

Air Quality Detection and Monitoring System for Asthmatic Patients

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Abstract

Review Article

Air pollution is a major environmental concern that significantly affects human health, especially for individuals with respiratory conditions like asthma. Pollutants such as carbon monoxide, nitrogen dioxide, sulfur dioxide, carbon dioxide, and volatile organic compounds can worsen asthma symptoms and trigger attacks. Traditional air quality monitoring systems are often expensive, fixed, and not designed to meet the specific health needs of individuals. This study presents an IoT-based Air Quality Detection and Monitoring System tailored for asthmatic patients. The system provides a portable, real-time, and affordable solution for monitoring air quality. The system uses an ESP32 microcontroller combined with an MQ-135 gas sensor to detect harmful pollutants. A DHT11 sensor measures temperature and humidity levels, which are important for asthma management. The system also includes a GPS module to track the user's location, especially in emergencies. If the air quality worsens beyond a safe threshold, the system triggers a buzzer alarm and sends SMS alerts to caregivers or medical professionals. In addition, real-time data is shown on an LCD screen and transmitted to a cloud-based platform for remote monitoring. The methodology approach involves designing and developing the system's hardware and software components. The sensors are calibrated to detect specific air pollutants, and the data is processed by the ESP32 microcontroller. The study reveals the importance of IoT solutions in healthcare and suggests future improvements, including the use of artificial intelligence for predictive analysis and expanding the range of detectable pollutants. This affordable and scalable solution contributes to better asthma management and public health.

Keywords: Pollution IoT-based, Air Quality, asthmatic patients, ESP2

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Introduction

In the last quarter-century, businesses have undergone remarkable growth. This rapid development has led to serious and complex environmental challenges [1]. The swift pace of urbanization and industrialization has resulted in a marked decline in air quality, contributing to an increase in respiratory and cardiovascular illnesses

[2]. Recognizing the critical role of environmental quality in people's well-being, the World Health Organization (WHO) has set guidelines for various air pollutants, including ozone, nitrogen oxides, and sulfur dioxide, to help mitigate the public health effects of air pollution [3]. Occurrences of cancer, measles, asthma, respiratory problems, cardiovascular heart & chronic cardiovascular problems have been recorded for raising such



pollutants. Approximately seven million people die prematurely each year due to exposure to polluted air according to the World Health Organization (WHO). Urbanization, industrialization, vehicular emissions, and deforestation are some of the primary contributors to the declining air quality in cities and rural areas [4].

Conventional air quality monitoring systems are usually deployed at fixed locations and rely on sophisticated, high-cost equipment to measure concentrations of pollutants such as particulate matter (PM), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), carbon monoxide (CO), and ozone (O₃) [5]. While these systems provide accurate data, their high cost, limited coverage, and infrastructure requirements make them inaccessible for continuous and widespread monitoring. Moreover, they often fail to capture the variability in air quality across different microenvironments within a city or region [3].

The advent of the Internet of Things (IoT) has revolutionized many sectors, including environmental monitoring. IoT technology allows for the integration of various sensors and devices, enabling real-time data collection, analysis, and communication. Sequel to that, the study proposes IoT-based air quality detection and monitoring system that is cost-effective, scalable, and capable of providing continuous air quality monitoring across a given area. Such a system can deliver timely alerts and actionable decisions, empowering authorities and individuals to take appropriate measures to mitigate the impact of air pollution and improve public health outcomes.

Air pollution is an escalating global concern, primarily driven by rapid industrialization, urbanization, and population growth. Emissions from factories, vehicles, and other anthropogenic activities release harmful pollutants such as sulfur dioxide (SO₂), carbon dioxide (CO₂), nitrogen oxides (NO_x), and particulate matter (PM), which contributes to respiratory diseases, environmental degradation, and climate change. Studies indicate that prolonged exposure to these pollutants increases the risk of asthma, cardiovascular diseases, and other severe health conditions [6]. Despite growing

awareness, the persistent rise in pollution levels continues to threaten public health, economic productivity, and overall quality of life, necessitating innovative solutions to monitor and mitigate air pollution effectively.

