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ASSESSMENT AND INVESTIGATION OF AN AUTONOMOUS NEURAL NETWORK-ORIENTED MODEL FOR PREDICTING TRAFFIC ACCIDENTS

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Abstract

The swift pace of urbanization has notably enhanced people's lifestyles, yet it has concurrently strained road infrastructure due to the surge in vehicle ownership, exacerbating traffic congestion at an alarming rate. The escalation in traffic volume stands out as a primary catalyst for road traffic accidents amid these burgeoning urban areas. In rapidly evolving metropolitan hubs, road traffic accidents loom large as a pressing concern. A significant body of research underscores the breadth of this issue and advocates for requisite remedies. Among all unnatural fatalities, road traffic accidents rank third, underscoring their gravity. Despite efforts by transportation engineers and academics to design roads adhering to appropriate standards, the inevitability of traffic accidents persists. When accidents occur, prompt identification of causative factors and implementation of apt corrective measures are imperative. This study aims to deepen understanding of the road traffic accident predicament along the Mumbai Pune Expressway (MPEW) and elucidate factors contributing to its elevated accident rates. Employing Artificial Neural Networks (ANN), this research endeavors to construct an accident prediction model to anticipate accident occurrences along the MPEW.

Keyword: ANN, MPEW, Road traffic Accidents, Planning, Deep learning Algorithm, Highway, Expressway.

INTRODUCTION

In recent years, substantial resources and effort have been dedicated to enhancing road and highway safety. However, transportation engineers continue to grapple with the challenge of designing and managing transportation systems that not only reduce travel time but also prioritize safety, among other social objectives.

India has witnessed a remarkable surge in road transportation and automotive traffic, driven by rapid economic growth and evolving consumer habits. This exponential growth has led to hazardous conditions on Indian roads, including highways and expressways, resulting in a concerning rise in traffic accidents, fatalities, and injuries year after year.

While road accidents are a global phenomenon, their impact is particularly severe in diverse communities like India's. The traffic situation on Indian multi-lane motorways might be even graver than reported due to incidents being underreported.

Additionally, factors such as poor vehicle maintenance, reckless driving practices, inadequate law enforcement, and a lax attitude among road users exacerbate the safety challenges on the roads. Consequently, road safety, especially on highways, has emerged as a pressing concern for both professionals and the general populace.

Road accidents not only cause loss of life but also entail significant economic ramifications, including property damage and productivity losses due to injuries. The annual cost of fatalities alone is estimated to surpass billions of dollars. Thus, road safety assumes critical importance as both a public health and safety concern and a developmental issue, given its far-reaching impact on the economy, public health, and overall well-being, particularly for individuals from less affluent backgrounds.

The economic progress of any nation is intricately linked to the availability and effectiveness of its transportation systems. The primary goal of these systems is to enable the smooth and secure movement of goods and people between different locations. However, the proliferation of automobiles on roads has brought about a pressing social concern in the form of traffic accidents, leading to loss of lives and property.

Numerous accident studies have revealed that road accidents stem not from natural phenomena but rather from human negligence and a lack of adherence to road safety regulations.

Additionally, environmental factors such as winter fog contribute significantly to the occurrence of road accidents. Consequently, ensuring road and highway safety has become an indispensable requirement in contemporary society.

In an effort to address road accident fatalities, the Maharashtra State Highway Police launched the "Highway Mrityunjay Doot" project on March 1, 2021. Through a comprehensive analysis of road accident fatalities, it was determined that the lack of prompt medical assistance posed a significant concern. Many instances revealed that injured individuals were not promptly evacuated and transported, exacerbating their medical conditions. To address this issue, groups comprising employees from nearby malls, petrol pumps, local eateries, hotels, and neighbouring villages were formed as part of the project.

These groups, known as "Mrityunjay Devdoot" (Angels of God), undergo training in first aid, including cardiopulmonary resuscitation (CPR), precautionary measures for lifting and transporting injured individuals, and more, facilitated by government, semi-government, or social organizations. The "Highway Mrityunjay Doot" project by the Maharashtra State Highway Police aims to prevent such scenarios and ensure timely and efficient evacuation of injured individuals within the critical "Golden Hour."

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.

The term "Artificial Neural Network" is derived from Biological neural networks that develop the structure of a human brain. As 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 must understand what a neural network consists of. To define a neural network that consists of many artificial neurons, which are termed units arranged in a sequence of layers. Itlooks at various types of layers available in an artificial neural network.

