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Real-Time Face Mask detection

Project Supervisor: Dr.S.Gowri,M.E.,Ph.d.,

Student Name : B.Karthikeyan

PROFESSIONAL TRAINING REPORT

at

**Sathyabama Institute of Science and Technology (Deemed to
be University)**

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering Degree in Computer Science and Engineering

By

Karthikeyan.B
(Reg. No. 38110242)



**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING SCHOOL OF
COMPUTING**

**SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY JEPPIAAR
NAGAR, RAJIV GANDHI SALAI,
CHENNAI – 600119, TAMILNADU**

April 2022



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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **B.KARTHIKEYAN(38110242)** who carried out the project entitled "**Real-Time Face Mask Detection**" under my supervision from january 2022 to April 2022.

Internal Guide

Dr.S.Gowri

Head of the Department

Submitted for Viva voce Examination held on _____

Internal Examiner

External Examiner

DECLARATION

I B. Karthikeyan hereby declare that the Project Report entitled Real-Time Face Mask Detection done by me under the guidance of Dr. /Prof./ Mr./Ms. Dr.s.Gowri and Engineering degree in Computer Science and Engineering.

DATE: 08/04/2022

B. Karthikeyan

PLACE : Chennai

SIGNATURE OF THE CANDIDATE

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TRAINING CERTIFICATE



ABSTRACT

After a rapid spread of Coronavirus (COVID – 19) in Wuhan –China in December 2019 ,World Health Organization (WHO) confirmed that this was a dangerous virus that could spread from person to person through droplets and airborne contaminants. To prevent the spread of Covid19,people should wear mask during this pandemic. Many new models are developed utilizing convolutional Neural Network to build a model as accurately as possible . The method proposed in this project uses the ResNet model to obtain multiple faces with a single (SSD – Single Shot Multibox Detector) image using a network (model) and MobileNetV2 Architecture used as face mask detector. This system should be used in Real-time applications which require face mask detection for safety purpose due to the outbreak of Covid-19.

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Introduction :

Corona Virus (COVID19) has caused a great deal of damage worldwide. At First corona virus identified in WUHAN - CHINA in December 2019, the World Health Organization (WHO) initially declared this disease as a corona virus outbreak and later declared it an epidemic. [1] Globally, as of now 15 September 2021, there were 225,680,021 confirmed Cases and 4,644,740 people died due to Covid-19 reported by WHO. The Corona virus has been transmitted from one person to another in a variety of ways. The disease spreads to a non-infected person when an infected person coughs or sneezes at some point. The only way to prevent the spread of corona infection is to keep the community distance and to wear face masks. But people do not take this seriously and roam the streets without wearing the right mask and not following proper safety procedures. Physically, it is difficult to keep track of a large number of people in public places. It is therefore important to create a software that can automatically identify people, whether they are wearing a mask or not wearing a mask. Face detection is a technology used to detect human faces in digital images over a long period of time. Using this technology, we can create a model for getting a face mask detection. In this paper, the face mask detection model has been developed using ResNet (SSD), OpenCV, Tensorflow, keras and MobileNetV2 architecture. This model is based on SSD (Single shot Multibox detector) and Resnet-10 architecture as the backbone. We use the Resnet (SSD) model to identify the face while the MobilenetV2 architecture is used to identify the object detection which is the mask detection. Here on this paper Resnet (SSD) [2] and MobileNetV2 models are used in combination to get the highest accuracy face mask detection model. This Algorithm provides more accuracy than other face mask detection algorithms like LeNet-5, AlexNet, YoloV4 etc. The dataset used for this program contains 7553 images which are provided by Kaggle. This model can also be used in the Realtime application to monitor peoples in public places. This system should be used in public places such as school, airport, railway stations etc. By using this system, it is easy to control people and helps to reduce active cases of

coronavirus. The rest of this paper is structured as follows; The second section describes the corresponding activities performed similarly to this paper in the name of Related Works. Section Three describes the methodology and implementation of this system. In the fourth phase the experimental results will be shared with the extracted images and the fifth phase concludes with the conclusion and references.

