TITLE

Urban Noise Pollution Management System with Real-Time Monitoring and Automated Mitigation

FIELD OF INVENTION

[0001] This invention relates to the field of This invention relates to the field of urban environmental management and more particularly to the monitoring, analysis, and mitigation of noise pollution in urban areas through the use of advanced technologies. The invention utilizes a network of high-sensitivity smart sensors for real-time noise detection and classification, capable of differentiating between various noise sources such as traffic, construction, and industrial activities.

[0002] Machine learning algorithms are employed to analyze the collected data, predict future noise trends, and identify potential noise pollution hotspots, allowing for pre-emptive action to be taken. The system integrates with existing urban infrastructure to provide a cohesive and coordinated noise management strategy.

[0003] Additionally, automated noise barriers are dynamically activated based on sensor data to mitigate noise in real-time, responding effectively to fluctuating noise levels.

[0004] A mobile application allows residents to engage with the system by viewing real-time noise levels, reporting disturbances, and receiving alerts when noise thresholds are exceeded. The system also features environmental impact assessments, linking noise pollution with other environmental factors, and ensures compliance with regulatory standards. This invention provides a comprehensive solution to

improve public health and urban living conditions by addressing noise pollution.

PRIOR ART AND PROBLEM TO BE SOLVED

[0005] The need for an Urban Noise Pollution Management System has become increasingly vital as urban areas continue to grow in both population and industrial activity. Noise pollution, often referred to as an "invisible threat," is an environmental issue that directly impacts human health, well-being, and quality of life. As cities expand, the levels of ambient noise from various sources—such as traffic, construction, public transportation, industrial activities, and social gatherings—are rising at an alarming rate.

[0006] Excessive exposure to noise pollution can lead to severe health consequences, including hearing loss, sleep disturbances, increased stress levels, cardiovascular diseases, and reduced cognitive function. According to the World Health Organization (WHO), noise pollution is one of the top environmental risks to health, contributing to thousands of cases of premature death each year. It not only affects individuals but also disrupts communities by lowering property values, reducing productivity, and causing long-term environmental damage to urban wildlife. Given the scale of the problem, there is an urgent need for innovative and effective methods to manage and mitigate noise pollution in modern cities.

[0007] Currently, cities rely on several conventional methods to manage noise pollution, each with its own limitations. One common approach is the use of static noise barriers or sound walls, constructed along highways, railway lines, or industrial zones. These barriers, often made from concrete, metal, or wood, block or deflect

sound waves to protect residential areas. However, these barriers are rigid, expensive to install, and their effectiveness diminishes as urban landscapes evolve, as they are unable to adapt to fluctuating noise levels.

[0008] Another method involves manual noise monitoring by regulatory authorities using handheld or stationary sound level meters. This method captures sound data at specific times but is labor-intensive, time-consuming, and only provides snapshots of noise levels, often missing the dynamic nature of urban noise. It is also reactive, leading to delayed interventions when noise issues arise.

[0009] Time-based restrictions limit noisy activities, especially during night hours. Though this approach aims to reduce disturbances, enforcement is often inconsistent, and it cannot account for unpredictable noise events like traffic jams or emergency sirens. Zoning laws are also used to regulate noise by separating residential and industrial areas, but rapid urban growth often outpaces the effectiveness of these regulations.

[0010] Lastly, cities often rely on noise complaints and enforcement mechanisms, where residents can report disturbances. This system is subjective and reactive, often leading to delayed or insufficient responses. These approaches do not provide a comprehensive solution to ongoing noise pollution, and they struggle to address the complexities of modern, densely populated urban environments.

[0011] The limitations of these methods highlight the need for a more advanced, real-time Urban Noise Pollution Management System, which can continuously monitor, predict, and mitigate noise pollution through adaptive and data-driven solutions.

[0012] One prior art describes Distributed network of communicatively coupled noise monitoring and mapping devices. The disclosed embodiments pertain to systems and methods for monitoring and mapping noise data from multiple noise monitoring devices. These devices may include hearing protection systems that detect noise and transmit noise data, including location information. The collected noise data from various devices is pooled and utilized to enhance the functionality or benefit of one or more of the noise monitoring devices.

