

Realtime Visual Object Recognition using Support Vector Machine comparing with K- Nearest Neighbor algorithm for improving accuracy

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Abstract

Aim: The aim of this research is to recognise objects by using machine learning algorithms from the images with improved accuracy. **Materials and Methods:** A total of 104 samples are there for the two groups. Novel Support Vector Machine is considered as group 1 and K- Nearest Neighbor Algorithm is considered as group 2. Group 1 consists of 52 samples and Group 2 also consists of 52 samples and the G power is 80%. **Results:** The accuracy for the Novel Support Vector Machine algorithm (92%) is more than that of the K- Nearest Neighbor algorithm (83%). The mean accuracy detection is $\pm 2SD$ and the significance value is 0.000 ($p < 0.01$) which shows the hypothesis is correct and it is carried out using an independent sample T test. **Conclusion:** Hence, the accuracy of Novel Support Vector Machine is found to be 92% which is more than the accuracy of the K- Nearest Neighbor algorithm which is 83%.

Keywords: Novel Support Vector Machine, Machine Learning, Object Recognition, K- Nearest Neighbor, Bounding boxes, Feature extraction.

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INTRODUCTION

Object recognition is a technique that allows you to recognise objects in the images. Machine learning and deep learning algorithms are used for the purpose of object recognition (LeCun, Bengio, and Hinton 2015). Object recognition works mainly by training the recognition model with image datasets which have a lot of images (Arai, Kapoor, and Bhatia 2018). In images the regions of attention are predicted by using object recognition technique (Rai and Le Callet 2018). Several algorithms make the difficulty of finding an image from the object easier. The algorithm preferred here is the Novel Support Vector Machine algorithm. There are a lot of applications for object recognition. Detecting anomalies which have industry specific usages is also an application of object recognition (Ramchandran and Sangaiah 2018). For example, in the field of agriculture it is useful in detecting the type of disease that affects the crop by examining the image of leaves of infected crops (Uddin and Bansal 2021). It is also helpful in recognising skin diseases in the medical industry (Kevin Zhou 2015).

More than 19000 articles were published from various sources such as IEEE Xplore, Google Scholar, Springer and many others in the past 5 years. The articles published may have an unique approach to recognise the objects from the images. The FAST corner detection is one of the unique approaches for object recognition which involves the test of accelerated segments to generate features from image (Setyadi and Ranggadara 2020). The FAST corner detection mainly works by distinguishing the corner pixel of an input image from the surrounding pixels which is mainly based on feature extraction (Liu et al. 2018). This FAST corner detection can also perform better even when the object is deformed. But this method is not effective in real time because of its slow computation time. Object recognition can also be done by using contextual information from images by using image matching (Mishkin, Matas, and Perdoch 2015). The FLANN matcher can also be used in object recognition with the help of corner detection techniques (Changan and Chilverri 2016).

Our team has extensive knowledge and research experience that has translate into high quality publications (Bhansali et al. 2021; Jayanth et al. 2021; Sudhakar, Ravel, and Perumal 2021; Sathiyamoorthi et al. 2021; Deepanraj et al. 2021; Raju et al. 2021; Arun Prakash et al. 2020; Kamath et al. 2020; Shanmugam et al. 2021; Rajasekaran et al. 2020; Adhinarayanan et al. 2020; Rajesh et al. 2020; Aurtherson et al. 2021). The research

gap for object recognition is inaccuracy which is because of the false detection of objects from images and also by generating multiple bounding boxes over a single object in the image. The existing methods lack accuracy for various reasons such as the one stated above. So, the main aim of this research is to increase accuracy for object recognition by comparing over different methodologies of object recognition.

Materials And Methods

This research article was carried out in the Department of Artificial Intelligence Laboratory belonging to Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences. This research article has two groups. The two groups are Novel Support Vector Machine (92%) and K- Nearest Neighbor Algorithm (83%) which are compared based upon their accuracies of object recognition from the images. There are 104 samples in total for the two groups which are divided equally which is 52 samples per group. The first group has the first 52 samples of accuracies and the remaining 52 samples of accuracies are for the second group. The number of samples are taken according to the previous study (Reinders et al. 2018) with confidence interval 95% and enrollment ratio defined as 1 and g power 80% and along with a threshold as 0.5G.

The requirements for this research are a dataset which consists of images which are necessary for training the object recognition framework. The framework requires a minimum of 4GB of RAM for easy access to the processor. Coming to the processor Intel i3 5th gen or Ryzen 3 are recommended. Hard disk space of at least 50GB is required to store the necessary images of the dataset which is downloaded from www.kaggle.com and to store the code and to install the plugins or any software. Graphics card of minimum 2GB is recommended to reduce the load on the CPU which helps in faster processing of the images. The online development environment Kaggle is used to develop the framework for object recognition.

