

NOISE POLLUTION MONITORING



Submitted by:

Bharathi P - 812921106006

Balamurugan A - 812921106005

Jagatheeshwaran K - 812921106017

Kavinish S - 812921106021

TABLE OF CONTENTS

1.Abstract

2.Objectives

3.Introduction

4.Problem definition

5.Design thinking

5.Noise pollution pattern

5.1 Construction

5.2 Traffic

5.3 Train

5.4 Industry

5.5 Aircraft take offs

6.High-noise areas

7.Source of noise pollution

8.Block diagram

9.Components

9.1 ArduinoUNO

9.2 MQ135 (Gassensor)

9.3 LM393 (Noisesensor)

9.4 ESP8266WIFIModule

9.5 16*2 LCDDisplay

9.6 LED

9.7 Buzzer

10.Internal block diagram

11.Program

12.Output

13.Conclusion

NOISE POLLUTION MONITORING

Abstract:

Noise pollution is a pervasive environmental issue that significantly impacts human health, well-being, and the overall quality of life. The need for effective monitoring and management of noise levels has become increasingly crucial, given its detrimental effects on public health, wildlife, and the ecosystem. Leveraging the capabilities of the Internet of Things (IoT), this project proposes the design and implementation of a comprehensive and scalable noise pollution monitoring system to provide real-time data collection, analysis, and visualization of noise levels in various environments. The IoT-based noise pollution monitoring system consists of a network of distributed sensor nodes strategically placed in key locations to capture ambient noise data. These sensor nodes are equipped with high-precision microphones and processing units to accurately measure noise levels and convert the analog signals into digital data. The data collected by these nodes are transmitted wirelessly to a central server, where advanced algorithms process and analyze the information to identify patterns, trends, and potential sources of noise pollution. To ensure the accuracy and reliability of the collected data, the system incorporates calibration mechanisms to account for factors such as temperature, humidity, and other environmental variables that may influence noise measurements. Additionally, the system is designed to operate in diverse environmental conditions, including urban, industrial, and residential areas, to provide a comprehensive understanding of noise pollution across different settings.

Objective:

The primary objective of the proposed project is to develop a comprehensive and scalable noise pollution monitoring system using Internet of Things (IoT) technology. The system aims to provide accurate, real-time data collection, analysis, and visualization of noise levels in various environments, with the overarching goal of mitigating the adverse impacts of noise pollution on human health, wildlife, and the environment.

- **Accurate Noise Data Collection:** The first objective is to ensure the accurate and reliable collection of noise data across different environments. This involves the deployment of a network of sensor nodes equipped with high-precision microphones capable of capturing and converting ambient noise into digital data. The system will be designed to account for various environmental factors that may influence noise measurements, thereby ensuring the accuracy and integrity of the collected data.
- **Real-time Monitoring and Analysis:** The system aims to provide real-time monitoring of noise levels, enabling the immediate detection of fluctuations and excessive noise in targeted areas. By leveraging advanced signal processing algorithms, the system will be capable of analyzing the collected data to identify patterns, trends, and potential sources

of noise pollution. It will distinguish between different types of sound sources, including those from transportation, industrial activities, and human activities, to provide insights into the specific sources contributing to elevated noise levels.

- **Identification of Noise Hotspots:** One of the key objectives is to identify and locate noise hotspots within urban, industrial, and residential areas. By strategically placing sensor nodes in various locations, the system will be able to pinpoint areas with consistently high noise levels, facilitating a targeted approach to noise control and mitigation strategies. This will enable urban planners and policymakers to prioritize areas that require immediate intervention and implement effective measures to reduce noise pollution in these hotspots.
- **Alerts and Notifications for Intervention:** The system aims to provide real-time alerts and notifications when noise levels exceed predefined thresholds. These notifications will enable prompt intervention and mitigation measures, allowing relevant authorities and stakeholders to take immediate action to address the sources of excessive noise. By facilitating timely responses, the system seeks to minimize the potential health impacts associated with prolonged exposure to high noise levels, thereby safeguarding the well-being of communities and the surrounding environment.
- **Data Visualization for Informed Decision-making:** The project aims to develop intuitive and user-friendly data visualization tools to present noise data in a comprehensible format. Through the use of interactive graphs, charts, and maps, the system will enable stakeholders, policymakers, and the general public to gain insights into noise trends and patterns. This will facilitate informed decision-making and the formulation of evidence-based noise control policies and regulations aimed at promoting sustainable urban development and preserving environmental quality.

By achieving these objectives, the project aspires to raise awareness of the adverse impacts of noise pollution and promote the implementation of proactive measures to mitigate its effects. The ultimate goal is to contribute to the creation of healthier and more sustainable living environments for communities, while fostering a greater understanding of the importance of sound environmental management and sustainable urban planning.

Introduction:

Noise pollution is a pervasive environmental challenge that has gained significant attention in recent years due to its detrimental effects on human health, well-being, and the overall quality of life. With the rapid growth of urbanization and industrialization, the issue of noise pollution has become increasingly prevalent, affecting not only densely populated urban areas but also suburban and rural communities. The World Health Organization (WHO) has identified noise as a leading environmental health hazard, linking it to various health problems, including cardiovascular diseases, sleep disturbances, and cognitive impairments. Additionally, noise pollution poses a threat to wildlife, disrupting ecosystems and affecting the behavior and

communication of numerous animal species. Recognizing the urgency to address this pressing environmental concern, there has been a growing interest in leveraging technological advancements, particularly in the field of the Internet of Things (IoT), to develop effective solutions for monitoring and managing noise pollution. The integration of IoT technology in environmental monitoring systems offers a promising avenue to collect real-time data, analyze trends, and identify sources of noise pollution, thereby enabling the implementation of targeted interventions and mitigation strategies. This project aims to contribute to the ongoing efforts to combat noise pollution by proposing the development of an IoT-based noise pollution monitoring system. The system seeks to provide a comprehensive and scalable approach to monitor, analyze, and visualize noise levels in diverse environments, ranging from urban centers to industrial zones and residential communities. By employing a network of strategically placed sensor nodes equipped with advanced microphones and data processing units, the system will enable the collection of accurate and reliable noise data, facilitating a deeper understanding of the spatial and temporal variations in noise pollution.

Problem definition:

- Noise pollution is a pervasive environmental issue that poses significant threats to human health, well-being, and the overall quality of life. With the rapid expansion of urban areas and the increasing prevalence of industrial activities, the levels of noise pollution have reached alarming levels, leading to a range of adverse effects on individuals and communities. The lack of comprehensive and real-time monitoring systems for noise pollution has hindered the effective assessment and management of this critical environmental concern. Traditional noise monitoring approaches often rely on manual measurements at limited locations, providing only a fragmented understanding of noise levels and their impacts.
- The absence of a robust and integrated monitoring system has resulted in a lack of precise data on the spatial and temporal variations of noise pollution, impeding the formulation of evidence-based policies and strategies for noise control and mitigation. Moreover, the inability to accurately identify the sources of excessive noise has hindered the implementation of targeted interventions to address specific noise hotspots and sources, further exacerbating the challenges associated with noise pollution management.
- The existing limitations in noise monitoring have contributed to a general lack of public awareness and understanding of the adverse effects of noise pollution on human health and the environment. Without comprehensive data and accessible information on noise levels and their implications, communities and policymakers often struggle to develop effective measures to minimize the impacts of noise pollution and promote sustainable urban development.
- Furthermore, the conventional approaches to noise monitoring are often resource-intensive and time-consuming, relying on manual data collection and analysis processes

that are prone to inaccuracies and inconsistencies. The absence of real-time data collection and analysis capabilities limits the ability to promptly respond to fluctuations

in noise levels and implement timely interventions to mitigate the adverse impacts on public health and well-being.

Design thinking:

Empathize with Stakeholders: Understand the needs and concerns of residents, environmental agencies, and urban planners regarding noise pollution.

- **Define the Problem:** Clearly define the specific challenges and goals for noise monitoring in the target area.

- **User Personas:** Create user personas for different stakeholders to guide the design process.

- **Ideation Workshops:** Conduct brainstorming sessions to generate innovative ideas for IoT-based noise monitoring solutions.

- **Prototyping:** Create low-fidelity prototypes to visualize and test potential solutions quickly.

- **User Feedback:** Collect feedback from potential users and stakeholders to refine the design.

- **Wireframing:** Develop wireframes to outline the user interface and data visualization components.

- **IoT Sensor Selection:** Choose appropriate sensors for measuring noise levels, considering factors like accuracy, cost, and power consumption.

- **Data Transmission:** Determine the most suitable communication protocols for transmitting data from sensors to a central server.

- **Data Storage:** Plan for secure and scalable data storage solutions.

