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Noise Pollution Monitoring System

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ABSTRACT: Around the world, noise pollution has grown to be a major problem. Hearing loss, bad social behavior, irritability, sleep disturbance, and the ability to understand people's words are some of the harmful effects of this pollution. Noise can impair people's comprehension and behavior in educational settings, and noisy environments are unsuitable for teaching and learning activities. One of the finest options for monitoring noise or sound intensity in the environment for human safety is Internet of Things (IoT) technology. This study aims to design an IoT-based noise monitoring system that includes a sound sensor, an IoT platform, an LCD, and LEDs. If the noise level surpasses the threshold noise limit established by Environmental Department of Health standard, the system will issue a real-time alarm. The data from the sound sensor will be sent into the cloud server and then transferred into the app for display and remote monitoring if it has an Android application.

KEYWORDS: Pollution, IOT, Health, Monitoring

I.INTRODUCTION

The purpose of this work is to present the construction of an Internet of Things (IoT) based noise monitoring system that includes a sound sensor, an IoT platform LCD, and LEDs. If the noise level exceeds the Environmental Department of Health standard's threshold noise limit, the system will issue a real-time alarm. The data from the sound sensor will be downloaded into the cloud server and then transferred into the Android application, which is outfitted with an Android application, to enable remote monitoring and display. A noise pollution monitoring system's main goal is to compile accurate and trustworthy data on noise levels over time. This information is useful for locating noise sources, gauging the scope of the issue, and putting effective mitigation measures in place. Decision-makers may make wise policy choices and take the necessary steps to lower noise levels and protect public health by regularly monitoring noise pollution. A noise pollution monitoring system uses sound level meters or microphones to record sound waves as its sensors. To provide full coverage of the area being monitored, these sensors are carefully positioned in various areas.

OBJECTIVE OF RESEARCH

The interface offers configurable reports, historical data analysis, and information on current noise levels. Users can create reports for additional research and decision-making, set thresholds and alarms, and visualize noise levels on maps. Systems for monitoring noise pollution are helpful for people and communities as well as for government organizations and city planners. Residents can receive information on local noise levels and voice concerns or complaints if noise levels are too high. This encourages openness, involvement of the community, and teamwork in tackling noise pollution issues.

LITERATURE REVIEW

[1] Air and Sound Monitoring System To apply air and sound monitoring system:

Arduino is utilized as the microcontroller, and its goal is to measure the environmental sound and air quality. It is connected to all sensors, including those for sound, temperature, and gas. It detects sound from the

environment and produces a digital output as a sound sensor or mic sensor. Additionally attached to Arduino is a Wi-Fi module, which is utilized to send data from the sensors to a cloud server. The data is stored on an internet server using an ESP8266 Wi-Fi module. Since the data from the sensor are essentially analogue signals, the data are converted using an analogue to digital converter (ADC) [12]. The measured value from the sensors is displayed on a 16 x 2 Liquid Crystal Display (LCD).

[2] Air and Noise Pollution Monitoring in the City of Zagreb by Using Mobile Crowd Sensing:
This technique aims to identify metropolitan regions with serious detrimental effects on human health by producing fine-grained noise and pollution maps. Users continuously acquire sensor readings from wearable and built-in sensors using their smartphones. The captured data is periodically and independently sent to cloud servers. Mobile Crowd Sensing (MCS) service is deployed on cloud servers to provide dense sensor readings and offer solutions to find novel phenomena in urban contexts [13]. The collected data and exposure measures are available for individual use and can be viewed via a web interface. The MCS app's purpose is to alert users to their surroundings so they can adjust their path if there is poor air quality or traffic congestion.

[3] The Noise Impact in the Learning-Teaching Process in an Elementary School:

Noise that is generated unnecessarily or that is coming from the immediate vicinity of a school might act as a barrier and impede community contact inside the building. The project's objective is to investigate the impact of noise coming from both inside and outside the school building, as well as whether or not the noise can affect primary school pupils' academic performance. According to the World Health Organization (WHO), the recommended noise level for school is 35 dB for classrooms and 55 dB for outside activities. Reverberation lasts for 0.66 seconds [14]. Surveys and the use of a sound level meter to monitor noise levels are used to gather data for the project. The findings indicate that a number of factors affect noise level. Even while the noise level in the vicinity of the school is still within acceptable limits, it will eventually interfere with kids' ability to study and be taught

