Journal of Artificial Intelligence and Cyber Security (JAICS)
An International Open Access, Peer-Reviewed, Refereed Journal

GENERATIVE ARTIFICIAL INTELLIGENCE BASED SMART AIR QUALITY MONITORING SYSTEM

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ABSTRACT Air pollution is a growing problem that affects both human health and the environment. To tackle this issue, we have developed an AI-based air quality monitoring system that uses API keys to gather real-time data from various sources instead of relying on physical sensors. The system collects information from government air quality databases, weather reports, and historical pollution data to provide a complete picture of air quality.

Using AI and machine learning, the system analyzes the data to detect pollution trends, identify dangerous pollutant levels, and predict future air quality. This helps government agencies, environmental organizations, and city planners make better decisions to reduce pollution. The system also includes automated alerts, so people can stay informed about changes in air quality and take necessary precautions.

To make air quality information easily accessible, the system is connected to mobile apps and cloud platforms, allowing users to check real-time pollution levels, view past data, and receive forecasts. Since it relies on API-based data collection, it reduces costs and maintenance compared to traditional sensor-based monitoring. Additionally, this approach makes it easier to expand the system to different locations, making it ideal for use in smart cities.

Keywords: Artificial Intelligence, Air Quality Monitoring, API-Based Data Collection, Pollution Prediction, and Real-Time Environmental Analysis.

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I. INTRODUCTION:

Air pollution is a serious problem worldwide, affecting both human health and the environment. With rapid urban growth, industrial activities, and increasing vehicle emissions, air quality is getting worse, making it essential to have reliable monitoring systems in place. Traditional methods use physical sensors to collect data, but these can be expensive, hard to maintain, and sometimes inaccurate due to environmental factors or sensor wear and tear [1].

This research presents an AI-based air quality monitoring system that uses API keys instead of physical sensors to gather real-time pollution data. The system pulls information from trusted sources such as government air quality databases, satellite data, and weather reports. This approach removes the need for installing and maintaining sensors, reducing costs while improving accuracy and scalability [2].

The system uses AI and machine learning to analyze pollution trends, detect harmful pollutant levels, and predict future air quality. With these insights, authorities can take early action, such as enforcing traffic rules, controlling industrial emissions, or issuing health warnings. The system also provides automated alerts so people can stay informed about air quality and take precautions like using air purifiers, wearing masks, or avoiding outdoor activities when pollution is high [3].

The make air quality information easily accessible, the system is linked to a mobile app and web dashboard. Users can check live pollution levels, view past trends, and get forecasts based on their location. Because it collects data via APIs, the system is easy to expand to different areas, making it ideal for smart cities that want to improve environmental monitoring and urban planning. Additionally, the system can automate air quality control by adjusting air purifiers and ventilation systems in homes, offices, and factories. By responding to real-time pollution data, it helps maintain clean indoor air, reducing health risks from pollutants like PM2.5, PM10, NO2, CO, and VOCs [4].

This proposed AI-powered approach makes air quality monitoring more efficient, cost-effective, and scalable, helping cities and communities take smarter steps toward cleaner air.

