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Survey on traffic flow prediction for intelligent transportation system using machine learning

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Abstract

Controlling traffic has been a problem in the past for a very long time. The technological age demands it. Nowadays, one of the primary means of technological advancement is the automobile. Intelligent Transportation Systems, also referred to as Intelligent Traffic Systems, use communication and information technology to address traffic control issues. The primary issue in transportation is the intelligent transportation system. A programme is ITS. By utilising sensors and connectivity, it is used to increase the effectiveness of transportation through sophisticated technologies. Through the use of the most recent traffic management systems, several issues, such as traffic congestion and low safety, can be resolved. The use of information, control, and electronic technologies that are based on wireless and wired communication enhances ITS.

Keywords: TFP; Traffic Congestion; Datasets; Deep learning

1. Introduction

The management of traffic in big cities could be difficult. Intelligent transportation systems have been put in place in many nations to reduce the costs related to traffic congestion (ITS). Models for predicting traffic flow can be helpful while developing ITS. Traffic Flow Prediction is useful in both local transportation and area management. Using information gathered from one or more observation stations over a prior time period, the TFP issue, a time series (TS) problem, aims to anticipate the amount of urban road traffic at some future time. The goal of this study is to use a TFP algorithm to teach the system to forecast traffic. Based on the user's search, the system may offer suggestions. Multiple causes interact dynamically to cause traffic congestion. These variables include changes in road design, traffic volume over time, meteorological information, accidents, road repair activities, and more.

2. Literature survey

Regarding the research topic, references are recognized in a number of ways. A summary of the literature review of the research initiatives that have been covered in the literature on the selected topic is provided in the section that follows.

Kumar, B. R., et al: In order to plan, oversee, and evaluate transportation projects. Offer a model for determining traffic volume. Even though numerous TFP approaches, such as time-series analysis, real-time, and historical, have been

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proposed, it is difficult to assess the accuracy and efficacy of time in prediction and there are conflicting results. Real-time ANN and SVR technology are used to anticipate traffic effectively.

Kumar, K., et al: It was advised to estimate short-term TF using an artificial neural network based on historical traffic data. Among the elements that are taken into consideration are the amount of traffic, the speed, the density, the day of the week, and the hour. In contrast to earlier analyses in the literature, this approach does not employ the average TF speed as an input variable. Instead, a number of input variables, including the speed, are used depending on the type of vehicle. The results demonstrate that the Artificial Neural Network functions as anticipated even when the TFP time period is expanded from 5 to 15 minutes. Furthermore, they show that the results are still good even when the input speeds of various automotive kinds are taken into account separately.

Salamanis, et al: Provide a mechanism for calculating traffic flow along with detailing both usual and atypical traffic scenarios. DBSCAN may be used to recognize traffic patterns since it employs a number of prediction models to illustrate a traffic pattern for each cluster in both normal and abnormal situations. A TS analysis-derived ARIMA model was integrated with the machine learning methods k Nearest Neighbor and Support Vector Regression (ML).

Wu, Y., et al: Show that a DNN can predict TF given a large amount of data. Modern DNN models perform better than straightforward approaches, however there are still issues with correctly using the spatial-temporal properties of TF. We restrict their comprehension as well. A DNN-BTF model to improve prediction accuracy is reported in this study. The DNN-BTF model is largely responsible for the TF's spatial-temporal periodicity. RNN were employed to mine temporal qualities, whereas CNN were utilized to mine spatial properties. The DNN-BTF model's comprehension of TF data was also demonstrated, dispelling the notion that neural networks are a "black-box" solution in the transportation sector. The proposed DNN-BTF model was assessed using PeMS data for a long-term horizon prediction challenge.