II.DISCUSSION

PROPOSED WORK
The proposed system can employs

1. **Sensor Network**: To capture a representative range of noise sources, a network of noise sensors with microphones and IoT capabilities should be installed throughout the city. The sensors should be strategically placed at different locations, such as busy intersections, residential areas, industrial zones, and recreational spaces.
2. **Data Acquisition**: Establish a central data acquisition component to accept and process data from the dispersed sensors for data acquisition. To gather and store the sensor data, use IoT gateways or a cloud-based platform. Use secure communication protocols to guarantee data confidentiality and integrity while being transmitted
3. **Data processing and analysis**: Create algorithms and signal processing methods to examine the noise data that have been gathered. Use algorithms for pattern recognition, spectral analysis, and noise filtering to extract useful information from the audio data. Classify various noise sources using machine learning or statistical models, then look for specific patterns or abnormalities. Use real-time data processing to create alerts and insights right away based on preset thresholds.
4. **Cloud Infrastructure**: Using a cloud-based infrastructure will allow you to store and handle huge amounts of noisy data. Use scalable and dependable cloud services to manage data processing, analytics, and storage. Use data backup and disaster recovery procedures to guarantee the availability and accuracy of your data.
5. **User Interface**: Create an intuitive user interface that may be accessed through web or mobile applications. Offer a real-time map of noise levels that enables users to travel the city and view noise data at particular spots. Make it possible to analyze historical data, allowing users to examine noise trends over time. Use programmable alarms and notifications to notify users when noise levels go above certain limits. Provide users with the ability to export data, create reports, and conduct data-driven analysis to aid in decision-making.

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6. **Community Engagement**: Public access to the system for monitoring noise pollution will help to facilitate community engagement. Enable locals to monitor noise levels in their communities, file noise complaints, and give input on the system's effectiveness. Encourage cooperation between residents, local government officials, and pertinent stakeholders to address noise pollution issues on a group level.
7. **Scalability and Upkeep**: Check that the system architecture is capable of growing when more sensors are added and the volume of data generated increases. To achieve reliable noise measurements, calibrate and maintain the sensors on a regular basis. update and upgrade the system to include new features, algorithms, and security measures.

METHODOLOGY:

Since close to 80 million individuals, or 20% of the EU's population, experience noise levels that experts deem excessive, noise monitoring is vital [9]. IoT enables the transfer of data to and from a device or thing, and because of its adaptability and affordability, it is growing in popularity every day [10]. IoT is therefore ideally suited to be utilized in monitoring the amount of noise in particular regions in order to solve the issue. The needs of contemporary society result in the development of noise sources, including industrial sources, transportation vehicles, military hardware, and construction. The UTM campus serves as the most notable example. The focus and intellectual growth of the students have been seriously hindered by the noise from traffic and building sites. Due to this problem, a system that will keep an eye on the noise level in those particular regions is required. The ability to choose whether an app is appropriate for studying is another option for pupils.

System Requirements:

1. Noise Sensors

Pick sensors that can measure noise levels with accuracy. They ought to have IoT capabilities for data transmission and built-in microphones.

2. Connectivity

Ensure dependable IoT protocols like LoRaWAN, Wi-Fi, cellular networks, or other low-power connectivity choices for data transmission.

3. Data Acquisition And Storage

Setting up a data acquisition component will allow you to gather, organize, and store sensor data. Select a scalable and secure storage architecture, like a local server or cloud platform.

Work Flow

1. Deploy IoT noise sensors: In this step, noise sensors with IoT capabilities are spread out around the monitoring region. These sensors will gather noise information from different places.
2. Sensor Data Transmission: Using IoT connectivity choices like Wi-Fi, cellular networks, or low-power IoT protocols like LoRaWAN, the deployed sensors wirelessly transfer the acquired noise data to a central data collecting system or cloud platform.
3. Data collection and processing: Incoming sensor data is collected and processed by the main data gathering component. It carries out tasks like data ingestion, archiving, and preliminary processing.
4. Noise Data Analysis and Pattern Recognition: In this step, the noise data that has been collected is examined and processed utilizing various algorithms and methods, including machine learning, pattern recognition, and signal processing. The goal is to find patterns, classify various noise sources, and extract insightful information.
5. Thresholds and Alerts: The system evaluates the noise data that has been analyzed against predetermined thresholds, which may be based on neighborhood standards or municipal ordinances. In order to allow the necessary stakeholders to respond appropriately, an alert system is activated if the noise levels go above specific criteria.

