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Artificial Neural Network Modelling of Traffic Noise in Agra - Firozabad Highway

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Abstract

The real commitment of the traffic clamor, towards in general commotion contamination situation, is an outstanding built up truth. Traffic clamor from thruways makes issues for encompassing territories, particularly when there are high traffic volumes and high speeds. Vehicular traffic clamor issue is contributed by different sorts of vehicles like overwhelming, medium trucks/transports, autos and bikes. Numerous western nations have created distinctive forecast models dependent on L10, Leq and different qualities. In India, the transportation part is developing quickly at over 7.50% per annum and number of vehicles on Agra - Firozabad Highway streets is expanding at an exceptionally quick rate. This has lead to stuffed streets and different sorts of contaminations. Among, commotion contamination is a critical sort which causes more irritation what's more, medical issues to the people. Along these lines, a need is being felt to build up a clamor forecast model appropriate for Indian street conditions. The aim of the paper was to assemble the models of sound weight level as an element of traffic power in avenue. The models were worked by utilizing counterfeit logical models or relapse trees. The previous included Nordic Prediction Method. The last were spoken to by Random Forest and Cubist. The examination of precision of all gotten models was directed. As well as can be expected be utilized during the time spent reproduction of comparable sound dimension information.

Keywords: Modeling, Traffic, Noise, Pollution, Nordic prediction method, random forest

I INTRODUCTION TRAFFIC INTENSITY AND SOUND

The dimension of street traffic clamor relies upon numerous parameters. Some of them are steady amid significant lot of time (street geometry, type and state of street surface), however different parameters, which are associated with traffic power, can change exceptionally quick: number of trucks, number of different vehicles, and normal vehicle speed.

Clamor can be characterized as the dimension of sound which surpasses the worthy dimension and makes inconvenience. Visit presentation to abnormal state of clamor causes serious weight on the sound-related and sensory system. Stretched out presentation to over the top sound has been demonstrated physical and mental harm.

In view of its inconvenience and unsettling influence suggestions, commotion adds to mental pressure and thus influences the general prosperity of those presented to it. Clamor is a noteworthy wellspring of grating among individuals. The significant wellsprings of commotion are Industrial clamor, Traffic clamor and Community clamor Out of over three parameters, the source that influences the most is Traffic clamor. In rush hour gridlock clamor, practically 70% of commotion is contributing by vehicle clamor. Vehicle clamor is made by motor and fumes arrangement of vehicles, streamlined rubbing, cooperation between the vehicle and street framework, and by the communication among vehicles. The significant concern is to study and advancement of a street traffic commotion demonstrates.

1.1 HARMFUL EFFECTS OF NOISE ON HUMAN BEINGS

Noise is considered a serious threat to the environmental health. Some of the adverse effects of noise pollution are given below:

1. It interferes with speech. In the presence of noise we may not able to follow, what the other person is saying.
2. Noise leads to emotional and behavioral stress. A person may feel disturbed in the presence of loud noise such as produced by heating of drums.
3. Noise may permanently damage hearing. A sudden loud noise can cause severe damage to the eardrum.
4. Noise increases the chances of occurrence of diseases such as headache, blood pressure, heart failure, etc.
5. Noise leads to increased heart beat, constriction of blood vessels and dilation of pupil.
6. Noise is a problem especially for patients who need rest.
7. Noise may cause damage to liver, brain and heart.

1.2 NOISE MEASUREMENT TECHNIQUES & INSTRUMENTS

Noise measuring devices typically use a sensor to receive the noise signals emanating from a source. The sensor, however, not only detects the noise from the source, but also any ambient background noise. Thus, measuring the value of the detected noise is inaccurate, as it includes the ambient background noise. Many different type of instruments are available to measure sound levels and the most widely used are sound level meters. (Fig. 1).

