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TO ANALYZE ARTIFICIAL NEURAL NETWORK TO EVALUATE AND DEVELOP A ROAD ACCIDENT PREDICTION MODEL

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ABSTRACT

People's lifestyles have improved as a result of the rapid development in urbanisation. However, these developments have placed a burden on roadways by expanding vehicle ownership, causing traffic problems to worsen at an alarming rate. The primary cause of road traffic accidents could be an increase in the rate of traffic volume.

In rapidly developing metropolitan agglomerations, road traffic accidents are a big concern. There is a substantial body of research literature that sheds light on the scope of the problem and the remedies that are required. Road traffic accidents are the third leading cause of unnatural death among all deaths. Transportation engineers and academics have attempted to construct safe roads that adhere to suitable design standards, yet traffic accidents are inescapable. If an accident occurs, the reasons that caused it must be identified, and suitable corrective measures must be established and implemented as soon as possible. The goal of this study is to gain a better knowledge of the problem of road traffic accidents on the Mumbai Pune Expressway (MPEW) and the factors that may contribute to the high accident rates. Using Artificial Neural Networks, this research will construct an accident prediction model to anticipate the amount of accidents along the MPEW (ANN)

Keywords: *Artificial Neural Network, Road traffic Accidents, Planning, Management, Prediction, Deep learning Algorithm, Highway, Expressway, MPEW*

I. INTRODUCTION

Significant effort and money have been expended in recent years to improve road and highway safety. A continuing problem for transportation engineers is to build and operate the transportation system in such a way that it serves a variety of social goals such as shortening travel time and increasing safety. There has been an increase in due to an exceptional surge in road transportation and automotive traffic in India as a result of and the economy's and consumers' consumption habits have grown at an exponential rate, resulting in dangerous conditions. Circumstances on our Indian roads, including highways and expressways The number of people killed or injured in traffic accidents on these roads is increasing year after year. The path Accidents, deaths, and injuries are global events, but the issue is more severe in mixed communities.

The traffic situation on Indian multi-lane motorways; the true situation is likely to be far worse due to underreporting of incidents to make the road worse

Furthermore, there is a culture of poor car upkeep, poor driving practice, and a lack of enforcing the law, and the casual attitude of road users Road safety has become a major concern for the general population, and highway safety in particular.

Professionals in particular, because road accidents are a major cause of death; Furthermore, the economic losses as a result of property damage or lost working days as a result of injuries the annual cost of fatalities is estimated to exceed billions of dollars. Road safety is both a health and a safety concern and development issue of significance given its magnitude and gravity, as well as the as a result, negative effects on the economy, public health, and general well-being individuals, particularly those with modest means

Road Accident Trend in India

There have been numerous types of vehicles on the road in India due to the development of road networks, such as cars, buses, motorcycles, trucks, vans, and others that have been used as a base to move from one place to

another. According to the statistics from the Road Transportation Department website in 2019, as shown in Figure, the registered public vehicles in India are increasing every year, indicating that road safety is an important aspect because it involves the majority of the people in this country who are primarily transported by road.

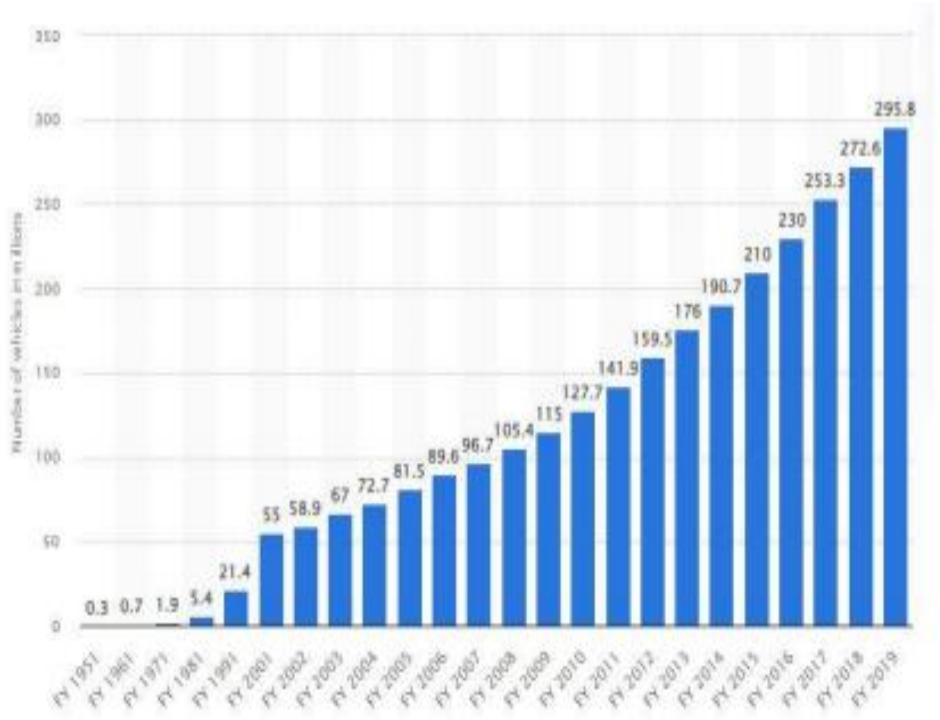


Fig1.1: Total cumulative of registered public vehicles in India upto year 2019 (MoRTH website)

It is quite concerned based on the development of the complete situation about motor vehicles for that period. This is due to the fact that, as the diversity of motor vehicles on the road has increased, so has the number of accidents that have happened in India. This scenario must be investigated, and study must be conducted to determine the root reasons of the accident. It is also critical to ensure that India's present transportation infrastructure is in perfect working order in serving all types of vehicle users in this country.

Safety on the Road

The availability of transportation is directly and strongly tied to the economic development of any country, and the objective of transportation systems is to facilitate the efficient and safe movement of freight and passengers from one location to another. The increasing number of automobiles on the road had produced a serious social problem in the form of traffic accidents, which resulted in the loss of lives and property. According to several accident studies, road accidents are not caused by natural causes, but rather by negligence and lack of road safety rules. Environmental factors, such as fog in the winter, also have a significant part in the causes of road accidents. As a result, road/highway safety is a modern-day necessity.

Initiatives to Improve Highway Safety

The Highway Police, Maharashtra State project "Highway Mrityunjay Doot" was launched on March 1, 2021.

Following a thorough investigation into the causes of mortality in road accidents, it was discovered that the lack of rapid Medical Aid was the biggest source of worry.

In many cases, the injured were not properly evacuated and transported, which compounded the injuries and medical condition. Employees from nearby Malls, Petrol Pumps, Local Dhabas or Hotels, and neighboring villages establish groups of up to 4-5 persons as part of this project. These groups are known as "Mrityunjay

Devdoot" (Angels of God) and are trained in First Aid (including CPR, precautionary procedures for lifting and transporting injured people, and so on) with the assistance of Government/Semi-Government or Social Organizations. The Maharashtra State Highway Police has developed the "Highway Mrityunjay Doot "Project to avoid any such scenarios and to enable timely and effective evacuation of people injured in accidents within the "Golden Hour," which is critical.

