Analysis of Noise Pollution Hotspot in and Around Kumbakonam using QGIS

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***Abstract*—Project focuses on the monitoring of community noise pollution in some selected area of in and around kumbakonam zone. The objectives of our project were to monitor and to assess the existing noise levels at the selected sites. A Lutran SL-4012 sound level meter used in the measurements. The measurements were taken for 24–hours in the residential area Annai anjugam nagar kumbakonam, silent zone nearest Palakarai kumbakonam, commercial area Bigstreet kumbakonam, Industrial area Thirubhuvanam near kumbakonam. The Equivalent Continuous Sound Level (Leq), minimum noise level, average noise level and maximum noise level were measured to assist in assessing the existing noise levels at the selected sites. Results showed that the monitored noise levels in terms of Leq, in commercial area ranged between 87.9 dB(A) to 72.5 dB(A) , industrial area ranged between 73.4 dB(A) to 57.3 dB(A), residential area ranged between 64.9 dB(A) to 51.2 dB(A) and in the silent zone ranged between 56.2dB(A) to 50.7 dB(A). These levels exceeded in commercial, residential, silent zone the level recommended by the World Health Organization. The industrial area is less in compare to the level recommended by the World Health Organization. The noise pollution dB(A) readings are also plotted by graph format. These noise levels cause sleeping disturbance, interfere with speech communication and message extraction. The main causes of such noise levels are related to transportation system, motor vehicles and traffic supported by poor urban planning. To reduce such noise levels by using noise insulating materials and create peaceful environment by advertised to using noise cancellation instrument.**

Keywords : Monitoring , Lutran SL-4012 Sound Level Meter, Commercial Area, Industrial Area, Residential Area, Silent Zone.

I. INTRODUCTION

Noise is playing an ever-increasing role in our lives and seems a regrettable but ultimately avoidable corollary of current technology. The trend toward the use of more automated equipment, sports and pleasure craft, high-wattage stereo, larger construction machinery, and the increasing numbers of ground vehicles and aircraft has created a gradual acceptance of noise as a natural byproduct of progress. Indeed, prior to 1972 the only major federal activity in noise control legislation was a 1968 amendment to the Federal Aviation Act, whereby the FAA was directed to regulate civil aircraft noise during landings and takeoffs, including sonic booms. Nevertheless, various noise-monitoring studies and sociological surveys in recent years have indicated the need for noise abatement. Noise pollution is thus another environmental pollutant to be formally recognized as a genuine threat to human health and the quality of life. The fundamental insight we have gained is that noise may be considered a contaminant of the atmosphere just as definitely as a particulate or a gaseous contaminant. There is evidence that, at a minimum, noise can impair efficiency, adversely affect health, and increase accident rates. At sufficiently high levels, noise can damage hearing immediately. Several organizations such as World Health Organization, International Labour Organization (ILO) and Occupational Safety and Health Administration (OSHA) have setup new standards for noise and take appropriate actions against their sources. As a result of continuous hard work, standards for noise pollution level in various work places during various times were developed.

Table 1. Noise standards developed by CPCB, WHO, ILO and OSHA organization

S.NO	AREA CODE	CATEGORY OF AREA/ZONE	Limits of Leq dB(A)	
			DAY TIME	NIGHT TIME
1	A	Industrial area	75	70
2	B	Commercial area	65	55
3	C	Residential area	55	45
4	D	Silence Zone	50	40

II. STANDARDS

The Noise Control Act of 1972 became Public Law PL 92574 in October of that year. Under the Act, the Environmental Pollution Agency (EPA) had to develop criteria identifying the effects of noise on public health and welfare in all possible noise environments and to specify the noise reduction necessary for protection with an adequate margin of safety. The EPA's basic "Identification of Levels" document (3) was published in March 1974 and it concluded that virtually all of the population is protected against lifetime hearing loss when annual exposure to noise, averaged on a 24-h daily level, is less than or equal to 70 A-weighted decibels (dB(A)) (See Section 6 for discussion on A-weighted decibels.) This noise-level goal forms the initial base of the long-range federal program designed to prevent the occurrence of noise levels associated with the adverse effect on public health and welfare. Even so, noise levels in excess of 55 dB (A) can cause annoyance. The federal government's regulatory development and related activity is aimed at the nnoyance-type noises that pervade the community. These noises in the approximate order of importance, especially to urban communities, are (1) surface transportation noise, (2) aircraft noise, (3) construction equipment and industrial noise, and (4) residential noise. Although states and municipalities retain primary responsibility for noise control, they often rely on EPA recommended limits of noise levels and exposures. Presently, industry is governed by noise regulations adopted by OSHA (Occupational Safety and Health Administration), which sets noise exposure limits at an employee's location for environments of steady noise, mixed noise, and impact noise. For steady noise (i.e., noise at a constant dB (A) level over a period of time), a maximum exposure of 90 dB (A) (about the sound level emitted from a loud engine) for an 8-h day is prescribed, with a halving of exposure time for each additional 5-dB (A) increment.

