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A Survey Paper on Traffic Prediction Using Machine Learning

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Abstract: ***Traffic flow prediction is an essential tool for traffic management, which can assist traffic operators in making informed decisions for traffic control and management. Accurate traffic flow prediction can also help commuters to plan their journeys efficiently and reduce travel time. The use of Support Vector Regression algorithm for traffic flow prediction has shown promising results in various studies, and it can be used to predict traffic flow at different time intervals, such as hourly, daily, weekly, or even yearly. Additionally, the application of machine learning and artificial intelligence techniques can further enhance the accuracy of traffic flow prediction, which can lead to more effective traffic management strategies.***
Keywords: Support Vector Machine, Traffic Prediction.

I. INTRODUCTION

The demand for efficient and intelligent transportation systems has increased with the growing population and urbanization. An intelligent transportation system applies innovative and advanced techniques to provide intelligent services to different modes of transport, making the transportation system more effective. These techniques provide traffic information to users in advance, improving the coordination and safety of the transport network. Accurate prediction of traffic flow is crucial for making decisions such as route guidance, mode of transport, and travel time. Congestion management, incident detection, and individual dynamic route guidance all require accurate prediction of traffic flow on the given road network.

Support Vector Machines (SVM) is a type of supervised learning algorithm that is widely used for classification and regression problems. It is grounded in statistical learning theory and can be used to define a function that predicts features of future data. Traffic flow prediction is a non-linear problem that can be addressed using support vector regression (SVR). However, it requires mapping the traffic flow prediction problem from a low-dimensional space to a high-dimensional feature space. Traffic flow is a time-varying quantity and exhibits non-linear and random characteristics.

In conclusion, an intelligent transportation system that can accurately predict traffic flow is essential for efficient and safe transport networks. SVM and SVR are effective tools for traffic flow prediction, which can aid in congestion management, incident detection, and individual dynamic route guidance. These techniques are grounded in statistical learning theory and require mapping from low-dimensional spaces to high-dimensional feature spaces to address non-linear and time-varying traffic flow characteristics.

II. LITERATURE SURVEY

In [1], the proposed method for traffic flow prediction is intended to provide increased accuracy for more precise traffic movement forecasting. The author notes the potential for further enhancements as deep learning technology continues to advance. The study focuses on improving current traffic control systems and aims to benefit traffic management in smart cities. The model can be applied to improve traffic flow and enhance traffic control in real-world scenarios.

In [2], Accurate traffic flow data is important for improving travel decision-making, reducing congestion, and lowering carbon emissions. Intelligent transit systems (ITSs) provide better accuracy for traffic flow prediction and are essential for the success of advanced traffic and public transportation systems. Real-time and historical data from various sensor sources are used for traffic flow dependency, but the large dataset dimension has made most existing traffic flow prediction systems and models somewhat inadequate. Transportation management is becoming more data-driven due to the increasing use of traditional sensors and new technologies.

In the paper [3], in order to predict road traffic in smart transportation systems, a classification model called m-KNN (Modified k Nearest Neighbour algorithm) was utilized, along with Principle Component Analysis (PCA) for feature extraction. To improve the accuracy of the m-KNN method, a preprocessing technique was applied to the training data, resulting in significant performance improvements. Accurately predicting road traffic is a crucial aspect of modern transportation systems, and this proposed method has proven to be a valuable tool in achieving this goal.

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In this[4] paper, by using various various computational techniques to improve the performance and precision of our predictions. Specifically, we employed a Support Vector Machine approach to distinguish between classification and regression tasks, with the ultimate aim of forecasting the values of our target variables.

In [5], the EAM (Efficient Automation Model) presented in this study demonstrates the benefits of automating the training and generalization of deep learning algorithms to achieve reliable and high-performing traffic prediction models. The numerical results indicate that the EAM has yielded promising results in terms of prediction accuracy and resource allocation.

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In [7], The SVM model offers strong learning capabilities and the ability to generalize well, especially when dealing with small sampleproblems. However, PSO may struggle with local optimal solutions, though the addition of a mutation operation can address this issue. The PSOM model has few parameters, a simple program, and a fast convergence rate. In this study, a traffic fatalities prediction model based on PSOM-SVM was developed, which optimized SVM parameters. The results showed that the PSOM-SVM model outperformed the neural network and BPNN methods in terms of prediction accuracy, as it avoided the problem of overlearning andoffered excellent generalization capabilities. While this model's application is limited to parameters like highway mileage, vehicle number, population size, and traffic fatalities, it is possible to supplement additional parameters in future studies to consider additional unknown factors. Ultimately, the PSOM-SVM model has the potential to reduce traffic accident casualties to some extent.

In [8], Ensuring a safe traffic environment and avoiding traffic congestion and accidents requires accurate prediction of traffic patterns. The Random Forest model is well-suited for this task, as it does not require initial weighting of properties and has a simple calculation process with low computational requirements. The model is also easy to implement, with fewer parameters and compatibility across a wide range of platforms. As a fast and effective data mining model, it has proven to be a valuable tool in predicting and preventing traffic congestion and improving overall traffic safety.