Related Works :

This section describes the related works which are done previously in this field. There are many models are used to develop Face mask detection system. Here the list of some [4][5][6][7][8][9][10][13][14] models which are discussed below. Author Mohamed Lakhdar Mokkadem et al. [3] Developed the face mask detection system using YOLOV4 model, which is similar to SSD model. YOLOv4 is a high precision model and single-stage object detection algorithm which is proposed in 2020. In this paper, the dataset is divided into three classes 1.wider face 2.FMD 3.RMFD contains 14409 images. This model gives results of average precision for 416×416 is 83% and precision equal to 86.29 with input 512×512 and precision equal to 88.82 with input size 608×608 which is less than our proposed model. Author J. R. V. Jeny et al. [4] Developed a face mask detector using MTCNN model. The datasets used in this paper contain 1139 images in which 659 images are with mask and remaining 480 are without mask images, which are trained and tested. As a result, this model gives F1 score as 0.91 whereas our proposed model gives 0.99 F1 scores as a result. so our model is slightly more accurate than this model In this paper [5] The author T. Q. Vinh et al. used YOLOv3 algorithm and haar cascade detector to detect the face. This algorithm was developed by Joseph Redmon et al. in the year 2018. This model has proven to be effective in object detection and vehicle detection systems. The dataset consists of 7000 images provided by MAFA. This model achieves an accuracy of 90.1 in the training of dataset In this paper [6] The author Mittal et al. developed a lightweight convolutional neural network-based model to achieve a comparable accuracy with different models developed in the past. The author uses the YOLOV3 model to train the

dataset. The dataset contains 494,414 sample images. This deep CNN based mask detection achieved 97.7% accuracy. In this paper [7] The author J. leamsaard et al. developed the face mask detection system using deep learning model using YoloV5 algorithm. The experimental results for this face mask detection system obtained from the deep learning models with different epochs, including 20,50,100,300,500. The dataset used in this model contains 853 images. Each image has different sizes, its label and bounding boxes are assembled in the PASCAL VOC format. The deep learning model for the face mask detection system has good performance with the accuracy of 96.5% with 300 Epochs. In this paper [8] The Author developed a transfer learning model to automate the process of detecting the mask in the face of human beings. The author developed this model using pre-trained deep learning model. This mask detection system is trained with Simulated Masked Face Dataset (SMFD). The transfer learning of InceptionV3 model achieved 99% accuracy in the training phase. In this paper [9] the author developed a combination of light weight neural network MobilenetV2 and single shot detector to achieve the balance of resource limitations and better accuracy. The dataset which is used to train the model consists of 3165 images. This system achieves 91.7% of precision score and 0.91 of recall values with FPA=28.07. In This paper [10] the author developed a face mask detection system using ResNet-101 and raspberry bi board. This model consists of two key components, One is deep transfer learning ResNet-101 as a feature extractor and the second one is a basic machine learning decision tree. This model is trained using 1570 images and achieves 96.02% of precision score.

III. PROPOSED WORK

This model is developed using Keras, TensorFlow, ResNet(SSD), MobilenetV2 and OpenCV. At first to detect the face from the given input we are using Resnet-10 which is single-shot Multibox detector(SSD) [2]. It is capable of detecting faces from Real-time video or from any images with high rate of accuracy. To obtain accurate result pretrained Resnet Caffe models are used in this system. MobileNetV2 architecture is used to detect the face and mask from a video stream. It is used to acquire faster and accurate detection of mask from the video stream. Using MobilenetV2, the base model has been created to access the imagenet which is pre-trained model to obtain better results.

A. Dataset Description

Dataset plays an important role in order to get better accuracy in the proposed model. The dataset used in this model collected from Kaggle platform. FACE MASK DETECTION DATASET [11] is the name of collected dataset from Kaggle. This dataset consists of 7553 images in total divided into 2 categories 1. With mask contains 3725 images 2. Without mask contains 3828 images. This dataset will undergo preprocessing, training and testing to acquire a better result.

