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AIR QUALITY MONITORING SYSTEM USING IOT

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ABSTRACT

The Arduino-based air quality monitoring system that addresses the escalating global concern over air pollution. Utilizing MQ135 gas sensor, DHT22 temperature and humidity sensor, and HC05 Bluetooth module, our system efficiently collects, processes, and transmits real-time sensor data. The MQ135 gas sensor accurately measures pollutants like carbon dioxide (CO2), ammonia (NH3), and benzene (C6H6) to assess air quality. The DHT22 sensor provides crucial temperature and humidity readings. Notably, our system calculates the air quality index (AQI) based on predefined thresholds and further categorizes air quality as ”good” or ”bad,” enhancing user understanding. To ensure data retention and analysis, we integrate a XAMPP database, securely storing sensor data and AQI values for long-term assessment. The system also enables wireless data transmission for real-time monitoring on mobile devices or computers. This cost-effective and scalable solution offers valuable insights for environmental monitoring and informed decision-making, empowering actions to combat air pollution’s adverse impact on health and the environment.

Keywords:

Air Quality Monitoring System, Air Quality Index IoT Internet of Things, Application Programming Interface, Temperature

INTRODUCTION

The Arduino-based Air Quality Monitoring System, a cutting-edge solution designed to address the urgent global concern of air pollution. Our innovative system incorporates the MQ135 gas sensor, the DHT22 temperature and humidity sensor, and the HC05 Bluetooth module to seamlessly collect, process, and transmit real-time sensor data for accurate air quality assessment. At the heart of our system lies the MQ135 gas sensor, renowned for its precision in measuring pollutants such as carbon dioxide (CO2), ammonia (NH3), and benzene (C6H6). This capability allows for a comprehensive analysis of air quality. Complementing this, the DHT22 sensor provides crucial temperature and humidity readings, offering a well-rounded understanding of environmental conditions. A standout feature of our solution is its ability to calculate the Air Quality Index (AQI) in real-time, utilizing predefined thresholds. This AQI value is then used to categorize air quality as either” good” or” bad,” providing users with easily interpretable information. To enhance user accessibility and convenience, our system seamlessly integrates with a Bluetooth mobile application. This intuitive application displays up-to-date air quality information, along with temperature and humidity data, directly on users’ mobile devices. This ensures that users can effortlessly monitor air quality anytime and anywhere, empowering them to make informed decisions about their activities and exposure. Our streamlined and cost-effective solution not only facilitates environmental monitoring but also empowers individuals and communities to take proactive measures against the adverse effects of air pollution on health and the environment. With the Arduino-based Air Quality Monitoring System, we are committed creating a cleaner and healthier future.

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RELATED WORKS

The related works air quality monitoring systems primarily rely on fixed monitoring stations equipped with sensors to measure common air pollutants. These stations are strategically located and designed to monitor pollutants such as particulate matter, nitrogen dioxide, sulfur dioxide, carbon monoxide, and ozone. The sensors at these stations collect data on air quality, which is then analyzed and reported periodically. However, the existing system has limitations when it comes to detecting a wide range of toxic and good gases in the atmosphere. The fixed monitoring stations have a limited number of sensors, and their focus is primarily on the measurement of common pollutants. They may not be equipped to detect specific toxic gases or gases that indicate good air quality, such as volatile organic compounds, hydrogen sulfide, ammonia, or carbon dioxide. Furthermore, the fixed nature of these monitoring stations limits their mobility and adaptability. They cannot be easily relocated to areas of interest or used to monitor air quality in remote or inaccessible regions. This lack of mobility makes it challenging to capture real-time variations in the concentration of toxic or good gases across different locations. Additionally, the data collection process in the existing system is often manual, requiring periodic visits to the monitoring stations for data retrieval. This process is time consuming and may lead to delays in data availability. It also limits the frequency of data collection, which is crucial for capturing fluctuations in gas concentrations and identifying potential sources of pollution. The existing air quality monitoring system, based on fixed monitoring stations, has limitations in detecting a wide range of toxic and good gases, lacks mobility, and relies on manual data collection and analysis. These limitations underscore the need for an innovative approach to develop a more versatile and mobile system for air quality monitoring.