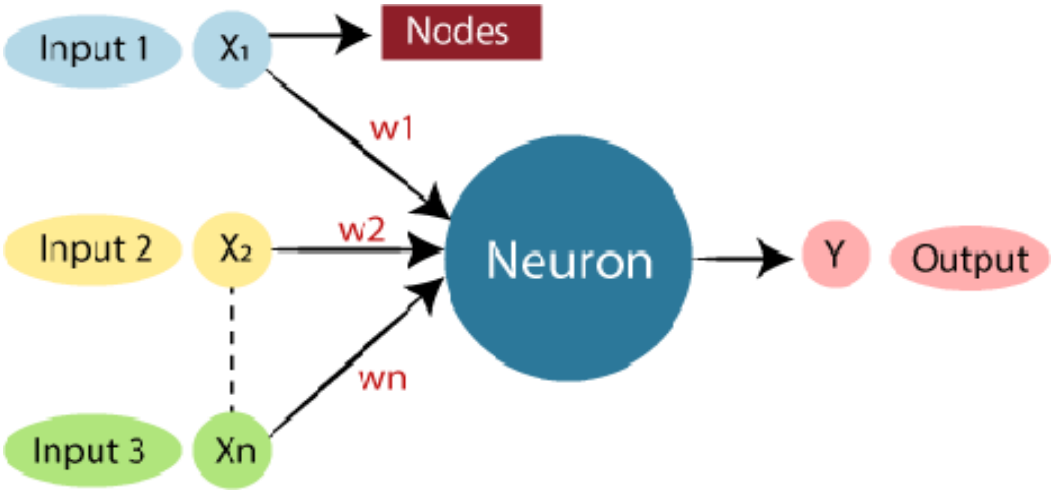

Fig 1: ANN Working

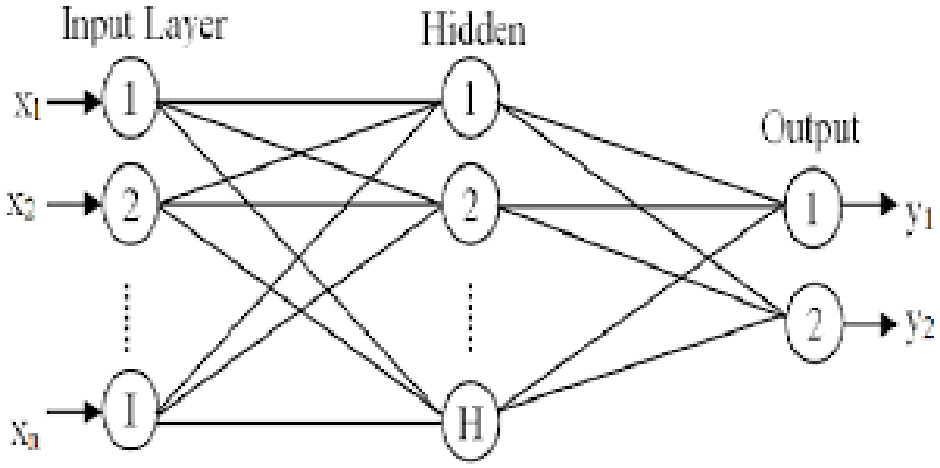

Fig 2: ANN Layers

Artificial Neural Networks (ANNs) typically consist of multiple layers, each performing specific operations on the input data. Here's a brief overview of the common layers found in ANNs:

Dense (Fully Connected) Layer:

Let x be the input vector to the layer, W be the weight matrix, b be the bias vector, and f be the activation function. The output y of a dense layer can be calculated as:

y=f(Wx+b)

Convolutional Layer:

Let I be the input feature map, K be the convolution kernel (filter), b be the bias term, and f be the activation function. The output O of a convolutional layer can be calculated as:

Oi,j=f(∑m,nIi+m,j+n·Km,n+b)

Here, (i,j)(i,j) represents the spatial location of the output feature map, and (m,n)(m,n) represents the spatial location of the kernel.

Recurrent Layer (e.g., LSTM):

Let xt be the input at time step t, ht be the hidden state at time step t, f be the activation function, W be the weight matrices, U be the recurrent weight matrices, and b be the bias terms. The output yt and hidden state ht of a recurrent layer (e.g., LSTM) can be calculated as:

ht=f(Wxt+Uht−1+b)

yt=Some Function of ht

Pooling Layer:

Let I be the input feature map, and pooling_function be the pooling function such as max pooling or average pooling. The output O of a pooling layer can be calculated as:

Oi,j=pooling_function(Ii:i+s,j:j+s)

Output Layer: This layer produces the final output of the network. The number of neurons in the output layer depends on the task the network is designed for. For example, in binary classification, there might be one neuron representing the probability of the positive class, while in multi-class classification, there would be one neuron per class, often with a softmax activation function to produce class probabilities.

