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Analysis of Mask Wearability Via Feature Based & Image Based Approach Using Image Processing

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Abstract: ***The world is fighting the Covid19 pandemic. There are so many essential equipment needed to fight against Coronavirus. One of such essentials is Face Mask. Firstly, face masks were not mandatory for everyone but as the day progresses scientists and Doctors have recommended everyone to wear face masks. Now To detect whether a person is wearing Face Mask or not, we will use Face Mask Wearability technique. Face Mask wearability Platform utilizes Image Processing to perceive if a person does/doesn't wear a mask. The application can be associated with any current or new IP cameras to identify individuals with/without a mask. Face Detection Methods are Feature Based Approach & Image Based Approach.***
Keywords: Python, IP Camera, Deep Learning, Image Processing, Machine Learning, Computer Vision, Convolution Neural Network.

I. INTRODUCTION

Ever since COVID-19 became a pandemic, the world has been looking for ideas and ways to stop its spread. Because the basic rule to control the expansion of corona virus is to maintain social distancing and always wearing a mask when visiting crowded or public places[1]. The infection directly affects the lung cells through the patient's respiratory tract, and causes the infection to recur, and creates an extremely unique problem. Its ability to concentrate over time is alarming and time it provides for treatment is abnormally limited.

A. Symptoms of COVID -19

The most common demonstrations of COVID are cough, loss of smell or taste, fatigue, sore throat, fatigue, dry cough, fever, storm, malaise and migraine. The rapid spread of the new coronavirus can cause severe muscle pain, and will bring stigma to individuals with weak and indigestible bodies without any problems. Countless people died in the dreadful phase of covid-19, whose lungs and various parts of the body were extremely tired. Doctors are dealing with various varieties of drugs and medicines around the world to find an effective way to limit exposure to extremely dangerous stages of infection.

B. Research towards COVID-19

In the fight against COVID-19, three well-known networks can be found in more specific promises with the help of advanced innovations. The computerized task can collect X-ray data and CT scan information to test the ability of COVID-19 with the help of artificial consciousness (AI). Given the limited ability of AI and AI People's Group to focus on time by performing various complex calculations, the prediction of COVID-19 holds great potential. Another academic network of numismatic experts and genuine executives deconstructed the fascinating spread model of corona extension to discover the need for different infection methods and social distancing.

C. Pipeline Overview

In this project we will see many important aspects of face mask detection not only for Covid19 cases but also for other regular cases. The goal of face detection is to determine if there are any faces in the image or video. If multiple faces are present, each face is enclosed by a bounding box and thus we know the location of the faces.

Human faces are difficult to model as there are many variables that can change for example facial expression, orientation, lighting conditions and partial occlusions such as sunglasses, scarf, mask etc. The result of the detection gives the face location parameters and it could be required in various forms, for instance, a rectangle covering the central part of the face, eye centres or landmarks including eyes, nose and mouth corners, eyebrows, nostrils, etc.

There are two main approaches for Face Detection:

1) Feature Base Approach
2) Image Base Approach

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D. Related Works

Projects for the same purpose have become need of the hour and thus widely experimented and executed due to the current ongoing COVID-19 pandemic. A study by Adnán Kabani and Université de Haute-Alsace, proposed a method to use a Haar-Cascade-based feature detector to individually detect the presence of a nose and mouth from an identified face using face detection technique[III]. They detailed that no mask is worn if we can successfully identify a mouth from a face, if we can identify the nose then the mask is worn incorrectly and if we cannot identify the nose or mouth from the identified face then the mask is worn correctly. This method is effective and intuitive, but has serious limitations: it can only process the entire face and one can easily fool the detector by covering Their mouth and nose with the help of hands.

Sujata and Chatterjee[V] proposed a model that could be effective in estimating the spread of COVID-19 using linear regression, multilayer perceptron and vector auto regression models in Kaggle data for COVID-19 Case in India.

Another approach is proposed by Chandrika Dev in her GitHub project[II]. Similar to our first proposed pipeline, it uses a Caffe-based face detector in conjunction with MobileNetV2 optimized for mask usage classification. He managed to achieve a good f1 score of 0.93 in the classification. However, it used a much smaller dataset of 4095 images, which may not be of the different races, genders and types of facial gestures that the system might fit in real-world settings. Its data is also divided into only two categories: with mask and without mask. So, no one can trace by the model if they are wearing the wrong mask (i.e., vulnerable organs, mouth and nose are not covered properly could not be detected).

II. APPROACHES

A. Feature Based Approach

Objects are usually recognized by their unique features. There are many features in a human face, which can be recognized between a face and many other objects. It locates faces by extracting structural features like eyes, nose, mouth etc. and then uses them to detect a face.

Typically, some sort of statistical classifier qualified then helpful to separate between facial and non-facial regions.

In addition, human faces have particular textures which can be used to differentiate between a face and other objects. Moreover, the edge of features can help to detect the objects from the face. In the coming section, we will implement a feature-based approach by using OpenCV[XIII] and evaluation using NumPy[XV].

B. Image Based Approach

In general, Image-based methods rely on techniques from statistical analysis and machine learning to find the relevant characteristics of face and non-face images. The learned characteristics are in the form of distribution models or discriminant functions that is consequently used for face detection.

In this method, we use different algorithms such as Neural-networks, HMM, SVM, AdaBoost learning. In the coming section, we will see how we can detect faces with MTCNN or Multi-Task Cascaded Convolutional Neural Network, which is an Image-based approach of face detection.

