

FACE_MASK_DETECTION and AUTOMATIC_GATE_CONTROL

PROJECT BY:

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During this pandemic times we all know that many shopping malls,theatres, companies etc....are not allowing people inside without face masks, for this security guards,watchmen should be always present at entrance and they have to allow inside only if we wear a face mask which is time consuming and paid work. So an alternative and best option is to use an AI based application which will automatically allows only those people who wear mask...



So I decided to make such an AI based project which runs on camera and opens the gate/door for a certain time automatically when it detects a person's mask and then automatically closes.

APPROACH:

(note: *It is recommended to open code in VS CODE for better results)*

Libraries i have used:(only python)

1.Opencv

It is a library used for image processing, in machine learning

2.Numpy

It is a built in python library, i used this to convert images to numpy Arrays and for doing some math on it

3.Sklearn-classification(scikit-learn)

It is on of the popular ML library in python.In sklearn i used Classification algorithm (supervised ML algorithm) mainly used for

Binary data classification to predict the input data to which category /class it belongs

4.pyfirmata

Pyfirmata is builtin library in python and in Arduino IDE which allows Serial communication between and allows to control and Communicate with arduino board pins.this should be installed in Both python and arduino IDE

HOW THIS PROJECT ACTUALLY WORKS..??:

When we run the program a separate window open for video capture ,it detects faces and searches for face mask if it finds mask then it calls arduino to turn on led as some sort of indication and then rotate servo(or open gate) to 60 degree and it waits for 5 sec because this 5 sec is max time for person to pass through,and automatically led will turn off, gate/motor closes or comes to initial position and again searches for mask.. It continuously searches until it finds a mask.

I divided my project into into 4 parts:

- 1.Face detection and collecting dataset for training,testing of ML algorithm***
- 2.Face mask detection by applying ML***
- 3.Aduino based gate control***
- 4.A 3d gate design in fusion360(extra feature to my project)***

1.Face detection and collecting dataset for training,testing of ML Algorithm

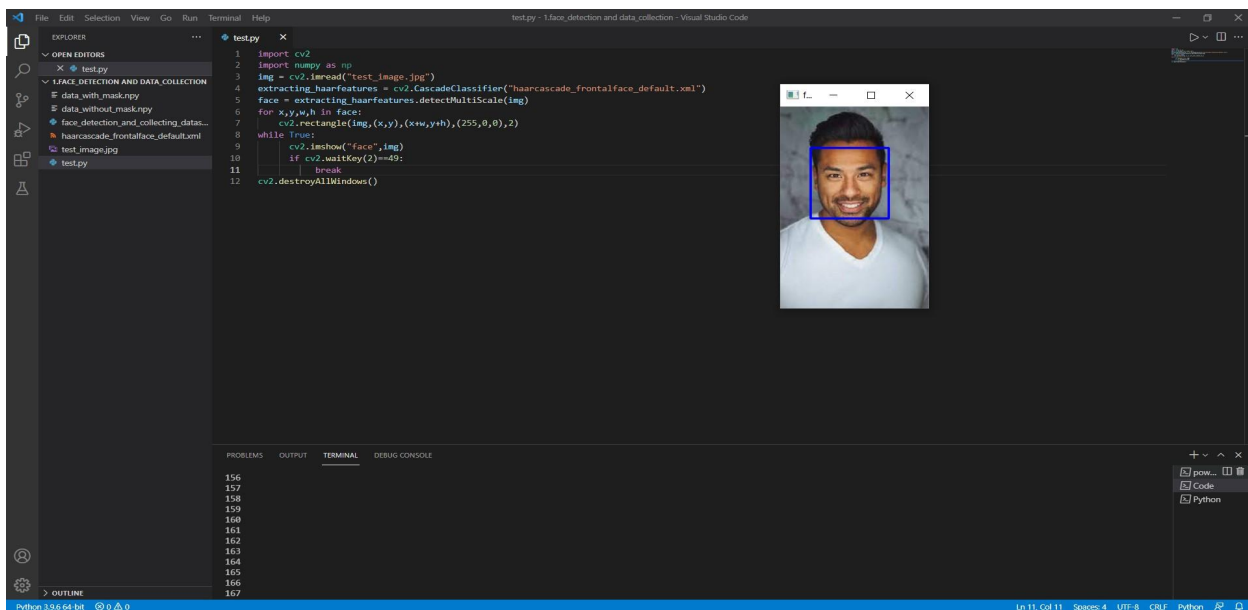
We all know that a video is nothing but a collection of many images/frames so by applying image processing on one image and then running this frame by frame using a loop we can perform image processing on an entire video.

