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Sensor-Based Real-Time Air Quality Monitoring System For Physically Challenged Asthmatic Patients

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ABSTRACT

Asthma, a chronic respiratory condition, has affected about 300 million people globally from 1970 to date, with approximately 250,000 lives lost each year, requiring careful air quality monitoring for effective management. Most of the existing systems focused on managing emergency cases for asthmatic patients, providing them help in managing the situation during an asthmatic attack. This work focused on the development of a system that could help both physically challenged asthmatic persons, children and non-physically challenged persons prevent asthmatic attacks. The system employed an air-quality sensing subsystem and a mobile application communicating wirelessly. The MQ-135 and MQ-2 gas sensors monitor air quality by measuring environmental factors that trigger asthma attacks. The system processes the data and sends alerts to the smartphone app via the ESP8236 module; activating the visual LED and audible buzzer alarm allows patients and caregivers to take timely precautions against harmful air conditions when levels reach 300 ppm. The Buzzer alarm and LED were incorporated to help blind and deaf asthmatic persons, respectively. The percentage accuracy and average response time were used as metrics for this work. A prototype system was successfully developed and tested at Elizade University using perfumes and smoke to disrupt the environment's air quality, demonstrating its potential for practical use. The system gives a response time of 27.25 and 32 seconds for MQ-135 and MQ-2 sensors, respectively. The accuracy of the system is 75% and 70% for MQ-135 and MQ-2 sensors, respectively. The system was designed for portability and easy mobility, allowing both physically challenged and non-physically challenged asthmatic patients to monitor air quality in real-time as they move between locations, as well as their next of kin.

INTRODUCTION

Millions of people worldwide suffer from asthma (Ding and Zhong, 2020), a common chronic respiratory disease that primarily affects the lungs and other parts of the respiratory system, particularly in children and those with underlying medical disorders (Abrams and Szefler, 2020). Asthma affects about 300 million people worldwide, and estimates suggest that by 2025, another 100 million people will have the condition (Faniyi *et al*., 2024). Asthma is responsible for the death of one out of 250 people globally (Jindal *et al*., 2023). Asthma management involves careful monitoring of environmental conditions, particularly air quality, in addition to medication (Sebastião *et al*., 2024). Asthma attacks and other respiratory problems can be made worse by exposure to dangerous pollutants such as nitrogen dioxide (NO2), carbon monoxide, particulate matter (PM2.5 and PM10), and other poisonous gases (Tiotiu *et al*, 2020; Thangavel *et al*., 2022; Chatkin *et al*, 2022). It has been discovered that the use of perfume and smoke could cause asthma symptoms (Shonazarovna and Technikum, 2025; Macchione *et al*., 2024; Agustina, 2024; Kazeme *et al*., 2022). Poor air quality presents a great inconvenience for those with asthma; it poses a serious risk to their health and can result in serious problems, recurrent hospital stays, and even potentially fatal circumstances (Tiotiu et al., 2020). In the work of Xie et al, (2020), it was reported that 71,811 U.S. children (mean age 8.6 years) showed a 16.1% asthma prevalence among those with developmental disabilities, including blindness and deafness, compared to 6.5% without disability. This indicates a high correlation between asthma and disability, especially in children.

Given the critical role that air quality plays in the health of asthmatic individuals, continuous monitoring of environmental conditions is essential. Conventional air quality monitoring techniques, which are frequently centralised and site-specific, cannot give asthmatic patients the real-time, individualised information they require to make informed health-related decisions (Ahmad *et al*., 2022). A system that can provide immediate feedback on air quality is becoming more and more necessary to help patients and carers respond quickly to potentially dangerous environmental circumstances. This need is particularly critical in metropolitan settings where pollution levels can vary dramatically over short distances. Advances in technology, particularly in the IoT and sensor development fields, have opened new possibilities for managing chronic health conditions like asthma. IoT-based systems can integrate multiple sensors to continuously monitor environmental parameters and transmit data in real-time to users, wherever they may be (Hassan et al., 2020). Such systems can be invaluable in healthcare, providing asthmatic patients with the tools they need to track air quality as they move through different environments, thus allowing them to take proactive steps to avoid exposure to harmful pollutants.

This work introduces a real-time air quality monitoring system specifically designed for asthmatic patients. The system consists of two main subsystems: an air quality sensing subsystem, equipped with advanced sensors like the MQ-135 gas sensor, and a mobile application that receives and displays the data. The sensing subsystem continuously measures key environmental pollutants, processes the data to assess air quality, and communicates this information wirelessly to the user's smartphone via the ESP8266 module. When pollutant levels exceed the safe threshold of 300 ppm according to WHO (Settimo *et al*., 2023), the system triggers immediate alerts through both the mobile app and on-device indicators, such as LEDs and buzzers. The inclusion of LEDs and a buzzer in the system makes it suitable for physically challenged individuals and children with asthmatic symptoms. This has not been put into consideration by the previous works.

