Face-mask Recognition Security CAM Using Python, Open-CV

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Abstract: *We present the application that would help to track the people who are not wearing mask in public areas to avoid the spreading of corona virus or any other kind of virus in this pandemic time. Our aim is to install security cam to identify who is with mask and without mask instead of a human doing that job. Because any human is volatile to the virus.*

Introduction:

The research is based on image recognition of a human face to identify whether a person is wearing a mask or not. To prevent the spread of virus governments are taking necessary steps and front line workers are risking their lives. It is our duty to be responsible and help everyone stop the virus spread. So as a part of our responsibility we have worked on a face mask recognition system that would help in detecting whether the person is wearing mask or not. It makes easy to identify if any person is without mask in public areas. Because it was a tedious and harmful job for any human to do in this pandemic situations.

Also people have been found everywhere without following safety measures such as face mask and social distance. So the project also aims to check and notify if the person is wearing a mask or not. So to organize the introduction the intention and motivation has been made clear that the research focuses on safety of a person or an individual in these unprecedented times of Covid and we would like to contribute our part with our research by making a device that would be very useful for the protection and safety of a person.

Literature Review:

There is huge amount of literature work was done on computer vision, Deep Learning and image recognition. In this paper we focused on face mask detection and thermal imaging. We go through some work related to ours. The Loey, Mohamed, et al. "A hybrid deep transfer learning model with machine learning methods for face mask detection in the era of the COVID-19 pandemic." *Measurement* 167 (2021): 108288 it was helped a lot to understand the process to develop our project. And, some methods took from article of Khan, Maliha, et al. "Face Detection and Recognition Using Open-CV." *2019 International Conference on* Computing, Communication, and Intelligent Systems (ICCCIS). IEEE, 2019. On the other hand we had gone some research on various papers and work to improvise our work. And, Some of images in our paper was subjected to copyright.

Method:

We explained in detail about our facial recognition algorithm clearly in this section. Complete framework of our proposed face mask detection algorithm was described and also the additional python scripts that are used in this project are also mentioned in this section.

In the first phase the focus is mainly to train the face mask detector. Firstly face mask data set is being loaded and then face mask classifier is trained with Keras/ TensorFlow and then serialization of face mask classifier to disk takes place.

1. The tools used in the algorithm are Python, Keras and OpenCV.

In this part we discussed about our second phase of the covid-19 face mask detector, and explained about our computer vision and deep learning was used to detect face mask. We had to use the deep learning techniques and deploy various samples to recognize and differentiate between the faces with mask and with out mask.

In the second phase face mask classifier from the the disk is loaded and it detects the faces in the image and then applies ROI of each face detected and then applies face mask and shows the results.

And then, we analyzed the database and we used it to up skill our custom face mask detector. After that we explained how we used the Python script to guide face mask finder in our database using Keras and TensorFlow.

We had to use Python text to train the face mask detector and analyze the final results.

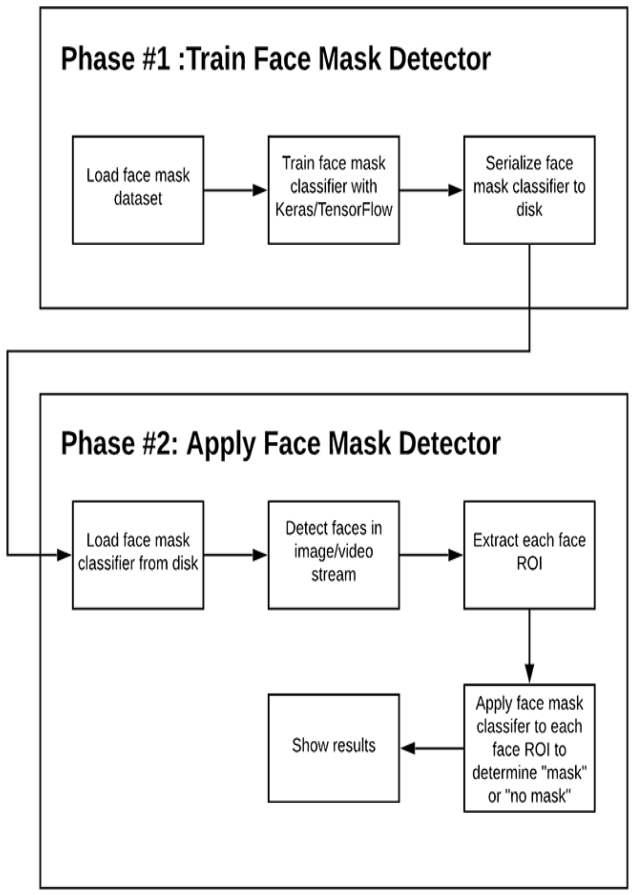
For COVID-19 professional face mask detector, we had to continue launch two additional Python scripts for use:

1 Find COVID-19 face masks in photos.

2 Find face masks in real-time Video Streaming.

We have used these two python scripts out of all the available scripts because of their ability to find the face masks and produce results accordingly.

