**Title Page:**

# Comparison of Novel Deep Sort algorithm against Support Vector Machine for Traffic Vehicles Classification in Tracking Moving Objects based on Accuracy

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**Keywords:** Deep Learning, Machine learning, Novel Deep Sort, Object Detection, Support Vector Machine, Traffic, Vehicle.

## ABSTRACT

**Aim:** The proposed work focuses on extracting the Comparison of Novel Deep Sortt algorithm against Support Vector Machine for Traffic Vehicles Classification in Tracking Moving Objects based on Accuracy with Improved Accuracy.classifying the vehicles in traffic. **Materials and Methods:** Vehicle classification in traffic is performed by Novel Deep Sort (N=24) of sample size and Support Vector Machine 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 Support Vector Machine which has accuracy of 85.92% and it shows that there is statistical significance difference between theNovel Deep Sort algorithm with Support Vector Machine with p=0.032 ($p<0.05$). **Conclusion:** Novel Deep Sort has higher accuracy of 88.54% in classification of vehicles Support Vector Machine algorithm of accuracy 85.92%



**Keywords:** Deep Learning, Machine learning, Novel Deep Sort, Object Detection, Support Vector Machine, Traffic, Vehicle.


## INTRODUCTION

Deep learning is a type of machine learning where an agent learns to make decisions by interacting with an environment (Biswal et al. 2021). A machine receives recognition for providing input, which helps it improve its methods over time and make it more suitable for activities like gaming, robotic control, and autonomous systems. Accuracy in Vehicle Classification for Moving Object Tracking in Traffic. Intelligent transportation systems depend on the application of traffic vehicle classification in tracking moving objects based on accuracy (Javed et al. 2022) . With the use of real-time vehicle movement monitoring and analysis, traffic surveillance technology facilitates effective traffic management (Dewangan and Sahu 2021a). automated law enforcement, and increased safety. Accurately detecting and tracking different kinds of cars on the road improves traffic flow, eases congestion, and increases overall road safety (Butt et al. 2021).

In the research of Comparison of Novel Deep Sort algorithm against Support Vector Machine for Traffic Vehicles Classification in Tracking Moving Objects based on Accuracy, various papers which conducted research on tracking of vehicles in traffic found in IEEE xplore, ScienceDirect and springer. 506 journals are found form IEEE Xplore digital library, 4548 articles from science direct, 14256 articles articles from springer. Research work (Hosseini and Fathi 2022) contains more citations 52 times and is about advanced detection like advanced sensing, object detection in traffic, enhancing the video analysis classifying the vehicles. The article (Kim, Na, and Choi 2023) contains more citations 56. The article enhances the efficiency of vehicle video analysis in IoT-enabled autonomous vehicle systems by combining movement detection and needed frame selection. Article (Jagannathan et al. 2021) contains more citations 51 times and is about among the most important features is vehicle detection using visual sensors like lasers and video. The article (Butilă and Boboc 2022) contains more citations 57 times and it involves developing the lightweight YOLOv5 approach's accurate detection and identification capabilities. The article (Butilă and Boboc 2022; Al-qaness et al. 2021) his paper provides vehicle classification using deep learning application .

The existing problem in traffic vehicle classification for tracking moving objects is rooted in the limitations of traditional classification algorithms which have low accuracy while classification of vehicle (Chaudhary et al. 2021), with accuracy providing as the main performance measure. Using association criteria to follow continuity and convolutional neural networks for robust feature extraction, (Pascale et al. 2021) the most advanced algorithm Novel Deep Sort combines deep learning techniques to improve object tracking. For traffic vehicle categorization in tracking moving objects, the Novel Deep SORT algorithm is compared to Support Vector Machine (SVM) based on a calculated combination of advanced deep learning capabilities and the tried-and-true adaptability of classical machine learning (Valverde, Hurtado, and Valada 2021). The goal of this research is to analyze the accuracy of traffic vehicle classification for tracking moving objects using the Novel Deep Sort Algorithm.