Traditional air quality monitoring systems, although essential, face significant limitations in their implementation and accessibility. These systems are typically expensive, stationary, and concentrated in specific locations, leading to poor coverage of localized pollution levels [4]. Moreover, their reliance on centralized infrastructure makes real-time data acquisition and personal health adaptations challenging. Many regions, particularly in developing countries, lack adequate monitoring facilities, leaving vulnerable populations without crucial information to safeguard their health. Even in urban settings where monitoring stations exist, they fail to provide personalized or real-time updates to individuals who may be at higher risk, such as asthmatic patients. In response to these challenges, IoT-based air quality monitoring systems present an innovative, cost-effective, and scalable alternative. By integrating smart sensors with cloud-based platforms, these systems enable continuous tracking of pollutants and environmental conditions in real time. Such technology empowers individuals, especially those with respiratory conditions, to take proactive measures by receiving instant alerts about hazardous air quality. Furthermore, remote monitoring capabilities ensure that caregivers and medical professionals can intervene when necessary. As pollution-related illnesses continue to rise, the development of efficient and affordable monitoring solutions is crucial in enhancing public awareness, reducing health risks, and fostering sustainable environmental policies.

This study aims to design and implement an IOT Based Air Quality Detection and Monitoring System for asthmatic patients that helps to monitor and alert upon the detection of any harmful gases around the area. The objectives of the study are:

- i. To design an IoT-based system for real-time air quality detection and monitoring system for asthmatic patients.

- ii. To develop an IoT-based system using the ESP32 board with sensors to detect harmful air pollutants, send notifications, and integrate a GPS module for emergency location tracking.
- iii. To test the system's functionality, accuracy, and reliability in real-world scenarios, ensuring effective pollutant detection and timely alert delivery.

The implementation of air quality detection and monitoring systems is essential for areas that are at high risk of air pollution, directly affecting human health such as industrial parks, production complexes, university laboratory complexes, and so on. This study holds significant importance as it addresses the critical need for more accessible and real-time air quality data. The proposed system enables continuous monitoring of air pollutants, which is crucial for timely health advisories and environmental interventions. Improved monitoring can lead to better public health results by providing individuals and authorities with up-to-date information on pollution levels, allowing for prompt actions to mitigate exposure.

Related Work

[7] implemented an IoT-based air pollution monitoring system. The primary objective of the study was to create a system where the industry does a lot of pollution which is to be monitored by IoT system over web. Also, it monitors the air quality levels in certain cities where there is more traffic. In this system, they have Sensor Array which includes: MQ135 which measures CO₂, SO₂, CH₄, NH₃, and MQ9 which measures CO and Propane (C₃H₈), and MQ2 which detects any Gas Leakage. The system adopted tools like ESP32 Microcontroller (Node MCU), which were used to read all sensor data. Node MCU ESP32 sends this sensed data to Blynk 2.0 Cloud using Wi-Fi connectivity. Blynk 2.0 Cloud was used for the system. One could see the real-time data on Cell Phones using the Blynk Application and on the Blynk Web Dashboard in Graph form. If the MQ 2 sensor detects any Gas Leakage, then the system will send a Notification on your Cell Phone. This system just requires a Wi-Fi Access Point for

connectivity, and it is very easy to maintain. If the system is not showing any readings OR if the system is showing Offline on the Blynk App on Cell Phone, then only we must check connectivity to the system OR Power Supply of the system.

[8] presented an Air pollution monitoring system using IoT devices. The study indicated that pollutants can be monitored using IoT technology. The toxic chemicals were identified by IoT devices and sensors. The system uses air sensors and noise sensors to detect and transmit this information. The IoT sensors were attached to certain areas which gave information to Arduino/Raspberry Pi about the air quality in that area and then the Arduino/Raspberry Pi enabled the data to be fed to the web server by connecting through the internet directly. The air quality of that area can be monitored through an Android app easily. Hence, it has been concluded that by using IoT-based air pollution monitoring system pollution can be detected easily. In conjunction with other data, this measure enables us to see air quality at a certain location on a map.

[8] worked on an Air pollution monitoring system using IoT devices. The purpose of their study was to understand Information on environmental variables and allow easy integration into any other type of internet-based architecture (IoT) which allows the use of sensors capable of collecting information on sensors related to smart city environment measurements, to provide data on environmental pollution-related information. The air pollution was monitored by using internet-based devices like IOT-based devices and sensors using Arduino/Raspberry Pi. The system uses air sensors and noise sensors to detect and transmit this information. Then take the data from the web server and store it on the Internet, Arduino/Raspberry Pi. The predictability describes the air-borne pollutants and particulate matter. In conjunction with other data, this measure enables us to see air quality at a certain location on a map.

