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Smart Sensor Network for Air and Noise Pollution Monitoring

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ABSTRACT

The main object of this project is to detect Environmental noise and air pollution levels are rising in urban areas and need to be controlled immediately. Air pollution may evolve from anthropogenic or natural sources. Air pollutants of atmospheric substances like CO, CO_2, SO_2, NO_2, and O_3 Suspended Particulate Matter (SPM), Repairable Suspended Particulate Matter (RSPM), and Volatile Organic Compounds (VOCs) have a great effect on the people health. An IoT-powered air and noise pollution monitoring system can monitor the level of both air and sound pollution. This data can be saved on web servers for further use. The system consists of air sensors that sense the presence of harmful gases and compounds in the air. It also monitors sound levels and reports them to the online server. The sensors interact with the microcontroller that transmits this data over the internet. The data can be used by authorities so that they can take measures to control the pollution. Therefore, the user can analysis and compare the air and sound pollution between two company. By further modification, in future work, monitoring pollution with larger data will be accomplished.

Keywords: Node MCU, MQ 135 Gas Sensor, LM393 sound sensor, Wi-Fi Module.

1. Introduction

Pollution is the beginning of hazardous substances into the surroundings. The substance that harms a natural resource is called pollutants. The cause of pollutants can be natural or created by human behavior. There are various types of pollution including air, noise or sound, water, and land. Air and sound pollution are a growing issue now not only in Malaysia [1].

Air pollution is necessary to monitor and overcame because it can give the health issue. Air pollution can be visible and invisible, both can make the living difficulty to breath and make the eyes burn. It also can increase the possibility to have the lung cancer. In 1984, there was an accident which is more than 40 tons of toxic gas leaked from a plant in Bhopal, India. The accident causes at least 3,800 people dead and many thousands more were permanently injured [2]. The World Health Organization (WHO) state that 4.2 million deaths every year occurs because of the outdoor air pollution [3].

There are many sources can cause sound pollution such as people, machines, building activities and construction, music performances, transportation system, industrial, animal, traffic etc. The sound pollution is most occurring at the urban area where there has traffic noise such as the horn from vehicles This pollution also found in the workplace [4]. It became common occupational hazard because of high sound level from the variety of equipment and activity especially in the food factory [5]. Not all noise or sound becomes

pollution, there are some conditions that will turn noise into pollution. The World Health Organization (WHO) defines noise above 65 decibels (dB) as noise pollution [3]. There is the one of the famous issues in Malaysia. In the previous research, monitoring system such as air monitoring systems, health monitoring systems are developed by using Bluetooth, GPS and GPRS wireless technologies. The proposed system is costly, and data is messy to recorded. It also become difficult in the remote area to record the data needed. The most preferred technique is cloud-based monitoring system was proposed. The monitoring system by using IoT become efficient to develop because the increasing usage of sensor and smart phones [6].

2. Literature Survey

The literature on air and noise pollution monitoring systems reveals a dynamic landscape marked by technological advancements and multidisciplinary approaches. Researchers have increasingly turned to advanced sensor technologies to address the complexities of monitoring environmental pollutants. Low-cost sensors and Internet of Things (IoT) devices have emerged as pivotal tools for real-time data collection, offering a cost-effective means to monitor air and noise quality across diverse locations.

Integration and data fusion are recurrent themes in the literature, emphasizing the importance of combining information from multiple sensors for a more accurate assessment of pollution levels. Wireless Sensor Networks (WSNs) play a prominent role, enabling the deployment of sensor nodes in expansive areas to create interconnected systems for efficient data gathering.

Machine learning and data analytics have gained traction for processing the vast datasets generated by monitoring systems. These tools contribute to pattern recognition, anomaly detection, and predictive modeling, enhancing the overall effectiveness of pollution monitoring. Additionally, there is a notable trend toward community-based monitoring, empowering citizens to actively participate in data collection and interpretation, fostering a sense of environmental stewardship.

Mobile applications have been developed to provide accessible real-time pollution data to the public, promoting awareness and engagement. The implications of pollution monitoring on policy-making are also explored, with researchers emphasizing the role of collected data in shaping effective environmental regulations.

Despite the progress, challenges and limitations persist. Accuracy of sensors, data privacy concerns, and the need for standardized protocols are acknowledged as areas requiring attention. Case studies within the literature highlight successful implementations of monitoring systems in various urban and industrial contexts, offering practical insights.