III. LITERATURE SURVEY

A new facial recognition system has been developed using principal component analysis (PCA) and complex neural networks. This experiment was performed with the differential algorithm, multilayer perceptron, innocuous base model, and support vector machine. This facial recognition journal provides the challenge of identifying multi-dimensional patterns and how they can be overcome in future research.

IV. DATA PROCESSING

Before Training & Testing Our Model, we are going to do Data Processing. Here first of all we will converts all the images available in our dataset folders into arrays. Using these arrays, we will create our deep learning module. We will import all required tools from respective modules. Thereafter we will create variables and objects to process the data and give us the final results as labels.

We are going to use this code and our dataset to build a CNN model using TensorFlow to detect if a person is wearing a face mask by using the webcam of PC.

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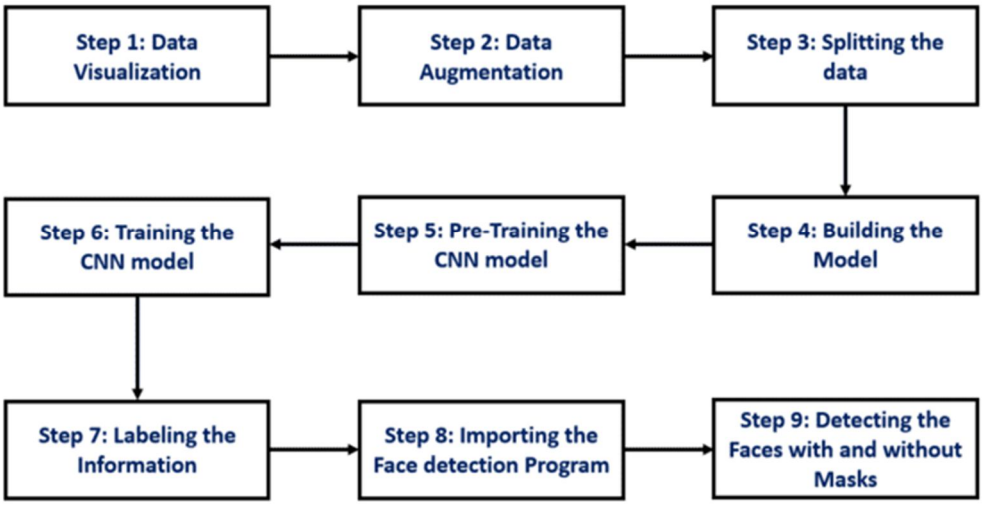

Fig1. Programming

V. DESIGN METHODOLOGY

We successfully developed a clever framework for finding masks in this document. With the number of Covid-19 cases declining, better jobs are being opened with half or full staff all around, specially at places with low risks. Educational institutions are also contemplating opening. Systems can be installed at the entrances of companies, schools, government, private offices and/or any place of interest to screen people without masks. If the system detects the face of a person without a mask or mask not worn properly, it will generate a message that will persuade them to wear the mask. The block diagram of the advanced structure is shown in Figure 1.

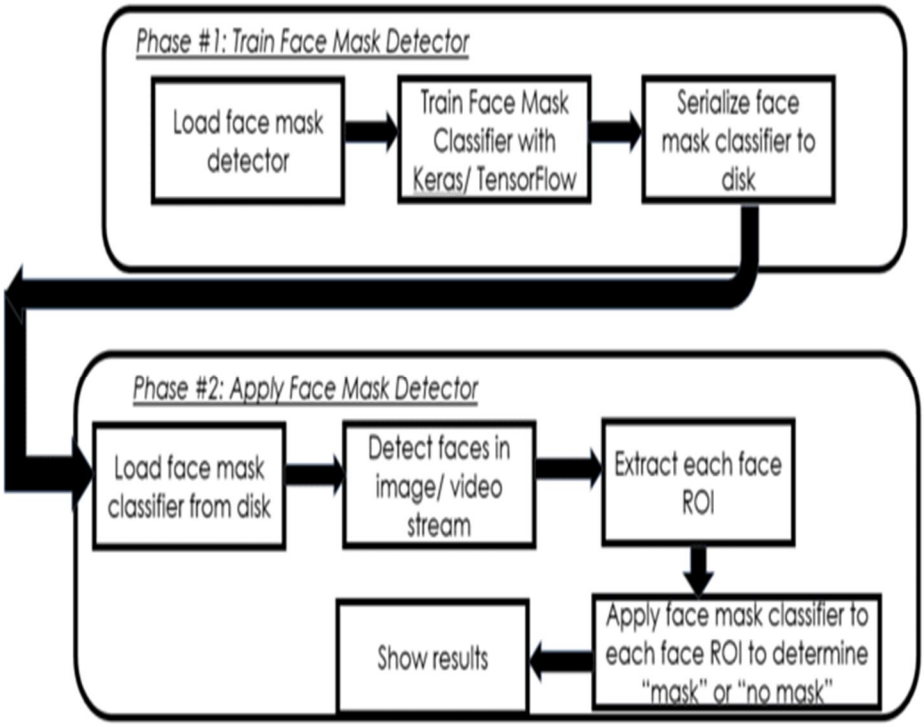

Fig2. Block Diagram

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A. Proposed Workflow

In order to detect if people under test are wearing a face mask to protect themselves, we made a less-complicated yet effective Convolutional Neural Network (CNN) model using libraries such as TensorFlow with Keras[XIV] and the OpenCV. Every dimension of the work is being described below.

