Title Page:

Accurate Classification of Vehicles for Moving Object Tracking in Traffic using Novel Deep Sort algorithm in comparison with Logistic Regression

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Keywords: Deep Learning, Logistic Regression, Machine learning, Novel Deep Sort, Object Detection, Traffic, Vehicle.

ABSTRACT

Aim: The proposed work focuses on performing accurate classification of vehicles for moving object tracking in traffic through Novel Deep Sort (NDS) over Logistic Regression Algorithm with improved accuracy. **Materials and Methods:** Vehicle classification in traffic is performed by Novel Deep Sort (N=24) of sample size and Logistic Regression of sample size (N=24), obtained by G power of 80%. **Results**: Novel Deep Sort has the accuracy of 88.54% which is relatively higher than Logistic Regression which has accuracy of 81.54% and it shows that there is statistical significance difference between the Novel Deep Sort algorithm with Logistic Regression with p=0.037 ($p<0.05$). **Conclusion**: Novel Deep Sort has higher accuracy of 88.54% in classification of vehicles Logistic Regression algorithm of accuracy 81.54%.

Keywords: Deep Learning, Logistic Regression, Machine learning, Novel Deep Sort, Object Detection, Traffic, Vehicle.

INTRODUCTION

Deep learning is a sort of machine learning that allows multi-layered artificial neural networks to extract complex structures and representations from massive amounts of data. Based on the architecture of the human brain (Jagannathan et al. 2021). Artificial intelligence has improved significantly due to deep learning, which excels in tasks like audio and image identification, natural language processing (Sanjana et al. 2020), and predicting. Various vehicle behaviors and occlusions make actual time vehicle tracking and classification in dynamic traffic conditions a challenging operation. In intelligent transportation systems, (Sanjana et al. 2020; Taheri Tajar, Ramazani, and Mansoorizadeh 2021) precise outcomes necessitate striking a compromise between the benefits of deep learning and traditional machine learning methods. Accurate vehicle categorization for moving object monitoring in traffic is useful for intelligent transportation systems and video analytics (Javed et al. 2022). Due to its robust object tracking capabilities and deep learning features (Dewangan and Sahu 2021) .

In the research of accurate classification of vehicles for moving object tracking in traffic**,** different papers which performed research on tracking of moving objects for vehicles in traffic are found in IEEE Xplore, ScienceDirect and Springer. 605 journals are found from IEEE Xplore digital library, 4752 articles from ScienceDirect, 15426 articles from springer. Research work (Sun et al. 2021) contains more citations 83 times and is about the classification of vehicles and advances technologies like intrusive sensing, enhancing the video analysis classifying the vehicles.The article (Xu et al. 2022) contains more citations 170. The article provides the combining motion detection and key frame selection to enhance vehicle video analysis in detection of moving objects and classification of vehicles. Article (Aboah 2021) contains more citations 69 times and is about the Vehicle detection with visual sensors like lidar and camera is one of the critical functions. The article (Galvao et al. 2021) contains more citations 37 times and it's about the enhanced lightweight YOLOv5 method for vehicle detection and to improve detection accuracy. The article (Parekh et al. 2022) his paper provides a survey of deep learning techniques for vehicle detection.

The existing problem in vehicle classification for moving object tracking in traffic lies in the limitations of conventional algorithms. In complex and dynamic traffic situations (Wang and Zhang 2022; Parekh et al. 2022) current approaches might have trouble correctly classifying vehicles, which could result in issues including a rise in misclassifications, a decrease in tracking accuracy,and conditions performance. The requirement to increase real-time traffic monitoring has led to the selection of a Novel Deep SORT algorithm for vehicle categorization, as opposed to Logistic Regression.(Wang and Zhang 2022)**.** With its deep learning capabilities. Deep SORT is anticipated to perform better than conventional Logistic Regression in identifying intricate patterns and data. Improving vehicle categorization accuracy for moving object tracking in traffic is the aim of this study.In near future it as a huge scope in attempting to determine a more successful and efficient method by presenting and assessing a Novel Deep SORT algorithm and contrasting it with Logistic Regression (Kraft et al. 2021)

MATERIALS AND METHODS

Research was conducted at the Saveetha School of Engineering, which is a division of the Saveetha Institute of Medical and Technical Sciences, in their advanced AR and VR facility. where a high configuration system is installed in the lab to conduct research and obtain results. Two groups with a sample size of 24 were taken into consideration for the review.80% of the G-power value with a 0.05 alpha value and 0.8 beta value with a 95% confidence interval have been calculated from the computation(Pan et al. 2021).

