

Accident Prediction Model for Mumbai-Pune Express Way

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In this paper, an effort has been made to present and discuss an accident prediction model for the Mumbai-Pune expressway of India using an (ANN) artificial neural network. Road Crash losses have been on a growing trend from the preceding decade or so in India and even in the world. As a result, traffic safety organization has emerged as a topic of thesis for researchers all over the world. The study, research help anybody to recognize the real causative factors behind an accident occur. The effect of one cause can be greater than the other. According to the survey it has been observed that there is no such prediction model for this particular expressway. Data of around five years from 2016 to 2020 with 1101 accidents and a few parameters have been utilized for the model processing and validation. Excess speeding, risky overtaking, alcohol consumed driving, unskilled drivers, rash and reckless driving, inferior knowledge of traffic rules and regulations and sometimes due to exhaustion of drivers also few other parameters to specify are avoiding the use of safety and protective equipment like helmets, seat belts, etc. landslides, boulders, sharp and deep curves, extreme foggy atmosphere, heavy rainfall and youngsters life scaring styles are some of the model boundaries included for the study. For this model development of the ANN, the Levenberg-Marquardt algorithm has been used, the sigmoid activation function. ie trail.

The implementation of the developed ANN model was assessed by mean square error (MSE), the root means square (RMSE), and the coefficient of determination. (R2).

The output of the model signifies that the curvature of the road and excess speed of the vehicles are the primary or the crucial concerns of the accidents on the Mumbai Pune expressway. The (ANN) Artificial neural network model predicts the brilliant work for calculating the number of road accidents for the said expressway.

1.Introduction

The curse all over the world maybe it a developed or a developing nation, the road mishap has been the primary reason for the fatality, injury or wound and disability. [15] (RMTO, 2010). To put down the number of road accidents, it is essential to study the various parameters especially on freeways, for the betterment of road safety measures are required to be verified

concerning the models, which are utilized based on the major factors like human behavior, road geometric design, environmental factors, and traffic flow characteristics. [16] (Mahmoudabadi, 2010 Maximum Road accident prediction models are developed using regression techniques. In 1949, Smeed [11] investigated the number of seriously injured persons in the accidents and compared the accident rates in different countries.

Artificial Neural Network plays a vital role in various engineering and different fields. Majorly in traffic and transportation engineering.[1]

It has also been shown its usefulness in travel behavior and management of flow.[2]. The intensity and harm caused by the road accident can be explained through Artificial Neural Network maybe related to driver, roadway, vehicle, or the environmental conditions. The foretelling or the prediction of traffic with other numerous correlations in between traffic variables can be effectively executed with the ANN. It frames reasonable and prompt ways for developing models with plenty of data. An ANN model assists to compare the statistics of road safety performance with vehicle losses.

The application of ANN in various fields has achieved expertise, maybe transport engineering. Abdel Wahab and Adel-Aty [3] determined the connection between the severity of the injury and vehicle path, climatic conditions, with various typical models designed using multilayers perceptron and non-compliant networks. To evaluate the sequence of events promptly the ANN model concept was preferred and selected. Changing lanes is a major risk factor.[6], where a research study helps to overall improve the safety of driving for the situations like passengers or driver may die or a seriously injured car driver etc. If compared with ANN and other conventional systems, ANN is a boon as it is capable of solving complex and non-algorithmic problems. It is perfect for dealing with new and unpredicted circumstances. It is not necessary to be aware of the statistical division of data and prior knowledge for model variables when building the ANN models. The ANN can make tricky, indirect relationships without any prior guess such as the black box.[8]. Neural networks learn by example. they cannot be programmed to perform a selected task. The examples should

be chosen rigorously otherwise helpful time is wasted or perhaps worse the network could be functioning incorrectly [17]. The most significant aspect of the ANN is its new architecture of information processing systems or data handling processes. Junctions related to minor variables readily signify minor values; related variables carry significant weight values. Neural networks, which are worth converting broad and flat data are non-linearize not straight, can integrate inputs and outputs. One more benefit of ANN includes that it permits the insertion of a large number of variables. The most vital thing is those road traffic accidents (RTAs) have a direct effect on the economy of developing or developed countries.