- **Data Visualization:** Design intuitive dashboards and reports to present noise pollution data effectively.

- **Real-time Monitoring:** Ensure that the system can provide real-time noise level updates.

- **Localization:** Consider the geographical location and distribution of sensors for comprehensive coverage.

- **Power Management:** Implement energy-efficient solutions to extend the lifespan of sensor batteries.

- **User Notifications:** Set up alerts and notifications for users when noise levels exceed predefined thresholds.

- **Data Analytics:** Incorporate data analytics to identify trends and patterns in noise pollution data.

- **Machine Learning:** Explore the use of machine learning algorithms to predict noise pollution based on historical data.

- **Accessibility:** Ensure that the monitoring system is accessible to individuals with disabilities.

- **Privacy and Security:** Implement robust security measures to protect user data and system integrity.

- **Scalability:** Design the system with scalability in mind to accommodate future

expansion.

- **Cost Analysis:** Conduct a cost-benefit analysis to optimize the overall project budget.
- **Regulatory Compliance:** Ensure that the system complies with local noise pollution regulations and standards.
- **Community Engagement:** Involve the local community in the monitoring process and seek their input.
- **Maintenance Plan:** Develop a maintenance plan to address sensor malfunctions and data discrepancies.
- **Continuous Improvement:** Commit to an iterative process of improvement based on ongoing feedback and technological advancements.

INNOVATION:

Noise pollution pattern:

1.Construction:

- Noise pollution in the context of construction refers to the excessive and disruptive levels of sound generated during building and infrastructure development activities. Construction projects often involve various heavy machinery, equipment, and processes that can produce high levels of noise, leading to detrimental effects on the surrounding environment and communities. Mitigating the impact of construction-related noise pollution is crucial for maintaining the well-being of both workers and residents in the vicinity.
- Construction activities such as demolition, drilling, excavation, and transportation of materials can contribute significantly to elevated noise levels. Heavy machinery like excavators, bulldozers, jackhammers, and trucks produce loud and persistent sounds, which can lead to annoyance, stress, and even hearing impairment if proper measures are not implemented.
- To address construction-related noise pollution effectively, several strategies can be employed. First and foremost, it is essential to adhere to noise regulations and guidelines set by local authorities and regulatory bodies. These regulations often specify permissible noise levels and appropriate working hours to minimize disturbances to the surrounding community.
- One of the most effective ways to manage construction noise is by implementing noise control measures directly at the source. This can involve using quieter equipment and machinery, employing noise-reducing technologies, and utilizing sound barriers and enclosures to contain the noise within the construction site. Ensuring that construction equipment is well-maintained and regularly serviced can also help reduce the overall noise output.

- Furthermore, scheduling construction activities strategically can help minimize the impact of noise on nearby residents. Avoiding noisy tasks during early morning or late evening hours, as well as during weekends and holidays, can significantly reduce the disturbance to the local community. Engaging in open communication and dialogue with the community about the construction schedule and potential noise disruptions can foster understanding and cooperation.
- Incorporating innovative construction practices and technologies can also contribute to noise reduction. Implementing prefabricated building components and modular construction methods, for instance, can lead to faster and quieter construction processes compared to traditional on-site construction. Additionally, utilizing electric or hybrid-powered machinery instead of conventional diesel-powered equipment can significantly decrease noise emissions and promote a more environmentally friendly construction approach.

2.Traffic:

- Traffic-related noise pollution is a pervasive issue in urban and densely populated areas, resulting from the continuous movement of vehicles on roadways. The constant hum of traffic, combined with the sounds of honking horns, engines, and braking, can have detrimental effects on the well-being of individuals living and working near busy roads. The adverse impacts of traffic noise pollution include annoyance, sleep disturbances, increased stress levels, and even long-term health implications such as cardiovascular diseases and cognitive impairment.
- To address traffic-related noise pollution, various strategies can be implemented. One approach involves the integration of urban planning and design principles aimed at reducing noise propagation. This can include the strategic placement of noise barriers, sound-absorbing pavements, and green spaces along roadways to mitigate the transmission of traffic noise to surrounding areas. Implementing traffic calming measures such as speed humps, roundabouts, and designated quiet zones can also help reduce the overall noise generated by vehicles.
- Furthermore, the promotion of public transportation and the adoption of alternative modes of transport, such as cycling and walking, can contribute to a reduction in traffic congestion and, consequently, lower noise levels. Encouraging the use of electric or hybrid vehicles can also significantly decrease the overall noise emissions from traffic, promoting a more environmentally friendly and quieter urban environment.
- In addition, the implementation of regulations and policies that define permissible noise levels for vehicles and roadways can play a crucial role in managing traffic-related noise pollution. Enforcing noise emission standards for automobiles and ensuring regular maintenance of vehicles can help limit excessive noise levels, contributing to a quieter and more livable urban landscape.

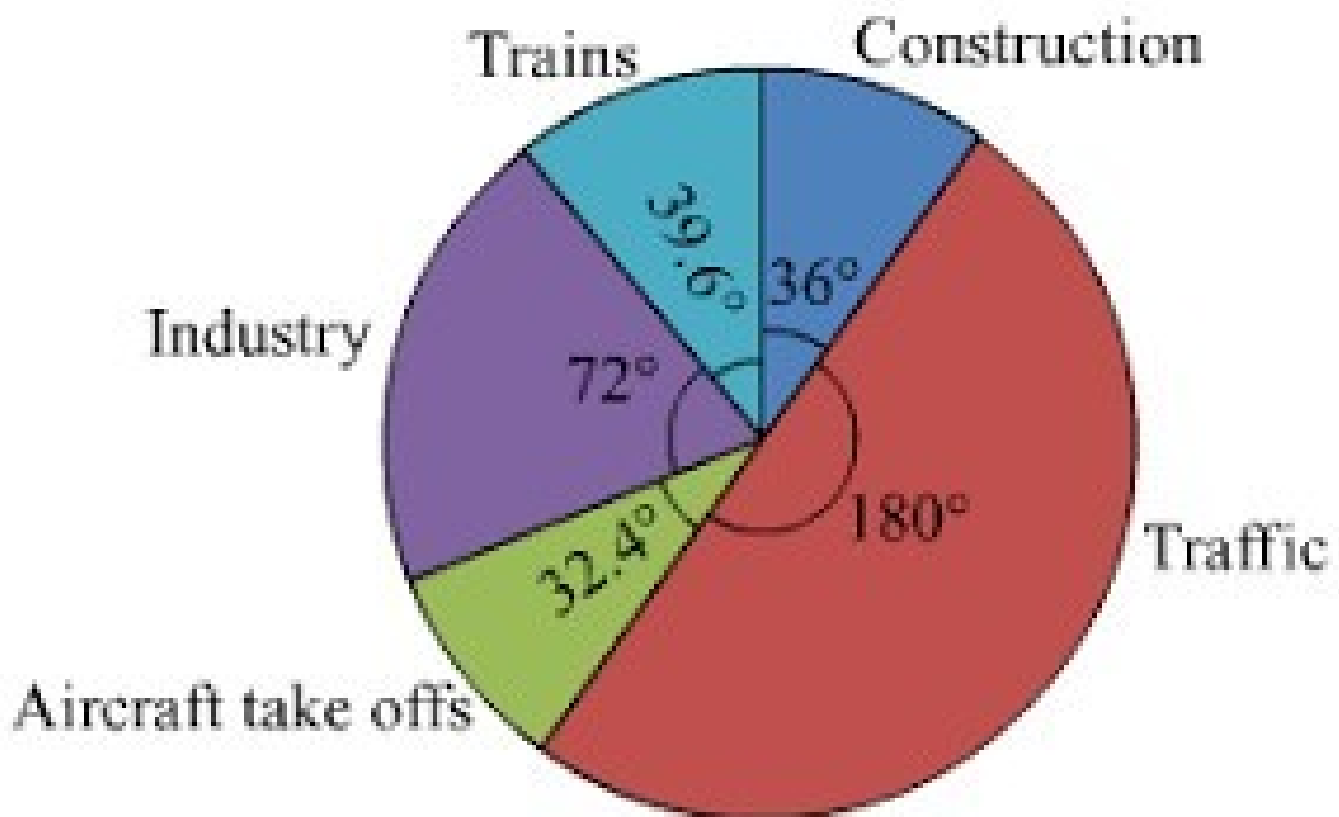
- Furthermore, the utilization of intelligent transportation systems (ITS) and traffic management technologies can help optimize traffic flow and minimize congestion, thereby reducing the overall noise generated by idling vehicles and stop-and-go traffic patterns. Implementing realtime traffic monitoring systems and dynamic route optimization strategies can lead to more efficient traffic management, resulting in a reduction in noise pollution and improved overall traffic conditions.
- By implementing these strategies in a comprehensive and integrated manner, urban planners, policymakers, and transportation authorities can work towards creating a more sustainable and harmonious urban environment, where traffic-related noise pollution is effectively managed, and the well-being of residents and communities is prioritized.