Support Vector Machine

Novel Support Vector Machine is an algorithm that falls under the category of supervised machine learning algorithm that is mostly used for the purpose of problems, where classification plays a key role. Here object recognition is also a classification problem which requires classification of the objects from the images.

Novel Support Vector Machine algorithm steps:

- Step 1: From the dataset, the image is imported and by using the HOG feature extraction. This feature extraction method is used to get the featured image.
- Step 2: Large sized images are resized for the object to be recognised by eliminating the unwanted portions of the image.
- Step 3: The object recognition framework with Novel Support Vector Machine classifier is built by training the model with dataset images.
- Step 4: Localization of the objects in the images with the bounding boxes are generated by using the Sliding Window Approach.
- Step 5: The multiple bounding boxes over a single object termed as false detections are reduced by generating Heatmap.
- Step 6: By eliminating the excess bounding boxes, the object is recognised accurately.

K- Nearest Neighbor Algorithm

K- Nearest Neighbor algorithm is mostly for the type of problems where classification and regression are required. It is classified as a supervised machine learning algorithm. This algorithm classifies new data based on the criteria of similarity based on the previously stored data that is taken from the neighbor.

K- Nearest Neighbor Algorithm steps:

- Step 1: Determine the parameter K which is actually the count of nearest neighbors.
- Step 2: By using the Euclidean distance method the distance between the training samples and query- instance is calculated.
- Step 3: Sort all the distances calculated to find the nearest neighbor based on Kth minimum distance.
- Step 4: Get all the training data categories for the sorted value that falls under K.

Step 5: As a prediction value, the majority of the nearest neighbors are used and generate bounding boxes.

Statistical Analysis

IBM SPSS version 26 is used to implement the statistical analysis. The independent sample T- test is performed with the help of comparison made between mean accuracies. The correlation table is generated by using bivariate correlation is SPSS. The independent variables are accuracy and number of images in (Kevin Zhou 2015) whereas the dependent variables are viewing angle and image size.

Results

The accuracy of the Novel Support Vector Machine algorithm is 92% and the accuracy of K- Nearest Neighbor algorithm is 83%. The group 1 is referred to the Novel Support Vector Machine algorithm and group 2 is referred to the K- Nearest Neighbor algorithm. Here both the groups are compared in terms of accuracy. So, the Novel Support Vector Machine algorithm performed better than K- Nearest Neighbor Algorithm.

Table 1 shows the sample data of the accuracies of Novel Support Vector Machine algorithm and K- Nearest Neighbor algorithm.

Table 2 shows the group statistics for size N=52, which contains mean accuracies and standard deviations for Novel Support Vector Machine algorithm and K- Nearest Neighbor algorithm.

Table 3 shows the independent sample T- test that compares Novel Support Vector Machine algorithm as well as K- Nearest Neighbor algorithm with confidence interval 95%.

Table 4 shows the bivariate correlation of the accuracies of both Novel Support Vector Machine algorithm and K- Nearest Neighbor algorithm.

Figure 1 is a graph that shows the comparison between the mean accuracy of the Novel Support Vector Machine and mean accuracy of the K- Nearest Neighbor algorithm along with the error bars.

Discussion

As aforementioned in the results it is evident that the Novel Support Vector Machine algorithm has performed significantly better than that of the K- Nearest Neighbor algorithm. The accuracy percentage of Novel Support Vector Machine is found to be 92% while that of the accuracy percentage of K- Nearest Neighbor is 83%.

There are many similar findings of the object recognition framework which uses machine learning and deep learning algorithms that can also perform well in object recognition (Silva, Sousa, and Costa 2021). Novel Support Vector Machine offers great accuracy and it is memory efficient because the decision function employs a sample of training points termed as support vectors (Roy, Kar, and Das 2015). The Novel Support Vector Machine algorithm performs effectively when there is a clear margin of separation (Kumar et al. 2020). When the data set contains more noise, such as overlapping target classes, Novel Support Vector Machine does not perform well. Feature vectors are necessary for the Novel Support Vector Machine algorithm in order to make it work on any problem that requires feature extraction (Chaitanya et al. 2021). The Novel Support Vector Machine algorithm is not scalable and suitable only for small datasets (Pantazi, Moshou, and Bochtis 2020).

The object recognition system has some limitations like mirroring, occlusion, rotation, lighting etc. The object recognition must be able to recognise the object even when it is mirrored. When an object is fully not visible to the system then it comes under the case of occlusion and the system must also handle these types of situations and recognise the object accurately. Even when the object is rotated the object recognition system must be able to resolve the issue and it should give correct output. Lighting plays a crucial role in terms of vision. The object which is located in low lighting condition must also be correctly recognised. All those above stated limitations show the different perspective of the object which creates confusion to the system. Future scope of the object recognition system is to increase the object- part relation which means the search for the objects and the parts must take place at the same time and the system can be further so that it can perform active vision.