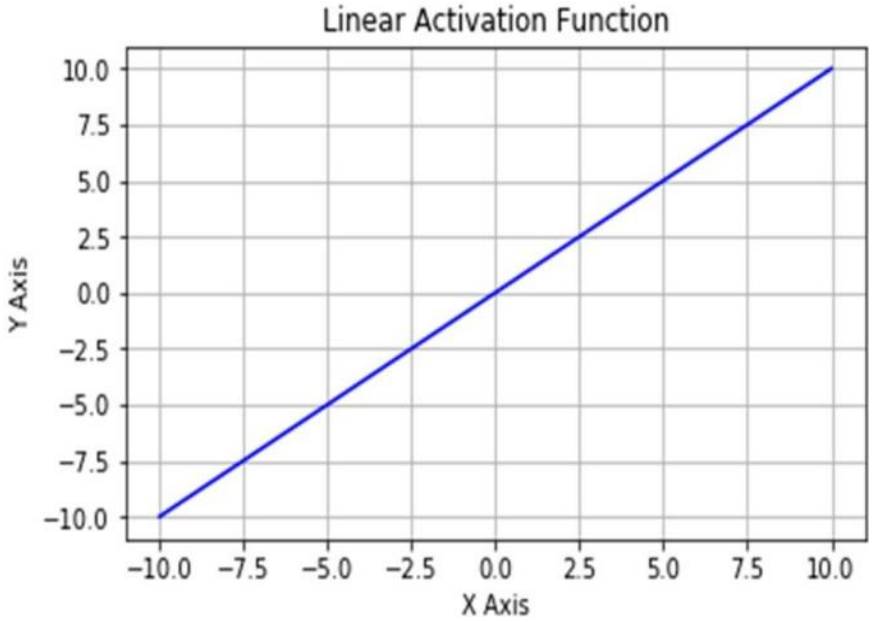

Fig 3: Linear Activation Function

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 does not do anything to the weighted sum of the input, it simply spits out the value it was given.Through examinations such as highway surveys and traffic analysis, it has been observed that the bottleneck issue on the city bypass highway stems from inadequate space for vehicles to navigate the junction at various times throughout the day. This limitation significantly impedes the smooth flow of traffic, leading to improper traffic movements and, consequently, an increase in accidents.

As mentioned earlier, the escalating number of incidents year after year has emerged as a significant safety concern. Hence, conducting this research is imperative to comprehend the magnitude of the problem, identify the root causes of accidents and injuries, and devise preventive measures. Moreover, it is crucial to develop effective solutions to ensure the safety of road users.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).

Objectıves

- 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.

RESEARCH METHODOLOGY

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.

