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Research Article

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Development of traffic noise prediction model for major arterial roads of tier-II city of India (Surat) using artificial neural network

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Abstract: In the issue of expanding noise levels the world over, road traffic noise is main contributor. The investigation of street traffic noise in urban communities is a significant issue. Ample opportunity has already passed to understand the significance of noise appraisal through prediction models with the goal that assurance against street traffic noise can be actualized. Noise predictions models are utilized in an increasing range of decision-making applications. This study's main objective is to assess ambient noise levels at major arterial roads of Surat city, compare these with prescribed standards, and develop a noise prediction model for arterial roads using an Artificial Neural Network. The feed-forward back propagation method has been used to train the model. Models have been developed using the data of three roads separately, and one final model has also been developed using the data of all three roads. Among the prediction in three arterial roads, the predicted output result from the model of Adajan-Rander showed a better correlation with a mean squared error (MSE) of 0.789 and R² value of 0.707. But with the combined model, there is a slight deterioration in mean squared value (MSE) 1.550, with R² not getting changed much significantly, i.e., 0.755. However, the combined model's prediction can be adopted due to the variety of data used in its training.

Keywords: prediction model, arterial roads, road traffic noise, ANN

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1 Introduction

Noise arises from manmade activities, especially the expansion and improvement of transport and industry [1]. Road transport is an essential contributor to the economic development and growth of a country [2]. Road network plays a significant role in the development of a nation. But on the other hand, it creates a noisy environment and affects humans and the surrounding environment [3]. Road traffic noise is a combination of sounds from tire-pavement interaction, engine noise, aerodynamic and braking element, road surface, horn honking, tire rolling noise, acceleration, deceleration, etc. [4–7]. Noise is getting more and more omnipresent, yet a disregarded shape of infection even in advanced international locations.

Road traffic noise is the most comprehensive source of ambient outdoor noise pollution in Europe [8–10]. Arterial roads in a city play several roles within the suburb and are a fundamental element of the transportation network that carries a wide range of private and public vehicles [11].

Generally, road traffic, heavy vehicles, machinery, jet planes, building equipment, manufacturing processes, and lawnmowers are significant sources of these unwanted sounds regularly sent into the ambient environment [12]. Though noise pollution is a slow and indistinct killer, very less effort has been made to ameliorate. Along with other pollution types, it has become a hazard to life quality [13, 14]. Traffic noise significantly affects physical as well as mental health and labor productivity, and it is a significant source of noise in an urban environment [15].

The noise produced from the interaction of vehicular tires and the road surface is a main contributor to the total traffic noise [5, 16-18].

Noise may cause disturbance, disrupt sleep, hypertension, and hinder cognitive development in children [1, 14, 19, 20]. The effects of extreme noise could be so severe that there is a permanent loss of memory or a psychiatric disorder [21]. Hence, there are many adverse effects [9] of excessive noise or acute exposure to noise.



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Environmental noise predictions are helpful in increasing scope of decision-making applications, generally for assessments where a decision is to be made regarding the future change to an environmental noise field [19, 22, 23].

Traffic noise prediction models have a difference in parameters and may produce different noise level estimates depending on the geographical condition [8].

Mine and Sevtap developed a model which predicts the annoyance level due to road traffic noise. They considered social aspects, urban development, and traffic characteristics. These models provide cost-efficient action plans since they help understand the aspect that directly affect annoyance levels [24]. ANN model was competent in identifying the relations. The distance from the road's boundary is also the main contributing factor, whereas heavy-vehicle volume was unexpectedly found to be minimum [25]. Agarwal and Swami developed an experimental noise prediction model for evaluating equivalent noise levels (L_{eq}); in respect of equivalent traffic density number under diversified traffic flow conditions, the author concluded that traffic noise depends on traffic flow present on roads [26]. Rajakumara *et al.* developed an empirical traffic noise prediction model in the scattered traffic flow conditions. They concluded that road traffic noise is a significant concern of people living in road networks in urban areas. This study helps assess the environmental consequences of road traffic noise during interrupted traffic flow conditions in urban areas of Indian cities [7]. Sonaviya and Tandel developed correction factor applying a mathematical model for road traffic noise prediction for a interrupted traffic flow [27].