The classification of vehicles in traffic videos file dataset is the dataset used in this suggested work. You can download this dataset from Kaggle. The 2GB file dataset contains a mix of regular and traffic-related CCTV footage.There are cars in the video. Given that the proposed study focuses on the identification of moving objects in traffic, an mp4 file containing a few automobiles serves as the dataset. The algorithm suggested in this research is applied to a dataset, and the outcome is compared with the comparison algorithm (Ammar et al. 2021) .

Google Colab, sometimes known as Colaboratory, is a cloud-based platform that gives users access to a free interactive Python code editor and runtime. Its quick Google Drive connection, GPU resource access, and collaborative capabilities make it especially popular in the machine learning and data science sectors. It is an accessible and potent tool for a variety of computational jobs since users can run code in a browser, create and share Jupyter notebooks, and utilize Google's computational resources.

Novel Deep Sort Algorithm

Vehicle classification in traffic is done using a Novel Deep Sort algorithm that tracks moving objects, sample size preparation group 1. Novel Deep Sort provides high-dimensional embeddings that accurately represent automotive visual features by combining a variety of deep learning approaches. Novel Deep Sort is a powerful method for precisely tracking and classifying autos in dynamic traffic circumstances. Novel Deep Sort has a significant positive impact on creative traffic surveillance systems. The ability to manage obstacles, improve e-learning, and provide a fresh identification all contribute to improving multi-object tracking accuracy. Novel Deep Sort performs exceptionally well at accurately tracking and classifying autos in dynamic traffic scenarios. Improved Vehicle Direction Precision with Novel Deep Sort Because of its unique Deep Sort re-identification ability, it is a crucial component of contemporary traffic management systems. When integrated, these features provide a comprehensive solution for accurate and timely tracking in various traffic scenarios. proposed Novel Deep Sort pseudocode algorithm shown in Table1 (Isaac-Medina et al. 2021)

Logistic Regression

Logistic Regression method is essential for improving the accuracy of Classification of Vehicles for Moving Object Tracking in Traffic,sample size preparation in group 2, First, the relevant details are taken out of the input data, including the size, shape, or color of the objects that were recognized. Following the computation of a weighted sum using these attributes, a logistic function is used. The logistic function converts the total into a number between 0 and 1, which indicates the possibility that the item is a member of a specific group (for example, a category of vehicles). To determine the final classification, this possibility is subjected to a threshold. Because of its ease of interpretation and simplicity, Logistic Regression is a good fit for situations with simpler data structures.However, in highly dynamic traffic settings, its performance might be restricted in comparison to more advanced techniques like Novel Deep Sort, which use deep learning for complicated pattern detection and feature extraction proposed algorithm pseudocode of decision tree shown in table 2 (Sommer and Wilko 2022)

Statistical Analysis

Using IBM SPSS version 27.0 To examine the standard error mean, mean, and standard deviation value, statistical software was utilized. Video frame as independent values. In this research project, recorded video data is input, Frame ID is used as a dependent variable, and a T-test analysis is done (Humayun et al. 2022)**.**

RESULTS

Table 1 contains the Novel Deep Sort pseudocode. A data set is split into two sets of models for training and testing, and those are allocated to various functions to calculate accuracy. The necessary libraries are imported from training with the dataset.

Table 2 contains the Logistic Regression pseudocode. A data set is split into two sets of models for training and testing, and those are allocated to various functions to calculate accuracy. The necessary libraries are imported from training with the dataset.

Table 3 shows the accuracy of the video dataset table for both Logistic Regression and Novel Deep Sort.

Table 4 displays the results of the Novel Deep Sort (N = 24), mean (88.54), standard deviation (2.395), standard error mean values (0.489), and the Logistic Regression (N = 24), mean (81.54), standard deviation (15.798, standard error mean values (3.225).

Table 5 provides the T-test values of statistical independence sample .The standard deviation is 7.000.The statistical significance difference between the Novel Deep Sort and Logistic Regression is demonstrated by the error difference of 3.262 and 95% Confidence Interval, with $p=0.037 (p<0.005)$

The Line Graph for Accuracy values for N=24 iterations of the Novel Deep Sort Model is shown in Figure 1. Y-axis: accuracy values, X-axis: iterations

The Line Graph for Accuracy values for N=24 iterations is shown in Figure 2. For X-axis: iterations and Y-axis: accuracy values, use logistic regression

The Line Graph for Accuracy values for N=24 iterations of both DeepSort and Logistic Regression is shown in Figure 3. Y-axis: accuracy values, X-axis: iterations The Red line represents the Logistic Regression algorithm, and the Blue line represents the Novel Deep Sort algorithm. According to the graph above, Novel Deep Sort outperforms Logistic Regression in terms of accuracy.

