Real-Time Face Mask Detection Using Python

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Abstract **- The topic that we have selected is called Face Mask Detector using Python OpenCV, tensor flow and deep learning. This means that we have developed software that would detect masks on a person or people in a video or image, it would tell them whether that they are wearing a mask or not. This particular project is achieved in two phases, where phase 1 would be to train the face mask detector and phase 2 would be to apply or deploy the face mask detection Software. In phase 1 of the project, our main focus would be to create a training model using datasets, where datasets consist of a huge number of images of people with face masks and people without a face mask. In phase 2 we would load the trained model and then detect the face and then categorize the face as to whether there is any mask or no mask on that. We see that Our Model build in Python Programming Language can detect the mask on faces once tested using video output.**

Index Terms **- Python, Face Mask, Convolutional Neural Network, Data Augmentation, Fine-tuning, MobileNetV2.**

I.INTRODUCTION

As we all know a huge pandemic came into existence in 2020 and has brought tragedy on many people and families due to the extent of destruction caused by this virus. So naturally, some things would need to do to protect ourselves from the virus or to prevent ourselves from getting that virus. And one of the biggest prevention that we could hope for and easily apply ourselves is the wearing of a face mask. By wearing a face Mask we prevent the virus from entering our body through the nose or mouth. And thus many places have applied mandatory rules to follow which would include wearing of face mask. And since people are people, many disobey this rule and do not wear a mask or wear them but not properly that is it would not cover their mouth or nose. But it is really difficult for a person to warn or alert people without masks in a huge group of people, and therefore we would require a technology-based approach that would make it easier to detect face masks on a person. So hence looking into this situation we decided to work on a project that would help allow us to understand how one can help society using technology as this project would help us to detect masks on a huge number of people in a huge area or places thus allowing one to alert those people for wearing their masks.

Face Mask detection has turned up to be an astonishing problem in the domain of image processing and computer vision. Face detection has various use cases ranging from face recognition to capturing facial motions, where the latter calls for the face to be revealed with very high precision. Due to the rapid advancement in the domain of machine learning algorithms, the jeopardies of face mask detection technology seem to be well addressed yet. This technology is more relevant today because it is used to detect faces not only in static images and videos but also in real-time inspection and supervision. With the advancements of convolution, neural networks and deep learning very high accuracy in image classification and object detection can be achieved. Probably because of the sudden emergence of the COVID-19 pandemic, at present, there is various facial recognition technology applied to people wearing masks [1]. Hanvon Technology reported that the accuracy of masked face recognition is about 85 %. But nowadays Internet of Things Security aspect is also an important parameter to maintain the security of the application or project [2]. An accuracy of over 90 % was obtained from Minivision Technology. The face-eye-based multi-granularity model achieves 95 % recognition accuracy. In, the authors used the YOLOv3 algorithm for face Mask detection. This method achieved 93.9 % accuracy. The accuracies achieved were on an artificial dataset which was not the case in this paper which uses both real and artificial images [3].

A model named SSDMNV2 has been proposed in this paper for face mask detection using OpenCV Deep Neural Network (DNN), TensorFlow, Keras, and MobileNetV2 architecture which is used as an image classifier. SSDMNV2 performs competently in differentiating images having frontal faces with masks from images having frontal faces without masks. To impede the COVID-19 transmission the proposed model can be integrated with surveillance cameras so that it can be used for the detection of people who are not wearing face masks [3]. This paper also keeps complete attention towards the removal of various inaccurate predictions mainly in cases of real-world datasets that occurred in different other proposed models.

Detection of face masks is an extremely challenging task for the present proposed models of face detectors. This is because faces with masks have varied accommodations, various degrees of obstructions, and diversified mask types. They are used to facilitate self-focusing, the interaction between humans and computers, and managing image databases [4]. Even after having such extraordinary and exceptional results in the existing face detectors, there is still high rising scrutiny in the development of more advanced face detectors as for existing models, event analysis and video surveillance is always a challenging job. Several reasons were found for the poor achievement of the existing face mask detection model as compared to the normal ones, two of them were First due to lack of suitable datasets with properly masked faces and facial recognition. Secondly, the presence of masks on the face brings a certain kind of noise, which further deteriorates the detection process. These issues have been studied in some existing research papers such as still, there is an excellent challenge for a vast dataset so that an efficient face mask detection model can be easily developed [5].

