DEVELOPMENT OF FACE MASK DETECTION TECHNIQUE USING MACHINE LEARNING

A Major Project Report

Submitted in partial fulfillment of requirement of the

Degree of

BACHELOR OF TECHNOLOGY IN COMPUTER SCIENCE AND ENGINEERING

BY

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Abstract

COVID-19 is one of the most dangerous virus which caused pandemic in human life, not only in terms of direct casualties but also regarding socio-economic impact. The outbreak quickly spread around the world. The 1-year anniversary of the global corona virus pandemic get passed away in 2021, but still no way to tell how long the pandemic will continue. After analyzing report by WHO of covid-19, to minimize the rate of covid-19 transmission, our national government advised citizens to wear face masks. A model using deep learning and MobileNetV2 for face mask detection is presented. This method was trained and checked on the real time dataset . There are 3,833 images in the Medical Masks Dataset, including 1918 images of people wearing no mask and 1915 images of people wearing masks. We adopted OpenCV to detect faces in real time from a live stream captured with our webcam. With the aid of computer vision and deep learning, we hope to classify whether or not the person in the video stream is wearing a face mask . If the camera captures a face without mask an Email notification will be sent out to the administrator and system alarm will ring.

Keywords : Corona virus, Tensor flow, Mask detector , Alarm system, Opencv

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Chapter-1

Introduction

Introduction

1.1

COVID-19, a pandemic disease caused by Severe Acute Respiratory Syndrome Corona virus 2, is currently affecting the entire world (SARS-CoV-2)[1] According to the world health organization ,COVID-19 is primarily transmitted from person to person by respiratory droplets. There is micrometer small covid-19 particles which always thrown out of our mouth while speaking singing, coughing, etc. We observed even after vaccination has started in India then too corona virus cases are increasing. According to the World Health Organization's Corona virus situation survey, over 124 million people are infected with the disease in 213 countries, killing over 2.73 million people worldwide as of March 23, 2021. India is now ranked third in the world for the number of cases of infected Corona virus. It has reported that it has 11.5 million infected people and 160 thousand killed people

Observing the global crisis, a new need for face mask identification has emerged. It is one of the technologies capable of detecting and checking the identity of an individual wearing a mask. [4] This report presents a accurate face mask detection system using Deep Learning. It can specify whether a person on real time video captured by webcam is wearing face mask or not. It can also detect people who are not wearing a face mask by sounding an alarm or sending an email warning to police, authority, or an observer. This system allows them to see who isn't wearing a mask on their faces.

1.2 Literature Review

According to [7] Human faces are difficult to model because there are so many factors that may alter, such as facial expression, lighting conditions, orientation and partial occlusions like shades, scarves, and masks. Face detection can be accomplished in two ways. 1. Image-based approach 2. Feature-based approach. Author in [2] applied image based approach for face detection and performed this task on dataset which contains mask and no-mask images. According to author [5] MobileNetV2 expands on MobileNetV1's concepts by using depth-wise separable convolution as a building block. V2, on the other hand, adds two additional architectural features: 1.Shortcut connections between the bottlenecks and linear bottlenecks between the layers . MobileNetV2 has used at the place of convolution neural network [5]. The authors were able to create a VGG-16 model for facemask detection that is both precise and fast. They also observed physical distancing between peoples [3].Deep learning algorithms try to take advantage of the uncertain structure in the input distribution to find good representations, often at multiple levels, with higher-level learned features described in terms of lower-level features

Madhura and Ninad [8] have previously begun work on a deep learning system that categorises images as mask or no mask. They used Face-mask net Classifier to train their model with 98.6% accuracy. In [7] the method is designed for checking the correct wearing of face protection from a video selfie. They used Haar-like feature to detect face.

1.3 Objectives

- To develop face mask detection technique using python .
- To identify whether the person on video stream is wearing a face mask or not with the help of computer vision.
- To implement this system at Cement Industries, Chemical Plants, Hospitals where chance of spread of disease .
- To Implement alarm system and Email Notification system to notify administrator.

My aim is to classify whether the person on video stream is wearing a face mask or not with the help of computer vision and deep learning. If the camera captures a face without mask an Email notification will be sent out to the administrator and system alarm will ring.

1.4 Significance

A mask acts as a shield to keep the respiratory droplets from getting into the hands of others. When worn over the nose and mouth, studies show that masks minimize the spray of droplets.[2]Many developed and developing countries around the world have made wearing a mask mandatory while leaving the house or going to public places. Face masks are also used in a variety of industries. Every location, such as pharmaceutical companies, cement plants, chemical plants, hospitals, while cleaning, construction areas, contaminated and polluted areas, and so on, was restricted by the government. Staff must wear a face mask to protect themselves from toxic substances at work (coughing, wheezing, shortness of breath, chest tightness, or trouble breathing, for example)

Chapter-2

2.1 Dataset

The dataset has been taken from Kaggle and few open source image libraries and Google images. There are 3833 photographs in this dataset, divided into two categories:

- With mask photographs : **1915**
- Without mask photographs: **1918**

With mask folder contains all the images of people mask wearing on their faces . Without mask folder contains all the images of people no mask on their faces .