3.Train:

- Train-related noise pollution is a significant environmental issue, particularly in areas near railway tracks and stations. The operation of trains, including the movement of locomotives, the screeching of brakes, and the vibrations generated by rail traffic, can contribute to elevated noise levels that have adverse effects on nearby communities. Prolonged exposure to train-related noise pollution can lead to sleep disturbances, annoyance, and potential long-term health implications for individuals residing in affected areas.
- To mitigate train-related noise pollution, various measures can be implemented. One approach involves the installation of noise barriers and sound insulation systems along railway tracks and near train stations. These physical barriers can help reduce the propagation of train noise to surrounding residential and commercial areas, effectively minimizing the impact on nearby communities.
- The implementation of noise-reducing technologies in train infrastructure and operations can also significantly contribute to noise pollution reduction. This can include the use of quieter rail wheels, sound-absorbing materials for train components, and the adoption of advanced braking systems designed to minimize screeching and noise emissions during train operations. Additionally, the regular maintenance of railway tracks and rolling stock is crucial to ensure that train components are in optimal condition, thus reducing the likelihood of excessive noise generation.
- Strategic urban planning and land use zoning can play a vital role in managing train-related noise pollution. By designating buffer zones and creating green spaces between railway tracks and residential areas, urban planners can minimize the exposure of communities to high levels of train noise. Integrating noise management considerations into the development of new residential and commercial properties near train lines can help mitigate the impact of train-related noise on future residents and businesses.
- Furthermore, the promotion of electrified train systems and the transition to electric or hybrid locomotives can contribute to a significant reduction in noise emissions compared

to traditional diesel-powered trains. Investing in the development and deployment of quieter and more energy-efficient train technologies can lead to a more sustainable and environmentally friendly rail transport system, thereby contributing to a quieter and more livable urban environment for nearby communities.

- By implementing a combination of these strategies and fostering collaboration between transportation authorities, railway operators, and local communities, it is possible to effectively manage train-related noise pollution and create a more harmonious and sustainable living environment for individuals residing near railway tracks and stations.



4.Industry:

- Industrial noise pollution is a prevalent issue that arises from the operation of manufacturing facilities, factories, and industrial plants. The machinery, equipment, and processes involved in industrial production can generate high levels of noise, leading to adverse effects on the surrounding environment and communities. Prolonged exposure to

industrial noise pollution can result in hearing impairment, increased stress levels, and decreased overall well-being for workers and residents in the vicinity of industrial sites.

- To address industrial noise pollution, various measures can be implemented. One approach involves the installation of sound insulation and acoustic barriers within industrial facilities to contain and reduce the transmission of noise to surrounding areas. Implementing noise control measures such as the use of sound-absorbing materials, vibration isolators, and noise-reducing enclosures for noisy machinery and equipment can significantly mitigate the impact of industrial noise on nearby communities.
- The adoption of advanced noise-reducing technologies and machinery is crucial for minimizing noise emissions from industrial operations. Employing quieter equipment, implementing regular maintenance schedules, and utilizing advanced engineering controls can effectively reduce the overall noise generated by industrial processes. Additionally, the implementation of noise-reducing strategies during the design and construction phases of industrial facilities can help preemptively address potential noise issues before they arise.
- Furthermore, the establishment of noise management protocols and guidelines within industrial complexes can promote a culture of awareness and responsibility among workers and industrial operators. Educating employees about the importance of noise management, providing training on the proper use of noise-reducing equipment, and implementing regular noise monitoring programs can help maintain compliance with noise regulations and standards, thereby fostering a safer and more conducive working environment.
- Adopting a proactive approach to community engagement and communication is essential for fostering positive relationships between industrial stakeholders and nearby residents. Encouraging open dialogue, addressing community concerns, and incorporating community feedback into noise management strategies can help build trust and mutual understanding. Implementing transparent communication channels and grievance redressal mechanisms can also ensure that the concerns of affected communities are adequately addressed and resolved in a timely manner.
- By integrating these comprehensive strategies and fostering a culture of responsible industrial noise management, industrial operators can minimize the impact of noise pollution on the surrounding environment and communities, creating a more sustainable and harmonious living and working environment for all stakeholders involved.

5.Aircraft take offs:

- Aircraft takeoffs generate significant noise pollution, particularly in the vicinity of airports and surrounding communities. The powerful roar of jet engines during takeoff can lead to high levels of noise that may impact the well-being of residents living near airports. Proactive measures aimed at mitigating aircraft takeoff-related noise are

essential to minimize disturbances and promote a more harmonious coexistence between airports and nearby communities.

- To address aircraft takeoff-related noise pollution, several strategies can be implemented. The development and adoption of quieter aircraft engine technologies play a crucial role in reducing noise emissions during takeoff. Investing in the research and development of advanced engine designs, incorporating noise-reducing components, and optimizing propulsion systems can lead to a significant reduction in the overall noise generated by aircraft during takeoff operations.
- The implementation of noise abatement procedures and flight path optimization techniques can also help minimize the impact of aircraft takeoff-related noise on surrounding communities. Adjusting takeoff angles, optimizing flight paths, and utilizing precision navigation technologies can contribute to reducing the duration and intensity of noise exposure during aircraft departure. Moreover, the scheduling of flights during off-peak hours and the implementation of curfews for nighttime operations can help limit the disturbance caused by aircraft takeoffs, particularly during sensitive hours when residents are more susceptible to sleep disturbances.
- Strategic airport planning and design can contribute to the effective management of aircraft takeoff-related noise. Integrating noise mitigation measures into airport infrastructure, such as the installation of sound barriers, the implementation of noise-reducing ground operations, and the establishment of designated flight corridors, can help minimize the propagation of aircraft noise beyond airport boundaries. Additionally, the adoption of land use zoning policies and urban planning regulations that restrict the development of residential areas in close proximity to airports can help minimize the potential exposure of communities to high levels of aircraft takeoff-related noise.
- Collaboration between airport authorities, airline operators, and local communities is crucial for fostering effective communication and implementing sustainable noise management strategies. Engaging in open dialogue, conducting regular community outreach programs, and facilitating community involvement in decision-making processes related to airport operations can help build trust and promote mutual understanding between stakeholders. By prioritizing community engagement and adopting a proactive approach to noise management, airports can work towards creating a more sustainable and harmonious environment for nearby communities while maintaining the efficiency and safety of aircraft takeoff operations.

High-noise areas:

When implementing a noise pollution monitoring system, it is essential to identify and prioritize high-noise areas to target monitoring efforts effectively. Some common high-noise areas for noise pollution monitoring include:

- **Urban Centers:** Busy city centers with heavy traffic, construction sites, and

industrial activities often experience high noise levels, making them crucial areas for monitoring.

- **Industrial Zones:** Areas surrounding manufacturing plants, factories, and industrial facilities are prone to high levels of noise pollution due to the operation of heavy machinery and equipment.
- **Transportation Hubs:** Airports, railway stations, and bus terminals are high-noise areas where monitoring is crucial to assess the impact of transportation-related noise on nearby communities.

CITY NOISE



- **Construction Sites:** Locations where construction activities are ongoing, including building construction, roadwork, and infrastructure development, are known to generate high levels of temporary noise pollution.
- **Entertainment Venues:** Areas surrounding stadiums, concert halls, and entertainment venues may experience elevated noise levels during events and performances, necessitating continuous monitoring to assess the impact on local residents.
- **Commercial Districts:** Business and commercial districts with high foot traffic, retail outlets, and restaurants can experience increased noise levels, especially during peak hours, requiring monitoring to ensure compliance with noise regulations.
- **Residential Areas:** Monitoring noise levels in residential neighborhoods is essential to assess the impact of various sources, such as traffic, industrial activities, and community events, on the well-being of residents.

- **Educational Institutions:** Schools, colleges, and universities often experience high noise levels during school hours and recreational activities, making it important to monitor noise levels to ensure a conducive learning environment.
- **Healthcare Facilities:** Hospitals, clinics, and healthcare centers require monitoring to maintain a peaceful and conducive environment for patients, staff, and visitors, as excessive noise can impact patient recovery and well-being.
- **Recreational Parks:** Monitoring noise levels in recreational areas, such as parks, playgrounds, and public gardens, is essential to assess the impact of recreational activities and events on the surrounding environment and nearby residents.

Identifying and monitoring these high-noise areas can provide valuable insights into the sources and patterns of noise pollution, enabling stakeholders to implement targeted interventions and policies to mitigate the adverse effects of excessive noise on public health and the environment.

