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IoT Based Air Pollution Monitoring System

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Abstract: ***In light of the growing concern for air quality and its impact on public health, there is an increasing demand for air pollution monitoring systems that are both effective and efficient. This article introduces an IoT-based Air Pollution Detection System that utilizes the power of Internet of Things (IoT) technology to provide real-time monitoring and analysis of air quality parameters. The system incorporates a network of advanced air quality sensors that can measure particulate matter (PM) concentrations, as well as various gas levels such as carbon dioxide (CO2), carbon monoxide (CO), nitrogen dioxide (NO2), sulfur dioxide (SO2), and ozone (O3). These sensors are integrated with a microcontroller that enables data processing and communication capabilities.***

The transmission of data collected by the sensors to a cloud-based platform is facilitated through a secure internet connection. This allows for centralized storage, analysis, and visualization of the data. The cloud platform utilizes advanced algorithms for data processing, enabling the calculation of air quality indices and the generation of real-time alerts when predefined thresholds are surpassed.

Access to the system's user interface is provided through both a web and mobile application. This user-friendly dashboard allows stakeholders to monitor air quality trends, view historical data, and receive timely notifications. Furthermore, the platform supports data analytics features, which facilitate in-depth analysis of air quality patterns over time.

By implementing this IoT-based Air Pollution Detection System, the need for comprehensive and reliable air quality monitoring solutions is addressed. The system's real-time capabilities and cloud-based infrastructure offer a scalable and adaptable framework for deployment in various urban and industrial environments. This system is expected to play a crucial role in enhancing public health awareness and supporting evidence-based decision-making for air quality management.

Keywords: Sensors MQ-135, MQ-6, DHT-11, Air Pollution, , Data Analysis, Real-time Monitoring, Cloud Platform, Environmental Monitoring, IoT.

I. INTRODUCTION

The issue of air pollution is a significant concern for all nations, regardless of their level of development. In particular, urban areas in developing countries are experiencing a rise in health problems due to the release of gaseous pollutants from industrialization and increased vehicle usage. The harmful effects of air pollution range from mild allergic reactions to serious illnesses such as bronchitis, heart disease, and aggravated asthma. Shockingly, air pollution is responsible for tens of thousands of premature deaths each year in the US alone, and millions worldwide. To address this issue, an IOT Based Air Pollution Monitoring System has been developed to monitor air quality over a web server and trigger an alarm when harmful gases such as CO2, smoke, alcohol, benzene, NH3, LPG, and NOx are present beyond a certain threshold level. The system displays air quality in PPM on an LCD and webpage for easy monitoring. Unlike conventional monitoring instruments, this system is compact, lightweight, and cost-effective, allowing for more widespread deployment in carefully selected locations where air pollution is most severe. Additionally, the system detects temperature and humidity for a more comprehensive understanding of air quality.

II. LITERATURE REVIEW

"A Comprehensive Review of IoT-Enabled Air Quality Monitoring Systems" by A. A. Al-Fuqaha et al. (2018)
This review paper provides a comprehensive overview of IoT-enabled air quality monitoring systems, focusing on their architecture, components, communication protocols, and applications. The authors discuss the challenges and opportunities associated with deploying these systems and highlight the potential impact of IoT on improving air quality.[1]

"IoT-Based Air Quality Monitoring: A Survey of Existing Approaches and Challenges" by M. H. Kabir et al. (2019)
This paper surveys existing approaches and challenges in IoT-based air quality monitoring systems. The authors discuss various sensor technologies, data acquisition and communication methods, and data processing and analysis techniques. They also highlight the need for efficient data management and visualization tools for these systems. [2]

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"IoT-Based Air Pollution Monitoring and Forecasting System" by M. A. A. Abbasi and M. Younis (2020)
This review paper focuses on the use of IoT for air pollution monitoring and forecasting. The authors discuss the integration of machine learning and artificial intelligence techniques into IoT-based systems to improve prediction accuracy and provide timely alerts about air pollution levels.[3]

"IoT-Based Air Pollution Monitoring System for Smart Cities" by S. D. Gupta et al. (2021)
This paper highlights the role of IoT in developing smart cities that prioritize air quality management. The authors discuss the design and implementation of IoT-based air pollution monitoring systems, emphasizing the importance of data security, privacy, and standardization.[4]

"IoT-Based Air Quality Monitoring System for Environmental Monitoring and Analysis" by M. S. M. Rahman et al. (2022)
This review paper focuses on the environmental applications of IoT-based air quality monitoring systems. The authors discuss the use of these systems to monitor air quality in various environments, including urban areas, industrial settings, and agricultural regions.[5]

"IoT-Based Air Pollution Monitoring System for Precision Agriculture" by M. K. Jayasri and S. G. Somasundaram (2023)
This paper explores the potential of IoT-based air quality monitoring systems in precision agriculture. The authors discuss the use of these systems to optimize crop growth, reduce pesticide usage, and improve overall agricultural productivity.[6]