Figure: 1 Depicts images of human wearing a mask

Figure: 2 Depicts images of human not wearing a mask

2.2 Packages used

Computer Vision

Computer vision is an interdisciplinary research discipline that studies how computers can learn to interpret artificial images or videos at a high level. From an engineering standpoint, it aims to simplify functions that the human visual system can do. It is a field that include processing analyzing and understanding image in general high dimensional data from the real world in order to produce numerical and symbolic information or It is a scientific and computer technology that allows it to extract information from images.

OpenCV

OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was created to provide a shared infrastructure for computer vision applications and to speed up the incorporation of machine perception into consumer products. Since OpenCV is a BSD-licensed software, it is simple for companies to use and change the code. It supports Windows, Linux, Android, and Mac OS and has C++, Python, Java, and MATLAB interfaces

Tensorflow

TensorFlow is a free and open-source software library for dataflow and differentiable programming across a range of tasks. It is a symbolic math library, and is also used for machine learning applications such as neural networks . Tensor Flow is capable of running on many CPUs and GPUs (with optional CUDA and SYCL extensions for general-purpose computing on graphics processing units). It enables developers to build machine learning software by using a variety of technologies, libraries, and community resources.

Keras

Keras is an API designed for human beings, not machines. Keras follows best practices for reducing cognitive load: it offers consistent & simple APIs, it minimizes the number of user actions required for common use cases, and it provides clear & actionable error messages. It also has extensive documentation and developer guides. Keras includes various implementations of widely used neural-network building blocks such as layers, objectives, activation functions, optimizers, and a host of tools to make dealing with image and text data simpler.

Jupyter notebook

The Jupyter Notebook is a server-client application that allows editing and running notebook documents via a web browser . The Jupyter Notebook app can be executed on a local desktop requiring no internet access or can be installed on a remote server and accessed through the internet.

Chapter 3

Proposed Methodology

The project Face mask detection has been achieved by adopting Deep Learning technique and MobileNetV2 Architecture. We have designed our project into three phases:

- Data Preprocessing
- Training face mask detector
- Implementing face mask detector.