Source of noise pollution:

Monitoring noise pollution involves identifying various sources of noise to assess their impact on the environment and human health. Some common sources of noise pollution that require monitoring include:

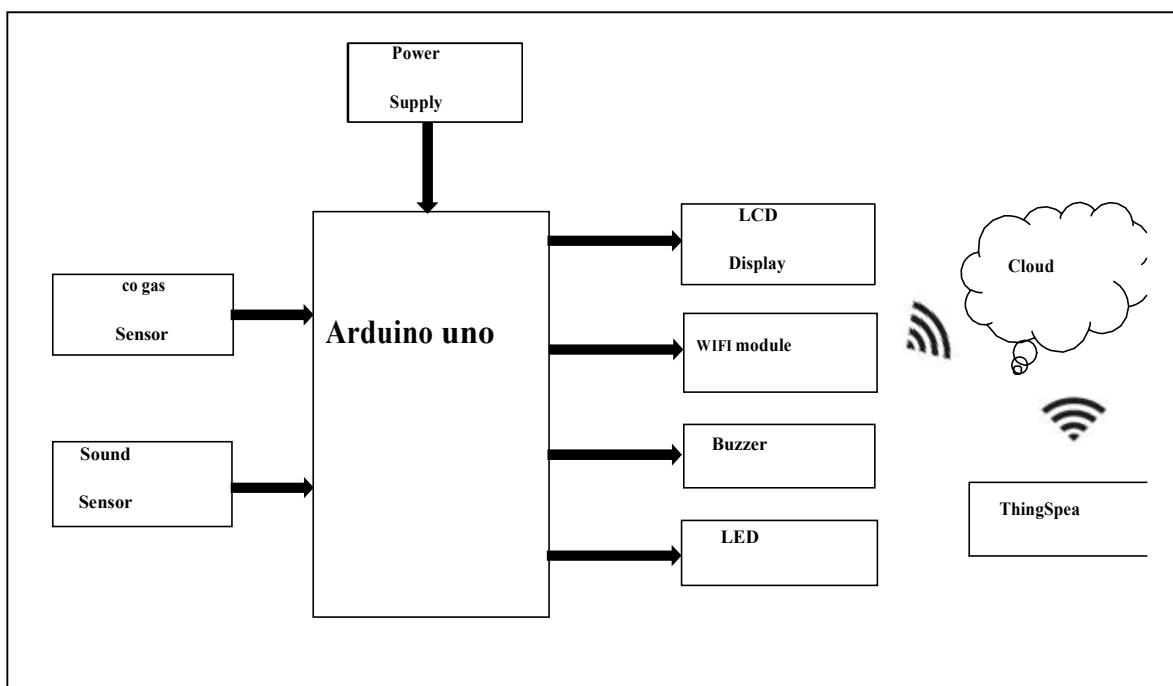
- **Transportation:** Monitoring noise from road traffic, including cars, buses, and motorcycles, as well as noise from railway systems and airports, is essential to assess the impact of transportation-related noise on communities near major transportation routes and hubs.
- **Industrial Activities:** Monitoring noise from industrial operations, including manufacturing plants, factories, and construction sites, helps assess the impact of industrial processes and machinery on nearby residential areas and the environment.
- **Construction Sites:** Monitoring noise from construction activities, such as drilling, excavation, and building construction, is important to evaluate the temporary impact of construction-related noise on surrounding communities.
- **Recreational and Entertainment Venues:** Monitoring noise from recreational events, entertainment venues, and outdoor activities is crucial to assess the impact of public gatherings, concerts, and sporting events on nearby residential areas and public spaces.
- **Commercial Establishments:** Monitoring noise from commercial establishments, including restaurants, bars, and shopping centers, is necessary to assess the impact of commercial activities and events on nearby residential and commercial areas.
- **Community Events:** Monitoring noise from community events, festivals, and

cultural gatherings is important to evaluate the impact of temporary events on nearby residential areas and public spaces.

- **Household Appliances:** Monitoring noise from household appliances, including air conditioning units, heating systems, and kitchen appliances, helps assess the impact of everyday domestic activities on indoor and outdoor noise levels in residential areas.
- **Construction Equipment:** Monitoring noise from construction equipment, such as excavators, bulldozers, and jackhammers, helps assess the impact of construction-related machinery and operations on nearby communities and the environment.
- **Public Infrastructure:** Monitoring noise from public infrastructure, including bridges, highways, and public transportation systems, is essential to assess the impact of infrastructure-related activities on nearby residential and commercial areas.
- **Outdoor Recreational Areas:** Monitoring noise from outdoor recreational activities, including playgrounds, parks, and sports facilities, helps assess the impact of recreational events and public gatherings on nearby residential areas and public spaces.

By monitoring these various sources of noise pollution, stakeholders can develop effective strategies and policies to mitigate the adverse effects of excessive noise on public health, well-being, and the surrounding environment.

Block diagram:



As shown in fig. in system we use arduino as main controller. In system we use MQ135 gas sensor for detecting or sensing gases and also use sound sensor LM393 module for detect the sound pollution. Sensed data of sensor given to analog pin of the arduino then digital output pin are connected to LCD, buzzer and LED. If air pollution is there then buzzer will start beeping and if sound pollution is there then LED will glow. All condition of pollution display on LED and we can also analyze past data using thingspeak in graphical form. Arduino is an open source prototype. Software will operate in Arduino IDE Computer code can be written and upload to the physical board. Arduino board is a board that can be functioned via Arduino IDE by sending a set of instructions to the microcontroller on it. For controlling Sensors. For arduino programming we are going to use Embedded C. We are going to build project in Embedded C and for monitoring that project we are using Cloud.

Components:

- ArduinoUNO
- MQ135 (Gassensor)
- LM393 (Noisesensor)
- ESP8266WIFIModule
- 16*2 LCDDisplay
- LED
- Buzzer

Arduino UNO:

Arduino is 8 bit microcontroller board based on the ATmega328P. The operating voltage is 5V. It has 14 pins digital input/output pins (Of which can be used 6 as PWM output)

Arduino UNO is an open-source microcontroller board, widely used for prototyping IoT (Internet of Things) projects due to its versatility and ease of use. It is equipped with a microcontroller, digital and analog input/output pins, and USB connectivity, making it an ideal choice for IoT applications.

In the realm of IoT, the Arduino UNO serves as a crucial component for connecting various sensors, actuators, and other devices to the internet. Its programmable nature allows developers to create innovative projects that can interact with the digital world. By integrating IoT technologies, the Arduino UNO can be used to monitor and control devices remotely, collect data, and automate tasks, thus enhancing efficiency and convenience.

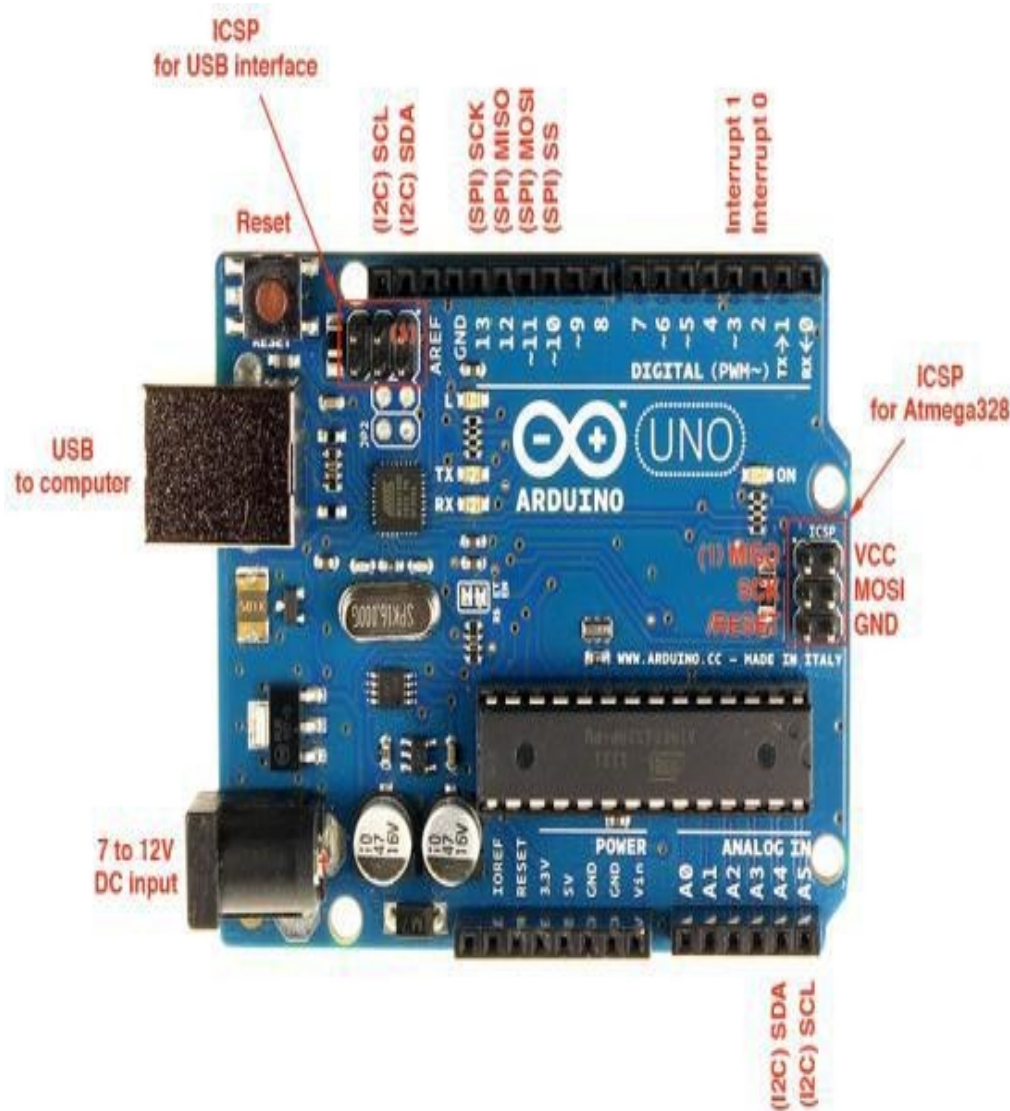
Using the Arduino UNO in IoT projects involves connecting the board to the internet via Wi-Fi or Ethernet shields, enabling communication with other IoT devices or web services. Through its digital and analog pins, it can collect data from sensors such as temperature, humidity, light, and