Looking forward, the literature suggests future directions for the field, including exploration of emerging technologies, refinement of sensor capabilities, and addressing gaps in current methodologies. This comprehensive survey underscores the evolving nature of air and noise pollution monitoring systems, reflecting a concerted effort to leverage technology and collaboration for a sustainable and healthier environment.

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3. Internet of Things (IoT)

The concept of the Internet of Things (IoT) represents a growing paradigm facilitating seamless communication among electronic devices and sensors via the internet. This transformative approach brings about significant changes in diverse facets of our daily lives. By harnessing the capabilities of smart devices and the internet, IoT offers innovative solutions that span a wide array of global industries [7].

IoT has been a game-changer in the field of air and noise pollution monitoring. IoT-based systems use sensors and devices to monitor and check real-time air quality and noise pollution in a specific location for smart environment . These systems can detect dangerous & poisonous chemicals. In addition, the system continuously monitors sound levels and activates a buzzer if the sound level exceeds the set threshold [8]. IoT-based air and noise pollution monitoring systems are scalable and cost-effective. They allow for remote monitoring and integration with smart city infrastructure. These solutions improve public health and enhance urban planning.

4. Operation

Air and noise pollution monitoring systems leveraging IoT and NodeMCU offer advanced capabilities to assess and manage environmental quality. In this system, sensors are deployed to collect real-time data on air quality parameters such as particulate matter (PM), carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and noise levels.

NodeMCU, a low-cost open-source IoT platform based on the ESP8266 Wi-Fi module, serves as a crucial component in this setup. The NodeMCU facilitates connectivity, allowing the collected data to be transmitted wirelessly to a central server or cloud platform. This enables remote monitoring and analysis, providing a comprehensive view of pollution levels over time.

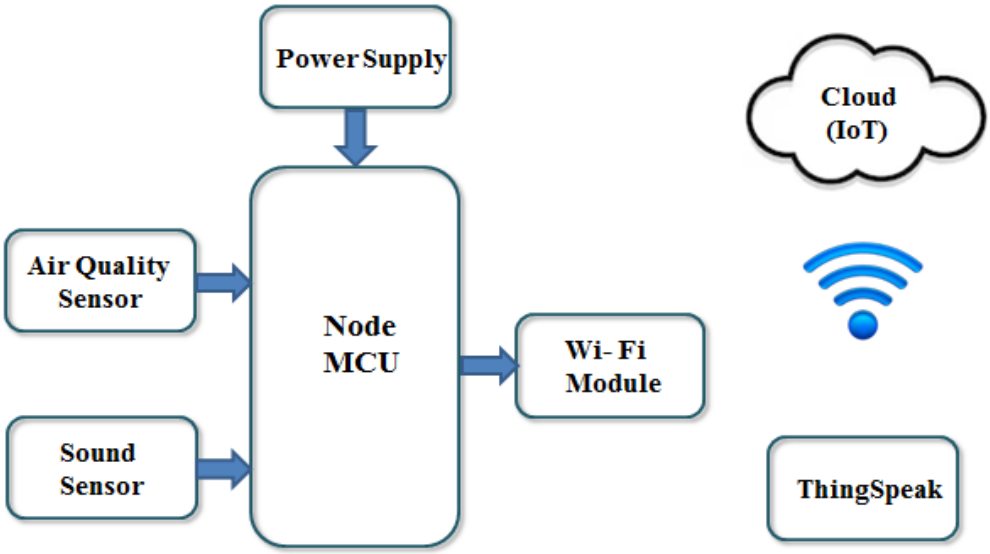

Figure 1: Block diagram of Air & Noise Pollution monitoring system

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Air quality sensors, integrated with NodeMCU, continuously measure pollutant concentrations. These sensors employ various technologies, such as optical, electrochemical, or semiconductor-based sensors, to detect specific pollutants. The collected data is then processed and transmitted in real-time, allowing prompt responses to changing environmental conditions.

The IoT aspect comes into play as the NodeMCU connects to the internet, enabling seamless communication between the monitoring devices and a centralized server. This connectivity allows for real-time data visualization, historical trend analysis, and even predictive modeling. Additionally, it facilitates the implementation of alert systems to notify relevant authorities or the public when pollution levels exceed predefined thresholds.

In the case of noise pollution monitoring, microphones or sound sensors are utilized to capture ambient noise levels. NodeMCU processes and transmits this data, enabling the monitoring of noise pollution trends in specific areas.

