IoT-Based Air Quality Monitoring System

1. Abstract

Air pollution is a major environmental concern affecting human health and ecosystems. This project presents an **IoT-based Air Quality Monitoring System** that measures air pollution levels in real time using gas and environmental sensors. The collected data is transmitted over Wi-Fi to a cloud platform, allowing users to monitor air quality remotely through graphs and dashboards.

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2. Objectives

- To monitor air quality in real time
- To measure harmful gases, temperature, and humidity
- To upload sensor data to the cloud
- To provide remote monitoring and analysis
- To create a low-cost and scalable IoT solution

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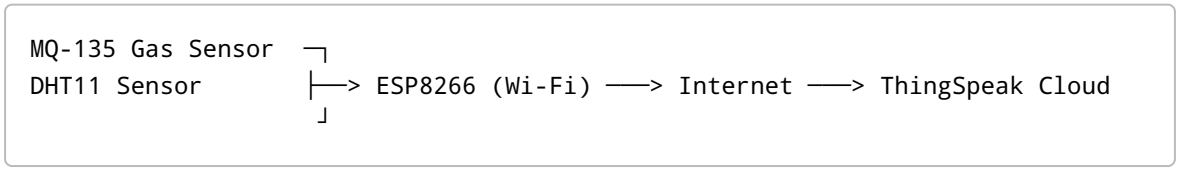
3. System Architecture

Block Diagram (Text Representation)



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4. Hardware Requirements

Component	Description
ESP8266 NodeMCU	Wi-Fi enabled microcontroller
MQ-135 Gas Sensor	Detects CO2, NH3, smoke, pollution
DHT11 Sensor	Temperature & Humidity
Breadboard	Circuit assembly
Jumper Wires	Connections
USB Cable	Power & programming

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5. Software Requirements

- Arduino IDE
- ESP8266 Board Package
- DHT Sensor Library
- ThingSpeak Cloud Platform
- Embedded C (Arduino)

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6. Circuit Connections

MQ-135 Gas Sensor

- VCC → 3.3V
- GND → GND
- AO → A0 (ESP8266)

DHT11 Sensor

- VCC → 3.3V
- GND → GND
- DATA → D4 (GPIO2)

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7. Working Principle

1. MQ-135 sensor detects air pollutants and outputs analog values.
2. DHT11 sensor measures temperature and humidity.
3. ESP8266 reads sensor values and processes them.
4. Data is sent to the ThingSpeak cloud using Wi-Fi.
5. Cloud dashboard displays real-time graphs.

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8. Algorithm

1. Start system
2. Initialize Wi-Fi connection
3. Read gas sensor value
4. Read temperature & humidity
5. Upload data to cloud
6. Repeat process every 15 seconds

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9. Arduino Code (ESP8266 + MQ-135 + DHT11 + ThingSpeak)

```
#include <ESP8266WiFi.h>
#include "DHT.h"
```

```
#define DHTPIN D4
#define DHTTYPE DHT11
#define MQ135 A0

DHT dht(DHTPIN, DHTTYPE);

const char* ssid = "YOUR_WIFI_NAME";
const char* password = "YOUR_WIFI_PASSWORD";

const char* server = "api.thingspeak.com";
String apiKey = "YOUR_THINGSPEAK_API_KEY";

WiFiClient client;

void setup() {
  Serial.begin(9600);
  dht.begin();
  WiFi.begin(ssid, password);

  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("WiFi Connected");
}

void loop() {
  float humidity = dht.readHumidity();
  float temperature = dht.readTemperature();
  int airQuality = analogRead(MQ135);

  if (client.connect(server, 80)) {
    String postStr = apiKey;
    postStr += "&field1=";
    postStr += String(airQuality);
    postStr += "&field2=";
    postStr += String(temperature);
    postStr += "&field3=";
    postStr += String(humidity);
    postStr += "\r\n\r\n";

    client.print("POST /update HTTP/1.1\n");
    client.print("Host: api.thingspeak.com\n");
    client.print("Connection: close\n");
    client.print("X-THINGSPEAKAPIKEY: " + apiKey + "\n");
    client.print("Content-Type: application/x-www-form-urlencoded\n");
    client.print("Content-Length: ");
    client.print(postStr.length());
    client.print("\n\n");
    client.print(postStr);
  }
```

```
  client.stop();
  delay(15000);
}
```

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10. Output

- Real-time air quality graph
- Temperature and humidity visualization
- Data accessible remotely via cloud dashboard

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11. Applications

- Smart cities
- Industrial pollution monitoring
- Indoor air quality monitoring
- Environmental research

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12. Advantages

- Real-time monitoring
- Remote access
- Low-cost implementation
- Easy scalability

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13. Limitations

- MQ-135 provides approximate values
- Requires proper calibration
- Wi-Fi dependency

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14. Future Scope

- GPS-based location tagging
- SMS / Email alerts
- Mobile app integration
- Machine Learning-based pollution prediction

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15. Conclusion

The IoT-based Air Quality Monitoring System successfully monitors environmental conditions in real time and uploads data to the cloud. This project demonstrates the effective use of IoT technology for environmental monitoring and can be extended for smart city applications.