SoundTrap REPORT

Noise pollution mitigation model for loud vehicles

WE HUB

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Product and Report by:

Project-D

Hyderabad, Telangana

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SOUNDTRAP

INTRODUCTION

The decadal growth of the urban population in India rose to 31.8% during the last decade (2010-2020). Rapid urbanization has led to various public health challenges, including environmental pollution. Most activities that cause pollution are essential to meet the needs of the growing population and development. Therefore, preventive measures to minimize pollutants are more practical than their elimination. Noise is regarded as a pollutant under the air (Prevention and Control of Pollution) Act, 1981. It has been defined as an unwanted sound. Noise consists of unpleasant, obtrusive, annoying, distracting, or persistent sounds that interfere with sleep or the ability to concentrate or enjoy life. The WHO guidelines for community noise recommend less than 30 A-weighted decibels (dB[A]) in bedrooms during the night for a sleep of good quality and less than 35 dB(A) in classrooms to allow good teaching and learning conditions. The WHO guidelines for night noise recommend less than 40 dB(A) of annual average outside of bedrooms to prevent adverse health effects from night noise. Noise is an underestimated threat that can cause a number of short- and long-term health problems. It is increasingly becoming a potential hazard to health, physically and psychologically, and affects the general well-being of an individual. Excessive noise interferes with people's daily activities at school, at work, at home, and during leisure time. It can disturb sleep, cause cardiovascular and psychophysiological effects, reduce performance and provoke annoyance responses and changes in social behavior.

It also interferes with communication, and this can even endanger life. However, it is a physical pollutant, not visible and the damage occurs silently, going undetected. This is also because sensitivity of the human ear gets automatically adjusted to ambient noise levels, even to increasing noise levels. Moreover, noise pollution control is overshadowed by other types of pollution such as air, water pollution, largely due to lack of awareness about its health implications. Epidemiologic studies on hearing and noise exposure are also lacking although it is the most common preventable cause of sensory-neural hearing loss.

MEASUREMENT OF NOISE

The response of the human ear to sound depends both on the sound frequency (Hertz) and the sound pressure (decibels). The range of hearing by a healthy young person is 20-20,000 Hz. There is individual variability in the sensitivity to different frequencies. Sensitivity to higher

frequencies decrease with age and exposure to noise. Noise exposure at one time can occur from various sources, therefore the average sound pressure level over a specific time period is usually measured. A widely used scale to measure sound pressure levels is the weighting scale, "A-weighting." It correlates with the subjective response of the auditory system, and is expressed as decibels in A-Scale (dBA). Though it is simple and convenient to use, it has limitations of poor predictability. Measurement of noise is done by noise level meters, at locations where people work. Noise dosimeter, which is worn by the person, has the advantage over noise level meter, of capturing the average noise exposure even while moving around. Impulse-sound level meters are preferably used for measuring impulsive sounds, as their short integration time is appropriate for the short integration time of the cochlea, where injury from noise exposure occurs.

To control the generation of noise by various sources in the environment, the Central Pollution Control Board, under the Ministry of Environment and Forests, Government of India, has set standards of sound for different categories of areas (residential, commercial, industrial and silence zones), separately for day-time and at night [Table 1]. It has also set permissible noise limits for vehicles at the manufacturing stage and noise standards for firecrackers.

Table 1

Ambient air quality standards in respect of noise

Area code	Category of area/zone	Limits in dB(A) leq*	
		Day time	Night time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence zones	50	40

*dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing. Source: Central Pollution Control Board, India

On 23rd March 2011, the Central Pollution Control Board established phase I of the Real Time National Ambient Noise Monitoring Network. It covers 35 locations in seven metro cities (Delhi, Hyderabad, Kolkata, Mumbai, Lucknow, Bangalore, and Chennai). It is a part of the implementation of the National Environmental Policy-2006 (section 5.2.8 [IV]), under which ambient noise is included as an environmental quality parameter. By phase II and phase III, 160 locations spread over 25 cities in 18 states will be established. Ongoing monitoring and appropriate implementation will be possible by this systematic network with central receiving station in Delhi.

MAGNITUDE OF COMMUNITY NOISE POLLUTION

Several studies have been conducted in various parts of the country to assess the ambient noise level. Majority of the total environmental noise is caused by motor vehicles. Day time noise levels measured along roads between two campuses of a University in Balasore, Orissa, ranged from 70.1 dB(A) to 120.4 dB(A) which are above the permissible limits for road traffic noise (70 dB[A]). Noise generated by different vehicles was also measured. None of the vehicles emitted within the permissible limits for road traffic noise. Vehicular air horns emitting loud noise and their misuse has been reported to be the major contributor to high noise levels. In a study which measured noise levels in the four zones as categorized by the Central Pollution Control Board, the highest average day-time noise level was detected in silence zones (73.53 dB[A]), i.e., not less than 100 m around hospitals, educational institutions, court, and religious places; and lowest in Residential areas (63.5 dB[A]). The highest average noise level for night time was in traffic intersection areas (71.18 dB[A]) and lowest in the industrial areas.

Increasing population, transportation demands, vehicular increase, and congestion of roads are factors that have intensified traffic noise pollution significantly in recent years. Studies assessing noise levels in different settings, week day and holidays, and different zones observed that average noise levels were above the permissible standards. Another convenient mode of transport in urban areas, the metro trains, were found to generate noise levels, above the permissible levels of 65 dBA (day) and 55 dBA (night) (commercial zone). Although the ambient noise level is reduced due to its predominant underground location, workers are at higher risk, particularly those stationed at the high noise level areas (engine noise, electric generator etc.).

Daily exposure to such noise levels over a long period can have harmful effects. With rapid urbanization, often unmatched by proper layout of roads, highways and buildings, industrial, residential, and commercial areas lie in close proximity. This disturbs the peaceful environment of residential areas. The ambient noise levels in silence zones were found to go even up to 90 dB. Both day time and night time noise levels in these silence zones were above the permissible limits. It causes distractions and annoyance not only in institutional areas, but also much discomfort and mental disturbance to patients in hospitals. Night time noise levels in residential areas also exceed the prescribed limits of 55 dB(A) in day-time and 45 dB(A) at night time.

In addition to the continuous traffic noise which people are exposed to, community festivities, public address systems, noise from machines at construction sites, etc., affect the quality of life. According to a study conducted in a residential area in Delhi during Diwali festival, the average ambient noise level on Diwali ranged from 76 to 80 dB(A), which was 1.2-1.3 times higher than on normal days in the area (57-69 dB[A] Leq). Intense high impact noise emitted by fireworks

pose a great risk, and can result in damage to the auditory apparatus. Neighborhood noise can also create an unfriendly atmosphere, misunderstandings, and hostility.

The World Health Organization has listed critical health effects, with corresponding noise levels and exposure time in specific environmental settings.

Noise Levels Hyderabad is Second Highest after Chennai in Noise Levels in South India according to the study conducted by CSE. Noise pollution is rising alarmingly. According to the TSPCB the noise levels recorded in Hyderabad was 80 .66 dB. The standard limit will be 65dB. Panjagutta cross roads are said to be the nosiest area in Hyderabad. Next to it is the paradise junction, Charminar, and Abids. As far as noise pollution is concerned, the monitoring is done mainly during festivals such as Diwali.

A few SPCBs and PCCs have initiated regular noise monitoring since 2008-09. As per available data, the laid down noise norms for respective zones (Industrial, Commercial, Residential or Silence) are exceeded at many locations. However, a definite trend cannot be ascertained for major cities, including Hyderabad, since data is available only for a limited period. The practice of exploding sound emitting firecrackers on religious occasions & weddings, playing of bands during processions, blowing of horns, operation of generator sets, movement of traffic (Highways, railways and airways), use of public address systems, construction activities and operation of generator sets increases the ambient noise levels in urban areas.

The Telangana Pollution Control Board is monitoring ambient noise levels at six different places in Hyderabad city and the average noise levels are exceeding the limits at all the places.

PROJECT LOCATION

Originating Office

The project is located in Hyderabad, Telangana. Hyderabad is a metropolitan city where population is in exponential growth. It makes the city prone to noise pollution. There are two major settings where noise occurs, viz., community noise and industrial noise.

Community noise (also called environmental noise, residential noise, or domestic noise) is defined as noise emitted from all sources, except noise at the industrial workplace. Major sources of community noise are automobiles, construction work, loudspeakers, recreational activities, fireworks, etc.

Noise in metro cities is inevitable. Cities never sleep; urban citizens have become adapted to noise menace. The only silent zones are hospitals, educational and research institutes, religious places and courts. The unit of measuring the noise is decibel (dB). The TSPCB in addition to air pollution also regularly monitors the noise pollution at the selected junctions of MCH. Generally, areas prone to high noise are industries and vehicular traffic zones. The level of noise recorded at

four significant commercial junctions under MCH. Hyderabad is the third noisiest metro in India after Mumbai and Lucknow as per a report by the Central Pollution Control Board.
The CPCB gathered data from 35 noise monitoring systems installed by it in nine metro cities for the period 2011-14. The noise monitoring systems in Hyderabad are at two commercial zones of Abids and Punjagutta, the Jeedimetla industrial zone, the silence zone at the zoo and the Jubilee Hills residential zone. The noise at Abids, Punjagutta and the zoo reached industrial levels. At all these places, the noise levels exceeded the prescribed limits of the CPCB in every reading.
This is the fallout of government departments like the Pollution Control Board, traffic police and transport, not acting to curb noise pollution in the city. An example of effectively controlling noise pollution was recently reported from Bodh Gaya in Bihar where government departments such as the Pollution Control Board, traffic police and transport departments came together to curb noise pollution — resulting in a drastic drop of nearly 50 per cent.

PROJECT ORIGIN/NEED

Conception of Idea

PROJECT ORIGIN

What or who is driving the project?
A team of students, Project-D in collaboration with WE HUB

PROJECT NEED

What problems need addressing?
Sound-related disturbances in the communities of urban cities

INTRODUCTION TO SOUNDTRAP

Back in the end of year 2019, The Students of Muffakham Jah College of Engineering and Technology developed an IOT device called the SoundTrap which is developed to solve the noise pollution problem of urbanized cities by addressing four key areas.

1) Vehicular Noise Pollution caused in residential areas
2) Vehicular Noise Pollution caused in schooling areas
3) Vehicular Noise Pollution caused in hospital areas
4) Data Collection and Challan system for all the areas.

All of these key areas are assigned for monitoring the sound data through our device and capture these lawbreakers in the act, we have developed a prototype that not only captures these law breakers at the scene with video evidence but also gives the number of decibels these law breakers were having at the time of crime with the timestamp, by doing this we are reducing the number of lawbreakers in the residential areas giving rise to a peaceful environment.

