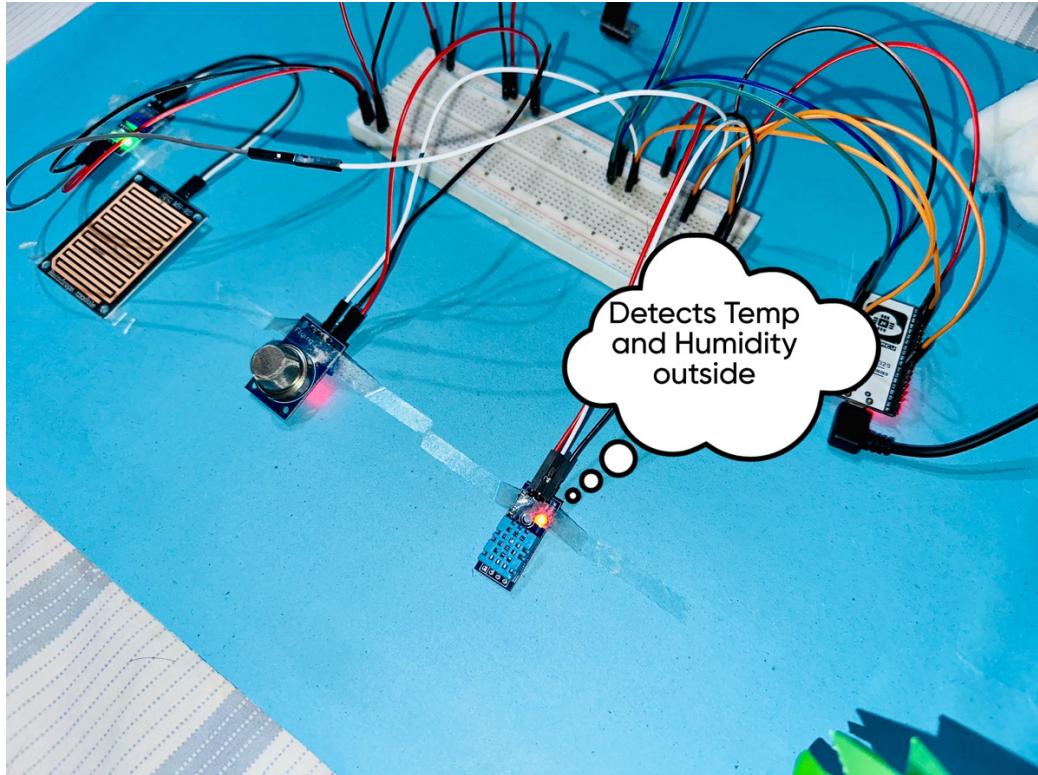


*Circuit Diagram*

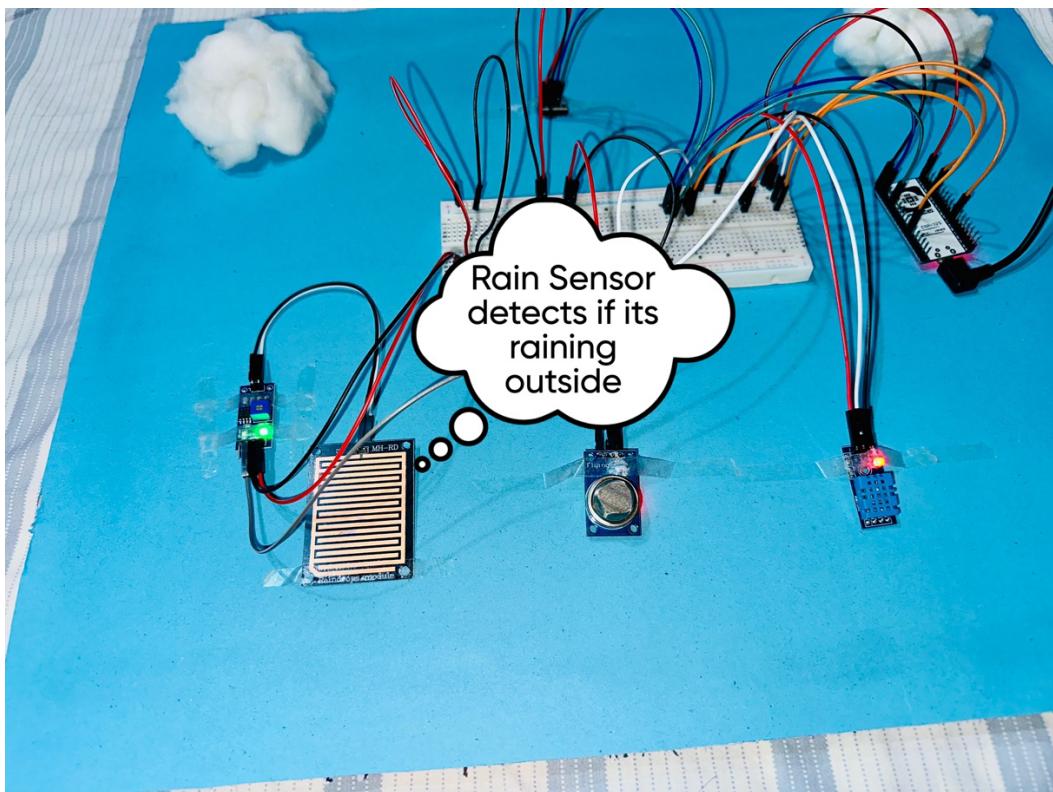
## 9. Screenshots



