International Journal of Scientific Research and Engineering Development-– Volume X Issue X, Year

Available at www.ijsred.com

RESEARCH ARTICLE OPEN ACCESS

AIR POLLUTION MONITORING SYSTEM

1. Student Computer Engineering, DR. D. Y. Patil polytechnic, Kolhapur
   Sanika Sandip Gurav
   Email: sanikagurav7910@gmail.com
2. Student Computer Engineering, DR. D. Y. Patil polytechnic, Kolhapur
   Tanvi Sachin Potdar
   Email: tanvipotdar63@gmail.com
3. Student Computer Engineering, DR. D. Y. Patil polytechnic, Kolhapur
   Pragati Sunil Rokade
   Email: pragati210706@gmail.com
4. Student Computer Engineering, DR. D. Y. Patil polytechnic, Kolhapur
   Bapu Uttam Gadhave
   Email: gadhavebapu07@gmail.com

----------**********----------

ABSTRACT:

*Air pollution is a major problem that affects health and the environment. This **Air Pollution Monitoring System** helps check air quality from anywhere using a computer or mobile device. The system detects harmful gases like **CO_2, smoke, alcohol, benzene, and NH_3** and measures air quality in **PPM (Parts Per Million)**. It displays real-time air pollution levels on an **LCD screen** and a **web server**, making it easy to monitor air conditions.*

Unlike old systems where people had to carry devices to check air quality, this project allows remote monitoring, making it more convenient and efficient. The system helps people stay aware of dangerous air conditions and understand pollution levels in different locations. It provides a simple and effective way to track air pollution and its harmful effects.

Keywords: *Air Pollution Monitoring, Real-time Air Quality Detection, PPM Measurement, Harmful Gas Detection, Remote Monitoring, Web-based System.*

----------**********----------

I. INTRODUCTION

Air pollution is a serious environmental issue that affects human health, plants, animals, and the overall climate. Rapid urbanization, industrialization, and the increasing use of vehicles have led to a significant rise in air pollution levels. Harmful gases such as CO_2, smoke, alcohol, benzene, and NH_3 mix with the air and make it dangerous to breathe. Prolonged exposure to polluted air can cause respiratory diseases, heart problems, and other serious health issues. Therefore, monitoring air pollution is essential to understand its impact and take necessary precautions.

Traditional air monitoring systems required people to carry specialized devices to different locations to measure pollution levels. This process was time-consuming, inconvenient, and not suitable for continuous monitoring. Additionally, these older systems often lacked real-time data accessibility, making it difficult to track pollution changes instantly. To overcome these limitations, the need

for a remote and efficient air quality monitoring system has become increasingly important.

This project introduces an Air Pollution Monitoring System that allows users to check air quality remotely using a computer or mobile device. The system measures pollution levels in PPM (Parts Per Million) and displays the data on an LCD screen as well as a web server. By using this system, people can monitor air quality in different locations without needing to carry physical devices. The ability to check real-time pollution data makes it easier to identify high-risk areas and take preventive measures.

By continuously tracking air quality, this system helps individuals, researchers, and environmental agencies gain better insights into pollution trends. It enables people to make informed decisions, such as avoiding highly polluted areas or implementing pollution control measures. The system makes air quality monitoring more accessible, efficient, and useful for everyday life, contributing to a cleaner and healthier environment.

II. LITERATURE SURVEY

Nihal Kularatna's study highlights the increasing environmental pollution caused by industries, automobiles, and other human activities, leading to severe consequences such as climate change, ozone depletion, and health issues like lung diseases and chronic conditions. The research effectively raises awareness about the dangers of pollution and underscores the necessity for stricter regulations to control industrial emissions. However, while the study provides valuable insights into pollution sources and their impact, it lacks practical solutions or mitigation strategies to address these environmental concerns. This gap suggests the need for further research focusing on sustainable practices and effective pollution control mechanisms.

Vijay Sivaraman discusses the critical issue of air pollution and its impact on human health, emphasizing that poor air quality contributes to millions of deaths worldwide. Chronic exposure to pollutants significantly increases the risk of cardiovascular and respiratory diseases, while short-term exposure can worsen pre-existing conditions like asthma and heart disease. The growing awareness of air pollution has led to an increased demand for monitoring systems and stricter environmental regulations. However, despite these efforts, controlling pollution effectively remains a challenge, particularly in highly industrialized areas and developing countries where regulatory enforcement and pollution management strategies are often inadequate.

Shaohang Zhao highlights the increasing concerns of air pollution due to industrial and transportation developments, particularly in developing countries. Traditional air quality monitoring stations, while accurate, are costly and require extensive maintenance, limiting their widespread deployment. To address this, the study explores Low Power Wide Area (LPWA) technology, which enables a cost-effective and energy-efficient IoT-based air quality monitoring system. The integration of wireless sensor networks (WSNs) allows real-time data transmission, making monitoring more effective and accessible. However, a significant challenge remains in the accuracy of portable air quality sensors, which, although efficient and easy to deploy, may not provide measurement precision comparable to traditional monitoring stations. Despite this, the use of LPWA for urban air monitoring presents a promising solution for smart city applications, improving spatial and temporal air quality data collection while reducing operational costs.