[9] Design and deployment of an IoT-based air quality monitoring system. This work presents the design and deployment of an IoT-based air quality monitoring system, named the Environmental Monitoring System (EnMoS). The system allows AQI monitoring for a wide area in real-time with a

visual web map application considering long-distance wireless technology and cloud database service. The study deployed a LoRa star network consisting of a gateway for data collection, then uploading to a cloud server and three wireless sensing nodes at three typical laboratories on campus. Each sensing node equips sensors for measuring environmental factors for AQI calculation such as particulate matter (PM2.5 and PM10), CO₂, air pressure, temperature, and humidity. Experimental results showed that node deployment strategies and methods have a significant impact on the efficiency of air quality sensing. In addition, for indicating conveniently obtained AQI values a web page was also developed to provide an interactive map along with corresponding charts. A case study on an actual LoRa network consisting of three sensing nodes and a gateway was conducted to validate the feasibility of the system.

[10] designed and developed IoT Based Air Quality Detection and Monitoring System. The Arduino Uno microcontroller was used as the backbone to develop the wireless sensor network system. To monitor and analyze air quality in real-time and log data to a remote server whilst keeping the data updated over the internet, the air pollution monitoring system was designed for this particular purpose. The MQ135 Gas sensor was used to collect air data. The sensor was calibrated to ensure that the analogue output from the sensor is proportional to the concentration of the pollutants being measured in parts per million (ppm). The data is transmitted via a WIFI module using the internet to the cloud servers, this information can be retrieved via Smartphone or web-enabled devices. The transmission and retrieval of data happen in near real-time. The data of the parameters being measured are displayed on a 16*2 LCD screen. An alarm would sound if any pollutant reached dangerously high levels or if the WIFI module fails to transmit information collected to the Cloud. The result was displayed on the designed hardware's display interface and could be accessed via the cloud on any smart mobile device.

[11] worked on an IoT-based real-time air pollution monitoring system. The proposed IoT-based real-time pollution monitoring system has a DAQ that is

connected to a remote cloud server with a cloud database. The IoT system is designed to measure pollution in real-time at any desirable location and hence is cost-effective when compared to the existing system of stationary monitoring. It also avoids the problem of inconsistent pollution values. The user interface helps people to know the pollution level in a certain area and the health hazards associated with it. People with specific allergies can refrain from visiting the place and hence be free from air-prone health hazards. The advantages of using a cloud server are that it is less expensive, always available, and is independent of the location or nature of the DAQ. The feature of the cloud that provides the service of software, platform, and infrastructure provides scope for scalability. The advantages of using a cloud database are horizontal scalability, elasticity, reduced cost, and ease of use. Cloud servers and databases are more suited for IoT applications as any number of IoT devices can easily connect, store, and retrieve data.

[12] examined an IoT-based air quality monitoring system that was designed to determine the air quality conditions in an area. The system monitors various kinds of air using sensors to see the levels of several substances in the air including O₃, SO₂, CO, and particulates reading sensor data using an Arduino microcontroller. Then the data is sent to the ThingSpeak cloud system using a WIFI module on Arduino by accessing the API provided by the ThingSpeak cloud service. Tools include an ATmega328-based microcontroller board, 16 MHz ceramic resonator, USB connection, power jack, and ICSP header. ThingSpeak is an open-source IoT application platform and API for storing and retrieving data from things using the HTTP protocol over the Internet or through a Local Area Network. The monitoring results were seen on the web page provided by ThingSpeak in graphical form.

[14] developed a smart air pollution monitoring system. The study proposes an air pollution monitoring system. The air pollution monitoring system was designed to monitor and analyze air quality in real-time and log data to a remote server, keeping the data updated over the internet. The model was designed using an Arduino Uno

microcontroller, Wi-Fi module 8266, MQ135 Gas Sensor, and a 16 by 2 liquid crystal display (LCD) Screen. The system overview procedure was classified into Five (5) layers. The first layer was the environmental parameters which are obtained by measurement. The second layer was the study of the characteristics and features of the sensors. The third layer was the decision-making, sensing, measuring, and fixing of the threshold value, periodicity of sensitivity, timing, and space. The fourth layer was sensor data acquisition. The fifth layer was the ambient intelligence environment. The sensor collected data when operated by the microcontroller and forwarded it over the internet for analysis via the Wi-Fi module. Air quality measurements were taken based on the Parts per Million (PPM) metrics and analyzed using Microsoft Excel. The air quality measurements taken by the designed system were accurate. The result was displayed on the designed hardware's display interface and could be accessed via the cloud on any smart mobile device.

