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# Face Mask Detection System Using Python and OpenCV

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**Abstract:** *The present scenario of COVID-19 demands an efficient face mask detection application. The main goal of the project is to implement this system at entrances of colleges, airports, hospitals, and offices where chances of spread of COVID-19 through contagion are relatively higher. Reports indicate that wearing face masks while at work clearly reduces the risk of transmission. It is an object detection and classification problem with two different classes (Mask and Without Mask). A hybrid model using deep and classical machine learning for detecting face mask will be presented. A dataset is used to build this face mask detector using Python, OpenCV, and TensorFlow and Keras. While entering the place everyone should scan their face and then enter ensuring they have a mask with them. If anyone is found to be without a face mask, beep alert will be generated. As all the workplaces are opening. The number of cases of COVID-19 are still getting registered throughout the country. If everyone follows the safety measures, then it can come to an end. Hence to ensure that people wear masks while coming to work we hope this module will help in detecting it.*

## I. INTRODUCTION

A new strain of virus was identified in humans, known as novel coronavirus (nCoV), which was never previously been identified in humans. Coronaviruses (CoV) are a wide group of viruses which cause illness that range from basic colds to infections like Middle East Respiratory Syndrome (MERS) and severe acute respiratory syndrome (SARS). The first infected patient of coronavirus was found in December 2019. The habit of wearing face masks while stepping out is rising due to the COVID- 19 corona virus epidemic. Before Covid-19, masks were worn by people to protect their health from air pollution. Scientists have concluded that wearing face masks works on decreasing COVID-19 transmission.

In 2020, the rapid spread of COVID-19 led the World Health Organization to declare COVID- 19 as a global pandemic. The virus spreads through close contact of humans and in crowded/overcrowded places. Among them cleaning hands, maintaining a safe distance, wearing a mask, refraining from touching eyes, nose, and mouth are the main, where wearing a mask is the simplest one. The solution can be to detect the people not wearing mask and informing their authorities. the face mask detection is a technique to find out whether the person is wearing a mask or not. In medical applications Deep learning techniques are highly used as it.

## II. LITERATURE REVIEW

The face mask detection model is very useful for public places like hospitals, airports, offices where a huge number of people travel from one place to another.

[1] In hospitals, we can embed this model in pre-installed CCTV cameras. If the workers of the hospitals are found without mask alarm will ring and the higher authorities of the hospital can take necessary actions against the worker.

[2] In airports, the entrance and exit gate of the airport should have this model. The System is prepared to recognize precisely whether an individual is wearing a mask or not.

[3] At the point when the calculation recognizes an individual without a mask, caution ought to be produced to alarm the individuals around or the concerned specialists close by, so fundamental activities can be taken against such violators.

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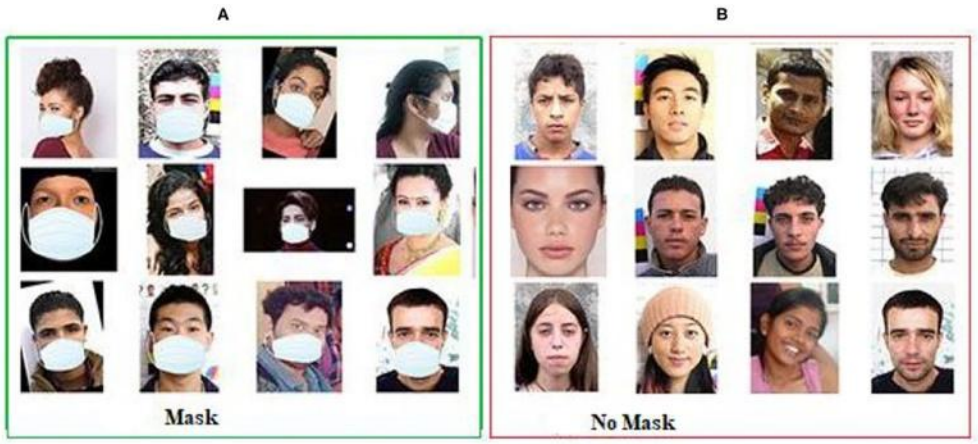
[4] Not only for Covid19 pandemic, any place and at whatever point facemask is commanded to relieve any air-borne illnesses, passage, what's more, leave access frameworks can be incorporated with such innovation to help in diminishing the spread of infection.
[5] The cameras are used to capture images from public places; then these images are feed into a system that identifies if any person without face mask appears in the image. If any person without a face mask is detected then this information is sent to the proper authority to take necessary actions.
[6] The trained architecture [Table 1] with multiple layers of convolution and max-pooling connected to dense neural network achieved 98.7% accuracy on distinguishing people with and without a facial mask for previously unseen test data. [7] The trained model showed 98.7% accuracy and AUC of 0.985 on the unseen test data.