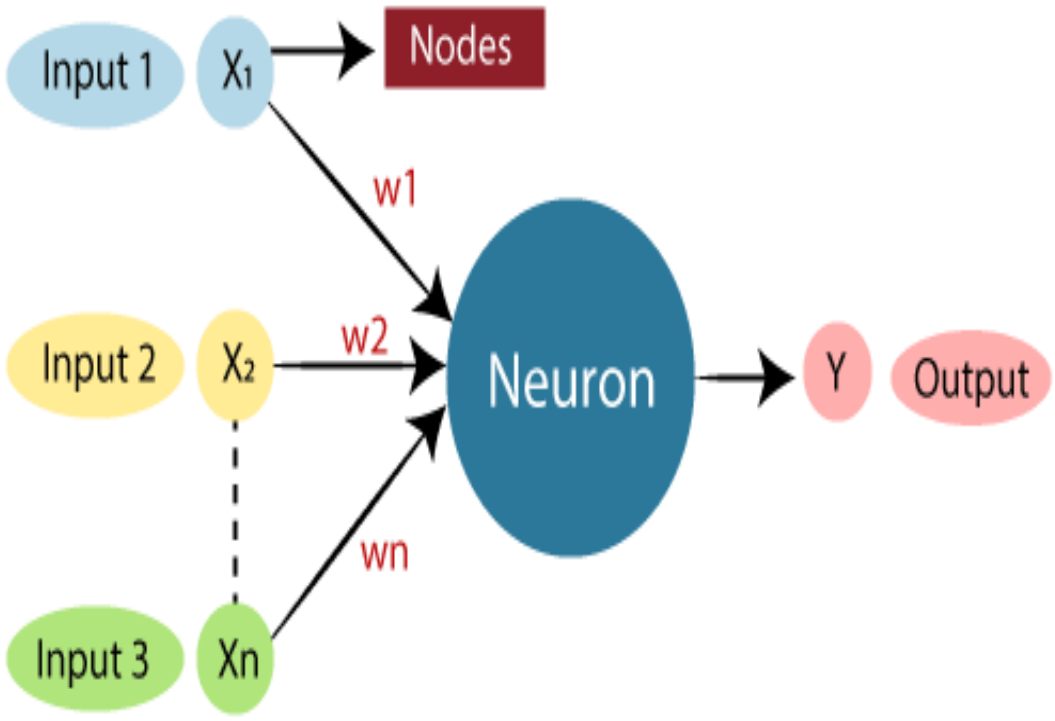
Artificial Intelligence Techniques

In highway safety research, statistical or accident prediction models are widely used. They can be used to identify important contributing elements or to establish relationships between crashes and explanatory variables such as traffic flows, traffic control type, and highway geometric characteristics, among other things. Aside from statistical models, neural network models have been created for road accident prediction and are being used effectively in numerous transport research domains, including traffic safety studies, with high performance. Artificial Neural Networks (ANN) are utilized to combine greater flexibility, precision, generalization, and forecasting power than traditional statistical models. ANN is one of the Artificial Intelligence (AI) algorithms that can outperform all other models for the prediction of road accidents and can readily represent non-linear functions without any statistical simulation.

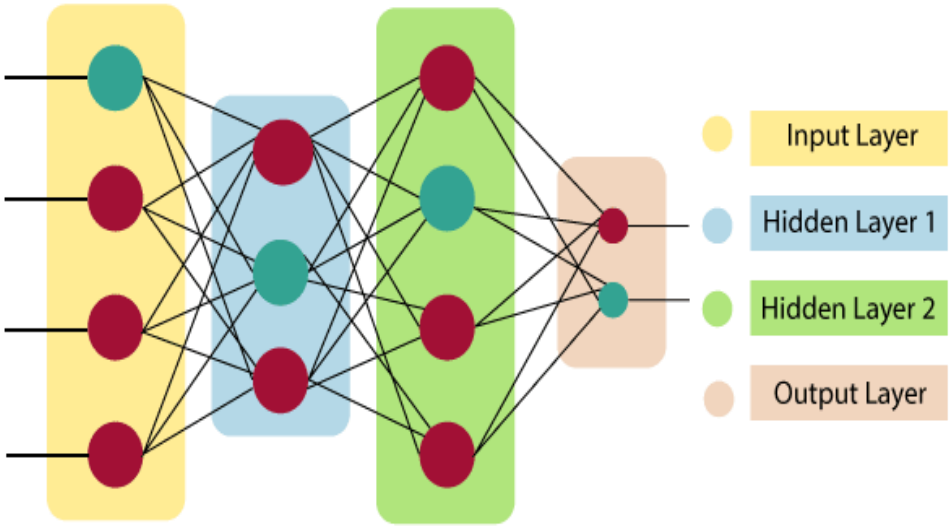
II ANN ALGORITHM

The term "**Artificial Neural Network"** is derived from Biological neural networks that develop the structure of a human brain. Similar to the human brain that has neurons interconnected to one another, artificial neural networks also have neurons that are interconnected to one another in various layers of the networks.

To understand the concept of the architecture of an artificial neural network, we have to understand what a neural network consists of. In order to define a neural network that consists of a large number of artificial neurons, which are termed units arranged in a sequence of layers. Lets us look at various types of layers available in an artificial neural network.



Artificial Neural Network primarily consists of three layers:



Input Layer : As the name suggests, it accepts inputs in several different formats provided by the programmer.
Hidden Layer : The hidden layer presents in-between input and output layers. It performs all the calculations to find hidden features and patterns.

Output Layer : The input goes through a series of transformations using the hidden layer, which finally results in output that is conveyed using this layer.

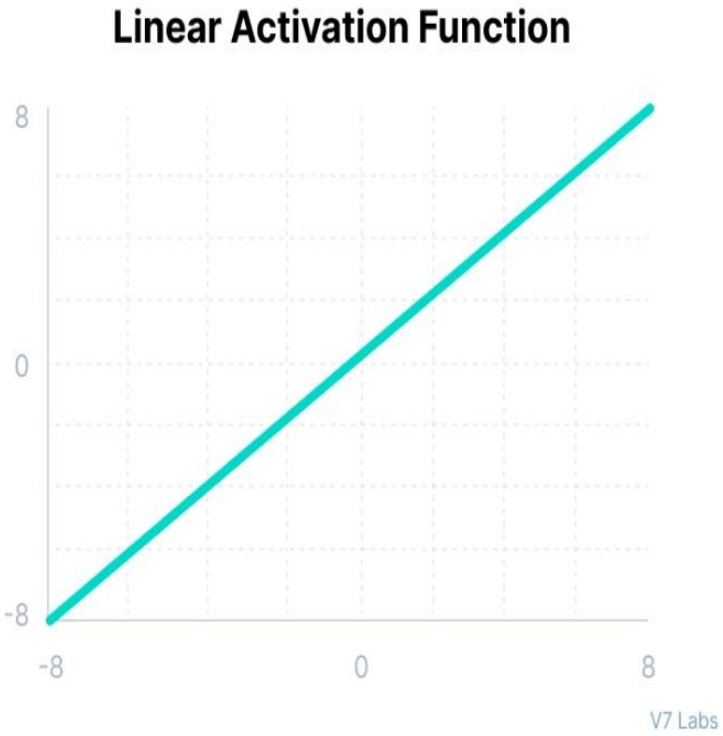
The artificial neural network takes input and computes the weighted sum of the inputs and includes a bias. This computation is represented in the form of a transfer function.

$$\sum_{i=1}^{n} Wi * Xi + b$$

It determines weighted total is passed as an input to an activation function to produce the output. Activation functions choose whether a node should fire or not. Only those who are fired make it to the output layer. There are distinctive activation functions available that can be applied upon the sort of task we are performing.

Linear Activation Function:
The linear activation function, also known as "no activation," or "identity function" (multiplied x1.0), is where the activation is proportional to the input.

The function doesn't do anything to the weighted sum of the input, it simply spits out the value it was given.



III. LITERATURE SURVEY

Develop an artificial neural network (ANN) model to predict construction projects performance in Syria Rana Maya, Bassam Hassan, Ammar Hassan, Journal of King Saud University – Engineering Sciences, 2 May 2021

The purpose of this paper is to enable members of the construction project team to understand the factors, which they must closely monitor to complete the project with the required performance. Therefore, the research aimed to develop an artificial neural network (ANN) model to predict construction project performance based on the above factors.

Research and applications of artificial neural network in pavement engineering: A state-of-the-art review Xu Yang a, Jinchao Guan a, Ling Ding c, Zhanping You, Science Direct, 23 March 2021

To Study the ANN architectures used in these studies mainly included multi-layer perceptron neural network (MLPNN), convolutional neural network (CNN) and recurrent neural network (RNN) for processing one-dimensional data, two-dimensional data and time-series data. CNN-based pavement health inspection and monitoring attracted the largest research interest due to its potential to replace human labor. While ANN has been proved to be an effective tool for pavement material design, cost analysis, defect detection and maintenance planning, it is facing huge challenges in terms of data collection, parameter optimization, model transferability and low-cost data annotation.

Quantification and control of disruption propagation in multi-level public transport networks Menno Yap a, Oded Cats, Johanna Törnquist Krasemann, Niels van Oort, International Journal of Transportation Science and Technology, Elsevier 21st Feb 2021

We propose a modelling framework to quantify disruption impact propagation from the train network to the urban tram or bus network. This framework combines an optimization-based train rescheduling model and a simulation-

based dynamic public transport assignment model in an iterative procedure. The iterative process allows devising train schedules that take into account their impact on passenger flow re-distribution and related delays. Our study results in a framework which can improve public transport contingency plans on a strategic and tactical level in response to short- to medium-lasting public transport disruptions, by incorporating how the passenger impact of a train network disruption propagates to the urban network level. Furthermore, this framework allows for a more complete quantification of disruption costs, including their spilled-over impacts, retrospectively.