VEHICULAR NOISE POLLUTION IN RESIDENTIAL AREAS

SoundTrap can be easily integrated in the residential areas, where it can be placed on the lane poles which is then connected to the camera system put out by the Traffic Police of Telangana. According to the laws (updated in 2021), the maximum sound produced by the vehicles in a residential area must be not more than 80 dB. Any sound over that causes problems to the residents of the neighborhood. If any vehicle crosses the above limit currently there is no automated way of penalizing the law breaker but with soundtrap whenever the lawbreaker breaks the 80 dB limit a video of them is generated with a timestamp and all the license details of the lawbreaker. This device works in collaboration with Telangana traffic police where this data is then processed and sent to the lawbreaker.

VEHICULAR NOISE POLLUTION IN SCHOOLING AREAS

SoundTrap can be easily integrated in the schooling areas, where it can be placed on the lane poles which is then connected to the camera system put out by the Traffic Police of Telangana. According to the laws (updated in 2021), the maximum sound produced by the vehicles in a residential area must be not more than 85 dB. Any sound over that causes problems to the students of the schools. If any vehicle crosses the above limit currently there is no automated way of penalizing the law breaker but with soundtrap whenever the lawbreaker breaks the 85 dB limit a video of them is generated with a timestamp and all the license details of the lawbreaker. This device works in collaboration with Telangana traffic police where this data is then processed and sent to the lawbreaker.

VEHICULAR NOISE POLLUTION IN HOSPITAL AREAS

SoundTrap can be easily integrated in the hospital areas, where it can be placed on the lane poles which is then connected to the camera system put out by the Traffic Police of Telangana. According to the laws (updated in 2021), the maximum sound produced by the vehicles in a residential area must be not more than 75 dB Any sound over that causes problems to the patients in the hospital. If any vehicle crosses the above limit currently there is no automated way of penalizing the law breaker but with SoundTrap whenever the lawbreaker breaks the 75 dB limit a video of them is generated with a timestamp and all the license details of the lawbreaker. This device works in collaboration with Telangana traffic police where this data is then processed and sent to the lawbreaker.

DATA COLLECTION AND CHALLAN SYSTEM FOR ALL THE AREAS

SoundTrap is a tool for detailed data collection, it collects sound data for each vehicle that produces more sound than the threshold value. This helps in accurate data collection for the challan system. Once the Data is collected it is temporarily stored in the soundtrap and at the end of the day, it is transferred to the Telangana Traffic Police where it gets processed. This data collection can also help in further models.

PROBLEM STATEMENT

What started as a tiny city with the spirit of hustle and drive is now home to almost 10 million people. This boom in population translates to expansion of the city area, which would further push towards an increase in vehicles, which is reasonable. However, with growing population of vehicles, there has been an increment of alterations in vehicles with aftermarket parts which would prove to be unfavourable for road conditions. An example of such an alteration is modified silencers and horns in bikes. This type of alteration in vehicles has made a literal 'boom' in sound pollution. The most affected zones by these sound emitting vehicles have been:

1. School Zones
2. Hospital Zones
3. Residential Areas

A quote from a reputable doctor:

"Continuous exposure to loud noise makes us irritable and more susceptible to anger. That is one of the reasons why we see so many cases of road rage. When the decibel units are loud near a residential area, especially during the night, it might affect the sleep of people living there. Many people do not think that this is an issue, but the truth is bad sleep cycles can affect our entire day, and by extension our lifestyle. It might also reduce our efficiency at work."

~Dr Ashok Kumar Singh, ENT Surgeon, Continental Hospitals

Daily exposure to such noise levels over a long period can have harmful effects. With rapid urbanisation, often unmatched by proper layout of roads, highways and buildings, industrial, residential, and commercial areas lie in close proximity. The ambient noise levels in silence zones were found to go even up to 90dB, both daytime and night-time noise levels in these silence zones were above the permissible limits. It causes distractions and annoyance in institutional areas, hospital areas, school areas, etc. Night-time noise levels in residential areas also exceed the prescribed limits of 45dB and 55dB in daytime.

Area code	Category of area/zone	Limits in dB(A) leq*	
		Day time	Night time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence zones	50	40

*dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing. Source: Central Pollution Control Board, India

There are laws and regulations against vehicular noise pollution. The regulations state the maximum noise which can be emitted from a vehicle in commercial and industrial zones can be 10 above 75dB, that is 85dB(A). However, for residential zones, it can be 10 above 55dB, that is 65dB(A), and for silence zones such as hospital zones it is permissible up to 60dB(A).

Even with proper laws and regulations in place to control vehicular noise pollution, it still remains a menace to public peace and mental welfare. The problem remains with the implementation of these laws. To date, most of the law breakers are caught manually. That is when the law breaker is caught red handed by a police officer. There has been no advancement, as of year 2022 to automate the process of catching a sound polluting vehicle and penalising it.

EXISTING CONDITIONS

PRESENT SOLUTION

Most of the solutions right now do not focus on accuracy but instead being first to approach.

We can take the case of Mumbai's present solution for the honking problem. Mumbai's soundtrack is a cacophony of beeps, dubbed the "honking capital of the world." Impatient drivers horn even at red lights, anticipating the green light. Mumbai police, fed up with the noise pollution, decided to take action. "The Punishing Signal" was put to the test in November of last year. At several key intersections throughout the city, decibel meters were linked to traffic signals. The clock that counts down from the red to green signal is reset if the sound level exceeds 85dB, around the level of a food blender.

People are more inclined to honk if they are waiting for a green signal for a lengthy time. However, cars with keen eyes may notice a sign above the lights that read "Honk More, Wait More."

"This is a continuous practice that we will perform randomly over the next couple of months till the public are aware of it, to avert mayhem," Pandey said of Mumbai. To drown out the constant drone of honks, drivers will have to crank up the volume while listening to John Lennon.

This solution is more of a social experiment but what it is not is an permanently viable solution that also works in collaboration with the traffic challan system.

The Hyderabad City Police Department has initiated an anti-vehicular noise pollution campaign. Hundreds of motorcycle exhaust silencers were damaged and two-wheelers were seized during the operation. The people of Hyderabad have been urged to join hands in making Hyderabad the "Best Livable and Non-Polluted City."

The Traffic Police in Hyderabad goes through monitoring all the vehicles manually. This is very ineffective. The solution takes a lot of time and is very difficult to manage. So, in the end, All the implemented solutions are almost ineffective on a bigger scale. Our solution is a lot more scalable and implementable. It is not confined by outdated formats; it is built on the platforms of tomorrow.

HOW IS IT OUTDATED

Currently the Traffic Police uses the manual sound level meter which is a handheld noise measuring device with a microphone. It is also called a Sound Pressure Level (SPL) Meter as the diaphragm in the microphone responds to change in the air pressure created by sound waves. Hence a sound level meter can instantly measure current sound pressure level (SPL) in an environment.

This process of catch holding these law breakers is a tedious and time-consuming which can definitely be automated and hence we developed a new Automated System that is the 'SoundTrap' to replace the Sound level Meters and most importantly the SoundTrap does not require any individual to monitor it on the actual site of installation and with this we can maximize the count of penalizing the law breakers with video evidence.

According to the stats from a particular week from July 2019, the Telangana State Traffic Police Department reported that 624 challans were levied upon the law breakers using the manual implementation that is the sound-level meters and this number would have increased in ten folds with the automation of existing system that is with the implementation of the SoundTraps across the residential areas of the twin city. The present implementation of using the Sound level meters has some uncertainties in terms of calculation of the decibels emitted by particular vehicle.

Uncertainties associated with the use of a sound level meter:

UNCERTAINTY THRESHOLD FOR NOISE MEASUREMENTS WITH A SOUND LEVEL METER

There are many uncertainties involved when using the SPL meter. They are as follows.

UNCERTAINTY ASSOCIATED WITH A-WEIGHTING MEASUREMENTS

A primary need for values of uncertainty is to demonstrate compliance with noise emission level declaration as required for numerous regulatory purposes, for example the European NPL Report DQL-AC 002 5 Directive 2000/14/EC "on the approximation of the laws of the Member States relating to the noise emission in the environment by equipment for use outdoors". This Directive requires that machinery is labelled with a guaranteed A-weighted sound power level. Here, a guaranteed sound power level means a single-number noise emission value including the uncertainties due to production variation and measurement procedures

UNCERTAINTY ASSOCIATED WITH FREQUENCY BAND MEASUREMENTS

Although numerous regulatory bodies require A-weighted noise emission values, the guide to the expression of uncertainties in measurement requires that any measured value should be accompanied by an associated measurement uncertainty. Several of the Standards in the ISO 3740 series include specifications for the determination of one-third-octave-band noise emission levels and so there is a need to assess measurement uncertainties associated with band limited values.

PROJECT DESCRIPTION/ INTENT/CONCEPT

Almost every traffic violation which occurs in the city daily has found the means to be automated. No helmet, triple riding, cell phone driving challans, have been automated with the city's surveillance system. However, the violation which is the most problematic to the citizens trying to live peacefully in the city, sound polluting vehicles, has been manual ever since discovery. Our product helps in solving the one major problem with the current solution, automating it.

Our product, the SOUNDTRAP**,** as the name's similarity to the Speed Trap suggests, is a device which will capture sound data and measure it with accuracy. The applications to this product will prove to be endless, when it will reach its full potential. The main objective of our product will be to detect and differentiate between public noise and vehicular noise and measure the vehicular noise with accuracy and alert the system and initiate the protocol when the law-breaking vehicle has been detected by the product.

The protocol on which the product will function is that when it detects that a vehicle is emitting a sound greater than 80dbA, it will automatically trigger the camera and record a small video clip of the passing vehicle, with the decibel rating and the timestamp and store it in server and also send it to the respective authorities. To monitor sound data, through our device and capture the law breakers in the act, we have developed a prototype that not only captures these law breakers at the scene with video evidence but also gives the number of decibels the vehicle was emitting at the time of crime, with the timestamp. By doing this we are reducing the number of lawbreakers in the residential areas giving rise to a peaceful environment. The video evidence is hereby forwarded to the traffic officials in an automated manner.

The product can be trained to differentiate between the different vehicular noise which will also help it to recognize the make and model of the vehicle passing by. With this, the results produced by the product will be more accurate than before. It will be able to differentiate between the white noise of the surroundings from the vehicles passing by, even better. If the product becomes capable enough to recognize the model of the vehicle passing by it, then it will be easier for the traffic officials to shortlist law breaking vehicles.