motion sensors. This data can be transmitted to online platforms or cloud services for real-time monitoring and analysis.

Furthermore, the Arduino UNO can act as a control hub for various actuators like motors, relays, or lights, allowing users to remotely manipulate physical devices. This capability is especially valuable for home automation, industrial automation, and smart agriculture, among other applications.

The Arduino software platform, with its simple and user-friendly interface, facilitates coding and uploading programs to the Arduino UNO, making it accessible to both beginners and experienced developers. Its compatibility with a wide range of sensors, shields, and software libraries further broadens its potential in creating innovative IoT solutions.

In essence, the Arduino UNO, with its adaptability and connectivity features, plays a pivotal role in the development of IoT applications, fostering a more interconnected and automated world.



MQ135 Gas Sensor:

The MQ135 is a gas sensor it used for detecting or sensing harmful gases in the atmosphere. It has wide detecting scope. It gives fast response and also it is a high sensitivity sensor. It is simple and long life device. They are used in air quality control equipment for building offices as a suitable for detecting of NH₃, alcohol, benzene, smoke CO₂ etc.

The MQ135 Gas Sensor is a popular gas detection module widely used for measuring the quality of air in indoor environments. Its ability to detect a range of hazardous gases such as ammonia, nitrogen oxides, benzene, and carbon monoxide makes it a valuable component in Internet of Things (IoT) applications. When integrated into IoT systems, the MQ135 Gas Sensor enables real-time monitoring and analysis of air quality, ensuring the safety and well-being of occupants in various settings.

When employed in IoT applications, the MQ135 Gas Sensor plays a crucial role in collecting and transmitting data on gas levels to a central monitoring system. This data can be accessed and analyzed remotely, allowing for timely responses to any fluctuations in air quality. By interfacing the sensor with microcontrollers such as Arduino or Raspberry Pi, users can develop sophisticated IoT applications that provide insights into the concentration levels of hazardous gases. This capability is particularly beneficial in environments where the presence of these gases can pose serious health risks.

Furthermore, the integration of the MQ135 Gas Sensor into IoT systems enables the creation of intelligent air quality management solutions. By setting predefined thresholds for gas concentration levels, the sensor can trigger alerts or activate mitigation measures when gas levels exceed safe limits. This proactive approach to air quality management is vital for maintaining a healthy environment and minimizing the risk of gas-related incidents in residential, commercial, or industrial spaces.

The MQ135 Gas Sensor's compact size, low cost, and low power consumption make it suitable for deployment in a wide range of IoT applications. Its compatibility with various microcontrollers and development platforms simplifies the process of data acquisition and analysis, making it accessible to developers and hobbyists alike.

By leveraging the data collected from the MQ135 Gas Sensor, IoT applications contribute to the development of smarter and more sustainable environments. Continuous monitoring of air quality not only ensures the safety of occupants but also enables the implementation of preventive measures to reduce air pollution and mitigate potential health hazards. Ultimately, the integration of the MQ135 Gas Sensor with IoT systems promotes the creation of safer and healthier living and working spaces.



LM393SoundSensor:

The sound sensor module provides an easy way to detect sound and is generally used for detecting sound intensity. The module detects when the sound has exceeded a threshold value. Sound is detected via a microphone and fed into an LM393 opamp.

The LM393 Sound Sensor is a simple yet effective electronic module used for detecting sound levels in an environment. With its adjustable sensitivity and digital output signal, it has found widespread use in various Internet of Things (IoT) applications where monitoring sound is essential. When integrated into IoT systems, the LM393 Sound Sensor can provide valuable insights into noise levels and enable the development of intelligent sound monitoring solutions.

In an IoT context, the LM393 Sound Sensor serves as a fundamental component for collecting and transmitting data on sound levels to a central monitoring system. By connecting the sensor to microcontrollers such as Arduino or Raspberry Pi, developers can create sophisticated IoT applications capable of analyzing sound patterns and identifying abnormal or excessive noise levels. This capability is particularly useful in environments where sound monitoring is crucial for maintaining safety, security, or operational efficiency.

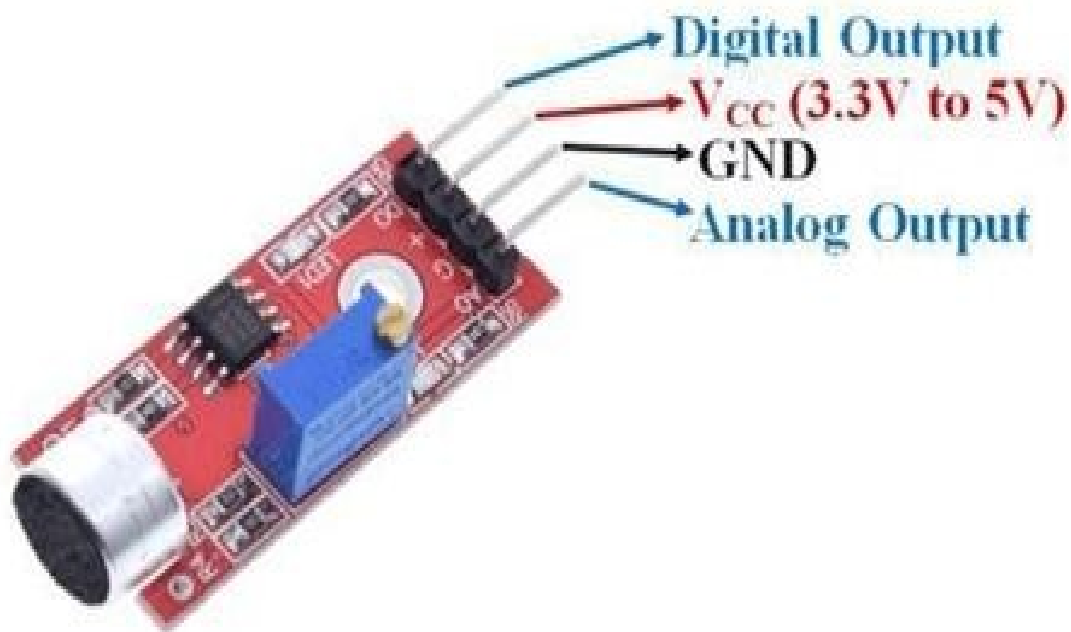
The integration of the LM393 Sound Sensor into IoT systems allows for the implementation of intelligent sound monitoring solutions. By setting predefined thresholds for sound intensity, the sensor can trigger alerts or activate specific actions when noise levels exceed acceptable limits.

This proactive approach to sound management is essential for various applications, including smart home security, industrial equipment monitoring, and public safety systems.

Furthermore, the LM393 Sound Sensor's compact design, low cost, and low power consumption make it suitable for deployment in a wide range of IoT applications. Its compatibility with various microcontrollers and development platforms simplifies the process of data acquisition and analysis, making it accessible to both experienced developers and hobbyists.