## MATERIALS AND METHODS

Study was done at the Saveetha School of Engineering, which is a part of the Saveetha Institute of Medical and Technical Sciences, within the well equipped AR and VR workplace. where an advanced setup system is installed in the lab to conduct research and obtain results. Two groups with a sample size of 24 were selected as factors for the review. After calculation, 80% of the G-power value with a 95% confidence interval, 0.05 alpha, and 0.8 beta are obtained (Al-qaness et al. 2021).

Vehicle identification in traffic video files is the dataset used in this proposed work. Downloads for this dataset are available on Kaggle. The 2GB file dataset includes a mix of regular and traffic-related CCTV footage. There are vehicles in the video. The dataset employed in this proposed research is an mp4 file including some automobiles because it involves identifying moving objects in traffic. This work describes an algorithm that is executed using a dataset and analyzes the outcome with a comparison algorithm (Dewangan and Sahu 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 (Jagannathan et al. 2021).

## Novel Deep Sort Algorithm (NDS)

Traffic vehicle classification is used by the Novel Deep Sort algorithm to track moving objects based on accuracy, sample size preparation group 1. Novel Deep Sort develops complex embeddings that accurately capture automotive visual features by combining various deep learning approaches. Novel Deep Sort is an efficient technique for accurately tracking and classifying automobiles in dynamic traffic scenarios. Novel Deep Sort ability to manage challenges, improve online learning, and provide a fresh identification is very helpful to innovative traffic surveillance systems as it raises the accuracy of multi-object tracking. Novel Deep Sort performs exceptionally well at accurately tracking and classifying autos in dynamic traffic scenarios. Novel Deep Sort improves the vehicle's direction accuracy. Because Novel Deep Sort can re-identify, it is an essential part of contemporary traffic management systems. Together, these features provide a comprehensive solution for precise and fast tracking in a range of traffic situations. Novel Deep Sort pseudocode algorithm shown in Table1 (Kraft et al. 2021) .

## Support Vector Machine

Support Vector Machine which is used to classify the Traffic vehicle classification is used by the Novel Deep Sort algorithm to track moving objects based on accuracy, sample preparation group 2. SVM's robust classification skills allow for accurate vehicle classification, which supports automated impact collecting, traffic management, and authorities activities. By tracking and controlling vehicular emissions, this technology is essential for improving urban transportation, maintaining security at crossings and checkpoints, and supporting environmental programs. SVM is particularly good at successfully detecting and monitoring a variety of vehicles in dynamic traffic settings because of its versatility, ability to handle both linear and non-linear classification problems, and capacity to maximize margins between classes and adapt to high-dimensional datasets. SVM pseudocode algorithm shown in table 2 (Biswal et al. 2021).

## Statistical Analysis

Version 27.0 of IBM SPSS for analyzing the standard error mean, mean, and standard deviation value, statistical software was utilized. Independent values for a video frame. In the present study, video recorded data is input, Frame ID is used as a dependent variable, and a T-test analysis is done (Butilă and Boboc 2022).

## RESULTS

The table 1 provides pseudocode for the Novel Deep Sort. To calculate accuracy, a data set is divided into two sets of models one for training and another for testing, and those sets of models are assigned different functions. The required libraries are imported from training along with the dataset.

The table1 provides pseudocode for the Support Vector Machine . To calculate accuracy, a data set is divided into two sets of models one for training and another for testing, and those sets of models are assigned different functions. The needed libraries are imported from training along with the dataset.

The video dataset accuracy for both Support Vector Machine and Novel Deep Sort is shown in Table 3.

Table 4 shows the N (24), mean (88.54), standard deviation (2.395), standard error mean values (0.489) for the Novel Deep Sort and Standard Vector Machine N (24), mean (85.92), standard deviation (1.349), standard error mean values (0.275).

The statistical independence samples' T-test results are shown in Table 5. The statistical significance difference between the Novel Deep Sort and Support Vector Machine is demonstrated by the mean difference of 2.625, standard error difference of 0.561, and 95% confidence interval, with $p=0.032 (p<0.005)$.