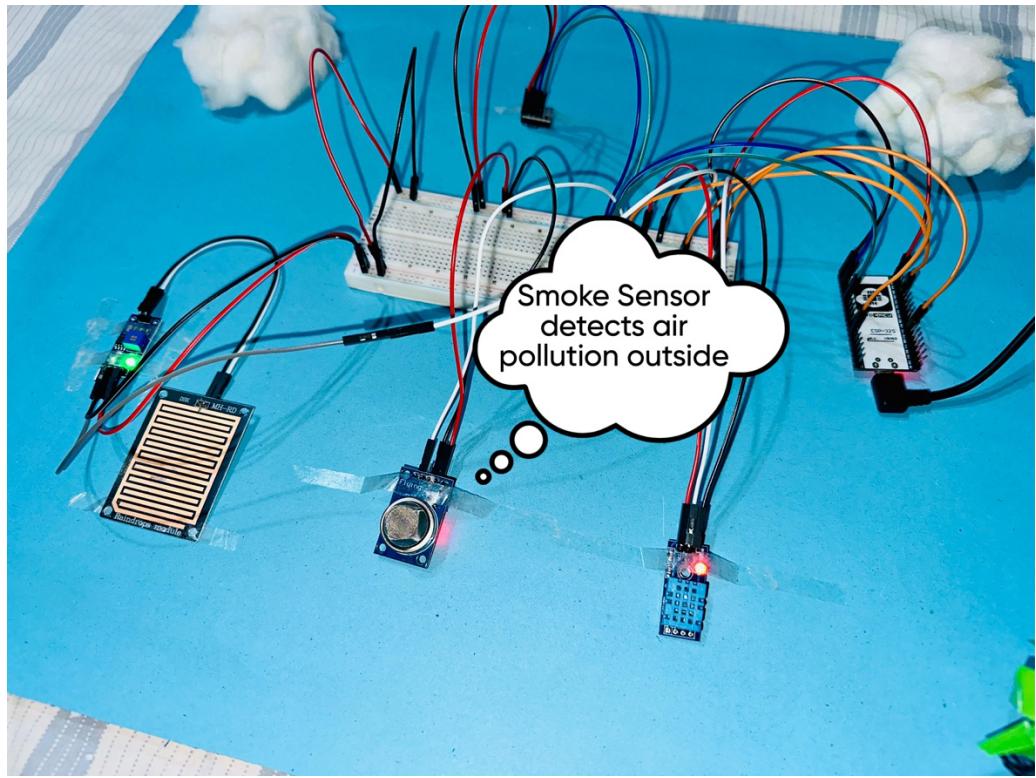
*Project Prototype Image*



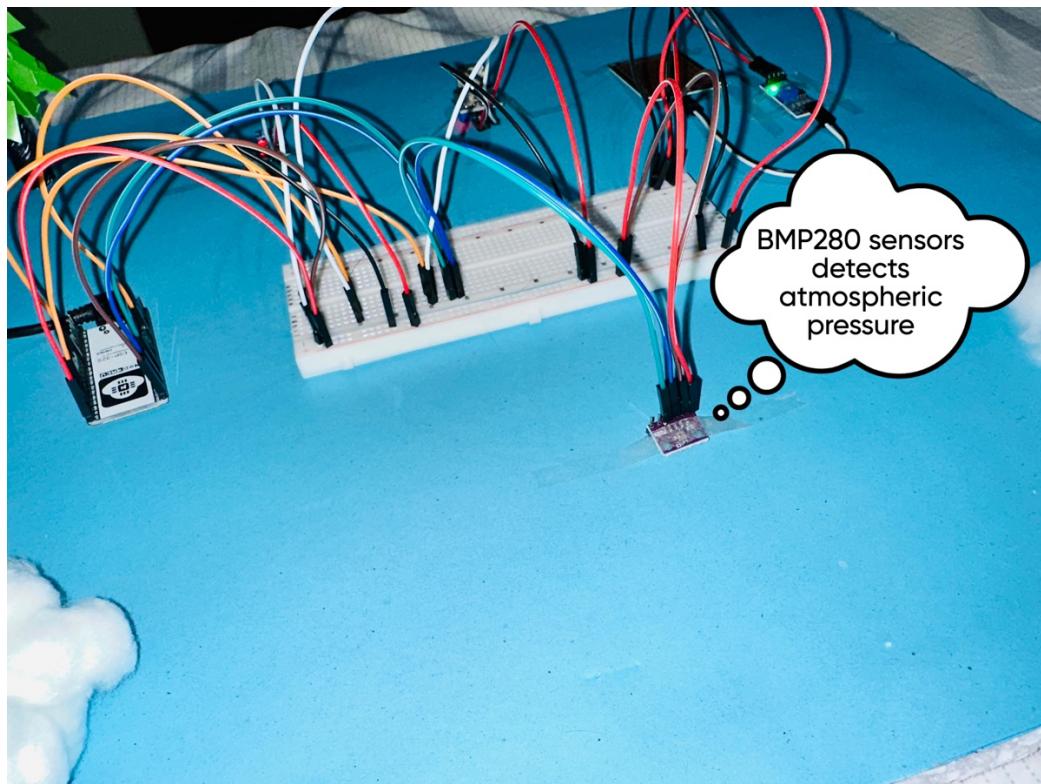
*DHT Sensor detects temperature and humidity*