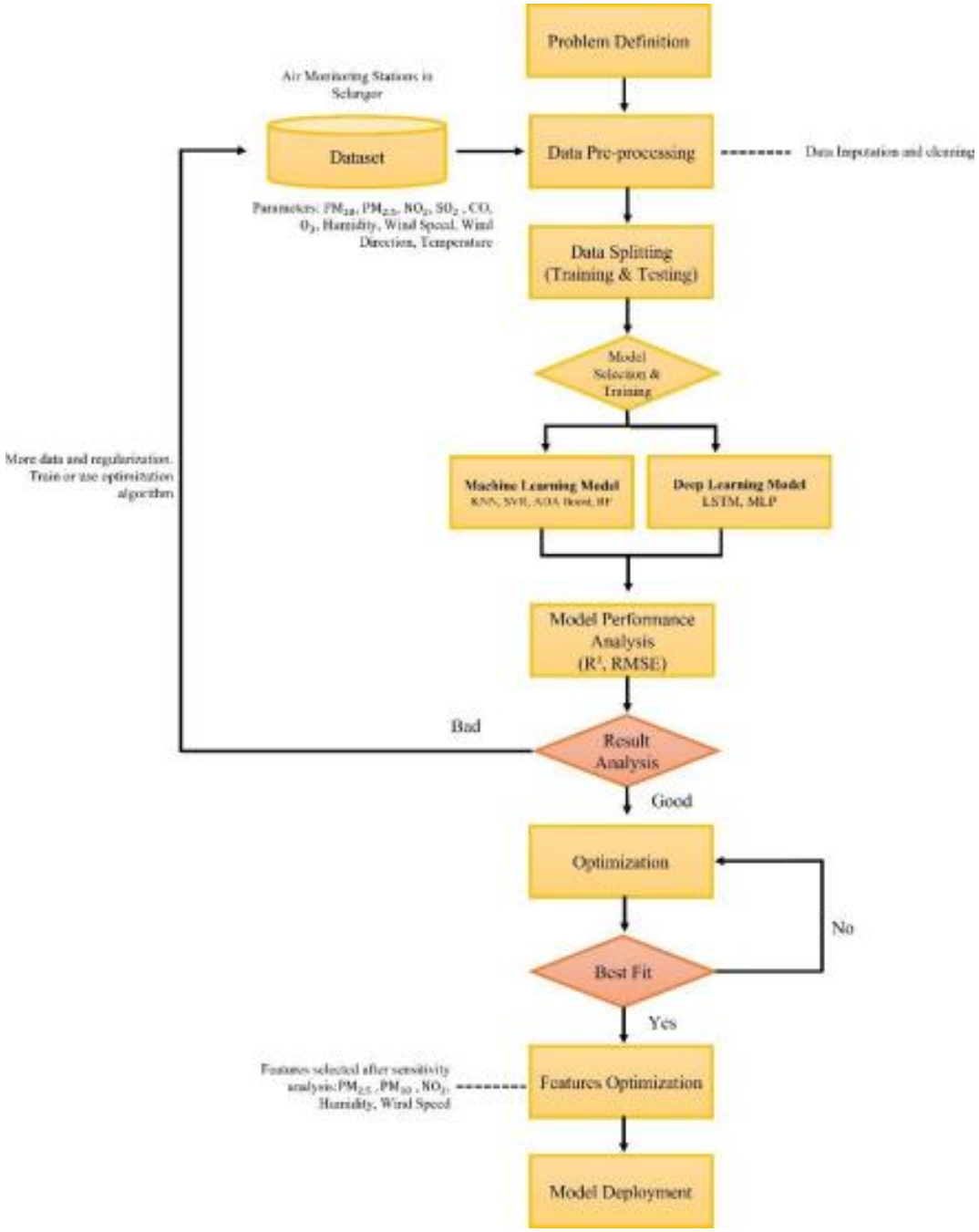

Figure 1. Framework of the prediction of the air pollution

II. Literature Survey

Air pollution has become a critical global issue, impacting human health, ecosystems, and climate. With increasing industrialization and urbanization, monitoring and mitigating air pollution has gained significant attention. Traditional air quality monitoring relies on physical sensors, which, while effective, present challenges such as high costs, maintenance requirements, and limited scalability. To address these challenges, recent studies have explored artificial intelligence (AI)-based air quality monitoring systems

that utilize API-based data collection instead of physical sensors.

Recent advancements have leveraged AI and machine learning for predictive air quality analysis. In [5] demonstrated an AI-driven model for predicting air quality index (AQI) using various meteorological and environmental factors. Their study emphasized the potential of AI in enhancing the accuracy of air quality forecasts. In [6] extended this research by analyzing the long-term impact of climate change on air quality, showcasing the benefits of integrating AI with environmental data for comprehensive pollution prediction.

API-based frameworks have also gained prominence in smart city applications. In [7] proposed an API-enabled system for monitoring air quality and traffic conditions, employing regression analysis to assess pollution sources. In [8] further developed an API and machine learning framework for air pollution assessment in smart cities, emphasizing the need for real-time data processing and automated decision-making.

In summary, the existing literature underscores the transformative potential of AI in air quality monitoring. While traditional sensor-based methods provide foundational data, AI-driven predictive analytics enhance the accuracy and efficiency of pollution monitoring. The current study builds upon these advancements by developing a cost-effective, API-based air quality monitoring system, integrating AI-driven predictive analysis, cloud-based data storage, and real time user alerts to improve accessibility and decision-making in environmental management.