Kennedy Okokpujie's research highlights the significance of real-time air pollution monitoring in ensuring public health and safety. The study emphasizes how smart sensors, Arduino microcontrollers, and Wi-Fi modules can be integrated to collect and analyze air quality data remotely. The system provides a continuous, automated approach to monitoring pollutants like CO, CO_2, NOx, and SO_2, improving awareness and early detection of hazardous air conditions. However, the effectiveness of such systems is dependent on stable internet connectivity, which may be a limitation in areas with poor network infrastructure. Despite this challenge, the study demonstrates that IoT-based air monitoring systems can significantly enhance environmental protection efforts, providing real-time insights that help mitigate the risks associated with air pollution.

Ruma Ghosh's study focuses on the increasing demand for low-cost and low-power gas sensors for air pollution monitoring. With rising levels of toxic gases and volatile organic compounds (VOCs) in urban areas, particularly in developing countries, air pollution has become a major health concern. The study emphasizes that smart buildings can integrate sensors to detect and manage hazardous gases such as CO_2, CO, and BTEX. However, the research also highlights a key limitation—many populations still lack awareness about the severe long-

term effects of air pollution, which leads to inadequate preventive actions. The study underscores the urgent need for advanced air quality monitoring systems to mitigate health risks and improve overall air quality.

With increasing pollution due to industrial emissions, vehicle exhaust, and urbanization, monitoring air quality has become essential for public health. Ramik Rawal's research emphasizes the importance of real-time air quality monitoring using IoT technology, which provides users with instant access to pollution data through a web-based platform. This approach enhances accessibility and awareness of air pollution, helping in timely decision-making. However, despite its advantages, the system faces challenges such as sensor accuracy limitations and dependency on stable internet connectivity for real-time updates. Nonetheless, IoT-based air monitoring solutions continue to evolve, offering innovative ways to address environmental concerns effectively.

Ayush Agrawal's study explores the role of IoT in monitoring air pollution, emphasizing its real-time data collection capability. The integration of sensors like MQ6 and MQ135 with Arduino allows continuous tracking of harmful gases, providing instant alerts when pollution levels exceed safe thresholds. This low-cost and scalable approach makes air quality monitoring accessible for industrial and urban environments. However, the study also highlights the challenge of accuracy due to environmental interferences and the limitations of budget-friendly sensors. To enhance reliability, future developments should focus on advanced calibration methods and improved sensor technologies to ensure precise air quality assessment.

Kane V discusses the rising concerns of air pollution due to transportation, population density, and climate change. The study highlights the limitations of conventional air monitoring stations, including high costs and lack of scalability, leading to the adoption of IoT-based systems. These new technologies offer an alternative approach but still face challenges such as lower accuracy, network scalability, and limited spatial and temporal resolution. The research emphasizes the need for more efficient, user-friendly, and cost-effective air monitoring solutions to provide better data accessibility and real-time pollution tracking.

Yohan Han's study explores the impact of industrialization on air pollution and highlights the role of technological advancements in tackling this issue. The research introduces an innovative approach that integrates 5G wireless networks, IoT sensors, edge computing, and blockchain technology to monitor air pollution in real-time. The main advantage of this system is its ability to provide accurate, tamper-proof, and real-time air quality data through blockchain encryption and edge computing. However, the main limitation is the high infrastructure cost associated with 5G networks, blockchain implementation, and cloud services, making it difficult for widespread adoption in developing regions.

Kyle Tingey's study highlights the severe impact of urban air pollution on public health, particularly focusing on PM2.5, which has been linked to life-threatening conditions such as asthma, lung cancer, and heart disease. The research emphasizes that over 80% of urban populations are exposed to air quality levels exceeding WHO guidelines, with millions of premature deaths attributed to ambient air pollution. A major advantage of this study is its reliance on global health data, which strengthens its argument for urgent air quality improvements. However, a key limitation is the lack of discussion on real-time monitoring solutions or technological interventions to mitigate pollution effects. This underscores the need for integrating IoT-based monitoring systems and advanced air quality management frameworks to address urban pollution effectively.

III. CONCLUSION

Air pollution remains a critical environmental and public health challenge, exacerbated by rapid industrialization, increasing urbanization, and rising vehicle emissions. Various researchers have explored different approaches to monitoring and mitigating air pollution, leveraging advanced technologies such as IoT, blockchain, wireless sensor networks, and 5G connectivity. While traditional monitoring stations provide accurate data, their high cost, limited scalability, and inaccessibility hinder widespread adoption. On the other hand, modern IoT-based systems offer real-time monitoring, cost-effectiveness, and greater accessibility, but they often struggle with issues like data accuracy, network scalability, and compatibility.

The studies reviewed highlight the urgent need for efficient air pollution monitoring solutions that can provide real-time, accurate, and cost-effective data for policymakers, researchers, and the general public. Future research should focus on enhancing sensor accuracy, integrating advanced data analytics, and improving network infrastructure to ensure effective air quality management. By addressing these challenges, technological advancements can play a significant role in

mitigating air pollution and ensuring a healthier environment for future generations.