With Mask



Without Mask



Fig.1.1. Sample images from dataset

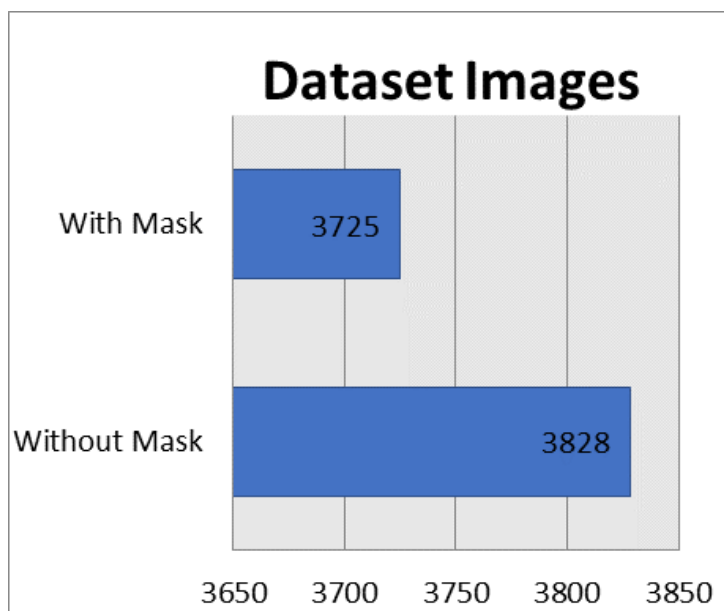


Fig.1.2. Classification of dataset.

B. Data Preprocessing

In the next step, the collected dataset has to undergo a process called data preprocessing. Generally, data preprocessing helps to improve the quality of collected data to extract the meaningful insights from the collected data. It transforms the raw data into a useful, readable format for the developed model. In this process using the preprocessed function load the images of both set, with mask and without mask images are loaded to resize them into 224*224 pixels in order to extract a perfect shape and to convert them into an array format. Then partition the data into training and testing to split 80% of the data for training and the remaining 20% for the testing phase. [11] [12]

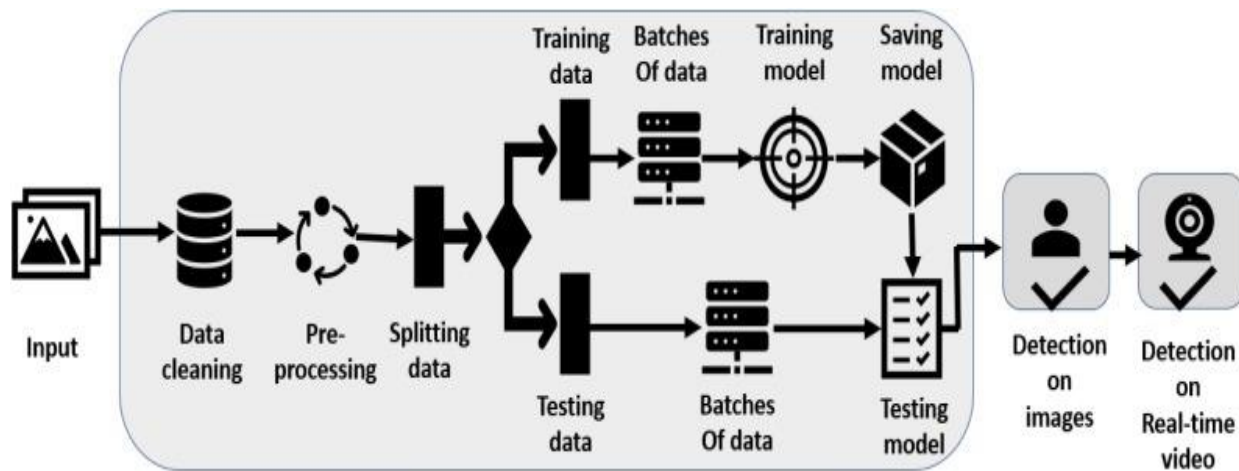


Fig.2. Proposed model Chart [12]

C. Training Phase

There are six stages in this phase, which are image data generator for data augmentation, resizing the size of the image, then converting into array base model with mobilenet, compiling the model and save the proposed model for the future predictions. The preprocessed data will increase the image count by Image data generator for data augmentation. The dataset images are rotated by some angle or flipped by some random angle or change the width range/height range to extract more sample images by this Image data generator. After the input images are processed as an array it is sent to Mobilenet. Instead of sending an input image to convolution neural network it is sent to mobilenet because Mobilenet are very faster in process when compared to the convolution Neural network also it uses lesser parameters. Initial Learning rate is given as 0.0001 to calculate the proper loss and to acquire better accuracy. Then load the Mobilenet with pre-trained Imagenet for fine tuning. The model is trained by 20 Epochs with batch size as 32. As a result of training phase mask detection model has been developed and validation accuracy and validation loss can be calculated for the proposed model.