2. Materials and Methods

2.1 Study Area

Mumbai-Pune expressway is restricted road access, linked to Mumbai and neighboring city Pune. It is a 6-lane road that does not give access to 2 and 3 wheeled vehicles having an average speed of 80 to 90 km/hr. under MSRDC. In the last few years complaints have been put forth about the tremendous increase in car crashes that lead to major fatal injuries both, still, proper investigation is needed for unreported crashes for proper establishment. Thus, proper investigation for road crashes should be done to identify, record, and know the actual collision issues the cause of road accidents can be one of the elements or blends of many elements. A mixture of human mistakes, the giant scale of traffic, and a large quantity of accidents has been witnessed by this path. Initially, in the first 10 years, the expressway has faced 1758 crashes with nearly 400 fatalities. Heavy rainfall caused terrific landslides in the month of June and July nearby the Khandala and Adoshi tunnels. To make the expressway casualty and fatality-free, Mahindra & Mahindra Ltd supported Save Life Foundation initiated the 'Zero Fatality Corridor' project.

The basic elements that are responsible for accidents are generally driver attitude, vehicle, traffic, and expressway characteristics also majorly on environmental effects.[11] Prominent reasons for road accidents can vary from unfavorable road conditions due to climatic variations to population growth. The road safety norms and standards of the Indian government have led to deduce the number of road accidents to some minor extent. The major cause and diagnosis of road accidents is a big challenge in front of the whole world as it plays a very vital role in each particular nation's economy. The crash forecast model correlates between the present level of road safety like fatalities, injuries, and parameters like length and width of road and traffic volume.

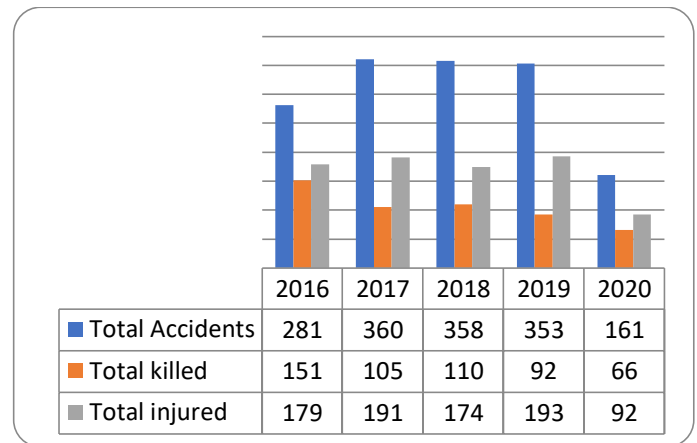


Fig.1 Accident statistics for Mumbai –Pune expressway

The above bar graph (fig.1) describes the comparison between accident statistics data for 5 years from 2016 to 2020. According to the graph, it is observed that maximum RTA cases occurred in 2017, maybe accidents, fatality or injuries. Contradictorily 2020 recorded the least cases as of due to pandemic.

2.2 Data collection

Data was collected from <https://highwaypolice.maharashtra.gov.in/en/reports> website and details from the police station. While the research was being done, it was seen that many accidental cases were not been registered, as they included minor injuries. Also, the primary reason for not reporting the cases was that the vehicle owners or even the victims didn't prefer it. Though the cases were not reported or registered they still had vital significance for crash analysis study. Mainly, to determine whether the cases had been filed or not regular follow-up or feedback was taken through concerned police stations every 2 weeks.

An accident or crash survey was done in a detailed scientific manner which included examination of crash scene, crash vehicles, or the harm caused to the victim.

To understand in detail, the crash scenario interviews were carried. a database has been made to store the data in a proper format which assists in analysis. Road Accident Sampling System-India, a scientific database has been built with the help of various measurements, observations, and notes on scientific collision data.

2.3 Artificial Neural Network

The artificial Neural Network technique from MATLAB-R2018a has been utilized for developing this prediction model. For this particular prediction model, ten input parameters, ten hidden layers, and one output layer are taken into consideration. For a hidden layer a sigmoid function has been used, to gain excellent outputs the software performs the iterations rather than repeats the process continuously.

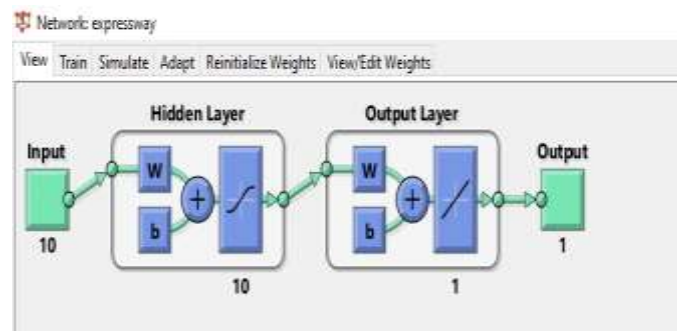


Fig. 2: Network diagram using ANN

After the formation of this network, seven iterations of training of network are done which resulted in excellent output or gain.

