BALTIC JOURNAL OF LAW & POLITICS
A Journal of Vytautas Magnus University
VOLUME 15, NUMBER 4 (2022)
ISSN 2029-0454

Cite: *Baltic Journal of Law & Politics* 15:4 (2022): 408-415
DOI:10.2478/bjlp-2022-004043

Improving Accuracy in Face Mask Detection based on Tensorflow Compared with Viola-jones Method for Pandemic Control

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Received: August 8, 2022; reviews: 2; accepted: November 29, 2022.

Abstract

Aim: This project aims to Improve Accuracy in Face Mask detection based on TensorFlow compared with Viola-Jones method for Pandemic Control .**Materials and Methods:** Tensorflow method and Viola-Jones method 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 Artificial Intelligence-based TensorFlow with a mean (98.82) when compared with the Viola-Jones method (89.61) with a significance (p = 0.007). **Conclusion:** The results show that the accuracy in TensorFlow-based Facemask detection is significantly better compared to the Viola-Jones method.

Keywords

TensorFlow, Machine Learning, Deep Learning, Novel Facemask Detection, Accuracy, Viola-Jones

INTRODUCTION

OpenCV contains many pre-trained for face, eye, mask, and smile. Detection of a face mask is to detect whether the mask is worn by the person or not (Blanco et al. 2022). In face detection, presence and location of a face in an image is detected, but does not identify it (Brownlee 2019). In face recognition systems, the faces in an image are detected first and then the persons are identified (Lin, Satapathy, and Rajinikanth 2020). 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. 2021; 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. The Viola-Jones algorithm works with frontal face images and features. These features are searched for to find a face in an image. In CNN, the weights are adjusted using transfer learning on the feature extraction model to provide classification on the given datasets (Khademi, Ebrahimi, and Kordy 2022) . The R-CNN detector is trained for

pedestrian identification using a deep learning feature extraction technique. The trials' results clearly reveal certain crucial truths regarding the performance of the R-CNN on various datasets (El Moataz et al. 2020).Viola-Jones object detection framework is developed by Paul viola and Michael Jones (Kar 2020) to provide a framework for general object detection. A model that integrates between 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 a lack of accuracy in real time face mask detection techniques. The purpose of this work is to improve accuracy in face mask detection in real time by using a novel facemask 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. G power used is 0.8. This project was done using Python IDE software.
In the sample preparation for Group 1, Viola-Jones Object Detection algorithm is selected, which is a simple algorithm for real time applications. 15 samples are taken from this group.
In the sample preparation for Group 2, TensorFlow which is a machine learning algorithm is used. It is used for a variety of applications, but it focuses on deep neural network training and inference. 15 samples are taken from this group.
Python IDE software is used for novel facemask detection for various values of frames per second and the corresponding accuracy values using Tensorflow 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 immolation tool are extracted into SPSS to calculate the mean, standard deviation, and significance. In this research work, the independent variables are image sets and the face mask detection 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 IDE is used for simulation. The independent t-test was carried out and found that the accuracy mean (98.82) is higher in Tensorflow than the Viola-Jones (89.61). Significance value is p =0.007. Figure 1 shows the image data in the form of arrays in the TensorFlow layer. Fig. 2 shows the image obtained by the real-time novel facemask detection system using TensorFlow. Fig. 3 presents the accuracy with TensorFlow compared with that of viola Jones based on frames per second. Fig. 4. shows the comparison of mean accuracy between TensorFlow and Viola Jones method. The mean value is higher in Tensorflow compared to the Viola-Jones method.
Table 1 shows the variation of accuracy for the groups (Viola-Jones and TensorFlow) for the corresponding frames per second values. Table 2 shows the t-test analysis of the Mean and Standard deviation of TensorFlow and Viola Jones parameters. Table 3 shows the Independent sample t-test output which shows the statistical significance between TensorFlow and Viola Jones.

