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Improving Accuracy in Face Mask Detection Based on Opencv Compared with Viola-Jones Method for Pandemic Control

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Abstract

Aim: This work aims to improve the accuracy in Face Mask detection based on OpenCV compared with the Viola-Jones method for Pandemic Control. **Materials and Methods:** OpenCV with Viola-Jones methods are chosen as two groups and each group with 15 samples respectively, which are collected using the training image datasets.G Power = 0.8. **Result:** The independent sample t-test result shows that the accuracy in (%) is improved for the OpenCV based face mask detection method with a mean (96.52) when compared with the Viola-Jones method (81.24) with a significance ($p<0.05$). **Conclusion:** The analysis shows that the accuracy of OpenCV based facemask detection is significantly better compared to the Viola-Jones method.

Keywords

OpenCV, Novel Facemask Detection, Accuracy, Deep Learning, Machine Learning, COVID-19.

INTRODUCTION

Open CV contains many pre-trained image sets for face, eye, mask, and smile. Facemask detection is identifying a person who is wearing a mask or otherwise. It's difficult to manually check if people are wearing their facemasks correctly and to notify in public and crowded places. The virus spreads through close contact with people and overcrowding in public places (Nagrath et al. 2021). According to WHO guidelines, the primary precaution to take to prevent the spread of the virus is to wear a facemask and maintain a social distance (Strom, n.d.; Howard 2021). Wearing a facemask is the most effective way to protect people from COVID-19. A model based on deep learning and classical machine learning classifiers is introduced for face mask detection (Loey et al. 2021a). Applications of face mask detection algorithms are COVID -19 prevention with highest accuracy with reduced time delay (Sethi, Kathuria, and Kaushik 2021; Loey et al. 2021b; Vadlapati, Senthil Velan, and Varghese 2021).

In the last 5 years, several research papers on face detection have been published in which 100 research articles were published in IEEE Xplore and 350 papers are published in Google Scholar. In face detection, the presence and location of a face in an image are detected but do not identify it (Sriratana et al. 2018). If people do not wear the mask, the system will give the message to wear a mask to prevent them from virus transmission. In conventional facial recognition systems, a face recognition algorithm is mapped on the faces to get the identity (Khosla et al. 2021).The algorithm works with frontal face images and the human face features with their relative location (Vadlapati, Senthil Velan, and Varghese 2021). Deep learning deals with structures modeled on the human brain. Authorities all around the world have recognized the power of artificial intelligence with deep learning and machine learning in order to battle the virus (Ng et al. 2021). A model that integrates deep transfer learning and classical machine learning algorithms is presented (Sriratana et al. 2018)**.**

Previously our team has a rich experience in working on various research projects across multiple disciplines (Venu and Appavu 2021; Gudipaneni et al. 2020; Sivasamy, Venugopal, and Espinoza-González 2020; Sathish et al. 2020; Reddy et al. 2020; Sathish and Karthick 2020; Benin et al. 2020; Nalini, Selvaraj, and Kumar 2020).The lacunae in the existing research are that there is low accuracy to compare with Viola-Jones.In this work, a learning-based approach is presented for identifying masks over faces in public places .The goal of this research is to improve real-time detection accuracy in order to create a novel face mask detection system.

MATERIALS AND METHODS

This study was conducted in the Embedded System Lab, Department of Electronics and Communication Engineering at Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences. This work was done using Python IDE software. Two groups are considered, which are OpenCV and Viola Jones methods. Each group consists of 15 samples, which in total gives 30 samples. G power is 0.8.
In the sample preparation of group 1, the OpenCV method is chosen. In this group, 15 samples are taken, and the accuracy is obtained by varying the frames per second in the image data set.
In the sample preparation of group 2, the Viola-Jones method is chosen. In this group, 15 samples are taken and the accuracy is obtained by varying the frames per second in the image data set.
Python IDE software is used for face mask detection for various values of frames per second and the corresponding accuracy values are noted down. The same process is followed for Viola-Jones method and accuracy values are noted down.

Statistical Analysis

The statistical software used in SPSS (Huang et al. 2016). The obtained values from the San simulation tool are extracted into SPSS to calculate the mean, standard deviation, and significance. In this work, the independent variables are image types and algorithms and the dependent variables are frames per second and accuracy.