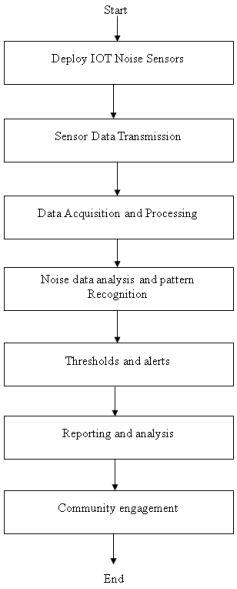

Fig-1: working flow of the based noise pollution monitoring system

6. **Analysis and Reporting**: The system gives customers the ability to produce reports and do data analysis on the gathered noise data. As a result, stakeholders are better able to understand the situation, spot patterns, and decide how to reduce noise pollution.
7. **Community interaction**: By making noise data accessible to the general public, the system fosters community interaction. Residents can view the noise levels in their neighborhoods, file noise complaints, and offer feedback. This encourages cooperation between stakeholders, government agencies, and individuals as a whole to address the problem of noise pollution.

III.RESULTS

As a result, the technology makes it possible to track the noise levels at various places in real-time. With the use of this data, authorities are able to make proactive decisions by having up-to-date visibility into the patterns and trends of noise pollution. In order to identify and categorize various noise sources, the system analyses and processes the noise data that has been gathered. As a result, authorities are better able to identify the causes of noise pollution and implement focused mitigation strategies. It encourages compliance monitoring systems that can help in monitoring and upholding noise limits and regulations. It offers unbiased information for assessing compliance and taking appropriate action in the event of infractions. It offers proactive noise control by notifying relevant stakeholders when noise levels exceed set limits using the system's threshold and alert mechanism. This makes it possible for quick reactions and interventions to reduce noise pollution and keep appropriate noise levels.

It deals with decision-making based on data: The availability of extensive noise data, analytics, and visualisations enables authorities to manage noise pollution based on data. They are able to locate noisy places, put noise reduction strategies into place, and assess the success of treatments. It increases civic involvement and awareness: Residents' knowledge of the problems with noise pollution in their neighborhood is increased by making noise statistics accessible to the public through user-friendly interfaces. It increases community involvement, makes it easier for citizens to provide input, and stimulates group efforts to alleviate the problems caused by noise pollution.

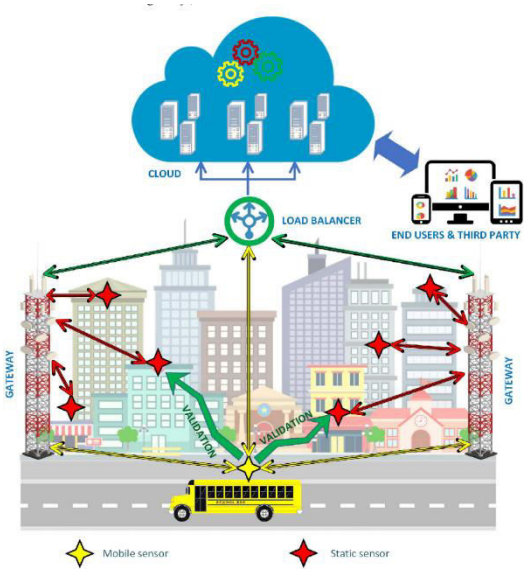

Fig-2: **Noise pollution sensors in smart cities**

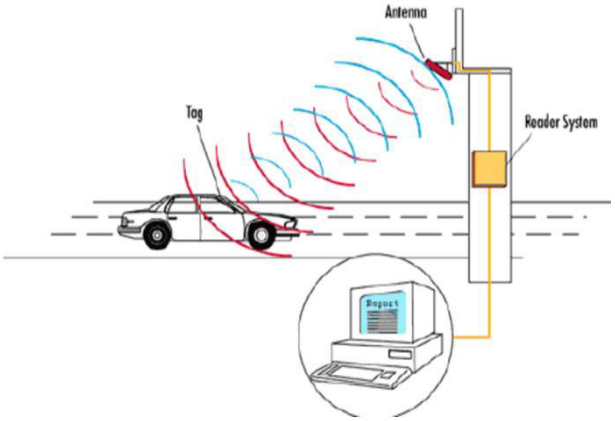

Fig-3: **Noise pollution monitoring in smart cities**

IV.CONCLUSIONS

In managing and reducing noise pollution in metropolitan areas, an IoT-based noise pollution monitoring system offers substantial advantages. This system offers helpful insights into noise levels, source identification, and compliance monitoring by utilising sensor technologies, data analysis, and real-time monitoring capabilities. It gives authorities the ability to make data-driven decisions, carry out targeted interventions, and effectively enforce noise rules. The method also encourages citizen participation and community engagement by making noise statistics accessible to the general public. In order to regulate noise pollution, it creates a shared duty between citizens, authorities, and stakeholders. A proactive approach to noise control, the formation of policies based on facts, and an IoT-based noise pollution monitoring system are all outcomes. It improves people's comfort and general well-being by fostering the development of healthier, quieter urban environments. IoT-

based noise pollution monitoring systems have a bright future ahead of them, with plenty of possible improvements and enhancements. the use of modern sensor technology More precise, sensitive, and reasonably priced noise sensors may be created as sensor technology continues to evolve. Additional features like several microphones for better directional noise detection and an increased signal-to-noise ratio may be incorporated into these sensors. Planning and administration of cities can be improved by integrating noise pollution monitoring systems with larger smart city projects. A deeper understanding of the urban environment can be attained by combining noise data with information from other sensors and sources, such as air quality sensors or traffic monitoring systems.

