A Synopsis on

Using ML for Facial Mask Detection

Submitted in partial fulfillment of the requirements
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Bachelor of Engineering

in

Information Technology

by

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CERTIFICATE

This is to certify that the project Synopsis entitled ***"Using ML for Facial Mask Detection"*** Submitted by ***"Harsh Saraiya (18104006), Saloni Rane (18104009), Prajakta Mhaske (18104036)"*** for the partial fulfillment of the requirement for award of a degree ***Bachelor of Engineering*** in ***Information Technology.***to the University of Mumbai,is a bonafide work carried out during academic year 2021-2022

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Abstract

COVID-19 pandemic has rapidly affected our day-to-day life and is continuously spreading all over the world. Wearing a protective face mask has become a new normal nowadays to prevent the spread of infection. Since people have become a bit careless towards wearing facial masks outdoors, this system detects the human individual through videos not wearing a mask and informs the authorities about it. This paper presents a simplified approach to achieve this purpose using some basic Machine Learning packages like TensorFlow, Keras, OpenCV. We have used the Res10 SSD Caffe model for face detection and Image classification is done through MobileNetV2 architecture for the implementation of our system. The proposed methodology demonstrated its effectiveness in detecting facial masks by achieving high precision, real-time detection and classification.

Introduction

Due to COVID-19 Pandemic many people have died and every day are infected by this virus. According to the World Health Organization (WHO)'s official Situation Report – 205, coronavirus disease 2019 (COVID-19) has globally infected over 20 million people causing over 0.7million deaths. 213 countries are affected by coronavirus, including all of the development countries like the USA, UK, Russia, China, Japan, Italy, etc. The major cause of the infected virus was the carefulness of the people and lack of their consciousness. Everyday people entire the office or other apartments without any mask on their faces. It's very difficult for surveillance all the time and also time-consuming. This research mainly helps to solve this problem and help people to protect themselves. Especially in COVID-19, it's an important thing to save ourselves from other people. Thus it is strongly recommended to use face masks in the general public to curtail the spread of Coronavirus. Further, with the reopening of countries from COVID-19 lockdown, Government and Public health agencies are recommending face masks as essential measures to keep us safe when venturing into public. To mandate the use of facemasks, it becomes essential to devise some techniques that force individuals to apply a mask before exposure to public places. Face mask detection refers to detecting whether a person is wearing a mask or not. In fact, the problem is reverse engineering of face detection where the face is detected using different machine learning algorithms for the purpose of security, authentication and surveillance. Face detection is a key area in the field of Computer Vision and Pattern Recognition. In recent years, face detection methods based on deep convolutional neural networks (CNN) have been widely developed to improve detection performance. Further, it is not easy to detect faces with/without a mask in public as the dataset available for detecting masks on human faces is relatively small leading to the hard training of the model. So, the concept of transfer learning is used here to transfer the learned kernels from networks trained for a similar face detection task on an extensive dataset. Several methods are available for detecting mask faces including different angles. This paper involves building a system for mask face detection using several classifiers available on CNN. Work with the CNN gives higher accuracy to detect the mask face in a particular area and it's a little bit sensitive when the face comes into the area of the webcam, so it's faster than others. In a sense the community remains safe while increasing flu stops are scattered in the air and make barriers to enter in the human body.

Objectives

1. To automate the process of face mask detection using a CCTV camera.
2. To Classify people into masked and unmasked category.
3. Image recognition of unmasked people and notification alert to the Authority about it.
4. To help stop the spread of airborne particles (corona virus) from the infected person's sneezing or coughing by the use of our system.
5. To ensure a safe working environment by creating an atmosphere of awareness and preparedness in the locality.

Literature Review

In this section, we review some similar works done in this domain. Although research on face detection has been going on for decades and has achieved great success, methodologies and algorithms that are earmarked for face mask detection are limited.

The proposed framework in [1] capitalizes on the MTCNN face detection model to identify the faces and their corresponding facial landmarks present in the video frame. These facial images and cues are then processed by a neoteric classifier that utilises the MobileNetV2 architecture as an object detector for identifying masked regions.