B. Deep Learning Architecture

The architecture using deep learning starts to differentiate and label many important non-linear characteristics from the given examples. Therefore, this educated architecture is used to estimate the trained pattern in problems pose to it other than examples feeded using the algorithm shown in Figure 2.

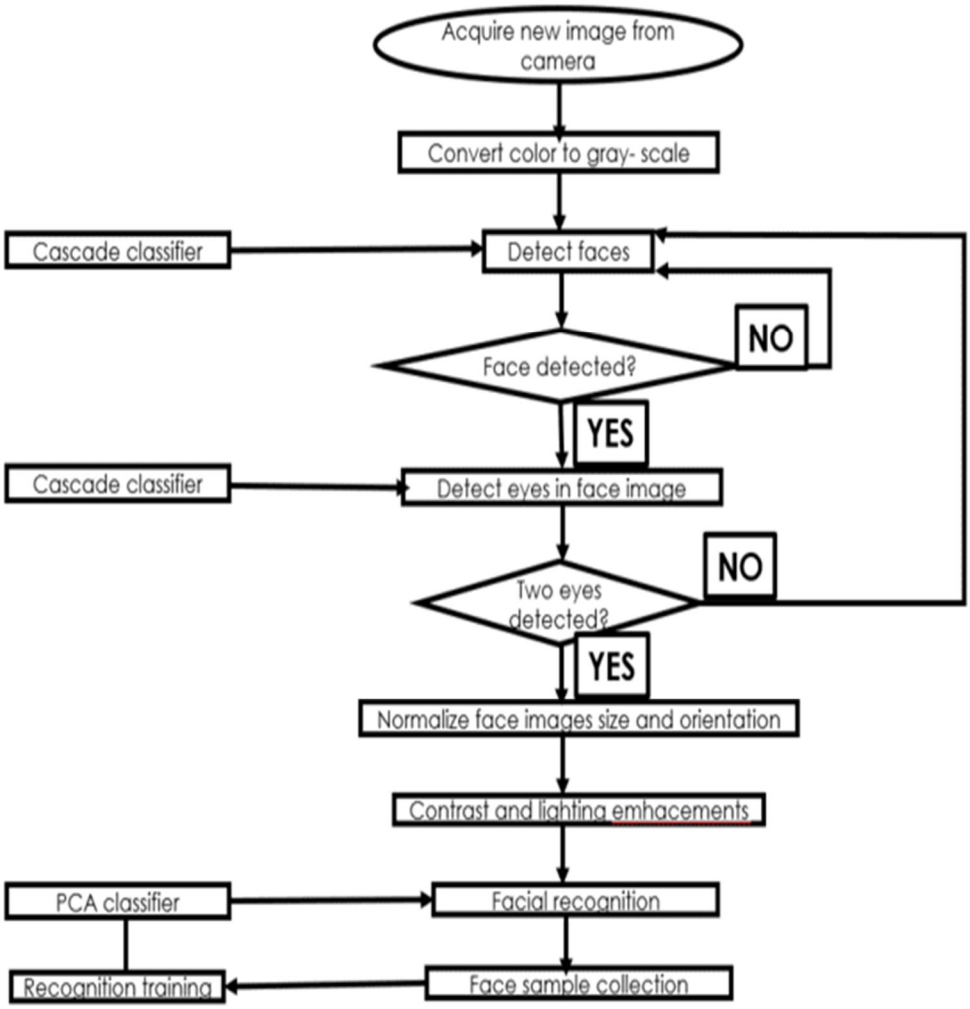


Fig3: Flow Chart

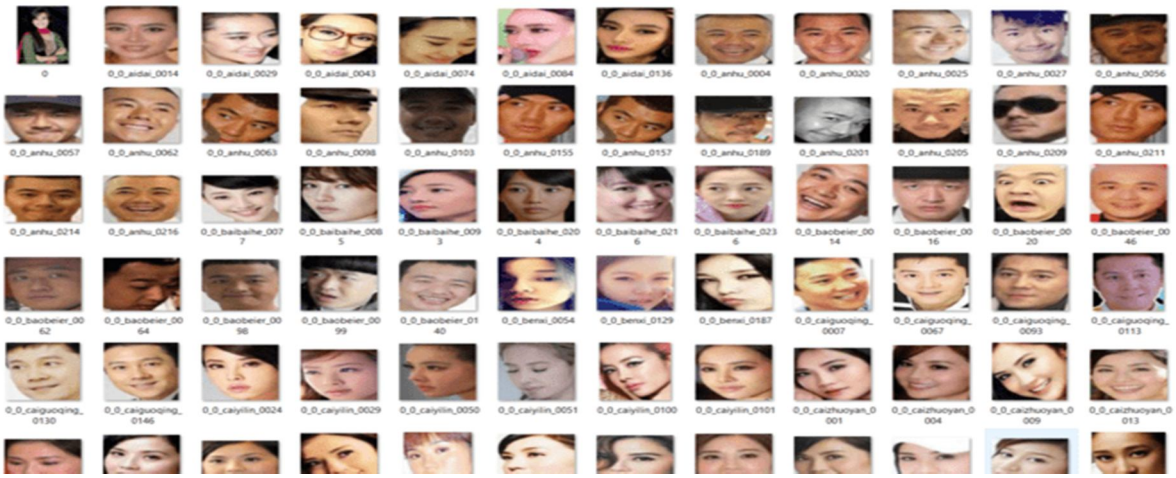
C. Image Processing

The Haar cascade classifier will detect the input in the form of video from the inbuilt-camera of the device. Video/ Images apprehended by the system's webcam require pre-processing before moving down to the succeeding steps. During the pre-processing phase, the image is converted to a grayscale image because the RGB color image contains lots of unnecessary data which is not needed for mask detection. Next, we resized the image (224 x 224) to keep the input image uniform throughout the architecture. The then images obtained are subjected to normalization, resulting in the pixel values to range between 0 and 1. The normalization aids the learning algorithm to grasp faster and acquire the required features from the images.

D. Dataset Collection

We have gathered various images for training our model working on deep learning. The structure of the learning strategy depends heavily on CNN. To train our deep learning architecture and thereafter test, data were collected from source. Only images of faces constitute our dataset. It has 1915 items under with-masks category and 1918 images under without-masks category. 90% of the images in each class are used for training purposes, and the rest 10% collection in each dataset are used for testing purposes. Fig. 3 demonstrates various items under each category viz with- and without- mask.