[15] considered an IoT-based air pollution monitoring system. The data of air was recognized by the MQ135 gas sensor and MQ6 LPG gas sensor. The MQ135 sensor was able to sense NH₃, NO, alcohol, Benzene, smoke, and CO₂. When connected to the Arduino it senses all gases and it gives the Pollution level in PPM (parts per million). MQ135 gas sensor gives output in the form of voltage levels which are converted into PPM. For converting the output to PPM, the Sensor provides a value of 90 when there is no gas near it and the air quality safe level is 350 PPM and it should not exceed 1000 PPM. When it exceeds the limit of 1000 PPM, it will cause Headaches, sleepiness, and stagnant, stuffy air. If it exceeds 2000 PPM, then it will cause increased heart rate and many different diseases. When the value is less than 1000 PPM, then the LCD and webpage display "Fresh Air". When the value increases from 1000 PPM, then the buzzer will start beeping and the LCD and webpage will display "Poor Air, Open Windows". And when it increases to 2000, the buzzer keeps beeping and gives an alert message on the smartphone through GSM. The LCD and webpage display "Danger! Move to fresh Air". It contains temperature and humidity, so it possibly shows the current temperature and humidity of the

air. The use of IOT technology enhances the process of monitoring various aspects of the environment such as air quality monitoring.

[13] Considered IOT-based air pollution monitoring and forecasting system. The authors build a framework that will help in monitoring and forecasting air pollution within a location at a particular time. The device was able to measure the level of gases in a highly dense area like markets hospitals, railway stations, bus stands, etc. from the remote-control room. If data is stored, the data is used for further experiments which can conclude a significant result. This system is IoT based which was used in the smart home for cooling, ventilation, and other purposes. These systems can become very helpful for society as respiratory health conditions are increasing day by day. Due to their high sensitivity, these systems can be used in chemical industries and defense agencies to detect any chemical attack. One of the advantages of the system was that at the early stage, the meter was powered by the source, but it could be powered by solar power.

Methodology

After reviewing the various methodologies available for the development of the IoT-based air quality detection and monitoring system, I have chosen Object-Oriented Methodology (OOM) for the following reasons:

1. **Complex System Design:** OOM is ideal for complex systems like ours, where multiple interacting components (sensors, microcontrollers, etc.) can be modeled as objects. This makes the system more modular, easier to understand, and manageable.
2. **Modularity and Reusability:** Each system component is designed as an independent object, making it easy to reuse or modify parts of the system (e.g., sensors, alert systems) without impacting others, and allowing for easy integration of new features.
3. **Scalability and Flexibility:** OOM supports the addition of new components or features (e.g., new sensors or algorithms) without

disrupting the system. This flexibility is crucial as the system grows or evolves over time.

4. **Real-World Modeling:** OOM allows us to model physical components (sensors, users) as objects that reflect their real-world behaviors, making the system intuitive and closely aligned with actual processes.
5. **Maintainability and Long-Term Support:** The modular structure of OOM makes it easier to update or maintain individual components (e.g., sensor algorithms or communication protocols) without affecting the entire system, ensuring long-term sustainability and reducing future development time.

After evaluating various software development methodologies, I have chosen the Object-Oriented Methodology (OOM) for the development of the IoT-based air quality detection and monitoring system for asthmatic patients. OOM provides the necessary flexibility, scalability, and modularity required for this complex, dynamic system. It aligns well with the system's need

for real-world modeling, ease of maintenance, and future expansion, ensuring the system can effectively meet the needs of asthmatic patients sustainably and efficiently.