The developed system is portable and easy mobility was successfully developed and tested at Elizade University, highlighting its potential deployment as a useful aid for asthmatic patients, especially the physically challenged and children. The system helps patients better control their asthmatic condition by giving them access to real-time data on air quality and timely notifications. This lowers the chance that asthma attacks would be brought on by bad air quality.

RELATED WORKS

Mwangi *et al*., (2020)developed an Internet of Things-based alarm system for patients with chronic asthma, which could activate in the event of an unexpected attack. Patients can simply use the keypad unit on the system to send SMS alerts to pre-registered emergency contacts and to sound a buzzer to alert people in the vicinity. The authors asserted that the system could be used to receive assistance within five minutes of an attack on a patient. According to the authors, the prototype of the system performed with an accuracy of 88% in notifying the emergency contacts. Despite the 88% accuracy recorded in this work, the five (5) minute duration required for the emergency personnel to be contacted is a lot of time when it comes to emergencies, because the shorter the response time, the lower the level of casualties.

Islam *et al*., (2022) developed an Internet of Things (IoT) device that monitors vital indications such as oxygen saturation, heart rate, humidity, ambient temperature, and air quality, utilizing the ESP8266 microcontroller. The system uses Wi-Fi to send data to Firebase, where it is accessed by physicians via a website and by patients via mobile apps. Also, the system has features for communication between patients and doctors via video call. According to the authors, the evaluation of the system showed excellent accuracy in detecting heart rate and SpO2, and it efficiently tracked humidity and air quality. In terms of room temperature measurement, it attained 65% accuracy. Even though the authors claimed that the system experienced excellent accuracy, the system was not suitable for emergencies because it requires both doctors and patients to access information on their devices, as well as requires internet connectivity to access the information.

Rafa *et al*., (2022) worked on a system that can gather data on heart rate, which used multiple sensors and an Arduino microcontroller, and mobile applications. The authors concluded that the system can be used to monitor patient status and emergencies in real-time. The system has an accuracy of 75.81%. The analysis of the data collected revealed which participants were particularly vulnerable to health deterioration, thus emphasizing the system's effectiveness in identifying patients who require closer observation. Although the system has an accuracy of 75%, the use of Bluetooth technology would limit the coverage area of the system to approximately 10 meters. This means the system could not reach doctors who are beyond 10 meters from the system.

Raghavendra *et al*., (2023) developed IoT-based remote health monitoring systems for asthmatic patients, utilising various sensors to collect data on oxygen saturation, heart rate, body temperature, humidity, volatile gases, room temperature, and electrocardiograms. The authors reported that the system enables doctors to remotely monitor patients, with the collected data sent for evaluation and consultation. It was reported that the system could help reduce the adverse effects of air pollution and support early detection and effective management of asthma, particularly in countries with high asthma prevalence. It was concluded that the system is cost-effective and user-friendly, displaying vital parameters in an application for real-time monitoring. It is noted that the system was not designed for emergencies. It only helps doctors monitor asthmatic patients from time to time.

Chakraborty *et al*., (2023) built indoor environmental parameters and health indicators with real-time tracking, data storage, analysis, and alert capabilities to provide asthma patients with a cost-effective remote health monitoring system. It was reported that the system could monitor the surroundings and health of patients using NodeMCU and Arduino microcontrollers equipped with various sensors. It also has an alert system for anomalous sensor readings. Even though the author reported that the system has 75.31% accuracy and 32 seconds response time, the system did not have an alarm feature to create awareness for people in the vicinity during emergency cases. Also, the response time could be minimized further to increase the survival rate with the system.

In summary, Mwangi *et al*., (2020) achieved 88% accuracy but take 5 minutes to contact emergency personnel, which is too slow for critical situations where faster responses could minimize casualties. In the work of Islam *et al*., (2022), despite high accuracy claims, it is unsuitable for emergencies due to its reliance on both doctors and patients accessing devices and requiring internet connectivity. Rafa *et al*., (2022), with 75% accuracy, is limited by Bluetooth technology, restricting its coverage to about 10 meters and preventing alerts to doctors beyond that range. Additionally, Chakraborty et al. (2023) reported 75.31% accuracy and a 32-second response time, yet it lacks an alarm feature for nearby alerts, with the potential to further reduce response times to boost survival rates. Consequently, this work developed an emergency system for physically challenged children and non-physically challenged persons with asthmatic symptoms, with the incorporation of LEDs and a buzzer in addition to a smartphone alert and message display on the Blynk app interface. The system senses its environment via sensors and raises an alarm for the users, passersby, next-of-kin, and medical personnel about the state of the gases in the environment of the user of the system.