In literature [2] the author has proposed a deep learning architecture that is trained on a dataset that consists of images of people with and without masks collected from various sources. The trained architecture achieved 98.7% accuracy on distinguishing people with and without a facial mask for previously unseen test data.

In this research [3] , two different methods are proposed to detect masked and unmasked faces in real-time. In the first method, an object detection model is applied to find and classify masked and unmasked faces. In the second method, a YOLO face detector spots faces whether masked or not and then the faces are classified into masked and unmasked categories with a dataset.

In this work [4] an existing object detector, Mask R-CNN, is trained for face detection with a small number of training examples and also to perform instance segmentation along with an object bounding box detection. The results indicate that the trained Mask R-CNN provides higher detection rates with respect to the baseline detector.

In literature [5] the author proposed the performance of the three algorithms: KNN, SVM and MobileNet to find the best algorithm which is suitable for checking who is wearing a mask in a real-time situation. The results show that MobileNet has the best accuracy for both the input images and input videos from a camera.

Literature [7] aims to present a review of various methods and algorithms used for human recognition with a face mask. Different approaches i.e. Haar cascade, Adaboost, VGG-16 CNN Model, etc. are described . A comparative analysis is made on these methods to conclude which approach is feasible.

Literature [6] provides a method of face mask detection on the basis of the SSD algorithm. SSD-Mask introduces a channel attention mechanism to improve the ability of the model to exhibit important features. At the same time, the information of different feature levels is fully utilized and the loss function is optimized.

Overall, the MobileNetV2 models are faster for the same accuracy across the entire latency spectrum. MobileNetV2 is a very effective feature extractor for object detection and segmentation. For example, for detection when paired with the newly introduced SSDLite the new model is about 35% faster with the same accuracy than MobileNetV1. As we have seen MobileNetV2 provides a very efficient mobile-oriented model that can be used as a base for many visual recognition tasks.

Problem Definition

Over the past decade face detection and recognition have transcended from esoteric to popular areas of research in computer vision and one of the better and successful applications of image analysis and algorithm based understanding. Because of the intrinsic nature of the problem, computer vision is not only a computer science area of research, but also the object of neuro-scientific and psychological studies also, mainly because of the general opinion that advances in computer image processing and understanding research will provide insights into how our brain work and vice versa. A general statement of the face recognition problem (in computer vision) can be formulated as follows: given still or video images of a scene, identify or verify one or more persons in the scene using a stored database of faces.

Proposed System Architecture/Working

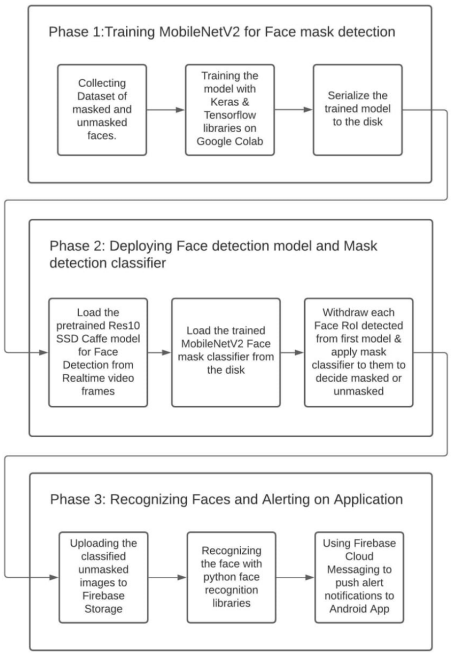

Figure 1: Block Diagram of Face Mask Detection System

In this proposed system we have three phases, each with its own respective substeps. First phase is training the face mask detector model. The second phase is Detection and Recognition. The third phase is Deployment on cloud. We have used the MobileNetV2 classifier model, a highly efficient architecture for face mask detection.

1. Training the Face mask model

   We have collected 1396 images of faces out of which 1000 are faces with masks and 396 images are without masks. These images are then loaded with a target size of 224x224 and then preprocessed using Keras mobilenetv2 library. We have split the dataset for the training and testing phase. We used 80% of the dataset for training and 20% for testing the model. We have constructed the training image generator for Data augmentation. After a few trial and errors, 1e-4 gave us best results and the fastest decrease of losses. The model was trained for 20 epochs with the batch size of 32. The training process generated a classification report and saved the respective trained model.