(a) With Mask



(b) Without Mask

Fig4: Dataset Bifurcation in Categories (a) With-Mask, (b) Without-Mask

E. Architecture Development

The learning model uses the concepts of CNN, which is crucial for identifying patterns in images. Data from both classes are needed to be viewed by the neural network. A network consists of an input layer, multi hidden layers, and an output layer. Hidden layers have multiple convolution levels. The features extracted from CNNs are used by many dense neural networks for the purpose of classification. Each of the 32 formations has three pairs of convection levels and then the highest pooling level. The convolution layer consists of 100 kernels of a 3x3 window size and 2×2 window size of max pooling level. This layer will combine the results of the previous convolution level and select the highest value in that 2x2 window. It reduces the local level of performance and thus reduces the number of parameters. As a result, the calculations for the network become simpler. The output of the resolution level will be flattened and converted into a 1-D array. So, there is a dropout layer and two dense layers. The dropout layer prevents network overfitting by removing the exclusion level drive. The dense layer consists of a series of neurons, each of which learns non-linear properties. The flat result will be given in the first dense layer of 50 knots. Then finally another dense layer containing two nodes as it has two classes with mask or without mask.

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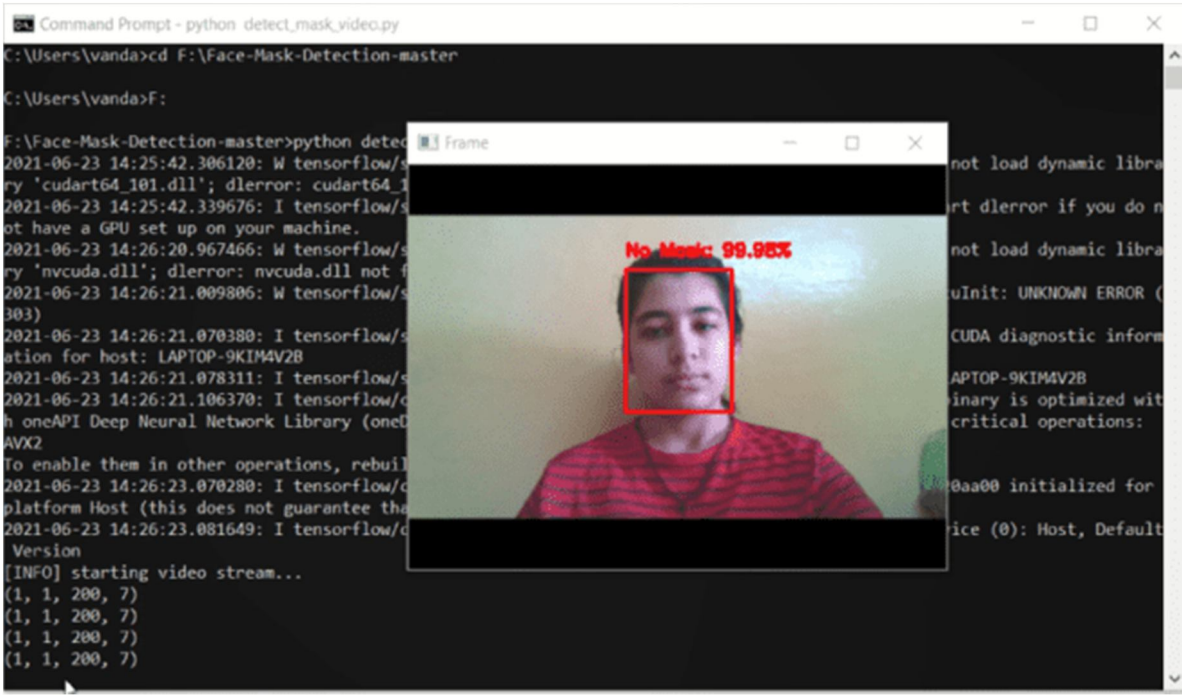
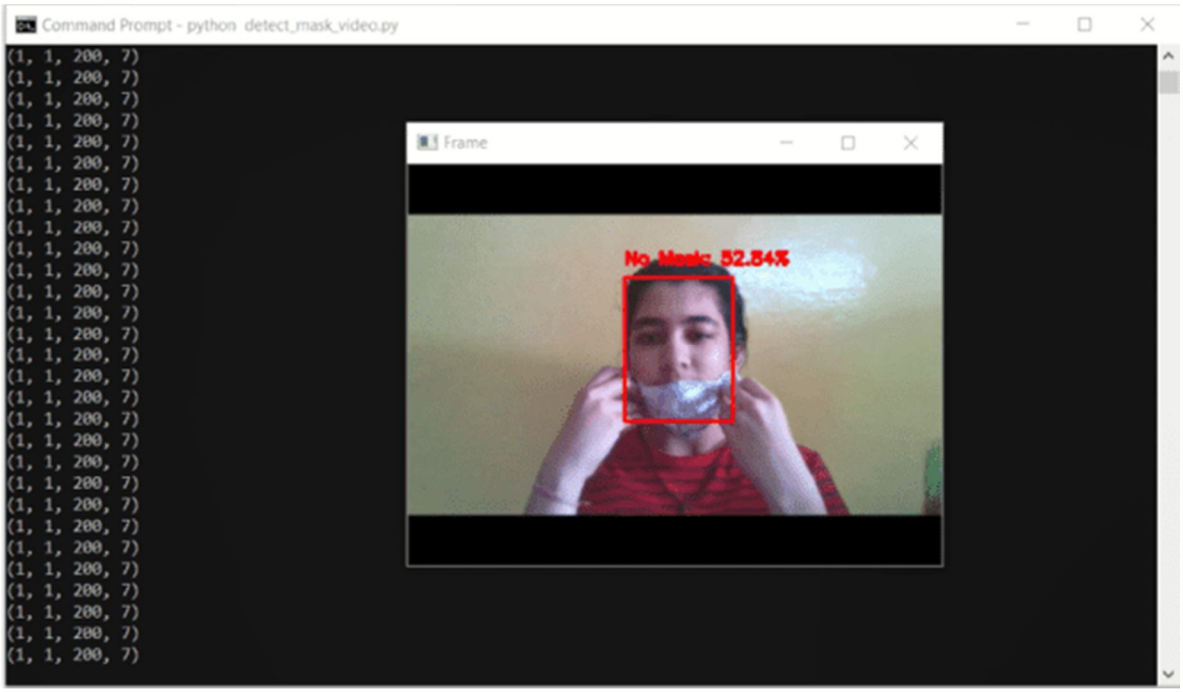
F. Alert Generation