II. RELATED WORK

In the past, various researchers and analysts have focused on grey facial images. Then came the Viola-Jones Detector, which provided advances in facial recognition technology, and the realization of facial expressions took place. She faced various problems such as posture and facial expressions, which made it difficult to block. So basically, it failed to work in dim light. Therefore, researchers began searching for a different new model that can easily get face masks and face masks.

In the past, many face data sets were developed to create the image of face mask modelling models. Previous datasets contain images downloaded from monitored sites, while recently created databases take online images such as WiderFace, IJB-A, MALF, and Celebi. Annotations are given to the existing faces in these archives compared to the previous ones. Larger datasets are much needed to make better training and test data and to make real-world systems easier. This requires a variety of in-depth reading skills that can read face directly from user-provided data.

Out of some of the projects that already exists regarding detecting face mask one of the biggest problems would be accuracy. Some of these projects do not provide accurate results about mask detection. Our project deals with a huge number of data and we make use of various deep learning, Keras and mobile netv2 like technologies to provide better assistance in our project to make a training model real smooth and which would bring up an accuracy percentage of around 99 per cent, which is an excellent number. Using a large number of different datasets which means to have images of people with different masks in different directions by performing some image data augmentation we get various amounts of data which would detect complex face positions too, hence helping in detecting these face masks much more properly.

III. METHODOLOGY

This particular project is achieved in two phases, where phase 1 would be to train the face mask detector and phase 2 would be to apply or deploy the face mask detection Software. In phase 1 of the project, our main focus would be to create a training model using datasets, where datasets consist of a huge number of images of people with face masks and people without a face mask. In phase 2 we would load the trained model and then detect the face and then categorize the face as to whether there is any mask or no mask on that.

To train a custom mask detector, we need to divide our project into two distinct phases, each with its sub-steps (as shown in Figure 1 above):

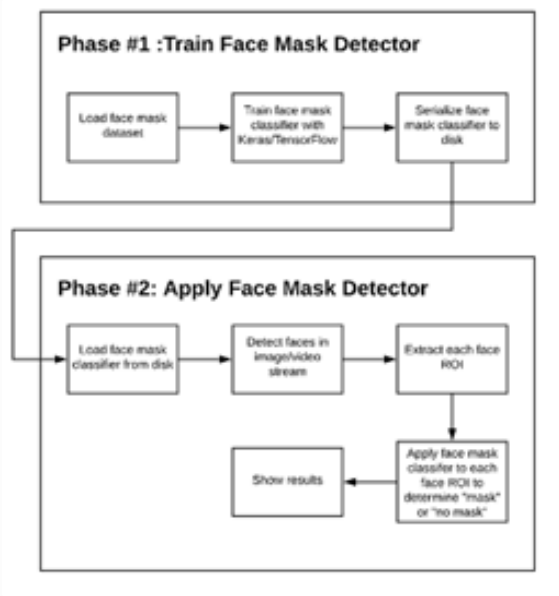

Figure 1- Two-Phase Architecture[6]

Training: Here we will focus on loading our face mask discovery database, model training (using Keras / TensorFlow) on this database, and making serial face detectors on disk

Deploying: Once the face mask detector is trained, then we can continue to load the mask detector, make a face detection, and then separate face-to-face like with_mask or without_mask.

