AIR QUALITY INDEX MONITORING

– USING THINGSPEAK

## A MINI-PROJECT REPORT

***Submitted by***

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***in partial fulfillment of the award of the degree of***

# BACHELOR OF ENGINEERING

**IN**

**COMPUTER SCIENCE ENGINEERING**



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**BONAFIDE CERTIFICATE**

Certified that this project **“AIR QUALITY INDEX MONITORING –USING THINGSPEAK”** is the bonafide work of **“RAKESH VS(210701205) , JINESH K(210701508)”** who carried out the project work under my supervision.

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## ABSTRACT

This project presents an IoT-based air quality monitoring system utilizing a NodeMCU microcontroller, DHT11 sensor, MQ135 gas sensor, and ThingSpeak platform. The system continuously measures temperature, humidity, and harmful gas levels in the air, providing real-time data for analysis and monitoring. Integration with ThingSpeak enables remote access to environmental data, while a buzzer provides immediate alerts for unsafe gas levels. The project offers a cost-effective and accessible solution for monitoring air quality in various settings, including homes, offices, and industrial environments. Additionally, the system's integration with ThingSpeak facilitates data visualization and trend analysis, empowering users to make informed decisions regarding indoor air quality management. Future enhancements, such as the inclusion of advanced sensors and machine learning algorithms, could further expand the system's capabilities for comprehensive environmental monitoring. By addressing the pressing need for continuous air quality assessment, this project contributes to the promotion of healthier living and sustainable environments.

## ACKNOWLEDGEMENT

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# CHAPTER 1 INTRODUCTION

In an era marked by increasing environmental concerns and the growing importance of health and well-being, the need for effective air quality monitoring systems has become paramount. This project addresses this need through the development of an IoT-based air quality monitoring system utilizing readily available components such as the NodeMCU microcontroller, DHT11 sensor, and MQ135 gas sensor. By harnessing the power of Internet of Things (IoT) technology, this system offers a cost-effective and accessible solution for monitoring key environmental parameters including temperature, humidity, and harmful gas levels in the air.

The integration of the NodeMCU microcontroller with sensors enables real-time data collection and analysis, providing users with valuable insights into their indoor air quality. Furthermore, by leveraging the ThingSpeak platform, this system offers remote access to environmental data, empowering users to monitor air quality levels from anywhere with an internet connection. With the inclusion of a buzzer for immediate alerts, this project not only enhances safety but also promotes proactive measures in response to changes in air quality.

# CHAPTER 2 LITERATURE SURVEY

**1.IoT-Based Air Quality Monitoring System:**

- Existing literature surveys the development and implementation of IoT-based air quality monitoring systems using various microcontrollers, sensors, and platforms. These surveys explore different sensor technologies, data transmission protocols, and cloud-based analytics solutions employed in such systems. They provide insights into the design considerations, challenges, and advancements in real-time air quality monitoring for both indoor and outdoor environments.

**2.Sensor Technologies for Air Quality Monitoring**:

- Literature surveys focusing on sensor technologies for air quality monitoring delve into the characteristics, advantages, and limitations of different sensor types, including gas sensors, particulate matter sensors, and environmental sensors. These surveys evaluate sensor accuracy, sensitivity, response time, and selectivity, helping researchers and practitioners make informed decisions when selecting sensors for their monitoring systems.

**3.Health Impacts of Indoor Air Pollution:** - Literature surveys on the health impacts of indoor air pollution provide a comprehensive overview of the adverse health effects associated with exposure to indoor air pollutants such as volatile organic compounds (VOCs), particulate matter (PM), and carbon monoxide (CO). These surveys highlight the importance of effective air quality monitoring and management strategies in mitigating health risks and promoting indoor air quality improvement initiatives.