RESULTS

The total sample size considering group 1 and group 2 is 30. Python IDLE is used for simulation. The independent t-test has been carried out and found that the accuracy mean for OpenCV (1.548) is higher than the accuracy obtained from Viola-Jones method with the significance (p=0.031).
Figure 1 shows the output of novel facemask detection using OpenCV. Fig. 2. shows the real-time novel facemask detection using OpenCV . Fig. 3 shows the comparison of accuracy values for novel facemask detection with OpenCV with Viola-Jones method for various frames per second values. Fig. 3. clearly indicates an improved accuracy with OpenCV compared to the Viola-Jones method. Fig. 4. gives the comparison of Mean

Accuracy (+/- 1SD) for the group 1 (OpenCV) and group 2 (Viola Jones).The computational efficiency of OpenCV provides better accuracy than the Viola Jones method. X axis represents Groups 1&2 (OpenCV and Viola-Jones), Y axis represents mean accuracy with +/- 1SD

Table 1 shows the variation of accuracy for the groups (Viola-Jones and OpenCV) and the corresponding frames per second values. Table 2 shows the t-test analysis of Mean and Standard deviation of OpenCV and Viola Jones methods. Table 3 shows the independent sample t-test with the statistical significance (p=0.031).

DISCUSSION

The accuracy in Face Mask detection based on OpenCV is compared with the Viola-Jones method. OpenCV with Viola-Jones methods are chosen as two groups and each group with 15 samples respectively, which are collected using the training image datasets. The independent sample t-test result shows that the accuracy in (%) is improved for the OpenCV-based face mask detection method with a mean (96.52) when compared with the Viola-Jones method (81.24) with a significance (p=0.031).

OpenCV is an open-source software library for machine learning and computer vision. This library provides an infrastructure for computer vision applications and to incorporate machine perception in end products (Meivel et al. 2021) (Militante and Dionisio 2020). The OpenCV library includes over 2,500 optimized algorithms, which include state-of-the-art computer vision and machine learning algorithms (Cabani et al. 2021).These algorithms can be used to detect and recognize faces and objects. Human actions, moving objects can be tracked . The images can be merged , similar images can be found from the databas (Prusty, Tripathi, and Dubey 2021) (Hassaballah and Awad 2020). OpenCV is a big open-supply library for pc vision, device learning, and photography (Militante and Dionisio 2020) (Hassaballah and Awad 2020). NumPy is an optimized library for numerical operations and all operations may be blended with OpenCV (Loey, Smarandache, and Khalifa, n.d.). But, applications like video compression and storage depend on other color spaces (Vadlapati, Senthil Velan, and Varghese 2021).

The important difference between Image Processing algorithms and Computer Vision (CV) algorithms is while the former deals with the image as an input and an output the later take an image as input and gives the features and or other details about the image as an output (Cabani et al. 2021) (Sethi, Kathuria, and Kaushik 2021). The first step in predicting if someone has appropriately donned a mask is to train the algorithm using a suitable dataset.(Brownlee 2019).After the classifier has been trained, the SSDMNV2 model can determine whether the person is wearing a mask (Brownlee 2019) (Sikka 2021).The process takes 40 milliseconds to manually check defaulters (Nagrath et al. 2021)(S, Rashmi, and Manohar 2021).

The limitations of pose variations are very sensitive to the facial recognition system. Changes in facial texture can be caused by head movement or different camera positions, resulting in an incorrect outcome. In future, a comprehensive face mask detection system can be developed to reduce the number of false positives.

CONCLUSION

This work analyzed the accuracy of face mask detection using OpenCV method and compared with the accuracy obtained using Viola-Jones method. The analysis shows that the accuracy mean (96.5) of OpenCV-based Facemask detection method is significantly better when compared with Viola-Jones algorithm (81.24).

DECLARATION

Conflict of interest

No conflict of interest in this manuscript.

Author Contributions
Author RL was involved in sample set preparation, statistical analysis, and paleograph. Author DS was involved in idealization, data declaration, concrete suggestion, and structuring the report.

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TABLES AND FIGURES

Table 1. Variation of Frames per second values for the two groups (Viola-Jones and OpenCV) and the corresponding accuracy in percentage.

S.No	Group (Viola-Jones)	Frames Per Second (FPS)	Accuracy (%)	Group (OpenCV)	Frames Per Second (FPS)	Accuracy (%)
1	1	100	75.36	2	100	98.36
2	1	120	76.54	2	120	98.2
3	1	140	79.25	2	140	91.25
4	1	160	76.5	2	160	98.53
5	1	180	73.65	2	180	98.55
6	1	200	70.22	2	200	97.25
7	1	220	70.55	2	220	95.44
8	1	240	70.35	2	240	99.25
9	1	260	71.6	2	260	98.52
10	1	280	74.45	2	280	98.35
11	1	100	73.17	2	100	96.4
12	1	120	67.85	2	120	87.25
13	1	140	75.03	2	140	98.52
14	1	160	73.33	2	160	99.01
15	1	180	78.55	2	180	98.57

TABLE 2. The t-Test analysis of Mean and Standard deviation of OpenCV and Viola Jones parameters.

