International Journal of Recent Advances in Multidisciplinary Topics
Volume 3, Issue 11, November 2022
https://www.ijramt.com | ISSN (Online): 2582-7839

Facemask Detection Using OpenCV

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***Abstract*: The latest problem that has emerged throughout the world is the COVID-19 pandemic. It is the need of the hour to implement social distancing and wearing of Masks. But we are in a country where enforcement of rules is quite difficult. Here comes Artificial Intelligence into the picture and we intend to use Python as an interface to implement our project, Face mask detection software. We are using many inbuilt Python Libraries. In the near future, many public service providers will ask the employees and consumers to wear masks properly, while in the office premises. For instance if we integrate a software for IT offices where every person marks his/her attendance by scanning the Iris of the eye, this is the exact place where we can apply our face mask detection algorithm and the further course of action can be taken accordingly. The action after a user is found not wearing any Mask can be an SMS/Email can be sent to the registered user warning him to wear his/her mask and if he/she isn't found wearing one for (say) 3 more times, the particular person will be fined some Amount. This will help us (as a country) to invigilate the COVID appropriate behavior by our fellow citizens. We have used a dataset of thousands of images, which will serve as test cases for real time detection for the code to run. The algorithm employs the dataset as a reference to detect the current event of detection. Also, for increasing the accuracy to a higher extent we will append the new cases into the already existing dataset.**

***Keywords*: Artificial Intelligence, COVID face detection, Machine Learning, Object (Mask) Recognition, OpenCV, Python.**

1. Introduction

A face mask detector is an algorithm in which we detect whether a person is wearing a mask or not. The idea for face mask detection comes from the pandemic of COVID-19. As COVID-19 is a contagious disease, to prevent it, we need to wear the mask in public spaces and to detect whether all people are wearing a face mask or not. The concept of face mask detection comes here. There is a difference between the terms such as "detection of the face under mask" and "detection of mask over face". Very little research has been done on the detection of masks over the face. So, our aim for a face mask detector is to detect masks over the face in public areas such as railway stations, bus stands, cinema halls, etc. Now, for making a difference between a person wearing a mask we need a dataset of photos of the person wearing a mask and a person without wearing the mask and we have to use that dataset. Now, in that dataset, we need different types of pictures such as dark-skinned persons wearing the white colour mask and fair skinned persons wearing the black colour mask, and different views of persons such as front view, right side view, left side view, etc. There are two cases in which current face mask discovery algorithms are unfit to reliably identify the masks. When there's a large number of people in a single image or videotape frame, it's delicate to precisely identify all of the faces "with mask and without mask." In our nation, ladies wear half- faced curtains that serve the same purpose as face masks, but the current styles don't identify them as face masks.

How to construct a more effective and accurate bracket approach is a crucial aspect for the perpetration of facial mask discovery ways in mobile terrain. Still, several deep literacy models are expensive and time- consuming in their evaluation way, making them infelicitous for mask discovery in the facial image paradigm in a mobile terrain. In order to overcome the failings of the being approach, the suggested system makes use of Depth wise divisible complications with Mobile Net for mask discovery in facial images (Depth wise divisible complication (DSC) was first proposed and is now extensively used in image processing for bracket tasks.

2. Methodology/Experimental

- Dataset Collection: The dataset was collected from Kaggle Repository and was split into training and testing data after its analysis.
- Training a model to detect face masks: A default OpenCV module was used to obtain faces followed by training a Keras model to identify face masks.
- Detecting the person not wearing a mask: An open CV model was trained to detect the names of the people who are not wearing masks.
- Sending the email: The system was designed to send an e-mail to the person not wearing a mask.

3. Components and Flowchart

The main tools and technology used in this project are OpenCV, NumPy, and Machine Learning algorithm, Keras, Kaggle, PyTorch and MobileNet. First, we take only the 224x224 dimension of the image from the actual image. This is done so as to crop only that area of the image which has a mask on it. Then it is preprocessed and converted into an array using NumPy libraries as deep learning models work only on arrays.

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80% of this data is used for training and 20% of this data is used for testing the machine learning model. The dataset was stored in google drive hence a special function had to be used to link the Google Collab notebook with the dataset. The machine learning model was successfully trained with an accuracy of 98.92%. So basically, the code has two parts, one Machine Learning model part and second, the OpenCV part. The OpenCV part is used to capture video feed from the camera, and the Machine Learning model is used to predict whether the images in the video feed are ones with or without masks.

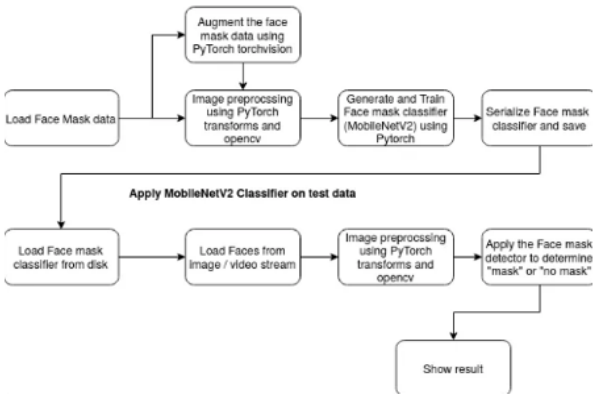

Fig. 1. MobileNetV2 classifier training process using PyTorch

Input: Dataset including faces with masks or without masks.