III. MEASUREMENT

In contrast to community noises, there are industrial noises within factories, workshops, and so forth that must be monitored in order to determine compliance with OSHA noise regulations. Such acoustical measurements are meant to evaluate employee exposure to work-related noises and require different measuring techniques. Measurement accuracy is ensured, acoustical instruments such as sound-level meters and dosimeters must be calibrated regularly. Calibration is required by OSHA before and after each day of use. If measurements are continuous over a period of hours, periodic checks on calibration are recommended. These calibration checks are necessary to obtain valid data. Calibrators called pistonphones are available that allow a rapid field calibration of acoustical instruments. Also, when purchasing instruments, it is worthwhile to ensure that the instruments are amenable to field calibration. Having to return an instrument to the factory for calibration can be time-consuming and expensive. Hearing conservation programs to monitor sound responses of employees are also part of the noise measurement program. Hearing tests are performed on employees with the aid of an audiometer.

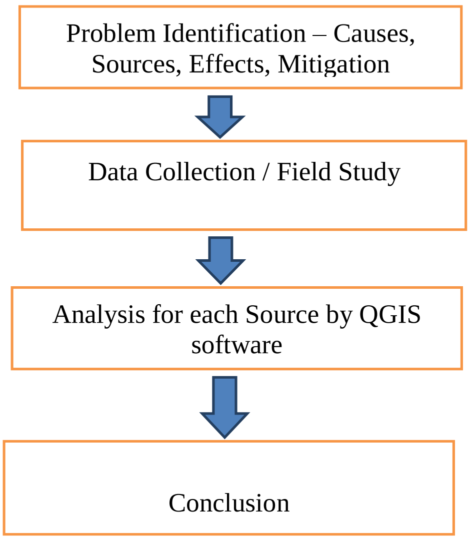
In order that noise measurements are valid for legal purposes, they and the devices that make these measurements must meet certain standards that were developed by the American National Standards Institute (ANSI). Indeed, if action against an alleged violation is contemplated, meter and recorder construction, calibration, and use must conform strictly to ANSI standards; if not, the quality and validity of the tests and data will come into question. In the above paragraphs, we have tried to present some of the more salient features of noise measurement and instrumentation.

Figure 1. Lutran sl-4012 sound level meter

III. METHODOLOGY

The methodology adopted includes a study of existing condition, real- time work made to explore the general system followed in the noise pollution mitigation measure.

Table 2. Methodology



IV. EQUIPMENT DETAILS

The noise level at all locations were measured with the help of **LUTRAN SL-4012** Sound level meter with **AUTO-RANGE AND RS-232C** is as shown in figure below.

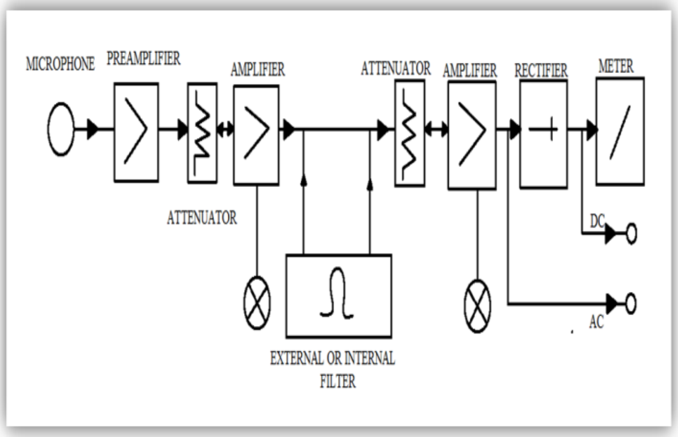


Figure 2. Block diagram of the sound level meter

A. SPECIFICATIONS

Display : 52 mm x 32 mm LCD (Liquid crystal display), 5 digits with annunciator

Function : dB (A & C frequency weighting), Time weighting (Fast, Slow), Hold, Memory (Max. & Min.), Max. hold, AC output, RS232 output

Measurement range : 30 - 130 dB

Resolution : 0,1 dB

Range selector : Auto range

Manual range : 3 range, 30 to 80 dB,

Frequency : 31,5 to 8.000 Hz

Microphone type : Electric condenser microphone

Microphone size : Out size, 12.7 mm DIA. (0.5 inch)

