AIR QUALITY MONITORING

DATE	22-10-2023
TEAM ID	354
PROJECT NAME	SMART CITY AIR QUALITY NETWORK

PHASE 3: Development Part -1 – Smart City Air Quality Network Project

PROJECT OVERVIEW:

This project aims to establish a comprehensive air quality monitoring system to assess and improve air quality in urban areas.The project will address environmental concerns and promote public health while ensuring compliance with local air quality regulations.

BUILDING A SMART CITY AIR QUALITY MONITORING PROJECT WITH SENSORS:

REAL TIME AIR QUALITY MONOTORING INFORMATION:

1. **Sensors:** Specialized air quality sensors are used to measure various air pollutants. These sensors can detect particulate matter (PM2.5 and PM10), gases like nitrogen dioxide (NO2), sulfur dioxide (SO2), carbon monoxide (CO), ozone (O3), and volatile organic compounds (VOCs).

2. **Data Collection:** Data from these sensors are collected continuously and transmitted to a central database or server. This allows for real-time analysis and reporting.

3. **Mapping:** The data is often mapped in real-time, providing a visual representation of air quality. This can be displayed on websites or mobile apps

4. **Pollutant Levels:** The data typically includes pollutant levels, which are often categorized as good, moderate, unhealthy for sensitive groups, unhealthy, very unhealthy, or hazardous, making it easy for the public to understand.

5. **Health Information:** Real-time air quality monitoring often provides information on the potential health effects of the current air quality, especially for vulnerable populations.

6. **Forecasting:** Some systems include forecasting models that predict air quality for the coming hours or days, helping people plan outdoor activities.

7. **Regulatory Compliance:** Data from these monitoring systems can be used to ensure compliance with air quality regulations and guidelines.

8. **Public Access:** Many monitoring networks make the data accessible to the public through websites, apps, or public displays, allowing individuals to make informed decisions about outdoor activities and health.

9. **Emergency Response:** Real-time monitoring is crucial during environmental emergencies, such as wildfires or industrial accidents, as it provides information for immediate response and public safety.

10. **Environmental Research:** The data collected is also valuable for scientific research, helping to better understand air quality patterns and trends.

BENEFITS:

Implementing IoT for Air Quality monitoring offers several benefits:

- ➢ **Public Health Protection:** It provides real-time information about air quality, helping individuals and communities take precautions and adjust their activities to reduce exposure to harmful pollutants, especially for vulnerable populations.

- ➢ **Environmental Awareness:** Monitoring fosters awareness about air pollution issues, encouraging people to advocate for cleaner air and environmentally responsible policies.

- ➢ **Timely Warnings:** It offers timely warnings during pollution events, such as wildfires or industrial accidents, allowing for swift evacuation or protective measures to be taken.

- ➢ **Economic Benefits:** Improved air quality leads to lower healthcare costs and increased worker productivity, benefiting the economy.

- ➢ **Efficient Resource Allocation:** Governments can allocate resources more efficiently by focusing on areas with the worst air quality, prioritizing pollution control measures where they are needed most.

➢ **Improved Quality of Life:** Overall, real-time air quality monitoring contributes to a higher quality of life by reducing exposure to harmful pollutants and promoting cleaner and healthier environments.

PROJECT PLANNING:

Define the scope, objectives, budget, and timeline for the project.

➢ **SCOPE:**

Define the geographical scope of your monitoring (e.g., a specific city, region, or industrial area) and the types of pollutants or air quality parameters you intend to measure.

➢ **OBJECTIVE:**

Clearly define the goals and objectives of your air quality monitoring project. What specific air quality parameters are you monitoring, and what are you trying to achieve with the data collected?

➢ **BUDGET:**

Develop a detailed budget that covers sensor acquisition, installation, maintenance, personnel costs, and other project expenses. Seek funding sources as necessary.

➢ **TIMELINE:**

Create a project timeline that outlines the key milestones and deadlines, including sensor deployment, data collection, and reporting.

PROJECT COMPONENTS:

1. Air Quality Sensors:

Various sensors are required to measure different air quality parameters. Common sensors include:

  - Particulate Matter (PM) Sensors (e.g., PM2.5 and PM10)

  - Gas Sensors (e.g., NO2, CO, SO2, O3

  - Temperature and Humidity Sensors

  - Pressure Sensors (for altitude and weather data)

2. Microcontroller or Single-Board Computer:

A microcontroller (e.g., Arduino, ESP8266, or ESP32) or a single-board computer (e.g., Raspberry Pi) is used to interface with the sensors, process the data, and manage communication.

3. Communication Modules: IoT devices require connectivity to transmit data. Depending on your project, you may need:

- Wi-Fi or Ethernet modules for local network connectivity.

- Cellular modules (e.g., 4G/5G) for remote or mobile deployments.

- Bluetooth or Zigbee modules for short-range communication.

4.Power Supply:

IoT devices may be powered by batteries, solar panels, or other sources. Ensure your power supply is reliable and long-lasting.

5.Enclosure:

An enclosure protects the hardware from environmental conditions. It should be weatherproof if the device is outdoors.

6. Data Storage

A storage component (e.g., microSD card or external memory) may be necessary to store collected data before transmission.

7. Antennas:

Antennas are needed for wireless communication, and the type of antenna depends on the communication module used.