DISCUSSION

The accuracy in the novel FaceMask detection based on TensorFlow is compared with the Viola-Jones method. The independent sample t-test result shows that the accuracy in (%)

is improved for the TensorFlow-based face mask detection method with a mean (96.52) when compared with the Viola-Jones method (81.24) with a significance (p=0.007).
In Tensorflow, as the mechanism of execution is in the form of graphs, it is easier to execute while using GPUs (Gai 2022). Data arrays with different dimensions and ranks that are given as input to the neural network are known as tensors (Baluprithviraj et al. 2021). To ensure better training and testing of models against the limited data availability , image augmentation techniques are to be included (El Moataz et al. 2020). It is easy to get and store the data of the employees in this system and to look for the people not wearing the mask (Mbunge et al. 2021). It is imperative to monitor the wearing of face masks for the entire day to ensure public safety in workplaces (Egger et al. 2017).The process takes 30 milliseconds when the defaulters are manually checked.(Gupta, Bhavsar, and Sao 2018). Organisations and industries are required to make sure that their employees correctly wear masks in order to use their services (Strom, n.d.).
The limitations of face mask detection are the face pose variations, which are very sensitive to the facial recognition system. Changes in facial texture may occur by head movement or different camera positions, resulting in an incorrect outcome.The implemented model will make a significant contribution to the health care services of the community. It could be extended in the future to ensure proper wearing of face masks.

CONCLUSION

This work focused on improving accuracy in face mask detection using TensorFlow method compared to Viola-Jones method for Pandemic Control.The analysis shows that the accuracy of TensorFlow based facemask detection is significantly better compared to the Viola-Jones method.The independent sample t-test result shows that the Accuracy is improved for TensorFlow method with a mean (98.82) when compared with the Viola-Jones method (89.61).

DECLARATION

Conflict of interest

No conflict of interest in this manuscript.

Author Contributions

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

Acknowledgment

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. VK Technologies, Trichy.
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. Variation of Frames per second values for the groups (Viola-Jones and TensorFlow) and the corresponding accuracy values

S.No	Group (Viola-Jones)	Frames Per Second (FPS)	Accuracy (%)	Group (TensorFlow)	Frames Per Second (FPS)	Accuracy (%)
1	1	100	88.36	2	100	97.55
2	1	120	88.65	2	120	97.85
3	1	140	87.99	2	140	98.26
4	1	160	83.69	2	160	99.5
5	1	180	86.45	2	180	99.8
6	1	200	70.23	2	200	98.57
7	1	220	83.64	2	220	98.65
8	1	240	87.36	2	240	98.14
9	1	260	87.33	2	260	98.53
10	1	280	80.55	2	280	98.68

ISSN 2029-0454
2022

11	1	100	82.35	2	100	94.56
12	1	120	89.38	2	120	96.53
13	1	140	89.65	2	140	98.62
14	1	160	88.66	2	160	98.11
15	1	180	79.36	2	180	98.65

TABLE 2. The t-Test analysis of Mean and Standard deviation of the two groups (TensorFlow and Viola Jones).The mean accuracy of Tensor Flow is greater than Viola Jones method

	Group	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
Accuracy	Viola-Jones	15	89.6120	2.41971	.62477
	TensorFlow	15	98.8267	2.22190	.27614

TABLE 3. Independent sample t-test shows statistical significance (p= 0.007) between TensorFlow 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.Error Difference	Lower	Upper
Accuracy	Equal variances assumed	8.309	.007	-13.490	28	0.000	-9.21467	.68307	-10.61387	-7.81546
	Equal variance not assumed			-13.490	19.269	0.000	-9.21467	.68307	-10.64300	-7.78633

ISSN 2029-0454
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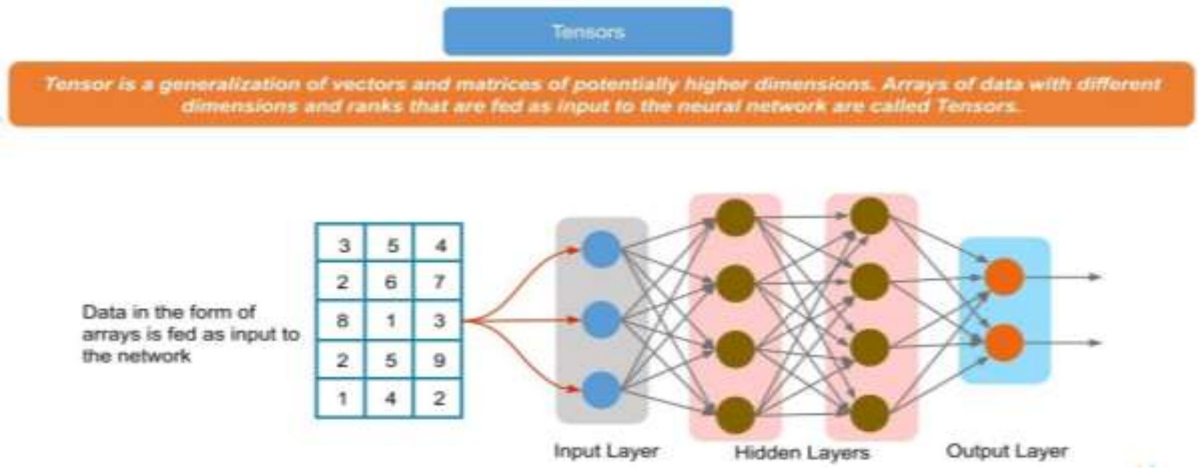