"IoT-Based Air Quality Monitoring System for Healthcare Applications" by B. S. Rawat and S. Singh (2023)
This review paper focuses on the use of IoT-based air quality monitoring systems in healthcare applications. The authors discuss the use of these systems to monitor air quality in hospitals, clinics, and other healthcare settings to improve patient health outcomes.[7]

"IoT-Based Air Pollution Monitoring System for Disaster Management" by A. K. Tripathi and A. Mishra (2023)
This paper highlights the role of IoT-based air quality monitoring systems in disaster management. The authors discuss the use of these systems to monitor air quality during natural disasters, such as wildfires and volcanic eruptions, to provide timely alerts and protect public health.[8]

III. METHODOLOGY

A. Device Building

1) Combining Arduino UNO, MQ-135, MQ-6, DHT-11, LCD, Arduino GSM Shield on Breadboard.
2) Coding the hardware in such a manner that it will transmit data as soon as pollution threshold reached/ pollutants detected sent to the web-server with the help of Arduino GSM shield and Embedded-C in Arduino.

B. Creating Web-Server

1) Creating a database in web-server
2) Coding the logic of pollution detection and threshold limits and various courses of events occurring due to the different pollution levels and different pollutants detection made by the device.
3) Understanding and processing of the data will be done on the web-server itself.
4) Provide connectivity between web-server and application.

C. Creating an Android Application

1) Making the fronted attractive and user-friendly with the help of XML.
2) Programming the backend of the application with the help of java

IV. FACILITIES REQUIRED FOR PROPOSED WORK

We use our device at low cost, portable and light weight as shown by block diagram in fig1.

1) MQ-135 sensor which can detect gases like Ammonia (NH3), Methane (CH4),Carbon Monoxide (CO), Carbon Dioxide (CO2), Alcohol (C2H5OH), Smoke.
2) MQ-6 sensor for detecting gases like LPG (Liquefied Petroleum Gas), Isobutane (C4H10), Methane (CH4), Propane (C3H8).

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3) DHT-11 sensor for determine temperature and humidity.
4) Arduino GSM Shield is used for transmit data within no time to the user through web-server which is later processed in the application.
5) An Android application in The phone will receive the data from the web server that data of air quality reaching at a certain low level of ppm which is comprehend and processed also it will indicate the various air pollutants detected by the device and it will notify and represent it in a user-friendly and interactive manner in the app.
6) Repeated Ignorance of the notifications given by application of a hazardous violation will automatically cause in to emergency call request to the nearest government emergency services

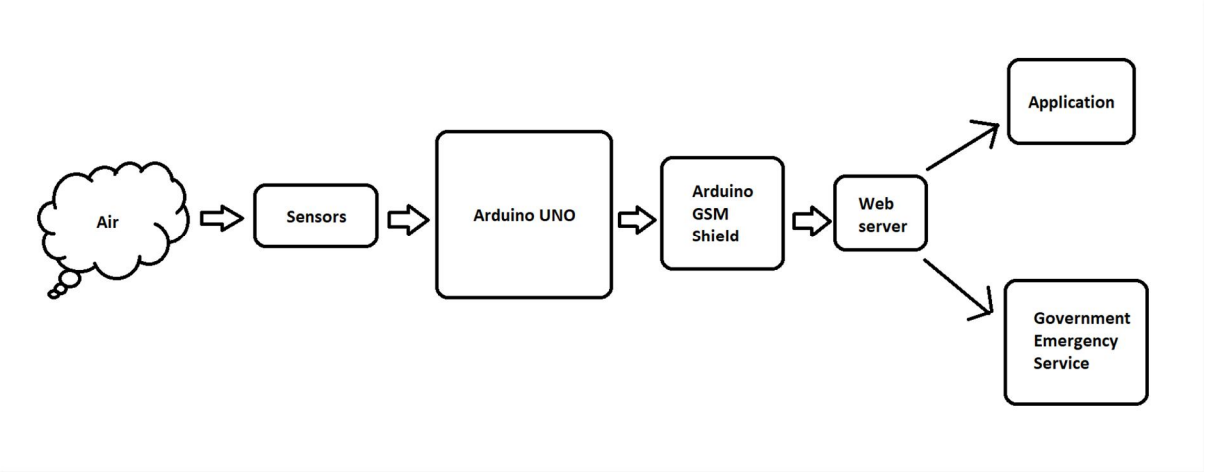


Fig1 :Air Pollution Monitoring System (Block Diagram)

V. CONCLUSION

In the face of escalating air pollution concerns, our IoT-based Air Pollution Monitoring System emerges as a beacon of hope, offering a transformative solution that addresses the pressing need for accessible, affordable, and user-friendly environmental monitoring. By leveraging the power of IoT and integrating a range of sensors with Arduino UNO, our project not only provides real-time insights into air quality but also fosters a proactive approach to combatting pollution.