8. Display :

An optional LCD or LED display can show real-time data to local users or passersby.

9. GPS Module:

If you want to track the location of your IoT devices, a GPS module can be added.

10.Control Unit (Optional):

For advanced systems, a control unit, such as a microcontroller, can automate tasks like sensor calibration and maintenance alert

C PROGRAM SCRIPT DEVELOPMENT :

- Develop a C program script that will run on the IoT for Air Quality Monitoring.
- This script should be responsible for the following tasks:
- Capturing audio data from the device's sensors.
- Formatting the collected data for transmission to the IoT platform.
- Managing secure device communication with the IoT platform.
- Implementing security measures, such as data encryption and device
- authentication.
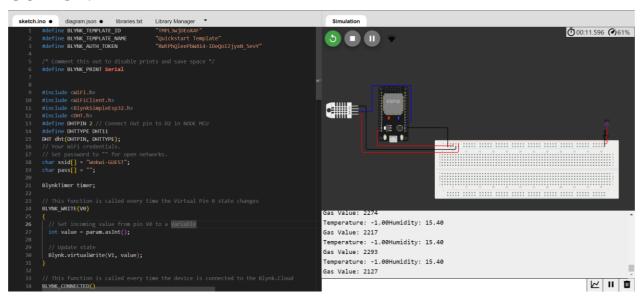
C PROGRAMMING:

```
#define BLYNK_TEMPLATE_ID        "TMPL3wjDEoX4F"
#define BLYNK_TEMPLATE_NAME       "Quickstart Template"
#define BLYNK_AUTH_TOKEN         "RWtPhQleePbW414-
IDeQoIZjyxN_5evY"
```

```
/* Comment this out to disable prints and save space */
#define BLYNK_PRINT Serial
```

```
#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>
#include <DHT.h>
#define DHTPIN 2 // Connect Out pin to D2 in NODE MCU
#define DHTTYPE DHT11
DHT dht(DHTPIN, DHTTYPE);
// Your WiFi credentials.
// Set password to "" for open networks.
char ssid[] = "Wokwi-GUEST";
char pass[] = "";
```

```
BlynkTimer timer;
```

```
// This function is called every time the Virtual Pin 0 state changes
```

```
BLYNK_WRITE(V0)
{
  // Set incoming value from pin V0 to a variable
  int value = param.asInt();

  // Update state
  Blynk.virtualWrite(V1, value);
}

// This function is called every time the device is connected to the Blynk.Cloud
BLYNK_CONNECTED()
{
  // Change Web Link Button message to "Congratulations!"
  Blynk.setProperty(V3, "offImageUrl", "https://static-
image.nyc3.cdn.digitaloceanspaces.com/general/fte/congratulations.png");
  Blynk.setProperty(V3, "onImageUrl",  "https://static-
image.nyc3.cdn.digitaloceanspaces.com/general/fte/congratulations_pressed.png");
  Blynk.setProperty(V3, "url", "https://docs.blynk.io/en/getting-started/what-do-i-
need-to-blynk/how-quickstart-device-was-made");
}

// This function sends Arduino's uptime every second to Virtual Pin 2.
void myTimerEvent()
{
  // You can send any value at any time.
  // Please don't send more that 10 values per second.
  Blynk.virtualWrite(V2, millis() / 1000);
}

void setup()
{
  // Debug console
  Serial.begin(115200);

  Blynk.begin(BLYNK_AUTH_TOKEN, ssid, pass);
  // You can also specify server:
```

```cpp
  //Blynk.begin(BLYNK_AUTH_TOKEN, ssid, pass, "blynk.cloud", 80);
  //Blynk.begin(BLYNK_AUTH_TOKEN, ssid, pass, IPAddress(192,168,1,100),
8080);

  // Setup a function to be called every second
  timer.setInterval(1000L, myTimerEvent);
}
int gas = 32;
int sensorThreshold = 100;
void loop()
{
  Blynk.run();
  timer.run();
  // You can inject your own code or combine it with other sketches.
  // Check other examples on how to communicate with Blynk. Remember
  // to avoid delay() function!
  float h = dht.readHumidity();
  float t = dht.readTemperature();

  if (isnan(h) || isnan(t)) {
    Serial.println("Failed to read from DHT sensor!");
    return;
  }

  int gasValue = analogRead(gas);
  Blynk.virtualWrite(V2, gasValue);  // Send gas value to Blynk
  Serial.print("Gas Value: ");
  Serial.println(gasValue);

  Blynk.virtualWrite(V0, t);
  Blynk.virtualWrite(V1, h);
  Serial.print("Temperature: ");
  Serial.print(t);
  Serial.print("Humidity: ");
  Serial.println(h);
}
```

OUTPUT:

4. Conclusion:

The Smart City Air Quality Network (SCAN) represents a visionary and essential initiative for our urbanized world. With the relentless growth of cities and the ever-increasing impact of pollution on public health and the environment, SCAN emerges as a beacon of hope and innovation. By leveraging advanced sensor technology, real-time monitoring, and data-driven insights, SCAN empowers cities to understand, address, and improve air quality comprehensively. This network's significance extends far beyond simply measuring pollutants; it embodies a commitment to public health, environmental preservation, and sustainable urban development.