	Group	N	Mean	Std. Deviation	Std.Error Mean
Accuracy	Viola-Jones	15	81.2427	4.42480	1.14248
	OpenCV	15	92.3967	2.22190	.57369

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TABLE 3. Independent sample t-test shows statistical insignificance (p=0.031) for Accuracy between the two groups -OpenCV and Viola Jones.

Levene's Test for Equality of Variances				**t-test for Equality of Means**					**95% Confidence Interval of the Difference**	
F			Sig.	t	df	Sig (2-tailed)	Mean Difference	Std.Err or Difference	Lower	Upper
Accuracy	Equal variances assumed	5.142	.031	-8.725	40	0.000	-11.15400	1.27843	-13.77274	-8.53526
	Equal variance is not assumed			-8.725	20.638	0.000	-11.15400	1.27843	-13.81548	-8.49252

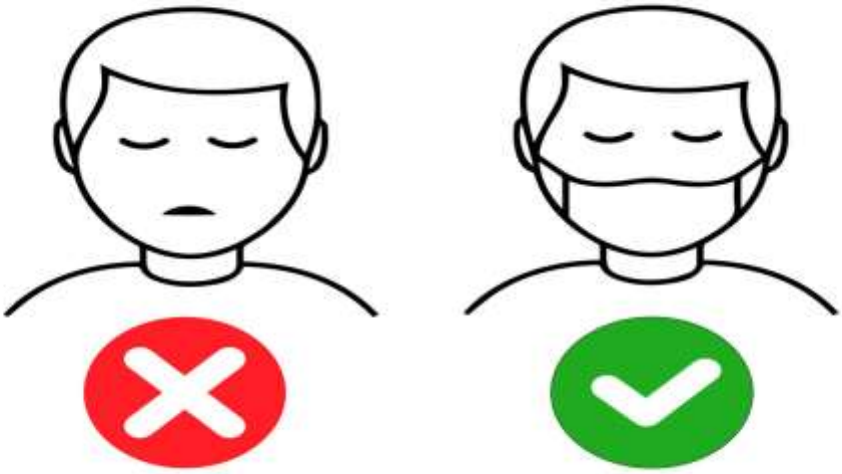

Fig. 1. The above image shows novel facemask detection using OpenCV.

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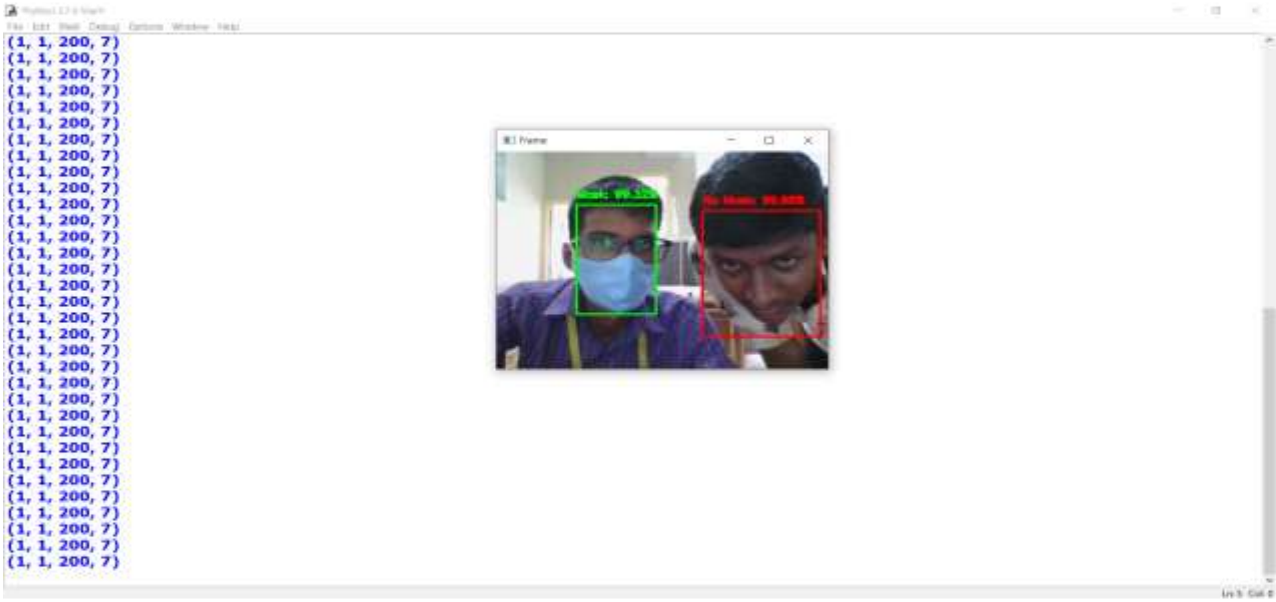