In [9], LSTM Networks are a powerful tool for traffic prediction, particularly in capturing long-term dependencies within traffic flow data sequences. As a deep learning approach, LSTMs are able to uncover latent feature representations that are not immediately apparent in the traffic flow data.

This paper[10] outlines a method for predicting short-term traffic flow in a transportation network, even when traffic data is not available. To achieve this, traffic flows were estimated in all links of the network using available information, and this information was used to make predictions for the entire network. By utilizing this approach, it is possible to better manage traffic flow and minimize congestion, even in situations where data may be limited or incomplete.

III. LITERATURE REVIEW

S.no	Paper Title	Author	Year	Algorithm/ Methodologies used	Disadvantages/limitations
1.	"Predicting Traffic for Intelligent Transport System Using Machine Learning Algorithms."	Sai Akshita Kanaparthy, Raveena Reddy Vemula, Sai Niyathi Padakant	2022	In this paper, different machine algorithms are employed for achieving higherefficiency and accurate results.To identify classification and regression, Decision Tree Algorithm (DT)is used. Based on the parameters supplied, it'sa graphical depiction of all possible solutions to a problem/decision.	Decision trees can be difficult to interpret and explain, particularly as the complexity of the model increases. This can make it challenging to communicate the results ofthe model to stakeholders, which is essential in trafficprediction for effective decision-making.

2.	"Prediction of HDD Failures by Ensemble Learning "	Narendran, Monishraj, Dr. Sathya Srivinas	2022	In traffic prediction, ensemble learning can be applied in several ways. For example, different models can be trained on different subsets ofdata, and their predictions canbe combined to produce an overall prediction.	Ensemble learning in traffic prediction can have some disadvantages, such as increased computational complexity due to the needto train multiple models. Additionally, ensemble methods may be more challenging to interpret than individual models, making it more difficult tounderstand how the predictions were made.
3.	"Traffic Data predictionin Intelligent Transportation System using m-KNN algorithmand Principle Component Analysis"	P.Pavithra , R.Vadivel	2021	System employed m-KNN (Modified k Nearest Neighbour algorithm) as a classification model and PCA (Principle Component Analysis) is used for Feature Extraction. Road traffic prediction is a critical component in modern smart transportation systems.	The main difficulty encountered in dealing with problems of text mining is caused by the vagueness of natural language.
4.	"Traffic Prediction for Intelligent Transportation System using Machine Learning. "	Gaurav Meena, Deepanjali Sharma, Mehul Mahrishi	2020	To identify classification and regression we have used a Decision Tree Algorithm (DT).The goal of this method isto predict the value of the target variables. Decision tree learning represents a function that takes as input a vector of attributes value and return a "Decision " asingle output value.	Decision trees are prone to overfitting on traffic data. They lack robustness and may not provide accurate predictions on new, unseen traffic patterns.
5.	"Machine Learning Methods for Traffic Prediction in Dynamic Optical Networks with Service Chains."	Daniel Szostakand Krzysztof Walkowiak	2019	Dynamic Optical Networks (DONs) are being increasingly used in traffic prediction due to their ability to provide high bandwidth and low-latency communication. They enable efficient and reliable data transfer, which is essential for traffic prediction systems to work effectively.	DONs may not be scalable enough to handle large- scale traffic prediction problems, as they rely on complex optical components and may require significant computational resources.

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6.	"Deep Learning-Based Traffic Prediction for Network	Sebastian Troia, Rodolfo Alvizu, Youduo Zhou, Guido Maier, Achille Pattavina	2018	Used a particular type of RNN, the Gated Recurrent Units (GRU), able to achievegreat accuracy. Then, we used the predictions to dynamically and proactively allocate the resources of an optical network.	While RNNs are effective at capturing short-term patterns, theymay struggle with longer-term dependencies in traffic data.
7.	"Traffic fatalities prediction using support vector machine with hybridparticle swarm optimization Optimization	Xiaoning Gu , Ting Li, YonghuiWang, Liu Zhang, Yitian Wang and JinbaoYao	2017	The hybrid PSO algorithm can be used to optimize the weights and parameters of amachine learning model, such as a neural network orregression model, to minimize the error in the predictions. By combining multiple optimization techniques, the hybrid PSO algorithm can leverage the strengths of each technique and produce more accurate predictions.	Swarm optimization techniques, including hybrid particle swarm optimization, can have limitations in traffic fatalities prediction including potential computational expenseand difficulty handlingmissing or incomplete data.
8.	"Traffic flow prediction with LongShort-Term Memory Networks (LSTMs)."	Hongxin Shao, Boon-Hee Soong	2016	LSTM model was applied on the data collected by Caltrans Performance Measurement System (PeMS). PeMS offers historical database of traffic flow information..	Limited ability to capture long-term dependencies: While LSTMs are effective at capturing short-term patterns, they may struggle with longer-term dependencies in traffic data.
9.	"Traffic Prediction of Road Traffic Congestion Based onRandom Forest "	Yunxiang Liu1 , Hao Wu	2015	In this paper, the randomForest package in R is selected to construct the traffic congestion model based on RF algorithm.	Random Forests can be difficult to interpret, making it challenging to understand which features are most important in predicting traffic patterns.
10.	"Traffic Flow Prediction for Road Transportation Networks With Limited Traffic Data	Afshin Abadi, Tooraj Rajabioun,and Petros A. Ioannou	2015	Use of Deep Recurrent Neural Networks (DRNN). DRNN was chosen because of its remarkable performance in many applications including HDDs failure prediction.	The computation of this neural network is slow, training the model can be difficult task, also it faces issues like exploding or Gradient vanishing.