[0013] Another prior art mentions Environmental noise monitoring system based on Android embedded platform. The invention reveals an environmental noise monitoring system built on an Android embedded platform, comprising a core board, bottom board, GPS module, wireless communication module, LCD touch screen, audio module, Android OS, and noise detection app. It integrates hardware and software using the Android platform and ARM processor, offering advantages such as high performance, compact size, low power consumption, and easy migration to existing mobile terminals.

[0014] Another prior art describes A kind of urban traffic noise inquiry system of wireless monitor. An urban traffic noise monitoring system consists of a wireless noise monitoring device, radio network gateway, noise data storage server, noise data processing server, cloud server, and subscription client. Noise data is collected at radio noise measuring nodes using a sound level meter integrated with a spectrum analyzer featuring WiFi functionality. The device records noise levels at specific locations, marked on a map using labeled coordinates, and transmits the data to the servers for analysis and client access.

[0015] The Urban Noise Pollution Management System represents a breakthrough in urban environmental management by offering a proactive, data-driven, and technologically advanced approach to noise pollution. By integrating real-time monitoring, predictive analytics, automated noise control, and public engagement, this invention addresses the critical gaps in traditional noise management methods and significantly enhances the ability of cities to improve the overall quality of life for their residents.

THE OBJECTIVES OF THE INVENTION:

[0016] Urban noise pollution has become a significant concern in modern cities, negatively impacting public health and quality of life. Noise from traffic, construction, industrial activities, and other sources contributes to stress, sleep disturbances, and hearing loss. Current methods to manage noise, such as static barriers, manual noise monitoring, and zoning laws, are often reactive, rigid, and inefficient. These approaches fail to provide real-time data, accurately differentiate noise sources, or adapt to dynamic urban environments.

[0017] The lack of comprehensive noise management systems leaves communities exposed to chronic noise, with limited intervention options. As cities grow and noise pollution becomes more complex, there is a critical need for an advanced system that can provide continuous, real-time monitoring, predictive analytics, and dynamic mitigation strategies. Addressing these shortcomings is essential to improve urban living conditions and protect public health.

[0018] So herein the development of the “Urban Noise Pollution Management System” has been proposed.

[0019] The principal objective of the invention is to provide an Urban Noise Pollution Management System that utilizes a network of smart sensors for real-time monitoring and identification of noise pollution sources, employing machine learning algorithms for predictive analytics and automated noise barriers for effective noise mitigation, with integration into existing city infrastructure and public engagement via a mobile application.

[0020] Another objective of the invention is to deploy high-sensitivity smart sensors capable of distinguishing between various noise types such as traffic, construction, industrial, and residential, ensuring precise identification of noise sources.

[0021] A further objective of the invention is to implement machine learning algorithms to analyze historical noise data, predict future noise pollution trends, and identify emerging noise hotspots for pre-emptive noise control actions.

[0022] An additional objective is to design automated noise barriers that dynamically activate based on real-time sensor data to block or absorb excessive noise, ensuring responsive and efficient mitigation measures.

[0023] Yet another objective of the invention is to ensure seamless integration of the noise management system with existing city infrastructure, including traffic management and public transport systems, to facilitate coordinated noise control strategies.

[0024] It is also an objective to develop a mobile application for public engagement, enabling citizens to view real-time noise levels, report disturbances, and receive notifications when noise exceeds safe limits.

[0025] Another objective is to incorporate environmental impact assessments that evaluate the correlation between noise pollution and other environmental factors, such as air quality and temperature, to provide urban planners with comprehensive data.

[0026] It is further intended that the system will be designed to adhere to local and international regulatory standards concerning noise pollution, ensuring legal compliance while improving urban living conditions.

[0027] A final objective is to develop the system with a scalable and modular architecture, allowing for easy expansion or customization based on specific urban requirements, including portable monitoring units for temporary noise control.

SUMMARY OF THE INVENTION

[0028] Current technologies used to manage urban noise pollution include static noise barriers, manual monitoring systems, and time-based noise restrictions. Static noise barriers are built along highways and industrial zones to block or deflect sound waves, but they are rigid and only effective in specific areas. They cannot adapt to changing noise levels, and their high construction and maintenance costs make them less feasible in the long term.

[0029] Manual noise monitoring involves regulatory authorities using handheld or stationary devices to measure noise levels, often producing only a snapshot of data at particular times. This method is labor-intensive, time-consuming, and lacks real-time responsiveness, which leads to delays in addressing noise issues.