1. Output: Image depicting where the mask is on the face or not?
2. Visualize the images in two categories and label them.
3. Convert the RGB Image to a Grey-Scale Image.
4. Resize the grayscale image to 100 crosses 100.
5. Normalize the image and convert it into a 4-dimensional array.

For building the CNN Model:

1. Add a convolution layer of 200 layers and add a second convolution layer of 100 layers.
2. Insert a flattened layer into the network classifier.
3. Add a dense layer of 64 neurons.
4. Add the final dense layer with 2 outputs for 2 categories.
5. Split the data and train the model.

4. Literature Review

This section could be a basic summary of the key techniques used in the face recognition system that apply principally to the front face of the individual. Due to the obvious distinctive shape of human images, established methods for identifying the person's face with and without masks does not respond well. From 5 papers we published, open CV detector will help detect people wearing masks and the ones not wearing it in public places. It is designed to work specially in huge crowds where detection of face masks is not easy. This detector will detect the faces with masks by showing a green square and the ones without it will be marked by the red square.

Some disadvantages from the papers we referred are:

No proper tools and components are given which are used for making this detector. Emailing/messaging system to employees or close community. Hence making it train 2 Models.

Features provided by literature survey:

There is a pathway given for facemask detection. Software system which facilitates face mask recognition in a distribution cabinet. It also emphasizes the use of convolutional network fully connected layers which is useful in detection techniques when a dynamic background is present. Connecting huge datasets and appending new ones which are detected. Using transfer learning in the most efficient way for face mask detection. Significant contribution to public healthcare

5. Results

The prospective system is a deep learning solution which uses OpenCV and TensorFlow to train the model. There is a combination of MobileNetV2 model with the SSD framework for a quick and systematic deep learning solution for real time human detection in video streams. The real time detection will verify the people wearing masks and the ones not wearing it. The dataset collected is divided into training dataset and the testing dataset. From this data collection, the images are categorized as “mask” and “no mask”.

The four important steps of the proposed system are:

- Data collection and preprocessing.
- Model development and training.
- Model testing.
- Model implementation.

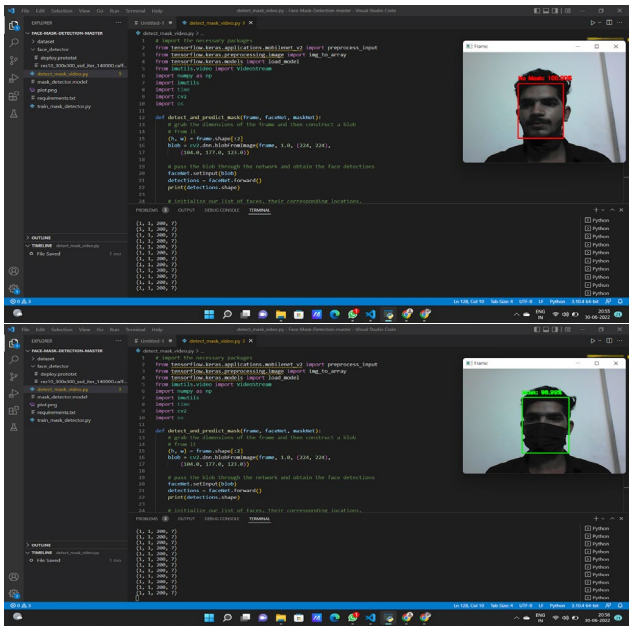

Fig. 2. Result

In this paper, the proposed approach uses computer vision and MobileNet V2 framework to help maintain a secure surrounding and to make sure the individual protection by automatically tracking public places to avoid the spread of the COVID-19 virus and help the forces by minimizing their physical inspection in containment zones and public areas through camera feeds in real time. Hence, the presented system

will operate in a coherent way in the current pandemic situation. We have reached in depth the tracking of social distancing and the recognition of face masks that assist to make sure human health first. The solution has the embryonic to remarkably reduce violations by real-time interventions, so the proposed system would improve public safety through saving time and helping to reduce the spread of coronavirus. This solution can be used in places like temples, shopping complexes, metro stations, airports, etc.

6. Future Scope

We have included all that we could to make this project helpful for the society, but still there is a lot that can be done in a few sections, as mentioned below:

Temperature Screening: Increased body temperature is another main symptom of COVID-19, at current scenario thermal screening is done using handheld contactless IR thermometers where health workers need to come in close proximity to the person need to be tested which makes the health workers exposed to get infected and also it's practically not possible to record the temperature for each and every person in public places, the proposed use-case can be equipped with thermal cameras based screening to check body temperature in public places that can add another helping hand to enforcement agencies to handle the pandemic effectively.

Coughing and Sneezing Detection: Long term coughing and sneezing is one of the main symptoms of COVID-19 as per WHO guidelines and also one of the prime ways of disease spread to non-infected people. Deep learning-based approach can be proved handy here to ascertain and limit the disease spread by improving our proposed solution with body gesture analysis to understand if an individual is coughing and sneezing in public places without wearing a face mask and based on outcome enforcement agencies can be alerted.

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