IV. CONCLUSIONS

Traffic flow prediction is an essential component of Intelligent Transportation Systems, serving as a foundation for advanced traffic information systems, advanced traffic control systems, and traveler route guidance systems. This study presents a traffic flow prediction model using support vector machine. Theexperiment's results demonstrate that the support vector machine-based model shows significant improvement in performance measures, providing satisfactory results. These findings indicate that the model is useful for predicting traffic flow in real-time, even for unknown data. Hence, the proposed modelcan be applied to real-world scenarios to enhance traffic management and improve the accuracy of trafficflow prediction.

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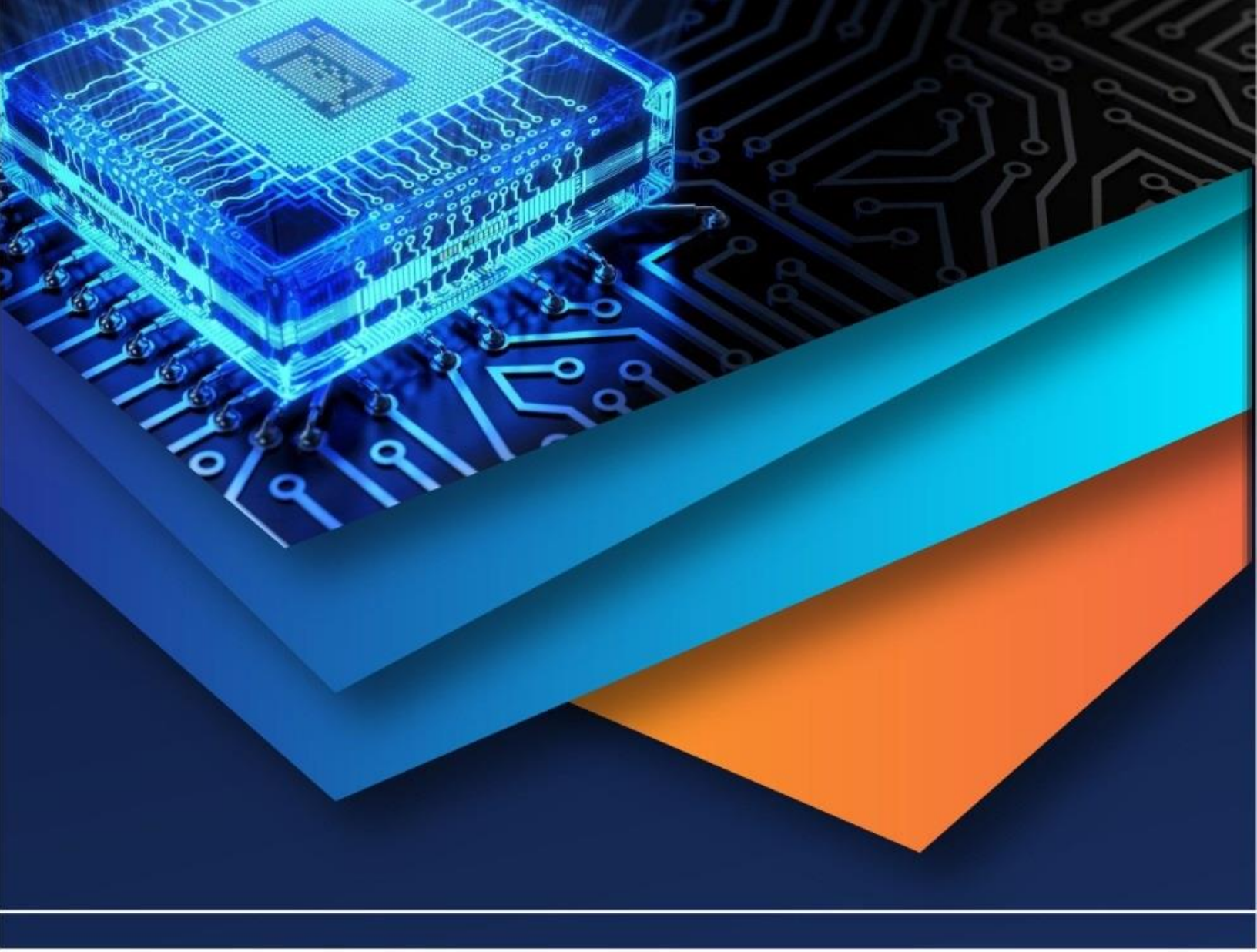
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