# EXISTING SYSTEM

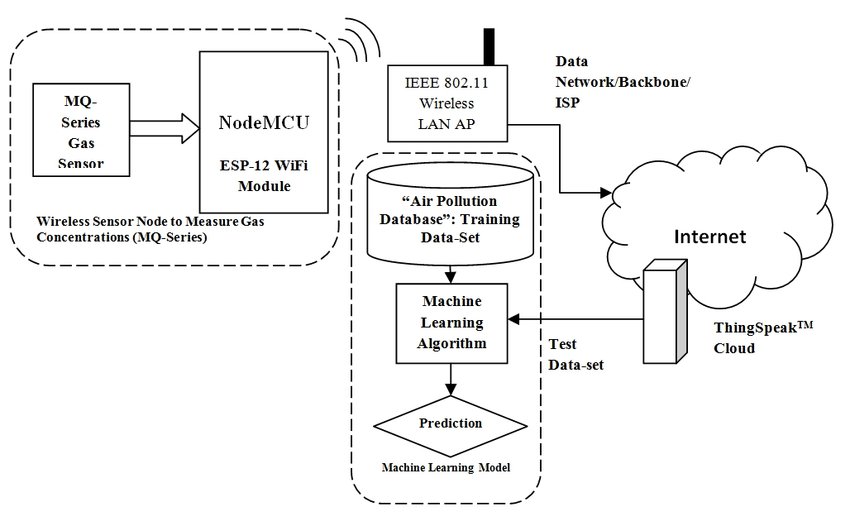
The existing system of the air quality monitoring project typically relies on traditional methods of air quality assessment, which often involve manual sampling and laboratory analysis. In such systems, air quality monitoring is conducted periodically or in specific locations using specialized equipment and trained personnel. Data collection and analysis are time-consuming and labor-intensive processes, limiting the scope and frequency of monitoring. Additionally, real-time data access and remote monitoring capabilities are often lacking, making it challenging to respond promptly to changes in air quality conditions. Overall, the existing system lacks the efficiency, accessibility, and scalability offered by IoT-solutions.

The existing system for air quality monitoring often involves stationary monitoring stations operated by government agencies or environmental organizations. These stations are equipped with sophisticated sensors and instruments capable of measuring various air pollutants, including particulate matter, gases, and volatile organic compounds. Data collected from these stations are typically used for regulatory compliance monitoring, public health assessments, and environmental research studies. However, the coverage provided by these stations is limited, leading to gaps in monitoring data, especially in remote or underserved areas. Furthermore, the data collected may not always be easily accessible to the public, and real-time monitoring capabilities may be lacking.

In addition to government-operated monitoring stations, there are commercially available air quality monitoring devices designed for indoor use. These devices are often portable and can measure parameters such as temperature, humidity, and some common indoor air pollutants. While these devices provide some level of convenience for homeowners and businesses to monitor indoor air quality, they may lack the accuracy and reliability of professional-grade monitoring equipment. Furthermore, the data collected from these devices are typically limited to the immediate vicinity of the device and may not provide a comprehensive picture of indoor air quality throughout a building or home.

Overall, the existing system for air quality monitoring faces challenges related to coverage, accessibility, and accuracy. There is a need for more widespread and affordable monitoring solutions that leverage advanced technologies such as IoT to provide real-time, continuous monitoring of air quality parameters.

# CHAPTER 3 PROJECT DESCRIPTION



## PROPOSED SYSTEM

The proposed system for air quality monitoring leverages Internet of Things (IoT) technology to provide a cost-effective, scalable, and accessible solution for real-time air quality monitoring. By integrating sensors such as the DHT11 for temperature and humidity measurements and the MQ135 for gas detection with a NodeMCU microcontroller, the system enables continuous monitoring of environmental parameters. Data collected from the sensors are transmitted wirelessly to the ThingSpeak platform, where they can be analyzed, visualized, and accessed remotely. Additionally, the inclusion of a buzzer allows for immediate alerts when harmful gas levels exceed predefined thresholds, enhancing safety. The proposed system offers a comprehensive approach to air quality monitoring, suitable for various applications ranging from indoor environments to outdoor settings.