[0030] Time-based noise restrictions limit loud activities during certain hours, typically at night. However, these restrictions are hard to enforce consistently and fail to address unpredictable noise events, such as traffic congestion or emergency services.

[0031] These methods also lack the ability to differentiate between various noise sources, such as traffic and construction, making targeted interventions difficult. Moreover, there is limited public engagement in current noise management systems, leaving communities without real-time solutions. This highlights the need for a more dynamic, real-time solution for effective urban noise pollution control.

[0032] The Urban Noise Pollution Management System is an innovative solution designed to tackle the challenges of noise pollution in urban environments. This system integrates advanced technologies to provide continuous, real-time monitoring and dynamic management of urban noise.

[0033] At the core of the system are high-sensitivity smart sensors, strategically placed on urban infrastructure like streetlights and building facades. These sensors continuously capture and measure ambient noise across a broad frequency spectrum, detecting various sources such as traffic, construction, and industrial activities. The data collected by these sensors is transmitted via secure wireless connections to a central control hub.

[0034] The central control hub processes this data using sophisticated machine learning algorithms. These algorithms classify different noise sources and analyze trends, allowing the system to predict noise hotspots and potential future disturbances. Based on this analysis, the system can trigger automated noise barriers installed at critical locations such as highways and construction sites. These barriers, made from materials like perforated steel or composite sound-absorbing substances, adjust dynamically to block or absorb noise based on real-time measurements.

[0035] The system also includes a mobile application that enhances public engagement. Through the app, residents can access real-time noise data, report disturbances, and receive notifications about noise levels and mitigation actions. This feature promotes community involvement and transparency, allowing citizens to play an active role in noise management.

[0036] Additionally, the system incorporates environmental impact monitoring modules that track factors like temperature and air quality, providing a comprehensive view of how noise pollution interacts with other environmental conditions. This integration ensures a holistic approach to managing urban noise pollution and its broader effects.

[0037] In summary, the Urban Noise Pollution Management System offers a technologically advanced, adaptive solution for improving urban living conditions. By combining real-time monitoring, predictive analytics, automated noise control, and public engagement, the system aims to enhance public health, comply with regulations, and create a more harmonious urban environment.

DETAILED DESCRIPTION OF THE INVENTION

[0038] While the present invention is described herein by example, using various embodiments and illustrative drawings, those skilled in the art will recognize invention is neither intended to be limited that to the embodiment of drawing or drawings described nor designed to represent the scale of the various components. Further, some features that may form a part of the invention may need to be illustrated with specific figures for ease of illustration. Such om and glass from the road using a vacuum suction mechanism and a magnetic mechanism attached to the machine at the bottom end. The metal that form disclosed. Still, on the contrary, the invention covers all modification/s, equivalents, and alternatives falling within the spirit and scope of the present invention as defined by the appended claims. The headings are used for organizational purposes only and are not meant to limit the description's size or the claims. As used throughout this specification, the worn "may" be used in a permissive sense (That is, meaning having the potential) rather than the mandatory sense (That is, meaning, must).

[0039] Further, the words "an" or "a" mean "at least one" and the word "plurality" means one or more unless otherwise mentioned. Furthermore, the terminology and phraseology used herein is solely used for descriptive purposes and should not be construed as limiting in scope. Language such as "including," "comprising," "having," "containing," or "involving," and variations thereof, is intended to be broad and encompass the subject matter listed thereafter, equivalents and any additional subject matter not recited, and is not supposed to exclude any other additives, components, integers or steps. Likewise, the term "comprising" is considered synonymous with the

terms "including" or "containing" for applicable legal purposes. Any discussion of documents acts, materials, devices, articles and the like are included in the specification solely to provide a context for the present invention.

[0040] In this disclosure, whenever an element or a group of elements is preceded with the transitional phrase "comprising", it is also understood that it contemplates the same component or group of elements with transitional phrases "consisting essentially of, "consisting", "selected from the group comprising", "including", or "is" preceding the recitation of the element or group of elements and vice versa.

[0041] Before explaining at least one embodiment of the invention in detail, it is to be understood that the present invention is not limited in its application to the details outlined in the following description or exemplified by the examples. The invention is capable of other embodiments or of being practiced or carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein is for description and should not be regarded as limiting.