Now after loading images using opencv For basic face detection in image I have used 'viola jones algorithm' which works on haar features selection in every image.what are haar features?? ...Haar features are features(some kind of black n white strips) found common in every face when image is converted to black n white ,after doing some math on haar features and in this algorithm a sliding window slides throughout the image searches for haar features, like this we can detect faces in the image.



Haar features

After this we have to extract faces from images frame by frame and to be stored in a dataset(have to make 2 datasets one with mask another without mask) for training and testing the ML algorithm.
(i have downloaded algorithm file 'viola-jones algorithm'--haarcascade_frontalface_default.xml)

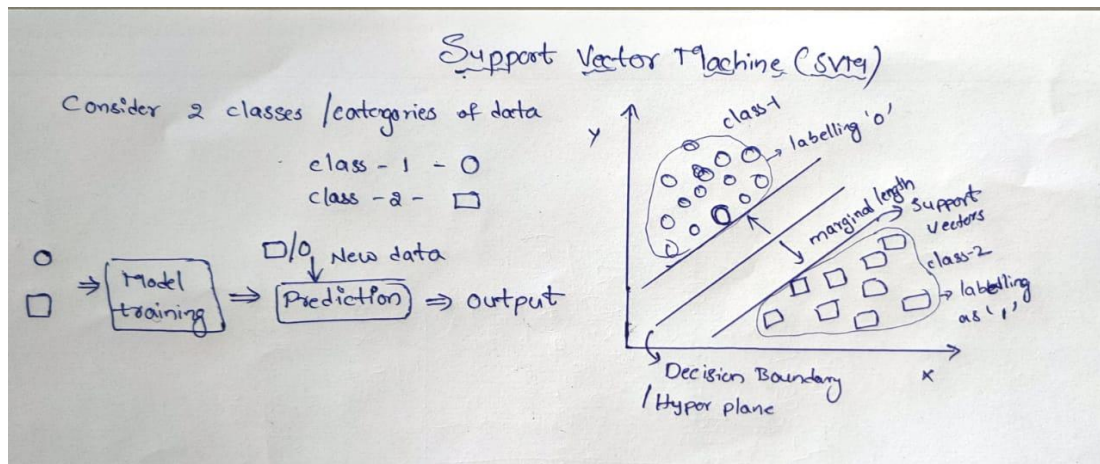


face_detection

2.Face mask detection by applying ML

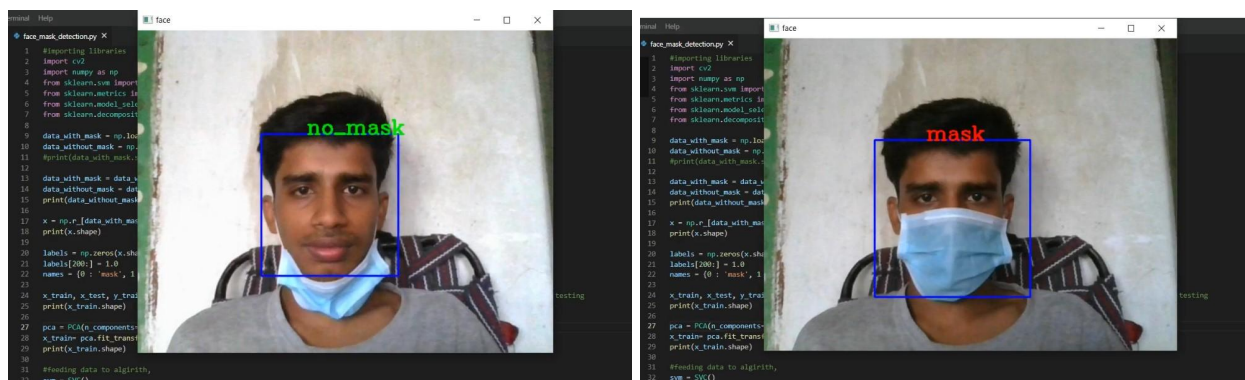
I have used the SUPPORT VECTOR MACHINE(SVM) algorithm which is one of the CLASSIFICATION algorithms in scikit learn(sklearn) .
You can see decision boundary line in image which classifies data into categories and also decides new input data to which category it belongs with help of support vectors