## REQUIREMENTS

### HARDWARE REQUIREMENTS

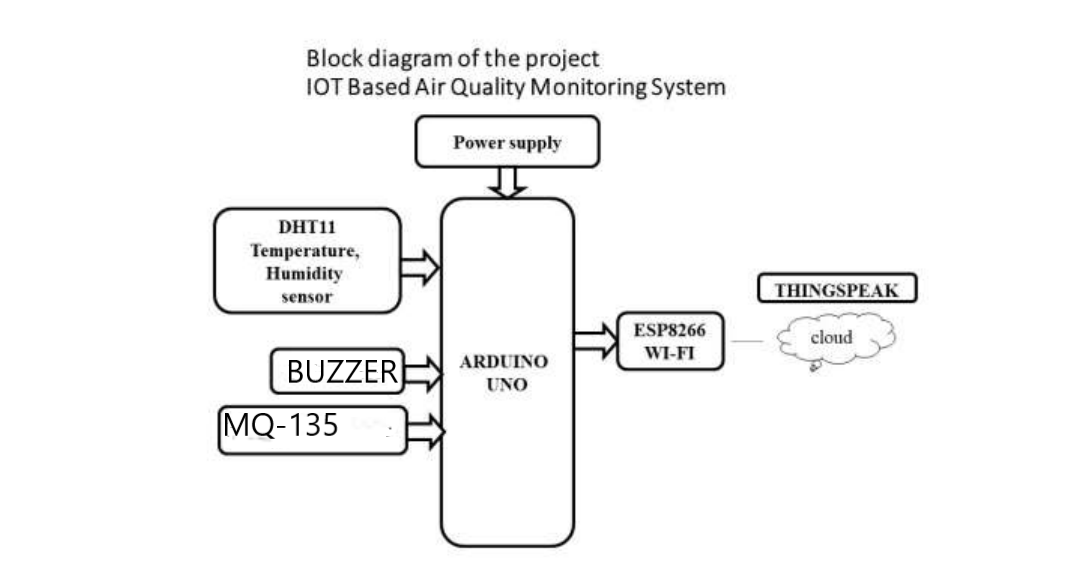
1. ESP32 Development Board
2. Gas Sensor (e.g., MQ-5)
3. Thingspeak-Compatible Device (smartphone or tablet)
4. Wi-Fi Router