[0042] Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which the invention belongs. Besides, the descriptions, materials, methods, and examples are illustrative only and not intended to be limiting. Methods and materials similar or equivalent to those described herein can be used in the practice or testing of the present invention.

[0043] The present invention discloses Urban Noise Pollution Management System. This invention integrates real-time monitoring, advanced data analytics, and automated noise mitigation mechanisms into a single, unified platform. The system consists of a network of smart sensors strategically deployed throughout urban areas to continuously monitor noise levels and differentiate between various noise sources. It employs machine learning algorithms to predict noise patterns and emerging hotspots, allowing authorities to take pre-emptive actions.

[0044] The Urban Noise Pollution Management System (UNPMS) is designed to seamlessly integrate into the urban landscape while providing cutting-edge technology for real-time noise monitoring and mitigation. The system will be composed of several key components, each engineered for optimal performance, durability, and ease of use. Below is an elaborate breakdown of the system's external appearance, internal components, their interaction, and installation parameters.

[0045] The UNPMS will have a sleek, modern design that blends into urban environments like streets, parks, and public buildings without disrupting aesthetics. The visible elements of the system include smart sensor nodes, which are mounted on poles, buildings, or streetlights. These sensors are encased in weather-resistant housing made from high-quality polycarbonate or aluminum alloy, ensuring durability against harsh outdoor conditions such as rain, heat, or pollution. Each sensor node will have a cylindrical or rectangular shape, approximately 30-40 cm in length and 10 cm in width, with rounded edges for a smooth, unobtrusive appearance. The units will be colored in neutral tones (grey, white, or black) to blend with urban infrastructure. At the base of each sensor node, small LED

indicators will provide real-time status updates, such as operational health, data transmission, and calibration, visible to maintenance personnel but not obtrusive to the public.

[0046] The automated noise barriers will also have a discreet yet functional design. These barriers, installed near high-noise areas (e.g., highways, construction sites), will be composed of sound-absorbing panels made from advanced acoustic materials such as glass wool, PVC, or perforated steel, optimized for durability and effectiveness. The barriers will feature an adjustable height mechanism that dynamically responds to noise levels. In their idle state, the barriers remain at minimal height, but when activated, they extend upward to provide enhanced sound attenuation.

[0047] Smart Noise Sensors are the core components responsible for detecting noise. Each sensor node is equipped with microphones calibrated to capture sound at various frequencies. These microphones are highly sensitive and can distinguish between different types of noise, such as traffic, construction, industrial noise, or even crowd sounds. The sensors have integrated decibel meters to continuously measure sound pressure levels and categorize noise intensity.

[0048] These sensors are designed in cylindrical or rectangular shapes, approximately 30-40 cm in length and 10 cm in width. Their sleek, modern casings, featuring rounded edges, allow them to blend seamlessly into urban surroundings, often mounted on streetlights or building facades. The sensors are equipped with small LED indicators near the base for maintenance and operational status updates. The casings are constructed from durable materials such as polycarbonate or aluminium alloy, providing resistance to

environmental conditions like rain, dust, and extreme temperatures. The polycarbonate ensures impact resistance, while aluminum offers lightweight and corrosion resistance. Inside, the sensors include high-sensitivity microphones to capture a wide frequency range, decibel meters encased in temperature-controlled modules, and vibration dampeners made from rubber or silicone to maintain accuracy.

[0049] Machine Learning Module, embedded within each sensor node is a local processing unit powered by AI and machine learning algorithms. This module processes raw audio data to identify noise sources and predict trends. The AI engine classifies the type of noise based on the acoustic signature and makes real-time decisions about necessary actions, such as activating noise barriers or notifying city authorities.

[0050] Housed within the sensor nodes, this compact module integrates seamlessly into the sensor architecture. It is not visible to the public, being securely enclosed within the sensor unit. The core components include circuit boards with microchips made from silicon for data processing, and the module's casing is made from thermal conductive plastic to manage heat. Key components include a high-performance AI-driven microprocessor cooled by fanless heatsinks made of aluminum, memory modules with flash memory chips for data storage, and a power supply unit with a small power regulation circuit to ensure consistent power flow.