The motivation of our model is to find those people who do not wear mask while going out. The learning architecture leads output on the input image and classify the image into with- or without- mask categories. If a person without a mask is found, a message will be displayed for not wearing mask or for not applying the mask properly and if a person wears mask properly then the further processes can take place. So, if everyone wears a mask properly, he/she will be safe from the corona virus. In this way, our system will help in limiting the growth of COVID-19.

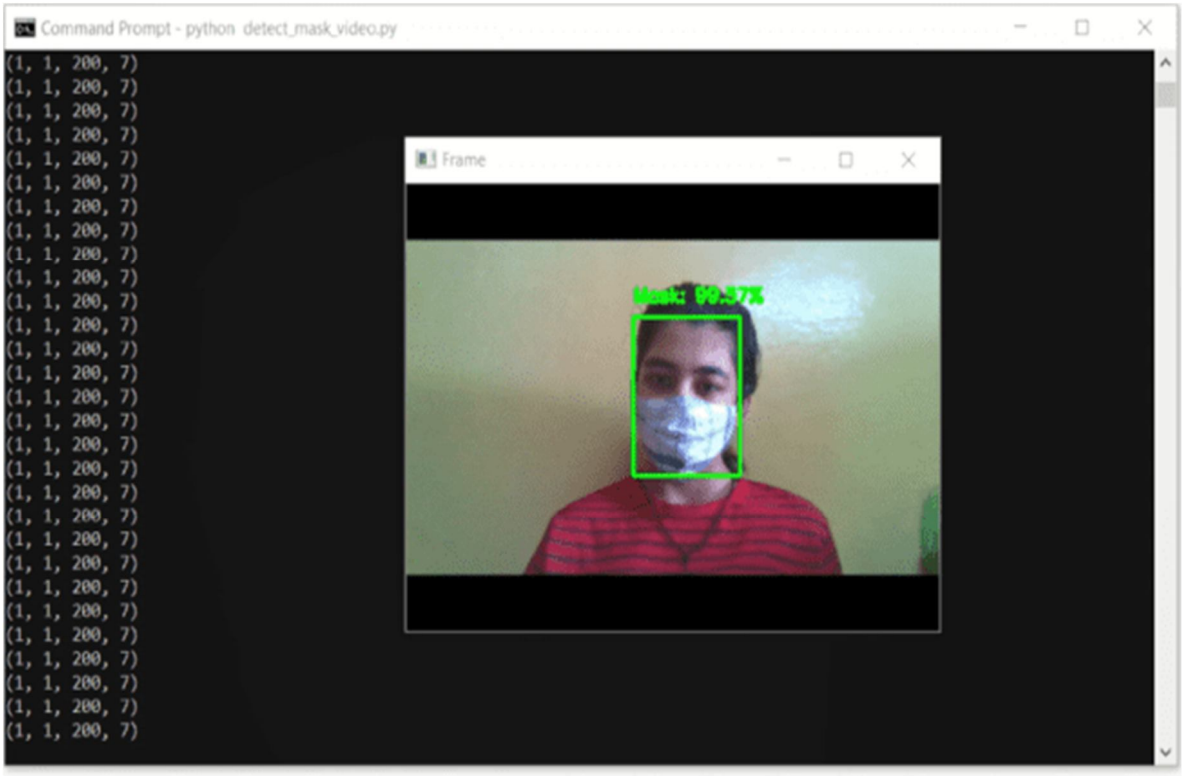
VI. RESULT ANALYSIS



(a): Without Mask (Single) Video Snapshot

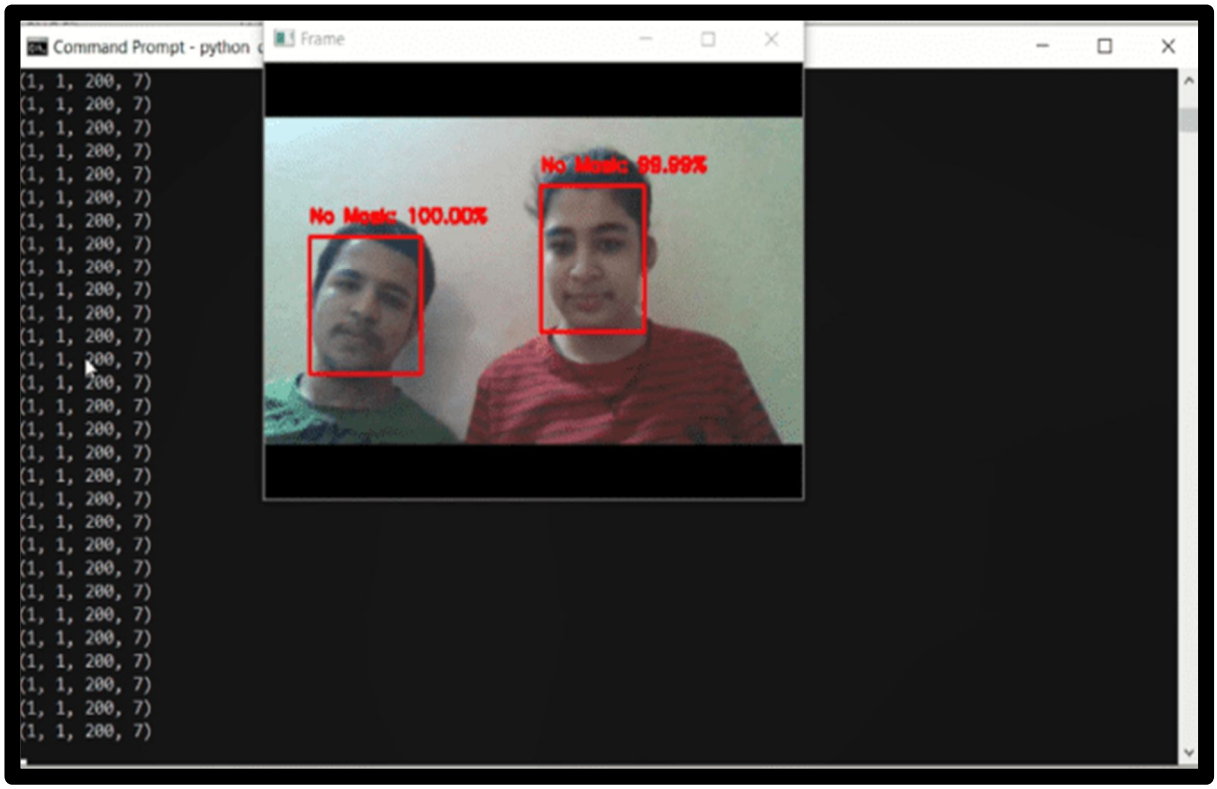


(b): Improper Mask (Single) Video Snapshot

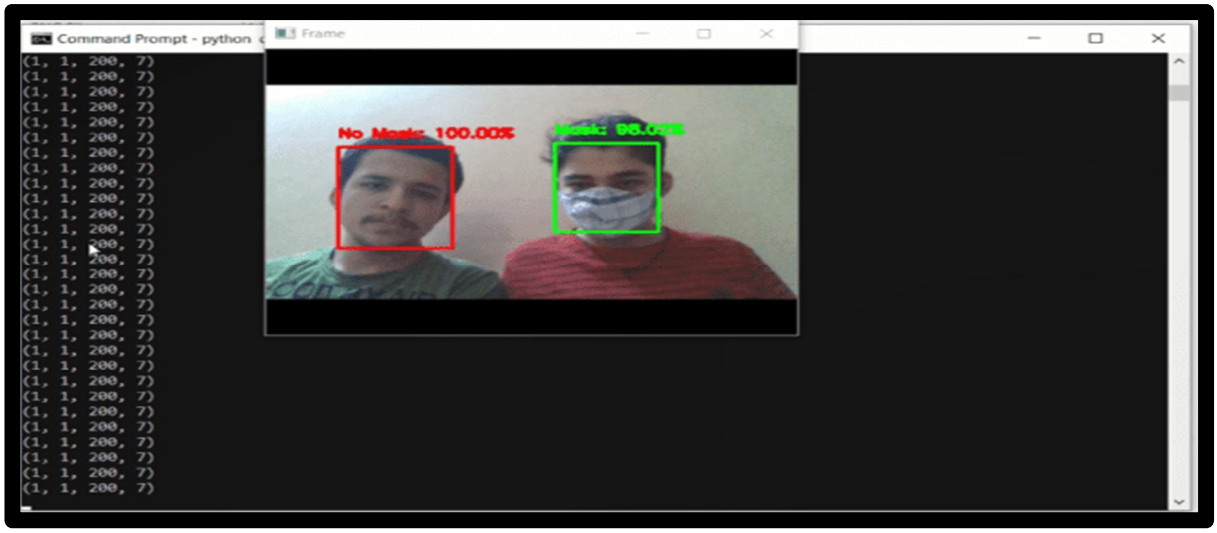


(c) With Mask (Single)