By leveraging the data collected from the LM393 Sound Sensor, IoT applications contribute to the creation of smarter environments with enhanced safety and efficiency. Continuous monitoring of sound levels enables the detection of anomalies, potentially preventing accidents, unauthorized access, or equipment failure. Moreover, the integration of sound data with other IoT sensors can enable more comprehensive environmental monitoring, leading to improved situational awareness and better-informed decision-making processes.

In conclusion, the integration of the LM393 Sound Sensor into IoT systems facilitates the development of intelligent sound monitoring solutions that enhance safety, security, and operational efficiency across a wide range of applications. By providing real-time insights into sound levels, IoT applications can effectively contribute to the creation of more responsive and adaptive environments.



ESP8266WIFIModule:

The esp8266 WIFI module is a self contained soc with integrated TCP/IP protocol stack that can give any microcontroller access to your WIFI network. The esp8266 is capable of either hosting an application or offloading all WIFI networking functions from another application processor.

The ESP8266 WiFi Module is a highly popular and cost-effective Wi-Fi transceiver module used in Internet of Things (IoT) applications. It serves as a crucial component in IoT projects by providing seamless connectivity to Wi-Fi networks, enabling devices to communicate and exchange data over the internet. With its compact design, low power consumption, and integrated TCP/IP protocol stack, the ESP8266 module has become a preferred choice for developers seeking to add wireless connectivity to their IoT devices.

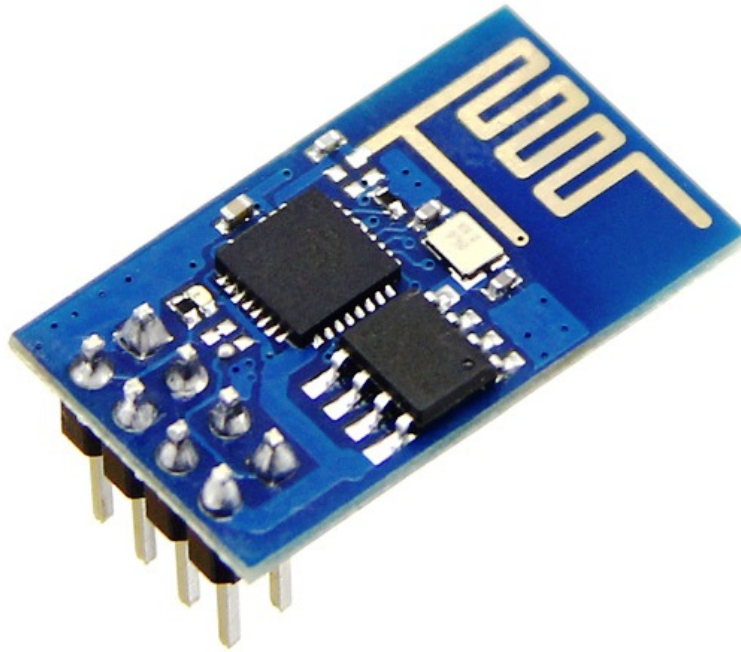
When integrated into IoT systems, the ESP8266 WiFi Module facilitates the development of smart and interconnected devices. By incorporating the module into microcontroller-based projects, such as those using Arduino or Raspberry Pi, developers can enable their devices to connect to local Wi-Fi networks and access the internet. This capability allows IoT devices to interact with online services, cloud platforms, and other IoT devices, enabling remote monitoring, control, and data exchange.

The ESP8266 WiFi Module's compatibility with various development platforms and its rich set of features, including support for secure connections and multiple Wi-Fi protocols, make it well-suited for a wide range of IoT applications. From smart home automation and industrial monitoring to wearable devices and environmental sensing, the module empowers developers to create innovative solutions that leverage the power of internet connectivity.

Furthermore, the ESP8266 module's low cost and widespread community support make it an attractive choice for both hobbyists and professionals interested in exploring IoT technologies. Its ease of use, coupled with a robust set of development tools and libraries, simplifies the process of integrating Wi-Fi connectivity into IoT projects, even for those with limited experience in networking and wireless communication.

In summary, the ESP8266 WiFi Module plays a pivotal role in enabling IoT devices to connect to the internet and communicate with other devices, thereby unlocking a wealth of possibilities for data sharing, remote control, and automation. Its affordability, versatility, and ease of integration make it a cornerstone in the development of innovative IoT solutions, contributing to the realization of a more connected and intelligent world.

In essence, the ESP8266 WiFi Module serves as a key enabler in the world of IoT, providing the necessary connectivity for devices to communicate and interact with the digital world. Its affordability, adaptability, and ease of integration contribute to the development of innovative IoT solutions, fostering a more connected and intelligent ecosystem for a variety of applications.



16*2LCDDisplay:

LCD is used for to display the condition there are three conditions in air pollution and three conditions in noise pollution means air and sound is clear, moderately polluted or highly polluted that is displayed on LED.

The 16x2 LCD (Liquid Crystal Display) is a widely used output device in Internet of Things (IoT) projects, serving as an effective means of displaying information in a user-friendly format. It consists of 16 columns and 2 rows, capable of displaying alphanumeric characters, symbols, and custom graphics. When integrated into IoT systems, the 16x2 LCD Display plays a pivotal role in providing real-time feedback and information visualization, enhancing the user experience and enabling seamless interaction with IoT devices.

In the context of IoT, the 16x2 LCD Display serves as an essential interface for presenting data collected from various sensors, actuators, or other connected devices. By integrating the display with microcontrollers like Arduino or Raspberry Pi, developers can design applications that showcase sensor readings, system status, alerts, and other relevant information. This capability enhances the user's understanding of the IoT system's operations and enables prompt decision-making based on the displayed data.

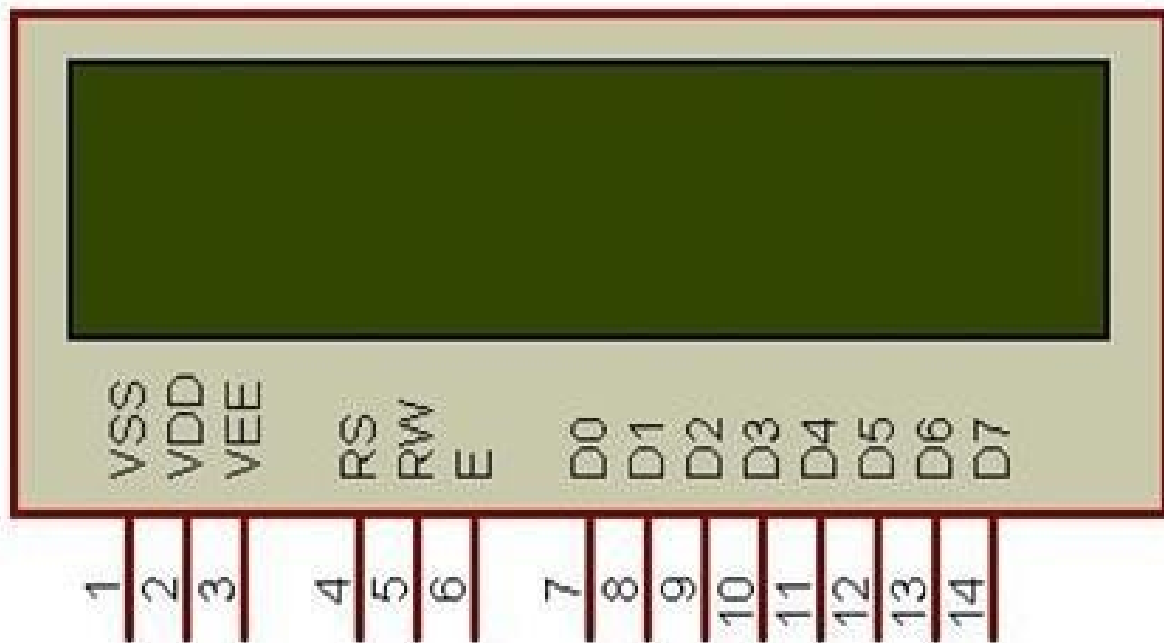
The 16x2 LCD Display's compatibility with various microcontrollers and its straightforward interfacing make it an ideal choice for a diverse range of IoT applications. Whether in smart

home automation, industrial monitoring, or environmental sensing, the display can provide users with real-time updates and visual feedback, thereby improving the overall user experience and facilitating more efficient system management.

Furthermore, the display's compact size, low power consumption, and durability make it suitable for deployment in IoT devices that require compact and energy-efficient visual output. Its ability to convey critical information at a glance contributes to the seamless integration of IoT devices into everyday life, enhancing convenience, productivity, and user engagement.