The prediction model can help to maintain the acoustic environment [28]. In this research work, artificial neural network technique has been used to expand a prediction model for fundamental arterial roads of Surat metropolis due to its abilities of mastering via examples with a wide variety and give short effects in contrast to other strategies.

This study's main objective is to assess ambient noise levels at major arterial roads of Surat city, compare these with prescribed standards, and develop a noise prediction model for arterial roads using ANN.

2 Material and methodology

The methodology followed for collecting field data such as traffic volume, traffic noise levels, vehicle spot speed, major arterial roads of Surat city, and instruments used in this study such as sound level meter, radar gun, and fieldwork has been narrated in subsequent sections.

2.1 Study area

For this research work. Surat city has been selected as the study area. Surat city is located in the western part of India in the state of Gujarat. The geographical location of Surat city is $210^{\circ}12'00.00"$ N and $72^{\circ}52'00.00"$ E near the bank of river Tapi. Surat is now the tenth-largest city of India, having an estimated population of 5million. The city is connected by road, rail and air transport. Some National and State Highways pass through the edge of the city. Thus, traffic coming to and as going through the city is very high. The city transportation framework is dominatingly road

Three arterial roads have been selected for the detailed survey based on the land use alongside the roads of Surat city. Amongst the selected roads, one is Athwa-Dumas road, one of the busiest roads in Surat. Many multi-story buildings, shopping complexes, restaurants are there alongside the road. It also connects the Surat airport to the city. The second is Adajan-Rander road. It is also an important arterial road that connects different villages and main centers in the city. The third one is Udhna-Sachin road; this is also an important road that connects to the city with the industrial hub Sachin. Hence, this road consistently contains high noise levels even in the off-peak hours because of the industrial activities.

2.2 Selection of location

While selecting the study location, some points are considered. The sampling point should not be near the intersection, the monitoring point should be selected at a straight stretch of road, and the traffic flow should be uninterrupted. Monitoring points should be far from public places like schools, colleges, courts, hospitals, etc.

2.3 Traffic noise measurement

Noise level readings were collected for each minute interval for a continuous 24 hrs. ($L_{ea,24hrs.}$) by using the Larson & Davis System 824 sophisticated sound level meter (SLM 824) and real-time analyzer. It has versatile capabilities with a rugged and user-friendly package. The sound level meter was held at about 1.5 meters above the ground near the road's edge.

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2.4 Traffic characteristics and geometrical dimensions of road measurement

It comprises traffic flow conditions, traffic volume, and average spot speed of vehicles. Handycam was used for recording the videos continuously for 24 hrs. After that, the traffic was counted by playing the videos, *i.e.*, manual counting for different vehicle categories. Average speed for different vehicle types was measured by a radar gun, *i.e.*, on-spot measurement. Road width was measured by meter tape & average building height was measured by counting the floors. (Assuming 1 floor = 3 meter). After the collection of data, a model has been developed using Artificial Neural Network in MATLAB software.

2.5 Assumption made in the study

The following assumption are composed in this study, within the practical limit, without any loss of generality:

- i. Traffic noise is quantifiable by the equivalent noise, L_{eq} , with A weightage.
- ii. The road stretch is linear and levelled with a reasonably good road surface condition, and therefore the effect of variation in road interface is negligible.
- iii. 2-W in this model means all types of motorized twowheelers, irrespective of engine capacity, *i.e.* 100 cc, 110 cc, 125 cc, 150 cc, 180 cc.
- iv. 3-W in this model means all types of motorized three-wheelers, irrespective of engine capacity, *i.e.* 100 cc, 110 cc, 125 cc, 150 cc, 180 cc.
- v. 4-W in this model means all types of motorized four-wheelers, irrespective of engine capacity, *i.e.* 800 cc, 1000 cc, 1200 cc, 1400 cc, and so on.
- vi. There is no barrier, either manmade or natural or, between the observer and noise source. (*i.e.*, traffic flow).
- vii. The model is applied under ideal meteorological conditions, *i.e.*, no significant influence of wind, temperature, humidity, and rainfall.
- viii. There are two forms of vehicle motion, such as cruising with steady uniform speed and stopping.
- ix. All the vehicles moving on roadways in the study locations fulfil the Indian Motor Vehicle Rules-1989.
- x. It is supposed that the environmental noise level due to vehicular motor traffic to a first approximation is a function of the traffic volume (composition) only.

3 Analysis of data

Data have been collected in the pilot survey and detailed survey, including noise level readings, classified traffic volume count, average vehicle speed, road width, and average building height at three selected arterial roads. The distance from the edge of the road is also main contributing factor, whereas heavy-vehicle volume was found to be the least.

3.1 Pilot survey

In the pilot study, data have been collected for one hour in each period, *i.e.*, peak (morning & evening) and off-peak period (afternoon), to overview the noise and traffic pattern in that area.

Details of this pilot survey are enumerated as under:

- (a) In this survey, readings were taken for three periods, i.e., morning & evening peak periods and afternoon off-peak periods (1hr for each period) at all three roads.
- (b) Noise level readings (dBA) (each minute reading for 1 hr.).
- (c) Categorized traffic volume count of one-way traffic, *i.e.*, two-wheeler, three-wheeler, four-wheeler & Heavy vehicles (15 min interval, for 1 hr.
- (d) Average speed measurements of one-way traffic for these vehicles (15 min. interval, for 1 hr.)
- (e) Width of the lane and average building height near the collection point.

3.2 Detailed study

For a detailed analysis, the noise measurement was done for continuous 24 hours, starting from 9.00 am morning to the next morning 9.00 am; readings were collected every minute for better accuracy and a large dataset. From this selected three arterial roads, Athwa-Dumas road, probably the busiest road, and the other two are significant major arterial roads that associate distinctive peri-urban zones and principle focus to the city. The determination of these roads emerged from the way that they have high traffic volume.

(A) Athwa-Dumas road

Observations for Athwa-Dumas road

24-Hrs. TRAFFIC VOLUME COUNT

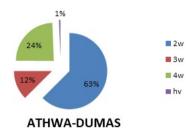


Figure 1: Traffic composition at Athwa-Dumas road

Table 1: Traffic composition

Type of vehicles	Volume	Count	
	Nos.	%age	
2w	52813	62.55	
3w	10569	12.51	
4w	20494	24.27	
H.V.	554	0.65	
Total	84430	100	

It can be seen from the chart that the contribution of different vehicle categories to the noise is as follows:

$$2 - w(63\%) < 4 - w(24\%) < 3 - w(12\%) < H.V.(1\%)$$

It is visible in the graph that the significant contribution to the noise levels is due to the 2-w. This road, located in a

posh area, has higher numbers of 4-w count (24%). Hence, this heterogeneity of traffic 2-w and 4-w (combined 87%) leads to congestion on roads, increasing traffic noise. From 9.00 am to 9.15 pm, the noise has an increasing trend. The maximum noise is 76.7 dBA at 9.15 pm. After that point, it starts decreasing due to the decreasing number of vehicles till 6.15 am. The minimum noise is 66.7 at 6.15 am. After that, it again starts increasing.