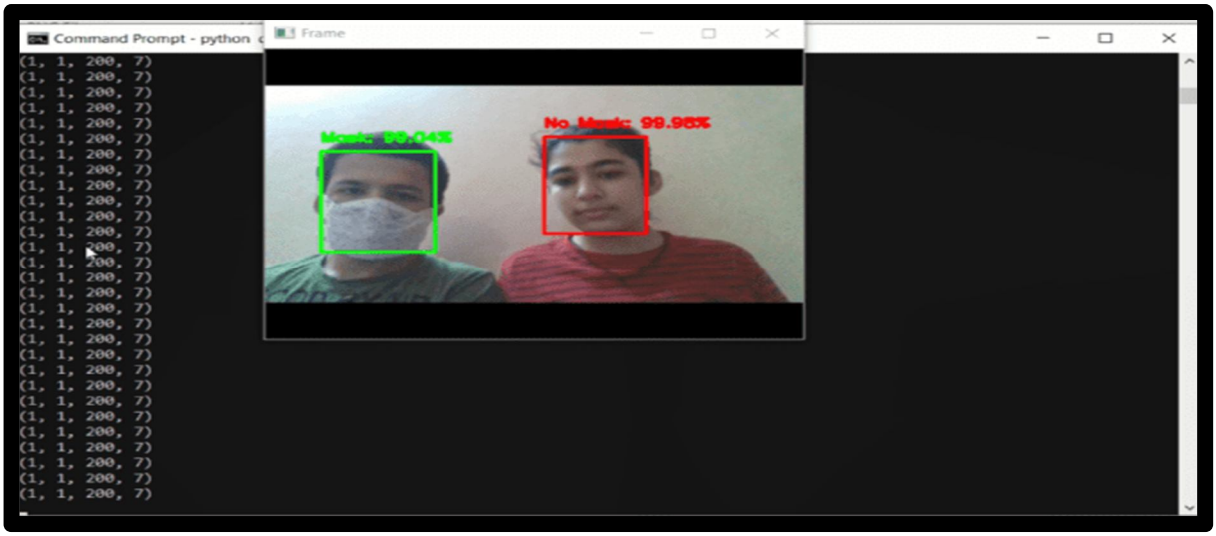
Fig5 (a-c): Video Snapshots for single input



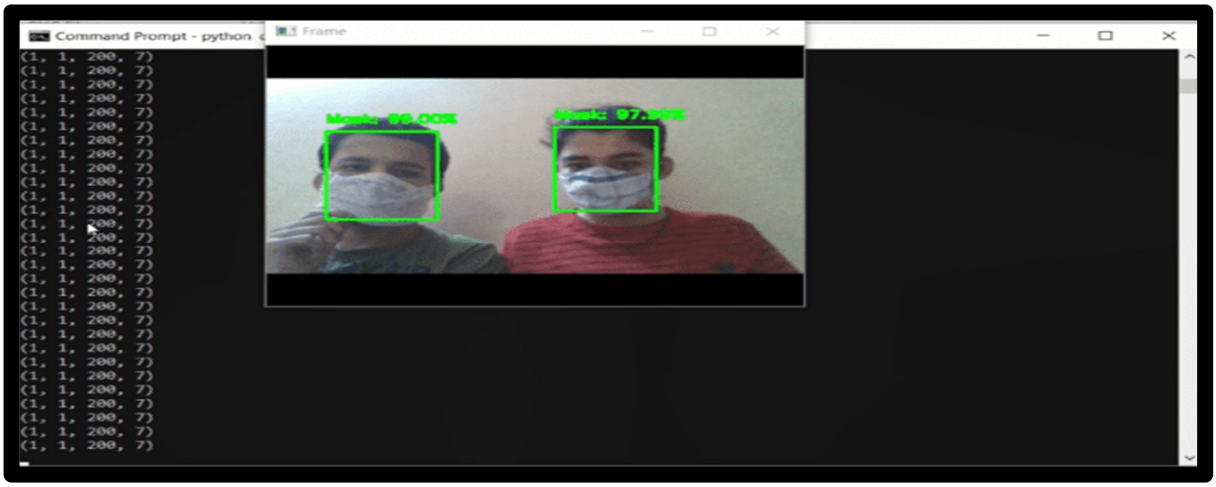
(a) Without Mask (Multiple)



(b) With & Without Mask I (Multiple)



(c) With & Without Mask II(Multiple)



(d) With Mask (Multiple)