The T-test findings for the Novel Deep Sort and Logistic Regression are displayed as a bar graph in Figure 4. It demonstrates unequivocally that the Novel Deep Sort's accuracy rate is higher than that of the Logistic Regression.

DISCUSSION

Significance is determined through the analysis of an independent T-test result. The Novel Deep Sort accuracy is 88.54, greater than the Logistic Regression accuracy of 81.54, and the difference between the two groups is significant. The significance value is 0.037, which is less than 0.05, which is significant.

The Novel Deep Sort method was determined to have more promising accuracy than the other real-world algorithms in the recent survey. The current system combines the two datasets with user data and discovers that the Novel Deep Sort yields the highest accuracy (Jagannathan et al. 2021)**.**By all measures, the suggested novel deep sort algorithm is faster and more accurate than the existing gradient boosting techniques (Parekh et al. 2022). Selecting the best data set and adding additional characteristics can improve the outcomes (Jagannathan et al. 2021). In their study articles, various researchers suggested the Novel Deep Sort algorithm and came to the conclusion that it produced superior outcomes than the other Deep learning algorithms. In certain instances, the decision tree and logistic regression algorithms suggested in certain articles for classifying cars in traffic proved to be more accurate than our suggested novel deep sort approach (Keipour, Mousaei, and Scherer 2020) In some research surveys some of the researchers have implemented the SVM algorithm to provide for the future (Asadi 2022) Accurate Classification of Vehicles for Moving Object Tracking in Traffic and found out that it provided more accurate results than ourNovel Deep Sort algorithm (Laroca et al. 2021).

The Novel Deep Sort algorithm with Logistic Regression for vehicle classification and tracking In order to assess the compromise between complexity and performance in real-world traffic conditions, components taken into consideration include the algorithm's computational efficiency and accuracy in managing dynamic traffic situations. The study's limitations include the possibility of difficulties applying the results to different traffic situations and the reliance on quality training data, which could affect how well the algorithm performs in various real-world situations. Furthermore, in contexts with limited resources, the computational complexity of deep learning models, such as Novel Deep Sort, may provide challenges. Future work in this area will examine hybrid models that combine the best features of both conventional machine learning approaches like Logistic Regression and deep learning techniques like Novel Deep Sort in order to improve vehicle tracking and classification in dynamic traffic situations.

CONCLUSION

By comparing two algorithms, the Novel Deep Sort algorithm's accuracy rate is 88.54, which is higher than the Logistic Regression algorithm's 81.54, helping to improve the tracking and classification of moving vehicles in traffic. This was achieved using multiple datasets. The classification rate in Novel Deep Sort is higher than in Logistic Regression, and its performance is higher overall.

DECLARATIONS

Conflict of Interest

No conflict of interest in this manuscript.

Authors Contributions

Author MK was involved in methodology, text analysis and writing the manuscript. Author ND was involved in review and editing, supervision and validation.

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TABLES AND FIGURES

Table 1. Novel Deepsort Pseudo code. Transformers play a key role in Novel Deep Sort . It analyzes the vehicles in traffic.

Input: Video dataset
Output: Accuracy
Step 1: ● data collection ● video dataset ● data processing
Step 2: **Object Detection:** Utilize a pre-trained object detection model to identify and locate vehicles in each frame of the video.
Step 3: **Feature Extraction:** Extract deep appearance features for each detected vehicle, using a pre-trained feature extraction model.
Step 4: **Data Association:** Perform data association to link detections across frames, associating features with tracked objects using methods like the Hungarian algorithm.
Step 5: **Object Tracking :** Implement object tracking which predicts the next state of each tracked object and updates it based on the associated features.
Step 6: **Vehicle Classification :** Optionally, integrate a classifier or decision rules to classify vehicles based on their features.
Step 7: **Visualization :** Optionally, visualize the results, displaying tracked objects, their trajectories, and any additional information in the video frames.

Table 2. Logistic Regression Pseudo code. Transformers play a key role in Logistic Regression . It analyzes the vehicles in traffic.