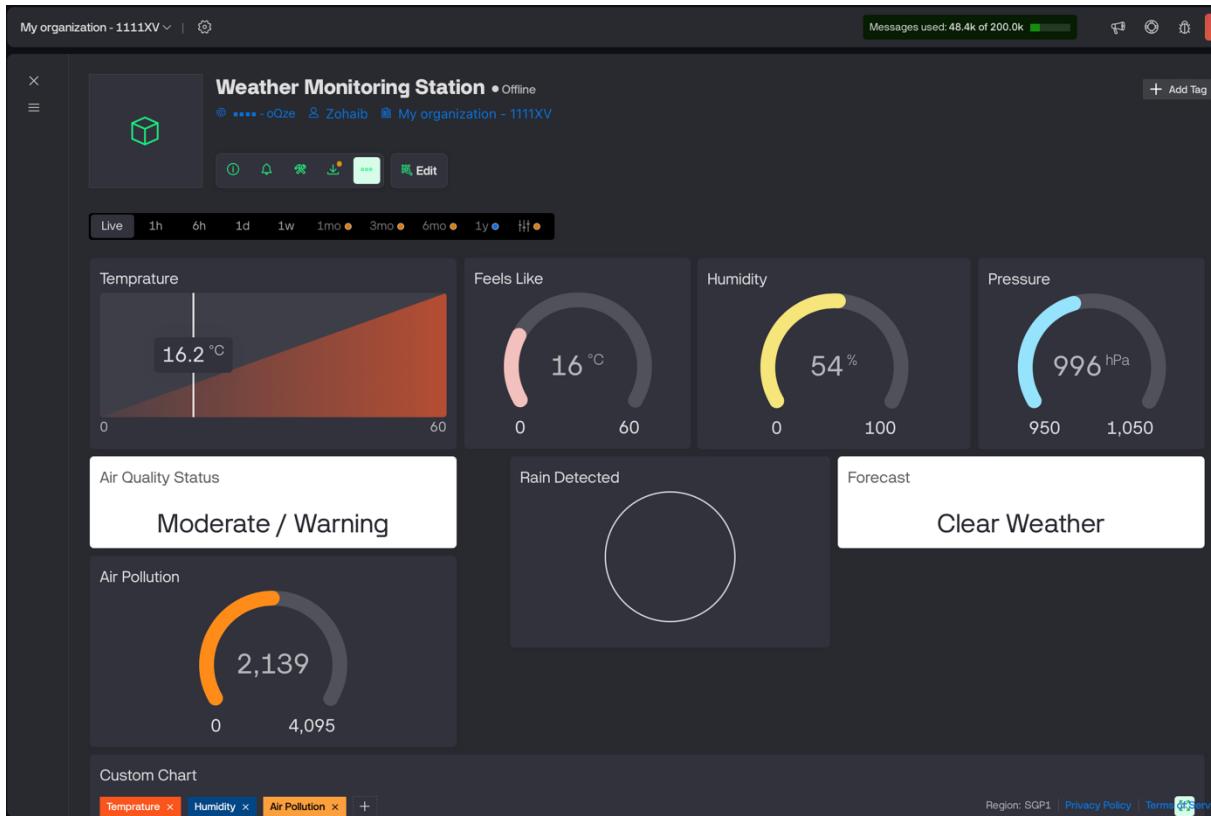
*Rain sensor detects if it's raining outside*



*Smoke sensor detects air pollution outside*



*BMP 280 sensor measure atmospheric pressure*



*Blynk Cloud Dashboard*