### SOFTWARE REQUIREMENTS

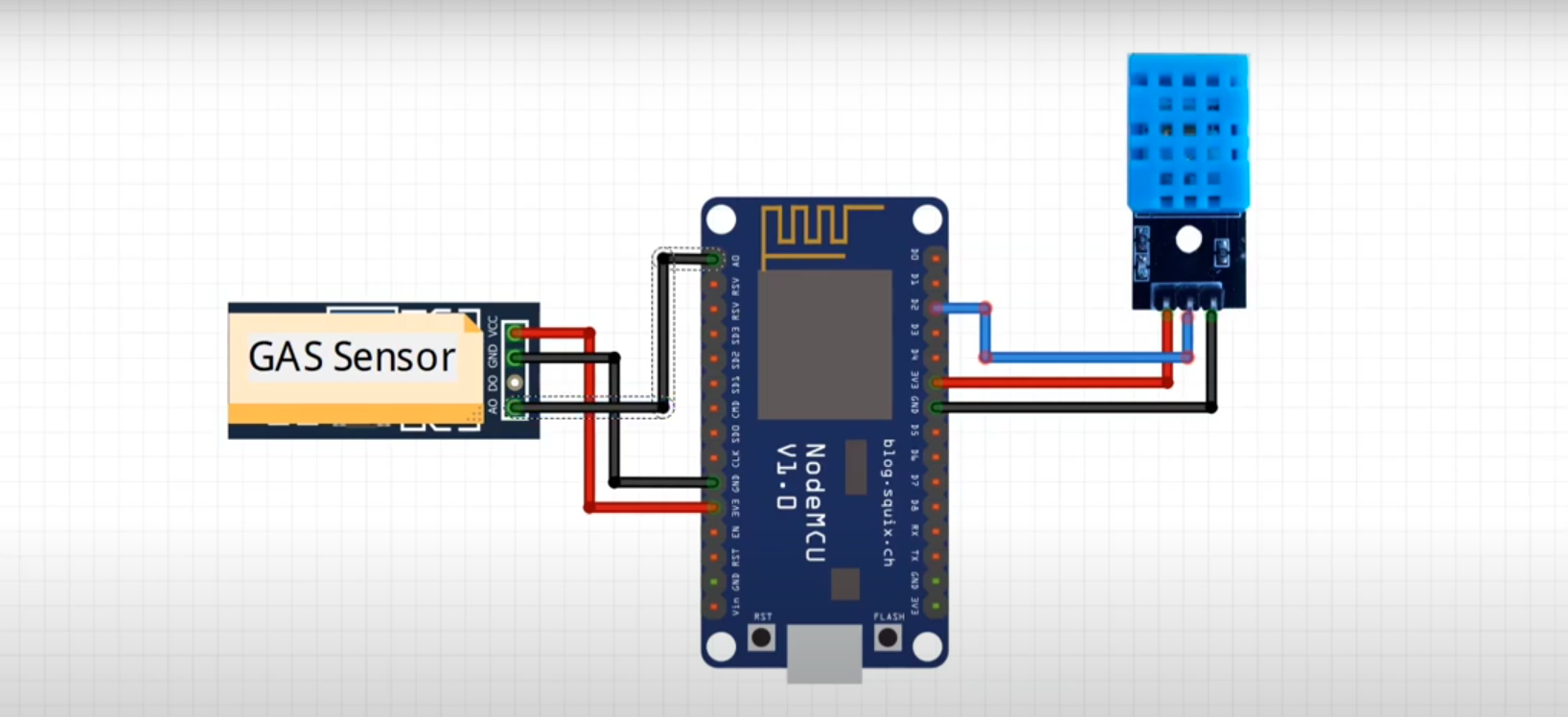
Thingspeak

* + - * Audrino ide

## ARCHITECTURE DIAGRAM

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CONNECTIONS:



**Figure 3**

Figure 3 shows the connections made to the gas sensor, buzzer with the ESP 32 The connections are provided as specified in the architecture.