Research on car-following model based on molecular dynamics Yanfeng Jia , Dayi Qu, Lewei Han, Lu Lin and Jiale Hong, 8 January 2021

We analyze the evolution rule of the disturbance in the traffic flow in different states with the help of the time-space diagram, and compare the molecular model and the classical optimal velocity model. The results show that the molecular car-following model can better describe the car-following behavior from the micro level.

The model built can describe the driver's car-following behavior more closely, so that the following car can better respond to the speed fluctuation of the leading car

Huaikun Xiang, Jiafeng Zhu, Guoyuan Liang and Yingjun Shen "Prediction of Dangerous Driving Behavior Based on Vehicle Motion State and Passenger Feeling Using Cloud Model and Elman Neural Network", : Research Article, 29 April 2021

In this paper, we propose a new method for dangerous driving behavior prediction by using a hybrid model consisting of cloud model and Elman neural network (CM-ENN) based on vehicle motion state estimation and passenger's subjective feeling scores, which is more intuitive in perceiving potential dangerous driving behaviors. To verify the effectiveness of the proposed method, we have developed a data acquisition system of driving motion states and apply it to real traffic scenarios in Shenzhen city of China. Experimental results demonstrate that the new method is more accurate and robust than classical methods based on common neural network.

Cost Forecasting of Public Construction Projects Using Multilayer Perceptron Artificial Neural Networks: A Case Study, Alcineide Pessoa, Gean Sousa, Research Article, and DECEMBER - 2021

To study present a computational model based on artificial intelligence, specifically on artificial neural networks, capable of forecasting the execution cost of construction projects for Brazilian educational public buildings. The database used in the training and testing of the neural model was obtained from the online system of the Ministry of Education. The neural network used was a multilayer perceptron as a back propagation algorithm optimized through the gradient descent method. To evaluate the obtained results, the mean absolute percentage errors and the Pearson correlation coefficients were calculated.

Determination of Efficacy of Traffic accidents Models for Projects using Artificial Neural Networks, Fuzzy Inference System and Regression Analysis Shabniya Veliyampatt, International Research Journal of Engineering and Technology (IRJET), Oct 2021

This research aims to compare the cost estimation models produced using various methods to determine their efficacy in producing realistic and accurate forecasts of building projects. The various Non-Traditional Methods employed in the study are Regression analysis, Artificial Neural Networks and Fuzzy Inference System. The result of the survey and literature review shows that many factors are affecting construction out of which 15 significant factors were identified by conducting t-test using SPSS Software. Data from 116 real executed construction projects in Kerala were collected for the most significant factors to build up models. The Models using ANN and FIS was done in Matlab whereas regression Analysis was carried out in SPSS Software

An Artificial Neural Network Approach to Predicting Most Applicable Post-Contract Cost Controlling Techniques in Construction Projects Temitope Omotayo, Awuzie Bankole, Research Gate, 28 July 2020

The ANN has been presented as method for analyzing cross-sectional survey data to predict the decision making of construction professionals in choosing the PCCTs in different phases in construction project delivery. The standardized rescaling of operationalized variables for pseudo-probability demonstrates how data collected using the questionnaire can be adapted for ANN analysis.

Using ANN to Predict the Impact of Communication Factors on the Rework Cost in Construction Projects, Roman Trach, Yuliia Trach, Research Article, 20 July 2021

This study aims to fill this knowledge gap. The article purpose was to create ANNs (artificial neural networks) for assessing and predicting the impact of communication factors on rework costs in construction projects. During the data collection phase, 12 factors that influence communication were identified and assessed. The level of rework costs in 18 construction projects was also calculated. We used ANN, which is a two-layer feed forward network with a sigmoid transfer function in the hidden layer and a linear transfer function in the output layer. The proposed model can be used by project management as the integration decision support tool aimed at decreasing the number of reworks and reducing energy and resource consumption in construction projects.

Optimization of structural elements in highly seismic areas using neural networks, V. Arana, M. Sanchez and P. Vidal2IOP Conference Series: Materials Science and Engineering2021

The aim of this research is to use Artificial Neural Networks (ANN) to dimension structural elements in regular 6-storey buildings. The necessary data for the training of the algorithm was elaborated manually with the help of the ETABS software; these were 30 buildings of reinforced concrete with a system of structural walls. The configuration and training of the neural network was carried out in the MATLAB software. The validation was carried out in an additional analyzed building in which the concrete savings were calculated, and the requirements of the current regulations were verified.

Using artificial neural networks to model bricklaying productivity Orsolya Bokor, Laura Florez-Perez, Giovanni Pesce, 2021 European Conference on Computing in Construction 2021

To obtain such productivity rates, the relationships between various factors and productivity need to be understood. Artificial neural networks (ANNs) are suitable for modelling these complex interactions typical of construction activities, and can be used to assist project managers to produce suitable solutions for estimating productivity. This paper presents the steps of determining the network configurations of an ANN model for bricklaying productivity.

Estimation and prediction in construction projects: a systematic review on machine learning techniques Sanaz Tayefeh Hashemi, O mid Mahdi Ebadati, · Harleen Kaur, Springer Article 15 September 2020

We categorized the models in three parts, as statistical, analogues and analytical model and analyze them based on their features. Correspondingly, papers have been thoroughly investigated based on the application area, method applied, techniques implemented, journals, which have been published in, and the year of publication. The most important outcome of this study is to find out the different analytics methods and machine learning algorithms to predict the cost estimation of construction and related projects and aid to find out the suitable applied methods

Application of Artificial Intelligence for the Estimation of Concrete and Reinforcement Consumption in the Construction of Integral Bridges Zeljka Beljkas, Milos Knezevic, Snezana Rutes and Nenad Ivanisevic, Research Article, 8th June 2020

The research on the use of artificial intelligence for the estimation of concrete and reinforcement consumption and the selection of optimal models for estimation; the estimation model was developed by using artificial neural networks. The best artificial neural network model showed high accuracy in material consumption estimation expressed as the mean absolute percentage error, 8.56% for concrete consumption estimate and 17.31% for reinforcement consumption estimate.

Cost estimation and prediction in construction projects: a systematic review on machine learning techniques Sanaz Tayefeh Hashemi, · Omid Mahdi Ebadati, Springer Article, 6 September 2020

Papers have been thoroughly investigated based on the application area, method applied, techniques implemented, journals, which have been published in, and the year of publication. The most important outcome of this study is to find out the different analytics methods and machine learning algorithms to predict the cost estimation of construction and related projects and aid to find out the suitable applied methods.

A Review on Cost Prediction Analysis of Construction Project Using ANN Model G. C. Sarode, Shubham E. Chandgude, International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET), April 2020

Cost estimation is an experience-based task, which involves evaluations of unknown circumstances and complex relationships of cost-influencing factors. An artificial neural network (ANN) is an analogy-based process, which best suits the cost forecasting domain. The primary advantages of ANNs include their ability to learn by examples (past projects), and to generalize solutions for forthcoming applications (future projects). Cost is an important aspect to everyone, especially in the construction projects. For any project requires accurate cost prediction in order to inspire the decision either forward or cancel the project

Artificial Intelligence and Parametric Construction Cost Estimate Modeling: State-of-the-Art Review Haytham H. Elmousalam, ASCE 2020

This study reviews the common practices and procedures conducted to identify the cost drivers that the past literature has classified into two main categories: qualitative and quantitative procedures. In addition, the study reviews different computational intelligence (CI) techniques and ensemble methods conducted to develop practical cost prediction models. This study discusses the hybridization of these modeling techniques and the future trends for cost model development, limitations, and recommendations. The study focuses on reviewing the most common artificial intelligence (AI) techniques for cost modeling such as fuzzy logic (FL) models, artificial neural networks (ANNs), regression models, case-based reasoning (CBR), hybrid models, diction tree (DT), random forest (RF), supportive vector machine.