5. Software Used

The MIT App Inventor and ThingSpeak platform synergize seamlessly for an efficient air and noise pollution monitoring system. MIT App Inventor facilitates user-friendly mobile app development, allowing individuals to create intuitive interfaces for real-time data display. Users can easily customize the app to visualize pollution metrics, enhancing accessibility.

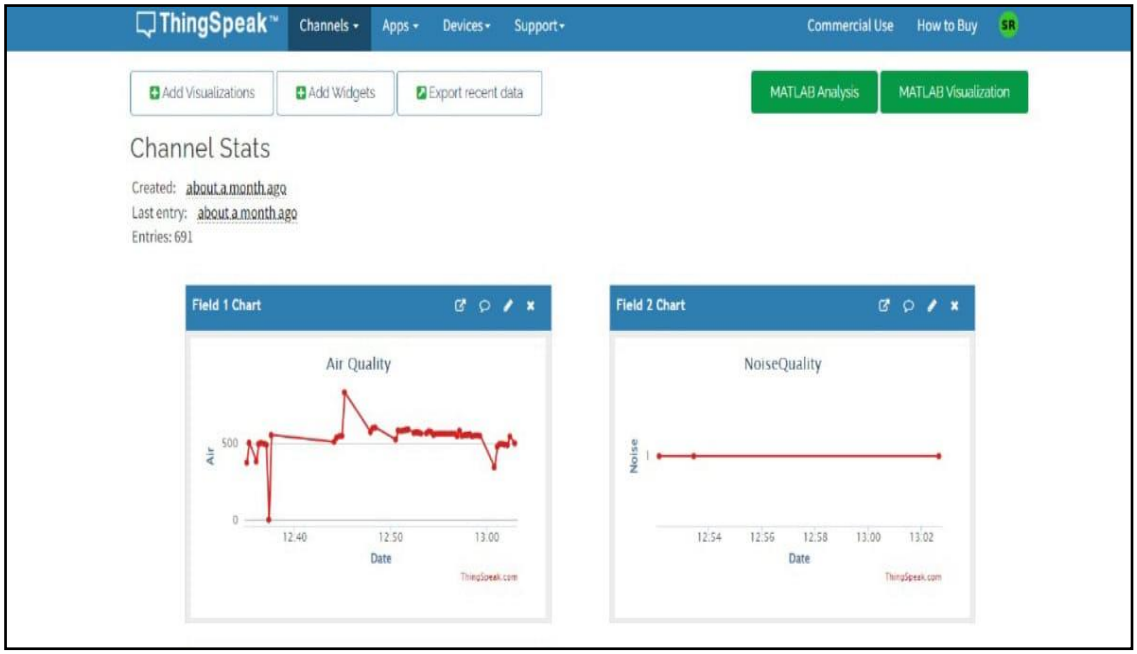

Figure 2**:** Thingspeak Channel Outputs

ThingSpeak, on the other hand, serves as a robust IoT platform, collecting and managing sensor data. Integration with MIT App Inventor enables users to effortlessly link

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their created apps with ThingSpeak channels. This connection ensures that data from air quality and noise sensors are efficiently transmitted and stored on the cloud.

Through the MIT App and ThingSpeak collaboration, users can remotely monitor pollution levels, receive alerts, and analyze historical trends. The system empowers communities and authorities with actionable insights, fostering environmental awareness. The combination of MIT App Inventor and ThingSpeak exemplifies a powerful marriage of mobile app development and IoT, offering a user-friendly solution for comprehensive air and noise pollution monitoring.

