

Mask Detection

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Abstract: Covid-19 is causing a severe health crisis in all over the world. India has also been gravely affected by it particularly during current 2nd wave. It's caused by novel coronavirus. There are some self-precautionary measures suggested to reduce the rate of mitigation of this disease, most important one among them is wearing a face mask. So, in this paper we are putting forward a system that will help authorities curb the spread of coronavirus by detecting the people who are not wearing a mask in a CCTV monitored area when a person not wearing face mask is detected, the system automatically forwards a message to the corresponding authority. The face mask recognition in this paper has been developed using a CNN model with the help of Tensor flow and Open CV. This system has been trained by providing a dataset of images either with or without a mask. Our system has a accuracy of 95.26% in real time. We sincerely hope that our study will be helpful in stopping the spread of coronavirus once implemented.

Keywords:

1. Introduction

Covid-19 pandemic has been disastrous for many countries individually and humanity as a whole. Covid-19 is caused by severe acute respiratory syndrome coronavirus 2(SARS-COV-2). It originated in Wuhan china. The disease has since been classified as a pandemic by WHO. Symptoms of covid-19 are wavering but in most cases include Fever, cough, headache, difficulty in breathing and a loss of smell and taste. Preventive measures to curb the spread include physical or social distancing, quarantining, and ventilation of indoor spaces, covering coughs and sneezes, hand washing and keeping hands from face. Use of face masks and covering is advised to stop the spread of virus through air channel.

People all over the world are having a atrocious time, both physical and mental health is taking a hit. At the time of writing this paper there has been 14,52,40,343 cases reported of coronavirus infection and 30,82,137 deaths. In my home country India 2nd wave has particularly been catastrophic with number of deaths hitting record reporting 2456 deaths on a particular day.

Although all the news is not gloomy, Vaccines have also been developed to fight this virus including Moderna, Pfizer-BioNTech, sputnik-v and Indian's own Covaxin but during the time it takes to get the whole population vaccinated we can't let our guard down and should keep on following preventive measures such as wearing a mask. Despite all these dire situation some people refuse to wear a mask or don't wear it properly. We can't let preposterous actions of some people affect health of millions others. The spread of covid-19 can be very limited and ultimately curbed if we can detect the people not wearing a mask and inform the authorities about them.

A face mask detection is a technique to detect wither a given person has put on a mask or not. Recently we have seen AI&ML being used in many techniques such as object detection. These already present architectures can be successfully for detecting a mask on a face as well. As, we know in a smart city there are many IoT sensors present to collect data to perform various operations, we can use them to perform our operations.

The main objective of this paper is to discern wither a person is wearing a mask or not and in case of unruliness inform the authorities via smart city network. We are using Tensor flow, Python, Keras library and Opencv to perform this operation. We will first use the CCTV to take the footage in and then use them to detect presence of face mask. The learning CNN model will be first trained by providing a set of images with mask and without mask. Whenever this model detects a face without a mask it informs city authorities with city network prompting them to necessary action.

2. Methodology

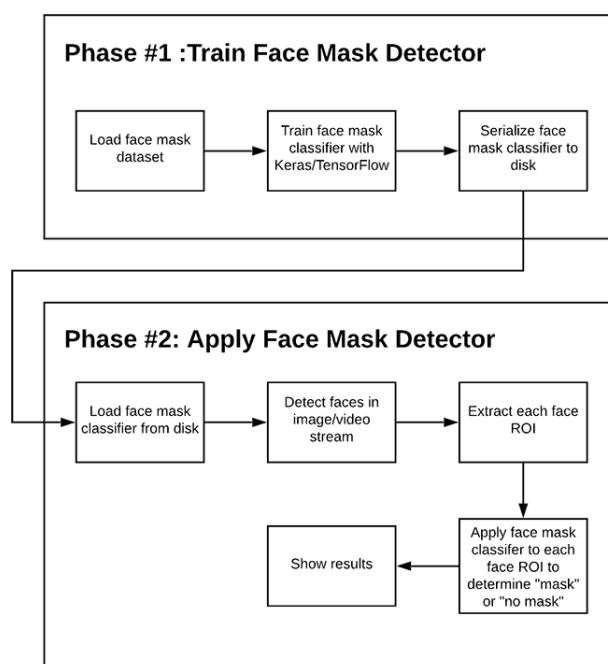


Figure 1. Different phases and steps involved in building the model.

We will divide our process of training a face mask detector, we will divide our whole project into two different phases:

Training: We'll use keras/Tensorflow to teach our model with the available face mask detection dataset.