Epoch	Training Loss	Training Accuracy	Validation Loss	Validation Accuracy
1/20	0.49508	0.8098	0.2598	0.9620
2/20	0.2209	0.9510	0.1273	0.9810
3/20	0.1383	0.9667	0.0816	0.9886
4/20	0.0982	0.9756	0.0585	0.9924
5/20	0.0659	0.9882	0.0472	0.9924
6/20	0.0718	0.9824	0.0398	0.9924
7/20	0.0599	0.9824	0.0348	0.9924
8/20	0.0418	0.9941	0.0314	0.9924
9/20	0.0415	0.9902	0.0281	0.9924
10/20	0.0388	0.9912	0.0259	0.9924
11/20	0.0311	0.9902	0.0254	0.9924
12/20	0.0351	0.9902	0.0232	0.9924
13/20	0.0315	0.9941	0.0222	0.9924
14/20	0.0279	0.9922	0.0211	0.9924
15/20	0.0310	0.9912	0.0203	0.9924
16/20	0.0211	0.9961	0.0192	0.9924
17/20	0.0257	0.9922	0.0187	0.9924
18/20	0.0190	0.9961	0.0186	0.9924
19/20	0.0138	1.0000	0.0182	0.9924
20/20	0.0167	0.9951	0.0181	0.9924

TABLE 1. ITERATION OF LOSS AND ACCURACY

D. Using Proposed Model in Real-time

The model which is developed in the training phase is only detect the mask from the input video stream. In order to detect the face, a separate pre-trained model has been used. To achieve a better accuracy this pre-trained model detects the face and the trained model using a dataset to detect the mask from the input video stream. OpenCV is used for the camera operation. This face mask detection model gives output with green color rectangular box if the detected face wears masks and gives the red coloured box if a person is not wearing a mask. Also, this model shows the accuracy of prediction in the live video stream.

EXPERIMENTAL RESULTS AND ANALYSIS

In this section, the prediction results will be shared with the accuracy rate. When the proposed model compiled and runs it starts to predict the input as shown in the fig 4. First the system starts to Initialize the webcam then it starts to extract the image from the input frame. By using the ResNet-10 and SSD model it detects the face from the input after this mask detection model will be loaded using mobilenet it uses to detect the mask from the detected faces. At last it displays the final prediction with rectangular box whether the person wears a mask or not as shown in the Fig 5,6.