On further developing the product, its scalability will expand to a great extent of applications. As the product will be able to differentiate between different noises, and also be able to recognize the vehicles passing by it, it can also be trained to recognize the various types of sirens used by emergency service vehicles such as ambulances, fire engines, police response vehicles of the city. The applications of recognizing such vehicles can be endless. It could help with managing the traffic signal junctions when an emergency vehicle is approaching it. The signal timers on the junctions can be altered when an emergency vehicle is arriving at the junction without any manual presence on the junction. This would help clear the way for it faster than manual work could do. Furthermore, the next junctions through which the emergency vehicle could pass can also be cleared for it to pass by with ease. The product will not only prove to be of great support for the current sound polluting vehicle problem, but also be a great investment for further scalable applications. It will provide endless possibilities and solutions in the sound domain if given time and resources to be developed in a proper environment.

The product will prove to be a great influence for residential areas and sound sensitive areas such as Hospital zones, School Zones, etc. Helping reduce sound pollution from vehicles in such areas will remain the top priority for our product. Penalising them will prove to be a great income source for the government, and will make a great impact by discouraging the aftermarket fittings which make the vehicle a sound polluting vehicle.

PROJECT DEVELOPMENT

TECHNICAL DEFINITION OFSOUNDTRAP

SoundTrap is regarded as an IoT device focusing on monitoring sound data and capturing lawbreakers in the act, we have developed a prototype that not only captures these law breakers at the scene with video evidence but also gives the number of decibels these law breakers were having at the time of crime with the timestamp, by doing this we are reducing the number of lawbreakers in the residential areas giving rise to a peaceful environment. The system also enables analysis of various sorts of data via Big Data Analytics from time to time to identify noise polluted and traffic prone areas.

COMPONENTS AND MODULES

In this section, various components and Modules being used for SOUNDTRAP developmentis discussed:

RASPBERRY PI 3B

The Raspberry Pi 3 Model B is the third generation Raspberry Pi. This powerful credit-card sized single board computer can be used for many applications and supersedes the original Raspberry Pi Model B+ and Raspberry Pi 2 Model B. Whilst maintaining the popular board format the Raspberry Pi 3 Model B brings you a more powerful processor, 10x faster than the first-generation Raspberry Pi. Additionally, it adds wireless LAN & Bluetooth connectivity making it the ideal solution for powerful connected designs.

LOGITECH WEBCAM

The Logitech C270 HD Webcam helps you to make high-definition video calls on your favorite platforms like Skype. At 30 frames per second, video quality is smooth, while images are crisp, colorful and contrasted. The built-in noise-reducing mic makes sure your voice comes across clearly, even if you're in busy surroundings. This Logitech C270 HD Webcam comes with a universal clip. You can either attach it securely to your screen or sit it on a shelf. Small, agile and adjustable, it brings a whole new angle to video calling.

LIBRARIES

As we write large-size programs in Python, we want to maintain the code's modularity. For the easy maintenance of the code, we split the code into different parts and we can use that code later ever we need it. In Python, modules play that part. Instead of using the same code in different programs and making the code complex, we define mostly used functions in modules and we can just simply import them in a program wherever there is a requirement. The Python Standard Library contains the exact syntax, semantics, and tokens of Python. It contains built-in modules that provide access to basic system functionality like I/O and some other core modules. Most of the Python Libraries are written in the C programming language. The Python standard library consists of more than 200 core modules. All these works together to make Python a high-level programming language. Python Standard Library plays a very important role. Without it, the programmers can't have access to the functionalities of Python. But other than this, there are several other libraries in Python that make a programmer's life easier. Let's have a look at some of the important libraries used in SoundTrap.

OPENCV

OpenCV (Open-Source Computer Vision Library) is an open-source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for

computer vision applications and to accelerate the use of machine perception in the commercial products. Being a BSD-licensed product, OpenCV makes it easy for businesses to utilize and modify the code. It has C++, Python, Java and MATLAB interfaces and supports Windows, Linux, Android and Mac OS. OpenCV leans mostly towards real-time vision applications and takes advantage of MMX and SSE instructions when available. A full-featured CUDA and

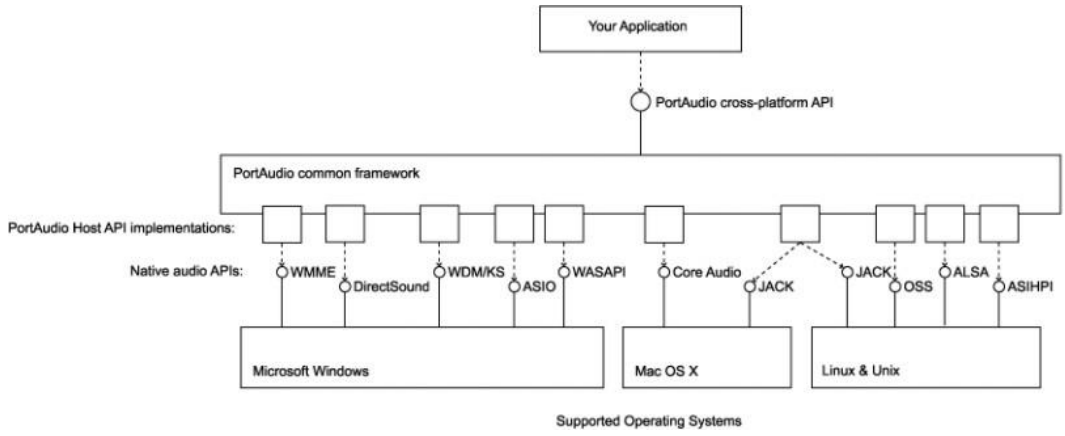
OpenCL interfaces are being actively developed right now. There are over 500 algorithms and about 10 times as many functions that compose or support those algorithms. OpenCV is written natively in C++ and has a templated interface that works seamlessly with STL containers.

PYAUDIO

PyAudio provides Python bindings for PortAudio, the cross-platform audio I/O library. With PyAudio, you can easily use Python to play and record audio on a variety of platforms. PyAudio is inspired by:

- pyPortAudio/fastaudio: Python bindings for PortAudio v18 API.
- tkSnack: cross-platform sound toolkit for Tcl/Tk and Python.

This schema illustrates the basic concept behind PortAudio as it interacts with various native audio APIs.



MATPLOTLIB

Matplotlib is a cross-platform, data visualization and graphical plotting library for Python andits numerical extension NumPy. As such, it offers a viable open-source alternative to MATLAB. Developers can also use matplotlib's APIs (Application Programming Interfaces) to embed plots

in GUI applications. The pyplot API has a convenient MATLAB-style stateful interface. In fact, matplotlib was originally written as an open-source alternative for MATLAB. The OO API and its interface is more customizable and powerful than pyplot, but considered more difficult to use.

SCIPY

SciPy in Python is an open-source library used for solving mathematical, scientific, engineering, and technical problems. It allows users to manipulate the data and visualize the datausing a wide range of high-level Python commands. SciPy is built on the Python NumPyextension. SciPy is also pronounced as "Sigh Pi." SciPy is a scientific computation library that uses NumPy underneath. SciPy stands for Scientific Python. It provides more utility functionsfor optimization, stats and signal processing. Like NumPy, SciPy is open source so we can use it freely. SciPy was created by NumPy's creator Travis Olliphant. SciPy provides algorithms for optimization, integration, interpolation, eigenvalue problems, algebraic equations, differential equations, statistics and many other classes of problems.

NUMPY

NumPy is the fundamental package for scientific computing in Python. It is a Python library that provides a multidimensional array object, various derived objects (such as masked arrays and matrices), and an assortment of routines for fast operations on arrays, including mathematical, logical, shape manipulation, sorting, selecting, I/O, discrete Fourier transforms, basic linear

algebra, basic statistical operations, random simulation and much more. At the core of the

NumPy package, is the ndarray object. This encapsulates n-dimensional arrays of homogeneous data types, with many operations being performed in compiled code for performance.

DEJAVU

Dejavu Project is an open-source audio fingerprinting project in Python. It can memorize recorded audio by listening to it once and fingerprinting it. Then by playing a song and recording microphone input or on a disk file, Dejavu attempts to match the audio against the fingerprints held in the database, returning the song or recording being played. Dejavu excels at the recognition of exact signals with reasonable amounts of noise. There are two ways to recognize audio using Dejavu. You can recognize it by reading and processing files on disk, or through your computer's microphone.

ALGORITHM

The Algorithm of Overall Process:

Step 1: Start the Process

Step 2: Start Recording Audio

Step 3: Convert Audio to Analog Signal

Step 4: Get Amplitude and Frequency From Analog Signal Step 5: Calculating Db Using Formula

Step 6: 80db Limit to Capture 10 Sec Video

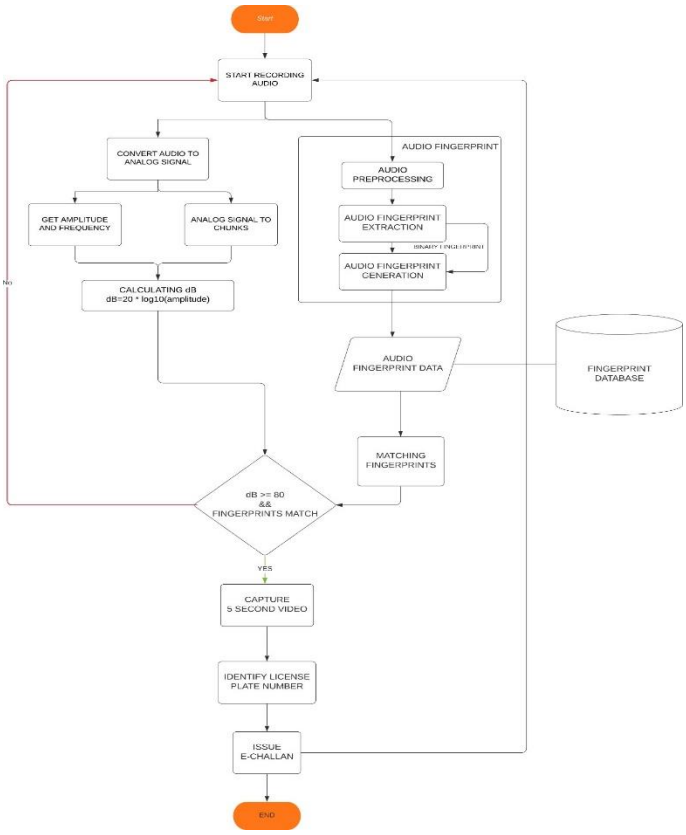
Step 7: Identifying Plate Number from Video

