AN EFFICIENT METHOD FOR HIGHWAY VEHICLE DETECTION BASED ON SPEED WITH CONVOLUTION NEURAL NETWORKS OVER SUPPORT VECTOR MACHINE

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Article History: Received: 12.12.2022 **Revised:** 29.01.2023 **Accepted:** 15.03.2023

Abstract

Aim: To Enhance the Accuracy of Vehicle Based on Speed using Convolution Neural Networks in comparison to Support Vector Machine.

Materials and Methods: Detection and Classification of Vehicles is a demanding concern. This study contains two groups i.e Novel Convolution Neural Networks over Support Vector Machine. Each group consists of a sample size of 10 and the study parameters include alpha value 0.05, beta value 0.2 and the power value 0.8.

Results: The Novel Convolution Neural Networks is 85.50% more accurate than the support vector machine of 71.80% in Vehicle Detection.

Conclusion: The CNN model is significantly better than the SVM in Analysis of Vehicle Detection. It can be also considered as a better option for vehicle detection. The significance value for performance and loss is 0.921 ($p>0.05$)

Keywords: Novel Convolutional Neural Network, Support Vector Machine, Analysis, Detection, Classification, Accuracy.

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1. Introduction

Detection, tracking and categorization of objects can be utilized for a variety of applications(Nagmode and Joshi 2008). Object detection is used in the Intelligent Transportation Systems (ITS) area for vehicle and pedestrian detection,traffic sign and lane detection and vehicle make detection (Li 2004).The ability to identify or categorize traffic-related items allows for additional improvements in road and traffic flow, as well as the prevention of major traffic accidents and the registration of traffic infractions and crimes such as stolen cars or speeding (Liao et al. 2020).Vehicle detection is useful for a variety of transportation applications, including vehicle navigation, vehicle safety, and so on (Ohn-Bar, Sivaraman, and Trivedi 2013). One of the most promising non-intrusive techniques for large-scale data collecting and deployment of modern traffic control and management systems is vehicle detection using video cameras. Applications of vehicle detection are anti-theft vehicle tracking and security management, oil and gas industry, ambulance tracking management system (Pinz 2006)**.**

In vehicle detection there are 25 articles published in IEEE and 10 articles in Scopus or Google Scholar ScienceDirect**.** Humans can easily recognise automobiles in pictures or films and discriminate between different types of vehicles (Dalal, Triggs, and Schmid 2006). The complexity of vehicle identification and classification for a computer programme is highly dependent on the data format (Song et al. 2019). Lighting and weather are two of the most difficult factors to overcome, not to mention the overall quality of the photos or film (Chollet 2017). Vehicles exist in a variety of forms and colors, and some models are even identical. Furthermore, detecting a large number of moving objects in real time is much more difficult (Wick 1975). Our institution is passionate about high quality evidence based research and has excelled in various domains (Vickram et al. 2022; Bharathiraja et al. 2022; Kale et al. 2022; Sumathy et al. 2022; Thanigaivel et al. 2022; Ram et al. 2022; Jothi et al. 2022; Anupong et al. 2022; Yaashikaa, Keerthana Devi, and Senthil Kumar 2022; Palanisamy et al. 2022).

Vehicle detection and categorization are critical components of intelligent transportation systems (ITS). Object detection, for example, is useful for studying traffic flow and behavior as well as detecting traffic accidents(Wick 1975). Various variables, such as fluctuating lighting and weather conditions, the amount of distinct vehicle kinds in one shot, or the distance between captured cars, might make the detection process more complex(Sushmitha, Satheesh, and Kanchana 2020).The existing literature on object detection combined with Novel Convolutional Neural Network (CNN) is discussed. This paper also discusses various methods for detecting and classifying vehicles. It covers approaches that employ CNNs as well as earlier methods that use feature extractors and support vector machine classification (Lubke and A. 1977).

2. Materials and Methods

Machine learning, Saveetha Institute of Medical and Technical Science, conducted the research. Convolution Neural Networks and Support Vector Machines are the two sample groups in this study. There are ten samples in each group, with a pre-test power of 0.921. With a sample size of 10, the threshold was set at 0.05, the G power was set at 80%, the confidence interval was set at 95%, and the enrollment ratio was set at 1. The classification dataset was obtained from the Kaggle(https://www.kaggle.com/pratikbarua/vehicle-detection-dataset) Database, an open-source data repository for Vehicle Detection using multiple machine learning approaches.

Data Preparation

To perform Vehicle Detection, the real time data sets used are Semantic Analysis. The input data set for the proposed work is Sentiment Analysis collected from Kaggle(https://www.kaggle.com/pratikbarua/vehicle-detection-dataset). The dataset contains more than 400 images and 5 videos of a moving vehicle and all the images and videos are dependent on each other for the vehicle tracking.