2. Detection and Recognition

   Face detection from the video frames is carried out by using a pre-trained Res10 SSD Caffe model with the OpenCV DNN module. Initially both the models are loaded from the disk and VideoStream from the required input is started using OpenCV and frames are read and resized. The Facial ROI is detected from the blob of the image and these are passed through the Caffe model. The faces and their corresponding location on the frame are then stored into a list. Then using the (startX, startY, endX, endY) coordinates of the Facial ROI, and converting it from BGR to RGB channel, ordering it, resizing them to 224x224 which was desired for the MobileNetV2 model and preprocessing the image using Keras libraries. Passing this list into the

MobileNetV2 model will return the predictions made on the Facial images whether masked or unmasked. Then looping over the coordinates and predictions list, a bounding box is appended over the real time frames of the Video Stream.If prediction = "Mask" bounding box color is assigned to Green and if prediction = "Unmask" bounding box color is assigned to Red.

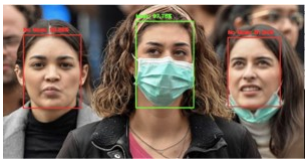

Figure 2: Image of masked and unmasked people from realtime video footage

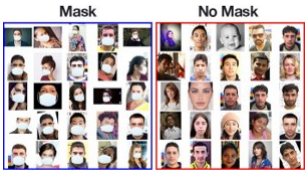

Figure 3: Samples from dataset including faces with masks and without masks

From the above classification, the unmasked faces will be used for facial recognition. For Face recognition, we have used a Python face-recognition 1.3.0 library which is built using dlib's state-of-the-art face recognition built with deep learning. This model will be trained on a known faces dataset of a company, a hospital staff, college campus and so on. The unmasked faces will be classified by this deep learning library and the authority will get to know the details of the unmasked person viz. Name, Unique Identification number, Department and so on.

3. Deployment on cloud

   For cloud storage Firebase is a useful platform developed by Google which we will implement for application development. It is the best mobile backend as a service because it offers a way to link the mobile applications to the backend cloud storage and backend APIs. Firebase manages all data real time in the database. So the exchange of data to and fro from the database is easy and quick. Google brought Firebase Cloud Storage in integration with Firebase SDK, which allows the users to store the file within a fraction of time in the cloud. We will be using these Firebase SDKs for storing video/images of the people without masks. Google Cloud Storage will be used to access the same files on the server. The uploaded files will be accessed from both Firebase and Google cloud and each file is stored in a Google Cloud Storage Bucket. This will allow us to download and upload files from mobile clients through Firebase SDKs and makes it possible to do server-side processing using Google Cloud. Firebase comes up with the Firebase Real-time Database which is hosted on a cloud and is a NoSQL database. The images of unmasked people which were collected earlier for the mask detection will be uploaded to the cloud storage.

   Firebase Cloud Messaging(FCM) connects the server and devices in such a way that receiving and sending the alert messages/notifications becomes quite easy and reliable. With the help of FCM, we will notify a concerned authority via firebase admin SDK. Using the firebase admin SDK, a notification will be pushed to the application. A custom notification will be sent to the concerned authority recognizing the details of the person without mask. The application will get notified when a person without a mask is detected. The application will be developed in Flutter as it provides better user experience, robust performance and enormous time and effort saving.

Summary

- In this pandemic situation, where whole world is dreaming to return to normal routine, this system will play effective role in monitoring the use of face masks at workplaces.
- By the development of this system, we can detect the mask on one's face and allow his entry in the workplace.
- This system also contributes to public healthcare, as it helps in keeping environment healthy.
- We will use OpenCV, tensor flow, keras , Pytorch and CNN to detect whether people were wearing face masks or not. The models will be tested with images and real-time video streams.

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1 Publication

Paper entitled **"Using ML for Face Mask Detection"** will be presented at **"CVPR 2022: IEEE/CVF Conference on Computer Vision and Pattern Recognition"** by **"Harsh Saraiya, Saloni Rane, Prajakta Mhaske".**