Fig. 1. Data in the form of arrays in the TensorFlow layer

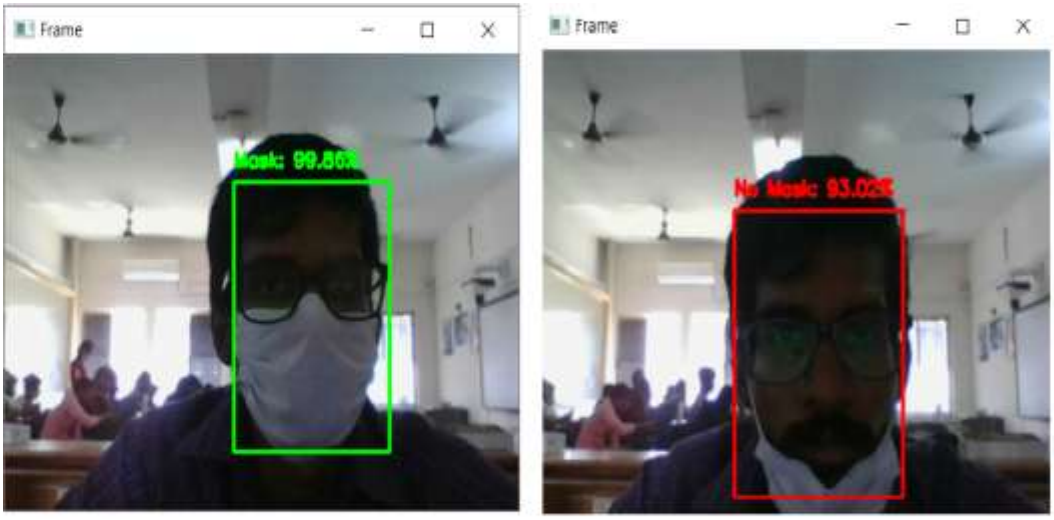

Fig. 2. Real-time novel facemask detection using TensorFlow

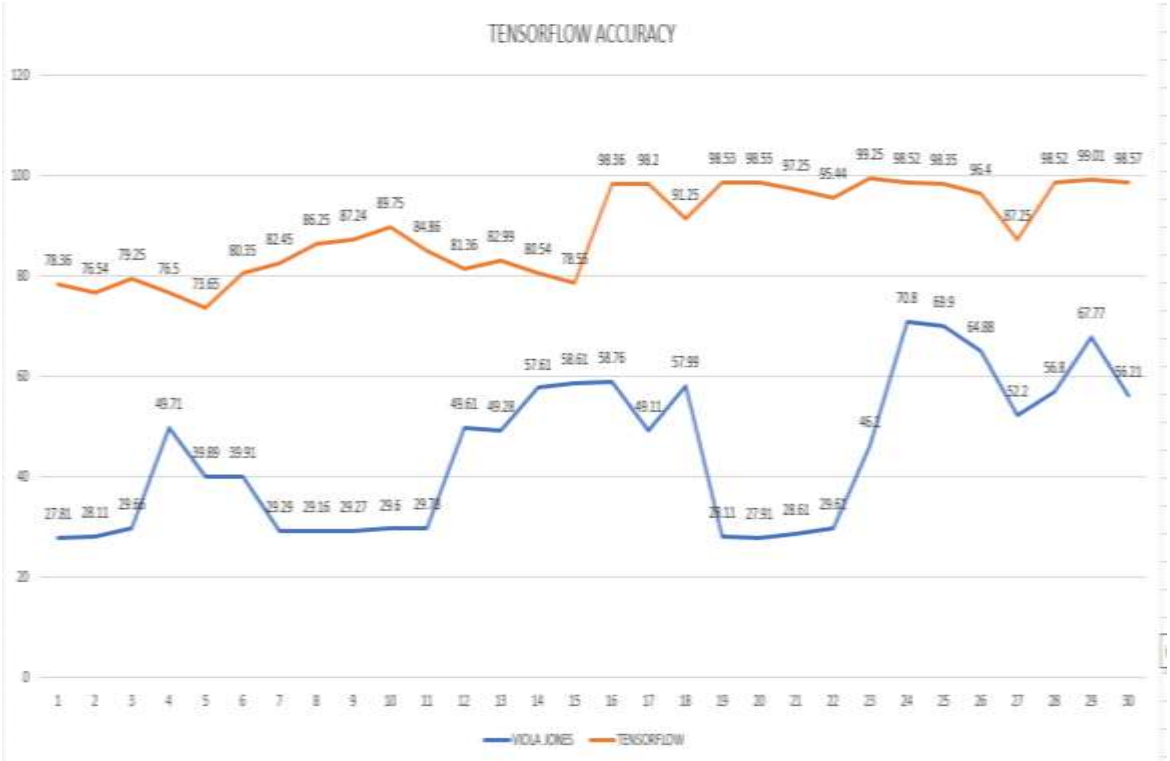

Fig. 3. The above output graph is accuracy output compared with TensorFlow and Viola Jones based on frames per second.