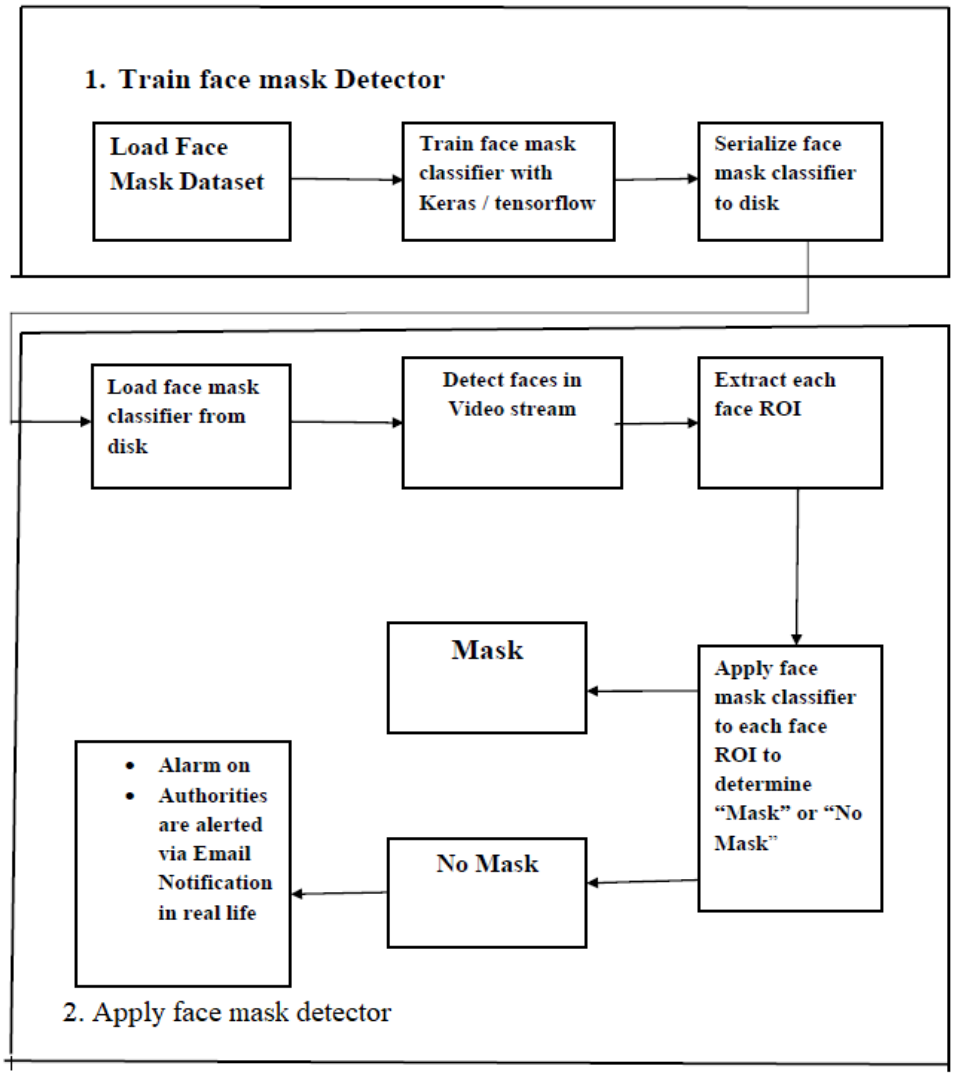

Figure 3: Decision flow chart of the proposed approach

First, we used a suitable algorithm to train the mask and non-mask images. After the model has been conditioned, pass on to the loading mask detector, which can detect and identify each face.

3.1 Data Preprocessing

Data preprocessing is a method for converting unclean data into a clean dataset. Data preprocessing entails converting data from available format to another format that is more user-friendly, desirable, and meaningful.

In the data preprocessing part, we converted all the images from the folders “with mask” and “without mask” into arrays so that with those array we created deep learning model .

1. Looping over the image path (With mask and without mask folder).

2. Resizing the input images uniformly to (224 x 224).

3.All the photographs in dataset is visualized as “with mask” and “without mask”. Initialized data and labels, labels are in alphabetical order so by using label binarizer to covert the data to numeric numbers(0,1).

4.Converting all images into array by using img_to_array function. This img_to_array function comes under keras.preprocessing.image module.

5. Appending the pre-processed input image .Finally Converting them into NumPy array.

6. Splitting the training and testing data.

3.2 Training of Model

Building the Model using MobileNetV2 Architecture :
After the input image is processed as an array we send the data into the MobilenetV2 and than we do max pooling on the same data and then flatten it to create fully connected layer which gives the output.
MobilenetV2 is faster than Convolution Neural Network. MobilenetV2 also uses less parameter. The weights of each layer in the model are predefined based on the Image Net dataset. The padding, strides, kernel height, input channels, and output channels are all represented by weights. MobileNetV2 was selected as the algorithm for creating a device-deployable model. On top of the MobileNetV2 model, a customized fully connected layer with four sequential layers was created. The layers are 1. Average Pooling layer with 7,7 weights 2. Linear layer with ReLu activation function 3. Dropout Layer 4.The final layer softmax function gives the result of two probabilities each one represents the classification of "Mask" or "No Mask".Image data generator creates many images with the help of single image by changing properties of that image which later used for layer training, we use Adam optimizer to optimize the result. The image data generated before is flown to train the existing training data. Later we predict the output by evaluating the network using Numpy array .
I've specified three hyper parameter constants which include my initial learning rate to 1e-4, number of training epochs to 20, and batch size to 32 , These data are taken at such lower rate to get better accuracy. We optimized MobileNetV2 on with mask/No mask dataset and attained a classifier that is **99% accurate.**