Improving the Results of the Earned Value Management Technique Using Artificial Neural Networks in Construction Projects Amirhossein Balali, Alireza Valipour, Research Article, 21 October 2020

The aim of this study is to minimize the shortcomings of the Earned Value Management (EVM) method using an Artificial Neural Network (ANN) and multiple regression analysis in order to predict project cost indices more precisely. A total of 50 road construction projects in Fars Province, Iran, were selected for analysis in this research. An ANN model was used to predict the projects' cost performance indices, thereby creating a more accurate symmetry between the predicted and actual cost by considering factors that influence project success. The input data of the ANN model were analyzed in MATLAB software. A multiple regression model was also used as another analytical tool to validate the outcome of the ANN

An artificial neural network approach for cost estimation of engineering services, Erik Matel, Faridaddin Vahdatikhaki, Siavash Hosseinyalamdary, This Evers & Hans Voordijk, International Journal of Construction Management, 29 Nov 2019

It is crucial for companies to have an accurate estimate of their projects. Nevertheless, given that very little is known about the scope and details of the project, the conventional cost estimation methods tend to be slow and inaccurate. With the rise of computing power, there is now a tendency to use Machine Learning (ML)-based methods, such as Artificial Neural Networks (ANNs), for more accurate cost estimation that can remain reliable in face of insufficient details during the tendering phase. While the use of ANN for cost estimation has been abundantly investigated from the perspective of contractors, there are very limited studies on the development and application of ML-based methods for engineering consultancy firms. Given that the nature of products/services offered by consultancy firms is inherently different from that of contractors.

Cost estimation in road construction using artificial neural network Ksenija Tijanic Diana Car-Pusic, Marija Sperac, Springer, 8 August 2019

The neural network has proven to be a promising approach to use in the initial design phase when there is usually a limited or incomplete set of data for cost analysis, and this method could yield much more accurate results and the estimation error could be reduced. Road construction projects on the territory of the Republic of Croatia are characterized by the overrun of planned costs. The experience of the contractor on previous road projects is an important element that can help to prevent errors and increase the chances of success in similar future projects.

Data on construction costs collected from past projects can be used to estimate costs at different stages of the project life cycle through artificial neural networks.

Evaluation of Constructions using Artificial Neural Network (ANN), Sandhya W T, International Journal for Modern Trends in Science and Technology, 09-November-2019

This study is to find the cost estimation by using Artificial Neural Network (ANN). Finally the accuracy of these models is identified with realistic estimated value. The method used to develop a neural network model analysis using Microsoft Excel Solver and trained in MATLAB software. These paper efforts are made to establish complete analysis of papers published related to ANN in construction. This paper discusses different research papers, articles, case studies that have been published in this field. There is great scope for ANN in the constructions cost estimation in future.

Construction Cost Estimation of Brazilian Highways Using Artificial Neural Networks Laís B. Barros, Marília Marcy and Michele T. M. Carvalho, International Journal of Structural and Civil Engineering Research Vol. 7, No. 3, August 2018

This paper focuses on the development of a more accurate estimation technique for construction highway projects using Artificial Neural Networks. Different architectures of the network with 10, 15, and 20 neurons were trained and tested with the back propagation algorithm. Based on this, data from fourteen highway projects in Brazil were collected and analyzed. Eleven parameters that contribute the most to the construction final budget were found after trials and errors. For the best scenario, an average cost estimation accuracy of 99% was achieved. This preliminary study showed the feasibility of the tool applied to projects in Brazil and may be used by public agencies in the future.

Estimation Model for I-Girder Bridge Superstructure Using Multiple Linear Regression and Artificial Neural Network, Inas Winalytra, Arief Setiawan Budi Nugroho, Applied Mechanics and Materials2018

Cost estimation model was developed based on thirteen data of detail engineering design of I-girder Bridge in Daerah Istimewa Yogyakarta (DIY). Factors influencing the cost of the superstructures of the I-girder Bridge were identified. Bridge span and width, the size of the sidewalk, and railing's type are considered as variables affecting the cost of superstructures. These variables are then arranged into two different analysis Multiple Linear Regression (MLR) analysis and Artificial Neural Network (ANN), in order to obtain the best estimation model. The results of the analysis showed that bridge span and width were the significant factors influencing cost.

An artificial neural network (ANN) model proposal for cost minimization and cost estimation based on building dimensions for reinforced concrete duplex villa in preliminary design, Latif Onur UĞUR, 2017

This study is to create connections / graphs showing the change of different design parameters and unit and average costs for reinforced concrete duplex houses. In this way, optimum cost-effective designs can be achieved. Another objective is to realize a cost estimation model based on a limited number of design parameters. Such a model will contribute to time and time savings in estimating low error rate cost to the preliminary design phase.

Construction cost prediction using neural networks Smita K. Magdum and Amol C. Adamuthe, ICTACT Journal on soft computing, October 2017,

This paper is to develop neural networks and multilayer perceptron based model for construction cost prediction. Different models of NN and MLP are developed with varying hidden layer size and hidden nodes. Four artificial neural network models and twelve multilayer perceptron models are compared. MLP and NN give better results than statistical regression method. As compared to NN, MLP works better on training dataset but fails on testing dataset.

Artificial Neural Network for Assessment of Energy Consumption and Cost for Cross Laminated Timber Office Building in Severe Cold Regions Qi Dong, Kai Xing and Hongrui Zhang, Research Article, 30 December 2017

This paper aims to develop an artificial neural network (ANN) to predict the energy consumption and cost of cross laminated timber (CLT) office buildings in severe cold regions during the early stage of architectural design.

Eleven variables were selected as input variables including building form and construction variables, and the values of input variables were determined by local building standards and surveys. ANNs were trained by the simulation data and Latin hypercube sampling (LHS) method was used to select training datasets for the ANN training.

Quazi Sazzad Hossain "A review on neural network techniques for the prediction of road traffic accident severity" Md. Ebrahim Shaik, Md. Milon Islam, (2021)
According to Asian Transport Studies 7, predicting traffic accident severity is an important phase in the intelligent transportation and traffic management system since it allows drivers at higher risk of serious accidents to be classified and therefore avoided from crashing. Among the several types of NNs, the multilayer perceptron neural network is the most common, universal, simple, widely utilized for road accident prediction, and important for most activities.

"Comparison of crash prediction models using MLR and ANN" Aanal Desai, Dr. L. B. Zala, Amit A. Amin RT&A volume 16, 2021
Validation was used to compare the two models, which involved displaying a graph between projected crashes by the models and observed crashes. It was discovered that the ANN produced better results. The ANN model's R2 value is 88.79 percent. The MLR model, on the other hand, came in at 58.67 percent, which is lower than the ANN model. The results reveal that the ANN model outperforms the Multiple Linear Regression model when it comes to predicting road crashes.

"Crash Prediction Modeling of Two Lane Undivided Highways Using Artificial Neural Network" Nivea John, Archana S, International Journal of Scientific & Engineering Research, Volume 10, (2019)
The study concluded that the ANN model's superiority is demonstrated by its low error value and r2 value. As a result, artificial neural networks can be used to forecast the number of accidents on two-lane undivided roadways. This also serves as a platform for connecting ANN to other planning models in order to achieve the best results in the field of transportation planning.

"An Artificial Neural Network model for road accident prediction: A case study of Khulna metropolotan city" Ebrahim and Hossain Q. 4th International Conference on Civil Engineering for Sustainable Development (ISBN-978-984-34-3502-6), 2018
According to the report, the ANN technique is a more flexible and assumption-free methodology that can evaluate and compare all traffic accident features. The model's superiority is indicated by low mean squared error values. The findings showed that, based on appropriate data, forecasted traffic accidents are near enough to real traffic accidents to be reliable in predicting future traffic accidents in Khulna Metropolitan City.

"Predicting road traffic accidents using artificial neural network models" Borja García de Soto, Markus Deublein, Andreas Bumbacher, Bryan T. Adey Infrastructure Asset Management Volume 5, 2018
The study concluded that the ANN model's performance varied based on the type of accident. When evaluating predictions utilizing data from 2010 to 2012, it was discovered that the ANN and BN models performed similarly for minor and severe injury events.

IV. PROBLEM STATEMENT

"By studying different examinations like Highway survey and traffic analysis that the problem at city by pass Highway is due to insufficiency of Highway space for the vehicles to pass through the junction at different instants of time in a day which is effecting the free flow of traffic, and improper movement of traffic also results in occurrence of accident in different instants of time."

As previously said, the number of incidents is increasing year after year and has become a major source of safety concern. As a result, doing this research is vital in order to grasp the scale of the problem, as well as to understand what causes accidents and injuries and what steps can be taken to prevent them. Furthermore, an effective solution for ensuring the safety of road users must be offered.

V. AIM OF PROJECT

This study focuses on accident investigations along the Mumbai-Pune Expressway, which runs through the Pune District. The goal of this study is to identify the primary elements that influence the occurrence of accidents and to construct an accident prediction model utilizing Artificial Neural Networks (ANN)

VI. OBJECTIVES

- To collect road accident data on MPEW.
- To analyze the accident trend and accident parameters on MPEW.
- To determine the critical accident variables for accident prediction purposes.
- To develop an Accident Prediction Model for MPEW by using Artificial Neural Network (ANN) applied software.