METHODOLOGY

The system was developed using an experimental approach. Figure 1 depicts the overall system architecture of the created smart air quality monitoring and alert system. The system consists of three main parts: a wireless communication part (ESP8266, which doubles as a microcontroller), a smart application part (Blynk), and a sensor part (MQ-135 and MQ-2 Gas Sensors). Moreover, the display is a 20x4 Liquid Crystal Display (LCD) Screen. Air quality sensors measure air quality. These sensors provide analogue signals as data. These analogue signals are transformed into a digital equivalent.

NodeMCU ESP8266 microcontroller

The NodeMCU ESP8266 microcontroller was used for wireless communication. The Wi-Fi module on this board serves as both an internet connection and a means of accessing air quality data. Due to its low cost, compact size, and versatility, as well as it supports for several peripherals, including I/O, SPI, I2C, I2S, UART, and ADC, and its compatibility with the Arduino IDE, the ESP8266 was used for this work. The ESP8266 is also known for its power-saving architecture, making it suitable for IoT and home automation projects.

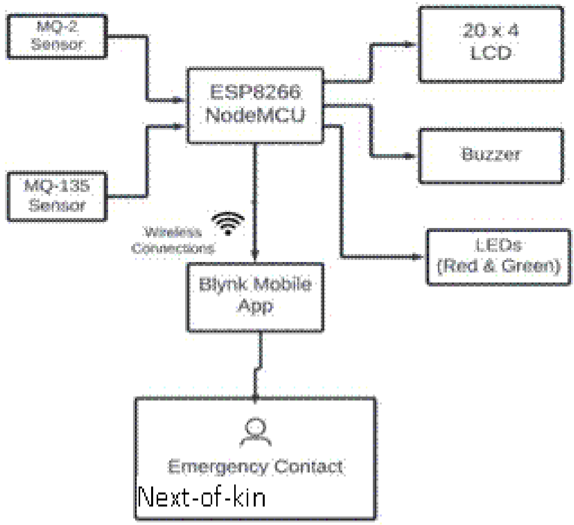


Figure 1: Architectural Overview of the System

The MQ-2 sensor

The MQ-2 sensor was one of the sensors used in this work because of its capacity to identify different gases such as propane, hydrogen, methane, alcohol, smoke, and carbon monoxide in the air. The sensor has a 200–10,000 ppm concentration detection range and runs at 5V. The sensor's sensitivity can be changed with a potentiometer, and its output voltage rises as the concentration of gas increases. The calibration of these gas sensors makes them extremely sensitive to volatile gases in the surrounding air.

The MQ-135 sensor

The MQ-135 sensor is the second sensor chosen for this work due to its capacity to sense NH3, NOx, alcohol, Benzene, smoke, CO2 and other gases; this makes it a perfect gas sensor for the Air Quality Monitoring system. Although the MQ-135 gives output in the form of voltage, the ESP8266 microcontroller connected to it has the capacity to sense the gases and pollution levels in ppm.

The MQ-2 and MQ-135 gas sensors were calibrated to ensure that their analog output voltages were directly proportional to the concentration of polluting gases in parts per million (ppm). During the calibration process, the MQ-135 sensor produced a baseline reading of approximately 90 in clean air when no gas was present, and a dedicated library was used to convert the analog voltage outputs into corresponding ppm values. The system was calibrated with a threshold value of 300 ppm for carbon dioxide (CO_2) and other common air pollutants, in accordance with health guidelines from the WHO (Settimo *et al*, 2023). These guidelines emphasize that prolonged exposure to CO_2 levels above this threshold can negatively affect human health, particularly among vulnerable groups such as asthmatic patients. The sensitivity of both sensors was adjusted using the onboard potentiometer to ensure accurate response to environmental volatile gases, including carbon dioxide, carbon monoxide, ammonia, and smoke. Establishing the alert threshold at 300 ppm enables the system to provide timely warnings, thereby allowing individuals, especially those with respiratory sensitivities, to take preventive actions against poor air quality and avoid potential health risks.

LCD, LEDs and Buzzer

The smart air quality monitoring system continuously measures pollutant levels using the MQ-2 and MQ-135 sensors, and when the concentration reaches or exceeds the 300ppm threshold, the microcontroller initiates alerts via visual indicators (LEDs and LCD) and audible signals (buzzers), as well as sending notifications to the next of the next-of-kin and other emergency contacts. This immediate notification is vital for asthmatic patients to act swiftly against deteriorating air quality. The visual indicators and audible signals were used to help asthmatic individuals with either visual or hearing problems. The system registers a baseline value of around 90 ppm in the absence of significant pollutants, with the safe air quality level being approximately 25 ppm.