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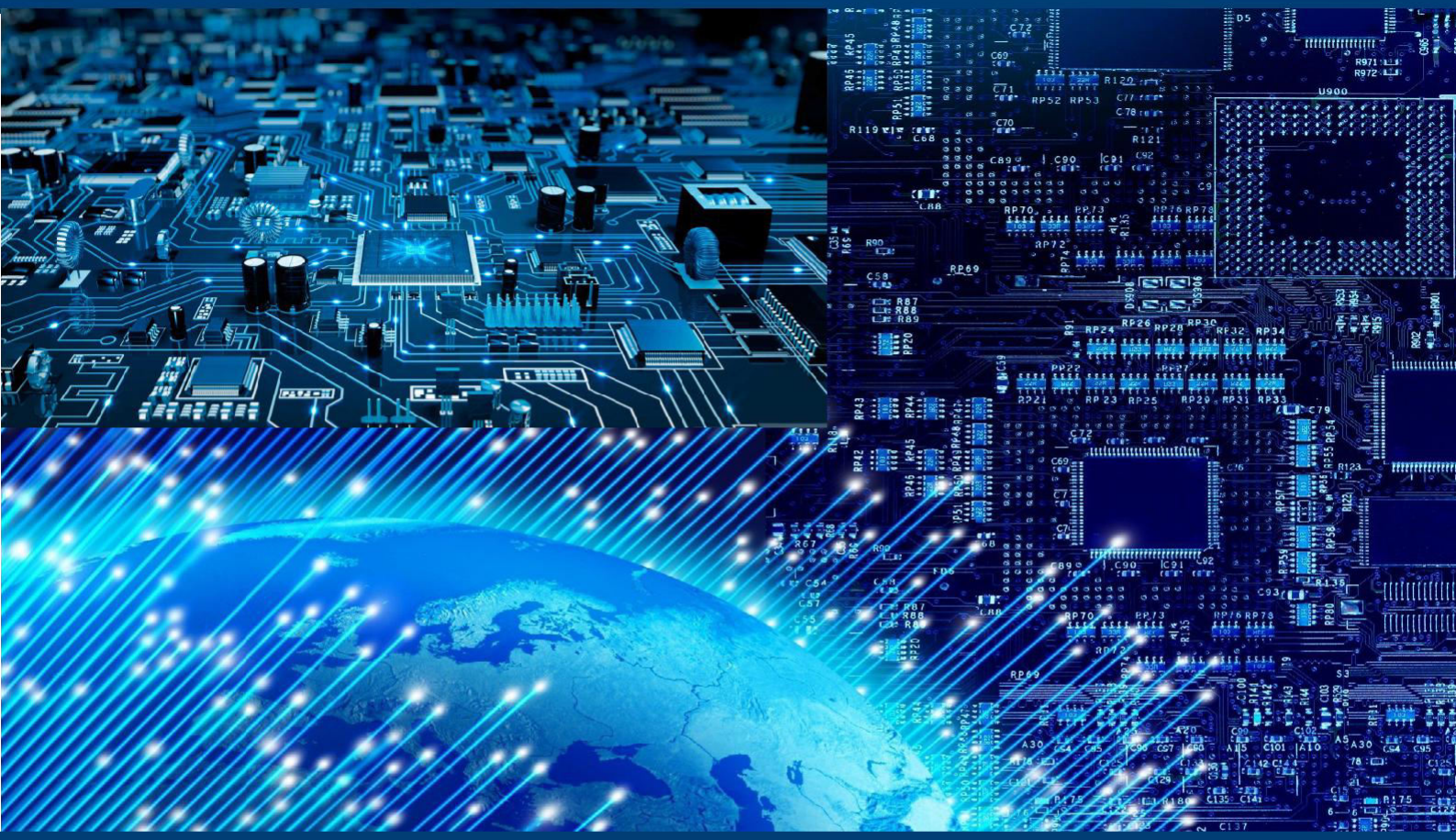

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