VI. RESEARCH METHODOLOGY

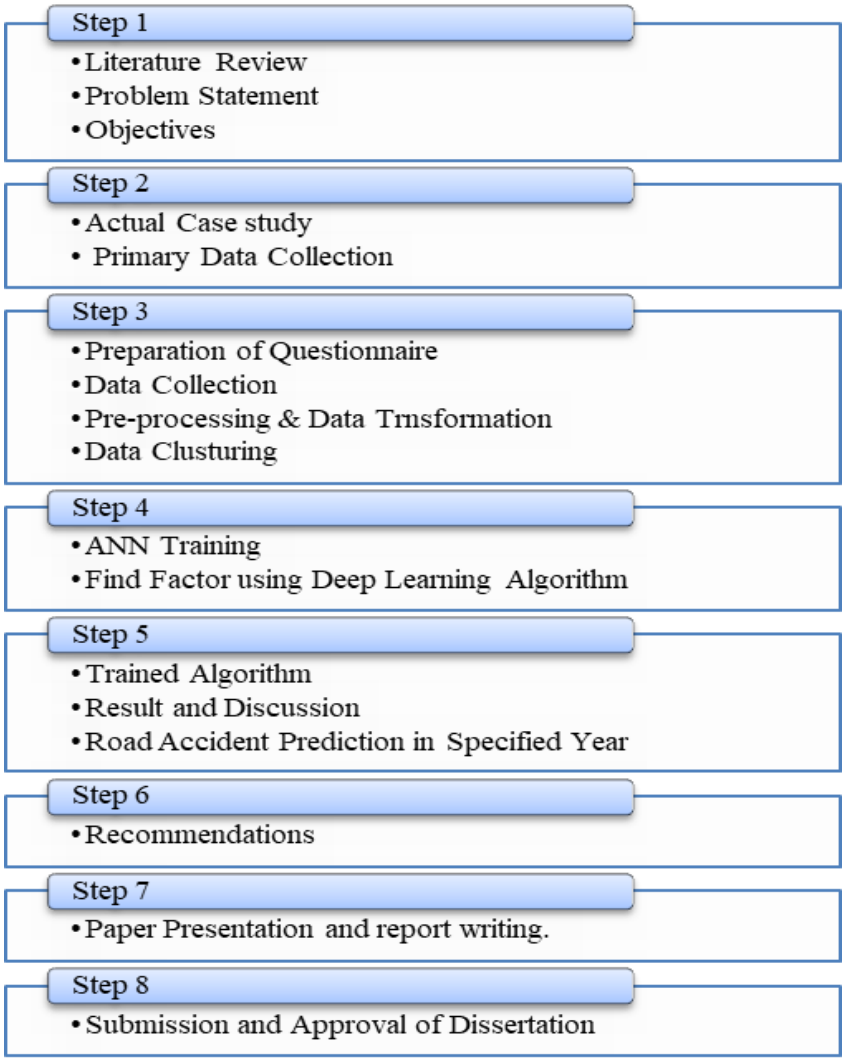


Figure1.2: Methodology Flow

Development and application of ANN model

What is ANN?

Artificial neural networks (ANNs) have gained popularity in recent years due to their ability to solve a wide range of issues. ANNs have been used to detect road traffic accidents in the transportation sector (RTAs). This section introduces basic neural network concepts and discusses why neural networks are appropriate for traffic data prediction.

A biological neuron is to the brain what an artificial neuron is to an ANN. The basic building block of the ANN is an artificial neuron. A neural network is a set of algorithms that attempts to uncover underlying relationships in a set of data by simulating how the human brain functions.

In this context, neural networks refer to neuron architectures that are either biological or artificial in nature. An ANN has three layers: an input layer that receives external signals, an output layer that sends external signals, and one or more hidden layers (nonlinear input transformations that have been entered into the network). Different learning rules have been employed for training networks. The multilayer perceptron (MLP) learning rule is one of the most well-known. MLP is a feed forward network in which data flows from the input side to the hidden layers and then to the output layer to generate outputs. The basic function of a neural network is depicted in Figure below.

The structure of an artificial neural network model for traffic accidents is depicted. The basic functions of all types of neural networks are data receipt from external situations or sources, deciding whether this data will be activated and taken into account or discarded as negligible, data analysis or error minimization through iteration of the data, and finally the output or performance for the entire trial.

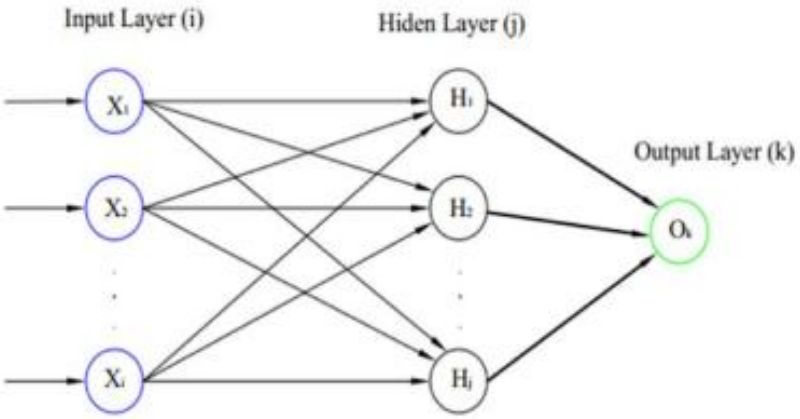


Figure1.3: General neural network structure

The total of the numerous x_n inputs multiplied by their corresponding weights of the relation w_n is thus the beginning stage of an artificial neuron. After that, the $w_n.x_n$ products are fed into the summing function, which is iterated to reduce error.

VIII. DATA COLLECTION & EXPERIMENTATION

The Mumbai–Pune Expressway (MPEW) (formally known as the Yashwantrao Chavan Expressway) is India's first 6-lane wide concrete toll road. It connects Mumbai, Maharashtra's capital, and Pune, the state's capital, across a distance of 94.5 kilometers. Pune, Maharashtra's cultural and educational hub, is India's financial capital. In the year 200, it was fully operationalized.

MPEW has witnessed a large number of road accidents, attributed to human errors and the large volume of traffic. In last three years 872 numbers of accidents have been recorded by Highway Police. Out of which 232 were recorded as fatal accidents and 268 users were killed, 392 were seriously injured and 67 suffered minor injuries.

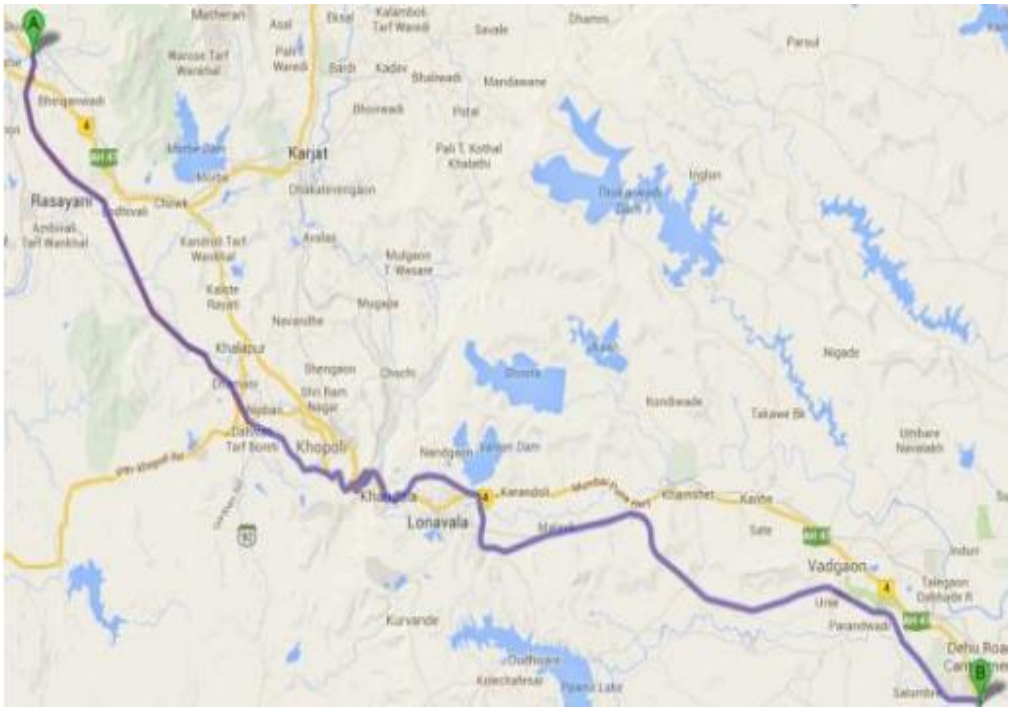


Figure1.4: Map Showing Mumbai – Pune Expressway

The expressway runs from Navi Mumbai's Kalamboli to Pune's Kiwale. Through passes and tunnels, it winds its way through the picturesque Sahyadri mountain ranges. Kon (Shedung), Chowk, Khalapur, Kusgaon, and Talegaon are the five interchanges. The two carriageways, each with three concrete lanes, are separated by a central median a tarmac or concrete shoulder on each side of the divider.