To accomplish this task, we will optimize the design of MobileNet V2, a highly functional architecture that can be used on powerful computer-enabled devices (e.g., Raspberry Pi, Google Coral, NVIDIA Jetson Nano, etc.). Deploying this method of face detector to installed devices can reduce the cost of making face mask detection systems, which is why we choose to use this technique.[6]

IV. RESULTS

After Finally Deploying Our Code in real-time we see that our system can successfully detect our faces with masks and with good accuracy as shown in the figure below:

	precision	recall	f1-score	support
with_mask	0.98	1.00	0.99	384
without_mask	1.00	0.98	0.99	386
accuracy			0.99	770
macro avg	0.99	0.99	0.99	770
weighted avg	0.99	0.99	0.99	770

Figure 2- classification Report

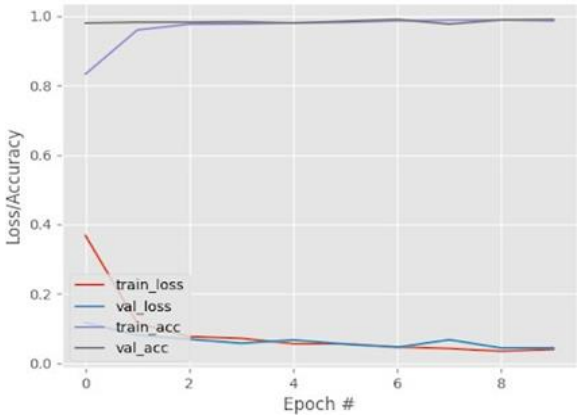

Figure 3- Training Loss and Accuracy

From above, we can say that our train_loss are decreased along with val_loss and simultaneously our train accuracy and val_acc is increased.

We have used our model in photos that contain one or more faces. We also applied it to videos and live video streams by removing and wearing masks one by one. Some screenshots of the results are shown below:

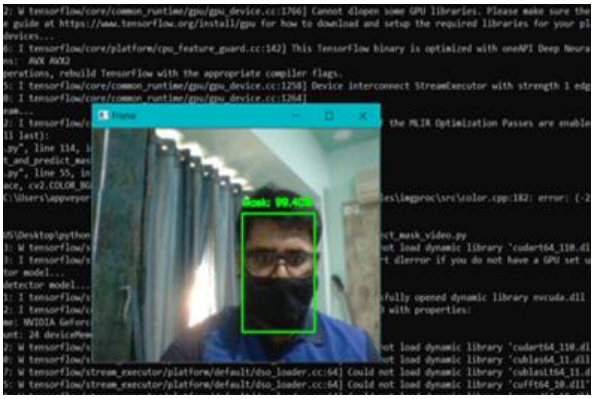

Figure 4- With Mask

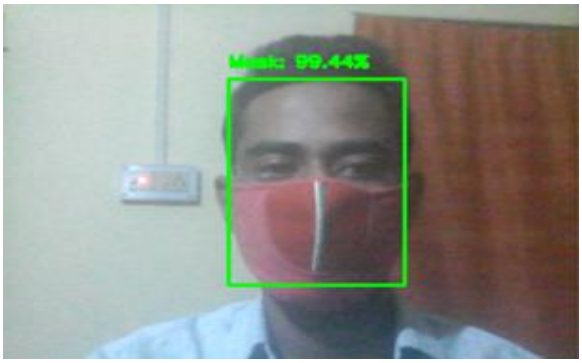

Figure 5- With Mask

From this amount of accuracy, we can use this model in real life for checking whether the user has worn the mask or not.

V. CONCLUSION AND FUTURE SCOPE

We can Finally Conclude that in this project we have successfully designed and deployed a python project where we have successfully recorded the observations and found that our model can detect mask on faces and with good accuracy which was seen on testing part of the model. We have used this model with real life video streaming where it is able to detect more than one faces perfectly.

Retail companies often use software to count the number of people entering their stores. Even in existing IoT systems, IoT appliance access structures used are different and organizations use their methods and models to maintain security.[7] They may also like to measure impressions on digital displays and promotional screens. We are planning to improve our Face Mask Detection tool and release it as an open-source project. Our software can be equated to any existing USB, IP cameras, and CCTV cameras to detect people without a mask.

VI. ACKNOWLEDGEMENT

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