

Towards Face Recognition with Mask

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1 Abstract

Face recognition is a well solved problem in the visual world. Current COVID-19 situation where wearing mask has been made compulsory at many work places, poses a new variant of this problem, i.e., to detect and recognize the face with mask. Towards this end, we have experimented the ability of current face detection tools like 1) Resnet10+SSD face detector 2) Dlib face detector 3) MTCNN to detect face with mask, followed by face recognition techniques like 1) Facenet, 2) LightCNN and reported the results and observations

2 Introduction and Motivation

Given the rising tensions around COVID-19, maintaining security in and around COVID-19 designated hospitals and quarantine centers is of high priority, as only restricted personnel are allowed to enter into such premises which include doctors, hospital staff, and very few other persons. Given the nature of the spread of COVID-19, all these people tend to wear protective equipment, basically a mask over their face.

3 Literature

Object Classification and Detection have always been a potential area of research in the area of Computer Vision. Owing to the great feature learning capabilities of Convolutional Neural Networks in the task of Image classification, to be precise, since AlexNet there has been a very diversified interests in exploring CNN's to tasks like Face Detection, Face recognition, Face verification among others. The models with the help of CNN's (and its smart variants like Dense Conv, Residual Conv Layers, Inception Net, etc.) have shown a great improvement on famous large scale datasets like VGG Face 2, LFW, MS-CELEB-1M.

4 Data

4.1 Data for Masked Faces

All the academic data available in the domain of face detection and recognition doesn't contain the faces with mask. Two methods for Data creation.

1. Collect real data from people - label them manually - Not possible - Time taking.
2. **Distillation- teacher forcing**
 - (a) Obtain a mask with transparent background.
 - (b) Download existing academic dataset - VGG Face 2.
 - (c) Run existing face detection tool, obtain facial landmarks.
 - (d) Overlay the mask at nose-chin parts of face after proper resizing in accordance with the landmarks obtained.

We have used dlib's face detection tool to obtain landmarks. We have used VGG Face 2 labelled test dataset (500 class, 1.6L images) for our further experiments. We didn't use VGG Face 2 train dataset owing to resource/space constraints.

4.2 Data for Face Recognition Task

We have used same VGG Face 2 test dataset as mentioned in the previous section.

1. For Facenet+SVM model
 - (a) Crop faces using MTCNN and resize them to (160,160).
2. For LightCNN model
 - (a) Train - Crop faces using MTCNN and resize them to (144,144).
 - (b) Test - Crop faces using MTCNN and resize them to (128,128).

5 Method

5.1 Face Detection

Face Detection task is performed using following methods :

1. Pretrained ResNet10 based Single Shot MultiBox Detector model.
2. MTCNN model.
3. Viola Jones face detection - Didn't give good results.

5.2 Mask Detection

Given from the literature that the light weight MobileNet V2 (3.4M parameters) is capable of achieving similar performance to other classification pipelines like Resnet50 (23M parameters), VGG16 (138M parameters), we have finetuned a pretrained MobileNetv2 model for our mask detection over masked face dataset as mentioned in Section 4.1 (2).

5.3 Face Recognition

For face recognition task, we have tested under 2 different setups.

1. Pre-Trained FaceNet embeddings + SVM.
2. Custom Trained LightCNN model embeddings + SVM.

6 Results

6.1 Results of Mask Detector

Total Images: 65003

Accurate Classification: 63221

Metric	Value
Accuracy	97.25%
Precision	99.7%
Recall	97.78%
F1 Score	98.73%

6.2 Results of Face Recognition

Total classes: 500

Accuracy with Facenet + SVM model: 86.6 %

Accuracy with Light CNN (on 500 class, 20 epochs - ideally should run for around 80 epochs): 84.4%

7 Qualitative Examples

7.1 Positive Example



Figure 1: An image with face mask

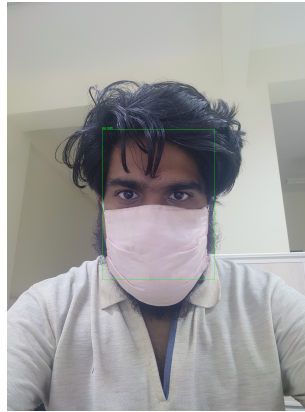


Figure 2: face detection output

7.2 Negative Example



Figure 3: An image of human face look alike face mask

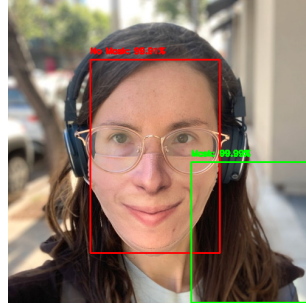


Figure 4: face detection output

8 References

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