Deployment: We can then use the detector to perform face detection and identify each face as mask or No_mask after it has been conditioned.

Prajana Bhandary generously shared her face mask dataset with us. It comprises approximately 1428 photographs, 718 of which feature people wearing masks and 710 of which do not. We'll use these images to train a CNN model in TensorFlow to detect whether or not anyone is wearing a face mask

Step 1: Visualization of data

We'll start by visualising the total number of images in both categories in our dataset.

The 'yes' group contains 718 images, while the 'no' group contains 710 images.

There are 718 photos in the 'yes' category.

There are 710 photos in the 'no' category.

Step 2: Data Augmentation

Then, to have more images for our training, we enlarge our dataset. Thus to enlarge our dataset, we will start by rotating and flipping each image in our dataset. After this process, Total number of pictures are 2855 in which 1435 images are in 'yes' set and 1420 images in the 'no' set.

There are 2855 examples in all.

The process described above is called data augmentation it's a technique in data analysis to increase the amount of data by adding moderately modified copies of existing data or creating a new synthetic data from existing data.

Positive examples as a percentage of total is 50.2% and

The total number of pos examples is 1436.

Negative examples as a percentage of total is 49.7% and the total number of negative examples is 1420.

Step 3: Dividing the data

We divide our data into two sets at this point :

- Training set :- This includes the images that will be used to train the CNN model.
- Evaluation set :- This will be used in testing the model.

Split size used will be 0.8 which infers that training set will be receiving 80% of the images and remaining 20% will be received by evaluation set.

- 1104 images would be classified yes in training set with 1096 images being classified no.
- 276 images would be yes in classified test with 275 images being classified no.

Step 4: Building the Model

Sequential CNN model will be build using conv2D ,Flatten, MaxPooling2D, Dropout and Dense constituting various layers. ‘softmax’ function will be used in last dense layer to generate an order that gives the likelihood of each of the two categories.

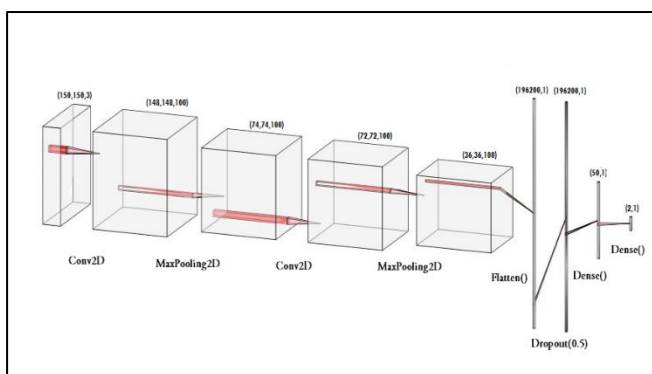


Figure 2. CNN model for face mask detection.

Step 5: Pre-Training of CNN model

Let us generate the ‘teach_gen’ and ‘eva_gen’ after we finish building our model in order to match them to our model in the next step.

The training set comprises 2800 images and the evaluation set consists 851 images.

There are 2800 images in 2 sets.

There are 851 images in 2 sets.

Step 6: Training of CNN model

This is an important phase in which we will fit our image from training and evaluation sets to our sequential model which was created with the keras library. The current model has been given 40 iterations , which ideally should be even greater to improvise on precision and avoid overfitting.

```
history = model.fit_generator(teach_gen,
                             epochs=30,
                             eva_data= eva_gen,
                             callbacks=[checkpoint])
```

>>Epoch 40/40

220/220 [=====] - 231s 1s/step - loss: 0.0368 - acc: 0.9728 - val_loss: 0.1072 - val_acc: 0.9526

After the 40th iteration , The model shows an accuracy of 97.28% with the training set and accuracy of 95.26% with the evaluation set thereby pointing to the conclusion that the model is well trained without any overfitting.

Following the separation, we can see that the optimal proportion of photos has been assigned to both the training and evaluation sets, as previously stated.

Step 7: Classifying the data

We mark two probabilities for our findings after we construct the model with '0' denoting 'NO_MASK' and '1' denoting 'MASK'. We will still use RGB values to adjust the hue of the boundary rectangle. Here 'RED' stands for 'NO_MASK' and 'GREEN' stands for 'MASK'

```
Show_lab = {0:'NO_MASK', 1:'MASK'}
```

```
Colour_lab = {0:(0,0,255), 1:(0,255,0)}
```

Step 8: Importing Face Recognition Program

We are gonna use this now to detect if someone is wearing a face mask or not using webcam of laptop or computer.

For this specific task we need to implement face detection.