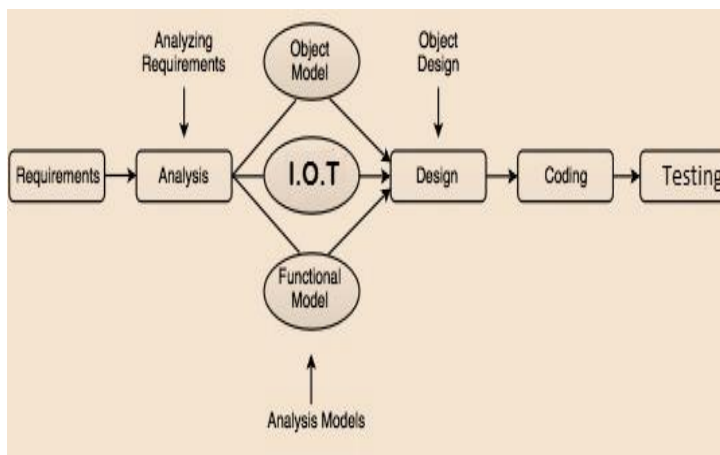


Fig 1. Object-Oriented Method

Analysis of the Existing System

The Internet of Things (IoT) has become a revolutionary technology in various domains, and healthcare is no exception. One significant application of IoT is in air quality detection and monitoring, particularly for individuals with respiratory issues such as asthma. While many existing systems cater to general air quality monitoring, they are not personalized for specific needs of asthmatic patients. Below is an analysis of the generalized IoT-based air quality detection and monitoring systems that are not tailored to individual asthmatic patients but focus on environmental factors.

1. Overview of Generalized IoT-based Air Quality Detection Systems

IoT-based air quality monitoring systems typically consist of a network of interconnected sensors that measure air parameters such as particulate matter (PM2.5, PM10), Sulphur dioxide (SO2), volatile organic compounds (VOCs), temperature, humidity, and other gases. These systems collect data in real-time and transmit it to a centralized cloud or local server for analysis and monitoring.

2. Key Features of Generalized Systems

- i. **Real-Time Monitoring:** Provides continuous, real-time data on various air quality parameters.
- ii. **Data Storage and Visualization:** Offers cloud storage and visualizations of air quality trends and historical data.
- iii. **Alert System:** Sends notifications (usually to mobile apps or emails) when air quality levels are poor, allowing users to take preventive actions.
- iv. **Automated Control:** Some systems integrate with smart devices (like air purifiers or ventilation systems) to automatically adjust the indoor air quality.

3. Examples of Existing Generalized IoT Air Quality Monitoring Systems

Several companies and research projects have implemented IoT-based air quality monitoring

systems that do not cater to specific medical conditions like asthma. A few examples include:

- i. AirVisual by IQAir: This system provides real-time air quality data by measuring PM2.5, CO2, temperature, and humidity. It offers general recommendations for users to improve air quality but does not provide personalized advice for individuals with respiratory conditions.
- ii. Awair: An air quality monitor that tracks temperature, humidity, CO2, VOCs, and PM2.5. While it provides alerts and recommendations for improving indoor air quality, it does not tailor its responses to individual health conditions.
- iii. PurpleAir: This system provides crowd-sourced air quality data, using sensors to track PM2.5 and other air quality parameters. It helps monitor air quality but does not offer specific advice for people with asthma.

V. Weaknesses of the Existing System

While generalized air quality systems are widely used for monitoring environmental air conditions, they do not address the personalized needs of individuals, particularly asthmatic patients. Here are the key limitations of these systems:

- a. Lack of Personalization for Asthma:
 - i. Generalized Alerts: Alerts are usually triggered based on predefined thresholds for air quality levels. However, asthmatic patients may have different sensitivities to pollutants, meaning a single threshold for all users is insufficient.
- b. Insufficient Contextual Awareness:
 - i. Environmental vs. Individual Factors: Generalized systems often focus only on environmental factors, such as air pollution levels or CO2 concentration. However, asthma is a chronic condition that requires individualized care. Factors like stress, exercise, and medication

adherence also play crucial roles in asthma management, and these systems do not capture such dynamics.

- ii. Lack of Historical Medical Data: Personalized systems would benefit from knowing the patient's asthma history (e.g., frequency of asthma attacks, sensitivity to pollutants), but generalized systems lack the ability to customize based on this data.
- c. Limited Feedback for Asthma Patients:
 - i. No Adaptation Based on Symptoms: General systems do not consider a user's real-time asthma symptoms, such as wheezing, breathlessness, or coughing. As a result, the system may not offer helpful actions in response to specific asthma exacerbations.
 - ii. No Proactive Intervention: Personalized systems could potentially offer proactive interventions, such as recommending medication, providing asthma action plans, or advising on when to avoid certain environmental conditions based on the user's symptoms and medical history.