## III. PROPOSED SYSTEM

**Dataset Collection**




Images from various sources are used to build a dataset. The size of datasets can be expanded by the application of data enhancement techniques. The photographs are stored in two files, “training dataset” and “test dataset,” each of which comprises 80 and 20% of the images, respectively. Bounding boxes, sometimes known as “data annotations,” are created around an area of interest using a variety of methods. Labelling pictures as “mask” or “NO mask” will be done using the Labelling tool in the proposed system.

**Image Enhancement**:
To draw attention to the foreground elements, the image is improved through preprocessing methods and segmentation techniques.

**Model Implementation:**
We ran the tests on an Intel Core i7 processor with an Nvidia GTX 1,080 graphics card and Windows 10. Python 3.5 was used as the programming language in this project.

**Training the Model:**
To distinguish between those wearing “masks” and those who aren't, the model is trained in an online GPU environment called Google Colab. A folder referred to as “the trained folder” is used for training purposes.

**Prediction:**
Using the test folder, the model is tested for its ability to identify and classify masks and no-masks that were found in the original photos.

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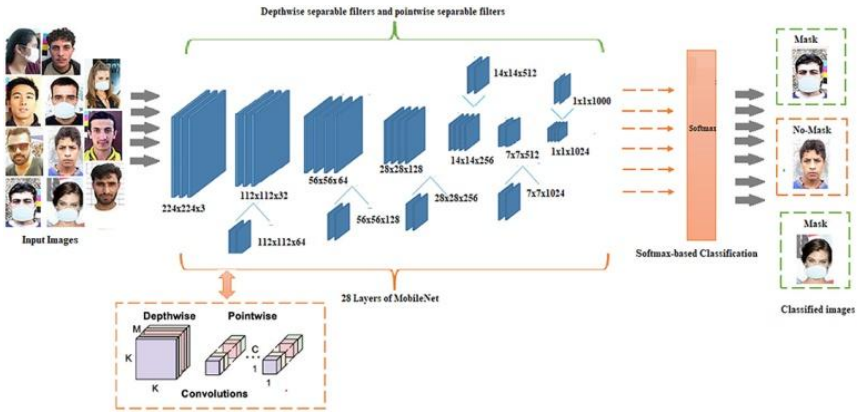


**Incorporated Packages**

**TensorFlow:**

TensorFlow [18], an interface for expressing machine learning (ML) algorithms, is utilized for implementing ML systems into various areas of computer science, including sentiment analysis, voice recognition, geographic information extraction, computer vision, text summarization, information retrieval, computational drug discovery and flaw detection to pursue research [18]. The proposed model, the whole Sequential CNN architecture (consists of several layers) uses TensorFlow at backend. It is also used to reshape the data in the data processing.

**Keras:**

Keras [19] gives fundamental reflections and building units for creation and transportation of ML arrangements with high iteration velocity. It takes full advantage of the scalability and cross-platform capabilities of TensorFlow. The core data structures of Keras are layers and models [19]. All the layers used in the CNN model are implemented using Keras, the conversion of the class vector to the binary class matrix in data processing, helps to compile the overall model.