When pollutant levels remain below 300 ppm, the system is designed to display “Good Air Quality” on the LCD screen, with no sound from the buzzer. However, if the levels exceed this threshold, the system is programmed to send a message to the buzzer to activate, and both the LCD and the Blynk application are programmed to display a “Bad Air Quality Detected” warning. The data is first shown on the LCD and then transmitted to a Wi-Fi module, which forwards the information to a remote server via the Internet. This data is accessible globally through the Blynk platform, providing real-time monitoring capabilities from any internet-enabled device. Data collected from the sensor was converted into a string and used to update the information sent to the patient's emergency contact of the patient. The emergency contacts include users’ next-of-kin and medical personnel. The data on the Blynk platform can be accessed via smartphones and other computing devices, thereby giving the users and his or her next-of-kin the opportunity to monitor the quality of air of the asthmatic patient in real time.

The circuit diagram of the developed system is shown in Figure 2 and the connection of the system’s components is presented in this sub-section. Each of the MQ-135 and M-Q2 sensors has four pins, each being connected appropriately as follows:

For the MQ-2 sensor;

i. The VCC pin of the sensor was connected to 5V on the microcontroller.

ii. The A-out pin was connected to A1 on the microcontroller.

iii. The GND pin was connected to the ground on the microcontroller.

iv. The D0 pin was left unconnected.

For the MQ-135;

i. The A-out pin was connected to A2 on the microcontroller.

ii. The VCC pin of the sensor was connected to 5V on the microcontroller.

iii. The GND pin was connected to the ground on the microcontroller.

iv. The D0 pin was left unconnected.

The buzzer was connected to pin D7, which starts to beep when the threshold value is reached. The GREEN LED was connected to pins D5 and D3, and the RED LED to pins D6 and D8 on the microcontroller. Lastly, the LCD was connected as GND to GND; 5v to VCC; A4 to SDA; and A5 to SCL. The ESP8266 runs on 3.3V, and a connection of 5V directly to it can damage it. Therefore, VCC and CH_PD were connected to the 3.3V pin of the board.

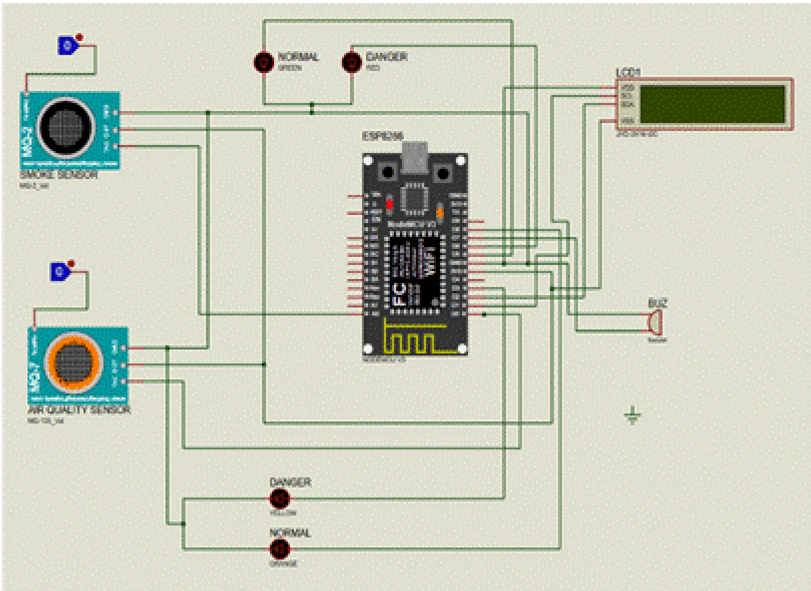


Figure 2: The circuit diagram of the developed system

System Flowchart

The flowchart shown in Figure 3 describes how the data was collected from the MQ-135 and MQ-2 sensors by the microcontroller. The microcontroller received the input values from the sensors and evaluated the values. If the value is greater than or equal to 300 ppm, then it activates the alarm buzzer, leading to a buzzer alarm sound, sends an ON signal to the Red LED, causing the Red LED to come on, uploads data to the Blynk App, initiates an SMS to Emergency contacts and displays the Air Quality information on the LCD. As long as the value is less than 300 ppm, the microcontroller sends an ON signal to the Green LED and also uploads the value to the Blynk app for real-time monitoring by the next of kin.

Performance Evaluation Metrics of the System

The metrics used in the evaluation of this system are percentage accuracy and response time.

Average Response Time: Average response time measures the average time it takes for the system to respond to an input. The system's average response time was calculated using Equation 1.

$$Average\ Response\ Time = \frac{\sum_{i=1}^{N} RT_i}{N} \quad (1)$$

Where RT_i is the Response Time at instance i, and N is the number of attempts.