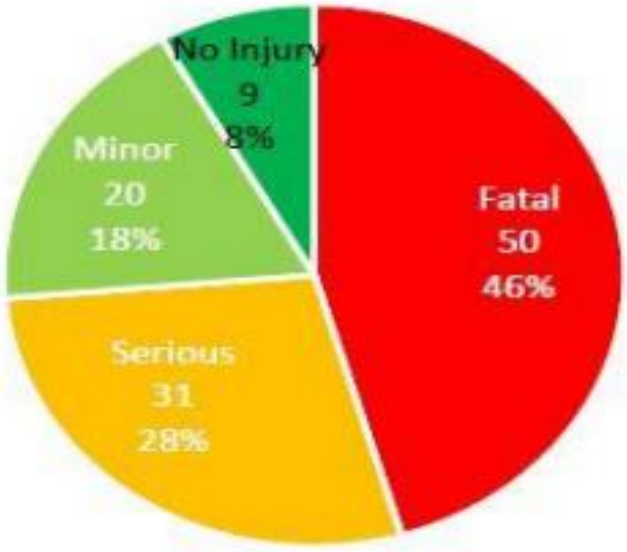
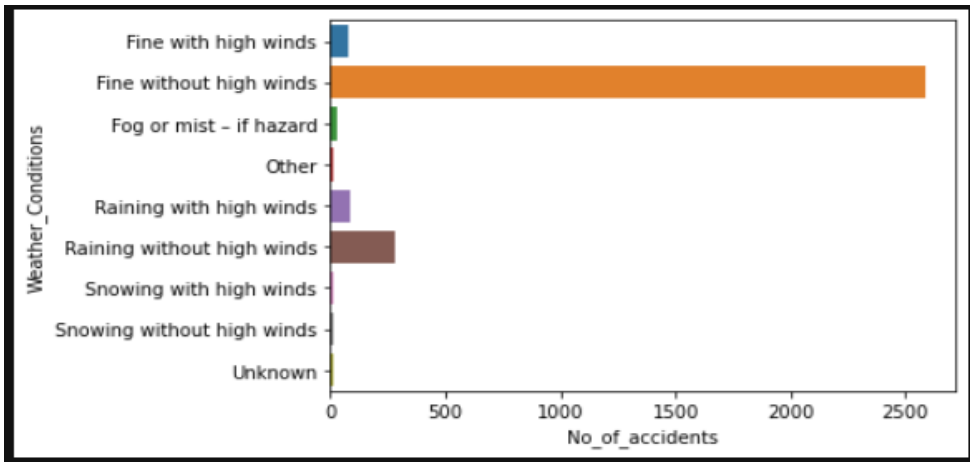


Fig1.5: Distribution of accidents by highest injury

Distribution of accidents by Weather Conditions



	Weather_Conditions	No_of_accidents	percent
0	Fine with high winds	81	2.603664
1	Fine without high winds	2588	83.188685
2	Fog or mist – if hazard	26	0.835744
3	Other	14	0.450016
4	Raining with high winds	84	2.700096
5	Raining without high winds	281	9.032465
6	Snowing with high winds	14	0.450016
7	Snowing without high winds	10	0.321440
8	Unknown	13	0.417872

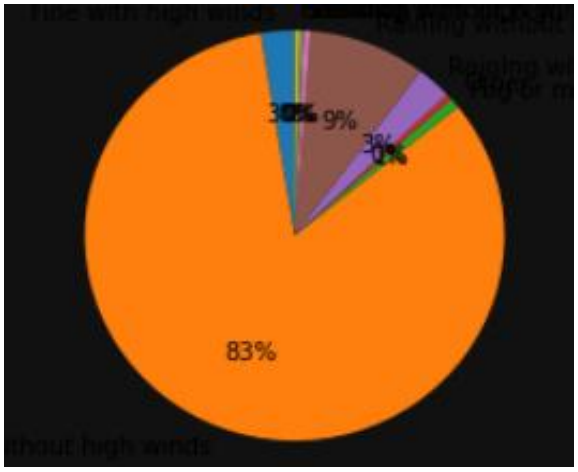
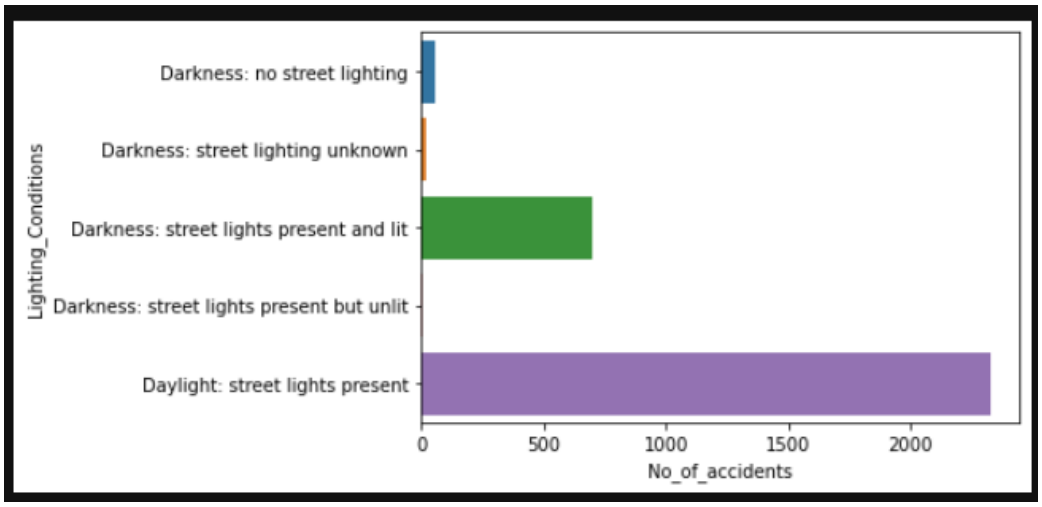


Fig. 1.6: Distribution of accidents by Weather Conditions

Distribution of accidents by Lighting Condition:

	Lighting_Conditions	No_of_accidents	percent
0	Darkness: no street lighting	58	1.864352
1	Darkness: street lighting unknown	21	0.675024
2	Darkness: street lights present and lit	696	22.372228
3	Darkness: street lights present but unlit	8	0.257152
4	Daylight: street lights present	2328	74.831244



