AI & CV Project Documentation

Titled: “Mask Recognition 1.0”

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1. General information about the project

The main premise of the project is facial detection via video capture and determining if the recognized person is wearing a facemask.

Resources used in the project:

- OpenCV – Library focused on real-time applications with functions to process images
- NumPy – Library containing a lot of advanced mathematical and scientific functions
- TensorFlow – Open source platform for machine learning
- Imutils – Convenience functions package for OpenCV to preform basic image procession tasks easier
- KERAS – Open source neural network library

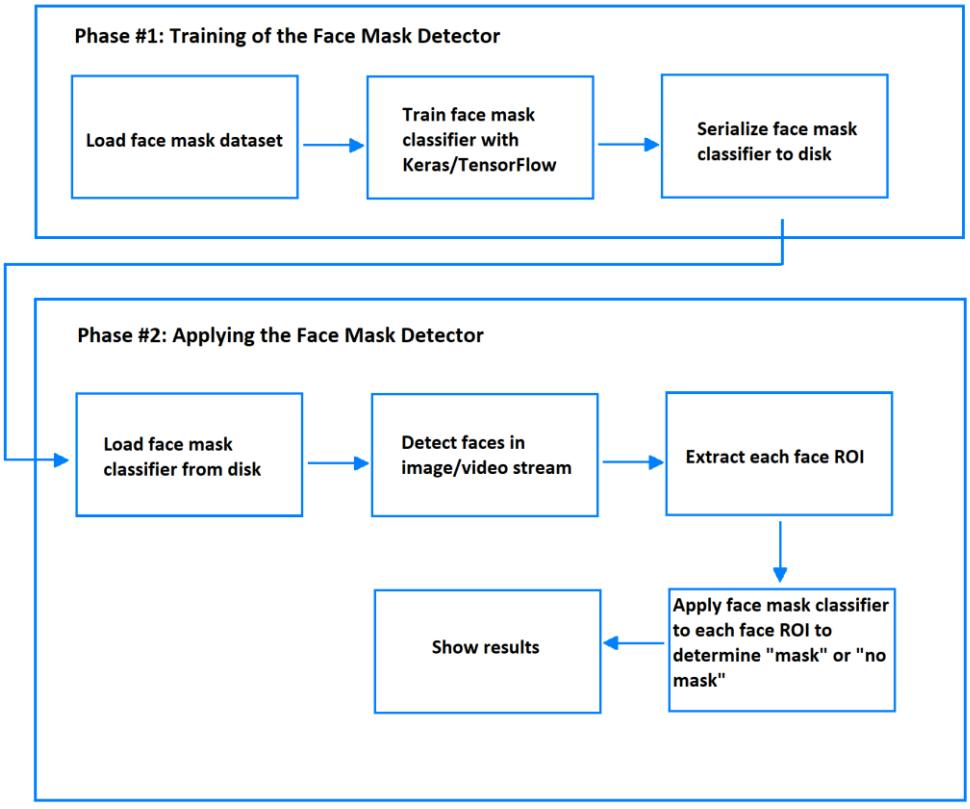
The idea:

Idea of creating a program to achieve our goals did not came from anywhere. We wanted to create something that would not be really simple and will stand out from the other students projects. Nowadays AI&CV is used almost everywhere where we have a little bit of more advanced technology. Let’s take Apple’s FaceID as an excellent example. It detects persons face with the usage of the front phone camera, sensors and a dot projector and based on the scanned and stored data associated with the users face and it creates a 3D map of the face. To unlock the device, FaceID checks if the person trying to unlock the phone is privileged to do that. Of course two students which started learning the basics of AI&CV would not be able to achieve such a complex and almost 100% reliable system. But using the opportunity we wanted to try ourselves with facial detection and processing the image to at least determine if the person is wearing a facemask or not. We won’t hide that the global pandemic and the percept of wearing facemasks was a great inspiration for our project as well.

2. How does it work?

The Program:

First of all we need a source of the image which will be processed. That is where we use OpenCV and the hardware video capturing device. We are getting every single frame and converting it to grayscale format. Also facial recognition is being applied to the frames to estimate if there is a person with a visible face enough to later on determine if he is wearing a facemask or not. At this point, the AI based on TensorFlow activated and starts doing it job. It searches for every region of interest and signs the result of a presence of a facial mask. The CV part is responsible for showing us the given result of the decision based on the AI and in prints out a box tracking the face of the user, and the “Mask on / Mask off” indicator.



3. AI Part:

The AI Part is where the real fun begins. After some brainstorm we figured out that TensorFlow with Keras working on top of it will be the most accessible and approachable way to go. It's the most user-friendly open source platform for machine learning and it got a lot of learning materials online such as video tutorials or documentation explaining how to make a reasonable approach to solve a given problem. The challenge of the AI part is to construct and train it. We used a whole bunch of photos (about 4.5k to be exact) of people wearing a facemask or not. To start, we load each photo to a numpy array and preprocessed it encoding a batch of images. As well as the datasets and labels interrelated with them. Then the construction of the head of the model that will be placed on the top of the base model. It is used because it will become the actual model that we will train later on in the code. The data used for training is being partitioned into training and testing splits with the proportion 80::20. Where 80% of it is used to train and the remaining 20% is used to test and assigned either to the train or test part of the data. The last part is to construct the training image generator and train the head of the network with the data validation and saving the model.

4. CV Part:

The CV Part is really simple. It takes care of reading the frames from a video capture device hooked up to the computer, converting it into grayscale and recognizing the face. In that exact moment when the face is recognized the AI model is activated. There are also some additional features like drawing a rectangle around the face and signing a tag to it "Mask On / Mask Off" depending of the prediction of the AI part. As well as displaying the output of the capture.