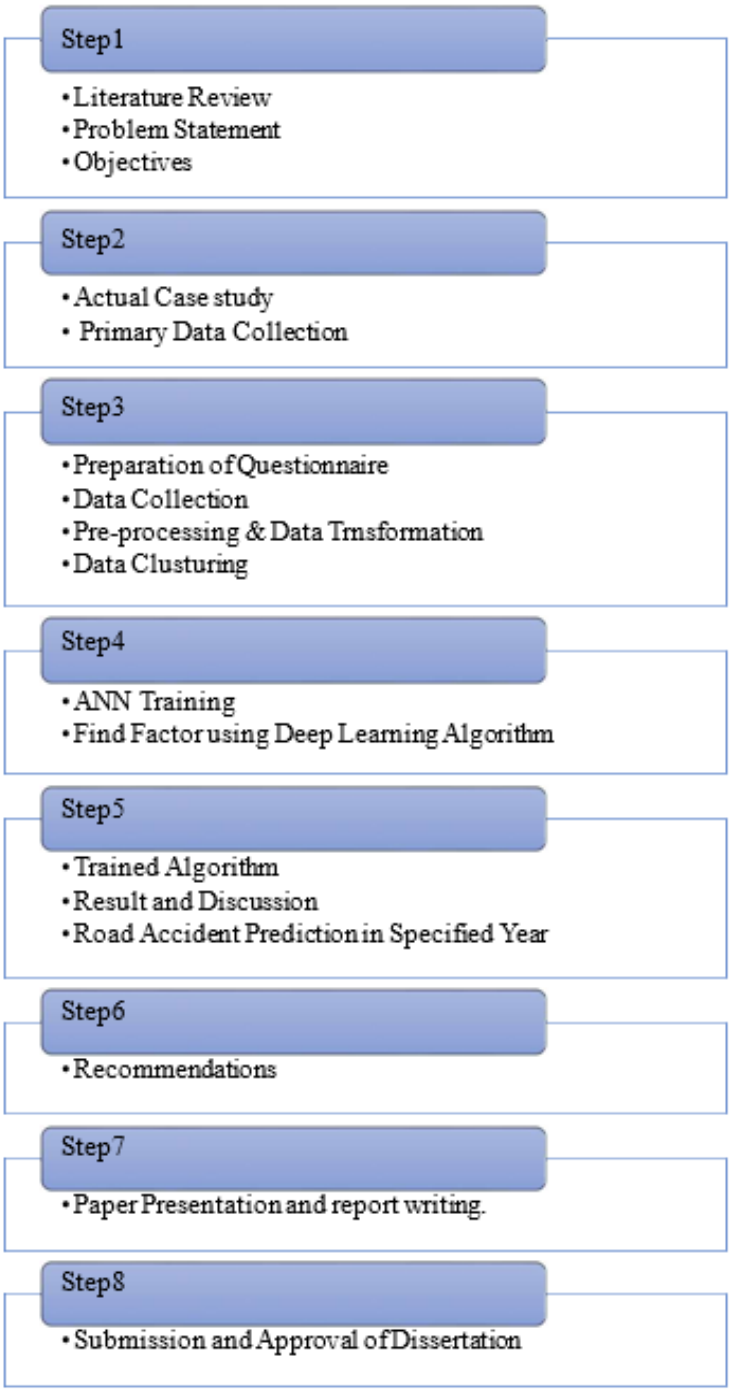

Fig 4: Proposed Methodology

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.

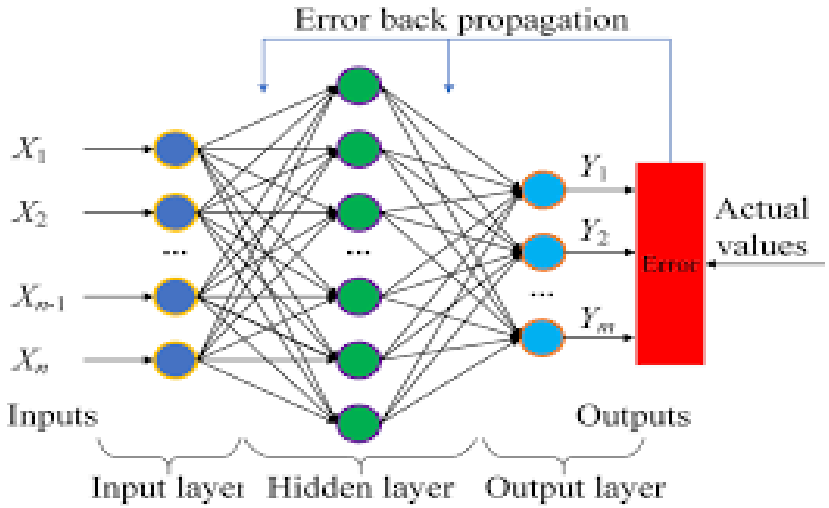

Fig 5: General neural network structure

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

LITERATURE SURVEY

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 InferenceSystem and Regression Analysis ShabniyaVeliyampatt, 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, 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 systematicreviewon machinelearningtechniques 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, FaridaddinVahdatikhaki, 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. “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.

Literature section explains and summarizes the different types of road accident prediction neural network models that have been studied in recent years. The accident prediction models reported in literature largely employ the fixed parameter modelling approach, where the magnitude of influencing of factors are fixed for any observation in the population. Several influencing variables related to traffic and road geometry that contributes to accident occurrence can be identified and to develop accident prediction models.The mixed traffic on Indian multilane highways/expressways comes with a lot of variability within, ranging from difference in vehicle types. This could result in variability in the effect of influencing variables on accidents across locations. The variability in factors and condition can be treated by ANN as it is a flexible model that can fit very effectively to the given data also, it is efficient and quick in analysis of the available dataset whether it is large or having statistical deficiencies.Hence for ANN is an efficient tool for the analysis of such models and is relatively new in transportation safety literature.

