
MEASUREMENT OF SOUND LEVEL USING ARDUINO – BASED SOUND METER

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ABSTRACT

Environmental noise pollution has become a major concern due to rapid urbanization, industrial growth, and increased transportation activities. Accurate measurement of sound levels is essential for monitoring, controlling, and mitigating noise pollution.

This research paper focuses on the measurement of sound levels using a sound level meter and analyzes noise intensity in different environments. The study highlights the importance of sound measurement in assessing public health risks and maintaining regulatory standards.

A sound level meter is used to quantify sound pressure levels in decibels (dB), providing reliable data for analysis. The research involves collecting sound data from multiple locations such as residential, industrial, and commercial areas. The measured values are compared with permissible limits defined by environmental standards. The study also evaluates variations in sound levels based on time, location, and activity.

The results indicate that noise levels in urban and industrial zones often exceed safe limits, leading to potential health issues such as stress, hearing loss, and sleep disturbances. This paper emphasizes the need for effective noise monitoring systems and awareness regarding noise pollution. The findings can be useful for policymakers, urban planners, and researchers working in environmental engineering and public health sectors.

KEYWORDS: Sound Level Meter, Noise Pollution, Decibel (dB), Environmental Monitoring, Acoustic Measurement, Noise Analysis, Sound Pressure Level, Urban Noise, Industrial Noise, Public Health, Environmental Engineering, Noise Control.

Literature Review

Several studies have been conducted on noise measurement and its impact on human health and the environment. Researchers have explored different methods and instruments for measuring sound levels, with the sound level meter being the most widely used device due to its accuracy and ease of operation. Previous work highlights that urban areas consistently experience higher noise levels compared to rural regions, primarily due to traffic, construction activities, and industrial operations.

Studies indicate that prolonged exposure to high noise levels can lead to serious health problems such as hearing impairment, hypertension, and psychological stress. Research conducted in metropolitan cities shows that noise levels frequently exceed the limits prescribed by environmental authorities. Various methodologies have been proposed to monitor and control noise pollution, including real-time monitoring systems and IoT-based sound measurement devices.

Additionally, literature suggests that noise mapping techniques are effective in identifying high-risk zones and planning mitigation strategies. Advances in digital sound meters and data logging systems have improved the accuracy and reliability of noise measurements. However, challenges still exist in terms of continuous monitoring and enforcement of regulations.

Overall, the literature emphasizes the importance of systematic noise measurement and analysis to address environmental and health concerns. This study builds upon existing research by focusing on practical measurement techniques and comparative analysis across different environments.

Problem Statement

Noise pollution is a growing environmental issue that affects human health, productivity, and overall quality of life. Despite the availability of regulatory standards, many urban and industrial areas continue to experience excessive noise levels. One of the major challenges is the lack of accurate and consistent monitoring of sound levels in different environments.

Traditional methods of noise assessment are often limited to short-term measurements, which do not provide a complete understanding of noise patterns over time.

Additionally, there is a lack of awareness and implementation of proper noise control

measures. This results in continuous exposure to harmful sound levels, especially in densely populated areas.

Another issue is the variability of noise levels due to factors such as traffic density, industrial operations, and time of day. Without proper measurement and analysis, it becomes difficult to identify critical sources of noise and implement effective solutions. Furthermore, existing data on noise pollution is often insufficient or outdated, making it challenging to develop accurate models and policies.

This research aims to address these problems by conducting systematic sound measurements using a sound level meter and analyzing the data to identify trends and critical zones. The study focuses on providing reliable data that can be used for better noise management and policy formulation.

Objectives

The primary objective of this research is to measure and analyze environmental noise levels using a sound level meter. The study aims to provide a comprehensive understanding of noise pollution in different areas and evaluate its impact on human health and the environment.

Specific objectives include

- To measure sound levels in various environments such as residential, commercial, and industrial areas.
- To compare measured noise levels with standard permissible limits.
- To analyze variations in sound levels based on time and location.
- To identify major sources contributing to noise pollution.
- To evaluate the effectiveness of sound level meters in environmental monitoring.
- To suggest possible noise control and mitigation strategies.

Another objective is to create awareness about the importance of noise measurement and its role in maintaining a healthy environment. The study also aims to provide useful data for researchers, policymakers, and engineers involved in environmental management.

By achieving these objectives, the research contributes to the development of better noise monitoring systems and helps in reducing the adverse effects of noise pollution.

METHODOLOGY

The methodology adopted in this research involves systematic measurement of sound levels

using a calibrated sound level meter. The study is conducted in multiple locations, including residential, commercial, and industrial areas, to obtain a diverse set of data.

The sound level meter is used to record sound pressure levels in decibels (dB). Measurements are taken at different times of the day, such as morning, afternoon, and evening, to capture variations in noise levels. Each measurement is recorded over a fixed duration to ensure consistency and accuracy.

Data collection is followed by data analysis, where the recorded values are compared with standard permissible limits. Statistical methods are used to analyze trends and identify peak noise levels. Graphs and charts are used to represent the data for better understanding.

Precautions are taken to ensure accurate measurements, such as proper placement of the sound meter and avoiding interference from external factors. Calibration of the instrument is performed before conducting measurements.

The methodology ensures reliable and consistent data collection, which is essential for accurate analysis and interpretation. This approach helps in identifying critical areas with high noise levels and provides a basis for further research and noise control measures.

System Design

The system design for sound measurement consists of a sound level meter integrated with data recording and analysis components. The sound level meter includes a microphone, signal processing unit, display, and data storage system.