Step 8: Issuing E-challan Using Plate Number

Step 9: Repeat Step 2 To Step 8 Until the Process End

Step 10: End

FLOWCHART

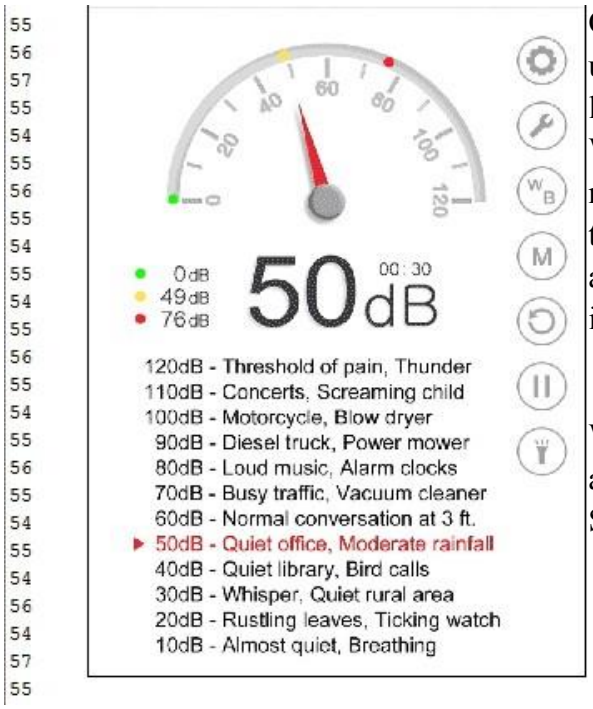


TESTING

The primary purpose of testing is to detect and correct device malfunctions and errors. Testing would help show how well a device functions under varying conditions. We carried out two types of testing. Firstly, as we wrote codes, we used a simulation software application to constantly simulate the codes and determine areas that require amendment or correction. This application has some limitations as it may not recognize some inherent problems that could only be discovered in real-time.

Secondly, we tested the codes by testing it in real-time with the 3 cases of traffic and SPL meter to compare the results of traffic dB.

WORKING WITH SOUND LEVEL METER:



Once we were ready with the code and hardware, we uploaded the code and opened the serial monitor to look at the dB values measured by the SoundTrap. We were testing the code indoors where there was not much noise except for the traffic outside and we got the below values on theserial monitor and the android application also displayed something close to this image.

We then started testing the code outdoors in traffic and there are 3 cases where we tested the SoundTrap

BACKGROUND

Noise pollution, a by-product of urbanization and industrialization, is now recognized as a major problem in urban areas with many adverse health effects. The most important factors raising noise pollution in urban areas are vehicular traffic, railway and air traffic. Vehicular traffic contributes to about 55% of the total urban noise. The need for studies regarding urbannoise

pollution and its consequences on the environment has motivated various researchers inseveral countries including India. Most cities in India have been facing serious noise pollution problems in the last few decades due to substantial growth in the number of vehicles, expansion of road network, industrialization and urbanization.

Assessment of traffic noise pollution is not easy and varies with types and physical conditionsof vehicles, speed, honking and road geometry. Estimation of traffic noise is more difficult in Indian cities considering the heterogeneity in traffic conditions including mixed vehicle types, congestion, road conditions, frequent honking and lack of traffic sense. Honking is a common occurrence in India, irrespective of road types and condition, traffic etc.. Driving attitude which includes impatience, over accelerating, sudden braking, abiding traffic rules etc. may also aggravate honking. We found that horn noise events increase equivalent noise level (Leq) 2 to 13 dB(A). Therefore, there is a need to consider such diverse factors in monitoring and assessment of traffic noise as well as planning of noise abatement measures. The objective of the study is to assess and quantify traffic noise and the impact of honking on it in the urban environment of Hyderabad, India. The study will help in defining new 'No Honking' zones in addition to assessing traffic noise and existing horn prohibited areas.

SAMPLING AREA

Traffic volume, noise levels, spot speed and honking were measured at three sampling locations in the study area during March 2020 – December 2020. The study area lies at Tank Bund Road in Hyderabad, Telangana, India. These are classified as national highways, major and minor roads respectively. Road details including geometry, category, number of traffic lanes and road conditions are considered in the study. The width of national highway, major and minor roads is 21 m, 15 m and 7 m respectively. Road conditions were almost the same for all roads with asphalt surface and footpaths on both sides. Road divider separates the flow of mixed traffic at highway (six lanes) and major road (four lanes) whereas the minor road doesn't have any divider.

CASE I

The first test case was in moderate traffic with 3-4 vehicles in a 2-lane road and the measured decibel rating was 82dB. SoundTrap worked with a 73% accuracy to detect vehicular noise pollution.

CASE II

The second test case was in moderate traffic with 3-4 vehicles in a 2-lane road and the measured decibel rating was 82dB. SoundTrap worked with a 73% accuracy to detect vehicular noise pollution.

CASE III

The third test case was in maximum traffic with more than 5 vehicles in a 2 lane road and the measured decibel rating was 82dB. SoundTrap worked with a 73% accuracy to detect vehicular noise pollution.

DATA COLLECTION

Traffic volume studies were conducted to determine the number, movements, and classificationof vehicles at a given location and sampling period. Traffic volume was recorded using a video camera and vehicles were counted by viewing recorded footage from cameras on a computer system. Vehicles were classified as heavy (truck, bus, bulldozer, trailer, dumper), medium (car, jeep, auto-rickshaw, loading rickshaw) and light (motorcycle, scooter) based on their size and noise emission level. Auto-rickshaw is a three-wheeler used as a common means of transportation in India. Noise emitted by traffic vehicles was measured as per standard methods using a sound level meter. Sound level meter was mounted on a tripod stand 1.5 m above ground level with slow response mode, frequency weighting "A" and data logging of 1 second time interval. Traffic noise was measured using a sound level meter at a distance of 12 m, 10 m and 5 m from the center of national highway, major and minor roads respectively.

Similarly, a speedometer (Speed Traffic Radar) was mounted on a tripod stand for monitoring the speed of vehicles. Noise emitted from a particular vehicle with corresponding speed was also measured and analyzed for noise-speed response.

DATA ANALYSIS

An attempt has been made to analyze traffic volume, vehicle speed and honking with their corresponding noise levels. Initially, traffic volume was monitored for 24 hours to identify peak

traffic hours in morning and evening. Later, two sets of traffic volume and noise data were monitored during morning and evening peak traffic hours. In the first set of data, traffic and noise levels were measured for 1 hour with a 15 minutes time interval while in the second set, honking along with traffic and noise levels were measured for 15 minutes with a time interval of 1 minute duration. Measured noise data in two sets of readings were analyzed for equivalent (Leq), minimum (Lmin) and maximum (Lmax) noise levels. Leq was further analyzed in each time step to assess the impact of honking using frequency components of traffic noise recorded in the sound level meter. A statistical analysis was performed to assess the impact of diverse conditions on traffic noise based on the relationship between traffic volume, road geometry and noise data.

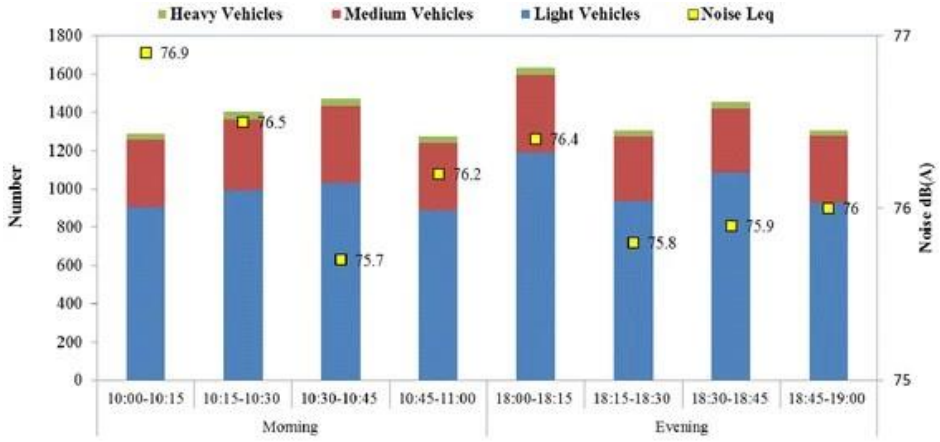
For this, analysis of variance (ANOVA) and correlation analysis were carried out to quantify the dependence of traffic volume - equivalent noise, honking - equivalent noise and vehicular speed - corresponding noise level.

RESULTS

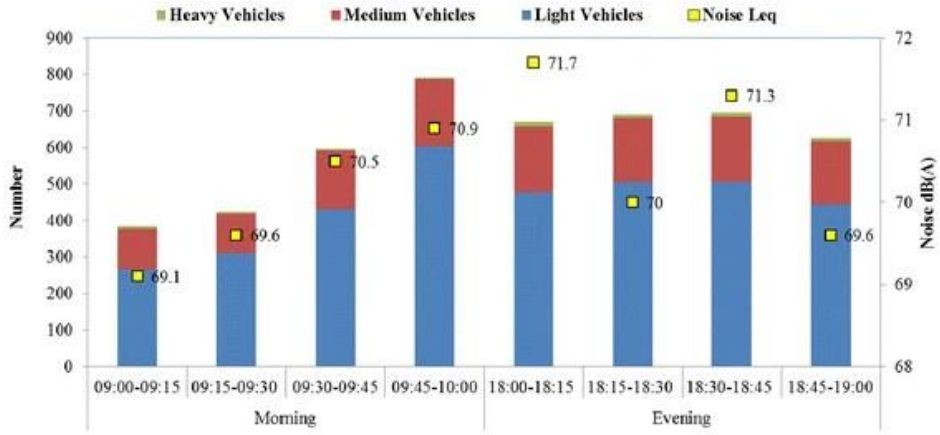
Based on the analysis of 24-hour traffic volume, peak traffic flows were observed between 10:00 and 11:00 in case of highway and between 9:00 and 10:00 for major and minor roads inthe morning. The number of light, medium and heavy vehicles passing through the highway were 3605, 1427 and 171, respectively during morning peak hour. The observed light, medium, and heavy vehicles on major roads were 2338, 612 and 11, respectively while on minor roads these values were 1587, 585 and 9, respectively. Similarly, peak traffic flow was observed between 18:00 and 19:00 for all categories of roads in the evening. Number of light, medium and heavy vehicles were 3552, 1663 and 138 at highway, 1861, 754 and 27 at major roads and 1528, 611 and 8 at minor roads, respectively.