We will use Haar Feature-based cascade classifiers for detecting the characteristics of the face.

```
face_clsfr=cv2.CascadeClassifier('haarcascade_frontalface_default.xml')
```

OpenCV created this cascade classifier to detect the frontal face by training thousands of photographs. The.xml file for the same must be downloaded and used in the face detection process.

Step 9: Identifying Masked and Unmasked Faces

We use the OpenCV library to run an endless loop for our web camera in the final step, where the Cascade Classifier is used to detect the face. The code is `webcam = cv2.VideoCapture(0)` demonstrates the use of a webcam

Each of the two classes ([MASK, NO_MASK]) would be predicted by the model. The mark will be selected and shown around our facility based on which chance is greater.

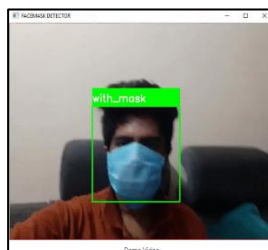


Figure 4. MASK

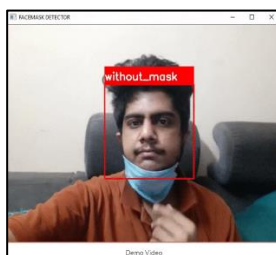


Figure 5. NO_MASK

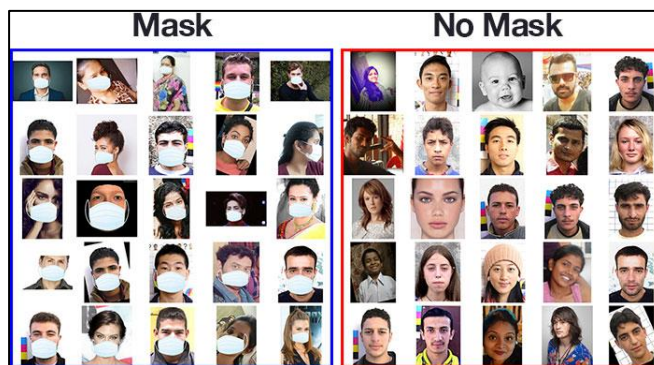


Figure 6. Dataset containing images of MASK and NO_MASK.

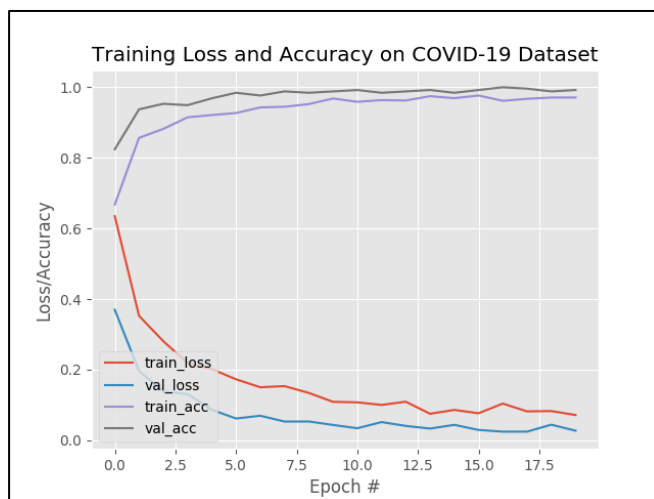


Figure 6. Accuracy/loss curve, which is demonstrating high accuracy and little signs of overfitting on the data .

3. Conclusion

We have presented a system for a smart city to curb the spread of coronavirus by detecting the person not wearing a mask and inform the authorities about him not following safety guidelines.

This system contains a face mask detection algorithm based on CNN model build using Tensor flow with keras library and Open cv. We have used image from dataset provided by Prajana bhandary containing images of people both with and without a mask. The accuracy of our system 96.19% in real time. We sincerely hope that our work will act as a crucial tool in implementing mandatory usage of face mask in public.

4. Limitation And Future Work

The proposed system faces difficulty in detecting face of each and every person is arduous so, it would be troublesome for our algorithm to detect faces of people without mask. Furthermore, it’s difficult for the system to distinguish between a face mask and a hand covered face.

If a violator is travelling in a vehicle then it’s difficult for the system to track him/her.

We also need a lot of CCTV cameras to collect the required data needed for processing and also considerable manpower to catch the violators. A great network connection is also needed cause this system works on sending sms in case of violation.

Future work may include the use of drones and other automated vehicles in place of personals to enforce proper implementation of law. We can also use LED signs and alarms to warn both the violator and public about him not wearing a mask. We can also use present object detection algorithms and train them in detecting presence of face mask on people in case of moving vehicles.

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