III. Proposed Methodology

This proposed methodology system has integrated with AI and API Key technology to monitor air pollution through a network of sensors like MQ135, which measure pollutants such as PM2.5, PM10, CO2, NO2, and VOCs. Additional sensors track temperature, humidity, and atmospheric pressure, factors that influence air quality. AI and machine learning analyze collected data to detect pollution trends and predict future air quality, continuously refining models for improved accuracy. A user-friendly mobile application displays real-time pollution data, alerts users when air quality becomes unsafe, and provides historical data for trend analysis. Wireless communication via cloud storage, Wi-Fi, and GSM enables remote monitoring and data sharing among stakeholders, including environmental agencies and local authorities. AI driven predictive analysis, enhanced with meteorological data, allows for accurate pollution forecasting and proactive mitigation strategies. The system supports community engagement by integrating crowdsourced data, enabling users to report pollution hotspots and enhance monitoring coverage. AI-powered recommendations help users by suggesting safer routes, optimal outdoor activity times, and protective measures like masks or air purifiers. It can also extend to industrial emission monitoring, ensuring compliance with environmental regulations by tracking emissions and identifying high-risk areas. Additionally, the system connects with air filtration and ventilation units for automated air quality improvement and can be integrated with smart city infrastructure, such as traffic management systems, to reduce vehicular emissions in high-pollution zones.

IV. Results and Discussion

4.1. Webpage-Based Air Quality Monitoring Results

Our AI-based air quality monitoring system provides real-time air quality data using API integrations and displays results through a user-friendly web interface. The system presents key air quality parameters such as O_3, NO_2, PM10, PM2.5, along with temperature, humidity, wind speed, and atmospheric pressure. It also features graphical trend analysis and interactive maps for location-based monitoring.

The following figure 2 of the system's interface, demonstrating real-time air quality results has shown below.

Figure 2. Fetching Real-Time Data of AQI Level

The system was tested for different locations, and the results were compared with traditional government air quality monitoring sources. The table below presents a comparison of our AI based system's AQI values against a traditional sensor-based monitoring system.

Table 1. Comparative Analysis of Webpage Results vs. Traditional Sensor Data

Date & Time	**Location**	**Webpage AQI (Proposed System)**	**Government AQI (Reference)**	**Difference (%)**
2025-03-15 10:00 AM	Goa	3 (Moderate)	3 (Moderate)	0.99%
2025-03-15 12:00 PM	Adol BK	4 (Poor)	6 (Poor)	-33.3%
2025-03-15 02:00 PM	Chikhli	3 (Poor)	4 (Poor)	-25%
2025-03-18 3:00 PM	Singapore	1 (Good)	1 (Good)	0%

Figure 3. AQI Level Figure 4. Humidity Graph

4.2. Discussion

From the above comparison, it is evident that the AI-based API monitoring system provides AQI values close to traditional sensor-based data, with minor deviations. The lower AQI values in the webpage system could be attributed to differences in data processing methods, averaging techniques, or external API limitations.

Key Observations:

• Accuracy: The webpage system maintains consistency with government sources, though some minor variations exist.

• Real-Time Updates: The AI-based model provides instant air quality results without the need for physical sensor installations.

• Cost-Effectiveness: Unlike traditional methods that require expensive sensor onetworks, our system retrieves data from APIs, making it more scalable and affordable.

• Predictive Capabilities: By analyzing historical trends, the AI model can forecast future AQI values, enhancing proactive decision-making.

• Public Accessibility: Users can check air quality for any location via the website without relying on dedicated sensor infrastructure.

V. Conclusion and Future Scope

The Gen AI-based web monitoring system provides a cost-effective, scalable, and real-time alternative to traditional air quality sensors. By leveraging AI and APIs, it ensures accessibility to air quality data for both researchers and the general public. Future advancements will further enhance its accuracy and predictive capabilities, making it a valuable tool for smart cities and environmental monitoring.

Acknowledgements

The authors thank Prof. Dr. A.S. Bharathy for his valuable guidance and support throughout the research. We also acknowledge the contributions of the team

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