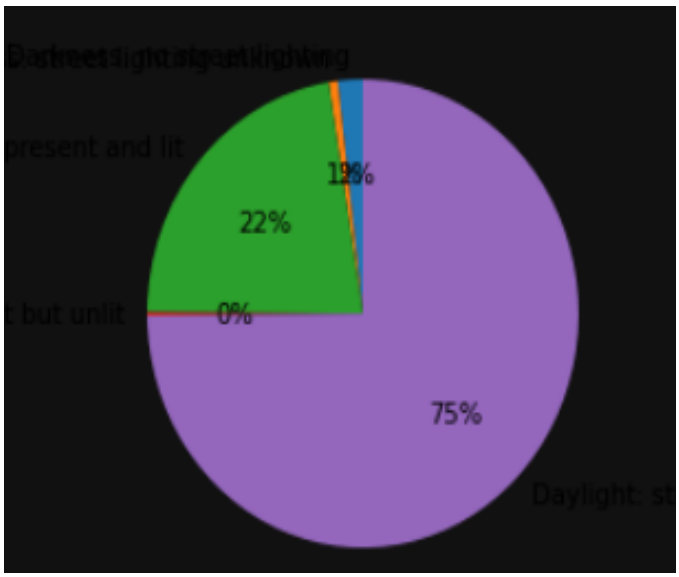
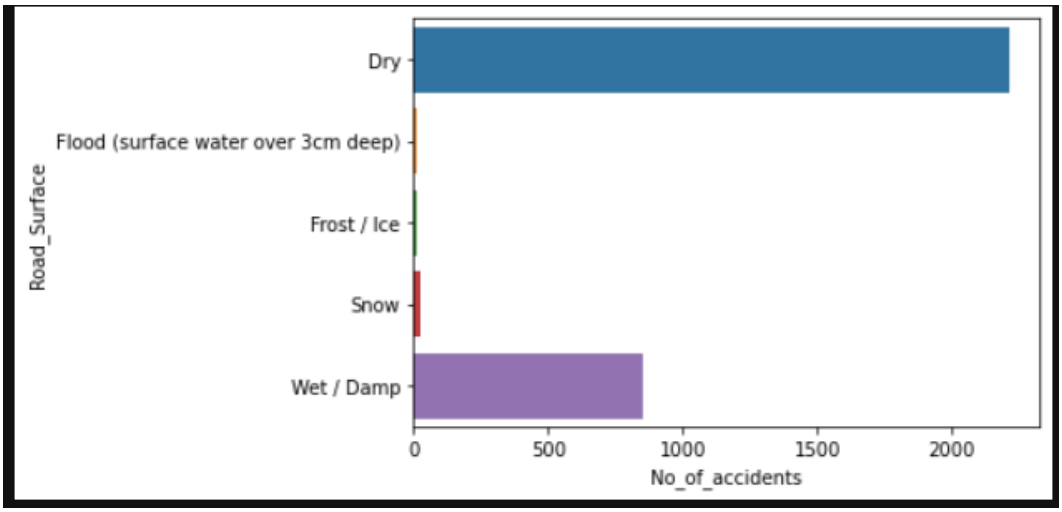


Fig 1.7: Distribution of accidents by Lighting Condition

Distribution of accidents by Road Surface:

	Road_Surface	No_of_accidents	percent
0	Dry	2216	71.231115
1	Flood (surface water over 3cm deep)	10	0.321440
2	Frost / Ice	13	0.417872
3	Snow	22	0.707168
4	Wet / Damp	850	27.322404



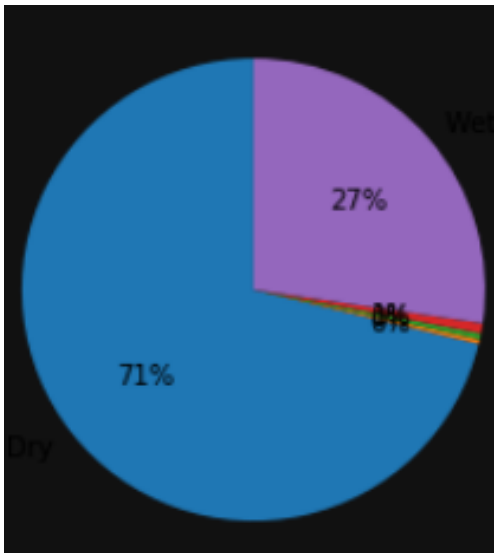


Fig 1.8: Distribution of accidents by Road Surface

Distribution of accidents Speed:

	Speed	No_of_accidents	percent
0	40	51	1.639344
1	45	67	2.153648
2	50	594	19.093539
3	60	666	21.407907
4	70	1056	33.944069
5	80	319	10.253938
6	90	160	5.143041
7	100	147	4.725169
8	110	51	1.639344

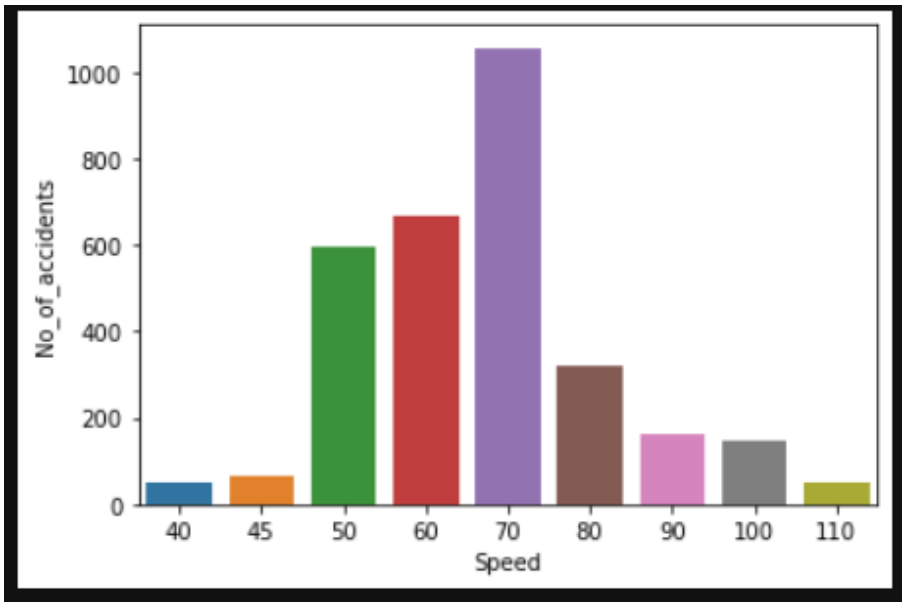


Fig 1.8: Distribution of accidents by Speed

Analysis of Contributing Factors

Most road traffic accidents and fatalities are caused by a combination of circumstances.

The injuries that resulted were thoroughly investigated and are detailed. Accidents and injuries are influenced by a variety of factors. The properties of contributing components are used to create a distribution.

The Venn diagram depicts (Human/Vehicle/Infrastructure) for road traffic accidents. The combination of human and vehicle components (56%) resulted in this diagram.

The combination of all factors (24 percent) has the greatest impact on the occurrence of accidents and the resulting injury cause, followed by human factors (14 percent).

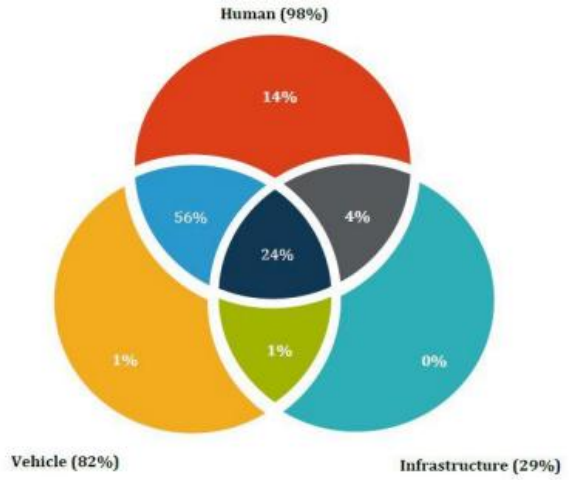


Fig1.9: Venn diagram distribution of accidents by contributing factor type

Table 1.1: Contributing human influencing the accidents

HUMAN FACTORS (Influencing accidents and injuries)	All accidents	Fatal accidents
Driver - Sleep/Fatigue/Drowsiness	35%	26%
Speeding - Exceeding speed limit	32%	38%
Overtaking on left side of vehicle	15%	24%
Improper lane change/lane usage	15%	12%
Parked - vehicle off the road	10%	10%
Driving too slow for conditions	10%	12%
Pedestrian – Dangerous behavior on roadway	10%	20%
Parked – Vehicle on road (Full or partial)	7%	12%
Driver Inattention	3%	4%
Pedestrian Inattention	4%	6%
Speeding - Excessive speed for conditions	4%	4%
Following too closely	3%	4%
Turning suddenly or without indication	3%	2%
Illegal road usage	2%	4%
Vehicle slowed down/ stopped suddenly.	2%	%
Driver – Alcohol	1%	2%
Seatbelt not used	66%	64%

Human error, vehicle characteristics, and infrastructure/ environmental factors are the three key contributing factors in traditional accident analysis. It should be noted that when investigating an accident, it is important to try to identify all possible contributing variables (human, vehicle, and infrastructure) that may have contributed to the accident's occurrence, as any of these aspects might have an independent or combined effect. Despite human flaws, this type of study provides a broader viewpoint and can aid in the identification of vehicle and infrastructure-related solutions.

Accidents and injuries are influenced by human factors.

For each contributing human component, Table1.1 tabulates all accidents and fatal accidents. More than one component can influence the cause of an accident or injury; thus, the sum of percentage influences will not match the amount of human variables influencing crashes.

Accidents and Injuries Caused by Vehicle Factors

The following are the vehicle factors that have been determined to have influenced accidents and injuries. The percentage of accidents is shown in table 1.2 each factor has an impact.