Figure.1 Sound Level Meter

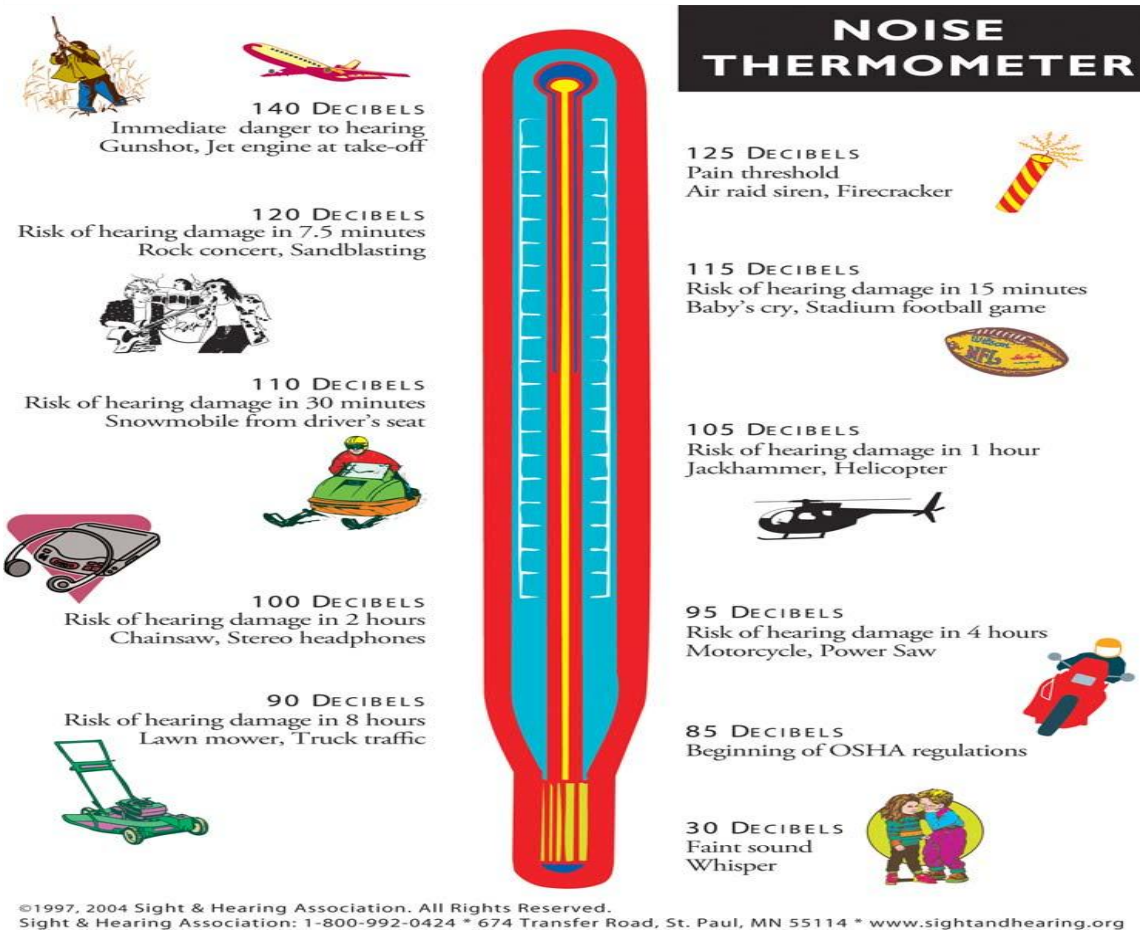

Figure 2 Comparative Sound Levels

II VEHICLE NOISE SOURCES

It is well established fact that vehicular traffic noise is a major source of community annoyance especially near highway carrying fast traffic. Many people consider the truck noise to be the principal offender. Numerous components of noise sources contribute to the overall truck noise. These sources, however, can logically be grouped into the major categories as under. 1. Power Plant and Transmission Noise Sources- engine, exhaust, intake, cooling system, drive train and so on, 2. Running gear Noise Sources – tyre road interaction, differential, propeller shaft. Noise from the power-plant increases as engine speed increases. While noise from tyre increases as vehicle speed increases. Trucks tend to operate at a nominally constant engine speed, so that engine and exhaust noise do not vary appreciably with vehicle speed. Therefore, at lower highway speeds the engine-exhaust noise is dominant, while at higher vehicle speeds tyre-pavement interaction becomes the dominant source of noise. The exact speed at which the tyre-roadway noise starts to dominate over the power-plant-

associated noise is a highly complicated function of such variables as tyre characteristics, engineexhaust characteristics, road surface, and vehicle design and condition. As a tyre rolls over a road surface, it displaces macroscopic and microscopic volumes of air. The 'macroscopic' applies to volume displacements of the same order as the volume of the tyre itself, and 'microscopic' applies to much smaller volumes. These air displacements generated pressure disturbances in the surrounding air. Pressure disturbances in the audio frequency range and of sufficient amplitude are responsible for the production of noise along the roadway.

