Journal of
Telecommunication, Switching
Systems and Networks

ISSN: 2454-6372
Volume 12, Issue 2, 2025
May–August
DOI (Journal): 10.37591/JoTSSN

https://journals.stmjournals.com/jotssn

Research JoTSSN

IoT Based Air and Sound Pollution Monitoring System

Palve Pragati Shahurao[1], Wavhal Pranav Sachin[1,*], Mhaske Preeti Dnyaneshwar[1],
Vanjari Vishwajeet Sampat[1], P.S. Kedge[2]

Abstract

One of the most important and significant elements influencing human lives and health, as well as the health of living things and the natural or constructed environment, is environmental pollution. The low-cost environmental pollution monitoring system described in this study will be used to measure temperature, dust, sound pollution, and highly toxic gases such as CO_2, CO, and CH_4. It was created based on user needs to identify and prevent exposure to air and noise pollutants. The system is made up of several temperature, sound, dust, and gas sensors that are all combined onto one platform. This is one of the most important concerns for maintaining human life and ensuring that humans cohabit peacefully. One of the most important concerns for the continued existence of peaceful cohabitation between humans and environment is this. The first stage in developing a remedy is assessing the damage and, if necessary, implementing preventative and eradication actions. The Internet of Things' developing technology offers a wide range of possible models for the aforementioned uses. The study that follows sheds light on a few of the models that were assessed and compares them all in order to investigate the field. This project suggests a GSM and ThingSpeak-based Internet of Things-based air and sound monitoring system. The system integrates sensors to monitor air quality and sound levels, sending SMS alerts via GSM when thresholds are exceeded. Data is also updated on ThingSpeak for real-time monitoring. An LCD module displays local readings.

Keywords: Arduino 328 SMD, air sensor, sound sensor, IoT module, GSM, buzzer

INTRODUCTION

Among the most pressing worldwide issues of the 21st century are environmental pollution, especially air and sound pollution, and the escalating threat of climate change. In addition to harming ecosystems, these environmental stresses seriously endanger human health and welfare. The degradation of environmental quality is mostly caused by unrestrained industry, rapid urbanization, and the growing number of automobiles on the road. The major causes of the concerning pollution levels in many cities worldwide include harmful emissions and noise from manufacturing, transportation, and urban infrastructure [1–3].

Numerous health problems, such as cardiovascular illnesses, hearing loss, mental stress, and respiratory ailments, have been connected to these pollutants. Furthermore, extended exposure to these environmental factors damages flora and animals and disturbs biodiversity. Effective and trustworthy environmental monitoring systems are crucial to reducing these negative consequences and implementing prompt preventive actions. However, conventional air and sound monitoring techniques, which mostly rely on human data gathering and

*Author for Correspondence
Wavhal Pranav Sachin
E-mail: pranavwavhal9921@gmail.com

[1]Research Scholar, Department of Computer Engineering, Rajgad Dnyanpeeth Technical Campus, Pune, Maharashtra, India
[2]Professor, Department of Computer Engineering, Rajgad Dnyanpeeth Technical Campus, Pune, Maharashtra, India

Received Date: April 01, 2025
Accepted Date: April 22, 2025
Published Date: May 24, 2025

Citation: Palve Pragati Shahurao, Wavhal Pranav Sachin, Mhaske Preeti Dnyaneshwar, Vanjari Vishwajeet Sampat, P.S. Kedge. IoT Based Air and Sound Pollution Monitoring System. Journal of Telecommunication, Switching Systems and Networks. 2025; 12(2): 6–12p.

fixed-location monitoring stations, are frequently out of date. These systems typically lack real-time data, have limited coverage, and are costly to operate. Effective decision-making is hampered by their inability to scale and respond, particularly in urban and industrial settings that are changing quickly [4].