(B) Adajan-Rander road

Observations for Adajan-Rander Road

24-Hrs. TRAFFIC VOLUME COUNT

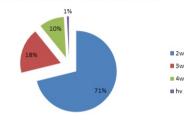


Figure 3: Traffic composition at Adajan-Rander road

Table 2: Traffic composition

Type of vehicles	Volume	Count
	Nos.	%age
2w	38939	71.16
3w	9858	18.01
4w	5448	9.95
H.V.	469	0.85
Total	54714	100

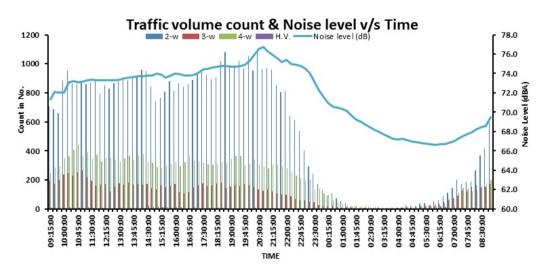


Figure 2: Graphical representation of noise level and traffic volume during 24 hrs. at Athwa-Dumas road

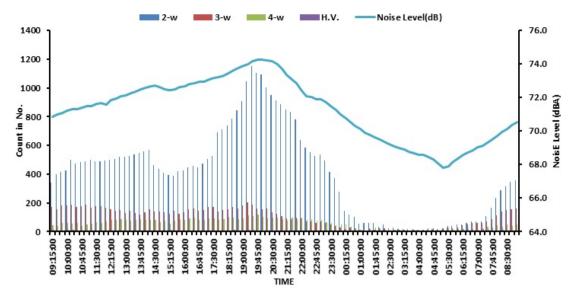


Figure 4: Graphical representation of noise level and traffic volume during 24 hrs. at Adajan-Rander road

At Adajan-Rander, the contribution to the noise of different categories of vehicle is as follows:

$$2 - w(71.16\%) < 3 - w(18.01\%) < 4 - w(9.95\%)$$

 $< H.V.(0.85\%)$

The noise levels in the Adajan-Rander road are less in comparison to Athwa-Dumas road. Also, the traffic volume on this road is less even in the peak hours. The maximum noise level at this road is 74.3 dBA at 7.45 pm & the lowest value is 67.8 dBA at 5.30 am. This L_{max} is nearly 2.5dB, lesser than Athwa-Dumas arterial road.

(C) Udhna-Sachin road

Observations for Udhan-Sachin road

Table 3: Traffic composition

Type of vehicles	pe of vehicles Volume	
	Nos.	%age
2w	41772	65.73
3w	13168	20.72
4w	8065	12.69
H.V.	540	0.84
Total	63545	100

24-Hrs. TRAFFIC VOLUME COUNT

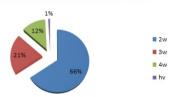


Figure 5: Traffic composition at Udhna-Sachin road

At Udhna-Sachin road, contribution to the noise of different categories of vehicle is as follows:

$$2 - w(65.73\%) < 3 - w(20.72\%) < 4 - w(12.69\%)$$

 $< H.V.(0.84\%)$

This arterial road has a peculiar traffic count of max 2-W and a higher 3-w (Autorickshaw). The reason, this being a majorly industrial area, working people class MIG and EWS prefer para-transit mode of transportation, *i.e.*, 3-w (autorickshaw).

It is visible in this graph, as shown in Figure 6, that the rate at which noise level is increasing is almost the same until 8.45 pm, where the maximum value is 74.7 dBA. Also, the traffic volume increase rate is nearly stable till 8.30 pm, after that the number of vehicles is getting reduced, and near about after 5.30 am, it again started increasing.

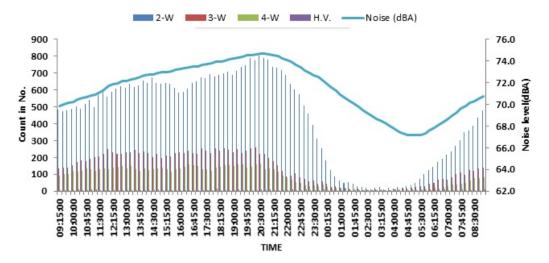


Figure 6: Graphical representation of noise level and traffic volume during 24 hrs. at Udhna-Sachin road

