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Face Mask Detection System

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Abstract: COVID-19 pandemic has affected the world severely, according to the World Health Organization (WHO), coronavirus disease (COVID-19) has globally infected over 176 million people causing over 3.8 million deaths. Wearing a protective mask has become a norm. However, it is seen in most public places that people do not wear masks or don't wear them properly. In this paper, we propose a high accuracy and efficient face mask detector based on MobileNet architecture. The proposed method detects the face in real-time with OpenCV and then identifies if it has a mask on it or not. As a surveillance task, it supports motion, and is trained using transfer learning and compared in terms of both precision and efficiency, with special attention to the real-time requirements of this context.

Keywords: Deep Learning, OpenCV, TensorFlow.

I. INTRODUCTION

The rapid spread of COVID-19 forced the World Health Organization to declare COVID-19 as a global pandemic.

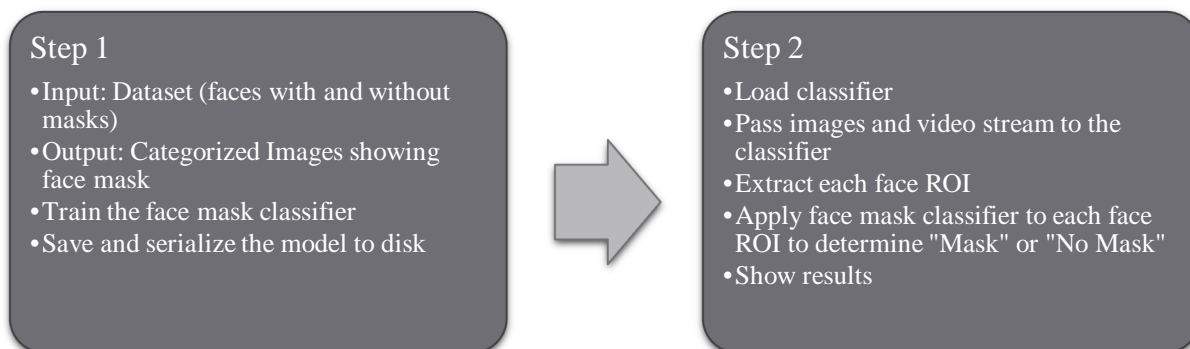
Wearing a mask is one of the prevention measures that can limit the spread of coronavirus. Therefore, it is necessary to wear a mask properly at public places like super-markets and shopping malls.

Facemask can interrupt airborne infection of coronavirus disease COVID-19 effectively, such that the disease never reaches the respiratory system of the person. Facemask is a non-invasive and cheap method to reduce mortality rate from the new coronavirus strain that attacks the respiratory system aggressively.

Since the outbreak of COVID-19, facemasks are routinely used by the general public to reduce exposure. Masks, when worn properly, effectively, prevent tainted individual to cause contact transmission as droplets carrying the virus may withal arrive on adjacent surfaces. The need to monitor large groups of people to curb the exponential growth in cases and death is becoming more difficult in public places. So, we propose an automation process for detecting face masks which could contribute to personal protection and public epidemic response, a Face Mask Detection System to identify whether a person is wearing a mask or not. We will use a two-phase architecture for detecting face and face masks using OpenCV and TensorFlow.

II. METHODOLOGY

The proposed method consists of a classifier and a pre-trained CNN which contains two 2D convolution layers connected to layers of dense neurons. The algorithm for face mask detection is as follows:



A. Data Preparation

Our approach deals with image and video data using Python libraries NumPy and OpenCV. All the images were labelled “mask” and “no mask”. For each image in the dataset we visualize the image in 2D, convert any Gray-scale image to RGB, resize the image input to 300 x 1 and normalize the image and convert it into 4 dimensional array.

B. MobileNet

MobileNet V2 builds upon the ideas of V1, using depth wise separable convolution as efficient building blocks. However, V2 introduces two new features to the architecture:

- 1) Linear bottlenecks between the layers
- 2) Shortcut connections between the bottlenecks

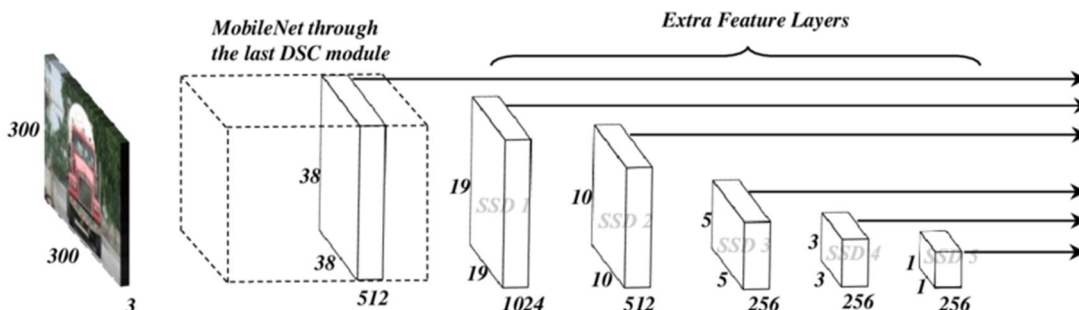


Figure 1 MobileNetV2 Architecture

The typical MobileNetV2 architecture has as many layers listed above, the weights of each layer in the model is predefined based on the ImageNet data. The weights indicate the padding, strides, kernel size, input channels and output channels. We chose MobileNet as the classifier to build a model because it can be deployed on a mobile device. The final layer SoftMax function gives the result of two probabilities each on represents the classification of “mask” or “not mask”.