VI. Analysis of the Proposed System

The proposed system aims to enhance the existing generalized IoT-based air quality monitoring solutions by introducing personalized considerations for asthmatic patients. The core innovation is the integration of real-time air quality data with individualized health metrics, allowing for tailored feedback and interventions specific to the patient's asthma condition. Below is a detailed analysis of the proposed system's components, benefits, limitations, and potential improvements.

1. System Overview

The proposed system leverages IoT sensors for continuous monitoring of air quality in the environment while incorporating real-time health

data from asthmatic patients (e.g., spirometry data, medication usage, oxygen saturation). It uses this data to provide personalized recommendations and alerts, enhancing asthma management and reducing the risks associated with poor air quality.

2. Key Components:

- i. IoT Sensors: Measures air quality parameters such as PM2.5, SO2, NO2, Ozone, temperature, and humidity.
- ii. Cloud/Local Server: Aggregates and analyzes data from both air quality sensors and health devices to generate personalized insights.
- iii. Mobile Application or Web Dashboard: Displays real-time air quality data and personalized feedback. This interface will allow patients to see both the current air quality and health metrics, with alerts tailored to the user's specific asthma condition.
- iv. Alert System: Sends notifications based on environmental air quality. It could include prompts for preventive measures, or immediate actions (e.g., using an inhaler or avoiding certain areas).

The proposed IoT-based air quality monitoring system with personalized asthmatic considerations has the potential to significantly improve asthma management by offering tailored recommendations and alerts based on both environmental data.

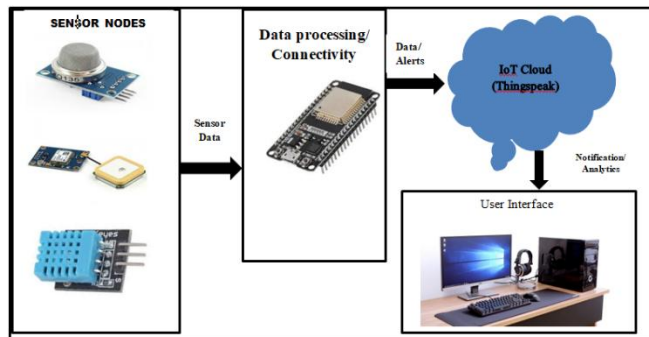


Fig.2: System Architecture.

Data Flow Diagrams (DFD) of the Proposed System

The **Activity Diagram** will illustrate how the **IoT-based Air Quality Detection and Monitoring System** operates for asthmatic patients. This system continuously monitors the air quality, alerts the user if harmful conditions are detected, and allows the user (or caregiver) to act based on the information provided as shown in Fig.3.

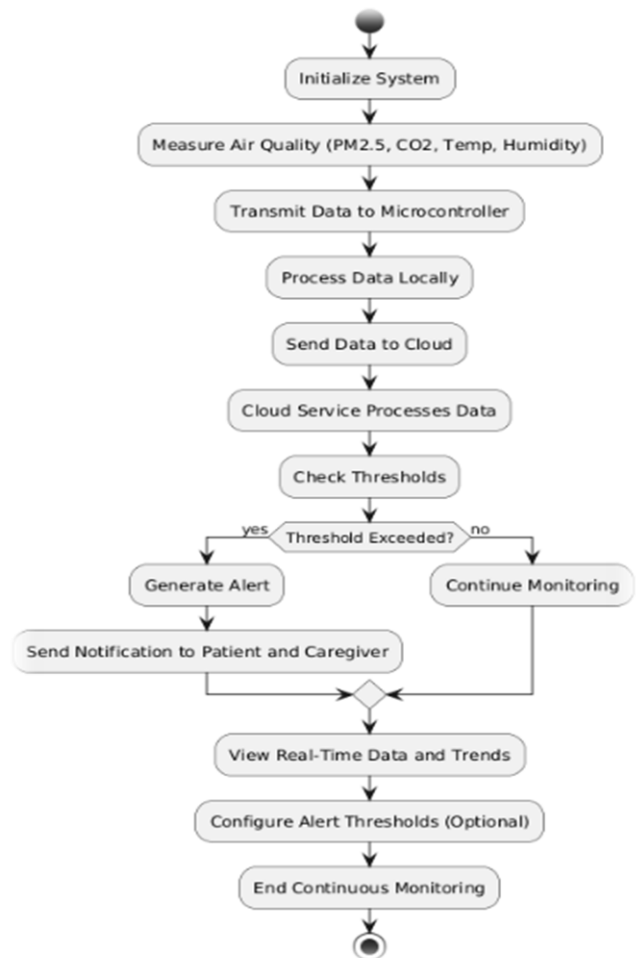


Fig. 3. Overall System Activity Diagram

The researcher employed an algorithm to describe the step-by-step structure of the system as shown in Fig 4.