Moreover, the 16x2 LCD Display's versatility allows for the incorporation of custom characters and symbols, enabling developers to create personalized and intuitive interfaces tailored to specific IoT applications. By leveraging this feature, developers can enhance the user experience and streamline the interaction between users and IoT devices, promoting user satisfaction and engagement.

In summary, the integration of the 16x2 LCD Display into IoT systems enables the effective presentation of data and information, enhancing user engagement and facilitating informed decision-making. Its compatibility, compact design, and customizable features make it an indispensable tool for creating intuitive and user-friendly interfaces in a wide range of IoT applications, thereby contributing to the development of smarter and more interactive IoT ecosystems.



LED:

Light Emitting Diodes (LEDs) are semiconductor light sources that have become fundamental components in the Internet of Things (IoT) ecosystem. As one of the most energy-efficient and versatile lighting solutions available, LEDs play a significant role in IoT applications, contributing to energy savings, data communication, and smart lighting management.

In the context of IoT, LEDs serve a dual purpose. Firstly, they can act as indicators to provide visual feedback on the status of IoT devices. When integrated with microcontrollers or IoT platforms such as Arduino or Raspberry Pi, LEDs can display different colors or patterns to signify various system states, such as connectivity status, data transmission, or error alerts. This visual feedback enhances user interaction, providing users with real-time insights into the operational status of IoT devices.

Secondly, LEDs are crucial in the domain of smart lighting, where they enable the creation of energy-efficient and controllable lighting systems. Through the integration of IoT technology, LEDs can be connected to smart lighting networks, allowing users to control and adjust the brightness, color, and scheduling of lighting systems remotely. This capability contributes to energy conservation, personalized lighting experiences, and improved ambiance in both residential and commercial settings.

The integration of LEDs into IoT systems is further enhanced by their compatibility with various communication protocols, enabling seamless integration with other IoT devices and platforms. For instance, LEDs can be integrated into larger IoT networks to signify specific events, trigger automated actions, or provide visual feedback based on data received from other IoT sensors or devices.

Moreover, the advancements in LED technology, including the development of smart LED bulbs and fixtures equipped with built-in communication capabilities, have revolutionized the way lighting systems are managed and controlled in IoT environments. By leveraging these smart LED solutions, users can create dynamic and adaptive lighting environments tailored to their preferences and requirements, thus enhancing comfort, productivity, and energy efficiency.



Buzzer:

Buzzer is a simple yet essential electronic component that produces audible sound signals, commonly used in Internet of Things (IoT) applications to provide auditory alerts, notifications, or alarms. When integrated into IoT systems, the buzzer serves as a valuable tool for conveying important information and enhancing user engagement through sound-based feedback.

In IoT applications, the buzzer is often employed to deliver audible alerts or notifications based on specific events or triggers. By integrating the buzzer with microcontrollers or IoT platforms such as Arduino or Raspberry Pi, developers can program the buzzer to emit different sound patterns or frequencies to signify various system states, including system errors, critical events, or user-defined actions. This capability enhances user awareness and provides real-time auditory feedback, ensuring that users stay informed about the status of their IoT devices or systems.

The integration of the buzzer into IoT systems also facilitates the implementation of audio-based alarm systems. By setting predefined thresholds or conditions, the buzzer can be programmed to emit distinctive sounds when certain parameters are exceeded, thus alerting users to potential risks or anomalies. This proactive approach to using audible alerts contributes to the overall safety and security of IoT environments, enabling users to take timely actions to address critical situations.

Furthermore, the buzzer's compatibility with various microcontrollers and its straightforward interfacing make it a versatile component for a wide range of IoT applications. Whether in smart home automation, industrial monitoring, or security systems, the buzzer serves as a reliable means of delivering timely and informative auditory feedback, enhancing the overall user experience and system performance.

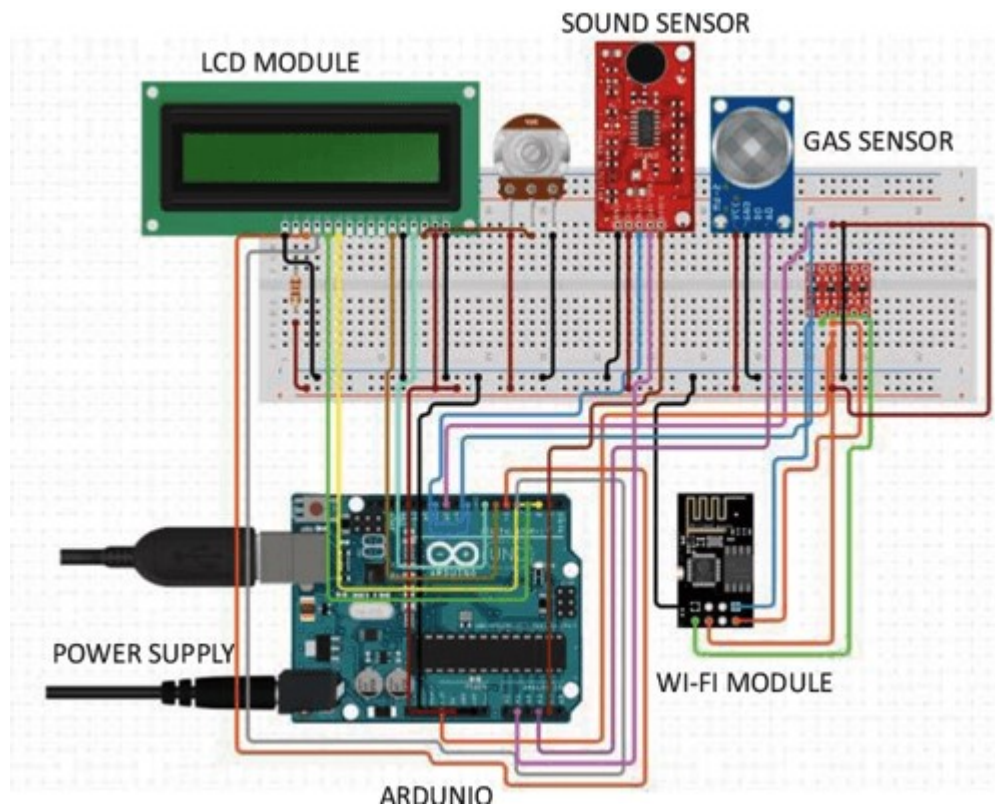


Internal block diagram:

In the context of the Internet of Things (IoT), an internal block diagram serves as a graphical representation depicting the internal structure and connections within an IoT system. It showcases the various interconnected components such as sensors, actuators, communication modules, and data processing units, highlighting how they collaborate to enable data acquisition, transmission, and analysis within the IoT ecosystem.

The internal block diagram in IoT provides insights into the functional blocks of the system, including how sensors gather data, how actuators respond to commands, and how communication modules facilitate data exchange with external networks or cloud platforms. This visual representation helps in understanding the flow of information between different IoT components, allowing for a comprehensive overview of the system's internal architecture and data processing mechanisms.

Moreover, the internal block diagram aids in the identification of potential points of failure or bottlenecks within the IoT system, facilitating efficient troubleshooting and system optimization. It serves as a valuable tool for IoT developers and engineers to design, analyze, and optimize complex IoT systems, ensuring smooth and efficient operation of interconnected devices and networks.



Program:

Coding:

To make and send alerting message facility via Telegram, we need to understand the skeleton of the coding. The whole program has two parts namely:

Configuration code: It consist all the backend details of Bolt IoT Wi-Fi Module and the Telegram.

Main code: It consists of the core coding of the facility.

To create above two mention files, executive the following steps:

Open the Digital Ocean Ubuntu server (For Windows /Mac Operating System) or open the terminal in the Ubuntu Operating System.

Step 1] We need to create a directory (folder) to store the two coding files mentioned above. To create a directory named alert, type out the following command

```
sudo mkdir alert
```

Step 2] Next we have to enter the directory that we just created. To enter the directory named alert type out the following command:

```
cd alert
```

Step 3] After entering the folder first we need to create the configuration python file which will hold all the backend details of the Bolt IoT Wi-Fi Module and Telegram.

To create the configuration python file in the folder which was created first type out the following command for creating the file with extension .py;

```
sudo nano configuration.py
```

Step 4] After the above mentioned file enter the following data into the file. Make sure that you add the updated Bolt API key, device id and Telegram details:

```
"""Configurations for Telegram alert message"""
```

```
BOLT_API_KEY = "XXXXXXXXXX" #This is your Bolt cloud API
```

Key.

```
DEVICE_ID = "XXXXXXXXXX" #This is the ID number of your
```

Bolt device.

TELEGRAM_CHAT_ID = "@XXXXXXXXXX" #This is the channel ID of the channel created in the

Telegram. Paste after @.