To assess the impact of traffic on noise levels, peak hour's traffic and noise levels were measured for a 15 minutes interval (Figure a, b and c) in the first set of data. As per reviewed literature, noise is directly proportional to traffic volume which means that traffic noise increaseswith increase in traffic volume. However, some conflicting results were observed in the present study. For example, at highway, lowest Leq [75.7 dB(A) during 10.30 to 10.45] was noted corresponding to maximum traffic volume and highest Leq [76.9 dB(A) during 10.00 to 10.15] was not corresponding to maximum traffic volume during morning hour (Figure a); at major road, highest Leq did not correspond to maximum traffic volume in evening peak hour (Figure b) and at minor road, lowest Leq did not correspond to minimum traffic volume in morning and evening (Figure c). However, Leq observations conformed to literature findings at highway for

highest and lowest Leq during evening peak hour (Figure a), at major road for highest Leq during morning and lowest Leq during evening (Figure b) and at minor road for highest Leq in morning and evening (Figure c). These results show mixed trends between traffic volume and equivalent noise.



a



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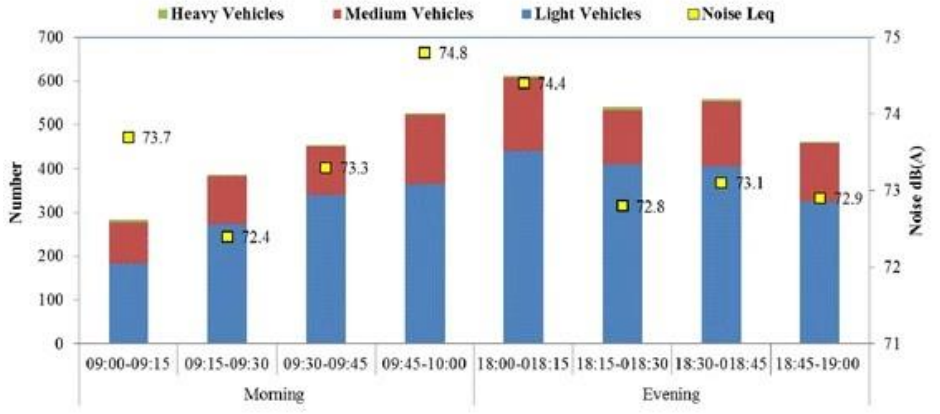


c

CONCLUSION

SoundTrap uses this noise pollution data to optimize its ML algorithm and will keep improving as the device collects more and more data on vehicular noise pollution. Monitoring and assessment of traffic noise in urban environments is complex due to various influencing factors such as traffic volume, honking, vehicular speed, road geometry etc. Traffic noise was assessed in the urban agglomeration of Hyderabad, India considering the above factors. Impact of heavy vehicles on traffic noise was more as compared to light and medium vehicles. Honking is a frequent phenomenon in Indian road context therefore it was observed that honking has a significant impact on traffic noise besides traffic volume and vehicular speed.

Previous studies also confirmed the effect of honking on traffic noise and used it as one of the input parameters intraffic noise prediction. These studies do not provide quantification of honking noise in heterogeneous traffic while present research provides quantification of noise due to honking based on frequency analysis of traffic noise. This was also confirmed by statistical analysis considering traffic noise and honking data. Using this, it was found that honking induced an additional 2 to 5 dB(A) noise over and above traffic noise. Further, increase in vehicular speedfrom 35 to 55 kmph also increases traffic noise by 4 to 5 dB(A) for all types of vehicles. The present study suggests that honking must also be a component, apart from monitoring of trafficvolume and vehicular speed in traffic noise assessment.

Additionally, the study will help in assessing existing horn prohibited areas and defining new ‘No Honking zones.

COMAPRISON WITH PREVIOUS SOLUTION

THE PUNISHING SIGNAL

Let’s take the example of the “Honking capital of the world”, Mumbai. The solution implemented there is called “The punishing signal”. It was put to test in November last year, at several key traffic intersections throughout the city. Decibel-meters were linked to the traffic signals. This meter would measure the amount of sound at the traffic intersection. It was made specifically for the intention of listening for horn sounds from the vehicles. When the horn sounds exceed the 85db mark, the signal timer would be reset. This would cause the vehicles at the junction to wait for longer times, if they honked more. People are inclined to honk if they were waiting at the green signal for a long time. Even though this concept was brought in to help encourage patience amongst the traffic commuters, we can argue that it will cause more frustration and irritation. This solution would better suit as a social experiment rather than a permanent viable solution, which works in collaboration with the traffic challan system. “This is a continuous practice that we will perform

randomly over the next couple of months till the public is aware of it, to avert mayhem", Pandey said of Mumbai.

The output of this solution was appreciable. The traffic authorities found a 32% decrease in average sound at traffic junctions between a week prior installation and one month after. However, this solution doesn't provide a proper justification to commuters. It doesn't single out the law breakers, rather the ones who don't deserve punishment face it because of the group of people they are surrounded by.

The SOUNDTRAP aims to help with penalising the vehicle emitting sound levels above 80db. All the meanwhile, it also helps gather proof of violation along with timestamps and location. All this information helps strengthen the case of penalising the law breaker, which will help the government income from the traffic violation fines.

MANUAL APPROACH

The Hyderabad City Police Department has initiated an anti-vehicular noise pollution campaign. Hundreds of motorcycle exhaust silencers were eradicated and motorcycles were seized during the operation. They have urged the people of Hyderabad to join hands in making the "Best Liveable and Non-Polluting city".

This campaign has been carried out widely across Hyderabad, and was publicly applauded. It has helped greatly with modified and aftermarket silencers and horns fitted in vehicles. A fine of ₹1000 is slapped on the law breaker for first time violation and ₹2000 for recurrent violations. The aftermarket silencers were bulldozed by the police officials after being seized and vehicles were impounded. The law-breakers were counselled by the authorised officials.

The main issue with this approach is that the law breakers have to be caught manually by the traffic officials. For this to happen, the traffic police have to set up checkpoints at various spots for catching the law breakers, and the law breakers have to pass by the setup check post. After catching the law breaker, the vehicle has to be manually checked for sound levels and then be issued the challan. All of this process is manual.

The SoundTrap aims to automate this hassle for the traffic police. The device will be set up in residential or sound sensitive areas, and it will surveil it for any noise polluting vehicle. Once it encounters a noise polluting vehicle, that is when it senses that the noise level from the vehicle has exceeded the 80db mark, it'll capture a video clip of the law-breaking vehicle, along with the decibel level, the timestamp and the location where the act occurred. The device will send all of this information to the traffic officials for them to process and penalise the law breaker.

The main focus of this project is to be more scalable and implementable. It will not be confined by the outdated formats, rather it will be built and scaled on the platforms of tomorrow.

LIMITATIONS OF SOUNDTRAP

Currently, the implementation of SoundTrap is limited to Residential and Sensitive areas for example near Hospitals, Government Offices, Minister Quarters, Offices since the impact of noise pollution is greatly noticed in these areas. The list of all target areas is discussed in detail under the Target Areas.

The current version of SoundTrap is not ready to install in the busiest sites of the city for example the cross roads, highways etc. since it does not have the functionality to segregate the noise it receives and hence it gives the incorrect results.

SCALABILITY OF OUR SOLUTION

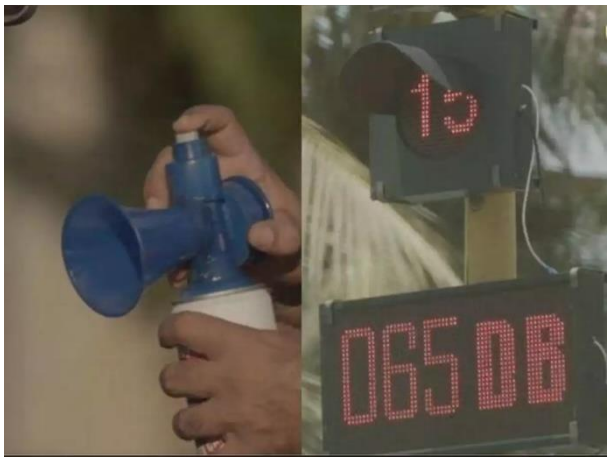
There are many areas where the solution is scalable-

- Scalability in terms of Hardware
- Scalability in terms of Software
- Scalability in terms of implementation

SCALABILITY IN TERMS OF HARDWARE

The device comprises components like Raspberry Pi and Microphone with Camera, a hardware like this can aid advancements to a bigger level. The untapped market this device caters opens doors to many future enhancements. Moreover, the hardware components fall into a common category so as to connect to many pre-existing devices. Factors like these increase the scalability of the product to a great deal.

Many colonies and gated communities have a camera attached to it, connecting the software of these devices to the pre-existing apparatus will expand its area of outreach and make the product more budget friendly. One doesn't need to make a new device from scratch which sort of dampens the production and radar of expansions, the integration to pre-existing components therefore aids the scalability.



Scalability in terms of production is achievable due to the common components and ease of access to its materials. Developing an integrated network within areas can also make reusability of the components much easier.

SCALABILITY IN TERMS OF IMPLEMENTATION

When it comes to scalability in terms of usage of the device, at this stage - since its primary target area is residential areas, it can also be expanded to silence areas such as hospitals and educational institutions. Instead of using physical servers to transport data from the device to the traffic control room, usage of cloud computing an make it easy for handling large frequencies of data at lesser frequencies in an affordable price range.

The present solution has the capability of increasing its scope to areas with hospitals and educational institutions with little to no changes.

SCALABILITY IN TERMS OF SOFTWARE

In addition to its hardware enhancements, the tech stack used in this project is highly adaptable and widely used. The programming language used here - PYTHON and its algorithm has a wide scope for integrating many software features. With this software stack there are less integration errors creeping into the code for future software enhancements. Integration of more machine learning algorithms will be comparatively easier and can be used for detecting sirens of emergency vehicles to alert subsequent signals that one such vehicle is approaching. The outputs of this can be recorded and analysed which can generate statistics to recognize which areas in the cities are contributing more to sound pollution.

The product's ability to use the same hardware and software for various other applications can make it easy for it to scale for a numerous amount of reasons. Using the same components with a few changes in algorithms or increasing some of its features with less compatibility issues can be performed with this device. The requirements installed can pretty much cater to almost all applications in the sound domain.