[0051] All data from the sensor nodes is transmitted wirelessly via Wi-Fi, LoRa, or 5G networks to a central control hub. This control hub is housed in a secure location within the city's infrastructure, such as a municipal building. It consists of powerful servers with cloud

integration, where the data from all sensor nodes is collected, stored, and analyzed.

[0052] Located in a secure, climate-controlled server room or data center, it resembles a standard IT server rack but includes additional cooling systems for high-performance processing. The server racks are made from steel with built-in ventilation systems, while internal components like processors, memory modules, and wiring are constructed from silicon, copper, and fiber optic cables. The hub features high-performance cloud-integrated servers with RAID arrays for redundancy, fiber-optic network switches for rapid data transfer, and liquid or fan-based cooling systems to maintain electronic integrity.

[0053] Automated Noise Barriers, positioned strategically in high-noise areas, interact dynamically with the noise sensors. They are equipped with actuators and servo motors that adjust their height and orientation based on real-time data from the sensors. For example, when traffic noise exceeds a predefined threshold, the barriers are extended to mitigate noise propagation. The barriers also feature vibration dampeners to absorb ground-based noise sources such as heavy machinery or trains.

[0054] They are designed as extendable, vertically adjustable panels, which rise and lower depending on noise levels. In their default retracted state, they measure 1.5 meters but can extend up to 3 meters when required. The panels have perforated surfaces with geometric patterns for sound absorption, and their finishes are either matte or glossy to suit urban aesthetics. Constructed from perforated steel or composite sound-absorbing materials like glass wool, PVC layers, or fiberglass, the barriers are supported by aluminum frames and coated

with weather-resistant finishes. They include electro-mechanical actuators in stainless steel housings for raising and lowering the barriers, layered noise absorption panels, and vibration dampeners at the base to absorb vibrations.

[0055] A dedicated mobile app is a vital component of the UNPMS, allowing citizens to access real-time noise data. The app displays noise levels across various zones, allowing users to report noise complaints, receive alerts about high-noise areas, and participate in community-driven noise mitigation efforts. The app also provides a feedback loop where users can tag noise events for further calibration of the system's machine learning models.

[0056] Users can view noise levels at their location, report disturbances, and check on city-mitigated actions. Components include geotagging with integrated GPS modules, data visualization through graphical libraries, and a feedback module that allows users to rate the effectiveness of noise mitigation efforts.

[0057] Additionally, the Environmental Impact Module monitors factors such as temperature, humidity, and air quality. Embedded within the same casing as the noise sensors, these sensors maintain a consistent design. They are housed in weather-resistant polycarbonate casings with ventilation for proper function. Components include air quality sensors using metal oxide semiconductor technology, and humidity and temperature sensors made from thermistors and hygrometers.

[0058] The system includes sensors for monitoring related environmental factors such as air quality, temperature, and humidity. This module is essential because environmental conditions can influence noise propagation. For instance, humidity and air pressure affect how

sound waves travel, and this data is fed into the system's predictive models to improve accuracy.

[0059] The smart sensors continuously monitor noise levels, and as they detect fluctuations, they immediately categorize the type and intensity of noise. For example, if traffic noise exceeds a certain threshold in a residential zone, the sensors send a real-time alert to the Central Control Hub. The Machine Learning Module processes the data, distinguishing whether the noise is traffic-related, construction-related, or crowd-related.

[0060] If the noise is traffic-based, the system might trigger a dynamic noise barrier to extend near the affected area, reducing noise transmission. If the noise is from construction, it can notify city authorities to impose temporary noise regulations or redirect traffic to mitigate the disturbance. The Mobile App provides real-time notifications to residents about ongoing noise issues and displays nearby noise levels, empowering citizens with actionable information.

[0061] The data continuously flows between the sensor nodes, central hub, and noise barriers, creating a closed-loop system that dynamically responds to urban noise in real time. Environmental data is also factored into the system to fine-tune the noise models, ensuring accurate noise prediction and mitigation strategies.

[0062] The installation of the Urban Noise Pollution Management System requires meticulous planning and precision. Smart noise sensors will be placed at strategic locations such as along major roads, near construction sites, around parks, and residential areas. The ideal height for sensor placement is between 2.5-3 meters above ground level to capture an accurate representation of environmental noise

without obstruction. Sensors must also be evenly spaced based on the area's geography and noise pollution density. Typically, sensors will be spaced 100-200 meters apart in highly congested zones and 500-1000 meters in quieter areas.