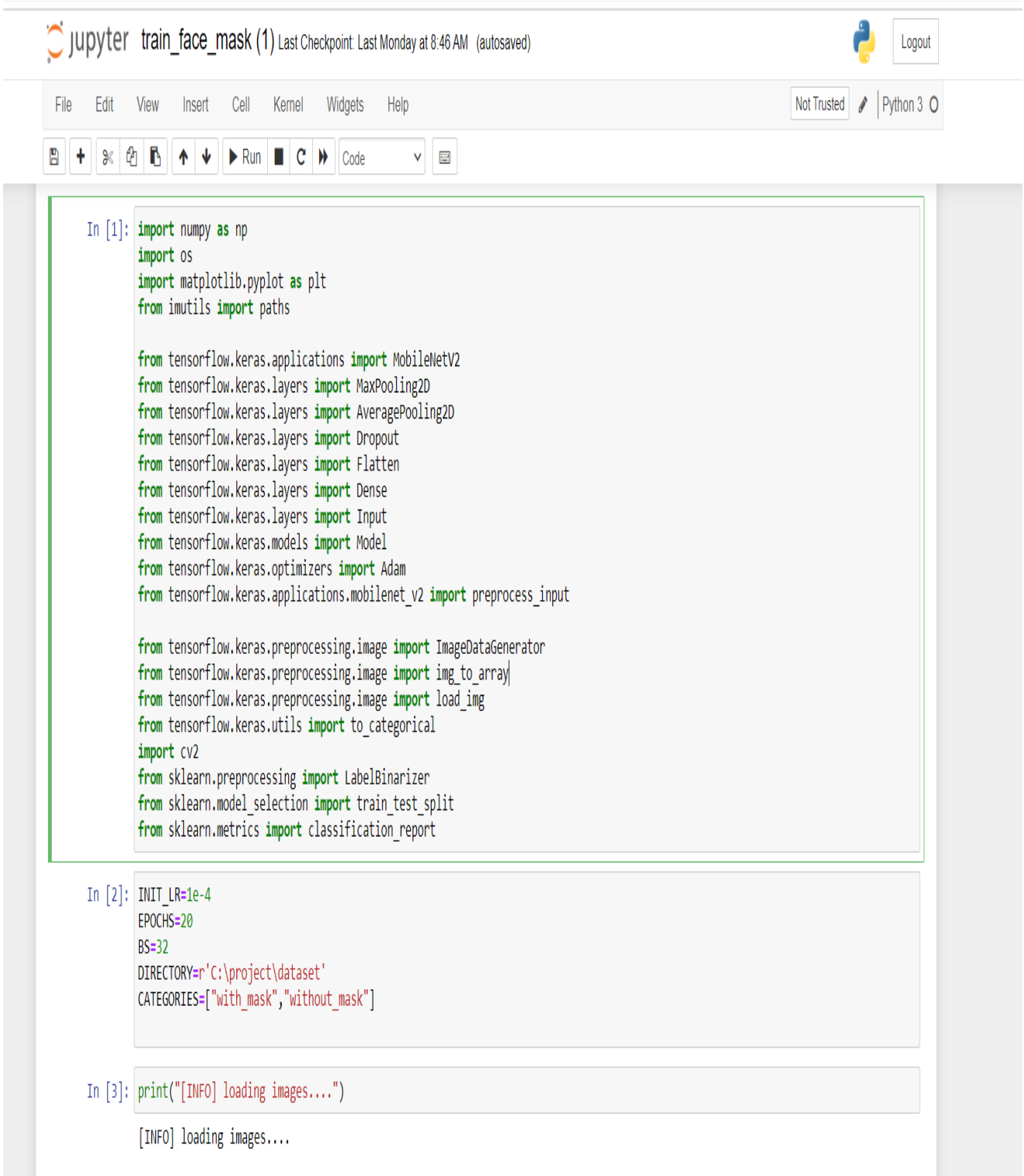

Fig 4 : Snippet of face mask detector training code

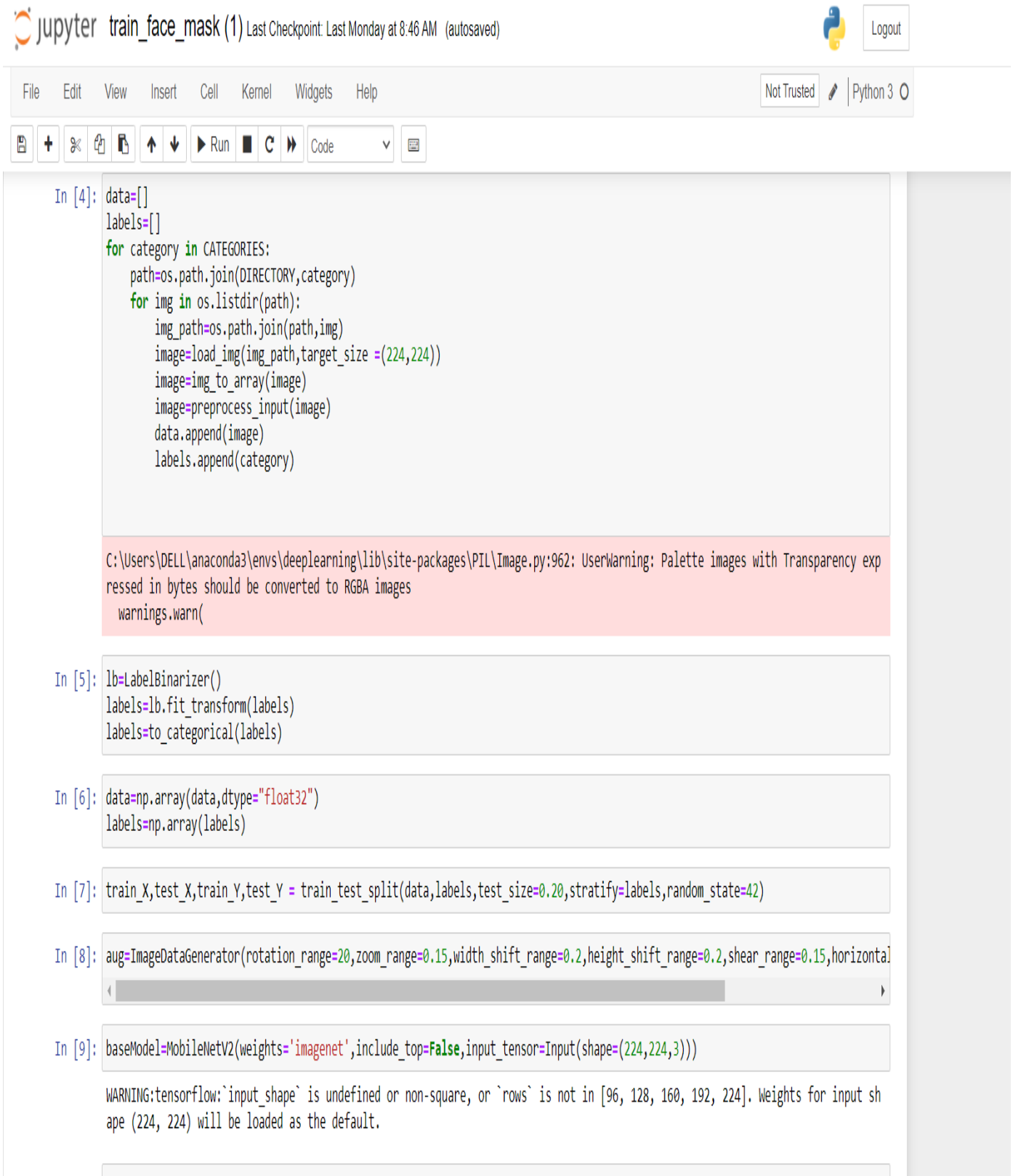

Figure 5: Snippet of data preprocessing code

3.3 Implementing face mask detector

1. Load face mask trained model and caffe model to detect faces in video

2 . To identify the fcee/faces using openCv by collecting real time data through webcam.

3. Now the real time data (frame/sec) we collected from the webcam to classify it using trained model to predict the output of the given real time input .

4. As a output we get frame in which if a person wearing mask it shows “Mask” with a rectangle of green color on his/her face and if a person is not wearing Mask it shows “No Mask” with a rectangle of red color on his/her face particularly.

5. If in case a particular person is not wearing mask so system automatically generates Email to notify administrator and also rings alarm system to prevent carelessness of not wearing mask.