"Two-Phase COVID-19 face mask detector":



Phases and every step to build a COVID-19 face mask detector algorithm with computer vision and deep learning with the help of Python, OpenCV.

In order to guide a custom mask detector, we divided our project into two distinct phases, each with sub-steps as described in the picture shown above:

Training:

Here we had targeted on getting our face mask detection data set from training a model by using keras on this data set, and then serializing the face mask detector to disk in the data set.

Deployment :

Once a face mask detector is guided, we continued to load the mask detector performing face detection , and then presenting each face with mask or absence of mask.

We reviewed each of these categories and related subsets in detail for the rest of this project.

Our Covid19 face "mask detection data-set"

Fig 1. Samples of people with mask.

Fig 2. Samples of people without mask.

The face mask detection database contained 'masked' and 'with out mask' images as shown in the Fig 1 and Fig 2 respectively.. We used the database to construct a COVID-19 face scanner for the computer vision and in-depth learning using Python, OpenCV.

The data-set consists of 1,150 images possession to two classes:

- with_mask: 560 images
- without_mask: 590images

Our aim is to train our self deep learning model to detect a person is wearing a face mask or not?

To create this data-set, we had the insightful solution of:

1 Taking normal pictures of faces from people.

2 And, Then creating a custom based computer vision Python script to add face masks to face of them, and then creating a artificial data-set.

And, this method is actually a simpler than it looks once you gave facial landmarks to the problem.

Facial remarks allow us to automatically assume the location of facial structures, and by including:

- Mouth
- Eyebrows
- Jawline
- Eyes
- Nose

To get facial landmarks and to construct a data- set of faces wearing face masks, Firstly, we start with an picture of a person not having a face mask as shown in Fig 3:

Fig 3. Person without mask for data set construction

And then, we applied face detection to compute the bounding box position of the face picture as shown in Fig 4 above:

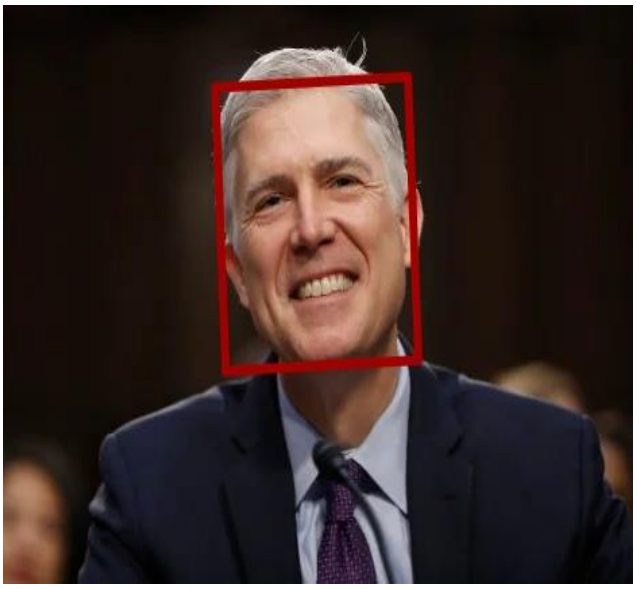


Fig 4. Picture after applying bounding box position.

Once, if we find out the where the image of the face is, we extracted the facial region Fig 5 of Interest(ROI):

Fig 5. Picture after applying facial landmarks.

And, from there, we applied facial landmarks, allowing us to localize and mark the eyes, nose, mouth, etc..,

And next, we want an image of a mask such as shown in Fig 6 below:

Fig 6. Picture of a face mask.

And, then self- executed and applied face mask to face by using facial landmarks. The mask is then re sized, rotated, and placed on precise location on the face like in Fig 7 placed below:

Fig 7. Picture after applying face mask to person.

And, then we repeated this process for all of our input images, thereby creating our own artificial face mask data-set:

Result :

The details are of the project face mask detection and auto body temperature detection research. We have conducted all these trails on a computer system that is installed with an Intel xeon processor and having very good RAM specifications. Also Open CV and python and Keras softwares are being used for conducting all the experiment.

The output displayed in this manner :

1. The first photo is displayed when there is no mask as shown in fig 8.

2. The second photo is displayed when the mask is present as shown in Fig 9 below.

Fig 8. Picture of a person without mask with accuracy.

Fig 9. Picture of a person with mask with accuracy.

Three classifiers namely decision trees and SVM and ensemble are used in these trails and also different data sets such as RMFD SMFD and other combined data sets are being used. These are very helpful when it comes to testing phase of the face mask. Through this research we have analyzed the working of the used classifiers and different performance matrices. The parameters such as accuracy and precision are widely checked for detection of face mask. We have different formulas to calculate accuracy and precision using the matrices that we used in the research.

Accuracy = (TP+TN)/ (TP+FP) + (TN+FN)

Precision = TP/ (TP+FP)

These are calculated mainly based on the number of true positive and true negative samples obtained from the matrices.where TP represents the count of True Positive samples, TN represents the count of True Negative samples, FP represents the count of False Positive samples, and FN represents the count of False Negative samples from the matrix.