6. Results

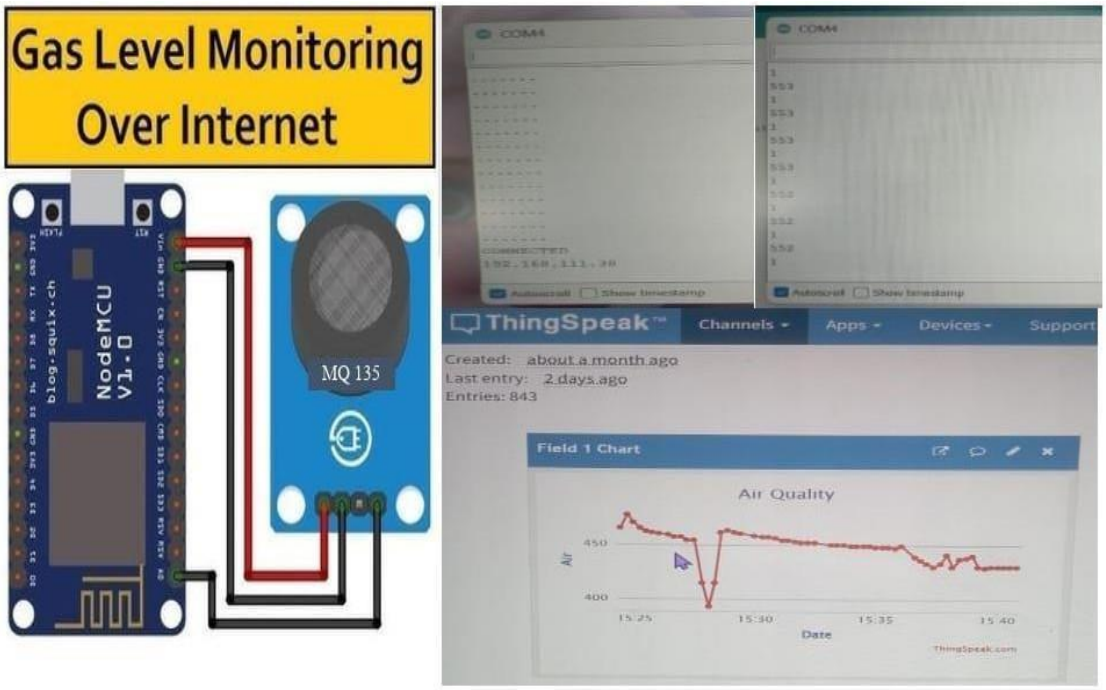

Figure 3: Output of the system

7. Conclusion

In conclusion, the implementation of an integrated air and noise pollution monitoring system is paramount for safeguarding public health and the environment. Such a system enables real-time data collection, analysis, and dissemination of crucial information, fostering informed decision-making. Continuous monitoring ensures early detection of pollutant spikes, allowing authorities to take swift corrective actions. Additionally, the system enhances public awareness by providing transparent data accessible to communities.

The benefits extend beyond immediate health concerns, contributing to long-term sustainability. Through data-driven policies, industries can be held accountable for their

environmental impact, promoting responsible practices. Moreover, an effective monitoring system aids in the identification of pollution sources, facilitating targeted mitigation strategies.

As technology evolves, advancements in sensor accuracy and data analytics will further refine the system's efficacy. Collaboration between governmental bodies, private sectors, and the community is essential for a comprehensive approach to pollution management. By prioritizing the integration of air and noise pollution monitoring, societies can strive towards cleaner, healthier environments for current and future generations.

References

[1] B Veena, Mr. M. Lakshmipathy, Dr. D. Jayakumar, Dr. G. N. Kondandaramaiah. An IoT based air and sound pollution monitoring system Journal of critical reviews vol 7, issue 06,2020.

[2] Edward Broughton The Bhopal disaster and its aftermath: a review Environ Health. 2005

[3] Ambient air pollution World Health Organization (WHO) https://www.who.int/health-topics/air-pollution#tab=tab_2

[4] Kurmis A.P., Apps S. Occupationally Acquired Noise-Induced Hearing Loss: A Senseless Workplace Hazard. Int. J. Occup.Med. Environ.Health.2007;20:127-136

[5] Malagie M., Jensen G., Graham J.C., Smith D.L. Chapter 67-Food Industry Encyclopaedia of Occupational Health and Safety 4th Edition

[6] Prajoona Valsalan, Tariq Ahmed Barham Baomar, Ali Hussain Omar Baabood IoT based Health Monitoring System Journal of Critical Review vol 7, Issue 4,2020

[7] Allanki Sanyasi Rao et. al. “Navigating the Internet of Things (IoT): Towards a Smart and Sustainable Future-Opportunities, Issues and Challenges” in an International Journal of Early Childhood Special Education, DOI: 10.48047/INTJECSE/V15I4.4,Vol.: 1, Issue: 04, July 2023, Pages: 20-31

[8] Md. Sanwar Hossain Mostafizur Rahman, Md. Tuhin Sraker, Md. ErshadulHaque Abu Jahid A Smart IoT based system monitoring and controlling the sub-station equipment Internet of Things; Engineering Cyber Physical Human Systems Volume 7, September 2019, 100085

[9] Ramik Rawal Air Quality Monitoring System International Journal of Computational Science and Engineering Volume 9, Number 1(2019), pp. 1-9