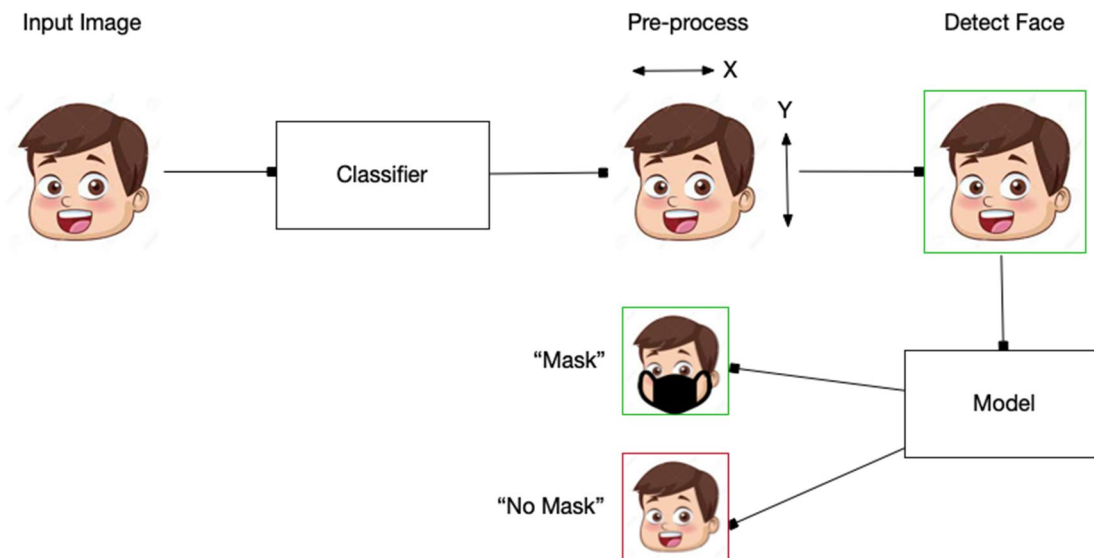


Figure 2 Approach Flowchart

III. TESTING AND RESULTS

In our project we calculate error by using f1-score, precision and recall.

A. Precision and Recall

In pattern recognition, information retrieval and classification (machine learning), precision (also called positive predictive value) is the fraction of relevant instances among the retrieved instances, while recall (also known as sensitivity) is the fraction of relevant instances that were retrieved. Both precision and recall are therefore based on relevance.

B. F1-Score

In statistical analysis of binary classification, the F-score or F-measure is a measure of a test's accuracy. It is calculated from the precision and recall of the test, where the precision is the number of true positive results divided by the number of all positive results, including those not identified correctly, and the recall is the number of true positive results divided by the number of all samples that should have been identified as positive. Precision is also known as positive predictive value, and recall is also known as sensitivity in diagnostic binary classification.

with_mask	1.00	1.00	1.00	138
without_mask	1.00	1.00	1.00	138
accuracy			1.00	276
macro avg	1.00	1.00	1.00	276
weighted avg	1.00	1.00	1.00	276

Figure 3 Evaluation of model

As observed above, 100% accuracy was resulted on our test set. We have successfully trained our model and tested it on our test set and real-time video stream using a laptop's camera. Our Mask detector correctly labels the person's face as either "Mask" or "No Mask". As you seen in the image bellow that the face is properly labelled "Mask" when a person is wearing a mask and labelled as "No Mask" when the person is not wearing a mask properly or entirely.

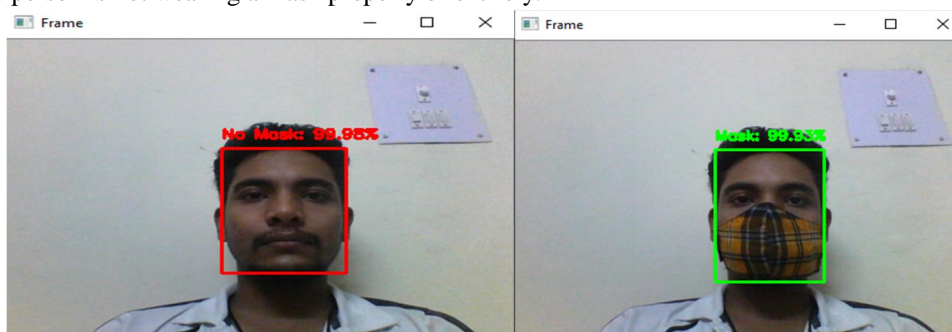


Figure 4 Live Stream test

IV. CONCLUSION

In this report, a face mask detection system was presented which was able to detect face masks. The architecture of the system consists of TensorFlow and OpenCV. A novel approach was presented which gave us high accuracy. The dataset that was used for training the model consists of more than 3800 face images. The model was tested with real-time video streams. The training accuracy of the model was around 99%. This model is ready to use in real world use cases and to implement in CCTV and other devices as well. Deploying our face mask detector to embedded devices could reduce the cost of manufacturing such face mask detection systems, hence why we choose to use this architecture.

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