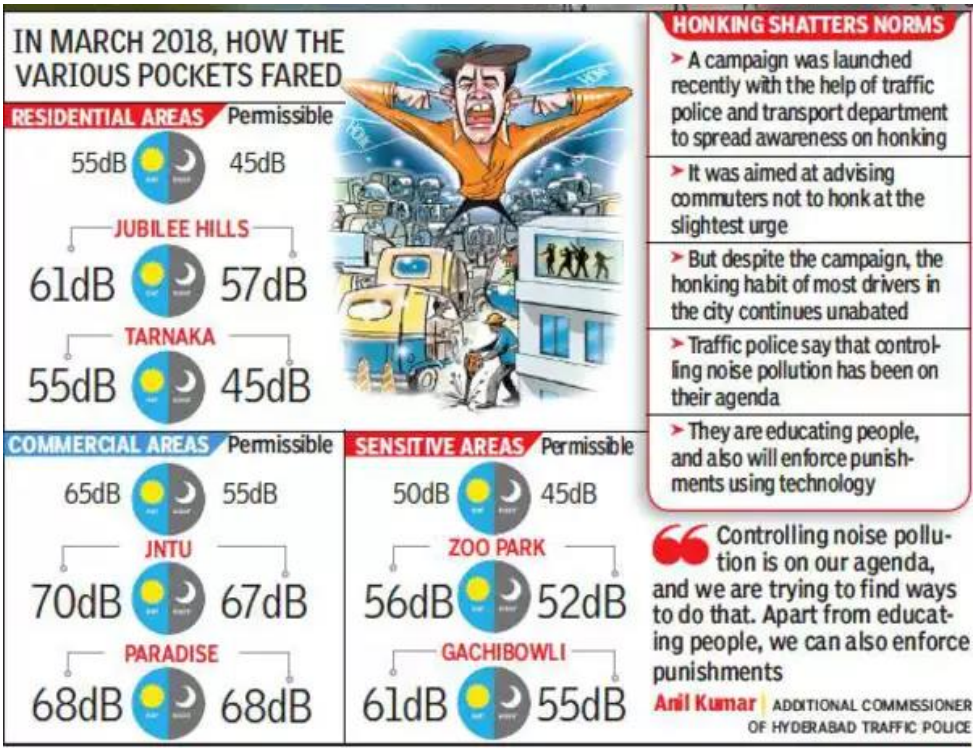
Scaling the device by adding more features to its code so it can increase its application to different areas as well can be done with this device.

Some of the enhancements for applications are:

1. Statistical analysis
2. Emergency Siren Detection

STATISTICAL ANALYSIS

Recording the outputs to generate statistics for sound polluting areas can not only ease the data gathering process but also provides relatively more accurate data. This uses the same hardware and software components but when the data to the traffic department is sent, it records it to another database and stores it as values for that specific are, which can be averaged out and used while generating reports that rank areas based on the decibel value it portrays on average.



EMERGENCY SIREN DETECTION

Attaching datasets of sirens of emergency vehicles can add up the feature of detecting such vehicles from a distance and acting upon it. The solution makes it possible to allow itself in integrating these advancements.

MARKET ANALYSIS

The Current Market for the SoundTrap is still niched. But that is both a blessing and a curse. It has a measly 806.5 Million market worth. The noise monitoring market is estimated to grow at a CAGR of 4.1 percent from USD 610.2 million in 2016 to USD 806.5 million in 2023. The study uses 2016 as the base year, and the prediction period is from 2017 through 2023. The report's goal is to give a comprehensive market analysis based on sample technique, precision type, connectivity, solution, application, and location. The research also includes a thorough value chain and information on the primary variables impacting market growth (drivers, constraints, opportunities, and industry-specific problems). In Addition, the key players are also strategically profiled, with their market rank and core competencies thoroughly analyzed, as well as the competitive landscape for market players and descriptions of product launches, acquisitions, partnerships, expansions, agreements, contracts, alliances, and collaboration in the noise monitoring market.

Growing occupational hearing impairment in industries, stringent government policies, demand for reducing noise pollution in urban areas, need for noise monitoring systems at airports to optimize profit and capacity, rising installation of all-in-one environmental monitoring solutions, and requirement of noise monitoring infrastructures in mining, wind plants, and petrochemical industry are some of the major factors driving the growth of the noise monitoring market.

In 2016, the noise monitoring market was dominated by permanent noise monitoring. This is due to the widespread use of permanent noise monitoring in areas where regular measurement is mandated by government regulations. In addition, real-time noise monitoring is mostly accomplished through persistent noise monitoring. During the projected period, cellular connectivity for noise monitoring is expected to grow at the fastest rate. Because noise monitoring allows enterprises and consultants to remotely upload noise data to a central system or cloud storage, the sector is experiencing rapid growth.

STAKEHOLDERS

Identify all individuals and groups with an interest in the project Local government, utility companies, adjacent property owners, road users, special interest groups, environmental agencies, bike/ped/transit, etc.

ENVIRONMENTAL ANALYSIS

EVALUATION OF TRAFFIC NOISE POLLUTION IN HYDERABAD CITY, TELANGANA STATE

NOISE LEVELS

Hyderabad is Second Highest after Chennai in Noise Levels in South India according to the study conducted by CSE. Noise pollution is rising alarmingly. According to the TSPCB the noise levels recorded in Hyderabad was 80 .66 db. The standard limit will be 65db. Panjagutta cross roads said to be the nosiest area in Hyderabad. Next to it is the paradise junction, Charminar, and Abids. As far as noise pollution is concerned, the monitoring is done mainly during festivals such as Diwali. A few SPCBs and PCCs have initiated regular noise monitoring since 2008-09. As per available data, the laid down noise norms for respective zones (Industrial, Commercial, Residential or Silence) are exceeded at many locations. However, a definite trend cannot be ascertained for major cities, including Hyderabad, since data is available only for a limited period. The practice of exploding sound emitting firecrackers on religious occasions & weddings, playing of bands during processions, blowing of horns, operation of generator sets, movement of traffic (highways, railways and airways), use of public address systems, construction activities and operation of generator sets increase the ambient noise levels in urban areas.

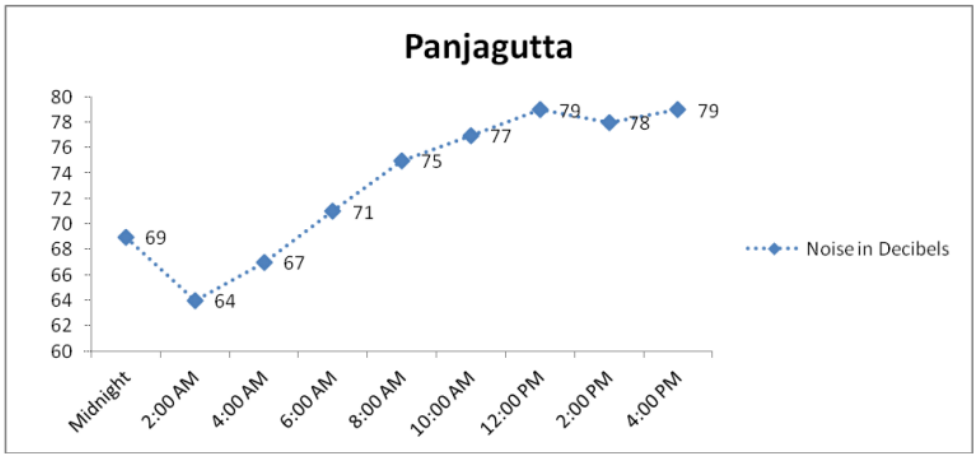
The Andhra Pradesh Pollution Control Board is monitoring ambient noise levels at six different places in Hyderabad city and the average noise levels are exceeding the limits at all the places. Noise pollution is above prescribed norms in city. Noise pollution in the city is touching a new peak, with both commercial and sensitive areas recording levels above the prescribed norms. Among the major centers monitored by the Telangana State Pollution Control Board (TSPCB), Panjagutta crossroads continues to remain as the noisiest area in the city. According to a six-month data collected by TSPCB, the average decibel level recorded till September 2017 was 80.66 against the standard limit of 65 dB. Similarly, the peak noise value at the junction rose to an average of 86.26 dB i.e., over 20 dB more than the standard. The busy Paradise junction in Secunderabad follows suit with the average noise level accounting to 80.49 dB with the peak noise value average at 86 dB and Charminar with 80.40 dB average and a peak noise level average of 85.96 dB.

Charminar	80.40 db	85.96 db	65 db
Abids	80.24 db	85.26 db	65 db
Sensitive Areas			
Zoo Park	67.70 db	73.30 db	50 db
KBR Park	69.40 db	74.73 db	50 db

Current Noise Levels in Hyderabad			
Commercial areas	**Average**	**Peak Noise Level Average**	**Permissible limit level**
Panjagutta	80.66 db	86..26 db	65 db
Paradise	80.49 db	86 db	65 db

BUSIEST JUNCTIONS

Surprisingly Abids, one of the busiest junctions in the city has fallen behind Panjagutta, Paradise and Charminar as far as noise pollution is considered. The popular shopping destination averaged at 80.24 dB with the peak noise value at an average of 85.26 dB. Even at sensitive areas like Zoo Park in Old City and KBR Park at Jubilee Hills recorded noise levels above the standard limit of 50 db. While noise level at Zoo Park stands at an average of 67.70 dB (peak average: 73.30 dB) the level at KBR Park stands at 69.40 dB with the peak noise value averaging at 74.73 dB.



