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Development of Anti-Honking Technology to Minimize Noise Pollution

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Abstract: **Transportation sector is one of the major contributors to the noise pollution in urban areas. The most important factors increasing noise pollution in urban areas are vehicular traffic, railway and air traffic. Increased noise levels induce stress, increase accident rates at workplace and stimulate aggression and other anti-social types of behavior. Honking is one of the major causes for noise pollution. This increase in noise pollution due to honking needs to be controlled effectively. We propose a method that can be implemented to reduce the impact of honking on noise pollution.**

***Index Terms*— Honking, Noise pollution, Traffic**

I. INTRODUCTION

Vehicular traffic contributes a lot to the total urban noise. Many cities in India have been facing serious noise pollution problems in the last few decades due to the growth in the number of vehicles, expansion of roads, industrialization and urbanization. Assessment of traffic noise pollution is not easy and changes with type and physical condition of vehicles, speed, honking and road geometry. Estimation of traffic noise is more difficult in India considering the diversity in traffic conditions including mixed vehicle types, congestion, road conditions, frequent honking and lack of traffic sense. Honking is a common occurrence, irrespective of road types and condition, traffic etc. Driving attitude that involves impatience, over accelerating, sudden braking, abiding traffic rules etc. may also increase honking. Therefore, there is a need to consider such factors in monitoring and assessment of traffic noise as well as planning of noise decreasing measures. The objective is to assess and quantify traffic noise and the impact of honking on it in the urban environment of Mumbai, India and then define ways and identify their efficiency in reducing noise pollution through honking.

The health significance of noise pollution[8] are noise-induced hearing impairment; interference with speech communication; disturbance of rest and sleep; psycho physiological, mental-health and performance effects; effects on residential behavior and annoyance; as well as interference with intended activities. Problems with concentration, fatigue, uncertainty and lack of self-confidence, irritation, misunderstandings, decreased working capacity, problems in human relations, and a number of stress reactions have also been identified.
Existing solutions to noise pollution[6] are

Solution 1: Creating silence zones near the hospitals and educational institutions in the city. This being an existing rule to reduce the disturbance to hospitals and educational institutions has also been able to reduce the noise levels in surrounding areas.

Solution 2: Using dipper lights at night instead of honking. This solution was proposed by RTO to increase the road safety as dipping the lights at night which flash in the driver's eyes has greater impact than honking. This solution also reduced the noise pollution through honking. These solutions minimize noise to a certain extent only.

Noise pollution monitoring report [6] done by Maharashtra Pollution Board Control is below:

Sr.	Monitoring Site	Date	Day Time (6AM-10PM) values in dB(A)					
A.	MUMBAI		L_{eq}	L_{max}	L_{min}	L_{10}	L_{50}	L_{90}
1.	Backside of High Court	15.12.2014	64.8	71.3	65.5	47.5	71.2	69.9
2.	Mumbadevi Temple	15.12.2014	56.3	70.8	41.5	41.6	66.8	57.1
3.	Borivali National Park	15.12.2014	64.8	89.0	48.6	37.3	87.9	69.4
4.	Antop Hill	15.12.2014	63.6	72.6	59.0	51.3	70.5	64.7
5.	Shivaji Park, Dadar	15.12.2014	68.3	83.2	59.2	49.7	80.9	74.2
6.	Santacruz Airport	15.12.2014	73.0	86.8	58.8	67.6	74.2	71.5
7.	Ghatkopar (W)	15.12.2014	60.7	82.1	50.4	40.0	79.6	63.2
8.	Vashi Naka, Chembur	15.12.2014	68.5	92.3	65.8	44.0	78.1	74.8
9.	Goregaon (E)	15.12.2014	67.1	89.9	57.2	45.1	82.9	69.5
10.	Charkop, Kandivali	15.12.2014	72.3	87.9	52.8	52.0	86.5	77.6

Fig.1. Noise pollution in Mumbai on 15th Dec, 2014

II. SYSTEM COMPOSITION

The anti-honking system basically consists of the following modules-GPS Receiver, SD-card reader, a microcontroller board, a system training module and a control module.

A. GPS Receiver

GPS use the satellite data to calculate an accurate position on earth. The display shows current position, a track of where the user has been and any user entered locations. The position reported by the receiver on the ground is a calculated position based on range-finding triangulation. GPS positioning is achieved by measuring the time taken for a signal to reach a receiver.

B. SD-Card

All the GPS co-ordinates are stored in the SD-card. The communication between the microcontroller and the SD card uses Serial Peripheral Interface Bus. Another pin must be used to select the SD card. This can be the hardware SS pin - pin 10 (on most Arduino boards) or pin 53 (on the Mega) - or another pin specified in the call to SD.begin().