4 Model development

After the data has been collected, the process of model development starts. An ANN model has been developed with the help of the collected data in the detailed study. MATLAB R2012a (7.14.0.739) has been used to create the model. In MATLAB, Neural Network Toolbox has been used to develop and run the developed model to predict the output values. Data has been normalized first to avoid the overflow of the network due to very large or small weights and to eliminate the effect of different input variables influence. Data have been normalized in the range of [0, 1] by the following formula:

$$X_{norm.} = \frac{(X_i - X_{min.})}{(X_{max} - X_{min.})} \tag{1}$$

The data cannot directly be used in the raw excel form in MATLAB. To use them, the data have to be converted into Mfile. After making M-files, data managers must be opened to import the M-files (INPUT, TARGET) and create the network. In this Data manager, all the decisions regarding creating the network have to be made, *i.e.*, Network type, training function, performance function, learning function, transfer function, number of neurons in the hidden layer, etc.

There is no hard & fast rule for deciding the number of neurons for the network. Neurons can only be determined by the trial and error method. The network has been developed with a different number of neurons, and the best number has been chosen based on MSE with those combinations. The table of MSE & R² with a different number of neurons is given below:

(A) For Athwa-Dumas road

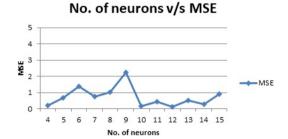


Figure 7: Graph between MSE & number of neurons

Table 4: Network functions

Network Type	Training Function	Learning function	Performance function	Number of Neurons	Transfer function
Feed-forward back propagation	TRAINLM	LEARNGDM	MSE	11	TANSIG

Table 5: Selection of neurons

Number of	Mean squared	R² value	Number of
neurons	error		epochs
4	0.212	0.971	13
5	0.655	0.960	19
6	1.369	0.947	12
7	0.75	0.962	10
8	1.039	0.935	15
9	2.239	0.841	21
10	0.167	0.971	23
11	0.419	0.952	49
12	0.138	0.984	24
13	0.527	0.950	27
14	0.257	0.980	19
15	0.918	0.847	31

A different number of neurons from 4 to 15 have been tried to develop the model, but the least MSE was obtained at 12. That's why; the number of neurons for the network has been fixed at 12. The MSE and R^2 at 12 are 0.138 & 0.984, respectively.

(B) For Adajan-Rander road

Table 6: Selection of neurons

Number of	Mean squared	R² value	Number of
neurons	error		epochs
4	0.284	0.979	21
5	0.255	0.981	27
6	0.197	0.987	19
7	0.992	0.814	20
8	0.799	0.873	25
9	0.066	0.981	28
10	1.280	0.812	35
11	0.723	0.952	29
12	0.539	0.973	22
13	0.219	0.982	33
14	0.347	0.959	22
15	0.309	0.971	21

The minimum value of MSE is 9. Therefore, the optimum number of neurons for the prediction model of Adajan-Rander road would be 9. The value of \mathbb{R}^2 at this point is 0.981.

The value of MSE varies from 0.066 to 1.280, with neurons ranging from 4 to 15.

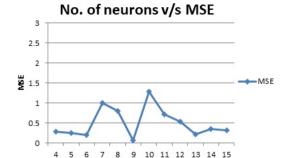


Figure 8: Graph between MSE & number of neurons

(C) For Udhna-Sachin road

Table 7: Selection of neurons

Number of	Mean squared	R ² value	Number of
neurons	error		epochs
4	0.480	0.942	29
5	0.827	0.909	23
6	0.452	0.953	34
7	0.379	0.968	21
8	0.251	0.981	26
9	0.930	0.892	21
10	0.721	0.932	35
11	0.301	0.947	27
12	0.124	0.971	19
13	0.256	0.963	30
14	1.108	0.872	39
15	0.812	0.921	28



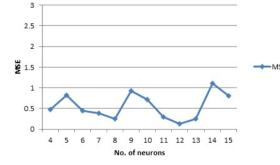


Figure 9: Graph between MSE & number of neurons

For Udhna-Sachin road, the minimum value of MSE is 0.124, which comes with 12 neurons. Therefore 12 neu-

rons have been fixed for the hidden layer in the model. The corresponding R^2 value at this point is 0.971.