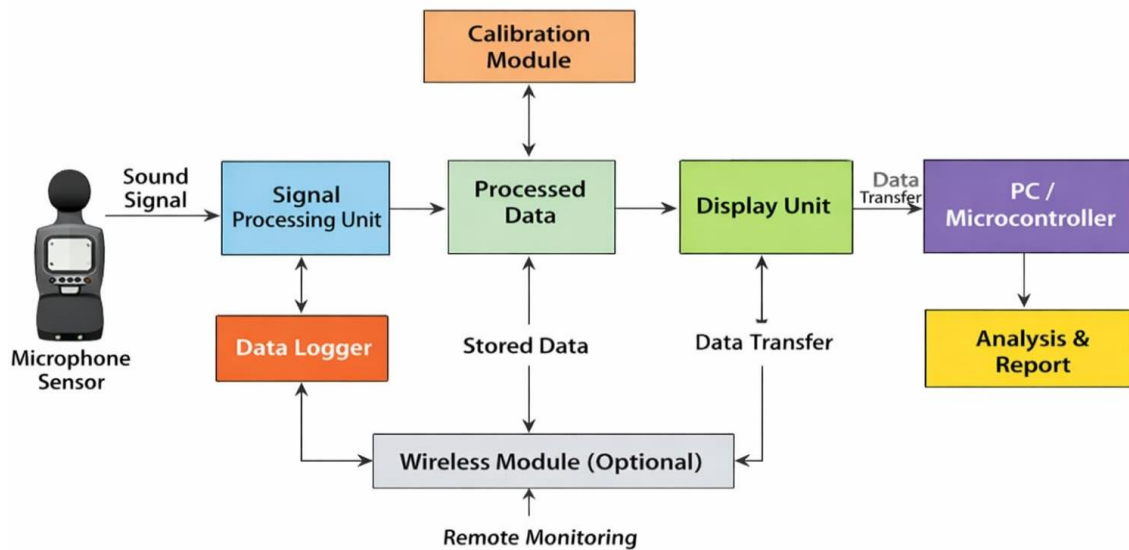
The microphone captures sound waves from the environment and converts them into electrical signals. These signals are then processed to determine the sound pressure level in decibels. The processed data is displayed on the meter and can also be stored for further analysis.

In advanced systems, the sound meter can be connected to a computer or microcontroller for real-time monitoring and data logging. Software tools are used to analyze the recorded data and generate reports. The system may also include wireless communication modules for remote monitoring.

The design ensures accuracy, portability, and ease of use. Proper calibration and sensitivity adjustments are included to maintain measurement precision. The system is designed to operate in different environmental conditions and provide reliable results.

Overall, the system design focuses on efficient sound measurement, data storage, and analysis, making it suitable for environmental monitoring and research applications.

Sound Level Meter System Design



Experimental Setup

The experimental setup involves the use of a sound level meter placed at selected locations for measuring environmental noise. The setup is designed to ensure accurate and consistent data collection.

The sound meter is mounted on a stand at a standard height above the ground to avoid interference from reflections and obstacles. Measurements are taken in open areas to capture ambient noise levels. Care is taken to minimize external disturbances during the experiment. Different locations are selected based on their characteristics, such as traffic density, industrial activity, and population. Measurements are recorded at regular intervals and under similar conditions to maintain consistency.

Environmental factors such as wind speed and temperature are also considered, as they may affect sound propagation. The sound meter is calibrated before each set of measurements to ensure accuracy.

Data is recorded manually or using a digital logging system for further analysis. The experimental setup is designed to provide reliable and reproducible results, which are essential for accurate noise assessment.

RESULT AND ANALYSIS

The results obtained from the sound measurements indicate significant variations in noise levels across different locations. Residential areas generally show lower noise levels compared to commercial and industrial zones. However, during peak hours, even residential

areas experience increased noise due to traffic and human activities.

The analysis reveals that industrial areas consistently exceed permissible noise limits, mainly due to machinery and heavy equipment. Commercial areas also show high noise levels, especially during business hours. Graphical representation of data helps in identifying trends and peak noise periods.

Statistical analysis is used to calculate average, maximum, and minimum sound levels. The results are compared with standard limits to assess compliance. In many cases, the measured values exceed safe limits, indicating a need for noise control measures.

The study highlights the impact of time and location on noise levels. It also identifies major sources of noise, such as vehicles, construction activities, and industrial operations.

Overall, the analysis provides valuable insights into noise pollution patterns and helps in identifying areas that require immediate attention.

CONCLUSION

This research study successfully demonstrates the measurement and analysis of environmental noise using a sound level meter. The findings indicate that noise pollution is a significant issue in urban and industrial areas, often exceeding permissible limits. The use of a sound level meter provides accurate and reliable data, which is essential for assessing noise levels and identifying critical areas. The study highlights the importance of regular monitoring and implementation of noise control measures. It is evident that noise pollution has adverse effects on human health and the environment. Therefore, effective strategies must be developed to reduce noise levels and improve quality of life.

The research contributes to the understanding of noise patterns and provides a foundation for further studies in this field. It also emphasizes the need for awareness and strict enforcement of noise regulations.

FUTURE SCOPE

The future scope of this research includes the development of advanced noise monitoring systems using modern technologies such as IoT and wireless sensor networks. These systems can provide real-time data and enable continuous monitoring of noise levels. Further studies can focus on noise mapping and predictive analysis to identify high-risk areas and implement preventive measures. Integration of artificial intelligence can enhance data analysis and improve accuracy.

Another area of research is the development of cost-effective and portable sound

measurement devices for widespread use. Public awareness programs and policy improvements can also be explored to reduce noise pollution.

The study can be extended to include the impact of noise on specific groups, such as children and elderly people. Overall, there is significant potential for innovation and improvement in noise measurement and control techniques.

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