Convolution Neural Networks

The Novel Convolutional Neural Network(CNN) are basic devices for profound learning, and are particularly suited for picture acknowledgment. Convolutional neural systems utilize pictures straightforwardly as information. The convolution arranges plays out the capacities that are performed by cells in the visual cortex, for example, extricating basic visual elements like situated edges, end-focuses, corners, and so forth. Convolutional neural systems consist of convolutional layers which remove helpful data from the information and take out superfluous fluctuation. Each phase in a convolutional system is made out of a channel bank, and highlights pooling layers. With numerous stages, a convolutional system can learn multi-level chains of importance of elements. The CNN plays a vital role in the vehicle tracking system and the pseudocode for CNN implementation is mentioned in Table 1. The below equation (1) has been used to detect the accuracy.

$$S(t) = (x * w)[t] = \sum_{a=-\infty}^{a=\infty} x[a]w[a + t] \quad (1)$$

Support Vector Machine

Support Vector Machine (SVM) could also be a supervised machine learning rule that will be used for every classification or regression challenge. However, it's primarily used in classification problems. At intervals the SVM rule, which has a tendency to tend to plot each info item as a degree in n-dimensional house (where n could also be a spread of choices you have) with the value of each feature being the value of a particular coordinate. It will solve linear and non-linear problems and work well for many smart problems. The thought of SVM is simple: The rule creates a line or a hyperplane that separates the data into classes. The below equation (2) has been used to detect the accuracy.

$$f(x) = \sum_i \alpha_i k(x_i, x) + b \quad (2)$$

Support Vector Machine SVM is one among the foremost standard supervised Learning algorithms, that is employed for Classification moreover as Regression issues. However, primarily, it's used for Classification issues in Machine Learning. The goal of the SVM algorithmic rule is to form the simplest line or call boundary that may segregate n-dimensional areas into categories in order that are able to simply place the new information within the correct class within the future. This best call boundary is named a hyperplane. Accuracy of vehicle detection. The pseudocode implementation for SVM is mentioned in Table 2. Table 3 shows the accuracy of Vehicle detection using Convolutional Neural Network. Table 4 shows the accuracy of Vehicle detection using Support Vector Machine. The attributes are ridges, pattern, pores, edge contour,color,image,etc. Dependent Variables are ridges, pattern, pores,edge contour.Independent variables are color, image. Independent T- test is carried out in this research work.

Statistical Analysis

The minimum requirement to run the softwares used here are intel core I3 dual core Central Processing Unit @3.2 GHz, 4GB RAM, 64 bit OS, 1TB hard disk space personal computer and software specification includes Windows 8, 10, 11, Python 3.8 and MS-Office.

The Vehicle Detection is predicted by the randomized method, a forest of randomized trees is trained and the final prediction is based on the majority vote outcome from each tree. This method allows weak learners to correctly classify data points in an incremental approach that are usually misclassified.

Statistical package for the social sciences version 23 software tool was used for statistical analysis. An independent sample T-test was conducted for accuracy. Standard deviation, standard mean errors were also calculated using the SPSS software tool. The significance values of proposed and existing algorithms contains group statistical values of proposed and existing algorithms.

3. Results

In statistical tools, the total sample size used is 20. This data is used for the analysis of the Novel Convolutional Neural Network and Support Vector Machine. Statistical data analysis is done for both the prescribed algorithms namely Novel Convolutional Neural Network and Support Vector Machine. The group and accuracy values are being calculated for given systems. These 20 data samples used for each algorithm along with their loss are also used to calculate statistical values that can be used for comparison. Table 5, shows that group, accuracy, and loss values for two algorithms content-based Convolutional Neural Network and Support Vector Machine are denoted. The Group statistics table shows the number of samples that are collected. Mean and the standard deviation is obtained and accuracies are calculated and entered.

Table 5 shows the Group, Accuracy and Loss value uses 8 columns with 8 width data for Vehicle detection system. Table 6 shows the Group Statistical analysis for Convolutional Neural Network and Support Vector Machine Mean, Standard deviation and Standard error mean are determined. Table 7 shows the Independent Sample Tests results. Figure1. shows the comparison of Novel Convolutional Neural Network and Support Vector Machine in terms of accuracy.