1. Initialize Components such as ESP32 Development Board, MQ-135 Gas Sensor, DHT11 Temperature and Humidity Sensor, LEDs and Buzzer, Power Supply Setup
2. Read Sensor Data from MQ-135 sensor, DHT11 sensor, GPS module
3. Convert raw sensor readings into human-readable values
4. Decision Making (If air quality is safe: Display "Good Air Quality" on LCD. Turn on Green LED. No alarm or alert is triggered).
5. Store the sensor readings in a cloud database for historical analysis and update the real-time air quality data for remote access.
6. Show real-time air quality data (gas levels, temperature, humidity) on the LCD display.
7. Repeat steps 2 to 6 continuously for real-time monitoring.

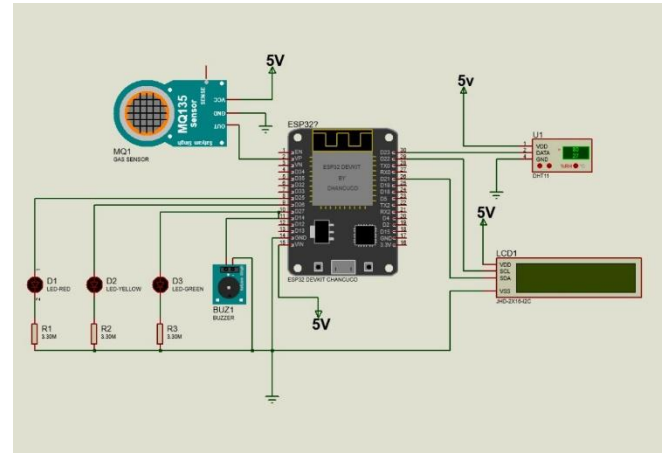


Fig. 5. High-Level model of the proposed system

Results and Discussion

The Test cases are derived to determine whether the logic conditions and decision statements are free from errors. Condition testing strategy in OT-Based Air Quality Detection and Monitoring System for Asthmatic Patients is used to check and confirm if the operators used are correct and to verify conditions such as when harmful air are detected and how it is monitored as depicted in Fig. 6.



Fig. 6. Admin Dashboard page

Fig 4. Algorithm of the proposed system

High-Level Model of the Proposed System:

The IoT-based Air Quality Detection and Monitoring System for Asthmatic Patients is designed to continuously monitor environmental factors that can impact the health of individuals with asthma. The system leverages the Internet of Things (IoT) technology to gather, process, and analyze real-time data on air quality parameters, providing users with insights and alerts to manage their health effectively. This section outlines the high-level model of the system, which includes key components such as sensors, data processing units, communication protocols, and user interfaces.

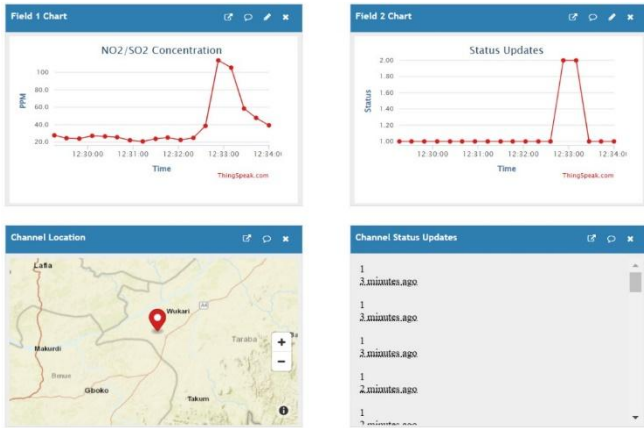


Figure 7. The System Output

Software programs are provided with test data as input, which influences the output based on how specific modules are executed as shown in Figure 6, Figure 7, Fig 8, and Figure 9.