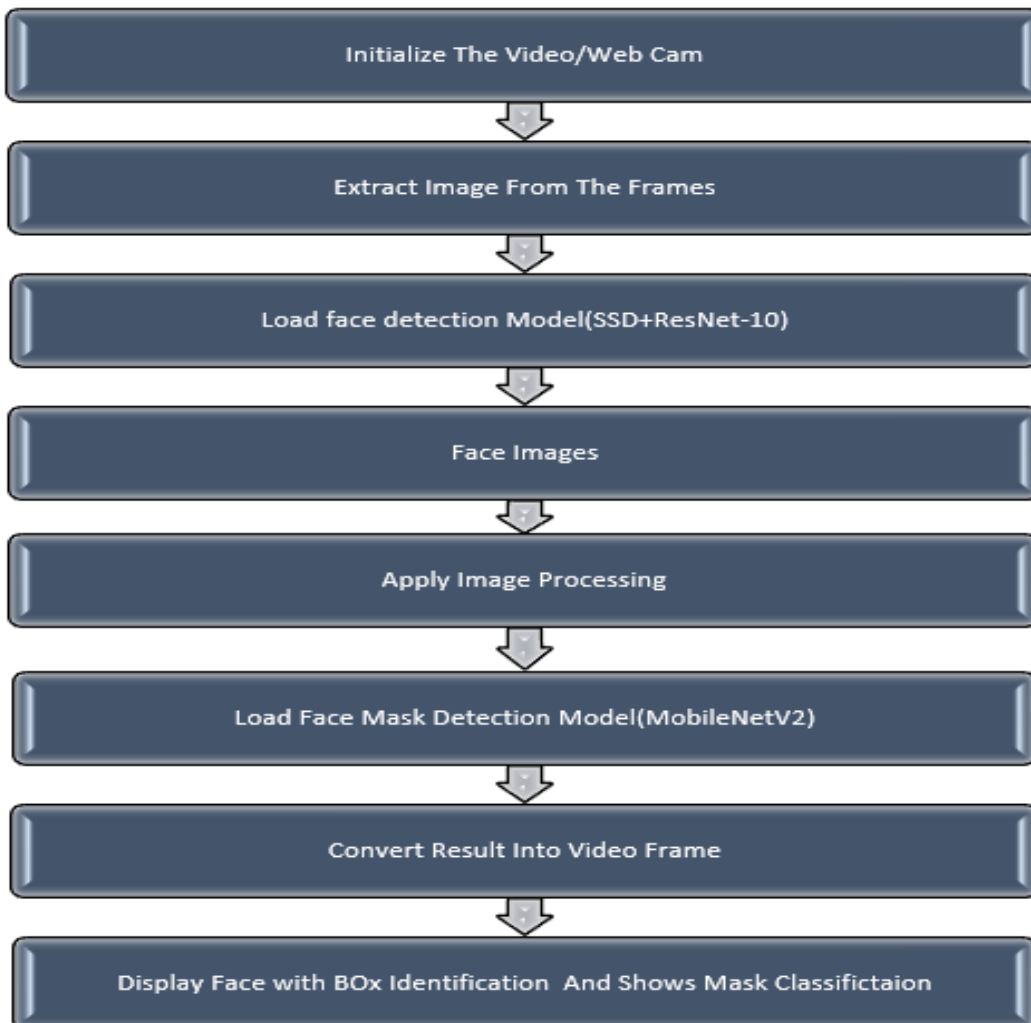


Fig.3.1. Runtime Flow Chart



Fig.3.2. Predicted output without Mask

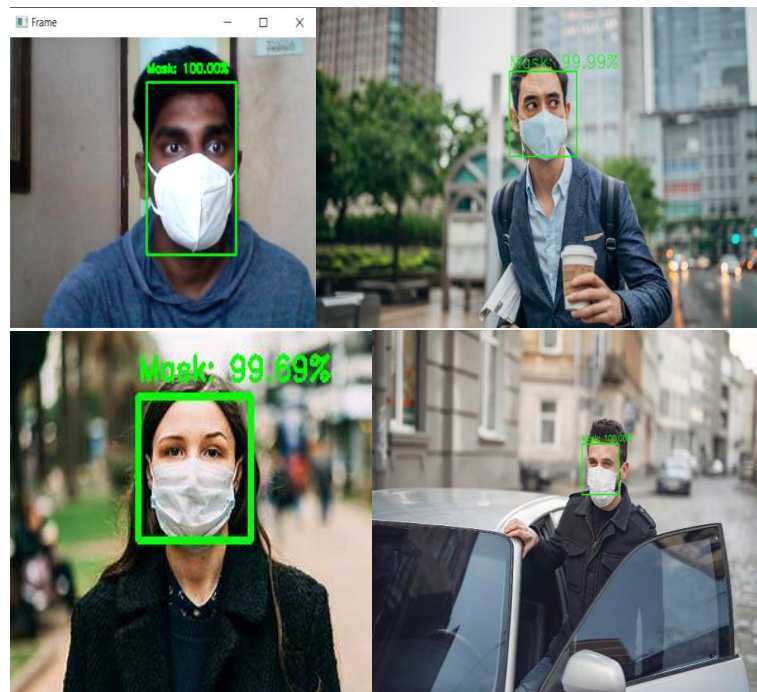


Fig.3.3 Predicted Output with Mask

After 20 Epoch Iteration the Training Loss is 0.0167 and Training accuracy achieves 0.9951 whereas validation loss and Validation Accuracy recorded was 0.0181 and 0.9924 as shown in Fig 7 and 8. This Face mask detection model achieved an accuracy of 99% with 0.99 F1-Score as shown in Tab 2. This model records the more accuracy than other face mask detection model (in Tab 3.).