4. Discussion

From the results of this study, CNN based vehicle detection using image segmentation and extraction method is proved to be having better accuracy than the Support vector machine. Novel Convolutional Neural Network algorithm has an accuracy of 85.50% whereas Support Vector Machines has an accuracy of 71.80%. The group statistical analysis on the two groups shows that the Novel Convolutional Neural Network algorithm (Group 1=10) has more mean accuracy than support vector machines (Group 2=10) and the standard error mean including standard deviation mean is slightly less than the Novel Convolutional Neural Network algorithm.

The network has to differentiate between cars and non-vehicles for the vehicle classification task(Wick 1975). Two CNN networks were trained and tested.(Laxmi and Das 2016). one without the SVM preprocessing phase and the other with the SVM preprocessing step(Song et al. 2019). The Adam optimizer and a learning rate of 0.001 were used to train both networks for 100 epochs(Jackal et 1991.). Due to binary classification, the loss function was binary cross entropy. There were 320 pictures in the training set and 80 in the testing set(Li 2004). The Novel Convolution Neural Networks is 85.50% more accurate than the support vector machine of 71.80% in Vehicle Detection.((Turing Institute (Glasgow, Scotland) and Siebert 1987)).

The limitation of the proposed model is the accuracy of the Novel Convolutional Neural Network algorithm may be affected due to the inconsistent data and difficulty in getting the right datasets for analysis. Most of the data is simulated from nature which is far from reality effective data preprocessing techniques, and the combination of Novel Convolutional Neural Network algorithm with other machine learning algorithms such as Novel Convolutional Neural Network algorithm (CNN) and Support vector machines (SVM) may give better accurate results in the future.

5. Conclusion

Based on the experimental results, the Novel Convolutional Neural Network (CNN) has been proved to detect vehicles more significantly than Support Vector Machine (SVM). It can be used in detecting vehicles in the Future(Sushmitha, Satheesh, and Kanchana 2020). The quality of datasets formed with good models should be adaptive and should not require a lot of fine-tuning on data sets.

DECLARATIONS

Conflicts of Interest

No conflicts of interest in this manuscript.

Authors Contributions

Author RA was involved in data collection, data analysis, data extraction, manuscript writing. Author CP involved in conceptualization, data validation and critical review of the manuscript.

Acknowledgement

The authors would like to express their gratitude towards Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences (Formerly known as Saveetha University) for providing the necessary infrastructure to carry out this work successfully.

Funding

We thank the following organizations for providing financial support that enabled us to complete the study.

1. Vee Eee Technologies Solution Pvt. Ltd.
2. Saveetha University.
3. Saveetha Institute of Medical and Technical Sciences.
4. Saveetha School of Engineering.

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TABLES AND FIGURES

Table 1. Pseudocode for Convolutional Neural Network (CNN)

// I : Input dataset records
1. Import the required packages.
2. Convert the Data Sets into numerical values after the extraction feature.
3. Estimate the background image.
4. Filter the object using CNN algorithm.
5.Track the object using CNN algorithm.
6. Calculate the accuracy of the model.
OUTPUT: Accuracy

Table 2. Pseudocode for Support Vector Machine(SVM)

// I : Input dataset records
1.Import the required packages.
2. Collect the data.
3. Convert the Data Sets into numerical values after the extraction feature.
4. Estimate the background image
5. Filter the object using the SVM algorithm.
6.Track the object using the SVM algorithm.
7.Calculate the accuracy of the model.
8.Print and show the accuracy.
OUTPUT: Accuracy

Table 3. Accuracy of Vehicle detection using Convolutional Neural Network

Test size	**Accuracy**
Test 1	90.00
Test 2	89.00
Test 3	88.00
Test 4	87.00
Test 5	86.00
Test 6	85.00
Test 7	84.00
Test 8	83.00
Test 9	82.00
Test 10	81.00

Table 4. Accuracy of Vehicle detection using Support Vector Machine

Test size	**Accuracy**
Test 1	85.00
Test 2	82.00
Test 3	79.00
Test 4	76.00
Test 5	73.00
Test 6	70.00
Test 7	67.00
Test 8	64.00
Test 9	62.00
Test 10	60.00

Table 5. Group, Accuracy and Loss value uses 8 columns with 8 width data for Vehicle Detection System.