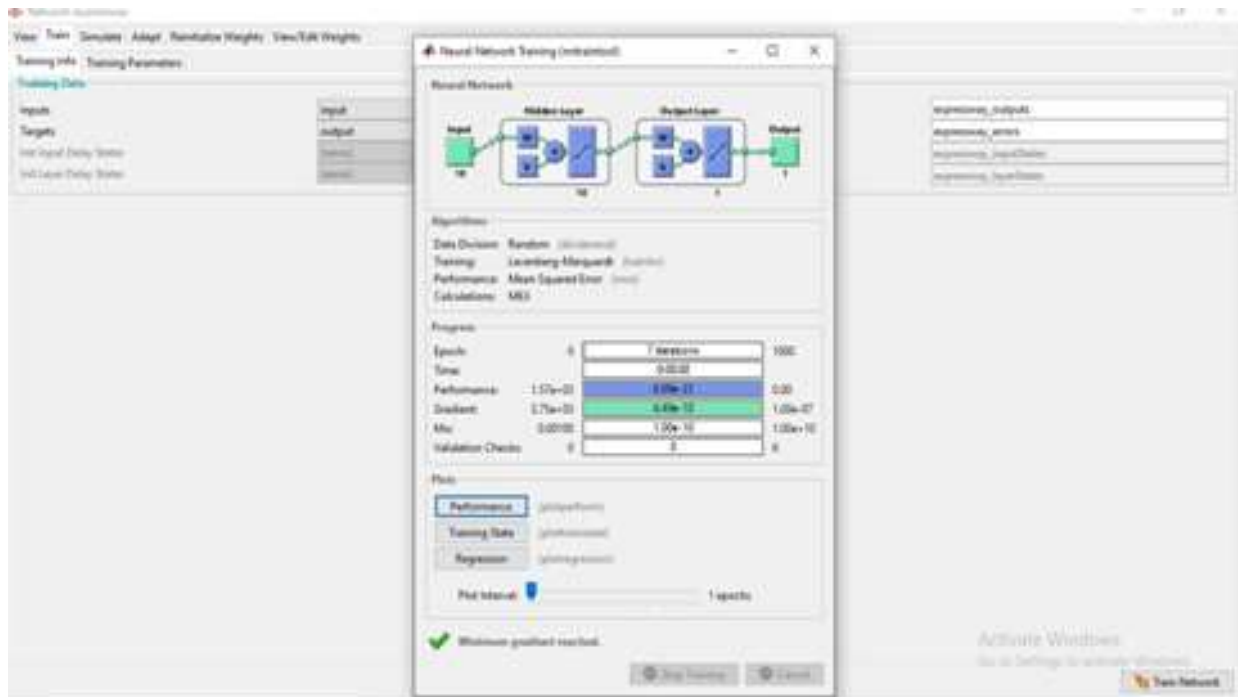


Fig. 3: Training of Network with iterations

3. Results and discussions

The below figure shows a developed accident prediction model with excellent prediction values with an overall accuracy of 99.7%. for validation, accuracy has been 96.05%