The collection and analysis of environmental data has been completely transformed by recent developments in wireless communication and the Internet of Things (IoT). IoT-based monitoring solutions offer a highly efficient, scalable, and affordable substitute for conventional techniques. These systems automatically gather environmental data, including temperature, humidity, sound levels, and air quality indices, using a network of linked sensors and smart devices. IoT-based solutions, as opposed to traditional monitoring systems, eliminate the need for manual intervention by enabling continuous, real-time data collecting and remote access to vital information. Real-time warnings and data-driven decision-making are two of the main advantages of IoT-enabled monitoring. Through integrated systems, sensors can immediately notify stakeholders of changes in air and sound pollution levels. In addition to enhancing response to environmental threats, this proactive strategy aids in long-term planning and sustainability-focused policymaking [5]. The usefulness of IoT-based environmental monitoring systems is further improved by the incorporation of GSM (Global System for Mobile Communications) technology. Even in places with inadequate internet connectivity, remote data access and control are made possible by GSM's dependable and secure data transfer across long distances. This increases the system's reach and dependability by guaranteeing that environmental data may be continually monitored and retrieved from almost anywhere.

In conclusion, a potent answer for contemporary environmental monitoring is provided by the confluence of IoT and GSM technologies. These intelligent systems' real-time, scalable, and remote monitoring features help them get beyond the drawbacks of conventional techniques. They are essential in tackling today's escalating environmental issues and laying the groundwork for a cleaner, healthier, and more sustainable future by facilitating more accurate monitoring of air and sound pollution.

MOTIVATION

Environmental contamination poses a serious risk to both ecological equilibrium and public health. The need for an efficient and cost-effective sound pollution monitoring system is crucial due to the following reasons.

Reduced Risk of Respiratory Diseases

Chronic exposure to contaminated air can cause lung infections, bronchitis, and asthma, among other respiratory conditions. Monitoring air quality helps in taking preventive measures.

Decreased Risk of Cardiovascular Diseases

Heart attacks and strokes are made more likely by air pollutants such CO, CO_2, and CH_4, which also contribute to cardiovascular illnesses. Early detection can help mitigate these risks.

Improved Mental Health and Well-being

Stress, anxiety, and disturbed sleep are known to be exacerbated by noise and air pollution. A monitoring system can help create awareness and promote healthier living conditions [6].

Enhanced Public Health Awareness

Real-time monitoring and data-sharing platforms (like ThingSpeak) educate the public and authorities about sound pollution levels, encouraging proactive measures.

Early Warning Systems for Health Risks

IoT-enabled systems can trigger alerts when sound pollution levels exceed safe limits, allowing timely actions to prevent health hazards.

OBJECTIVES

1. Investigate the impact of air and sound pollution on public health.
2. Analyse the effectiveness of IoT-based monitoring systems.
3. Explore machine learning applications for predictive modelling.
4. User-friendly interface for data visualization and analysis.
5. Scalability to support multiple locations for environmental monitoring.

SCOPE

1. *Multi-pollutant monitoring:* The system measures air quality parameters such as CO_2, CO, CH_4, temperature, humidity, dust, and noise levels [7].
2. *IoT-based real-time data transmission:* The system continuously collects environmental data and transmits it to a cloud-based platform (ThingSpeak) for real-time access.
3. *Alert mechanism:* GSM-based SMS alerts notify users when sound pollution thresholds are exceeded, ensuring timely action.
4. *Integration with smart city initiatives:* The project aligns with smart city frameworks to enhance environmental management and urban planning.

LITERATURE SURVEY

A study describes that air monitoring is crucial to human existence; it is crucial to gather data on the temporal dynamics of air changes. It is crucial to keep an eye on the air during certain threats in any sector. This study's main goal is to provide an embedded system for designing an air monitoring system that allows industry-wide air parameter monitoring. Such a setup has an LPC1768 microprocessor (ARM9) and two sensors that measure temperature, gas, and humidity. The microcontroller collects the data from the sensors and uses serial communication to deliver the data to LABVIEW, which stores the data on an Excel document and allows us to receive SMS messages on our mobile devices using the GSM module. The LPC1768 (ARM9) microcontroller serves as the foundation for the system's little circuitry. Embedded C programs are created with the Keiluvision4 IDE. Programs are loaded into microcontrollers via JTAG [5–7].