C. Microcontroller Based Card (ARDUINO NANO/UNO/MEGA):

Arduino nano/uno/mega is used for the method depending on the number of input/output lines. The arduino used will receive an input from GPS about the co-ordinates of the different places mentioned above and these co-ordinates will be passed on to the SD-card module.

D. System traning module:

This part of the module is required for the starting process. The 2 keys of the keyboard are required to mark the start and stop of the acquisition of GPS co-ordinates. LCD display is required to display the location along with its co-ordinates. This information is stored in the SD-card module. This module may or may not be used while designing.

E. Control module:

This is the main module of our anti-honking system. This module is used to control the quality (frequency) and quantity (DB level) of the Horn applied. Places mentioned above require that the volume of the horn be low. So as soon as the vehicle reaches within 3m of the above mentioned places, the DB level of the horn has to reduce automatically. The time of the day also is taken into consideration whether it is day or night. Along with this, the other thing that can be controlled is the number of honkings. The GPS is also required to provide with the time for this consideration. The frequency of the horn (single tone/multi-tone) can also be controlled.

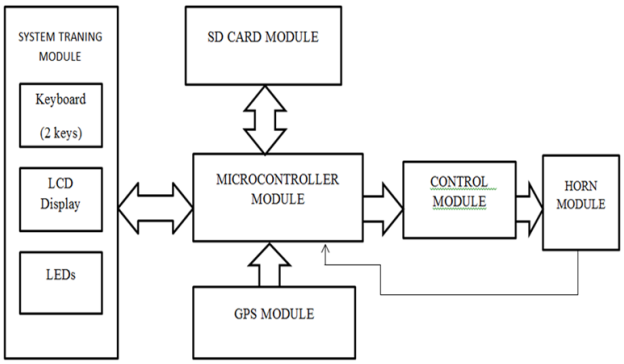

Fig. 2. System Composition

III. METHODOLOGY

The methodology of anti-honking technology consists of 2 parts- a system training module and a horn control module.

A. System Training Module

Training is to be provided to the system only at the initial stages. Acquisition of GPS Co-ordinates of the noise restricted areas in Mumbai is done at the first stage. NMEA data is obtained by Arduino module and is written to SD-Card. GPS communicates with arduino serially. The interface bus that can be used are RS-232, SPI, SCI, etc. GPS module interfaced is used to give information about noise restricted areas such as schools, hospitals, colleges, etc in and around Mumbai. LCD display and led's use may be optional.

B. Horn Control Module

The Horn control module is designed using fuzzy logic. We use the MATLAB Fuzzy Logic Toolbox for the control module. The Fuzzy Logic Toolbox provides a number of interactive tools that allow accessing many of the functions through a Graphical User Interface (GUI). Fuzzy Logic Toolbox allows to build these two types of systems:

1. Fuzzy Inference System (FIS) and
2. Adaptive Neuro-Fuzzy Inference System (ANFIS).

Fuzzy Inference [5] is the process of formulating the mapping from a given input to an output using fuzzy logic. Fuzzy inference system is composed of five functional blocks:

1. a rule base containing a number of fuzzy if-then rules;
2. a database which defines the membership functions of the fuzzy sets used in fuzzy rules.
3. a decision-making unit which performs the inference operations on the rules

4. a fuzzification interface which transforms the crisp inputs into degrees of match with linguistic values
5. a defuzzification interface which transform the fuzzy results of the inference into crisp outputs.

There are two types of fuzzy inference systems that can be implemented in the Fuzzy Logic Toolbox:
1. Mamdani-type and
2. Sugeno-type.

Mamdani's fuzzy inference method [5] is the most commonly used fuzzy methodology and it expects the output membership functions to be fuzzy sets and is the one we are using in our work. A membership function is a mathematical function which defines the degree of an element's membership in a fuzzy set. In our work we are using the Gaussian Membership Function. It is given by:

y = gaussmf(x,[sig c]) (1)

The rules are defined and a Fuzzy Rule Based System (FRBS) is created.The horn Decibel level is given as the input to the control unit. The sound level is evaluated whether it is too high for noise restricted areas, and thereby decibel level is reduced. The time of the day(day or night) is also given as an input so that at night time horn level is almost zero. Number of horns continuously pressed will lead to the horn level becoming nil.

III. CONCLUSION

Honking is a frequent phenomenon in Mumbai road context therefore it is observed that honking has significant impact on traffic noise other than traffic volume and vehicular speed. Thus we have proposed a model to reduce excessive honking and hope that it will contribute a bit to reduce noise pollution due to honking.

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Hyperlinks

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