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.

Figure 2 shows the line graph for accuracy values for the N=24 iterations of the support vector machine with the following axes: Y: accuracy values, X: iterations.

The accuracy values for N=24 iterations of the Line Graph for both Support Vector Machine and DeepSort are shown in Figure 3. Y-axis: accuracy values; X-axis: iterations. The Novel Deep Sort method is indicated by the blue line, while the Support Vector Machine algorithm is indicated by the red line. Based on the graph above, Novel Deep Sort outperforms Support Vector Machine in terms of accuracy.

The novel deep sort and support vector machine T-test results are displayed as a bar graph in Figure 4. It is evident that the Novel Deep Sort has a greater accuracy rate than the Support Vector Machine.

**DISCUSSION**

Determining significance involves examining results of an independent T-test. The difference between the two groups is substantial, and the Novel Deep Sort accuracy is 88.54, larger than the Support Vector Machine's accuracy of 85.92. The significance value is 0.032, which is less than 0.05, which is significant.

Comparing the Novel Deep Sort algorithm to other real-world algorithms, the survey revealed that it had a higher promising accuracy (Kasper-Eulaers et al. 2021). By combining the two datasets with user data, the current framework will determine which has the highest accuracy, the Novel Deep Sort (Mehedi et al. 2021). The suggested Novel Deep Sort algorithm offers superior accuracy by all measures and is substantially faster than the previous gradient boosting techniques. By adding additional features and selecting the best data collection, the outcomes can be improved (Butt et al. 2021). Researchers who have published research publications proposing the Novel Deep Sort algorithm have found that it outperforms existing Deep learning algorithms in terms of performance (Kim, Na, and Choi 2023). In a few cases, the Decision Tree, Support Vector Machine, and SVM algorithms suggested for specific articles for the purpose of classifying automobiles in traffic proved to be more accurate than our suggested Novel Deep Sort approach. Researchers have used the SVM algorithm to classify traffic vehicles in the future for tracking moving objects in study surveys. They discovered that this approach produced findings that were more accurate than our novel deep sort algorithm (Dewangan and Sahu 2021b)

The classification of traffic vehicles for tracking moving objects in dynamic traffic scenarios depends on evaluating many variables, including accuracy and computational efficiency. It aims to identify the limitations between SVM and the deep learning approach like Novel Deep Sort for the best results in precisely tracking and classifying vehicles under various traffic situations. The study's limitations include the possibility of difficulties applying results to many kinds of traffic situations and dependence on excellent training data, which could affect the performance of the algorithm in various real-world situations. The future scope aims to improve vehicle classification accuracy in dynamic traffic conditions by investigating hybrid models that include Novel Deep Sort and Support Vector Machines for beneficial effects.

## CONCLUSION

The objective of this study was to compare the accuracy values of the Novel Deep Sort and Support Vector Machine algorithms for tracking and classifying moving vehicles in traffic. Using multiple datasets, the Novel Deep Sort algorithm produced an accuracy value of 88.54, which was higher than the Support Vector Machine algorithm 85.92. When compared to the Support Vector Machine, Novel Deep Sort performs better and has greater classification than both of them.

## 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 Deep Sort Pseudo code. A key aspect of Novel Deep Sort is transformers. It analyzes the moving vehicles in traffic.

| |
|---|
| **Input:** Video Set |
| **Output:** Accuracy |
| **Step 1:**<br>● data collection<br>● video dataset<br>● data processing |
| **Step 2:**Initialize Novel Deep Sort parameters Initialize CNN weights for object detection |
| **Step 3:**Read video frames For each frame in the video |
| **Step 4:**Extract deep features For each detected object |
| **Step 5:**Associate objects between frames Use an association metric |
| **Step 6:**Vehicle classification For each tracked object |
| **Step 7:**Output results Visualize or output the refined tracking results for analysis |