A study investigated that the technology presented in this study is a cutting-edge way to keep an eye on the air quality at a specific location and display the data globally. The Internet of Things (IoT), a sophisticated and effective way to connect objects to the internet and link the entire universe of things in a network, is the technology underlying this. Here, items might include everything from sensors to electronic devices to automobile electronics. The system uses sensors to measure and regulate environmental parameters including temperature, relative humidity, light intensity, and CO_2 level. The data is then sent to a web page, where it is shown as graphical statistics. Anywhere in the globe may obtain the updated data from the established system over the internet [8].

A study highlights the critical situation in a country with an extremely low supply-to-demand ratio, such as India. Our goal in this research is to pinpoint the regions where solar and wind energy may be produced at a reasonable cost. This is accomplished by keeping an eye on atmospheric parameters including temperature, humidity, wind speed, and light intensity. Our idea is based on a sensor-equipped remotely controlled system that collects air data and sends measured values to the ground. In this study, we have examined many approaches for designing an atmospheric air monitoring system that is affordable, long-lasting, and resilient to harsh air conditions. It is predicted that the system will cost close to $ 30. It is a very helpful tool in a nation like India and is incredibly dependable and deployable [9].

Air pollution causes millions of premature deaths each year. In cities, where the air is laden with harmful particles and gases from factories, power plants, and automobiles, many fatalities take place. Additionally, the COVID-19 epidemic has raised awareness of the significance of indoor and outdoor air quality monitoring. However, because of their high cost, the available data are specifically restricted for usage by organizations and are not generally available to the public. The goal of the project is to create an inexpensive air quality monitoring instrument that measures NO_x, SO_x, CO, O_3, $PM_{2.5}$, temperature, and humidity. An Internet of Things (IoT) solution based on inexpensive sensors and an open-source Arduino system was used to create the Air Quality Monitoring Prototype (AQMP) prototype. Every minute, data for the parameters NO_x, SO_x, CO, O_3, $PM_{2.5}$, temperature, and humidity are captured and kept in a database. The cloud is used for data transfer, and the web and cell-phones are used for presentation. The steps of the process include system design, hardware selection and construction, software installation, and testing. However. Various amounts of chromium (Cr) were added to zinc oxide (ZnO) nanofibers (NFs) by electrospinning (ES), and pyrolysis was performed at 600°C to form pure and Cr-doped ZnO NFs. The morphology, structure and optical properties of the NFs were characterized using scanning electron microscopy (SEM), X-ray diffraction (XRD) and ultraviolet-visible spectroscopy (UV-Vis). It was found that the structure of the NFs became rougher, and the diameter decreased with the increase of the Cr content. The maximum diameter of 150 nm was observed for 4 w% Cr-doped ZnO NFs. The bandgap energy decreased as the doping concentration increased [10].

GAP ANALYSIS

Existing Air and Sound monitoring systems face several limitations that reduce their effectiveness. Traditional monitoring stations are fixed in specific locations, making it difficult to collect data from remote or less accessible areas. Furthermore, these systems are not feasible for widespread deployment due to the high cost of installation and maintenance. A lot of traditional techniques also depend on human data collecting, which is laborious and prone to mistakes and delays. Another major drawback is the lack of real-time alerts, as many systems do not provide immediate notifications when Sound pollution levels exceed safe thresholds, preventing timely interventions. Furthermore, limited accessibility of data restricts public awareness and decision-making by authorities. To address these issues, there is a need for a cost-effective, automated, and real-time monitoring system that provides accurate environmental data with remote access and instant alerts, ensuring better management of Sound pollution and Air conditions.

PROPOSED SYSTEM

The proposed system is an IoT and GSM-based Air monitoring and Sound pollution monitoring system designed to provide real-time environmental data with remote accessibility. It consists of IoT sensors that measure parameters such as temperature, humidity, air quality, and harmful gas levels, which are processed by a microcontroller (such as Arduino or Raspberry Pi). A GSM module is then used to send the gathered data to a distant database or cloud server for analysis, storage, and display. Users can access the data through a web or mobile application, allowing for real-time monitoring and historical trend analysis. Additionally, the system includes an automated alert mechanism that sends SMS or email notifications if Sound pollution levels exceed predefined safety thresholds. Designed to be cost-effective, scalable, and energy-efficient, the system can be deployed in urban areas, industrial zones, and remote locations, making it an ideal solution for smart city initiatives and environmental management.