Input: Video Dataset
Output: Accuracy
Step1: **Initialize Parameters:** Initialize the weights and biases of the Logistic Regression model
Step2: **Preprocess Video:** Read the input video file frame by frame. Apply any necessary preprocessing steps, such as resizing frames or normalizing pixel values.
Step3: **Feature Extraction:** Extract relevant features from each frame, such as color histograms, shape descriptors, or motion features.
Step4: **Data Labeling:**Manually label the frames with ground truth information regarding the presence or absence of vehicles
Step5:Classification on Video Frames: Apply the trained Logistic Regression model to classify vehicles in each frame of the video. Assign a binary classification (vehicle or non-vehicle) based on the obtained probability scores.
Step6: **Iterative Refinement:**Refine the model iteratively by adjusting hyperparameters, changing feature sets, or employing more sophisticated techniques to enhance accuracy
Step7: **Output Results:** Generate a new video file or visualization with the model's classifications for further analysis and detecting the vehicles.

Table 3. With N=24 sample size ,video data input is taken, the accuracy rate is calculated in every for Novel Deep Sort and Logistic Regression. The Novel Deep Sort has more accuracy compared to Logistic Regression

S.No	Novel Deep Sort Accuracy (%)	Logistic Regression Accuracy (%)
1	89	87
2	88	85
3	86	80
4	88	84
5	86	85
6	88	85
7	89	86
8	89	84
9	90	85
10	96	86
11	88	85
12	87	82
13	95	80
14	88	88
15	88	82
16	86	80
17	87	85
18	88	84
19	87	86
20	89	84
21	88	86
22	87	86
23	89	87
24	89	87

Table 4. Statistics for independent samples comparing deep sort with Logistic Regression algorithm. In deep sort , the mean accuracy is 88.54, whereas in Logistic Regression it is 81.54. Deep sort has a standard deviation of 2.395 and Logistic Regression has a standard deviation of 15.798. Standard error mean for deep sort 0.489 is and Logistic Regression 0.584

Group Statistics					
	Algorithm	N	Mean	Std. Deviation	Std. Error Mean
Accuracy	**NDS**	24	88.54	2.395	0.489
	LR	24	81.54	15.798	3.225

Table 5. T-Test for Statistical Independent Samples comparing deep sort with Logistic Regression Algorithm, 95% Confidence Interval. It shows that there is a statistical significance difference between the deep sort algorithm and Logistic Regression with p=0.037 (p<0.05).

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference: Lower	Upper
Accuracy	Equal variances assumed Equal variances not assumed	2.711	0.106	2.146	46	0.037	7.000	3.262	0.435	13.565
	Equal variances not assumed Equal variances assumed			2.146	24.057	0.042	7.000	3.262	0.269	13.731

