BreathX: A Personal Air Quality Checker using IOT

Kalpana Sonval[1], Krishna Yerne[2], Sejal Vairagade[3], Rutuja Shinde[4],
Nikita Shelar[5]

[1] Assistant Professor, [2,5] Students of Computer Engineering

[1-5] Department of Computer Engineering, SPPU University/Zeal College of Engineering and Research

[1]sonvalkalpana@gmail.com, [2]krishnayerne27@gmail.com , [3]sejalvairagade1305@gmail.com ,
[4]rutujas074@gmail.com
[5]shelarnikita611@gmail.com

Abstract— **Air pollution has become one of the most critical challenges in today's world, especially in urban areas like Delhi where the Air Quality Index (AQI) frequently rises to hazardous levels. Poor air quality leads to severe health issues including respiratory problems, allergies, and long-term diseases. However, individuals often lack real-time awareness about the actual quality of the air they breathe.To address this issue, we have developed "Breath X – The Personalized Air Quality Monitor System", an IoT-based solution that provides real-time monitoring of environmental parameters. The system is built using a NodeMCU (ESP8266) microcontroller integrated with sensors such as DHT11 for temperature and humidity, MQ135 for detecting gas concentration, and an ultrasonic sensor for smart system activation. An OLED display presents the readings instantly, while the data is simultaneously uploaded to the ThingSpeak cloud platform for visualization and storage.The proposed system not only displays real-time environmental conditions but also lays the foundation for future enhancements like integration of PM2.5/PM10 sensors, mobile notifications, and personalized health recommendations. With its low cost, portability, and cloud connectivity, Breath X has the potential to become a personal environmental companion, empowering individuals to make informed health and lifestyle decisions in polluted environments.**

Keywords—Air Quality Monitoring, IoT, NodeMCU (ESP8266), DHT11, MQ135, Ultrasonic Sensor, OLED Display, ThingSpeak, Cloud Computing, Personalized Health Insights, Smart Environment, Real-Time Monitoring.

I. INTRODUCTION

Air pollution has become one of the most critical environmental and health challenges of the 21st century. Rapid urbanization, industrialization, vehicular emissions, construction activities, and seasonal crop burning have all contributed to rising levels of pollutants in the atmosphere. Cities like Delhi, for instance, frequently experience hazardous levels of smog and particulate matter, pushing the Air Quality Index (AQI) to levels far beyond the safe limit. According to several health reports, long-term exposure to polluted air can lead to respiratory diseases, cardiovascular problems, and reduced life expectancy. This situation highlights the urgent need for innovative solutions that can help individuals monitor, understand, and respond to changes in air quality around them.

Traditionally, air quality monitoring has been carried out using large, expensive, and stationary government-operated monitoring stations. While these stations provide accurate data, they are limited in number and cannot provide localized, personalized, or real-time insights to the general public. Individuals often lack access to the information that can directly help them make decisions such as whether it is safe to go outside, when to use masks, or when to use air purifiers. Hence, there is a strong demand for cost-effective, portable, and user-friendly systems that empower people to stay informed about their immediate air environment.

With the rapid development of the Internet of Things (IoT) and sensor technologies, it has become possible to design compact devices that can sense, process, and transmit data in real time. IoT-enabled systems offer advantages such as remote accessibility, cloud integration, and the ability to analyze and visualize data through dashboards and mobile applications. Such systems not only raise awareness but also enable users to take preventive actions to safeguard their health.

In this context, our project introduces "Breath X – The Personalized Air Quality Monitor System." Breath X is a smart IoT-based device designed to monitor environmental parameters such as temperature, humidity, and gas concentration. The system is built around the NodeMCU (ESP8266) microcontroller, which provides both processing capability and Wi-Fi connectivity. Sensors like DHT11 (for temperature and humidity) and MQ135 (for gas detection) are integrated into the system, while an ultrasonic sensor is used for automated system activation based on proximity. The results are displayed on an OLED screen in real time, and the collected data is also uploaded to the ThingSpeak cloud platform for storage, visualization, and analysis.

The novelty of Breath X lies in its potential to provide personalized health-related insights. Unlike traditional monitoring devices that only display numbers, our system can be extended to give health-specific recommendations, alerts, and warnings tailored to users, especially those with conditions such as asthma or respiratory sensitivity. With future improvements such as the addition of PM2.5/PM10 sensors, mobile app integration, and AI-driven predictive analytics, Breath X can evolve into a comprehensive solution that not only monitors but also intelligently guides individuals to make better lifestyle and health decisions.

Thus, Breath X represents a step towards bridging the gap between large-scale environmental monitoring and individual awareness, providing people with real-time, personalized air quality data in a cost-effective and accessible manner.

II. Literature Review

Air quality monitoring has been a subject of extensive research due to the increasing impact of pollution on human health and the environment. Several studies and systems have been developed using different sensing technologies, communication protocols, and IoT platforms to measure and analyze air quality. A review of the existing literature provides a strong foundation for understanding the challenges, limitations, and advancements in this domain.