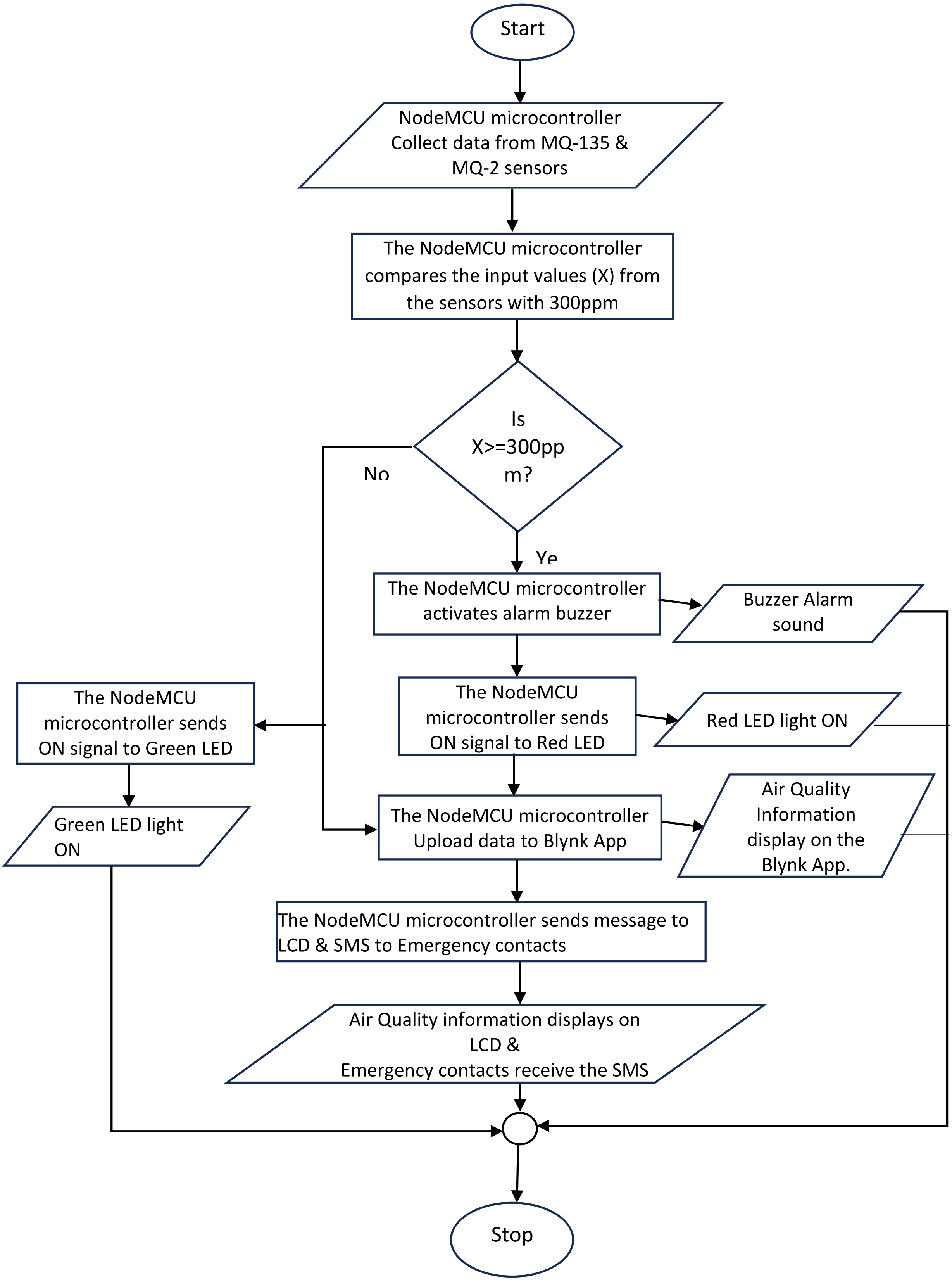


Figure 3: Flowchart of the developed System

Accuracy: Accuracy is a common metric used to measure the correctness of the system's performance.

The percentage accuracy of the system was calculated using Equation 2.