**Table 2.** Support Vector Machine Pseudocode. Transformers play a key role in Support Vector Machine. It classifies the vehicles in the traffic.

| |
|---|
| **Input:** Video Set |
| **Output:** ACCURACY |
| **Step 1:**Import necessary libraries, including scikit-learn for SVM, video processing libraries and others. |
| **Step 2:**Use video processing libraries to read frames from the input video file**.** |
| **Step 3:**Manually or using a labeled dataset, assign labels (0 for non-vehicle, 1 for vehicle) to each frame. |
| **Step 4:**Split the dataset into training and testing sets to evaluate the SVM model's performance. |
| **Step 5:**Initialize an SVM model with a chosen kernel (e.g., linear) and regularization parameter |
| **Step 6:**Utilize the trained SVM model for real-time classification of vehicle presence in each video frame**.** |
| **Step 7:**OUTPUT<br>Classification of vehicles in traffic |

**Table 3.** With N=24 sample size ,video data input is obtained, the accuracy value is calculated in every for Novel Deep Sort and Support Vector Machine. When compared to Support Vector Machine, the Novel Deep Sort showed higher accuracy.

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

**Table 4.** Statistics for independent samples comparing Novel Deep Sort with Support Vector Machine algorithm. In Novel Deep Sort , the mean accuracy is 88.54, whereas in Support Vector Machine it is 85.92. Novel Deep Sort has a standard deviation of 2.395 and Support Vector Machine has a standard deviation of 1.349. Standard error mean for Novel Deep Sort 0.489 is and Support Vector Machine 0.275.

| **Group Statistics** | | | | | |
|---|---|---|---|---|---|
| | **Algorithm** | **N** | **Mean** | **Std. Deviation** | **Std. Error Mean** |
| **Accuracy** | NDS | 24 | 88.54 | 2.395 | .489 |
| | SVM | 24 | 85.92 | 1.349 | .275 |

**Table 5.** T-Test for Statistical Independent Samples comparing Novel Deep Sort with Support Vector Machine algorithm, 95% Confidence Interval. It shows that there is statistical significance difference between the Novel Deep Sort algorithm and Support Vector Machine with p=0.032 (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**<br>**Equal variances not assumed** | 1.850 | .180 | 4.678 | 46 | 0.032 | 2.625 | 0.561 | 1.496 | 3.754 |
| | **Equal variances not assumed**<br>**Equal variances assumed** | | | 4.678 | 36.251 | 0.035 | 2.625 | 0.561 | 1.487 | 3.763 |