1. Traditional Monitoring Systems

Conventional air quality monitoring is largely carried out by government-operated stations that employ high-cost and high-precision equipment to detect pollutants such as PM2.5, PM10, SO2, CO, O3, and NO2. While these systems are accurate, they are limited in number and geographically sparse. As a result, they cannot provide localized or real-time updates to individuals at the ground level. This gap has motivated the development of portable and IoT-based systems.

2. IoT-Based Air Quality Monitoring

In recent years, researchers have leveraged the Internet of Things (IoT) to design low-cost and scalable monitoring systems. IoT-enabled devices are equipped with microcontrollers, sensors, and communication modules to collect and transmit data to cloud platforms. For instance, several studies have used Arduino, Raspberry Pi, or NodeMCU with sensors such as MQ-series gas sensors and DHT sensors to measure pollutants and environmental parameters. Data visualization is often performed using cloud services like ThingSpeak, Blynk, or Firebase, enabling remote monitoring and analytics.

3. Sensor Technologies for Air Quality

Different sensors have been employed to monitor air quality. Gas sensors such as MQ135 are widely used to detect CO2, NH3, benzene, alcohol, and smoke. Particulate matter sensors like PMS5003 and SDS011 are more advanced and provide direct readings of PM2.5 and PM10 concentrations. Temperature and humidity sensors such as DHT11 and DHT22 are integrated to support AQI calculations, as these environmental factors influence pollution dispersion and sensor accuracy. However, low-cost sensors often face calibration challenges, which researchers attempt to solve using machine learning models or cloud-based corrections.

4. Cloud Platforms and Data Visualization

ThingSpeak has emerged as a popular cloud platform in research projects because it offers easy integration with IoT devices, free academic usage, and built-in MATLAB analytics. Other alternatives such as Adafruit IO, Firebase, and AWS IoT are also used, but they require additional programming effort or higher costs. Literature suggests that cloud platforms not only allow data storage and visualization but also enable predictive modeling for future air quality trends.

5. Gaps and Limitations in Existing Work

Although many IoT-based systems have been proposed, several limitations remain. First, most systems are prototypes limited to a single location and lack portability. Second, many systems only display numerical values without offering personalized insights or recommendations for users. Third, while pollutant monitoring is achieved, few systems integrate health awareness or tailor data for vulnerable populations such as asthma patients. These gaps highlight the need for a user-centered, personalized, and portable air quality monitoring system.

6. Positioning of Breath X

The review of literature demonstrates the potential of IoT technologies in bridging the gap between traditional monitoring stations and individual awareness. Our project, "Breath X – The Personalized Air Quality Monitor System," builds upon this foundation by integrating low-cost sensors (DHT11, MQ135), real-time OLED display, ultrasonic activation for smart control, and ThingSpeak cloud connectivity for remote monitoring. Unlike many existing systems, Breath X emphasizes personalization and future scalability. With enhancements such as PM2.5/PM10 sensors, mobile notifications, and AI-driven insights, the system can contribute meaningfully to both academic research and practical applications in highly polluted regions like Delhi.

In summary, the literature reveals a growing trend of IoT-based solutions for environmental monitoring, but there remains a strong demand for systems that are cost-effective, portable, user-friendly, and personalized. Breath X aims to address these gaps by providing a comprehensive, scalable, and impactful solution for air quality monitoring.

III. Material and Methodologies:

This proposed personalized air quality monitoring system, titled "Breath X", leverages IoT-enabled embedded hardware for real-time environmental data acquisition and analysis. Utilizing sensors such as MQ135 for gas detection and DHT11 for temperature and humidity measurement, along with an ultrasonic sensor for proximity-based activation, the system ensures both accuracy and energy efficiency. The NodeMCU ESP8266 microcontroller serves as the processing and communication hub, converting sensor inputs into user-friendly outputs displayed on a 128x64 OLED screen.

For cloud-based monitoring, the system integrates with ThingSpeak IoT analytics platform, enabling secure data storage, real-time visualization, and trend analysis. Data preprocessing involves calibration of raw sensor values and normalization for consistency across varying environmental conditions. The software stack is implemented in Arduino IDE using embedded C/C++ with Wi-Fi protocols for seamless data transmission.

The architecture emphasizes portability, personalization, and scalability, supporting future extensions such as mobile app integration, push notifications, and AI-driven air quality predictions. Optimization focuses on reducing power consumption through smart activation and efficient update cycles, making the system practical for daily usage. The proposed *Breath X* framework demonstrates a cost-effective, reliable, and user-centric approach to localized air quality monitoring, particularly relevant in high-pollution environments such as urban areas.