The system's user-friendly interface, displayed on an LCD screen, makes critical air quality information readily understandable for individuals and companies alike. The incorporation of the Arduino GSM Shield extends the reach of our solution, enabling remote monitoring and timely alerts. This connectivity ensures that both companies managing diverse locations and individuals concerned about their immediate surroundings can take informed actions to mitigate the impact of air pollution.

Moreover, our commitment to affordability and the use of open-source technologies make this solution widely accessible. It is not just a technological advancement; it is a tool for empowerment. Companies can now integrate sustainable practices into their operations, and individuals can make informed choices that contribute to a healthier environment.

As we conclude this project, we envision a future where our IoT-based Air Pollution Monitoring System plays a pivotal role in shaping a cleaner, healthier world. This undertaking represents more than a technological achievement; it symbolizes a step toward democratizing environmental awareness, fostering a sense of responsibility, and collectively working towards a sustainable future.

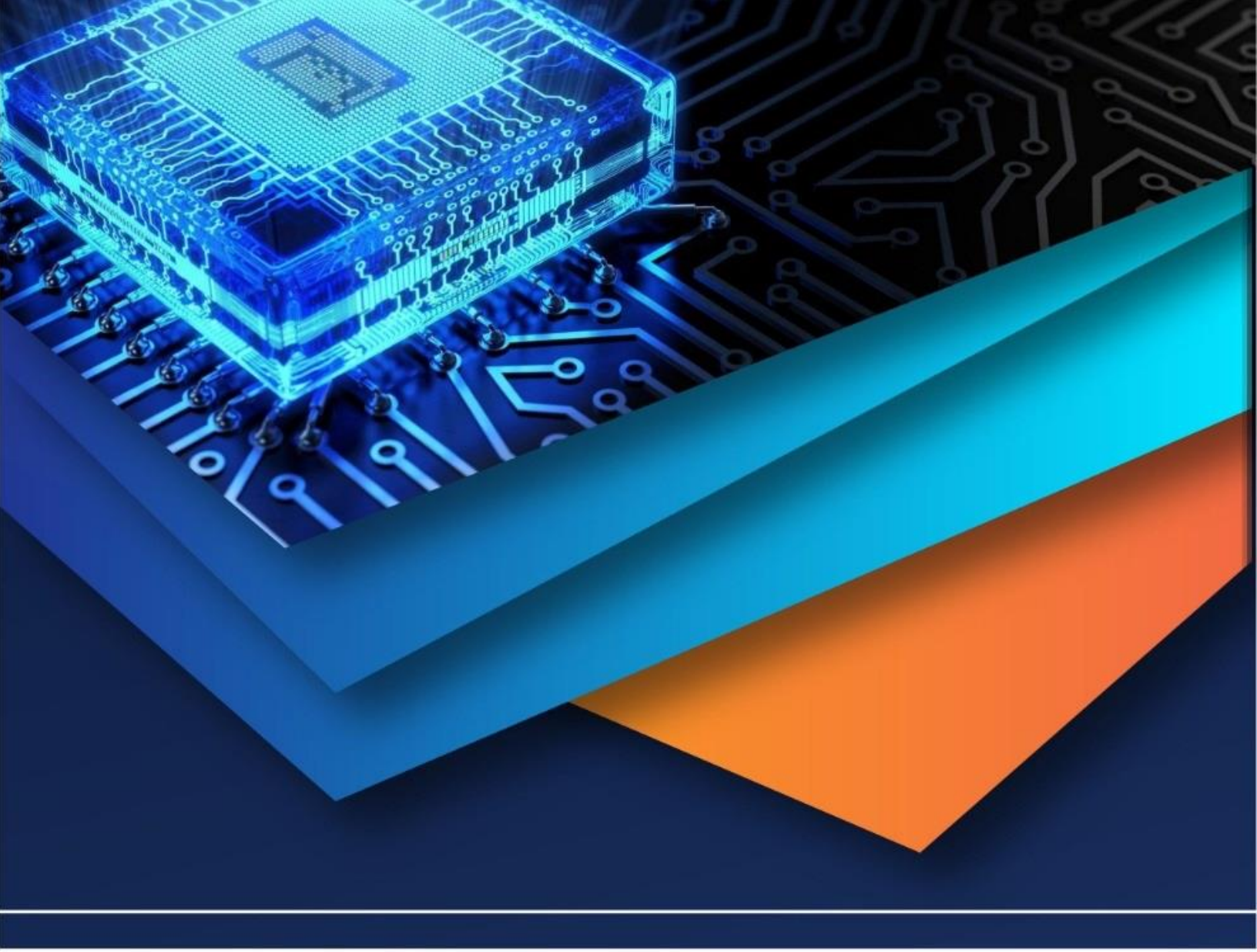
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