PROPOSED SYSTEM

- PROBLEM DEFINITION The Project aims to address the rapid increase in air pollution, which has become system using Arduino-based sensors. The goal is to provide a cost-effective, scalable, and efficient solution for real-time air quality monitoring, enabling valuable insights for environmental monitoring and decision-making processes.
- OVERVIEW The Real-time Air Quality Monitoring System utilizes Arduino as the central control unit to collect, process, and transmit sensor data. It includes the MQ135 gas sensor for detecting pollutants like CO2, NH3, C6H6, and other harmful gases. The DHT22 sensor provides real-time temperature and humidity readings, crucial for assessing air quality.
- PHASES Arduino processes the collected sensor data, performing data fusion and analysis to calculate the Air Quality Index (AQI) based on predefined thresholds. AQI is a critical metric for assessing air quality levels, allowing users to make informed decisions about their activities and health. The system integrates with a database for data retention and accessibility. Processed data and AQI values are securely stored, enabling long-term storage, historical analysis, and comparison of air quality trends. Calculated AQI is wirelessly transmitted using the HC05 Bluetooth module, enabling real-time monitoring and visualization on mobile devices or computers. Users access AQI information remotely, receiving timely updates about air quality.
- Planning Phase: Define project goals, objectives, and requirements. Analyze existing methods, establish a timeline, allocate resources, engage stakeholders, and conduct a risk assessment.
- Research and Design Phase: Research air quality monitoring tech. Select suitable sensors (MQ135, DHT22), design data collection and processing architecture, and create user-friendly data visualization. Address ethical and safety considerations.
- Development Phase: Assemble hardware (Arduino, sensors), develop software for data collection, fusion, AQI calculation, and integrate secure data storage. Test and refine for accuracy and reliability.
- Testing and Evaluation Phase: Conduct rigorous testing for functionality, sensor accuracy, and database integration. Evaluate calculated AQI against air quality standards. Collect usability feedback. Deployment and Integration Phase: Prepare for real-world deployment. Integrate with existing monitoring infrastructure, provide training and support to users, optimize system performance through pilot testing .
- Maintenance and Enhancement Phase: Continuously monitor system performance, address issues, and gather user feedback for improvements. Enhance capabilities, usability, and database management as needed.

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METHODOLOGY

The proposed methodology focuses on designing an IoT-based air quality monitoring system utilizing drones for enhanced accuracy and real-time information. The architecture comprises interconnected components, with the Mobile Application serving as the user interface for accessing real-time data and historical information. Facilitating wireless communication, the Bluetooth module (HC05) links the mobile application and the Arduino board, which functions as the central microcontroller platform. Sensors, including the DHT22 for temperature and humidity and the MQ135 for air quality and gas detection, provide essential data. The OLED Display visualizes real-time information, presenting air quality parameters and environmental conditions. The power supply ensures uninterrupted operation, while the microcontroller processes data using predefined thresholds and conversion formulas to determine air toxicity. A monitoring application, developed for web or mobile platforms, enhances accessibility, allowing users to monitor air quality, receive real-time updates, and analyze historical data.

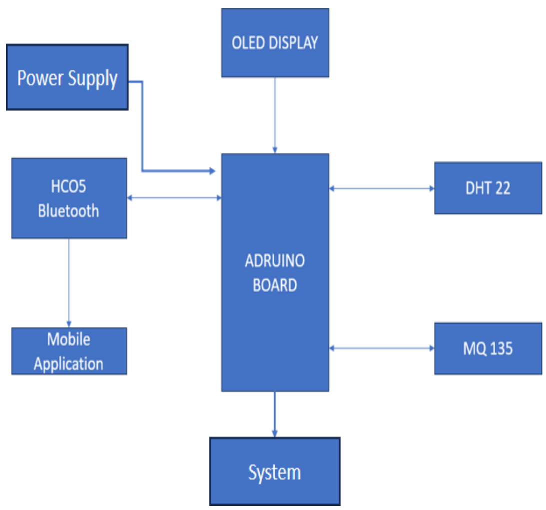

Fig..1: ***Architecture diagram***

- Mobile Application: The user interface for real-time data access and historical information.
- Bluetooth (HC05): Facilitates wireless communication between the mobile app and Arduino board.
- Arduino Board: Serves as the central microcontroller platform for data integration and communication.
- DHT22 Sensor: Measures temperature and humidity for monitoring ambient conditions.
- MQ135 Sensor: Detects air quality and harmful gases, contributing crucial data for analysis.
- OLED Display: Visualizes real-time information on air quality parameters and environmental conditions.
- Power Supply: Ensures uninterrupted operation by providing necessary power to all system components during monitoring missions.
- Microcontroller Algorithms: Executes essential algorithms and calculations to derive meaningful insights about air quality and toxicity levels.
- Monitoring Application: Developed for web or mobile platforms, it interacts with the microcontroller to retrieve air quality and toxicity data, allowing users to monitor conditions, receive real-time updates, and analyze historical data.