Calibrator : B&K (Bruel & Kjaer) multifunction acoustic calibrator 4226

Output Signal :AC output: AC 0.5 Vrms corresponding to each range step Output impedance - 600 ohm RS232. output Terminal 1: RS232 computer interface terminal, photo couple

Output terminal : isolated Terminal 2: AC output terminal Terminal socket size: 3.5 mm dia. phone socket

Calibration VR :Build in external calibration VR, easy to calibrate on 94 dB level by screw driver

Operating Temperature : 0 to 50°C (32 to 122°F)

Operating humidity : less than 80%RH

Power Consumption : approx. DC 6 mA

Dimension : 268 x 68 x 29 mm Weight : 285 gr. (0,63 lb)

Accessory included : Instruction Manual

Optional Accessories : 94 dB Sound Calibrator

V. NOISE POLLUTION OBSERVATION AND CALCULATION

A. COMMERCIAL AREA

Noise levels were recorded at BIGSTREET (**COMMERCIAL AREA**) in kumbakonam, Tamil Nadu, India. The noise levels were recorded from morning (04.02.2017) 06.00 AM to (05.02.2017) 05.45 AM at Saturday to Sunday through the location. Noise measurements were taken at distances of 1 m from nearest road border. The height of noise measurement was 1m above the road surface. . The continuous noise level in commercial area is calculated by the following equation

L_{eq} = 10log[1/(t2-t1) {$^{t2}{}_{t1}$ $P^2{}_A$ / $P^2{}_0$ dt]

L_{eq}(Day time) = 87.9 dB(A)

L_{eq}(Night time) = 72.5 dB(A)

B. INDUSTRIAL AREA

Noise levels were recorded at THIRUBHUVANAM (**INDUSTRIAL AREA**) near kumbakonam, Tamil Nadu, India. The noise levels were recorded from morning (06.02.2017) 06.00 AM to (07.02.2017) 05.45 AM at Monday to Tuesday through the location. Noise measurements were taken at distances of 3 m from nearest road border. The height of noise measurement was 1m above the road surface. . The continuous noise level in an industrial area is calculated by the following equation

L_{eq} = 10log[1/(t2-t1) {$^{t2}{}_{t1}$ $P^2{}_A$ / $P^2{}_0$ dt]

L_{eq} (Day time) = 73.4 dB(A)

L_{eq}(Night time) = 57.3 dB(A)

C. RESIDENTIAL AREA

Noise levels were recorded at ANNAI ANJUGAM NAGAR (**RESIDENCIAL AREA**) in kumbakonam, Tamil Nadu, India. The noise levels were recorded from morning (02.02.2017) 06.00 AM to (03.02.2017) 05.45 AM at Thursday to Friday through the location. Noise measurements were taken at distances of 1 m from nearest road border. The height of noise measurement was 1m above the road surface. The continuous noise level in residential area is calculated by the following equation

L_{eq} = 10log[1/(t2-t1) {$^{t2}{}_{t1}$ $P^2{}_A$ / $P^2{}_0$ dt]

L_{eq} (Day time) = 64.9 dB(A)

L_{eq}(Night time) =51.2 dB(A)

D. SILENT ZONE

Noise levels were recorded at near PALAKARAI government hospital **SILENT ZONE** in kumbakonam, Tamil Nadu, India. The noise levels were recorded from morning (03.02.2017) 06.00 AM to(04.02.2017) 05.45 AM at Friday to Saturday through the location. Noise measurements were taken at distances of 10 m from nearest road border The height of noise measurement was 1m above the road surface. . The continuous noise level in silent zone is calculated by the following equation