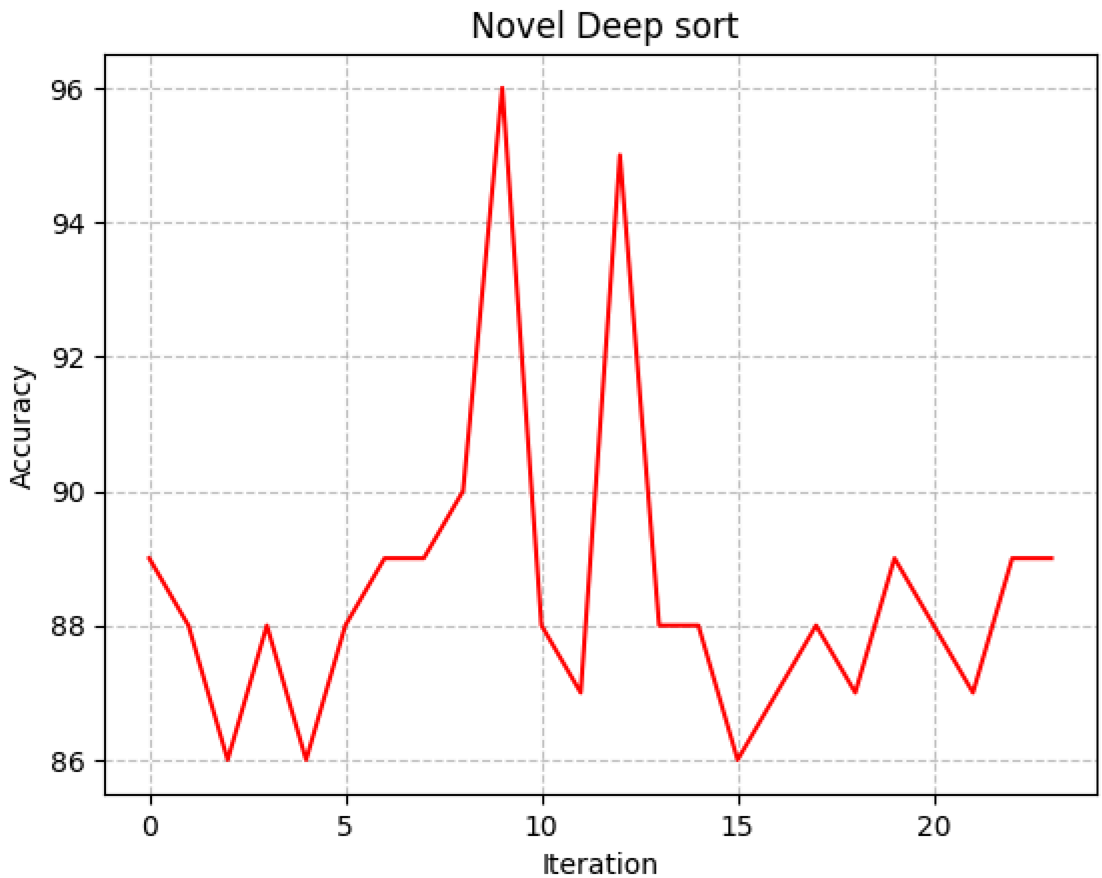

Fig. 1. Line Graph for Accuracy values for N=24 iterations for Deep Sort Model. X-axis:iterations, Y-axis:Accuracy values.

Fig. 2. Line Graph for Accuracy values for N=24 iterations Logistic Regression for X-axis:iterations, Y-axis:Accuracy values

Fig. 3. Line Graph for Accuracy values for N=24 iterations for both DeepSort and Logistic Regression. X-axis: iterations, Y-axis: Accuracy values. The Blue line indicates deep sort algorithm and Red line indicates Logistic Regression algorithm. By the above graph Novel Deep Sort has higher Accuracy then Logistic Regression.

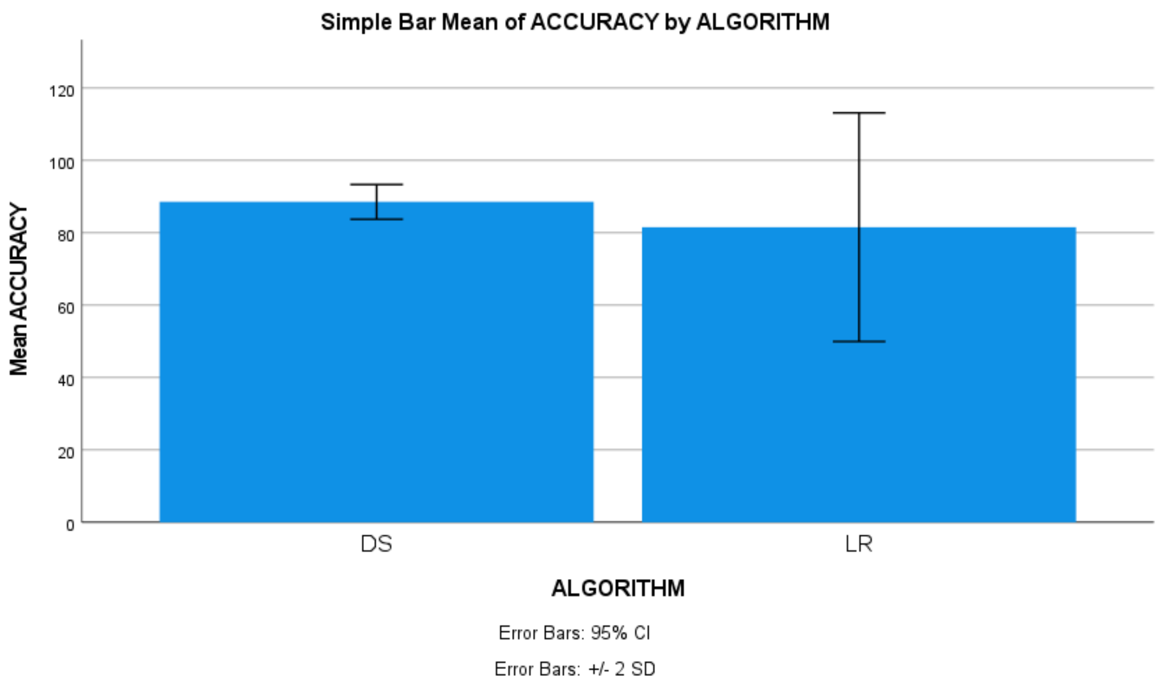

Fig. 4. The Novel Deep Sort method has a greater mean accuracy of 88.54 than the Logistic Regression algorithm, which is 81.54, according to the comparison of mean accuracy. Additionally, the Novel Deep Sort algorithm has a lower standard deviation than the Logistic Regression approach. Mean accuracy is plotted on the Y-axis, while novel deep sort against the logistic regression technique is plotted on the X-axis. ± 2 SD is used to represent the error bar.