## OUTPUT

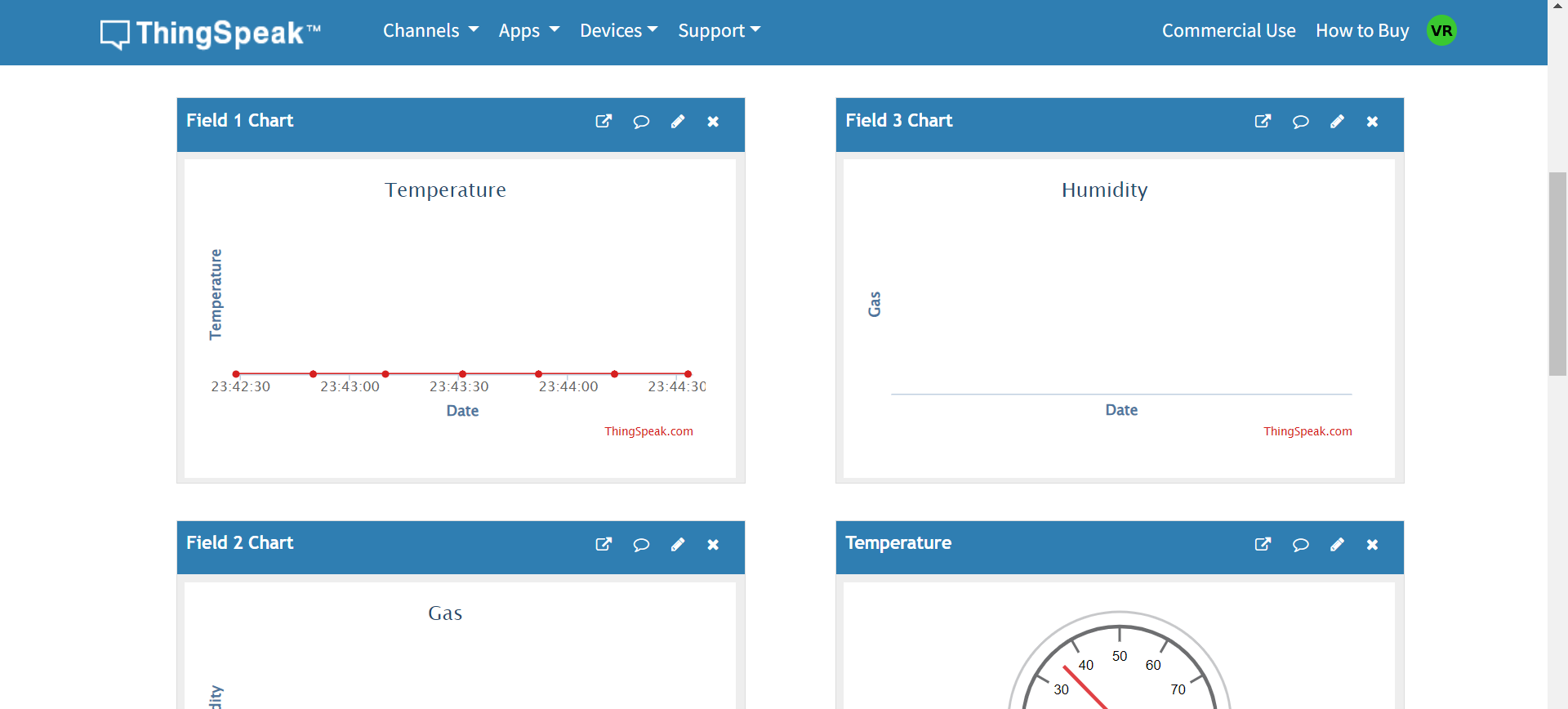


Figure 1. Showing gas level in **thingspeak** console

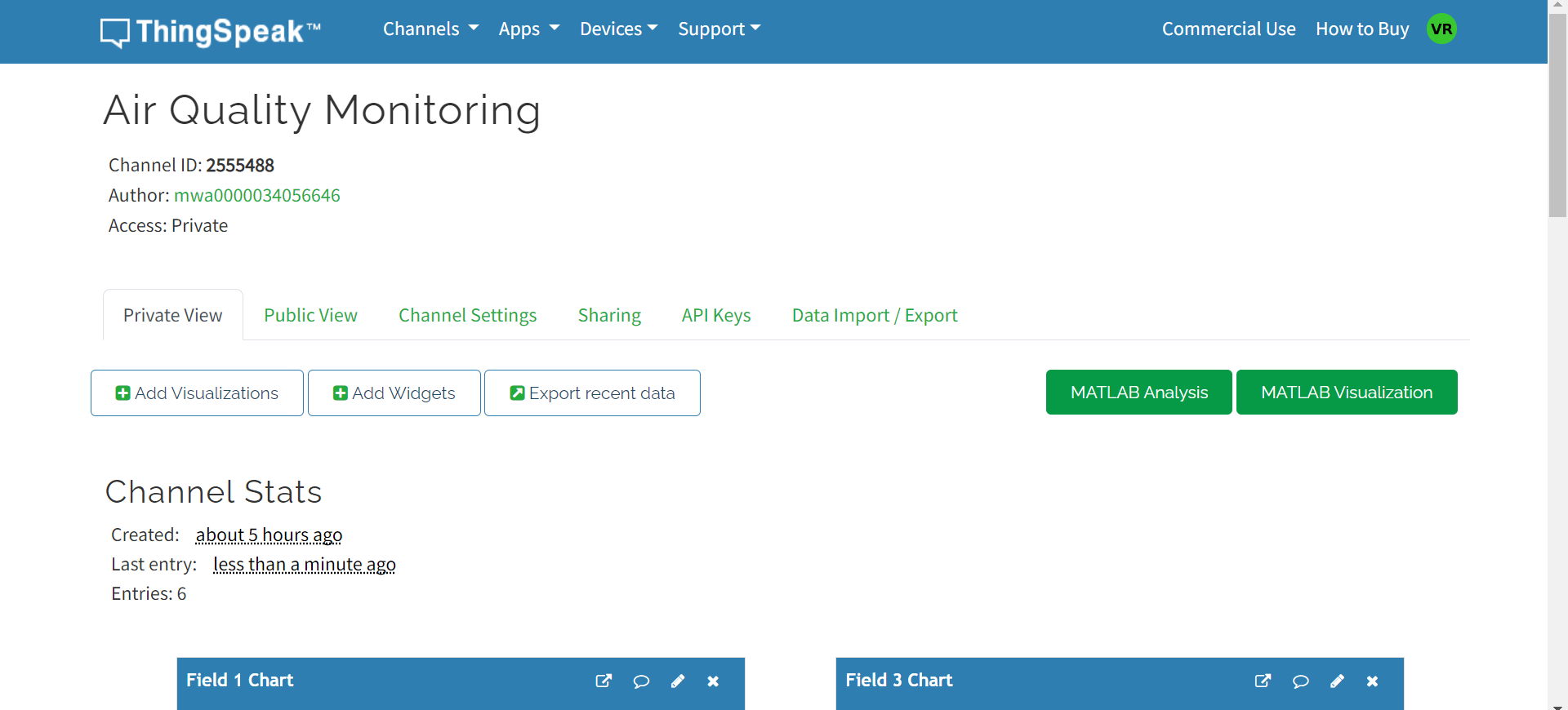


Figure 2.Realtime data in thingspeak iot app

## CHAPTER 4 CONCLUSION AND FUTURE WORK

In conclusion, the IoT-based air quality monitoring system presented in this project offers a versatile and accessible solution for real-time environmental monitoring. By leveraging the capabilities of IoT technology and integrating sensors with a cloud-based platform, the system provides users with valuable insights into air quality conditions. The inclusion of a buzzer for immediate alerts enhances safety, while the remote access capabilities enable monitoring from anywhere with internet connectivity. Future work could focus on expanding the system's capabilities by incorporating additional sensors for more comprehensive environmental monitoring. Additionally, enhancements to the data analytics and visualization capabilities could further improve the system's utility and usability. Continued research and development in this area have the potential to advance our understanding of air quality dynamics and contribute to the development of effective strategies for mitigating air pollution and promoting public health.

**APPENDIX I**

#include <ESP8266WiFi.h>

#include <DHT.h>

#include <ThingSpeak.h>

#define DHTPIN D2 // Pin connected to DHT11 data pin

#define DHTTYPE DHT11 // DHT 11

#define BUZZER\_PIN D6 // Pin connected to the buzzer

#define GAS\_THRESHOLD 535 // Adjust this value according to your requirements

DHT dht(DHTPIN, DHTTYPE);

// Replace with your network credentials

const char\* ssid = "VSRAKESH";

const char\* password = "rakeshvivo";

// ThingSpeak settings

unsigned long myChannelNumber = 2555488;

const char \* myWriteAPIKey = "VOM7T6OCM2Q2HHVB";