$$L_{eq} = 10\log[1/(t2-t1)\ \{^{t2}_{t1} P^2_A / P^2_0\ dt]$$

$$L_{eq}\ (\text{Day time}) = 50.7\ dB(A)$$

$$L_{eq}(\text{Night time}) = 56.2\ dB(A)$$

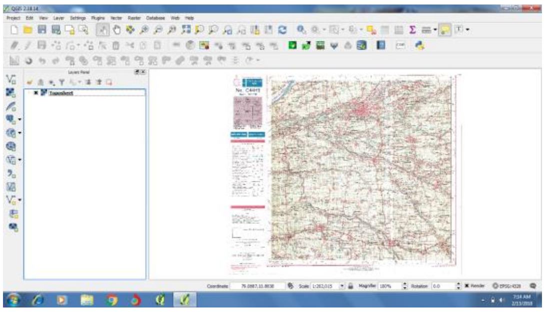


Figure 3. Kumbakonam Toposheet in QGIS

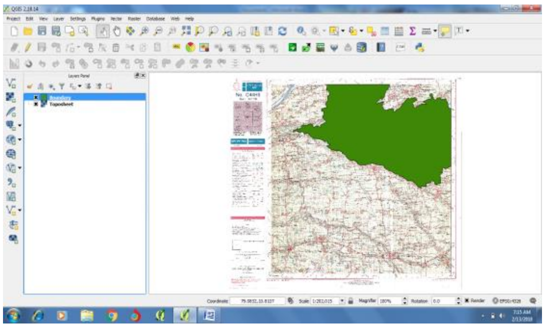


Figure 4. Digitizing Kumbakonam Taluk Boundary

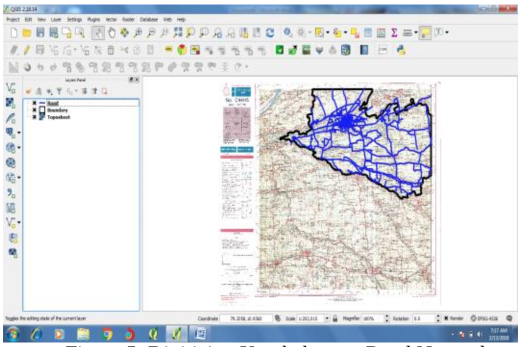


Figure 5. Digitizing Kumbakonam Road Network

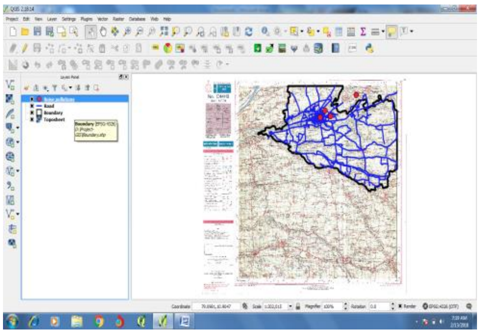


Figure 6. Digitizing Noise Pollution Area in QGIS

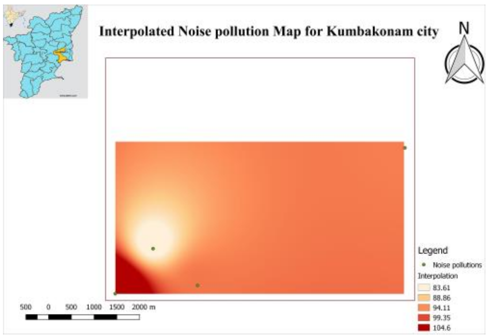


Figure 7. Noise Pollution – HOTSPOT

VI. CONCLUSION

The Results showed that the monitored noise levels in terms of Leq, in commercial area ranged between 87.9 dB(A) to 72.5 dB(A) , industrial area ranged between 73.4 dB(A) to 57.3 dB(A), residential area ranged between 64.9 dB(A) to 51.2 dB(A) and in the silent zone ranged between 56.2dB(A) to 50.7 dB(A). These noise levels exceeded in commercial, residential, silent zone the level recommended by the World Health Organization. The industrial area is less in compare to the level recommended by the World Health Organization. So we give solution to reduce such noise levels by using noise insulating materials and create peaceful environment by advertised to using noise cancellation instrument.

Table 2. Leq STANDARD VS ACTUAL VALUE

S.No.	**Category of Area/Zone**	**Limits of leq dB(A)**		**Actual leq dB(A)**	
		Day time	**Night time**	**Day time**	**Night time**
1	Residential	55	45	64.9	51.2
2	Silent	50	40	56.2	50.7
3	Commercial	65	55	87.9	72.5
4	Industrial	75	70	73.4	57.3

Table 3. NOISE POLLUTION MINIMUM, MAXIMUM dB(A) VALUE TO FREQUENCY (Hz)VALUE

Category of Area	**Minimum Value dB(A)**	**Minimum Value Hz**	**Maximum Value dB(A)**	**Maximum Value Hz**
Commercial	30.8	34.67369	123.7	1531087
Industrial	31.2	36.30781	95.2	57543.99
Residential	30.4	33.11311	95.8	61659.5
Silent	30.1	31.98895	79.6	9549.926

VII.SCOPE OF FUTURE WORK

To innovate the noise controlling equipment to control the noise level in exceeded places to prevent the harmful effects causing to humans, animals and birds to create the peaceful environment. Construct the building by using some noise insulating materials to prevent unwanted noise entered into the buildings

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