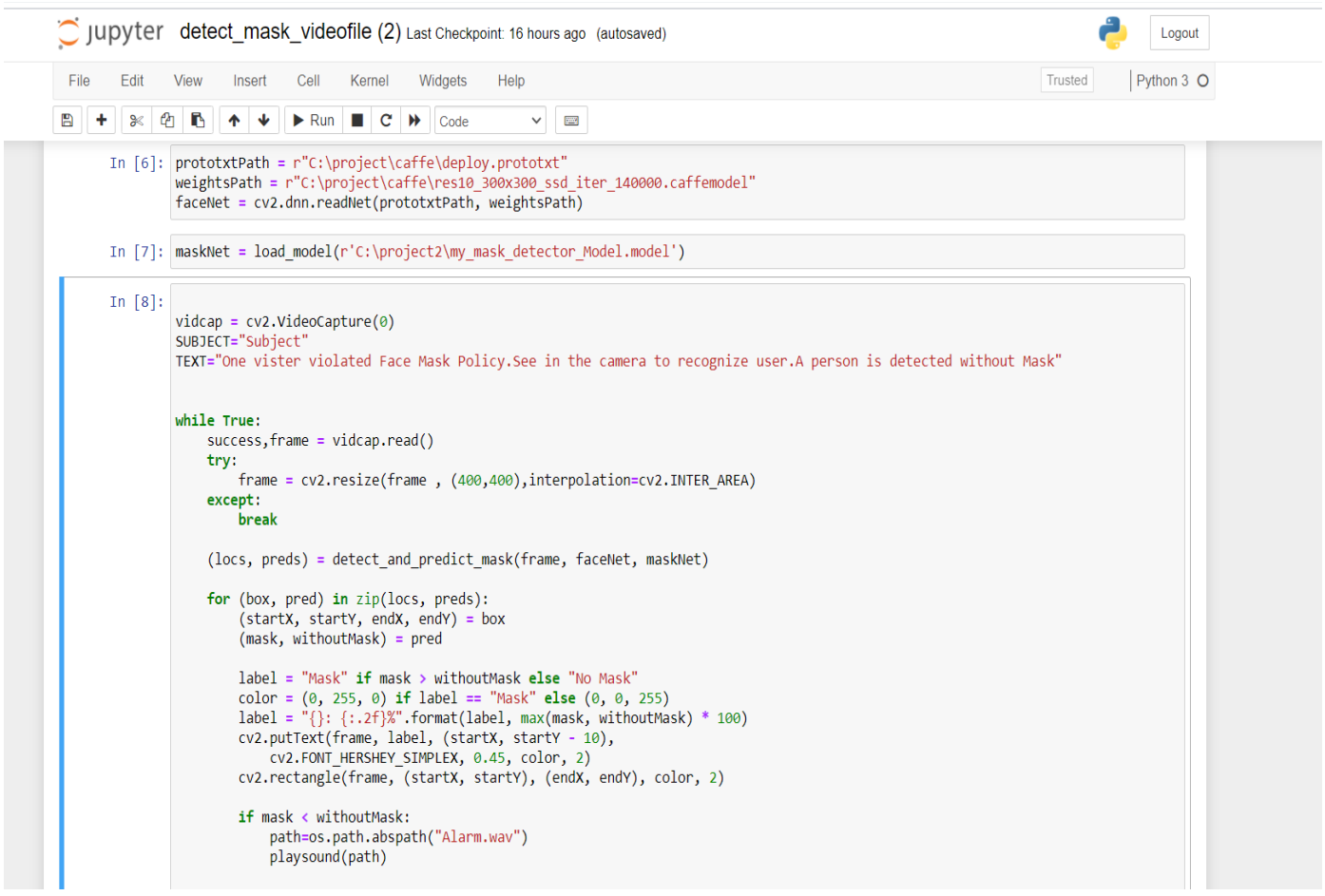

Figure 6: Snippet of Face mask detector Testing code

Chapter-4

Result and Discussion

After successfully training, implementing and testing the code following output was obtained. The accuracy and iteration curves were plotted. Figure4 depicts the training loss and accuracy plot. The method attains 99% accuracy (shown in fig 7). Screenshots of the outputs have been displayed ahead. Figure 10 depicts that when a person is wearing facemask the system indicates that particular person is wearing the facemask. Figure 11 depicts that when a person is not wearing facemask the system indicates that particular person is not wearing the facemask and tells that person to kindly wear the facemask. Successfully implemented alarm system in case of particular person not wearing mask so system automatically generates Email to notify administrator and also rings alarm system to prevent carelessness of not wearing mask.