Architecture

IoT based air and sound pollution monitoring system (Figure 1):

- *IoT sensors collect real-time data:* Sensors gather raw data from the environment (e.g., temperature, motion, humidity).
- *Pre-processing:* The data is cleaned and possibly filtered or compressed to reduce noise and make it suitable for transmission.
- *Transmission stage:* The pre-processed data is sent to a central system, often via wireless networks.
- *Storage stage:* Data is stored in a database or cloud platform for later access and analysis.
- *Analysis stage:* Analytical models or algorithms interpret the data to extract insights or detect anomalies.
- *Output stage:* Results of the analysis are prepared for presentation; this could be visual dashboards or automated responses.

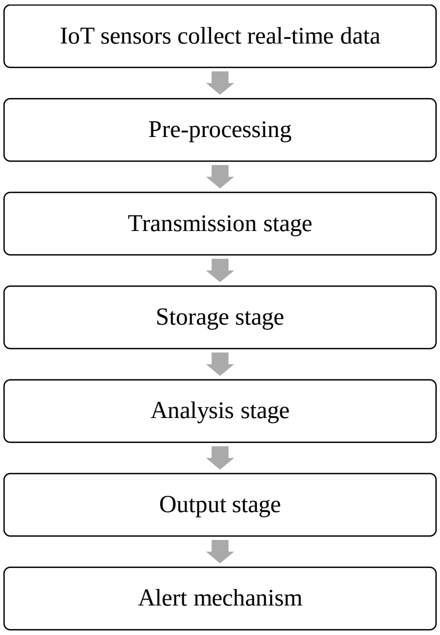

Figure 1. IoT Based air and sound pollution monitoring system.

- *Alert mechanism:* If the analysis detects predefined thresholds or patterns, alerts are triggered (e.g., notifications, emails, alarms).

Algorithm

The operational flow of the proposed air and sound pollution monitoring system commences with the crucial initialization of IoT sensors and the establishment of reliable communication via the GSM module. Following this setup, the system actively reads environmental data, specifically focusing on air quality parameters and sound levels [8]. The collected data then undergoes a critical comparison against predefined safety thresholds. Should these thresholds be exceeded, an immediate alert is triggered and dispatched as an SMS message through the GSM network, ensuring timely notification of potential environmental hazards. Simultaneously, the gathered data is also transmitted and updated on the ThingSpeak platform, facilitating remote access and analysis. For immediate local awareness, the measured readings are displayed on an integrated LCD module. This cyclical process, starting from data acquisition to threshold comparison, alert generation, remote data update, and local display, repeats continuously, ensuring consistent and real-time environmental monitoring. Following are the steps.

- *Step 1.* Initialize IoT sensors and establish GSM communication.
- *Step 2.* Read air quality and sound level data.
- *Step 3.* Compare data with predefined thresholds.
- *Step 4.* Send SMS alert via GSM if thresholds exceeded.
- *Step 5.* Update data on ThingSpeak.
- *Step 6.* Display local readings on LCD module.
- *Step 7.* Repeat steps 2–6.

RESULTS AND DISCUSSION

Temperature, humidity, air quality, and noise levels are all efficiently measured by the suggested IoT and GSM-based air and sound pollution monitoring system employing real-time sensors. Remote access and storage are made possible via the GSM transmission of data to a cloud platform. To ensure prompt actions, the system sends out SMS notifications when pollution levels reach above predetermined criteria. Local readings are shown via an LCD module, while trend analysis and historical data are provided by the cloud platform [5]. This technology supports smart city projects and is scalable, making