(D) For all the three roads

Table 8: Selection of neurons

Number of Mean squared		Mean squared R ² value	
neurons	error		epochs
4	0.306	0.965	17
5	0.412	0.967	8
6	0.458	0.956	7
7	0.398	0.96	3
8	0.258	0.975	10
9	0.436	0.973	3
10	0.347	0.962	4
11	0.022	0.97	10
12	0.362	0.969	13
13	0.641	0.967	11
14	0.577	0.967	7
15	0.521	0.965	9

A different number of neurons from 4 to 15 have been tried to develop the model, but the least MSE was obtained at 11. That's why the number of neurons for the network has been fixed at 11. The MSE and $\rm R^2$ at 11 are 0.022 & 0.970, respectively.

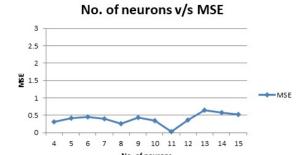


Figure 10: Graph between MSE & number of neurons

Training of network

After selecting the different functions and neurons, the network is needed to be trained with the inputs. Here the feedforward back propagation network has been used. Therefore, for training, the desired output in the form of a Target matrix is required to feed the network. In this study, the numbers of inputs are 10 & the output is 1. So, the structure of the network will be the same as given in Figure 11.

The real data has been divided into the following parts:

1) Training: (70%)

These are presented to the network during training, and the network is adjusted conforming to its error.

2) Validation: (15%)

These are used to compute network generalization and to halt training when generalization stops improving.

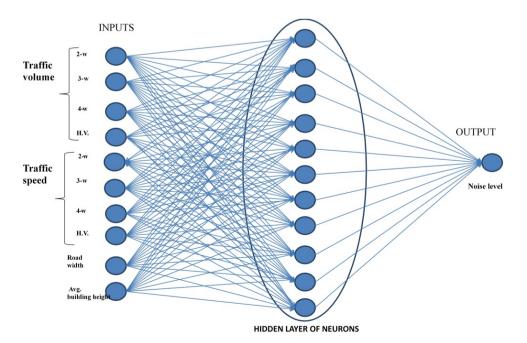


Figure 11: Structure of the Network

Table 9: Range of different parameters for the combined model

Value	Noise Level	Traffic volume count (15 min.)			Avg. Traffic speed (km/h)			Road	Building		
	(15 min.) L_{eqA}	2-w	3-w	4-w	H.V.	2-w	3-w	4-w	H.V.	width (m.)	Ht. (m)
Max.	76.7	1154	264	445	24	40	31	42	28	17	15
Min.	66.6	6	2	2	0	28	20	21	0	7.5	9

3) **Testing: (15%)**

These do not influence training and give an independent measure of network performance during and after training [29].

5 Results and discussions

The accuracy of the network can be assessed by the MSE & R^2 [30]. If the value of MSE is near zero, the model is generally considered acceptable. If R^2 value is near about 1, the relation between input & output parameters is considered good.

(A) For Athwa-Dumas road

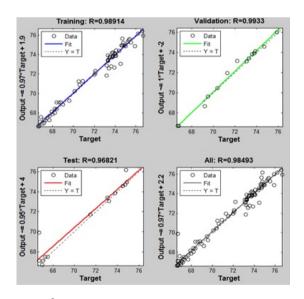


Figure 12: \mathbb{R}^2 value graph of training, validation, and test of Athwa-Dumas road

The model developed using Athwa-Dumas road readings gives MSE=0.138 and R^2 =0.984 in training and MSE=2.40 and R^2 =0.516 in prediction.