**OpenCV:**

OpenCV (Open-Source Computer Vision Library) [20], is an open-source computer vision and ML software library, is utilized to differentiate and recognize faces, recognize objects, group movements in recordings, trace progressive modules, follow eye gesture, track camera actions, expel red eyes from pictures taken utilizing flash, find comparative pictures from an image database, perceive landscape and set up markers to overlay it with increased reality and so forth [20]. The proposed method makes use of these features of OpenCV in resizing and color conversion of data images

## IV. THE PROPOSED MODEL

The proposed method consists of a cascade classifier and a pre-trained CNN which contains two 2D convolution layers connected to layers of dense neurons. The algorithm for face mask detection is as follows:

**Data Pre-Processing**

Data preprocessing involves conversion of data from a given format to much more user friendly, desired and meaningful format. It can be tables, images, videos, graphs, etc. This organized information fit in with information model and captures relationship between different entities [6]. The proposed method deals with image and video data using Numpy and OpenCV [20].

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Algorithm 1: Face Mask Detection

Input: Dataset including faces with and without masks
Output: Categorized image depicting the presence of face mask
**For** each image in the dataset do
    Visualize the image in two categories and label them
    Convert the RGB image to Gray-scale image
    Resize the gray-scale image into 100 X 100
    Normalize the image and convert it into 4 dimensional array
**End**
**For** building the CNN model do
    Add a Convolution layer of 200 filters
    Add the second Convolution layer of 100 filters
    Insert a Flatten layer to the network classifier
    Add a dense layer of 64 neurons
    Add the final dense layer with 2 outputs for 2 categories
**End**
Split the data and train the model

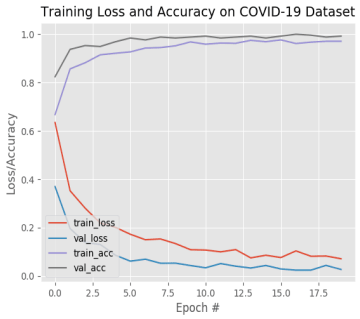
## V. CONVOLUTIONAL NEURAL MODEL

CNN is a type of deep learning model for processing data that has a grid pattern, such as images, which is inspired by the organization of animal visual cortex and designed to automatically and adaptively learn spatial hierarchies of features, from low- to high-level patterns. CNN is a mathematical construct that is typically composed of three types of layers (or building blocks): convolution, pooling, and fully connected layers. The first two, convolution and pooling layers, perform feature extraction, whereas the third, a fully connected layer, maps the extracted features into final output, such as classification. A convolution layer plays a key role in CNN, which is composed of a stack of mathematical operations, such as convolution, a specialized type of linear operation. In digital images, pixel values are stored in a two-dimensional (2D) grid, i.e., an array of numbers, and a small grid of parameters called kernel, an optimizable feature extractor, is applied at each image position, which makes CNNs highly efficient for image processing, since a feature may occur anywhere in the image. As one layer feeds its output into the next layer, extracted features can hierarchically and progressively become more complex. The process of optimizing parameters such as kernels is called training, which is performed so as to minimize the difference between outputs and ground truth labels through an optimization algorithm called backpropagation and gradient descent, among others.

**Software and Hardware:**

8 Gb Ram is used to train the CNN model. Single programming language used in the proposed system. Python 3.6 is used to build the CNN model and for the web application development, to make user compatible to use the system. Efficient library of Python i.e, 'keras and Tensorflow' is used.

## VI. RESULT



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As you can see, we are obtaining **~99% accuracy** on our test set.
Looking at above figure, we can see there are little signs of overfitting, with the validation loss *lower* than the training loss.
Given these results, we are hopeful that our model will generalize well to images *outside* our training and testing set.

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