SI.NO	**Name**	**Type**	**Width**	**Decimal**	**Columns**	**Measure**	**Role**

1	Group	Numeric	8	2	8	Nominal	Input
2	Accuracy	Numeric	8	2	8	Scale	Input
3	Loss	Numeric	8	2	8	Scale	Input

Table 6. Group Statistical analysis for Convolutional Neural Network and Support Vector Machine Mean, Standard Deviation and Standard Error Mean are determined

	Group	N	Mean	Std Deviation	Std.Error Mean
Accuracy	CNN	10	85.5000	3.02765	0.95743
	SVM	10	71.8000	8.63842	2.73171
Loss	CNN	10	14.5000	3.02765	0.95743
	SVM	10	28.2000	8.63842	2.73171

Table 7. Independent Sample Tests results with confidence interval as 95% and level of significance as 0.05 (Convolutional Neural Network appears to perform significantly better than Support Vector Machine with the value of p=0.921)

		Levene's test for Equality of variance		**T-Test for equality of mean**						
				t	**df**	**Sig(2-tailed)**	**Mean difference**	**Std. Error Difference**	**95% confidence of Difference**	
		F	**Sig**						**Lower**	**Upper**
Accuracy	**Equal variances assumed**	11.479	.921	4.733	18	.000	13.70000	2.89463	7.61861	19.78139
	Equal Variances not assumed	-	-	4.733	11.178	.001	13.70000	2.89463	7.34133	20.05867
Loss	**Equal variances assumed**	11.479	.921	-4.733	18	.000	-13.70000	2.89463	-19.78139	-7.61861
	Equal Variances not assumed	-	-	-4.733	11.178	.001	-13.70000	2.89463	-20.05867	-7.34133

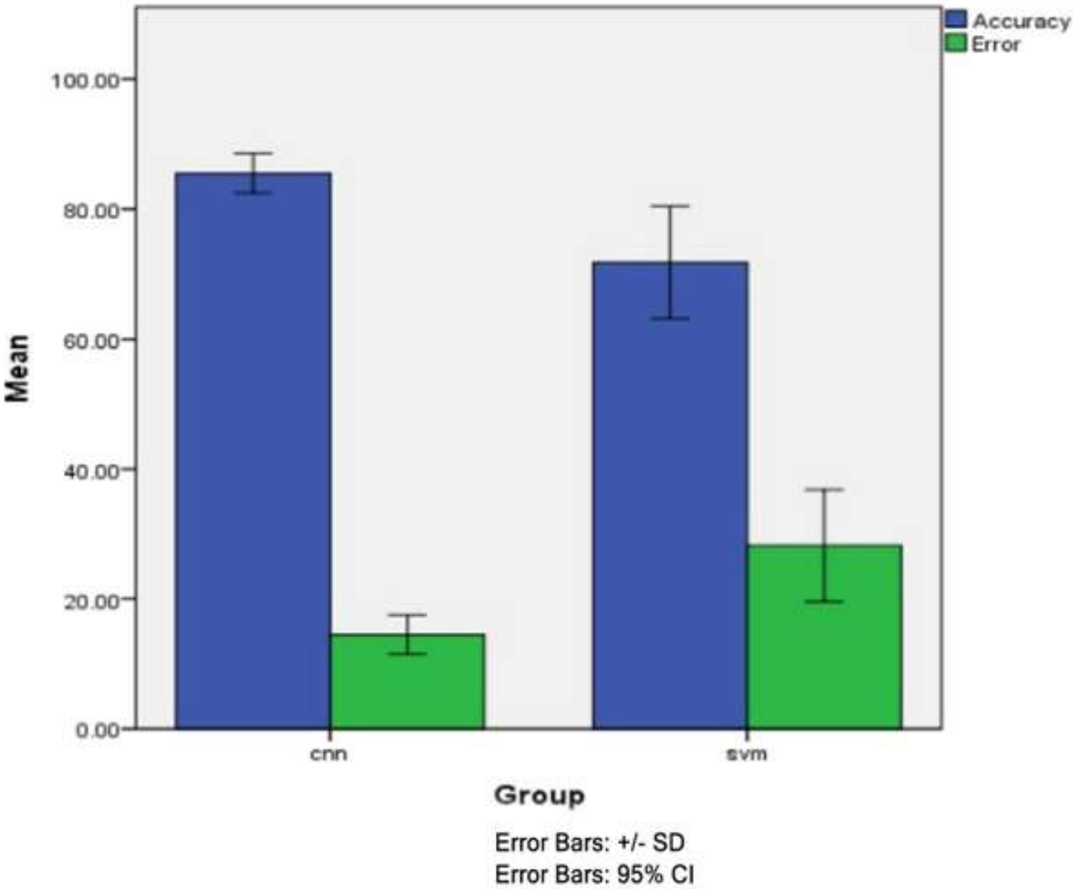

Fig. 1. Comparison of Novel Convolutional Neural Network and Support Vector Machine in terms of accuracy. The mean accuracy of Novel Convolutional Neural Network is greater than Support Vector Machine and the standard deviation is also slightly higher than Support Vector Machine. X-axis: Novel Convolutional Neural Network vs Support Vector Machine. Y-axis: Mean accuracy of detection + 1 SD.