Ma, D., et al: They describe a powerful prediction-based pattern matching technique in their publication [12]. Historical data is first categorized using algorithms for grouping data based on patterns. Short-term memory and conventional neural networks are then utilized to train it separately for each group (CNN's-LSTM). The prediction that most closely resembles the training set of data is selected. It is determined for each time point how similar the target day and each group are to one another. They illustrate how picking the optimal predictor can improve prediction accuracy using a case study from Seattle.

Rahman, F. I.: To more accurately predict TF, integrates ML methods with three kinds of weather-related data. KNN, SVM, and ANN are three machine learning techniques used in this research. It could be challenging to select the optimum ML TFP model for a particular set of data, though. This study shows how choosing one of three essential ML algorithm components affects prediction accuracy. The weather training uses previous TF data for five months. Then, the TF for a month is predicted. In one-hour TFP, KNN performs better than SVM and ANN.

Jia, T., et al: A spatiotemporal neural network model based on deep learning is provided, it is crucial to carefully evaluate TF patterns in order to precisely build citywide traffic flow for each road segment. Temporal relationships are learned using recurrent conventional networks, whereas spatial dependencies and handling spatial sparsity are learned using tightly coupled conventional networks. They intend to incorporate a range of weights in their model since they want to combine the results of those hybrid networks. This goal is supported by outside data, like the day of the week. Using taxicab trajectory data from Wuhan, China, the model was trained and validated.

3. Results

Year	Author	Simulation Model	Types of prediction	ML/DL Algorithm used/ Comparative Model
2020	Kumar, B. R., et al.	ANN (R,Software and MATLAB)	Short Term Prediction	SVR ,ANN
2013	Kumar, K., et al	ANN Model	Short Term Prediction	Artificial Neural Network (ANN)
2018	Wu, Y., et al.	Hybrid model-Deep Neural networks (DNN-BTF) model	Long Term Prediction	Convolutiona Neural Network and Recurrent Neural Network
2018	Ma, D., et al.	CNN and Long short-term memory model.	Short Term Prediction	Deep neural network (DNN)
2020	Nadia Shamshad., et al	LSTM Model	Long -Short Term	ANN and Support Vector Machine
2015	Tselenti s, D. I ., et al	ARIMA	Short Term Prediction	ARIMA Bayesian model
2016	Xu, Y., et al	Variable Selection Based Support Vector Regression model	Short Term Prediction	MARS, Spatio Temporal Bayesian MARS, ARIMA
2015	Kumar, K. et al	Sensitivity Model	Short-Term Prediction	ANN and Sensitivity Model
2020	Qu, W., et al	KNN+ Elman	Short Term Prediction	Clustering, KNN, BP, Elman Neural network

4. Discussion and Future Works

This review's objective is to raise knowledge of IT'S and TFP in general. Numerous papers have examined various methods for determining TF for ITS. Some studies have focused primarily on studying seasonal TFP, and accurate methodologies are required to estimate urban TF. The majority of researchers use readily available datasets to demonstrate how well their work is understood or evaluated. The accuracy of the model could deteriorate when applied to real-world datasets. It is also underlined how challenging it is to create a TF forecast system that can account for all elements. This review article's main goal is to give an overview of ML-based TFP and its application in ITS. It's conceivable that using using ML-DL techniques will help in handling traffic forecasting properly. Peer-reviewed studies state that one crucial area of study is how to build a model that can capture the temporal and geographical features of TF while also forecasting the complex future conditions. More research is required in the field of integrated hybrid learning model utilization in ITS traffic forecasting.

5. Conclusion

It has been determined that a machine learning algorithms will be used to construct the traffic flow prediction system in the system. The price of fuel is also having a significant impact on the transportation sector. The high cost of fuel prevents many individuals from affording the car. Consequently, there may be various variations in the traffic data. There is another situation when people would prefer to go alone and not share a vehicle; this has an impact on traffic congestion. In light of these comparisons with these years' worth of data sets, this projection can assist in evaluating the traffic flow. The forecasting or prediction can assist consumers or users in making an informed decision about how to navigate the road traffic and choose which route to take.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest.

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