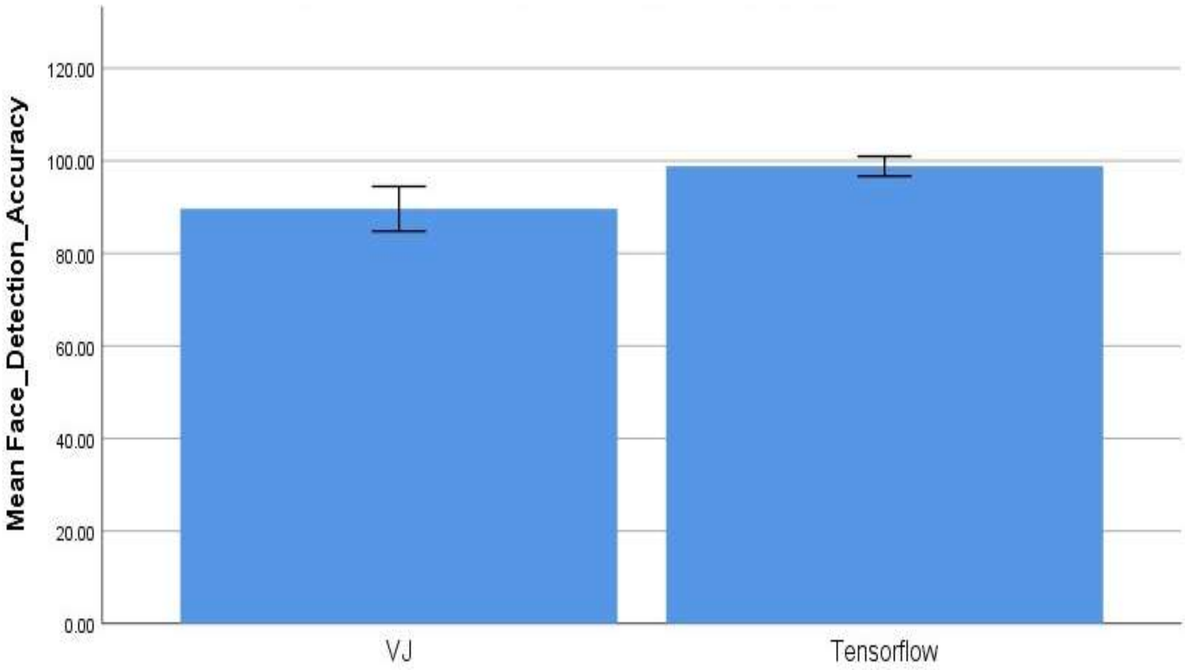

Fig. 4. Comparison of Mean Accuracy (+/- 1SD) for the group 1 (TensorFlow) and group 2 (Viola Jones). The machine learning concept in TensorFlow provides better accuracy than the Viola Jones method. X axis represents Groups 1&2 (Tensorflow and Viola-Jones), Y axis represents mean accuracy with +/- 1SD