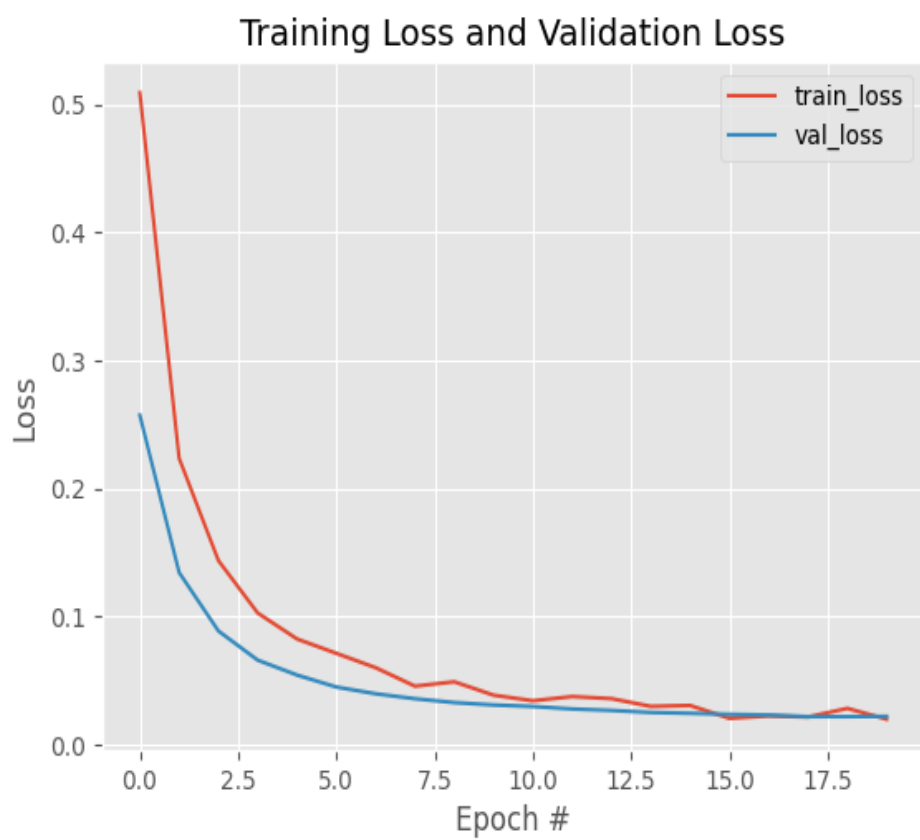


Fig.3.4. Training Loss and Validation Loss

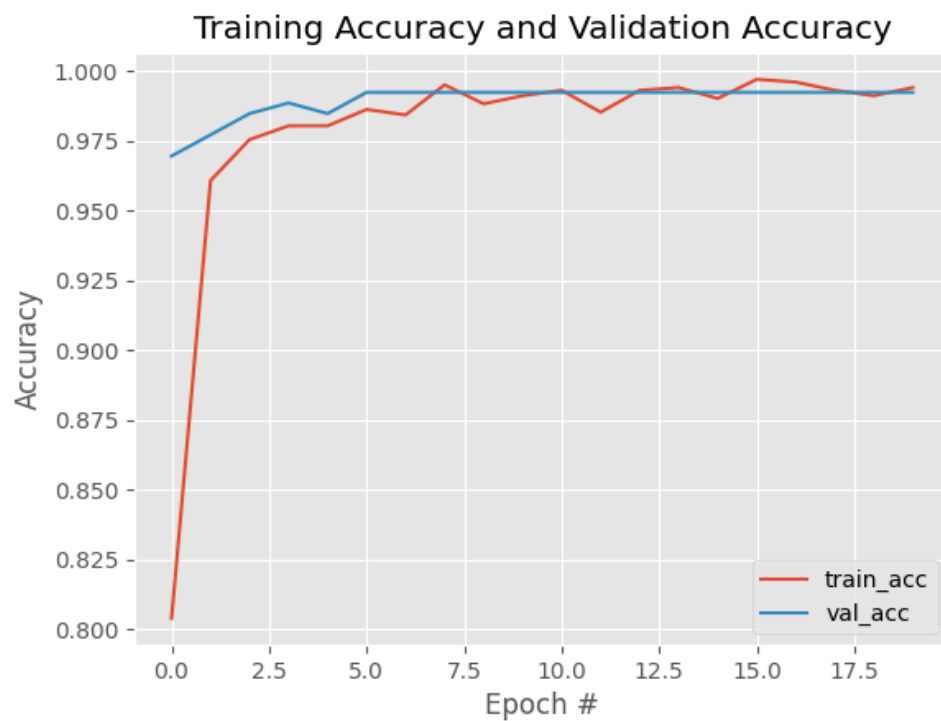


Fig.3.5. Training Accuracy and Validation Accuracy

TABLE II. PERFORMANCE REPORT

Dataset	Classification Report			
	Precision	Recall	F1-Score	Support
With Mask	0.99	0.99	0.99	132
Without Mask	0.99	0.99	0.99	131
Accuracy	-	-	0.99	263
Macro Avg	0.99	0.99	0.99	263
Weighted Avg	0.99	0.99	0.99	263