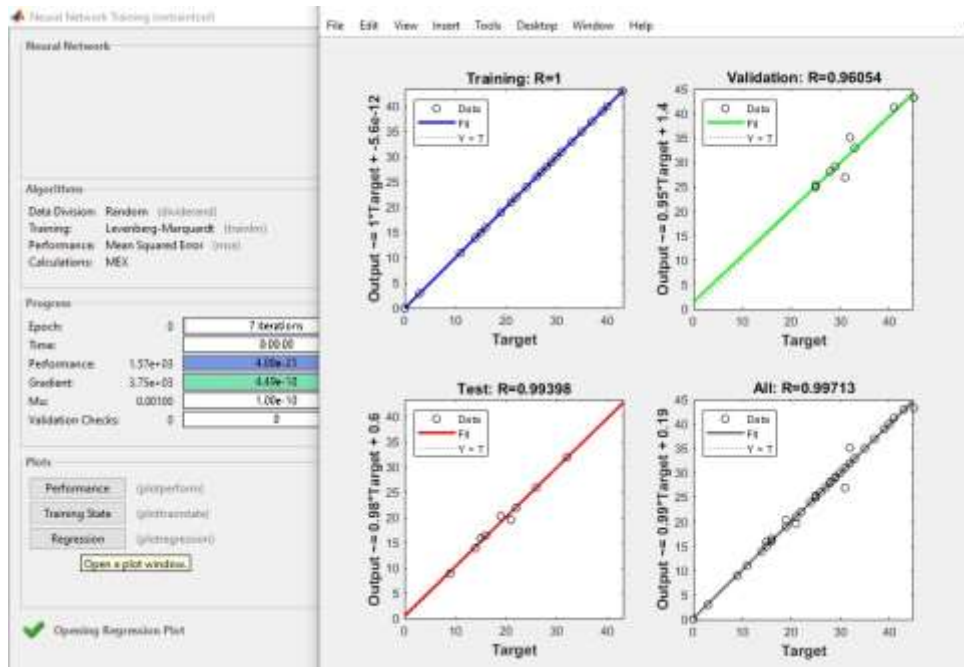


Fig. 4: Excellent performance given by ANN prediction model

Once the simulation is done the predicted values are with a minor error of 0.72%



Fig. 5: Simulation of Network

Figure (6) below represents the three curves, the data sets of training, testing, and validation. The total input and output data were divided into for training, testing, and validation of the model as 70%, 15%, and 15% respectively. The training of neurons continues till the error has reached its least where the

network memorizes the training set then the process is stopped. This technique or method automatically frees the problem of over-fitting, which plagues many optimizations and learning algorithms. The best validation performance is 3.3017 at epoch 7.

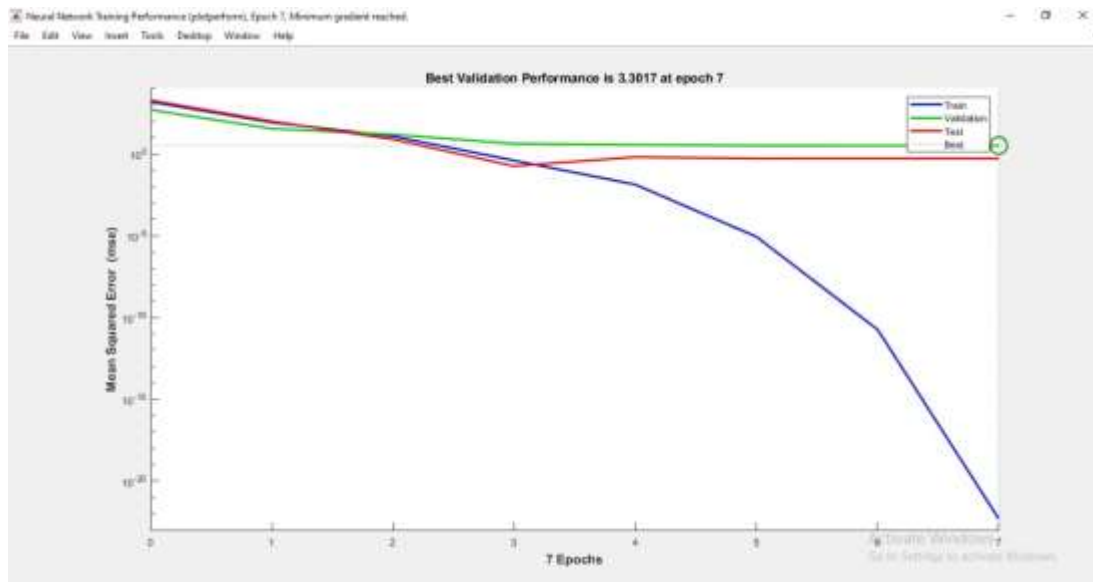


Fig. 6: Validation performance of Model

Conclusion

For a successful case study, this model was developed for examination and prediction of (RTA) Road Traffic accidents for this Mumbai Pune expressway. As detailed before that this particular model was developed by considering data from 2016 to 2020 for accurate prediction. For the design of the system, the parameters considered were the number of accidents, reckless driving, risky overtaking, drunken drivers, overpopulation and overloading, the insufficient skill of driving and inadequate knowledge of traffic discipline, tiredness of drivers least use of protective gear like helmet, seat belts, sharp curvature, landslides, etc. by estimating the performance and evaluation of the model, we came under the observation that ANN is the perfect model compared to statistical methods.

Before this research there was no such type of model developed for this particular expressway, further study shows an excellent accuracy of 99.7%.

The model helps us give results of accidents to happen because of line with same input variables and if at all any change the model needs to be revised accordingly. Since ANN is a very developed and scientific model any type of revision can be calculated in very little or an inch of time. So, it concludes that ANN is the most excellent predictive output model for this particular expressway.

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