[0063] A reliable, high-speed network is crucial for data transmission. The sensors will require continuous power supply, which can be provided through solar panels or traditional power lines. The use of 5G or LoRa ensures low-latency communication between sensor nodes and the central control hub.

[0064] These barriers will be positioned near roadsides, industrial zones, or other noise hotspots. Each barrier will need secure ground foundations to support the automated mechanisms. Depending on the urban layout, barriers can either be permanently installed or use modular, portable systems for events or temporary noise sources like construction sites.

[0065] The system’s mobile app will be deployed across multiple platforms (iOS and Android) and needs secure access points for the public to view noise data, report issues, and receive updates. Additionally, the app will integrate with city traffic and event management systems to provide a unified interface for noise management.

[0066] The system must adhere to local noise regulations and environmental standards. Each component, especially the barriers and sensors, must be approved by regulatory authorities to ensure they meet safety and effectiveness standards.

[0067] The network of smart noise sensors continuously monitor ambient noise using high-sensitivity microphones, detecting a broad range of

frequencies and intensity levels. Data from these sensors is transmitted to a central control hub via secure LoRa or 5G connectivity. This hub, aggregates and analyzes the data using sophisticated machine learning algorithms. These algorithms classify noise sources—such as traffic, construction, or industrial activities—and predict noise trends and potential hotspots.

[0068] When excessive noise levels are detected, the system activates automated noise barriers installed at key locations like highways and construction sites. Public engagement is facilitated through a mobile application, which offers users real-time noise data, allows them to report disturbances, and provides updates on mitigation actions. This app integrates seamlessly with the system, enhancing transparency and community involvement.

[0069] Here’s a detailed case study example for the Managing Noise Pollution in Downtown Metropolis.

[0070] Scenario: In downtown Metropolis, noise pollution is a persistent issue, primarily driven by heavy traffic, ongoing construction projects, and bustling commercial activities. The Urban Noise Pollution Management System (UNPMS) has been recently deployed in this area to address these challenges and enhance the quality of life for residents.

[0071] System Deployment: Smart sensors are strategically installed along major roads, construction sites, and commercial zones. These sensors continuously monitor ambient noise levels, distinguishing between different sources such as traffic noise, construction machinery, and public events. The data is transmitted to the central control hub every few seconds, where machine learning algorithms

analyze the information to identify noise patterns and predict potential hotspots.

[0072] Real-Time Response: One afternoon, a construction site in downtown Metropolis begins operations, resulting in a sharp increase in noise levels. The sensors in the vicinity detect this surge and immediately relay the data to the central hub. The machine learning algorithms recognize the construction noise and assess that it exceeds the permissible noise thresholds for that time of day.

[0073] In response, the system activates automated noise barriers positioned along the perimeter of the construction site. These barriers, equipped with sound-absorbing materials, adjust dynamically to mitigate the noise impact. The system also sends an alert to the construction site management through the mobile application, notifying them of the excessive noise levels and recommending immediate adjustments to their equipment or work schedule.

[0074] Public Engagement: Residents in nearby apartments receive notifications via the UNPMS mobile application about the noise levels and the measures being taken. They are informed about the ongoing situation and can view real-time data on the app. This transparency helps alleviate concerns and keeps the community informed.

[0075] Long-Term Impact: Over time, the system's predictive analytics feature identifies recurring noise hotspots around certain commercial areas. The data guides city planners in implementing additional noise control measures and adjusting traffic patterns to alleviate persistent issues. Environmental impact modules also track changes

in air quality, providing insights into how noise pollution affects broader environmental factors.

[0076] Conclusion: The Urban Noise Pollution Management System effectively manages the noise pollution in downtown Metropolis through real-time monitoring, automated responses, and community engagement. By adapting dynamically to noise sources and providing timely notifications and interventions, the system enhances urban living conditions and supports a more harmonious environment for both residents and businesses.

[0077] The Urban Noise Pollution Management System offers a scalable, modular solution for modern cities seeking to address the growing problem of noise pollution. Its real-time monitoring, predictive analytics, and dynamic noise barriers provide an effective means of improving urban living conditions, while its integration with city infrastructure and public engagement features ensure broad applicability and community involvement.