Which are drawn parallel to the decision boundary and touching the nearest data, for more accuracy marginal length should be more.



(for reference: <https://scikit-learn.org/stable/modules/svm.html>)

After collecting data and after doing some manipulation on training data I have labelled data so as to train ML algorithms. While feeding collected dataset to SVM the dataset has to be divided as 2 parts one for training and another for testing the algorithm which can be determined by output accuracy. Accuracy should be maintained $0.95 < \text{accuracy} \leq 1$. Now algorithm trained when we input a new image it has to predict to which category it belongs (mask or no_mask), if mask detected it shows "mask" and calls Arduino_control function



3. Aduino based gate control

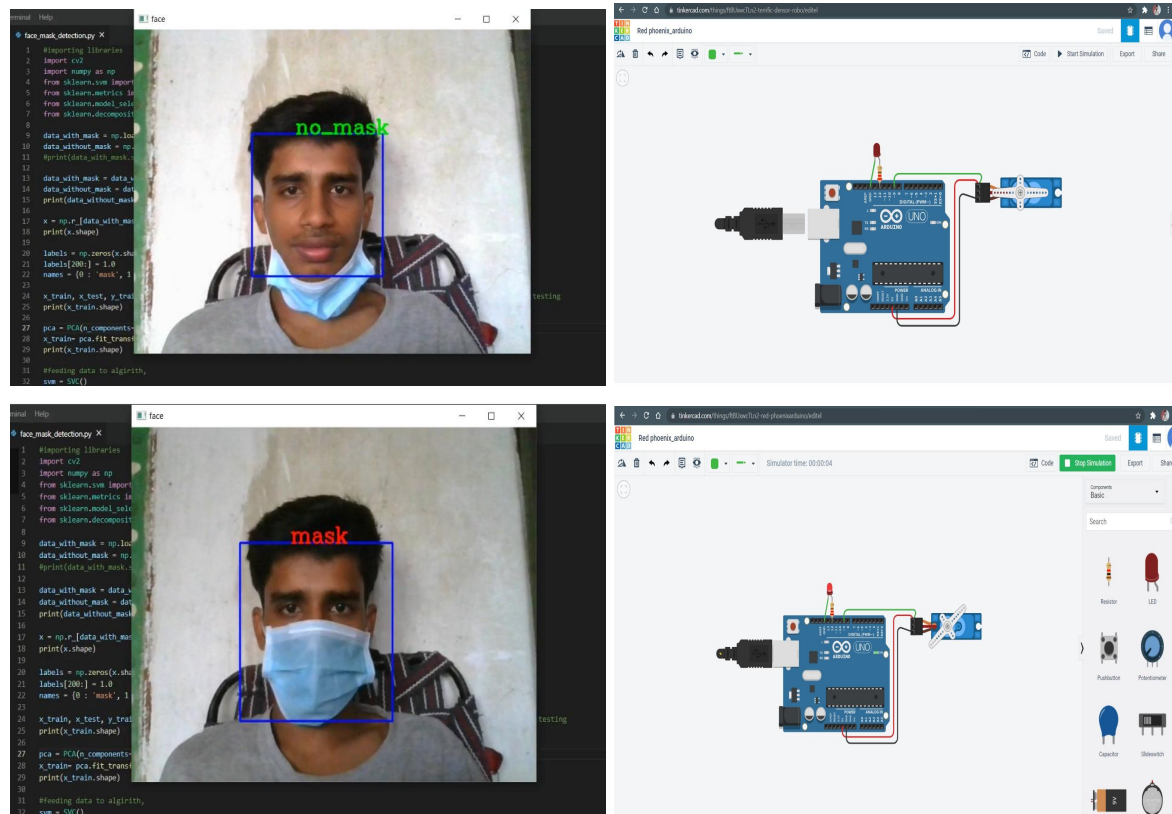
I have written a separate function for arduino control which is called when a face mask is detected.