Fig6 (a-d): Video Snapshot for Multiple Inputs

VII. FURTHER WORKS

1) *Airports:* The Face Mask Detection System can be used at airports to detect travelers without masks. Face data of travelers can be captured in the system at the entrance. If a traveler is found to be without a face mask, their picture is sent to the airport authorities so that they could take quick action. If the person's face is already stored, like the face of an Airport worker, it can send the alert to the worker's phone directly.
2) *Hospitals:* Using Face Mask Detection System, Hospitals can monitor if their staff is wearing masks during their shift or not. If any health worker is found without a mask, they will receive a notification with a reminder to wear a mask. Also, if quarantine people who are required to wear a mask, the system can keep an eye and detect if the mask is present or not and send notification automatically or report to the authorities.
3) *Offices:* The Face Mask Detection System can be used at office premises to detect if employees are maintaining safety standards at work. It monitors employees without masks and sends them a reminder to wear a mask. The reports can be downloaded or sent an email at the end of the day to capture people who are not complying with the regulations or the requirements.
4) *Traffic Systems:* It can be used at the traffic lights and signals in order to check whether people are wearing masks or not and an automatic database can be created supporting the traffic police to make challans for penalties.

VIII. CONCLUSION

Analysis of Mask Wearability Via Feature Based & Image Based Approach Using Image Processing is a project born to serve the world in times of prevailing crisis during COVID-19 pandemic. It is a great tool which can help all the working people to work under less pressure. It reduces the threat of advancing the highly contagious virus by displaying whether the person is wearing/ not wearing a mask or is not wearing it properly. Thus, minimizing human effort at each stage of entry can provide a safe way to control the rules set by the government.

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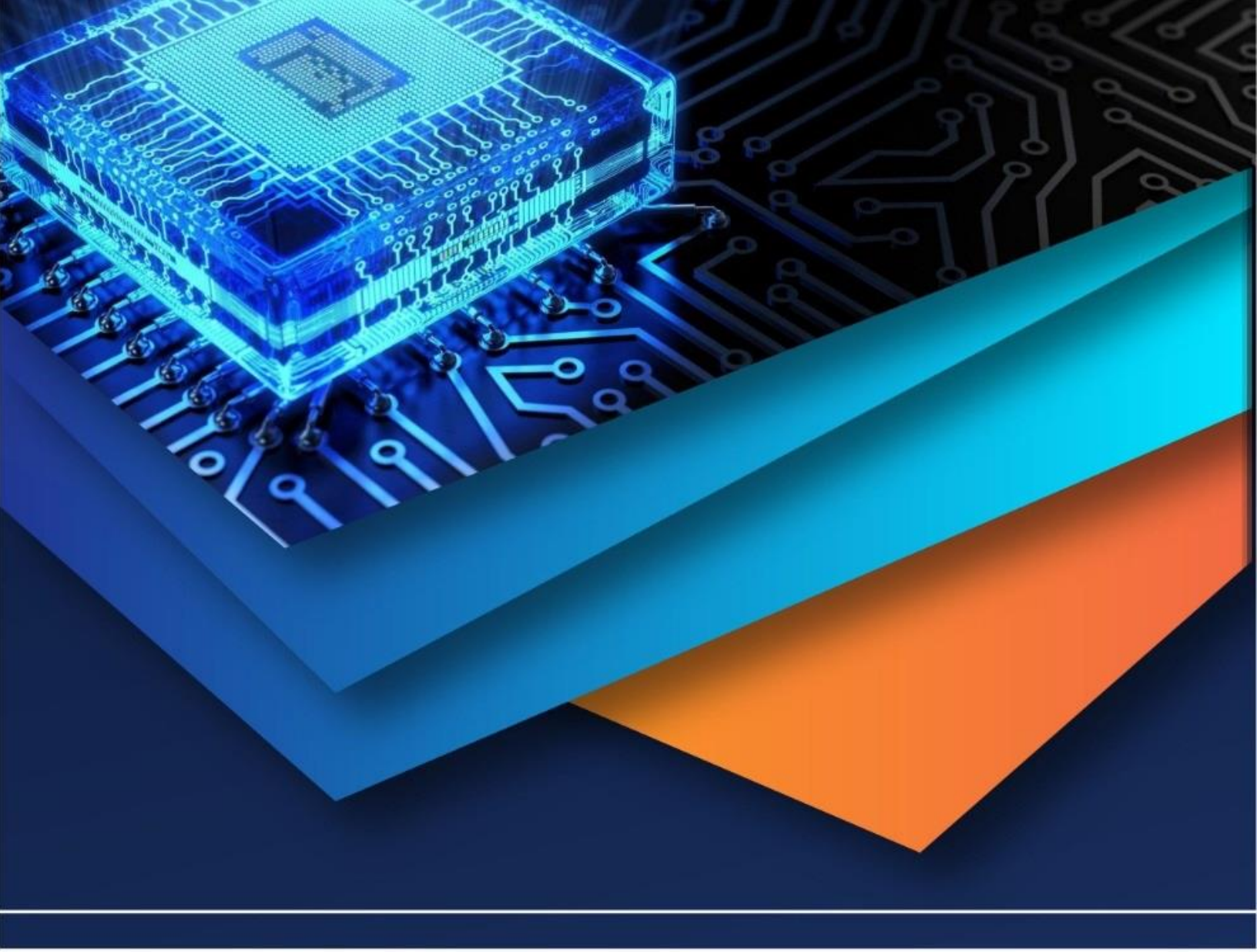

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