As we have already said three data sets are used for training and testing. The data set1 is provided with various examples of face photos and different kinds of mask photos. For the DS1, the decision trees classifier achieved a validation accuracy with performance metrics ranging from 92% to 94%. In DS2 the decision trees classifier has got validation accuracy of 96% with performance matrices as shown in Fig 10. For DS3 we got a validation accuracy of 98% as shown in Fig 11 with the performance matrices since DS3 is a combined data-set of DS1 and DS2.

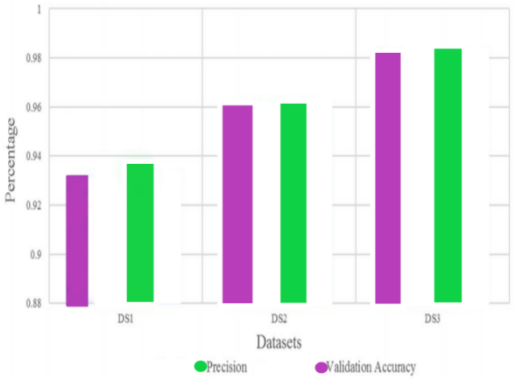


Fig 10. The picture depicts the accuracy performance of different sets of data and their performance.

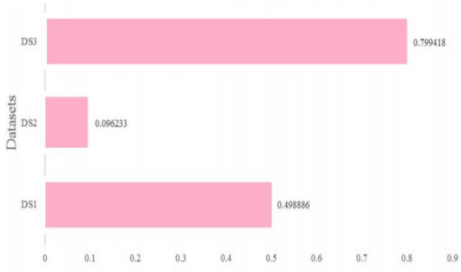


Fig 11. The picture depicts the time consumed by different data sets(DS) for training purpose.

The dataset2 is for the detection of fake masks and real masks. Dataset3 is a data-set obtained by combining the both the 1 and 2 data sets and has large data. The same experiment is performed with SVM classifier which was earlier performed with tree classifier and the results found were astounding. The below figure represents the validation accuracy and precision metrics for SVM classifier. In SVM for DS1 we obtained an accuracy of 98 percent while for DS2 it is approximately 100 percentage. In DS3 it is about 99 percent so the validation accuracy and precision matrices are better with SVM classifier when compared with Tree classifiers respectively shown in Fig 12 and Fig 13.

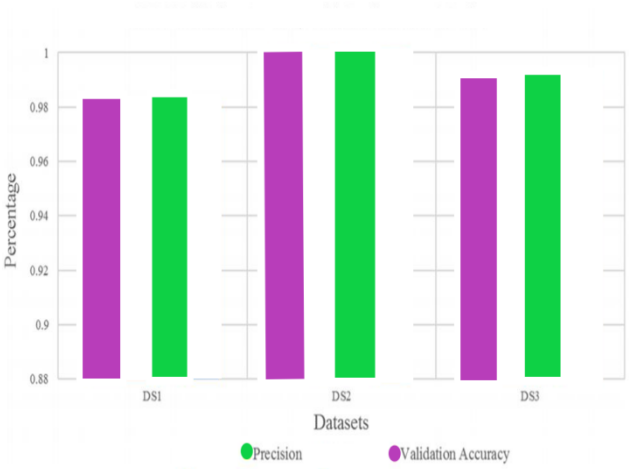


Fig 12. The picture depicts the accuracy and precision of the SVM classifier.

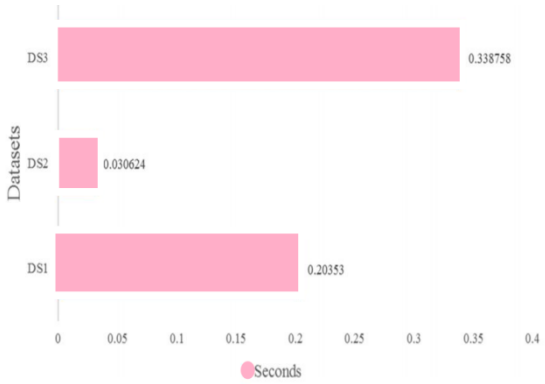


Fig 13. The picture depicts the time consumed by different DS which is data sets in SVM classifier.

Using these classifiers the accuracy of 55 to 90 percentage is obtained. In machine learning we all work for accuracy which comes from collection of great amounts of data which in turn is useful for the better prediction of the results.

Conclusion :

We all are aware that corona virus is causing huge health damage all over the world. Governments are taking valuable measures in stopping of the virus spread. Vaccine is also being distributed all over the world on a priority basis. In these unprecedented times when the World is getting affected by pandemic, safety becomes the first and foremost priority for everyone. So keeping in view of the safety measures given by various health organizations and governments this project is very useful for protection of the people. In measuring of body temperature for the early detection of corona virus many doctors and staff are risking their

lives by going near to the people. Through this research we will be able to measure the body temperature without the actual presence of a person. And the second part of the research is face mask detection which will be very helpful as the governments are promoting wearing of face masks and here we will detect whether the person is using mask or not by using different data sets and machine learning.

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- Fig 1 to Fig 5 all images are subjected to copyrights from google and from other search engines.
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