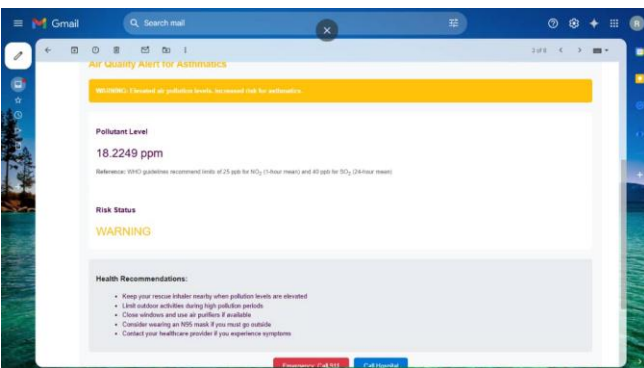


Figure 8: Email Alert

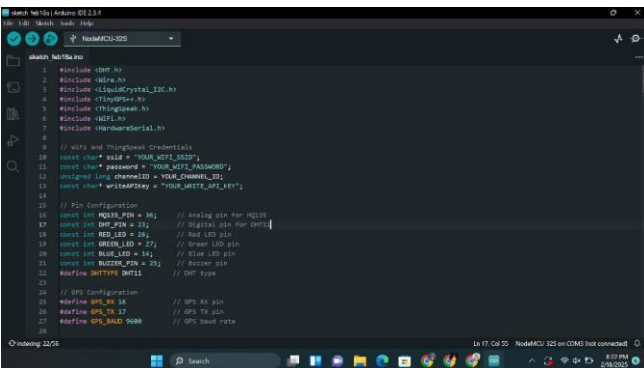


Figure 9: The test data

The study focuses on tackling the problem of air pollution, which has significantly impacted asthmatic patients due to factors like overcrowding and the presence of harmful air pollutants in the modern world. A potential solution has emerged to address the challenges faced by industries and society, particularly the need for individuals to carry tools and devices, such as inhalers, to protect themselves from dangerous air pollutants. This solution aims to create a safer environment for vulnerable patients, as the rising risk of exposure to polluted air can sometimes lead to life-threatening situations if not identified or addressed promptly.

Performance testing evaluates the responsiveness of a system under various conditions. Each function within the system is designed to operate within predefined parameters, ensuring optimal performance. The system's effectiveness is highly promising when compared to traditional methods of detecting air pollution or contaminated environments, thanks to the innovative elements integrated into its design and functionality.

Conclusion, Recommendations, and Future Work

The study focuses on designing and developing an IoT-based air quality detection and monitoring system tailored for asthmatic patients. The system utilizes an ESP32 development board and incorporates sensors to detect harmful air pollutants in real time. It aims to provide timely alerts to both patients and their care teams, enabling proactive measures to avoid asthma triggers. In summary, the IoT-Based Air Quality Detection and Monitoring System for Asthmatic Patients were achieved successfully and the objectives drawn at the starting point of the project were established. The study employs the Object-Oriented methodology, which is a sequential approach that commences with requirement analysis and ends with implementation. The Arduino IDE is utilized in the programming process to enable the system's functionality. For the proposed system to function effectively, a few pieces of hardware and software are needed. The purpose of the IoT-Based Air Quality Detection and Monitoring System for Asthmatic Patients, which uses Buzzer, Breadboard Power Supply, DHT11 Temperature and

Humidity Sensor, MQ-135 Gas Sensor, LCD, Esp32 Development Board, GPS Module, Laptop System and mobile phone, is to cut down on the amount of time and money wasted looking for gadgets and devices in detecting and monitoring contaminated air and to avoid asthmatic patients from being victims. The data collected by sensors is transmitted to a cloud-based platform, where it is analyzed and made accessible to users via a mobile or web application. The system provides real-time alerts and recommendations to asthmatic patients, helping them avoid environments with poor air quality that could trigger asthma attacks. Additionally, the system can be integrated with healthcare providers for remote monitoring and timely intervention. With modern technology, this problem can be solved. IoT-Based Air Quality Detection and Monitoring System for Asthmatic Patients can be improved in the future by exploring the use of artificial intelligence (AI) to predict air quality trends and investigate the potential of adapting the system for other respiratory conditions, such as chronic obstructive pulmonary disease (COPD).

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