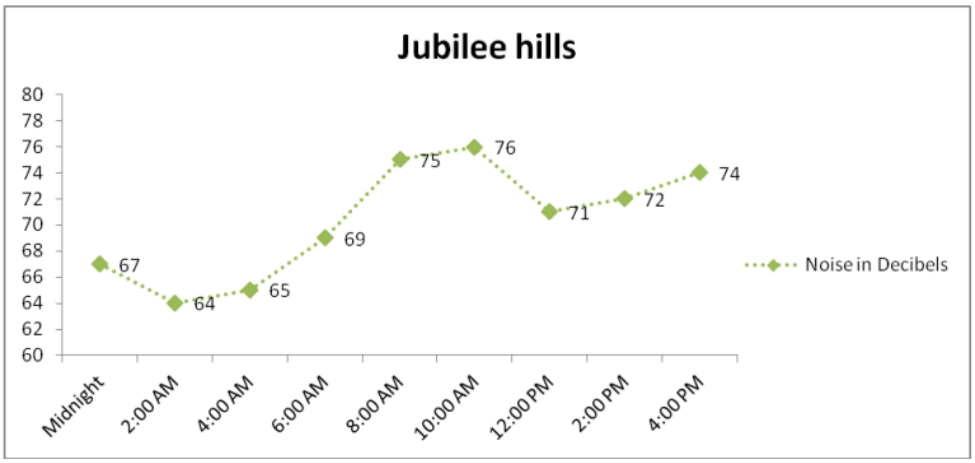
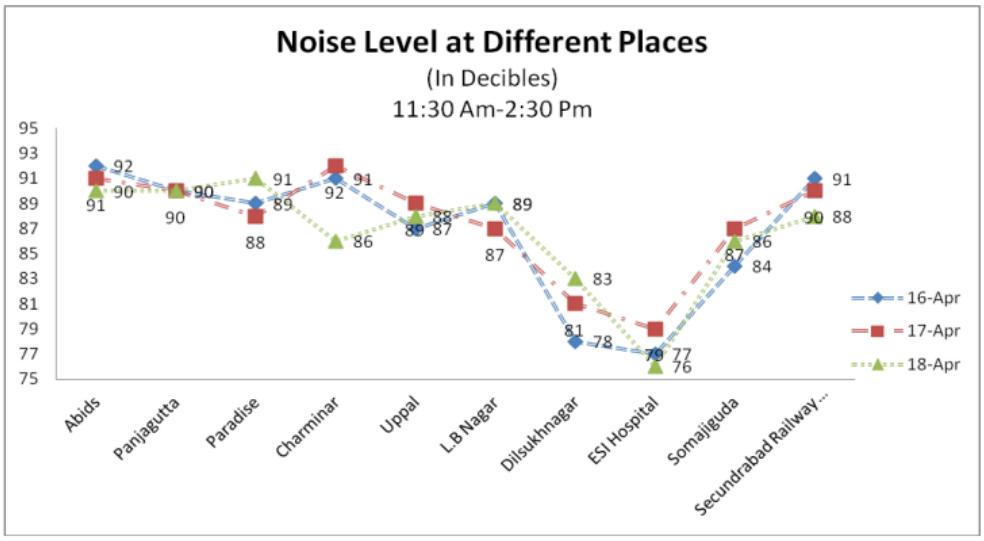
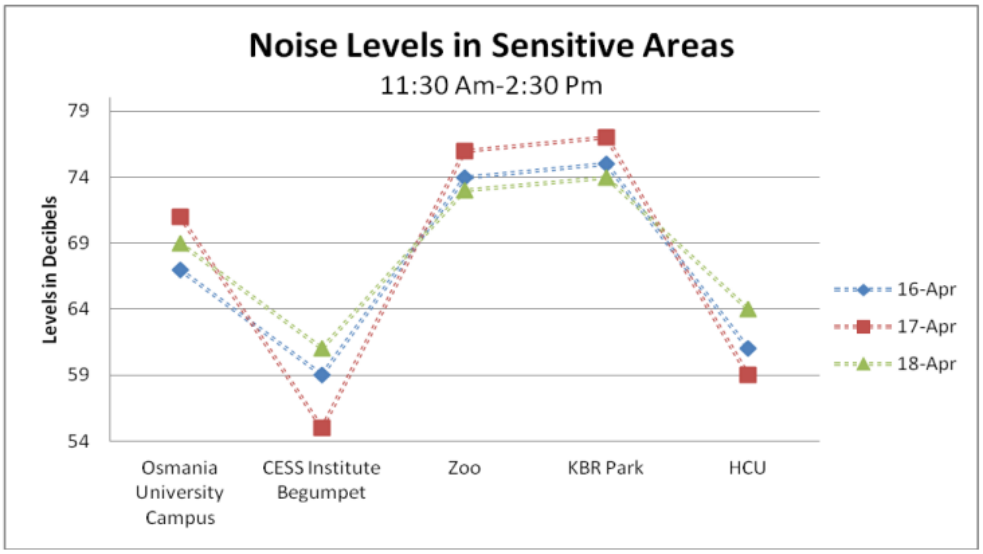


Fig: Evaluation of Traffic Noise Pollution in Hyderabad City, Telangana State





The city is fast becoming a concrete jungle of chaos and cacophony. An endless stream of private vehicles, honking buses and heavy vehicles and mushrooming two-wheelers. All leading to traffic snarls and adding to the load of air and noise pollution. Like most metros, Hyderabad, once known for its salubrious climate, is fast becoming a concrete jungle of chaos and cacophony. Evaluation of Traffic Noise Pollution in Hyderabad City, Telangana State.

OBSERVATION: NOISE LEVELS ARE RISING AND ARE WELL ABOVE THE STIPULATED LIMITS

The measurements taken in the busy areas of Panjagutta, Abids and Paradise hover around 90 dB. Sometimes, they even touch 92 dB against the prescribed limit of 65 dB for commercial zones. Even the minimum documented noise levels at these centers stay put at 70 dB, clearly way above the acceptable limits. Officials of the Andhra Pradesh Pollution Control Board (APPCB) say that the rising noise levels have a deleterious effect on the health of the citizens leading to hypertension, irritation, dizziness, and trauma and skin disorders apart from

possibilities of causing cardio-vascular ailments. Civic bodies like the Hyderabad Metropolitan Development Authority and Greater Hyderabad Municipal Corporation which have to earmark schools, hospitals and courts as ‘Silence Zones' and take ‘measures for abatement of noise', have done precious little. The traffic police, who are expected to act on the noise levels, have not equipped themselves with the paraphernalia such as noise meters. Nor are their personnel trained in measuring noise levels. Thus, a center such as Panjagutta, with the Nizam's Institute of Medical Sciences nearby, if declared as a ‘Silence Zone', should not have the noise level crossing 50 dB. But the facts are otherwise. The noise level here is a dizzying 90 dB.

HEALTH ANALYSIS

From a health perspective, noises over the 60 decibels prove to be very harmful.

The consequences of such noises may be classified by two types

i. Direct
ii. Indirect

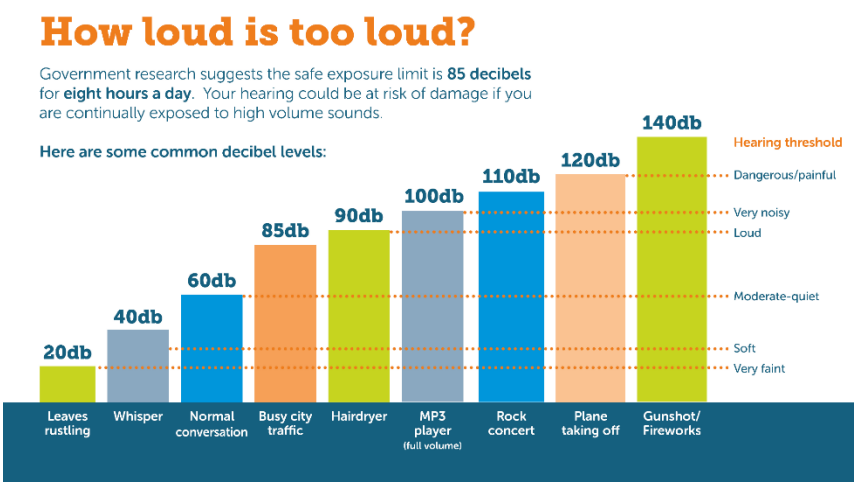
DIRECT CONSEQUENCES

The adverse health effects of noise are auditory disorders such as hearing impairment, tinnitus, ear ache, noise-induced hearing loss, and non-auditory manifestations which include headache, psychological disturbances manifested by irritability, inability to concentrate on one's work thereby reducing work efficiency, disturbance in sleep and rest, and interference with speech communication.

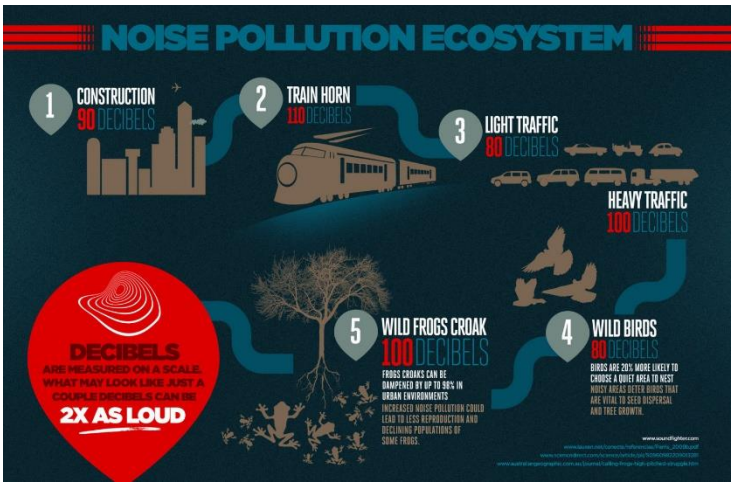
Hearing impairment has been defined as an increase in the threshold of hearing. The affected person is unable to understand speech in day-to-day life. Noise-induced hearing impairment mainly occurs in the frequency range of 3,000-6,000 Hz, and with increased exposure, at lower frequencies. Speech intelligibility can be reduced even at 10 dB, averaged over 2,000-4,000 Hz, over both ears. Above 30 dB hearing impairment (averaged over 2,000-4,000 Hz, over both ears), a social hearing handicap is noticeable. Significant hearing impairment occurs on exposure to prolonged exposure to noise levels of 70-85 dB.

Noise-induced hearing loss has been scientifically established as an adverse health effect of noise. In temporary hearing loss, the hearing threshold is elevated temporarily, known as temporary threshold shift. With chronic exposure, permanent threshold shift occurs. In this case, hearing loss becomes permanent due to irreversible damage to the sensory cells of the cochlea. Noise-induced hearing loss usually first affects the hearing threshold at high frequencies above the range of speech perception at around 4 kHz. Hence, it is often not noticed till it becomes severe.The susceptibility of an individual to develop noise-induced hearing loss varies greatly.

Therefore, it is difficult to predict the extent of hearing loss a person will acquire when exposed to a certain noise.



Noise-induced hearing loss was estimated among automobile drivers, traffic police, roadside hawkers, shop keepers, and garment workers in Bangladesh. More than two-thirds of the participants were unaware of their hearing impairment and 78% had poor knowledge about the adverse effects of noise on health. Tinnitus and hearing loss were reported by traffic policemen, in a study conducted in Bangladesh. Hearing loss was associated with the duration of exposure. With exposure time of 6-10 years, 20% had mild sensori-neural hearing loss and those exposed for 11-20 years, 28% had mild to moderate sensori-neural hearing loss. Noise-induced hearing loss was also detected on audiometric tests among traffic personnel in Malaysia.