2.2 EFFECTS OF VARIOUS FACTORS ON TRAFFIC NOISE

Rapidly changing population patterns on the national scene and developed public expectancy in terms of environmental effects have generated the requirement to furnish environmental impact statement is the noise that my result from the traffic noise is more complicated due to the facts that highways are not flat, straight or free from natural terrain variation. The factors like vehicle speed, density, traffic mix, width of median and number of lanes are not constant. Therefore, for traffic noise each of these parameters is taken into account.

2.3 NOISE PREDICTION MODELS Traffic noise prediction models are required as aids• in the design of highways and other roads and sometimes in the assessment of existing or envisaged changes in traffic noise conditions. They are commonly needed to predict sound pressure levels, specified in terms of (Leq)L10,etc., set by government authorities. Environmental laws require the Environmental• Impact Statement(EIS) to take into account the effect of the proposed noise on all existing and potential elements of the environment, not only statutory criteria. This calls for a variety of descriptors and criteria. Special descriptors are sometimes required for the assessment of complaints about road traffic noise.

III.DEVELOPMENT OF NOISE MODEL

3.1 Software Used

The software used for modelling vehicular noise is SPSS (version 20). SPSS (originally, Statistical Package for the Social Sciences, later modified to read Statistical Product and Service Solutions) is a comprehensive and flexible statistical analysis and data management solution. In this study, the data sheets from excel is imported to SPSS and is used for conducting multiple linear regression analysis.

3.2 Noise Model

Regression method is a statistical technique which can be used to find the relationship between a dependent variable and some independent variables. The equation derived using regression method is purely empirical in nature. In modelling the vehicular noise, A-weighted Equivalent Continuous Sound Level (L_{Aeq}) is the dependent variable and the independent variables are the percentage of each category of

vehicles, traffic volume and speed. The step by step procedure is given below. Before doing any complicated statistical analysis, it is important to know how each parameter are distributed. Therefore a scatter plot was drawn between L_{Aeq} and Volume, L_{Aeq} and Speed, L_{Aeq} and traffic composition. The scatter plot shows the relationship between L_{Aeq} and other independent variables. Next step is to develop the noise model. The collected data was divided into two parts in the ratio 1:5. 80% of the data was used for formulating the model and the remaining 20% was used for model validation. The model formulation was carried out using the software SPSS 20. The target variable is L_{Aeq} and the input variables were % of car, % of two wheelers, % of three wheelers, % of heavy vehicles, volume in PCU/min and speed in km/hr. By multiple linear regression analysis L_{Aeq} was calculated. Both forced method of variable entry and stepwise method of variable selection was chosen for regression analysis.

IV. SCOPE FOR FUTURE WORK

1. In this work, vehicle speed was measured using hand held speed radar gun. The speed of vehicles only in the measured direction was considered in this study. The results may be improved if the speed of vehicles plying the opposite direction is also considered.
2. All the measurements were taken at single location on seven week days. If different locations and timings are adopted, then better results can be obtained.
3. In the present work only three parameters like, total number of vehicles (Q), Vehicle speed (V), atmospheric temperature (Ta), Surface temperature (Ts) and relative humidity (H) are only considered in this study. If more parameters are included in the prediction and it may give better results.
4. In this study only two lane road is considered for the modeling. The noise predicting model for different category of roads with different lane widths may be more realistic.
5. In this study the stretch is selected without the presence of median. But now-a-days, the four laning and six laning works are carried out with sufficient medians. Hence the presence and width of median may be considered for further study.
6. This study is done for uninterrupted free flow traffic. But the nature of noise level may differ in an uninterrupted traffic flow condition. Hence that traffic flow condition may be considered in future study.
7. This study was carried in flexible pavement. The characteristics of noise will be totally different in rigid pavements. Hence it is wide open to explore the level of noise in rigid pavements.

V Conclusions

All models produced by Cubist and Random Forest are very accurate (mean absolute error below 0.6 dB and RMSE below 0.7 dB on the test set) and can be used in the process of reconstruction of missing equivalent sound level data. The models were elaborated for given thoroughfare and time of day, but the same methodology can be applied for other 24h sub-intervals and other roads.

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