(B) For Adajan-Rander road

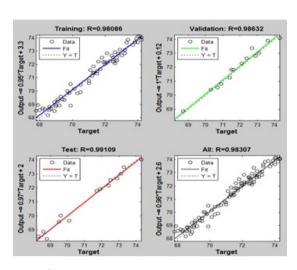


Figure 13: \mathbb{R}^2 value graph of training, validation, and test of Adajan-Rander road

Adajan-Rander road, MSE=0.066 and R^2 =0.981 in training and MSE=0.789 and R^2 =0.707 in prediction

(C) For Udhna-Sachin road

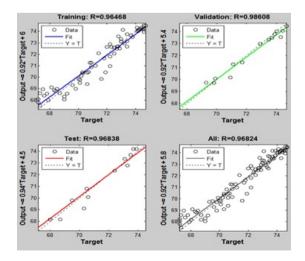


Figure 14: \mathbb{R}^2 value graph of training, validation, and test of Udhna-Sachin road

Finally, for Udhna-Sachin road, MSE=0.124 and R^2 =0.971 in training and MSE=1.25, R^2 =0.651 in prediction

(D) For all the three roads (combined)

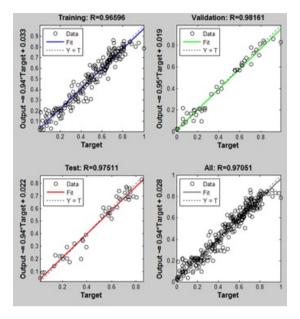


Figure 15: ${\sf R}^2$ value graph of training, validation, and test of all three roads

Hence, amongst all the three individual prediction models, Adajan-Rander road results are better because they give less MSE and better R^2 values. The reason may be due to the same type of land use, *i.e.*, commercial along the entire corridor. Also, one more reason for better MSE and R^2 value for Adajan-Rander road might be the homogeneous nature of traffic and hence lesser L_{eq} values as compared to other two arterial roads. For the other two corridors, *i.e.*, Athwa-Dumas and Udhna-Sachin corridors, having mixed land use, which may be the reason for slightly weaker MSE and R^2 values.

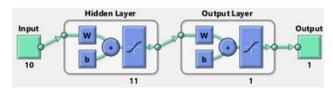


Figure 16: Developed Neural Network

Model Validation

Models have been developed using data of Athwa-Dumas road, Adajan-Rander road, and Udhna-Sachin road separately. A final model has also been developed using all the three road data combined. After that, the prediction of noise levels at another road (Adajan-Hazira road) has been made using these four models.

(A) Prediction at Adajan-Hazira road using the model of Athwa-Dumas road

OBSERVED v/s PREDICTED VALUES

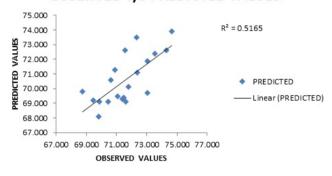


Figure 17: Observed v/s Predicted values at Adajan-Hazira road

(B) Prediction at Adajan-Hazira road using the model of Adajan-Rander road

OBSERVED v/s PREDICTED VALUES

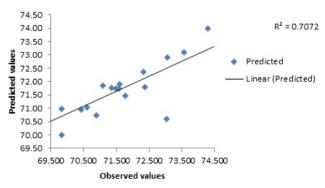


Figure 18: Observed v/s Predicted values at Adajan-Hazira road

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(C) Prediction at Adajan-Hazira road using the model of Udhna-Sachin road

OBSERVED v/s PREDICTED VALUES

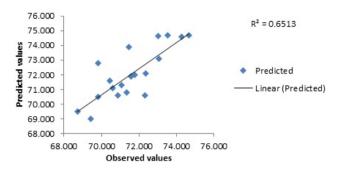


Figure 19: Observed v/s Predicted values at Adajan-Hazira road

(D) Prediction at Adajan-Hazira road using the model of all three roads

OBSERVED v/s PREDICTED VALUES

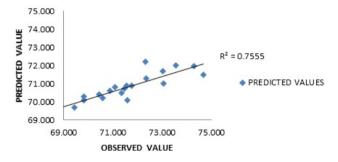


Figure 20: Observed v/s Predicted values at Adajan-Hazira road

Among all the prediction results, results obtained by the Adajan-Rander road and combined model are better. They are showing less MSE and better R^2 values.