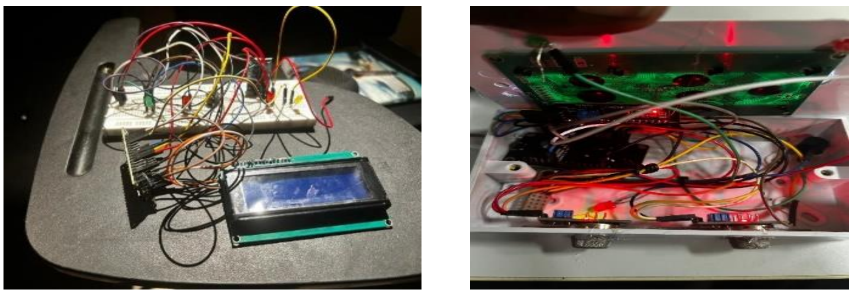
$$Percentage\ Acuracy = \frac{T_{sa}}{T_{aa}} * 100 \qquad (2)$$

where $T_{sa} is$ Total number of successful attempts, T_{aa} is Total number of all attempt

RESULTS AND DISCUSSIONS

The development and testing of the system were carried out at Elizade University, Ilara-Mokin. Restrictions on the use of some substances within the school necessitated the use of perfume and smoke for testing the system, since they are substances that could cause asthma symptoms (Shonazarovna and Technikum, 2025; Macchione *et al*., 2024; Agustina, 2024; Kazeme *et al*., 2022). In Kazeme *et al*., (2022), perfume was reported to trigger asthma in 75% of people with shortness of breath. According to the work, among the side effects of perfume on consumers, asthma is the worst. The work also reported that most perfume components that cause asthma triggers include Limonene, linalool, diethyl phthalate (DEP), eugenol, geraniol, citronellol, hexyl cinnamal, benzylacetone, eucalyptol, ethanol, toluene, methyl salicylate, coumarin, benzene, and dibutyl phthalate (DBP).

Figures 4A and 4B show the developed system at the coupling stage. Figure 4A shows the components and cables used for the system's connection on a breadboard, while Figure 4B shows the components connected within a case before closing the casing. Some of the key features of the developed system are illustrated in Figure 5A, B, C, and D. Figure 5A displays a welcome message that states "Welcome to Smart Air Quality Monitoring and Alert System" on the LCD. Figure 5B shows the provided mobile interface message generated by the Blynk alert system, providing users with real-time notifications regarding air quality levels. Figure 5C depicts the real-time monitoring system for air quality data. It displays readings from the MQ-2 and MQ-135 sensors, measured in ppm. Additionally, it indicates the status of the LEDs (RED and GREEN), which signal the air quality conditions. Figure 5D shows the developed system, showcasing the MQ-2 sensor, MQ-135 sensor, LED indicators, and LCDs, highlighting the integrated components that contribute to effective air quality monitoring.



A B

Figure 4: The developed system at the coupling stage.

Considering the response time of the system, the values obtained from the work are presented in Table 1, Table 2, and Table 3. Table 1 contains the readings for the MQ-2 Sensor (Smoke), Table 2 contains the readings for the MQ-135 Sensor (Gas), and Table 3 indicates the system's response time to different functionalities during the system's testing.