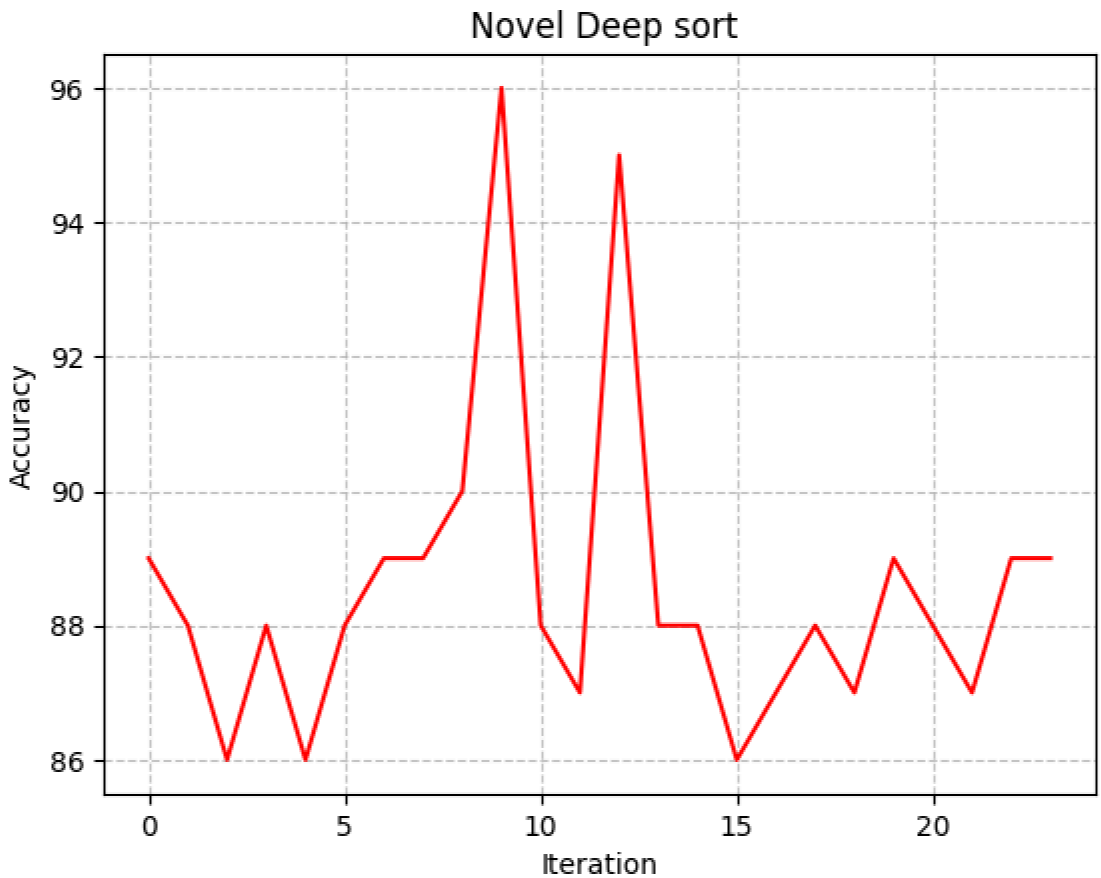


**Fig. 1.** Line Graph for Accuracy values for N=24 iterations for Novel Deep Sort Model. X-axis:iterations, Y-axis:Accuracy values.