[0078] While there has been illustrated and described embodiments of the present invention, those of ordinary skill in the art, to be understood that various changes may be made to these embodiments without departing from the principles and spirit of the present invention, modifications, substitutions and modifications, the scope of the invention being indicated by the appended claims and their equivalents.

FIGURE DESCRIPTION

[0079] The accompanying drawings, which are incorporated in and constitute a part of this disclosure, illustrate an exemplary embodiment and explain the disclosed embodiment together with the description. The left and rightmost digit(s) of a reference number identifies the figure in which the reference number first appears in the figures. The same numbers are used throughout the figures to reference like features and components. Some embodiments of the System and methods of an embodiment of the present subject matter are now described, by way of example only, and concerning the accompanying figures, in which

[0080] Figure 1 demonstrates the line diagram of the system

[0081] Figure 2 illustrates the flow diagram of the working

ABSTRACT:

This invention describes an Urban Noise Pollution Management System designed to address urban noise pollution through advanced technology. The system employs a network of high-sensitivity smart sensors to monitor noise levels in real time, accurately identifying and classifying noise sources such as traffic and construction. Data from these sensors is analyzed by machine learning algorithms at a central control hub to predict noise trends and hotspots. Automated noise barriers, dynamically adjusted based on real-time data, provide targeted mitigation. The system integrates with city infrastructure and features a mobile application for public engagement, allowing residents to view real-time noise levels, report disturbances, and receive alerts. It also includes environmental impact modules to monitor related factors like air quality. This comprehensive approach offers precise, adaptive noise control, enhancing urban living conditions and public health while fostering community involvement and improving regulatory compliance.

Signatory for,

I/WE CLAIMS

1. A system for managing urban noise pollution, comprising:

   a network of smart sensors distributed across urban areas, each sensor configured to continuously monitor real-time noise levels and differentiate between various noise sources, including but not limited to traffic, construction, industrial, and residential noise;

   at least one machine learning module operatively connected to the smart sensors, the machine learning module being configured to analyze noise data, identify and classify noise sources, and predict future noise pollution trends based on historical data;

   automated noise mitigation means, comprising noise barriers, the noise barriers being operatively responsive to sensor data for dynamic activation to block or absorb noise;

   a central control unit configured to receive and process data from the smart sensors, manage the operation of the noise mitigation means, and issue alerts to authorities when noise pollution thresholds are exceeded;

   an interface for integration with existing city infrastructure, wherein the system coordinates with traffic lights, public announcement systems, or other relevant infrastructure to implement noise control measures;

   a mobile application operatively connected to the central control unit, enabling users to view real-time noise levels, report noise issues, and receive alerts regarding noise pollution in their vicinity;

   wherein the system further includes compliance modules configured to assess noise pollution data against regulatory standards and generate reports on noise pollution impact on public health.

2. The system of claim 1, wherein the smart sensors are further configured to monitor environmental factors, including air quality and temperature, and wherein said environmental data is correlated with noise pollution data to enhance the accuracy of noise source identification.

3. The system of claim 1, wherein the machine learning module utilizes predictive analytics to forecast noise pollution hotspots and trends, enabling the system to initiate preemptive noise mitigation measures.
4. The system of claim 1, wherein the noise barriers are composed of energy-efficient materials that minimize the system's environmental footprint, said barriers being selectively activated based on the type and severity of detected noise.
5. The system of claim 1, further comprising public dashboards accessible via the mobile application or web interface, the dashboards displaying real-time and historical noise pollution data, and providing visualizations of noise patterns over time and space.
6. The system of claim 1, wherein the central control unit is configured to dynamically adjust the operation of the noise barriers based on the classification of noise sources and their respective intensities, ensuring targeted and efficient noise reduction.
7. The system of claim 1, further comprising a portable noise monitoring unit, said unit being deployable for temporary use in areas of transient noise pollution, such as during public events or construction projects.
8. The system of claim 1, wherein the mobile application enables residents to contribute supplemental noise data via their smartphones, the supplemental data being aggregated with sensor data to improve noise monitoring accuracy.
9. The system of claim 1, wherein all noise data collected by the system is encrypted to ensure privacy and security, with data collection being anonymized in compliance with local and international data protection regulations.
10. The system of claim 1, wherein the machine learning module is further configured to assess the impact of noise pollution on public health, generating actionable insights for urban planners, including recommendations for noise mitigation in high-risk areas.