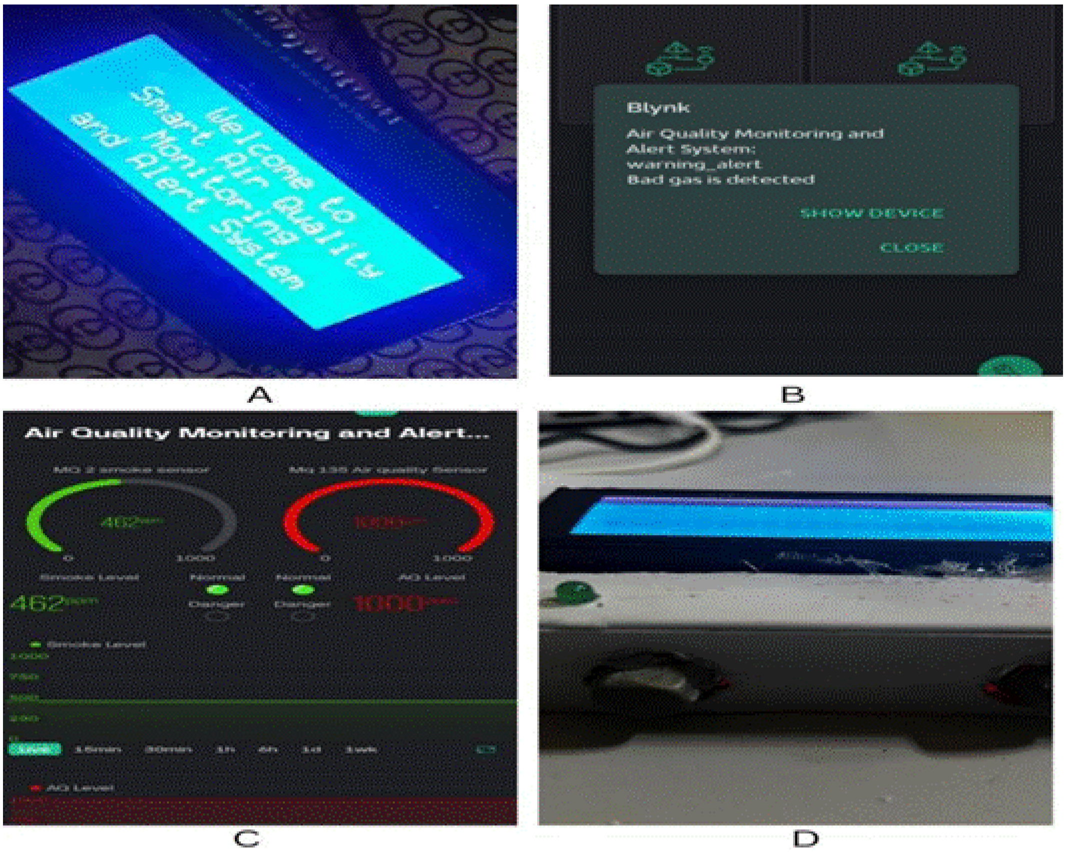


Figure 5: System features of the developed system

Table 1: MQ-2 Sensor (Smoke) Readings

Number of Attempts	Value of Air without the presence of smoke (ppm)	Value of Air with the Presence of Smoke
1	25	520
2	28	519
3	29	523
4	24	517
5	26	515
6	33	516
7	24	513
8	26	497
9	37	496
10	38	493
11	34	489
12	38	442

Table 1 compares air quality values measured in parts per million (ppm) across multiple attempts, both with and without smoke. In smoke-free conditions, air quality values range from 24 to 38 ppm. When smoke is present, ppm values increased significantly, initially between 520 and 497 ppm, gradually decreasing to 442 ppm. This pattern highlights the system's ability to detect and differentiate between normal and smoke-affected air quality at different levels of concentration. With the threshold value of the system set at 300 ppm, the system would be able to determine the pollution of the air in the environment, and the user of the system and other stakeholders could be alerted and take caution.

Table 2: MQ-135 Sensor (Gas) Readings

Number of Attempts	Value of Air without the presence of perfume (ppm)	Value of Air with the presence of perfume (spray)
1	25	902
2	28	500
3	29	1022
4	24	768
5	26	674
6	33	914
7	24	823
8	26	503
9	37	568
10	38	754
11	34	856
12	38	737

Table 3: System Evaluation based on response time.

Attempt	Sensor to Blynk (Seconds)	Initialize Wi-Fi Module (Second)	Fetch Data from Cloud (Seconds)	Fetch Data from Sensor (Seconds)	Send SMS Alert (Seconds)
1st	2	5	1	2	2
2nd	3	4	4	5	3
3rd	1	3	3	2	1
4th	4	10	1	1	4
5th	2	11	3	2	2
6th	2	6	2	1	2
7th	4	8	4	3	4
8th	1	9	1	1	1
9th	2	15	2	3	2
10th	3	20	1	1	3
11th	5	12	1	1	5
12th	2	23	1	1	2
13th	1	45	3	3	1
14th	2	13	5	5	2
15th	2	14	7	6	2
16th	4	23	9	6	4
17th	3	11	2	2	3
18th	3	10	5	5	3
19th	2	23	6	5	2
20th	2	22	2	2	2
21th	1	30	1	1	1
22th	1	12	2	3	1
23th	3	4	2	2	3
24th	2	3	4	4	2
25th	1	7	2	2	1
Average Time	**2.32**	**13.72**	**2.96**	**2.76**	**2.32**

Table 2 presents the readings recorded by the MQ-135 sensor in detecting harmful gaseous substances for an asthmatic patient. In Table 2, in air without perfume, values range from 24 to 38 ppm, indicating a baseline level. When perfume is introduced, ppm values rise sharply, reaching as high as 1022 ppm, though they vary significantly, ranging from 500 to 1022 ppm across attempts. This variability shows the system's ability to detect and respond to distinct air quality changes caused by perfume presence.