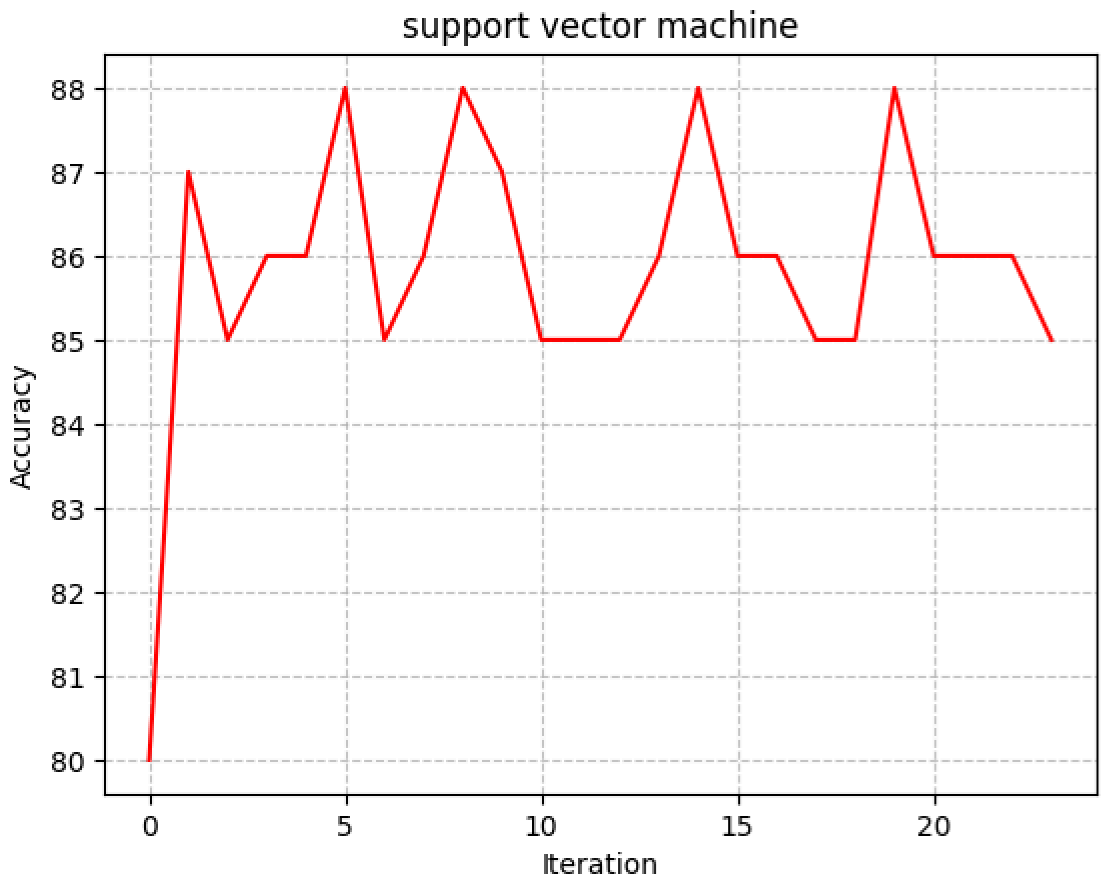


Fig 2. Line Graph for Accuracy values for N=24 iterations Support Vector Machine for X-axis:iterations, Y-axis:Accuracy values