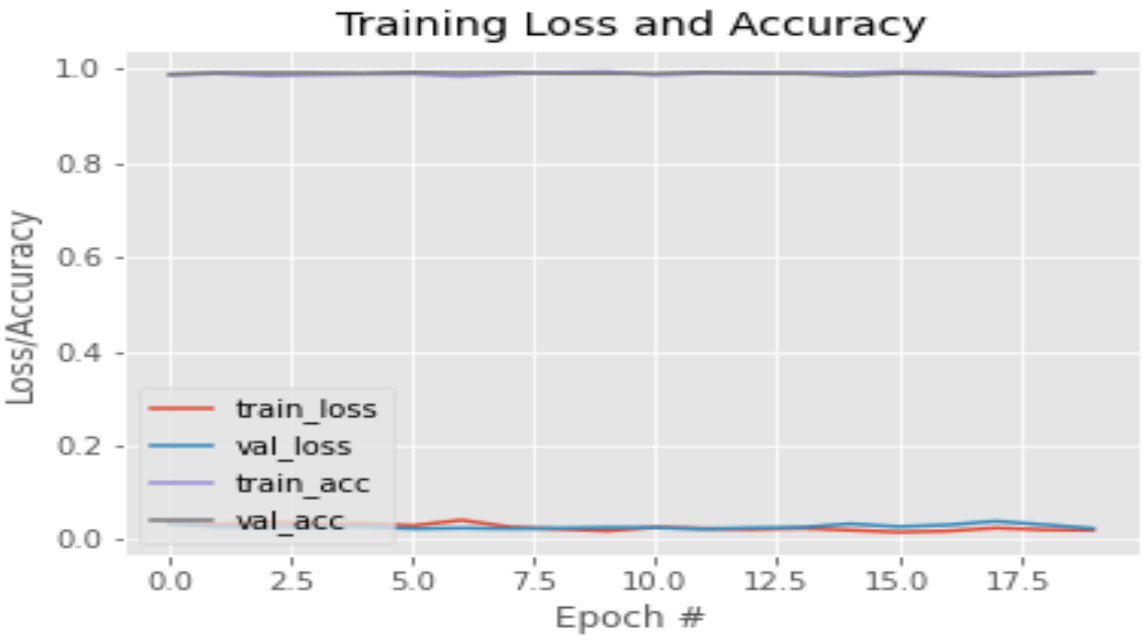

Figure 7 : epochs # vs accuracy and loss corresponding to dataset

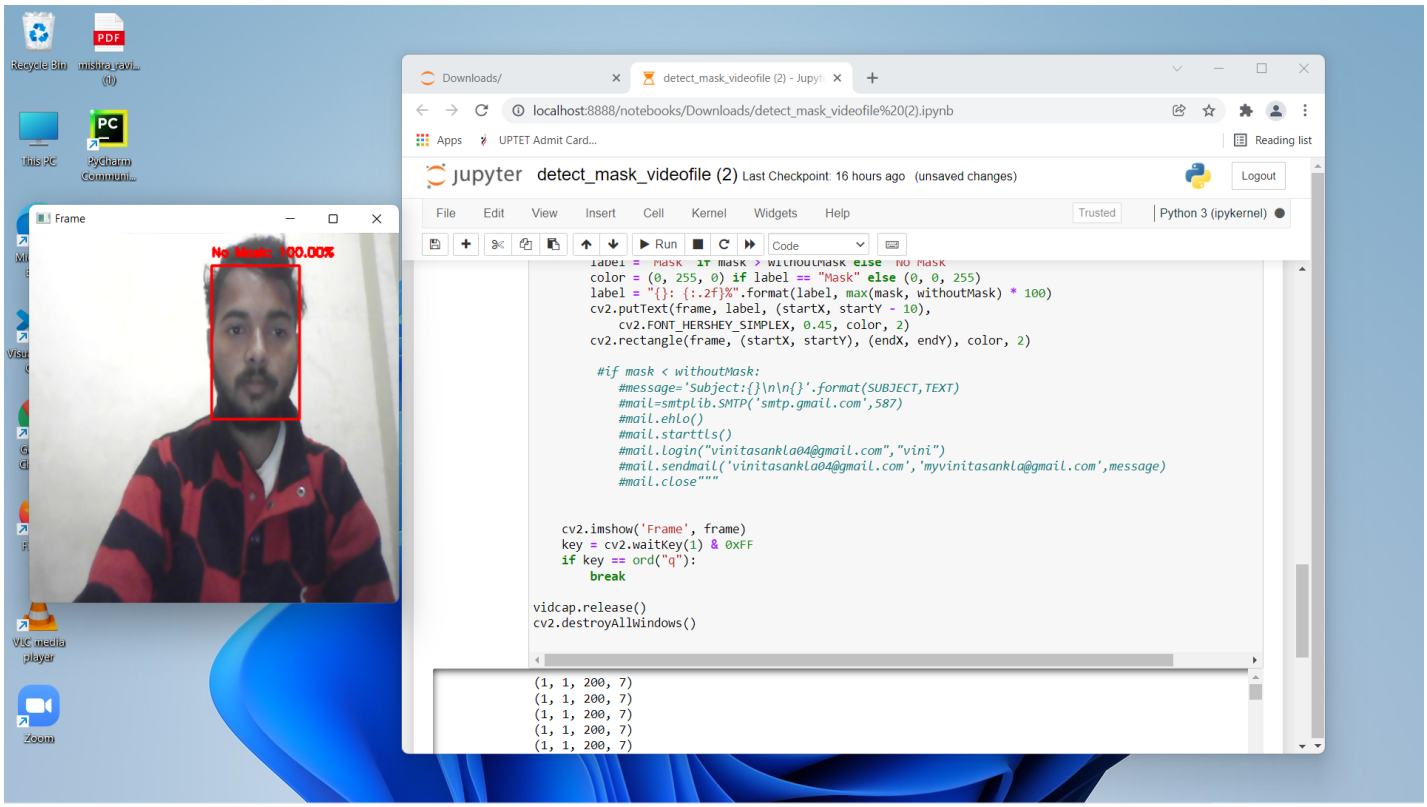

Figure 8 Analyzing the results of test photograph with a probability of 100% , revealed that Mask was not worn.