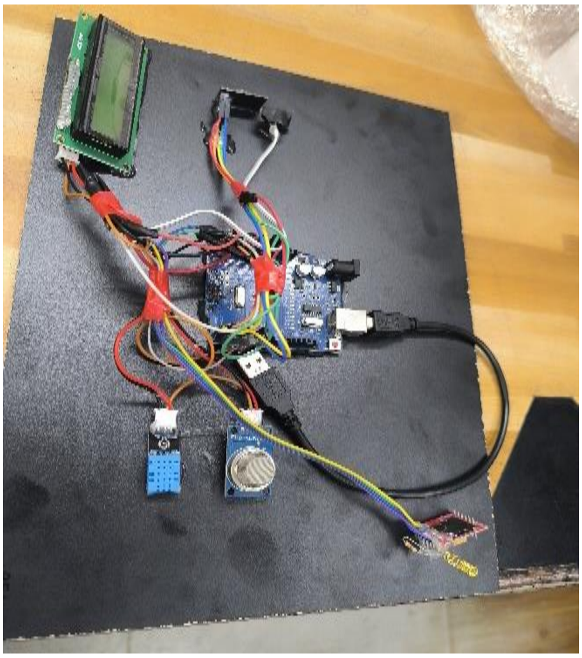

Figure 2. Setup of IoT based air and sound pollution monitoring system.

it perfect for urban and industrial zones. This system provides real-time monitoring and alarms, which makes it more economical and effective than traditional approaches that depend on permanent stations and manual data collecting. The device helps reduce health hazards related to air and sound pollution by offering real-time warnings and ongoing data. It is a useful instrument for improving environmental management and public health. Figure 2 represents the setup of IoT based air and sound pollution monitoring system.

CONCLUSION

The IoT and GSM-based Air monitoring and Sound Monitoring system provides an efficient, real-time, and automated solution for tracking environmental conditions. By integrating IoT sensors, microcontrollers, and GSM technology, the system ensures continuous data collection, remote accessibility, and instant alerts, addressing the limitations of traditional monitoring methods. Its ability to provide accurate and real-time environmental data makes it highly useful for government agencies, environmental organizations, and smart city initiatives. The system's scalability and cost-effectiveness allow for widespread deployment, contributing to better air quality management and proactive decision-making. By leveraging modern technology, this solution enhances environmental monitoring, public safety, and sustainable urban development, making it a valuable tool for combating Sount and climate change.

REFERENCES

1. Alam GJ. Environmental pollution of Bangladesh—it's effect and control. Pulp and Paper. 2009; 51: 13–17.
2. WHO. Burden of disease from household air pollution for 2012. World Health Organization Global Health Risks. Geneva, Switzerland: WHO; 2014; 1–17.
3. Gonzalez T. PHE 302 Social and Environmental Determinants of Health. New York: City University of New York (CUNY); 2024.
4. Chriscaden K, Osseiran N. (2016 Sep). WHO releases country estimates on air pollution exposure and health impact. [Online]. World Health Organization. https://tinyurl. com/um4bk6j8.
5. Pope Iii CA, Burnett RT, Thun MJ, Calle EE, Krewski D, Ito K, Thurston GD. Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution. JAMA. 2002 Mar 6; 287(9): 1132–41.

6. Fine GF, Cavanagh LM, Afonja A, Binions R. Metal oxide semi-conductor gas sensors in environmental monitoring. Sensors. 2010 Jun 1; 10(6): 5469–502.
7. World Health Organization. WHO guidelines for indoor air quality: selected pollutants. WHO guidelines for indoor air quality: selected pollutants. WHO; 2010.
8. Thaker T. ESP8266 based implementation of wireless sensor network with Linux based web-server. In 2016 IEEE Symposium on Colossal Data Analysis and Networking (CDAN). 2016 Mar 18; 1–5.
9. Asghar MH, Negi A, Mohammadzadeh N. Principle application and vision in Internet of Things (IoT). In IEEE International Conference on Computing, Communication & Automation. 2015 May 15; 427–431.
10. Rajesh V, Prabhu NN, Shivamurthy B. Acetone vapor sensing characteristics of Cr-doped ZnO nanofibers. Cogent Eng. 2024;11:2311090. doi:10.1080/23311916.2024.2311090.