Response time of the system

The average response time was computed using the values in Table 3 and Table 4 with Equation 1. Table 3 summarizes the system's response time across six parameters over twenty-five attempts. The columns in the table are communication response time of Sensor to Blynk, Initialize Wi-Fi Module, fetch data from cloud, fetch data from sensor, and send SMS alert. The average response time to send data from the sensor to the Blynk platform is 2.32 seconds. This value could vary based on the user's internet speed. Initializing the Wi-Fi module took 13.73 seconds, influenced by network visibility and the authentication process. Fetching data from the cloud to the mobile device averages 2.96 seconds, also impacted by internet speed. The time to transfer data from the sensor to the microcontroller is 2.76 seconds. SMS alerts also average 2.32 seconds, with service provider responsiveness playing a key role in this value. The response time of the system with respect to notification during an emergency is lower than the ones obtained in the works of Mwangi *et al*., 2020 and Chakraborty et al., 2023, although it is higher than the one obtained by Raghavendra *et al*., 2023. This work has the capacity to increase the survival rate compared to the systems in the works of Mwangi *et al*., 2020 and Chakraborty *et al*., 2023. This also indicates that the response time of the system could be improved further to increase the survival rate. Table 4 indicates the response time of the system to detect and communicate results on different output devices using the two sensors, MQ-2 and MQ-135. The response time of the system using the MQ-2 sensor is 32 seconds, while the response time of the system using theMQ-135 sensor is 27.25 seconds. Both sensors experienced fluctuations during testing, with the MQ-135 responding faster than the MQ-2. Both sensors are affected by varying conditions, highlighting their comparable yet variable performance in air quality detection. The response time of the system using the MQ-135 sensor is better (smaller) than the ones reported in previous works. For instance, Chakraborty *et al*. (2023) and Mwangi *et al*. (2020 reported system response times of 32 seconds and 5 minutes, respectively.

Table 4: Response Time of the system on two sensors MQ-2 and MQ-135

Number of attempts	Response time for MQ-2 sensor	Response time for MQ-135 sensor
1	30	23
2	15	10
3	10	15
4	35	35
5	29	25
6	54	23
7	52	10
8	31	31
9	43	54
10	23	31

11	47	25
12	12	26
13	51	66
14	19	19
15	33	33
16	27	13
17	53	16
18	10	20
19	44	25
20	27	45
Average	**32 secs**	**27.25 secs**

Figure 6 shows the response time of the system to the two sensors used in this work. Even though MQ-135 occasionally lags, its lower average response time (27.25 seconds) indicates that it might be better for applications needing faster average detection. The variations in both sensors imply that variables like temperature, humidity, or target gas concentration that are not specifically mentioned in the data affect response times. According to this study, the particular application's tolerance for variability in comparison to average speed may determine which of the two sensors is best.

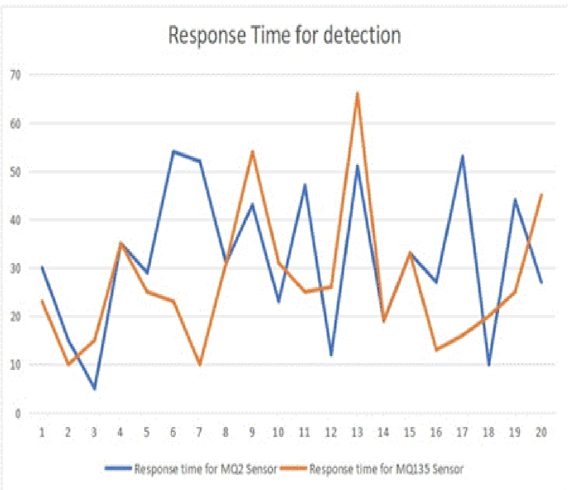


Figure 6: Graph showing the response time of the system

System performance based on accuracy

Apart from the average response time, the system was also evaluated using accuracy. During the testing, the system was exposed to different conditions. Out of the twenty (20) tests, the system was able to detect smoke successfully fifteen (15) times, the system was able to detect smoke successfully and message sent to different outputs as indicated in section 3.0. Using Equation 2, the percentage accuracy of the system is 75%. This value is comparable to the result obtained in the work of Chakraborty *et al*., 2023. The test was also conducted by exposing the system to perfume and the system was able to detect it and send a message to all the output platforms, as discussed in Section 3.0. Out of the twenty (20) attempts, fourteen (14) were successful. Using equation (3.2), the percentage accuracy of the system in response to perfume is 70%. Although this value is slightly lower than some of the related works, this work has an advantage in terms of response time lower than most of the related works, as well as an alarm system and LED indicator purposely designed for physically challenged and children with asthmatic symptoms.

CONCLUSION

In this work, a real-time system for detection of substances that could trigger an asthma attack has been developed and successfully tested. The system effectively addresses a critical need in asthma care by providing a real-time air quality monitoring solution that detects perfume and smoke, alerting the patient, medical team, and next-of-kin to take prompt action. Testing of the system revealed a 75% accuracy rate and an average response time of 27.23 seconds, demonstrating its practical utility across scenarios involving smoke and perfume. Evaluated at Elizade University, the prototype shows significant potential for portable, real-time air quality monitoring in diverse settings. Looking forward, this approach could serve as a foundation for broader healthcare applications, supporting other environmentally sensitive groups, with future enhancements possibly including additional sensors to boost sensitivity. Also, the accuracy of the system could be improved through the integration of machine learning models for better detection.

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