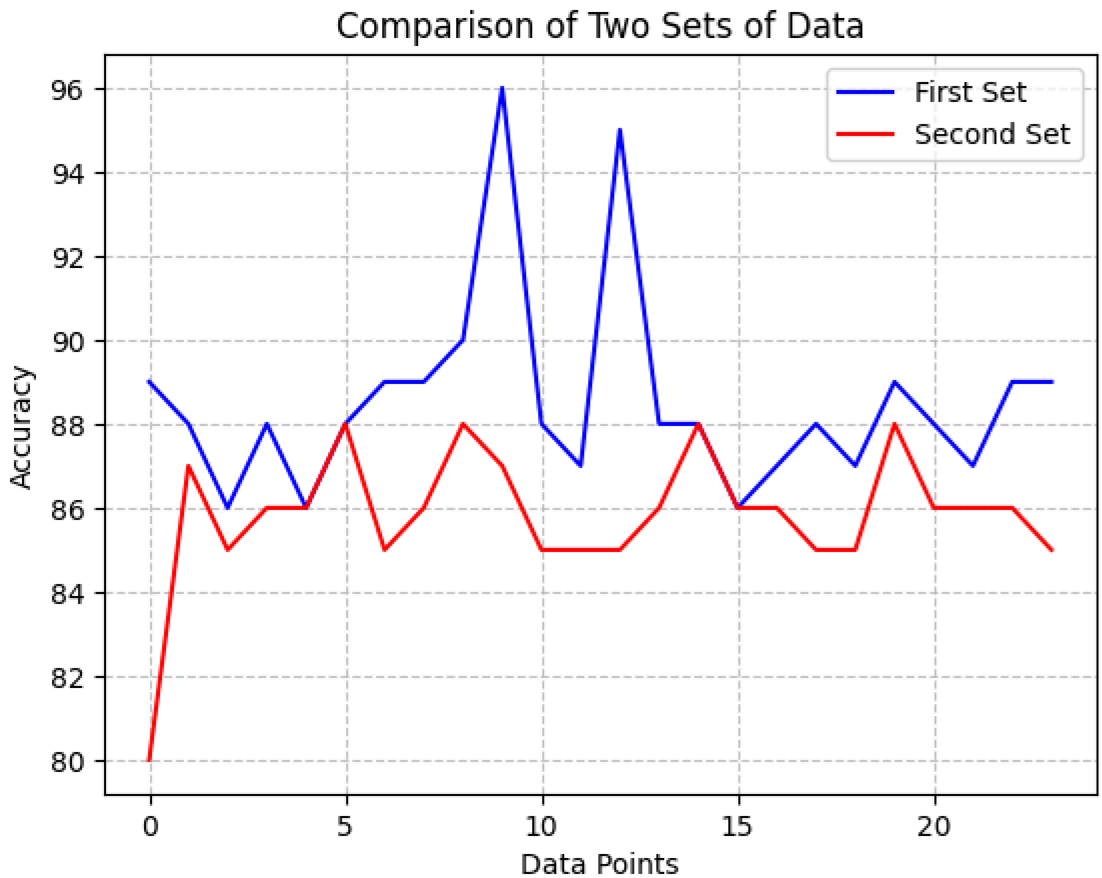


**Fig 3.** Line Graph for Accuracy values for N=24 iterations for both DeepSort and Support Vector Machine. X-axis:iterations, Y-axis:Accuracy values. The Blue line indicates the Novel Deep Sort algorithm and the Red line indicates Support Vector Machine. By the above graph Novel Deep Sort has higher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

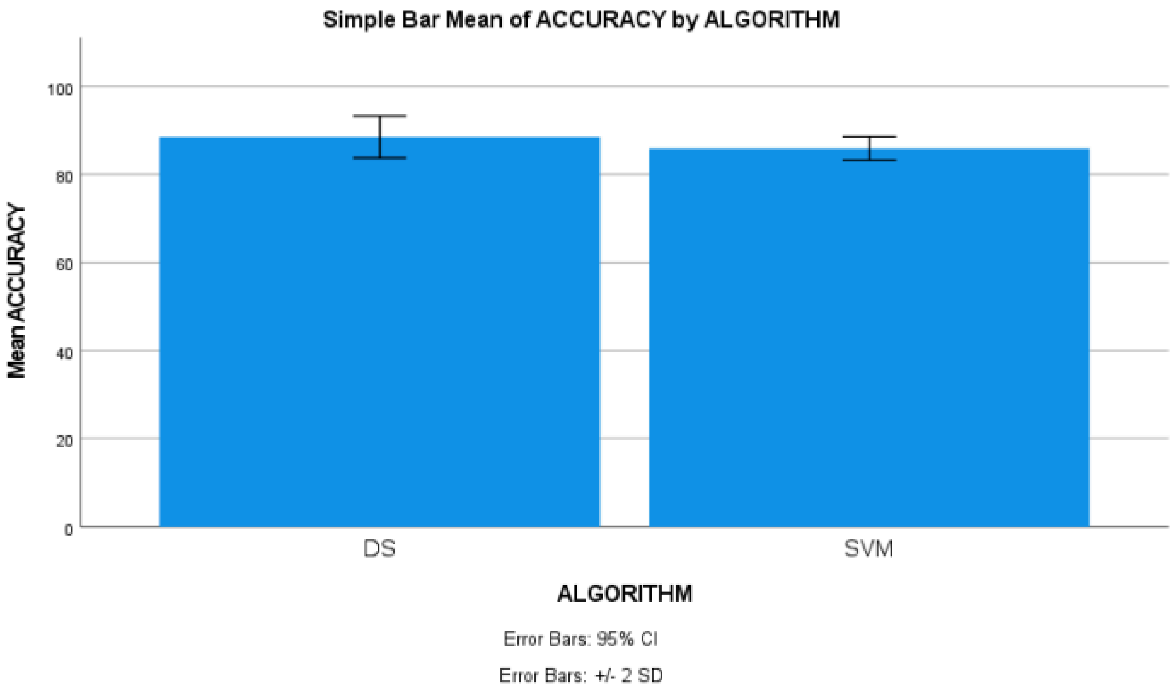


**Fig. 4.** The Novel Deep Sort method has a greater mean accuracy of 88.54 than the Support Vector Machine algorithm, which is 85.92, according to the comparison of mean accuracy. Also, compared to the Support Vector Machine technique, the Novel Deep Sort standard deviation is smaller. Mean accuracy is plotted on the Y-axis, while Novel Deep Sort against the Support Vector Machine technique is plotted on the X-axis. ± 2 SD is used to represent the error bar.