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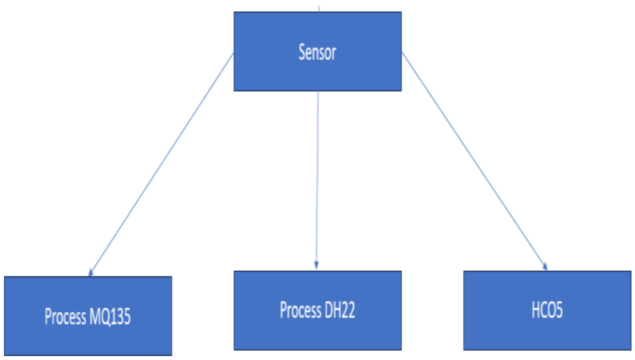

Fig.2:LEVEL0(Over view of the Air Quality Monitoring System)
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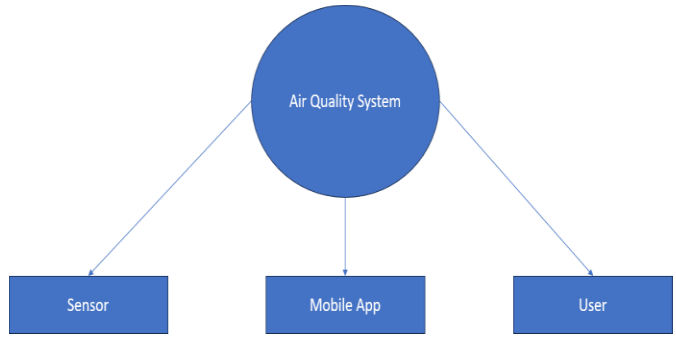

Fig..3:LEVEL1 (Detailed Components of the Air Quality Monitoring System)

RESULT

In this project, the focus lies on collecting air quality values through specialized sensors, evaluating pollutant concentrations, and monitoring temperature and humidity levels. The gathered data is then analyzed to determine whether the air quality is categorized as good or bad. By providing real-time feedback and alerts, users can make informed decisions about their Indoor environment, implement necessary precautions, and promote a healthier living space. The project aims to raise awareness about environmental concerns and protect the well-being of individuals and future generations by enabling proactive actions to mitigate the harmful effects of poor air quality.

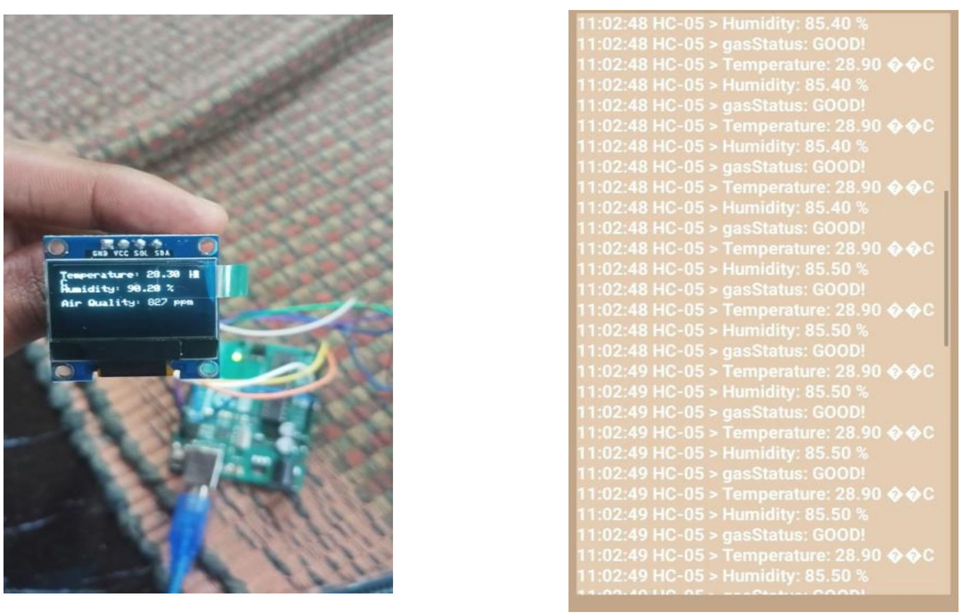

Fig.5: Output

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The air quality monitoring system's user interface will display both numerical AQI values and qualitative indicators, such as"Good" or"Bad." This combination ofinformation allows users to quickly assess the current airquality conditions with a simple glance at the screen. The numerical AQI value provides a precise assessment, while the qualitative indicator of ferzan easy-to-understand representation of the air quality level. This clear and straight forward display enables users to make informed decisions and take appropriate actions based on the air quality information presented on the screen.

CONCLUSION

In conclusion, our air quality monitoring project is designed to provide real-time, accurate data on air quality conditions. By leveraging IoT technology, sensors , and data analysis techniques, been able individuals, communities, researchers, and policy makers to make informed decisions and take proactive measures to improve air quality. With the ability to monitor pollutant levels, temperature, and humidity, our project empowers users to understand potential risks, make adjustments to their daily routines, and implement targeted interventions. By promoting awareness, timely alerts, and data-driven insights, our project contributes to creating healthier environments and fostering a better quality of life. Through the collaborative efforts of individuals and stakeholders , we can collectively work towards mitigating the impact of air pollution and ensuring cleaner, safer air for everyone.

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