TELEGRAM_BOT_ID = "botXXXXXXXXXX" #This is the bot ID of the bot created in the Telegram. Paste after bot.

THRESHOLD = 80 #Threshold beyond which the alert should be sent.

Step 5] Save the file by clicking "ctrl+x" and press enter. Next create another file which will include the main coding of the facility.

sudo nano alert.py

Step 6] Enter the following code into the newly created file:

```
import requests          #for making HTTP requests
import json              #library for handling JSON data
import time              #module for sleep operation
from boltiot import Bolt  #importing Bolt from boltiot
                          module
import configuration      #configuration file
mybolt = Bolt(configuration.BOLT_API_KEY,configuration.DEVICE_ID)
def get_sound_sensor_value_from_pin(pin):
try:
response = mybolt.analogRead(pin)
data = json.loads(response)
    if data["success"] != 1:
        print("Request not successful")
```

```

        print("This is the response->", data)

        return -999

        sound_sensor_value = int(data["value"])

        return sound_sensor_value

except Exception as e:

    print("Something went wrong when returning the sensor value")

    print(e)

    return -999

def send_telegram_message(message):

    url = "https://api.telegram.org/" + configuration.TELEGRAM_BOT_ID + "/sendMessage"

    data = {

        "chat_id": configuration.TELEGRAM_CHAT_ID,

        "text": message

    }

    try:

        response = requests.request(

            "GET",

            url,

            params = data

        )

        print("This is the Telegram response")

        print(response.text)

        telegram_data = json.loads(response.text)

    return telegram_data["OK"]

    except Exception as e:

```

```

print("An error occurred in sending the alert message via Telegram")

    print(e)

    return False

while True:

    #Step 1

    sound_sensor_value = get_sound_sensor_value_from_pin("A0")

    print("The current sensor reading is:", sound_sensor_value)

    #Step 2

    if sound_sensor_value == -999:

        print("Request was unsuccessful. Skipping.")

        time.sleep(10)

        continue

    #Step 3

    if sound_sensor_value >= configuration.THRESHOLD:

        print("Sensor value has exceeded threshold")

        message = "Alert! Noise disturbance around the XYZ Hospital. Random and unidentified sound
        intensity has crossed " + str(configuration.THRESHOLD) + str("dB") + \

        "The current sound sensor reading is " + str(sound_sensor_value) + str("dB") + str("To, The
        Police Incharge, Immediate action required. Thankyou.")

        telegram_status = send_telegram_message(message)

        print("This is the Telegram status:", telegram_status)

    # Step 4

    time.sleep(50) #Time interval to get the status update.

    Step 7] Exit the code editor using "ctrl+x" and then run the code that you have written using the
    following command.

    sudo python3 alert.py

```

www.py - C:\Users\Bharathi P\Downloads\www.py (3.12.0)

File Edit Format Run Options Window Help

```
sudo mkdir alert
cd alert
sudo nano configuration.py
"""Configurations for Telegram alert message"""
BOLT_API_KEY = "XXXXXXXX" #This is your Bolt cloud API
Key.
DEVICE_ID = "XXXXXXXX" #This is the ID number of your
Bolt device.
TELEGRAM_CHAT_ID = "XXXXXXXX" #This is the channel ID of the
channel created in the
Telegram. Paste after @.
TELEGRAM_BOT_ID = "botXXXXXXXX" #This is the bot ID of the bot
created in the Telegram. Paste
after bot.
THRESHOLD = 80 #Threshold beyond which the
alert should be sent.
sudo nano alert.py
import requests #for making HTTP requests
import json #library for handling JSON data
import time #module for sleep operation
from boltiot import Bolt #importing Bolt from boltiot
module
import configuration #configuration file
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try:
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if data["success"] != 1:
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return sound_sensor_value
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print("Something went wrong when returning the sensor value")
print(e)
return -999
def send_telegram_message(message):
url = "https://api.telegram.org/" + configuration.TELEGRAM_BOT_ID + "/sendMessage"
data = {
"chat_id": configuration.TELEGRAM_CHAT_ID,
"text": message
}
```

Ln: 1 Col: 0

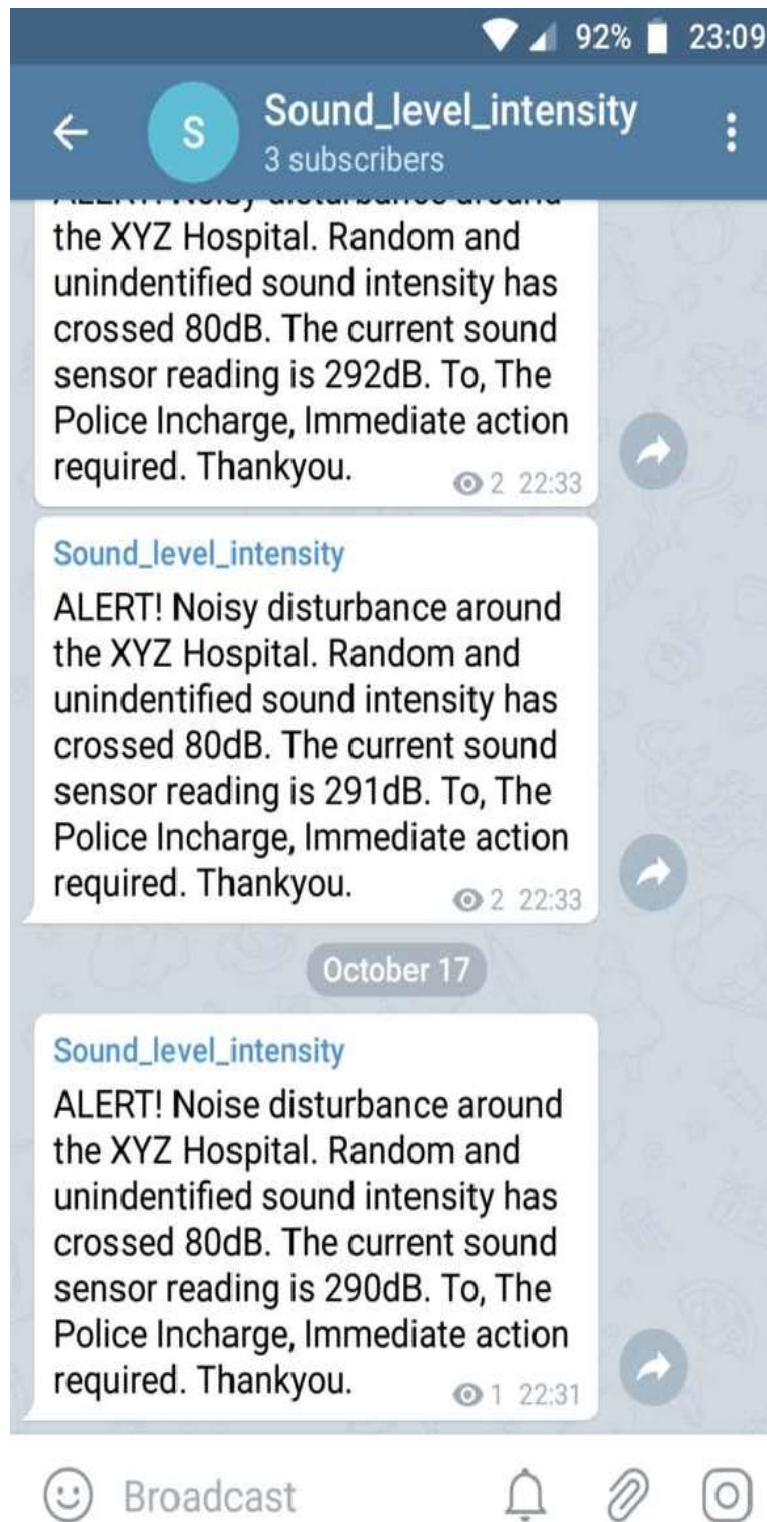
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"text": message
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try:
response = requests.request(
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)
print("This is the Telegram response")
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message = "Alert! Noise disturbance around the XYZ Hospital. Random and unidentified sound intensity has crossed " + str(configuration.THRESHOLD) + str("dB") + \
"The current sound sensor reading is " + str(sound_sensor_value) + str("dB") + str("To, The Police Incharge, Immediate action required. Thankyou.")
telegram_status = send_telegram_message(message)
print("This is the Telegram status:", telegram_status)
# Step 4
time.sleep(50) #Time interval to get the status update.
sudo python3 alert.py
```

Ln: 1 Col: 0

Output::



Conclusion:

By using this project each and every variation we can analyze and inform nearby people in time. We can also analyze data from home using thing speak. The most important factor of this system is that it is small, cost efficient and portable. Sensors are available easily anywhere. This system is fully helpful to save the lives and overcome all the problems related to environment.