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 10 | Oct - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

IV. Proposed Model

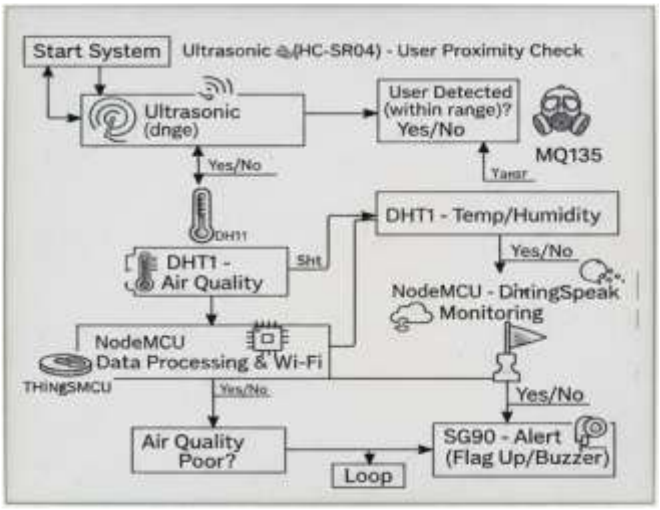

Figure 1 Proposed Model

The proposed model, Breath X – Personalized Air Quality Monitoring System, is designed to provide real-time monitoring of environmental conditions using IoT-based hardware and cloud integration. The system uses MQ135 gas sensor to detect harmful gases, DHT11 to measure temperature and humidity, and an ultrasonic sensor for smart proximity-based activation. NodeMCU ESP8266 acts as the central controller, processing sensor data and displaying it on a compact OLED screen.

For remote monitoring, the data is transmitted to the ThingSpeak cloud platform, where it is stored, visualized, and analyzed through interactive graphs. This makes the system accessible both locally (via OLED display) and globally (via cloud dashboard). The model ensures portability, low-cost implementation, and user personalization, making it suitable for individuals in high-pollution environments.

Proposed Model

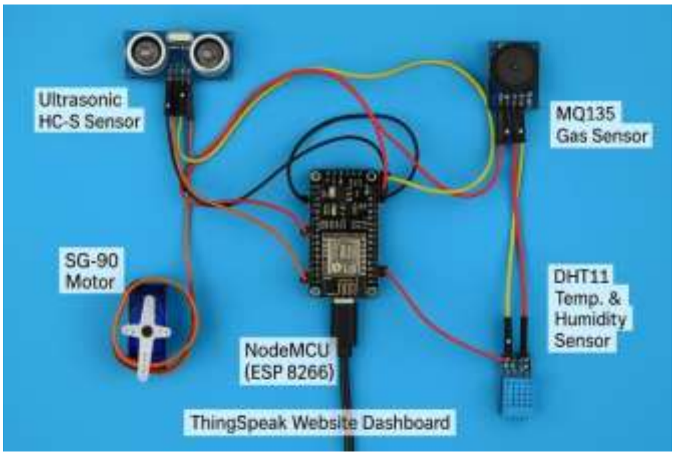

Figure 2: Proposed Model

Observation and conclusion

1. The system successfully measured temperature, humidity,and gas concentration (air quality index) in real-time using DHT11 and MQ135 sensors.
2. The ultrasonic sensor was used to enable a proximity-based activation mechanism, ensuring that the system works when a user is nearby, thus saving power.
3. The OLED display provided instant and clear feedback to users with real-time readings.
4. The integration with ThingSpeak Cloud allowed efficient data logging, storage, and visualization, making it possible to track long-term environmental conditions remotely.
5. Observations showed that gas sensor values spiked significantly in polluted or enclosed environments, validating the sensor's ability to detect poor air quality.
6. Humidity and temperature values were consistent with expected environmental conditions, ensuring reliability.
7. Overall, the system demonstrated low cost, portability, and accuracy, making it feasible for personal and community-level deployment.

References

[1] M. Osmani, B. Hoxha, A. Mazrreku, G. Koduzi, A. Skenderi, S. Osmani, and E. Hoxha,
"Tackling Pollution Through Data: Air Quality Monitoring," in Proc. 12th Int. Eur. Conf.
Interdisciplinary Scientific Research, Roma, Italy, Jul. 2025.

[2] M. H. Mahmood, K. T. Y. Kamal, and S. S. Hussein, "Monitoring Indoor Air Quality
Using Low-Cost IoT," Journal of Techniques, vol. 7, no. 2, pp. 21–28, Jun. 2025
.

[3] G. Tamrakar, R. Sharma, and S. Rohilla, "Smart IoT-Based Air Quality Monitoring and
Alert System for Urban Environments," International Journal of Environmental Sciences,
vol. 11, no. 2, pp. 628–632, 2025.

[4] M. Hameed, "Monitoring Indoor Air Quality Using Low-Cost IoT (Preprint Variant),"
Technical Journal (ResearchGate Preprint), Jan. 2025.

[5] M. E. Karar, A. M. Al-Masaad, and O. Reyad, "GASDUINO – Wireless Air Quality
Monitoring System Using IoT," Information Sciences Letters, vol. 9, no. 2, pp. 113–117,
May 2020