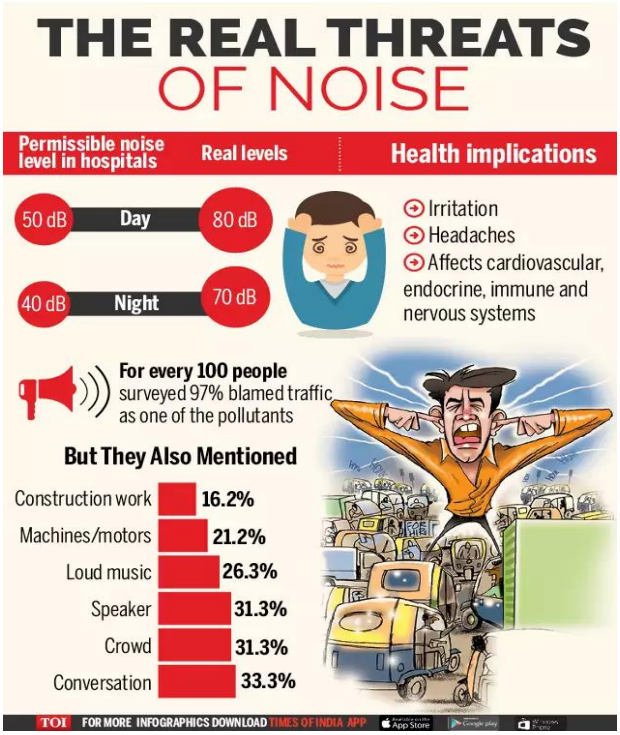
Auditory morbidity is a serious issue which should not be neglected. It can lead to miscommunication, accidents, loss of livelihood, etc. It can be prevented or greatly reduced by periodic audiometric check-ups, ear protection, and awareness training.

INDIRECT CONSEQUENCES

A primary psychological response to noise is annoyance. At a noise level of 50 dB, an adult can get moderately annoyed, and around 55 dB, seriously annoyed. In a study across Europe, the relation between noise annoyance and medically diagnosed illness was assessed. People who were annoyed by neighborhood noise over a long time were found to be at higher risk for cardiovascular disease, depression, and migraine. People who were persistently annoyed by traffic noise were found to be at higher risk for respiratory health problems. Lower risk of annoyance-induced illness in older persons was suggested to be due to being concealed by

senility. Emotional stress triggered by noise was suggested to play a role in the respiratory problems in children.

A study conducted in Orissa found that, though people experienced noise-induced symptoms such as headache, bad temper, hearing problem, loss of concentration, and sleep disturbance, they were unaware of the ill-effects of noise on health.Noise pollution creates negative emotions of annoyance in the people. Residents living near roadways reported frequent irritation (52%), hypertension (46%), and loss of sleep (48.6%) due to noise pollution. Sleep is disturbed when indoor noise levels are above 30 dB, and 45 dB for sleeping outdoors. After-effects of sleep disturbance include headache and inability to concentrate in one's work and irritability.



As much as the indirect consequences indicate, noise has always been a major inconvenience. Apart from the direct and indirect consequences of noise pollution that gives rise to new health concerns, these majorly trigger underlying diseases. Especially in residential areas where a decent amount of elderly has chronic ailments like heart disease, blood pressure etc., vehicles violating the sound threshold of 60dB can trigger these conditions which will eventually have an adverse effect.

TARGET AREAS

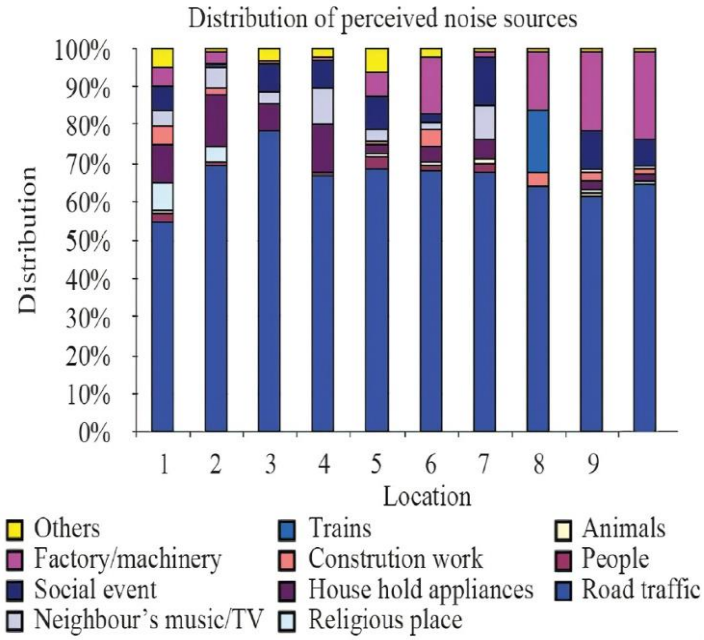
The target areas for this device have been selected based on the level of impact and exigency of the situation.

This can be divided into two categories:

a) Sensitive areas

b) Residential areas

SENSITIVE AREAS

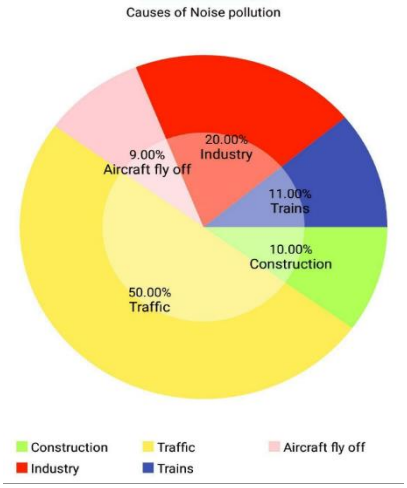


Sensitive areas comprise of schools, colleges, universities, hospitals, medical institutions etc. and residential areas comprise of colonies and gated communities. These areas have been targeted because of several reasons,

a) Highest impact of disturbance through vehicular noise

b) Device can work more accurately since lesser frequency of vehicles

c) Device's impact can be conveniently monitored



In addition to this, sensitive areas that are called 'Silent Areas' which consist of educational institutions and hospitals fit as perfect target areas for this device. Statistics have shown that these areas have recorded higher decibel levels and are a huge inconvenience.

With decibel levels in the city increasing rapidly, sensitive zones are falling prey to noise pollution. Statistics with the Pollution Control Board show that sound produced in some commercial and sensitive zones are higher than permissible levels. Noise monitoring systems in Hyderabad are located at commercial zones of Abids and Punjagutta, Jeedimetla industrial zone, the silence zone at Zoo Park, Gachibowli and Jubilee Hills' residential zone. According to the Central

Pollution Control Board (CPCB), the biggest contributors to ambient noise pollution across India, including Hyderabad are Industries, Transport vehicles, construction activities and firecrackers. Most of them emit noise in those sensitive areas.

Even the minimum documented noise levels at these centres stay put at 70 dB, clearly way above the acceptable limits. Officials of the Andhra Pradesh Pollution Control Board (APPCB) say that the rising noise levels have a deleterious effect on the health of the citizens leading to hypertension, irritation, dizziness, trauma and skin disorders apart from possibilities of causing cardio-vascular ailments.

The Andhra Pradesh Pollution Control Board's job seemingly ends with monitoring the noise levels and, under 'The Noise Pollution (Regulation and Control) Rules issued in the year 2000', the local municipal body and the government should enforce them. But, as is clearly evident, controlling the daily din is not being touched upon.

Civic bodies like the Hyderabad Metropolitan Development Authority and Greater Hyderabad Municipal Corporation which have to earmark schools, hospitals and courts as 'Silence Zones' and take 'measures for abatement of noise', have done precious little. The traffic police, who are expected to act on the noise levels, have not equipped themselves with the paraphernalia such as noise meters. Nor are their personnel trained in measuring noise levels.

Thus, a center such as Punjagutta, with the Nizam's Institute of Medical Sciences nearby, if declared as a 'Silence Zone', should not have the noise level crossing 50 dB. But the facts are otherwise. The noise level here is a dizzying 90 dB.

When Sound Trap is placed in one of these, not only will it ease the inconvenience due to vehicular noise, but a fairly large number of perpetrators can be tracked and fined increasing the awareness of this issue. Important activities taking place in these hospitals will be carried out more peacefully with less disturbances and can reduce risks of many noises associated issues.

Educational institutions are one of the prime target areas for the implementation of this device because disturbances while studying can have a major impact among all the students. It is quite relatable that whenever construction work goes on near a school, all the classes face a lot of disturbance and studies are impacted a great deal. Moreover, after proper implementation of this device, the students can get educated at an early stage of the importance of curbing noise pollution and its consequences.

RESIDENTIAL AREAS

Residential areas are the primary concerns where this device can have a significant amount of impact with near to no limitations. The impact here is considered high because residential areas have all age groups which are relatively more susceptible to the dangers of noise pollution when compared to traffic junctions and market areas. Be it colonies or gated communities, a mere thump of a modified Royal Enfield would be risky enough to perplex an elderly with a heart condition or an infant sleeping peacefully. Accuracy is comparatively higher because the majority of lanes can't have more than 3 vehicles commuting at the same time which can aid in accurately detecting the perpetrator. Thus, residential areas cover the impact and exigency factors making it a suitable target area.

Post implementation, based on the results of earlier stages of implementation- there is a possibility of increasing the scope of target areas. These target areas summaries the importance of the device and impact it brings onto the community. Cities will be a lot more peaceful if these target areas are free of noise pollution. Knowing the consequences of this implementation, the perpetrator will be comparatively more aware and decrease the use of components in their vehicles that would cause such noise which eventually results in lower noises even in the non-target areas like signals and junctions.

ACKNOWLEDGEMENTS

The following delegates and stakeholders participated in the consultation meeting:

Hyderabad State Police Department

www.hyderabadpolice.gov.in

WE HUB

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Women Entrepreneurs Hub (WE Hub) was announced in 2018 by the Government of Telangana, with the vision to create a best practice model in Incubation dedicated to Women Entrepreneurs in India.

WE Hub promotes and fosters women entrepreneurship by way of Incubation, Access to government and by building a collaborative ecosystem. WE Hub provides access totechnical, financial, government and policy support required to start-up, scale up and accelerate with global market access, to all women entrepreneurs in the country. The overall mandate and goal of WE Hub is to eliminate financial, societal and support barriers for women and help them succeed in theirenterprises.

The approach at WE Hub lies in unlocking the potential of women entrepreneurship in India to include a level playing field for the high-impact, employment-creating entrepreneurs through Acceleration programs, Enable the willing, middle—the ambitious solopreneurs and small business owners—to scale and become high-impact entrepreneurs through Incubation programs; Expand the funnel to get more women to start enterprises and build, strengthen and scale productive enterprises through Pre-incubation programs.

www.wehub.telangana.gov.in

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