Amongst all three individual models developed, the model of Adajan-Rander road gives the best results when validated. Among the prediction in three arterial roads, the predicted output value from the model of Adajan-Rander showed a better correlation with a mean squared error (MSE) of 0.789 and R² value of 0.707. It may be due to the same type of land use in the Adajan-Rander zone. But with the combined model, there is a slight deterioration in mean squared value (MSE) 1.550, with R² not getting changed much significantly, *i.e.*, 0.755. However, the combined model's prediction can be adopted due to the variety of data used in its training. The developed prediction model

can be successfully applied to any arterial roads of tier-II cities of India, with a predominant commercial land use.

Table 10: Training results

Model developed by using readings of	MSE	R ²
Athwa-Dumas road	0.138	0.984
Adajan-Rander road	0.066	0.981
Udhna-Sachin road	0.124	0.971
Combined	0.022	0.979

Table 11: Prediction results

Model developed by using readings of	MSE	R ²
Athwa-Dumas road	2.401	0.516
Adajan-Rander road	0.789	0.707
Udhna-Sachin road	1.252	0.651
Combined	1.550	0.755

Model limitation

Individual models for all three arterial roads and the combined model have been validated, giving reasonable output accuracy. But one drawback of this model development process is that it provides no clue which variable is more influential. It also does not provide any equation regarding the correlation between the variables. It directly provides us with the output results by arranging weights between neurons. ANN-based traffic noise prediction model can also be developed by including more input variables, *i.e.*, road surface type, meteorological factors like wind speed, humidity, temperature, etc.

6 Conclusions

The major aim of this study is to develop and optimize noise prediction model for arterial roads of a city in the developing country like India, using noise emission equivalency. Noise and traffic data have been collected for a continuous 24 hrs. at three different arterial roads of Surat city for developing a traffic noise prediction model. The real data has been divided into 15 min. Interval. The model has been developed by the Artificial Neural Network toolbox in MATLAB software. The entire data set has undergone the necessary ANN process of training (70%), validation (15%),

and testing (15%). The developed model has ten input variables and one output variable. There is one hidden layer with eleven numbers of neurons.

At all three arterial roads understudy, the noise levels during day time and night time are above the permissible norms of Noise Pollution (Regulation and Control) Rules, 2000. Model developed by using Athwa-Dumas road readings gives MSE=0.138 and R²=0.984 in training and MSE=2.40 and R²=0.516 in prediction, for Adajan-Rander road, MSE=0.066 and R²=0.981 in training and MSE=0.789and R²=0.707 in prediction and finally for Udhna-Sachin road, MSE=0.124 and R²=0.971 in training and MSE=1.25, R²=0.651 in prediction. Hence, amongst all the three individual prediction model results obtained by the Adajan-Rander road, it is better due to the same land-use type. It gives less MSE and better R² values, whereas in the combined model, there is a slight deterioration in mean squared value (MSE) 1.550, with R² not getting changed much significantly, *i.e.*, 0.755. However, the combined model's prediction can be adopted due to the variety of data used in its training. One of the drawbacks of this ANN model is that it gives no clue that it is a more influential variable. It also does not provide any equation regarding the correlation between the variables. The factors not considered in this study, but contributing to the generation and absorption of noise are vegetation along the roadside and the number of heavy vehicles passed through the road at afternoon 1:00 pm to 5:00 pm. To improve the MSE and R² value, traffic noise models may be optimized using evolutionary computing tools like genetic algorithm. Also, only three independent variables have been taken into consideration such as vehicular speed, count and building height, but reduction and generation of noise levels also depends on vegetation along road, honking of horns, type of pavements.

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