Table 1.2: List of contributing vehicle factor

VEHICLE FACTORS (Influencing accidents and injuries)	All Accident	Fatal Accident
Absence of Reflectors	4%	8%
Defective - Brakes	1%	2%
Vehicle-other	1%	2%
Passenger Compartment Intrusion - Underride/Override & Other	67%	72%
Seatbelts not available/usable	24%	20%
Knock-down of Pedestrian	11%	22%
Runover of Pedestrian	2%	4%
Unsecured Cargo	1%	2%
Ejection	16%	26%

Infrastructure Factors influencing Accidents and Injuries

Following are the contributing infrastructure factors determined to have influenced the accident. The table shows the percentage of crashes influenced by each factor

Table 1.3: List of contributing Infrastructure factors

INFRASTRUCTURE FACTORS (Influencing Crashes and Injuries on the MPEW)	**All accident**	**Fatal Accident**
Inadequate warning about accident / parked vehicle	8%	12%
Shoulder – Narrow	3%	2%
Sharp Curvature	2%	2%
Gap-in-Median	2%	2%
Poor road marking/signage	1%	2%
Slippery road surface	1%	--
Animal/Object on roadway	1%	--
Poor object conspicuity	1%	--
Object impacts - roadside – manmade structures	12%	10%

Site images of Infrastructure factors causing accidents (Image source: JP research India, accident report (2020)

Unguarded bridge pier Bridge wall

Curbstones & flowerpots

Narrow sholder

Roadside parked vehicle with no sholder

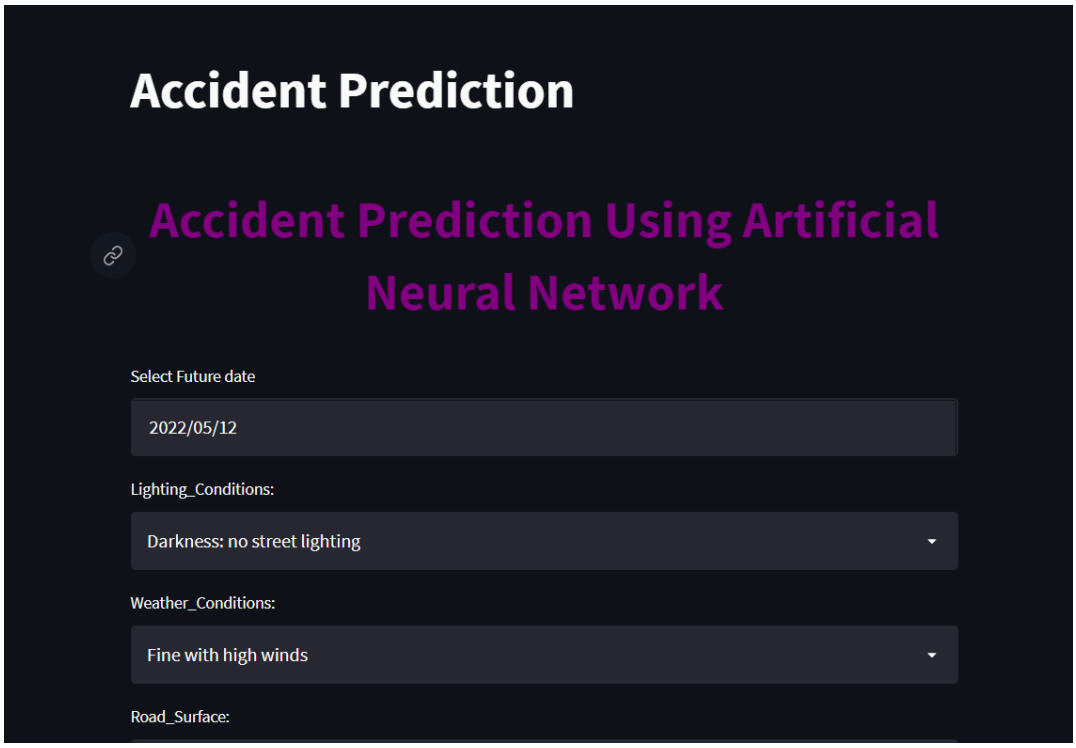
Concrete barrier

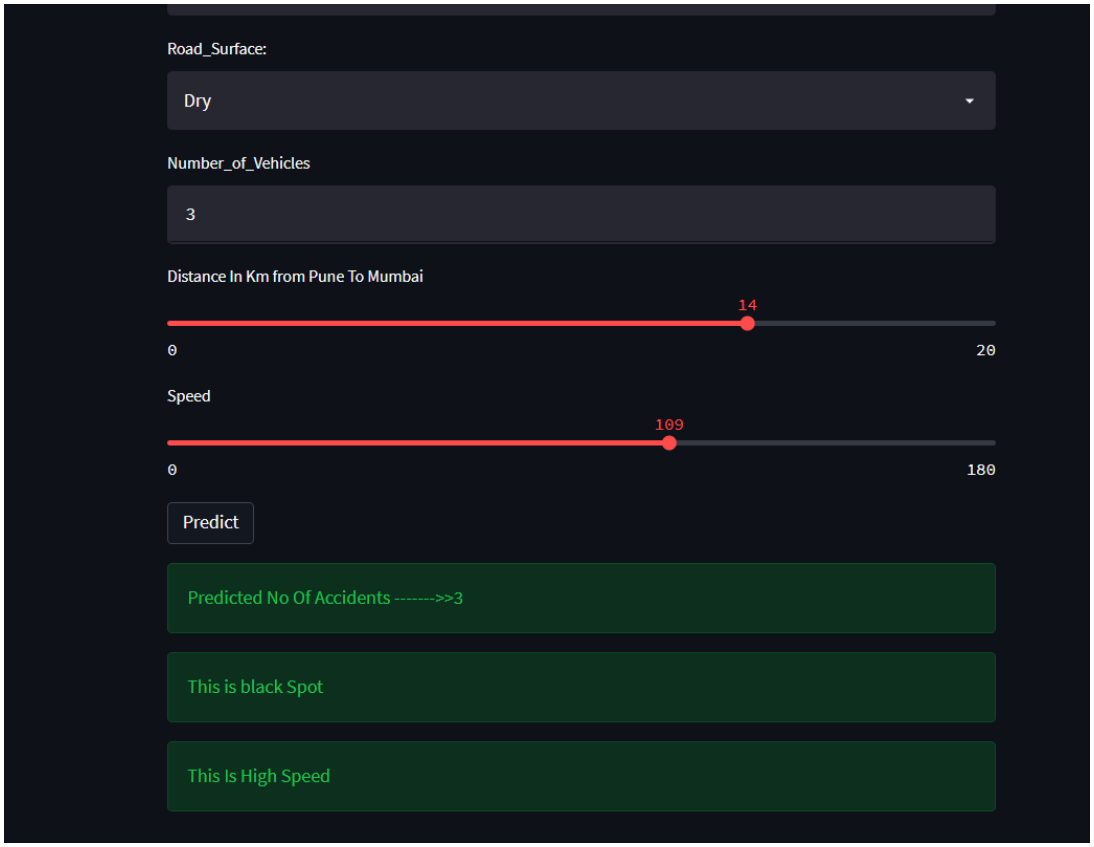
CONCLUSION

The following are the important results based on the above discussions on road traffic accidents for the Mumbai-Pune Expressway:

- Between the hours of 00:00 and 09:00, 56 percent of all accidents and 54 percent of fatal accidents occur.
- Crashes with another vehicle going ahead, waiting, or stopped (rear-end collisions), leaving the carriageway to the left or right, and pedestrian accidents account for 90% of all accidents and 94% of fatalities.
- Trucks, vehicles, and pedestrians account for 95% of all road users engaged in collisions and 98 percent of all road users with at least one fatality.
- Car occupants were outside the vehicle in 4.58 percent of pedestrian accidents while the vehicle was parked, broken down, or being pushed to the side of the road.
- Factors that cause accidents, together with their severity in percentages

RESULTS


Accident Prediction
Accident Prediction Using Artificial Neural Network
Select Future date
2022/05/12
Lighting_Conditions:
Darkness: no street lighting
Weather_Conditions:
Fine with high winds
Road_Surface:


Road_Surface:
Dry
Number_of_Vehicles
3
Distance In Km from Pune To Mumbai
14
0
20
Speed
109
0
180
Predict
Predicted No Of Accidents ------->>3
This is black Spot
This Is High Speed

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