TABLE III. COMPARISON BETWEEN DIFFERENT ARCHITECTURES

SI.NO	Comparison of Accuracy and F1-Score for Different Architectures			
	Architecture Used	Year	Accuracy	F1-Score
1	LeNet-5	1998	84.6	0.85
2	Alex Net	2012	89.2	0.88
3	YoloV3	2016	92.7	0.91
4	SSD and MobileNetV2 (proposed Model)	2021	99.1	0.99

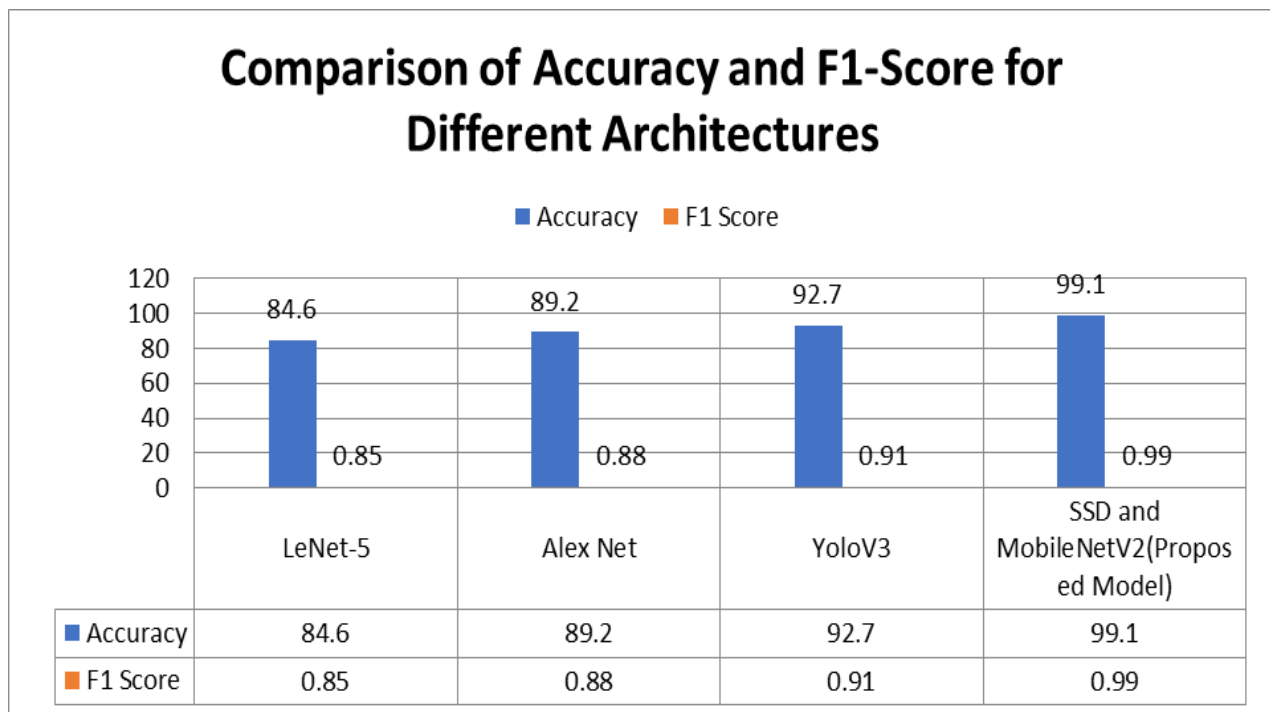


Fig.3.6. Graphical Representation of Table 3

CONCLUSION

Corona virus (Covid-19) is causing a global health crisis. Studies have shown that wearing a mask and keeping social distance reduce the risk of virus transmission and offers a great Security. IN this paper, a face mask wearing detection method based on SSD and mobileNetV2 Architecture is proposed to Detect the mask from people face in public places Through Webcam or CCTV. At first, SSD algorithm is used to detect faces followed by mobilenet architecture used to detect mask from the Human Face. Finally, the proposed work of face mask detection Successfully achieved using MobilenetV2 architecture and gives best Result with Perfect accuracy of mask detection. However, the percentage of Training accuracy and Validation accuracy achieves 99.5% and 99.2% respectively. This method achieves good detection results in the detection of wearing a face mask and has broad Application prospects in this pandemic prevention and control