Fig. 2. Real-time novel facemask detection using OpenCV

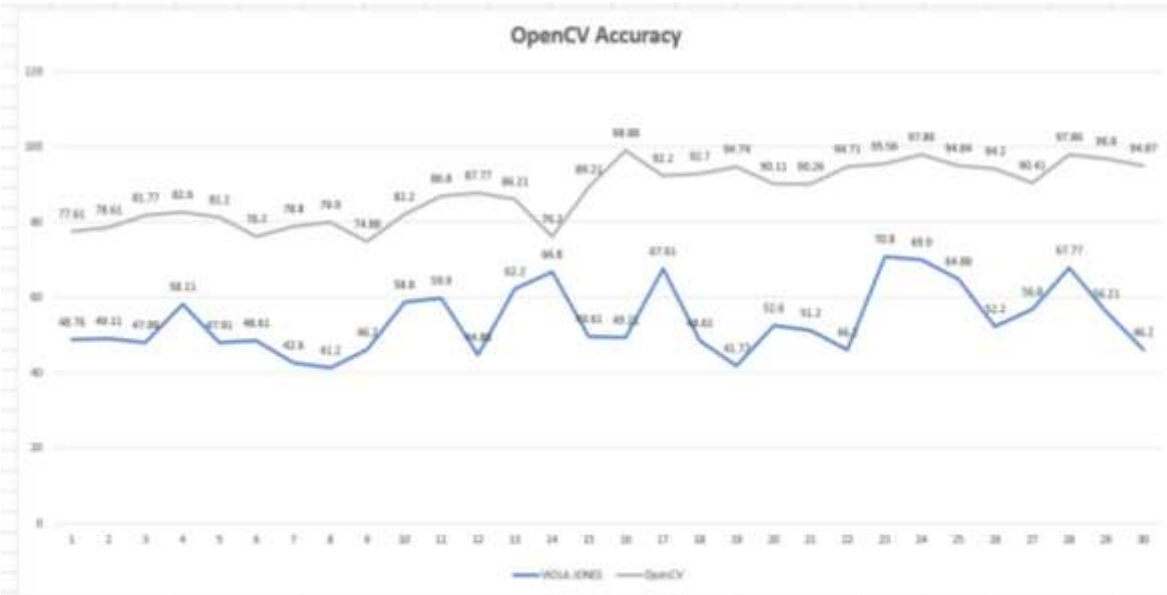

Fig. 3. Comparison of accuracy using novel facemask detection with OpenCV with Viola-Jones method.

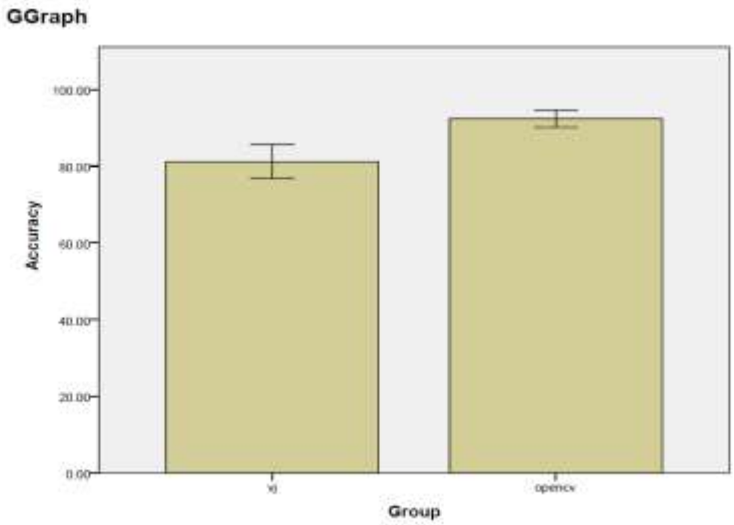

Fig. 4. Comparison of Mean Accuracy (+/- 1SD) for the group 1 (OpenCV) and group 2(Viola Jones).The computational efficiency of OpenCV provides better accuracy than the Viola Jones method. X axis represents Groups 1&2 (OpenCV and Viola-Jones), Y axis represents mean accuracy with +/- 1SD