IV. REFERENCES

[1] Ayush Agrawal, "IoT-Based Air Pollution Monitoring System," Int. J. Eng. Res. Technol., vol. 8, no. 10, pp. 1234–1238, 2019.
[2] Kane V, "Air Quality Monitoring Using IoT," Int. J. Sci. Res., vol. 7, no. 5, pp. 150–155, 2018.
[3] Yohan Han, "Real-Time Air Pollution Monitoring Using 5G and Blockchain," IEEE Access, vol. 8, pp. 100–110, 2020.
[4] Kyle Tingey, "Urban Air Quality Monitoring with IoT Sensors," Environ. Sci. Technol., vol. 54, no. 14, pp. 8500–8508, 2020.
[5] N. Kumar and N. Kumar, "Air Pollution Monitoring for Health Research and Patient Care," Ann. Glob. Health, vol. 85, no. 1, pp. 1–8, 2019.
[6] S. K. Singh, "A Comprehensive Review on Indoor Air Quality Monitoring Systems for Enhanced Living Environments," Sustain. Environ. Res., vol. 30, no. 1, pp. 1–12, 2020.
[7] M. A. Hossain, "Air Quality Sensing and Monitoring: A Comprehensive Review," Int. J. Sci. Res. Publ., vol. 10, no. 5, pp. 225–235, 2020.
[8] J. M. Barcelo-Ordinas, "A Survey of Wireless Sensor Network Based Air Pollution Monitoring Systems," Sensors, vol. 15, no. 12, pp. 31392–31427, 2015.
[9] P. Ferrer-Cid, "Graph Signal Reconstruction Techniques for IoT Air Pollution Monitoring Platforms," IEEE Internet Things J., vol. 7, no. 8, pp. 7105–7117, 2020.
[10] H. Karnati, "IoT-Based Air Quality Monitoring System with Machine Learning for Accurate and Real-time Data Analysis," arXiv preprint arXiv:2307.00580, 2023.
[11] A. Gangwar, "The State-of-the-Art in Air Pollution Monitoring and Forecasting Systems using IoT, Big Data, and Machine Learning," arXiv preprint arXiv:2304.09574, 2023.
[12] I. Gryech, "Applications of Machine Learning and IoT for Outdoor Air Pollution Monitoring and Prediction: A Systematic Literature Review," arXiv preprint arXiv:2401.01788, 2024.
[13] M. M. Alam, "Air Quality Monitoring System Using IoT," Int. J. Eng. Adv. Technol., vol. 8, no. 6, pp. 3182–3186, 2019.
[14] S. R. Chowdhury, "Low-Cost Air Quality Monitoring Systems: A Review of Field Deployments, Applications, and Future Directions," Sci. Total Environ., vol. 667, pp. 390–403, 2019.
[15] A. Kumar, "Air Quality Monitoring System Based on IoT Using Raspberry Pi," Int. J. Innov. Technol. Explor. Eng., vol. 8, no. 6, pp. 247–251, 2019.
[16] S. Sharma, "IoT-Based Air Pollution Monitoring System Using Arduino," Int. J. Eng. Res. Technol., vol. 8, no. 5, pp. 227–230, 2019.
[17] M. S. Islam, "Development of an IoT Based Real-Time Air Quality Monitoring System," Int. J. Online Biomed. Eng., vol. 15, no. 12, pp. 45–58, 2019.
[18] P. S. Pillai, "Air Pollution Monitoring System Using IoT," Int. J. Eng. Res. Technol., vol. 8, no. 4, pp. 563–566, 2019.
[19] R. K. Kodali, "IoT Based Air Quality Monitoring System," in Proceedings of the 2017 International Conference on Control, Automation, Communication and Energy Conservation (INCACEC), 2017, pp. 1–5.
[20] S. Rajasegarar, "High-Resolution Air Quality Monitoring Using Mobile Sensing Networks," IEEE Internet Things J., vol. 6, no. 3, pp. 7324–7337, 2019.
[21] M. S. Hossain, "A Comprehensive Survey of IoT-Based Air Pollution Monitoring Systems," IEEE Access, vol. 7, pp. 25857–25876, 2019.
[22] A. P. Singh, "Real-Time Air Quality Monitoring System Using IoT," Int. J. Eng. Adv. Technol., vol. 8, no. 5, pp. 2522–2526, 2019.
[23] S. K. Gupta, "IoT-Based Air Pollution Monitoring and Prediction System," in Proceedings of the 2018 International Conference on Computing, Power and

Communication Technologies (GUCON), 2018, pp. 304–309.

[25] M. A. Hossain, "A Comprehensive Review on Air Pollution Monitoring and Health Effects with a Focus on Bangladesh," Int. J. Environ. Res. Public Health, vol. 16, no. 13, pp. 2485–2502, 2019.

[26] S. R. Chowdhury, "Low-Cost Air Quality Monitoring Technologies and Their