WiFiClient client;

void setup() {

Serial.begin(115200);

delay(10);

dht.begin();

WiFi.begin(ssid, password);

Serial.println("Connecting to WiFi");

while (WiFi.status() != WL\_CONNECTED) {

delay(500);

Serial.print(".");

}

Serial.println("WiFi connected");

ThingSpeak.begin(client);

// Initialize buzzer pin

pinMode(BUZZER\_PIN, OUTPUT);

}

void loop() {

// Reading temperature and humidity

float h = dht.readHumidity();

float t = dht.readTemperature();

// Check if any reads failed and exit early (to try again).

if (isnan(h) || isnan(t)) {

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

return;

}

// Reading gas level

int gasValue = analogRead(A0);

// Print values to serial monitor

Serial.print("Humidity: ");

Serial.print(h);

Serial.print(" %\t");

Serial.print("Temperature: ");

Serial.print(t);

Serial.print(" \*C\t");

Serial.print("Gas Level: ");

Serial.println(gasValue);

// Update ThingSpeak channel with new data

ThingSpeak.setField(1, t);

ThingSpeak.setField(2, h);

ThingSpeak.setField(3, gasValue);

int x = ThingSpeak.writeFields(myChannelNumber, myWriteAPIKey);

if (x == 200) {

Serial.println("Channel update successful.");

} else {

Serial.println("Problem updating channel. HTTP error code " + String(x));

}

// Buzzer control

if (gasValue > GAS\_THRESHOLD) {

// Turn on the buzzer

digitalWrite(BUZZER\_PIN, HIGH);

// Wait for some time

delay(3000);

// Turn off the buzzer

digitalWrite(BUZZER\_PIN, LOW);

}

// Wait 3 seconds before sending another update

delay(3000);

}

**REFERENCES**

1. T. Li, Y. Tian, and C. J. Tan, "An IoT-Based Air Quality Monitoring System Using Raspberry Pi," 2018 International Conference on Electrical and Computing Technologies and Applications (ICECTA), Ras Al Khaimah, United Arab Emirates, 2018, pp. 1-5.