Manual questions:

- Do you consistently wear the necessary safety gear (e.g., helmets, gloves, goggles)?
- Have you received safety training relevant to your job?
- How often do you undergo safety training or refreshers?
- Are you aware of emergency procedures and protocols?
- Is safety equipment provided by the employer adequate and regularly maintained?
- Have you experienced any accidents or near misses in the past? If yes, please describe.
- Have you observed any accidents or near misses involving coworkers? If yes, please describe.

- Do you have any medical conditions that may affect your ability to perform your job safely?
- Are you well-rested and in good physical condition when performing your duties?
- Do you feel comfortable reporting safety concerns to your supervisor or management?
- How is safety communicated and promoted within your workplace?
- Are there any environmental factors that could contribute to accidents (e.g., weather conditions, poor lighting)
- Are there any ongoing maintenance or repair issues that could pose safety risks?
- Is there anything else you would like to add regarding workplace safety or accident prevention?
- Was distracted driving a factor (e.g., phone use, eating)?
- Was driving under the influence of alcohol or drugs a factor?
- Were there any signs of fatigue or drowsy driving?
- Response time of emergency services (police, ambulance, etc.).
- Description of any injuries sustained by drivers or passengers.
- Were there any witnesses to the accident? If yes, what did they observe?
- Did the drivers involved provide statements regarding the accident?
- Were any citations issued or charges filed as a result of the accident?
- Were any changes made to road signage or infrastructure following the accident?
- In hindsight, what measures could have been taken to prevent the accident?
- Are there any suggestions for improving road safety in the area?
- Is there any other information relevant to the accident that hasn't been covered?

RESULTS

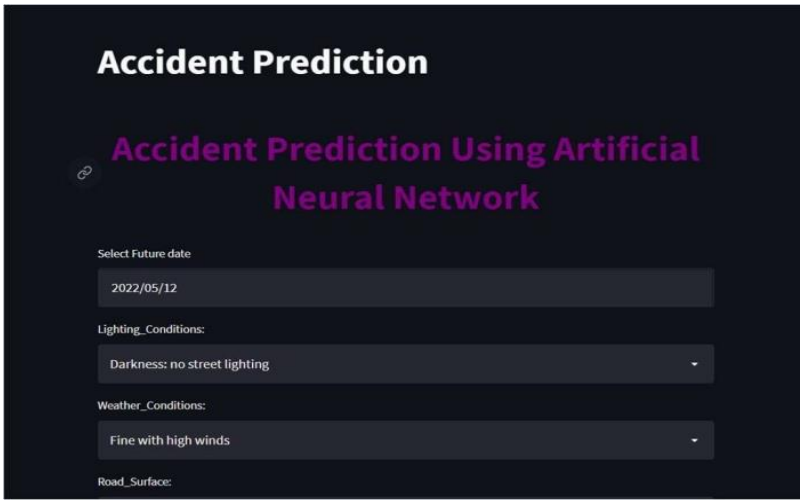

Fig 6: Accident Prediction using ANN

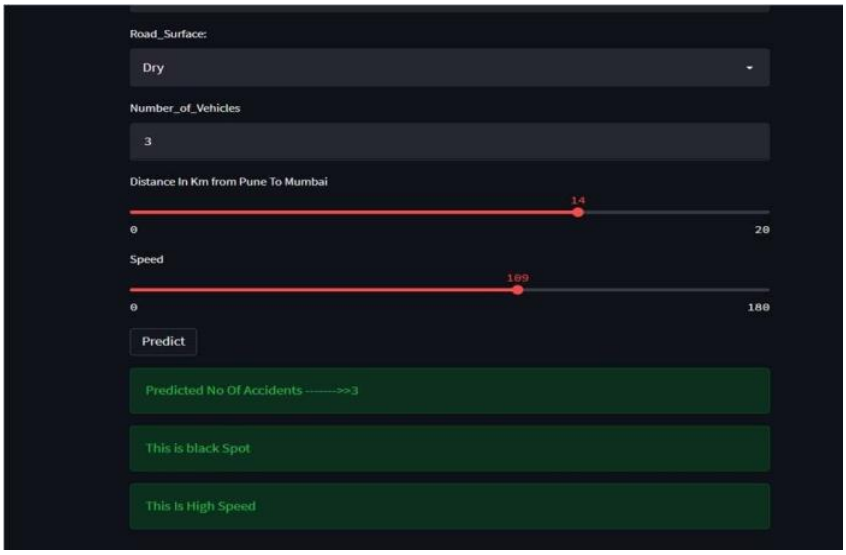

Fig 7: Number of prediction accidents

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

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