Conclusion

Hence the Novel Support Vector Machine algorithm which has an accuracy percentage of 92 performed better

than the K- Nearest Neighbor algorithm with accuracy percentage 83. So, by using the Novel Support Vector Machine algorithm in object recognition gives better accuracy than the K- Nearest Neighbor algorithm.

DECLARATIONS

Conflicts of Interest

No conflict of interest in this manuscript

Authors Contribution

Author TSE is involved in data collection, data analysis and manuscript writing. Author VK was involved in conceptualization, data validation and critical review of the manuscript.

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TABLES AND FIGURES

Table 1. The following table 1 consists of accuracies of sample size of 10 for both Novel Support Vector Machine algorithm and K- Nearest Neighbor algorithm.

S. No	SVM	KNN
1	89.07	87.45
2	93.34	90.23
3	96.76	84.11
4	93	89.96
5	85.01	80.63
6	97.97	85.73
7	94.55	88.93

8	89.12	81.34
9	96.89	80.91
10	90.76	82.04

Table 2. The following table shows group statistics for which shows sample size of N=52 for each group. The mean percentage of the Novel Support Vector Machine algorithm is 92.92% whereas the accuracy percentage of the K- Nearest Neighbor algorithm is 83.78%. Standard deviation as well as standard error rate is also shown.

	Groups	N	Mean	Std. Deviation	Std. Error Rate
Accuracy	SVM	52	92.9231	4.40074	0.61027
	KNN	52	83.7885	3.99675	0.55425

Table 3. The following table shows the independent sample T- test and the equal variance assumed is compared with equal variances in the accuracy with confidence interval of 95%.

		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 variance assumed	1.18	0.279	11.08	102	.000	9.134	.82439	7.499	10.769
	Equal variances			11.08	101	.000	9.134	.82439	7.499	10.769

Table 4. The following table shows the bivariate correlation of the accuracies of the both Novel Support Vector Machine and K- Nearest Neighbor algorithm is 0.111 with significance value as 0.000.

Pair	N	Correlation	Significance Value
SVM and KNN	52	0.111	0.000

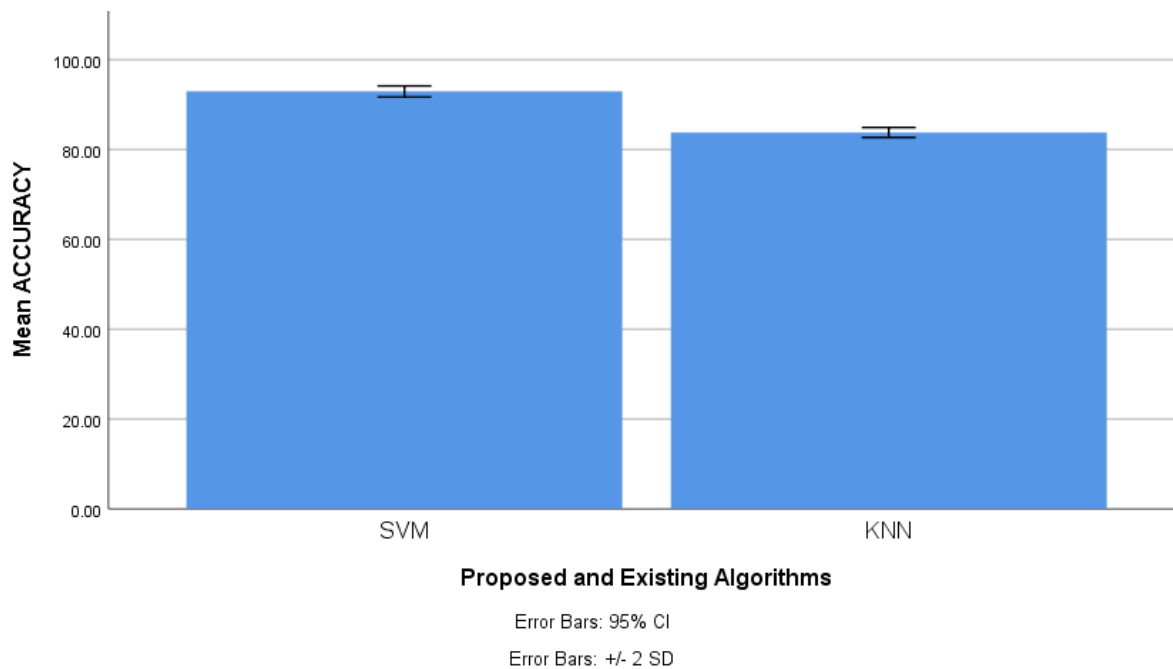


Fig. 1. The figure 1 is a bar chart which compares the mean accuracies of both the existing and proposed algorithm. The accuracy is taken on the Y-axis while the proposed and existing algorithm is taken on X-axis. The accuracy of the Novel Support Vector Machine is 92% and K- Nearest Neighbor algorithm is 83%. The mean accuracy detection is $\pm 2SD$.