2. A. K. Mandal, S. Ghosh, and D. Sarkar, "Real-Time Air Quality Monitoring Using IoT," 2019 IEEE Region 10 Symposium (TENSYMP), Kolkata, India, 2019, pp. 13-16.

3. A. Khattak, M. Z. Shakir, and M. A. Akbar, "Design and Development of an IoT-Based Air Quality Monitoring System," 2019 International Conference on Electrical, Communication, and Computer Engineering (ICECCE), Istanbul, Turkey, 2019, pp. 1-4.

4. H. R. D. S. Silva, T. A. J. Bandara, and S. H. L. L. Kariyawasam, "An IoT-Based Air Quality Monitoring System Using Arduino," 2020 15th IEEE Conference on Industrial Electronics and Applications (ICIEA), Tokyo, Japan, 2020, pp. 731-736.

5. Y. Wang, J. Zhang, and Y. Zhang, "Design and Implementation of Air Quality Monitoring System Based on IoT," 2017 IEEE International Conference on Smart Cloud (SmartCloud), New York, NY, USA, 2017, pp. 96-100.

6. M. H. Khan, M. S. Ali, and M. Z. Hassan, "IoT-Based Smart Air Pollution Monitoring System," 2021 IEEE International Conference on Sustainable Engineering and Technology (ICSET), Kuala Lumpur, Malaysia, 2021, pp. 1-6.

7. S. Ghosh, A. Chakraborty, and S. Banerjee, "An IoT-Based Air Quality Monitoring System Using Raspberry Pi," 2020 IEEE International Conference on Advanced Networks and Telecommunications Systems (ANTS), Kolkata, India, 2020, pp. 1-4.

8. J. Wang, J. Zhang, and H. Hu, "An IoT-Based Air Pollution Monitoring System Using LoRa Technology," 2021 IEEE International Conference on Internet of Things (iThings) and IEEE Green Computing and Communications (GreenCom) and IEEE Cyber, Physical and Social Computing (CPSCom) and IEEE Smart Data (SmartData), Edmonton, AB, Canada, 2021, pp. 222-227.

9. H. B. Rizvi, M. Akhtaruzzaman, and S. E. Islam, "IoT-Based Smart Air Quality Monitoring System for Smart Cities," 2019 IEEE International Conference on Electrical, Computer and Communication Engineering (ECCE), Cox's Bazar, Bangladesh, 2019, pp. 1-5.

10. M. H. Z. Chowdhury, M. M. Alam, and M. T. Akanda, "An IoT-Based Air Quality Monitoring System Using Arduino," 2021 IEEE Region 10 Symposium (TENSYMP), Dhaka, Bangladesh, 2021, pp. 598-603.

11. A. K. Singh, S. Sharma, and S. Upadhyay, "Design and Development of IoT-Based Air Quality Monitoring System," 2019 International Conference on Machine Learning, Big Data, Cloud and Parallel Computing (COMITCon), Faridabad, India, 2019, pp. 99-103.

12. S. Chakraborty, S. Chakraborty, and M. Singh, "IoT-Based Air Quality Monitoring System for Smart Cities," 2020 IEEE International Conference on Communication, Computing and Electronics Systems (ICCCES), Kolkata, India, 2020, pp. 1039-1043.

13. M. T. T. Haque, M. E. Hossain, and M. A. Alam, "An IoT-Based Smart Air Quality Monitoring System," 2018 IEEE International Conference on Circuits and Systems (ICCS), Dhaka, Bangladesh, 2018, pp. 1-5.

14. S. D. Jha, A. P. Kumar, and A. Singh, "Design and Development of IoT-Based Air Quality Monitoring System," 2019 2nd International Conference on Advanced Computational and Communication Paradigms (ICACCP), Gangtok, India, 2019, pp. 1-6.