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— of Presentation —

This certificate is presented to Dr./Prof./ Mr./Ms. **KARTHIKEYAN.B**.....

has presented a paper titled **A Real Time Face Mask Detection Using SSD**.....
..MobileNetV.....

in the 2021 Fourth International Conference on Computing and Communications Technologies
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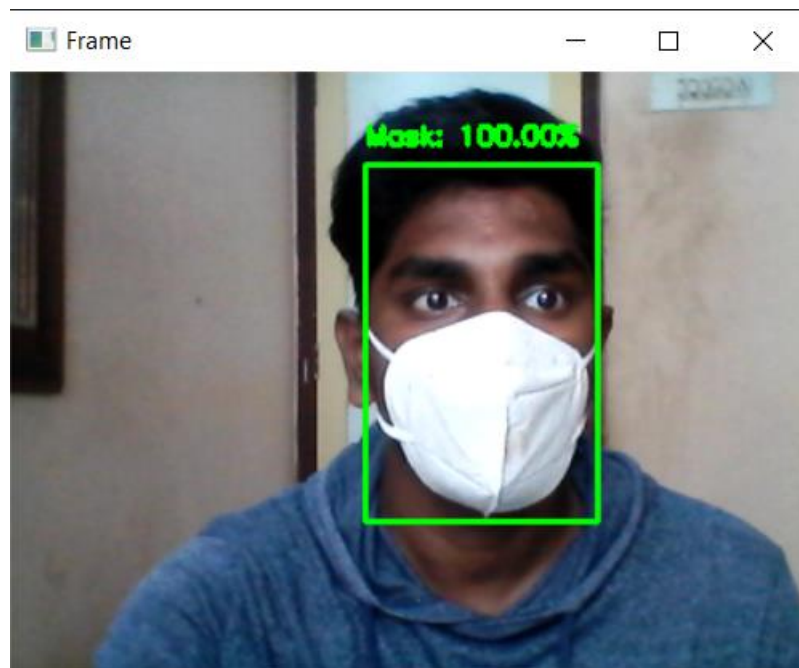
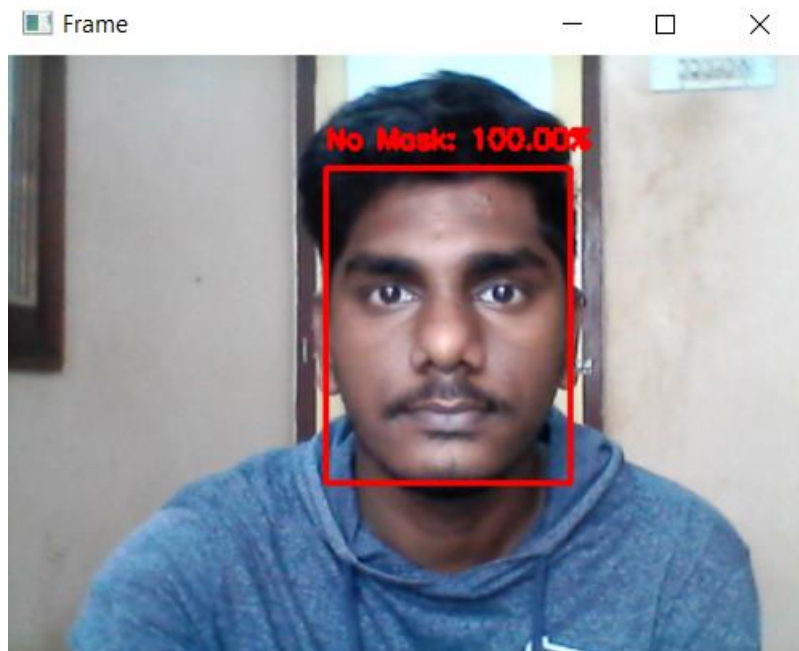
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Screenshots



Frame