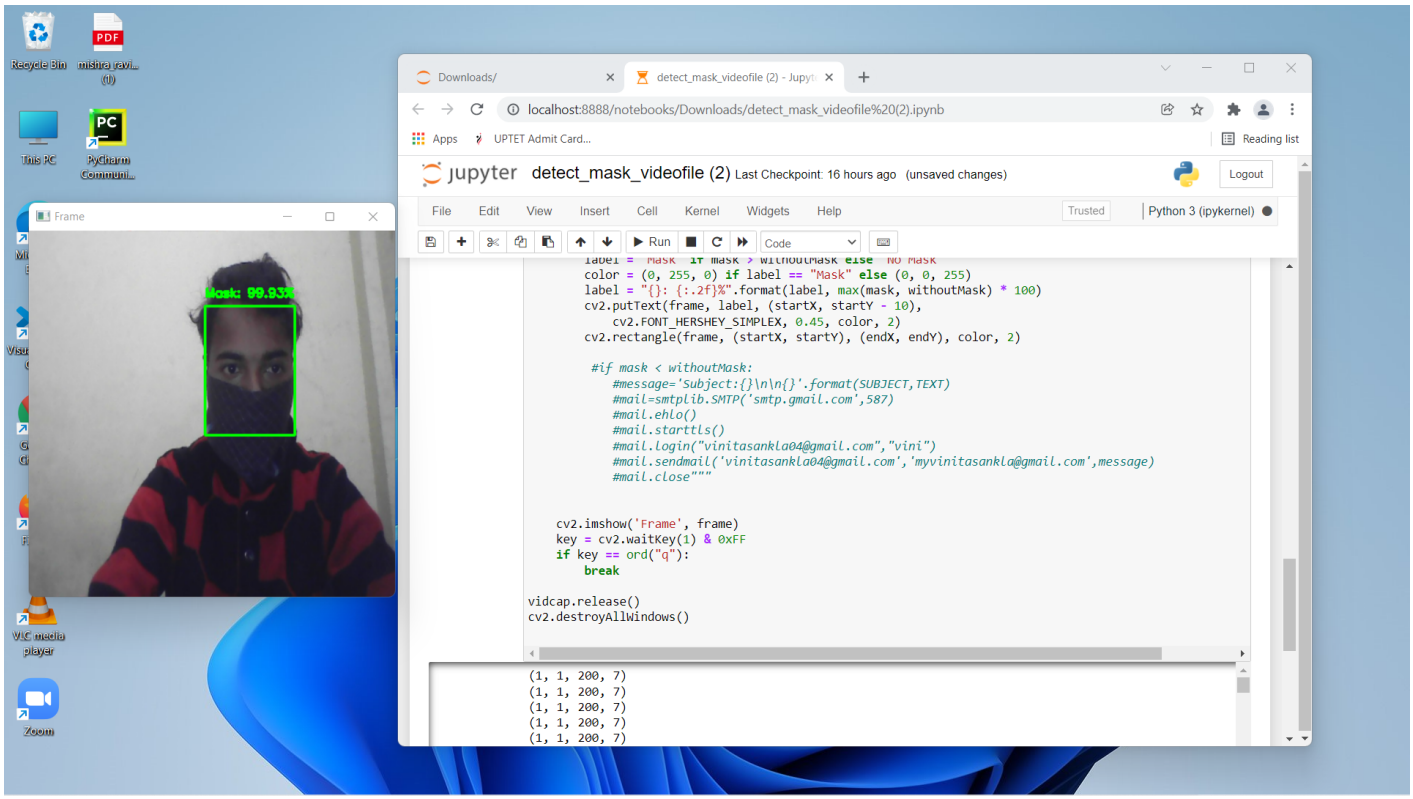

Figure 9 Analyzing the results of test photograph with a probability of approx 100%, revealed that Mask was worn.

Chapter-5

Conclusion

This report represents a deep learning model to detect if a person is wearing a face mask or not. We adopted OpenCV, keras, tensor flow, and mobilenetV2 to specify whether people were wearing face masks or not. The model is tested with photographs and real time video streams. The accuracy rate of detecting a person with a mask is 99% . This model was built using MobileNetV2 architecture. Successfully built alarm system to alert a person who didn't wear mask and implemented Email notification system to notify respected authorities . This system can prevent spread of covid-19. This framework may be used as an example of edge analytics. This system could be implemented at Cement Industries, Chemical Plants, Hospitals where chance of spread of disease, and at airport to detect travelers without masks.

Chapter-6

Future works

In future I thought to add up some extension to this project

1. To count the number of objects who aren't wearing mask and notify them using email to the observer

2. To increase the accuracy and quality so that the current model can work with high definition camera which is established there on the traffic signals and nearby to the road to observe traffic.

Appendix

- **Plagiarism Check**

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PLAGIARISM SCAN REPORT

Words	885	Date	April 18,2021
Characters	5678	Excluded URL	

0%	100%	0	44
Plagiarism	Unique	Plagiarized Sentences	Unique Sentences

Content Checked For Plagiarism

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The remainder of the paper is laid out as follows: Section 2 contains similar studies on face mask recognition. The essence of the dataset used is represented in Section III. The specifications of the packages used to build the proposed model were discussed in Section IV. Section V gives an outline of our process, as well as the findings and interpretations of our experiments. Section VII represents conclusion and future work .

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PLAGIARISM SCAN REPORT

Words	648	Date	April 18,2021
Characters	4226	Excluded URL	

0%	100%	0	30
Plagiarism	Unique	Plagiarized Sentences	Unique Sentences

Content Checked For Plagiarism

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Implementing face mask detector

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PLAGIARISM SCAN REPORT

Words	383	Date	April 18,2021
Characters	2508	Excluded URL	

0%	100%	0	18
Plagiarism	Unique	Plagiarized Sentences	Unique Sentences

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Figure 4 : Epochs # versus Accuracy and Loss

Figure 5: : Analyzing the results of test photographs with a probability of 100.00% and 100.00%, respectively, revealed that Mask was worn.

Figure 6: Analyzing the results of test photographs with a probability of 100.00% and 100.00%, respectively, revealed that Mask was not worn.

VII CONCLUSION

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Sources	Similarity

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