As extra features we can also add temperature detection, and also add speakers

Below is an arduino circuit with LED, SERVO motor. Two terminals of the led connected to ground(GND) and output pin(12) ,three wires of motor connected to output signal pin(10), ground(GND) and 5v dc pin respectively.

(to access this circuit in Tinkercad:

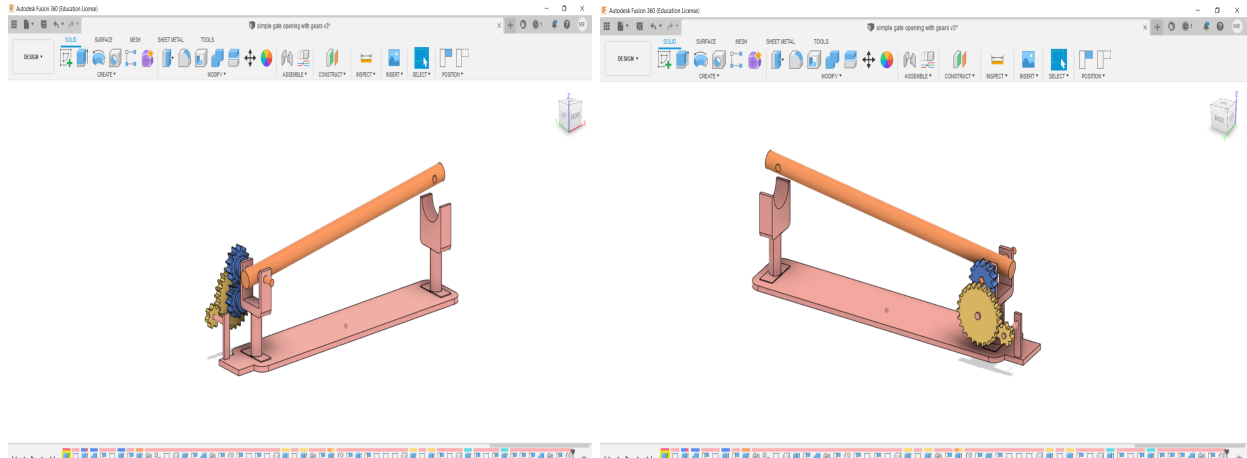
https://www.tinkercad.com/things/ftBUxwcTLn2-red-phoenixarduino/editel?sharecode=kWZybuf_yUKFD38Arrl1R5iPegcUJgx_wLChiYukrCM)



4.A 3d gate design in fusion360(extra feature to my project)

As I am at home and fully online I have used only a motor without connecting to the gate . I am not able to make a physically real gate so I decided to make 3d type gate design in software so that I can express my ideas.

Purpose of using GEARS: actually servo motors have some specified torque and capacity to rotate/lift some loads..if motor is able to lift our desired type of gate then it will be very beneficial and can directly connect shaft of motor with gate with rubber belts...now the problem is what if the motor i bought not able lift gate ??



This problem can be sort by increasing the TORQUE of the motor to desired level with Gear system ,eventually speed of motor gradually decreases ..here we are converting speed to torque, vice versa as per our needs. I linked motion of all gears with motion link mechanism

For this project I designed the above gate mechanism,instead we can also use a slider crank mechanism.

Applications:

- 1. It is very much useful in theatres,shopping malls,trains,buses in covid times.*
- 2.As it runs fully automatically no need of man work.*

Thank you!