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# Face Mask Identification Using a Machine Learning Approach

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**Abstract:** The COVID-19 epidemic has triggered a global healthcare emergency. Because it frequently spreads through newly created droplets from a coronavirus-infected individual, this virus is harmful to other people. Public spaces have a larger risk of transmission. Wearing a facemask in public is one of the greatest methods to avoid becoming sick, according to the World Health Organization (WHO). In this project, we present a technique that makes use of TensorFlow and OpenCV to identify human face masks. A border box around the subject's face indicates whether or not a mask is present. If a person's face is stored in the database, it can recognise their name if they are not wearing a mask, and if it does, an email alerting them to the issue and advising them to take the necessary measures will be sent to that individual.

**Keywords:** Machine Learning, OpenCV, Classifiers, Convolution Neural Networks (CNN), TensorFlow.

## 1. Introduction

COVID-19 significantly affects human survival. Millions of individuals lost their lives as a result of the epidemic, which also had an impact on billions more. Most commercial enterprises, along with those in the fields of education, the economy [1,], religion, travel, employment, entertainment, food security, and other sectors, all had a negative impact. The Black Death, which almost killed 60% of Europe's population in the 14th century, follows next. Before the virus grows in the body of its host and begins to impact them after infection, it spreads to nearly everyone who comes into touch with the infected person for around 14 days. As a result, it is particularly difficult to monitor the [2] spread of COVID-19. Droplets released while coughing or sneezing are the main means by which COVID-19 is spread. Everyone who comes into direct and close touch with an infected person contracts the virus (within a meter). As a result, the infection swiftly spreads across the populace. Since the nationwide lockdowns were released, it is far more difficult to keep track of and treat the virus [3]. Face masks can be used to inhibit the transmission of viruses. A face mask is 96% effective at stopping the transmission of viruses, according to research. However, because some people could decide not to wear masks, it is challenging to confirm if everyone is. In these situations, computer vision will be quite helpful. For telling if someone is wearing a face mask, there are no reliable apps [4]. This makes it even more crucial to develop a reliable way of identifying face masks on individuals in order to ensure safety in places like highly populated areas, residential neighborhoods, big factories, and other establishments [5]. This project combines machine learning classification with OpenCV [6] and TensorFlow to recognize facemasks on humans. These are used to predict a set of data points' class, target, labels, and categories. The categorization category contains. During supervised learning, targets are given input data. Numerous applications, such as target marketing, spam detection, and medical diagnostics, make use of them [7].They employ a mapping function (f) from discrete output variables (Y) to input variables (X).

## 2. Related Work

To identify faces wearing masks, the authors in [8] employed the PCA (Principal Component Analysis) technique, which is crucial in the security business. One of the few literary works that explore the issue of identifying human faces disguised behind masks. They discovered that the presence of a facemask reduces the accuracy of recognizing a human face by 70%. The [9] developers have created a method to recognize when someone is wearing a facemask. Three kinds of facemask usage situations might be made: correct facemask use, improper facemask use, and no facemask use. This technique had a detection accuracy of above 98 percent. In [10], the researchers introduced a Generalized Intersection over Union (GIoU) method based on Mask R-CNN for face recognition. They devised this method to reduce background noise by accurately recognizing the face in place of the bounding box, which adds noise to the characteristics of the face and reduces the accuracy of detection. Nicolae-Cătălin Ristea and Radu Tudor Ionescu [11] proposed a cutting-edge data augmentation technique for mask recognition from speech. Original and translated utterances that had been transformed into spectrograms were supplied as inputs to a range of ResNet neural networks with varied depths. In order to remove a face mask from a face and recreate the face without the mask, the authors of [12] employed the CelebA dataset and a GAN-based network with two discriminators. Conventional techniques have proven beneficial for this purpose, including the Histogram of Gradients [14] and Haar Cascade [13]. They provide an alternative to feature engineering, although they perform less well overall than contemporary neural networks in terms of accuracy and speed. These days, CNN-based object identification algorithms are frequently used for similar tasks. They can be divided into two groups: Multiple-Stage Detectors. The detecting process is broken down into many phases by these detectors. Using a selective search and a dual-stage detector like the RCNN [15], you may get a list of interesting places. After that, each region's CNN feature vectors are individually deleted. Single-Stage Detectors, a single-stage detector performs detections in a single pass.

These techniques employ a region proposal phase like multi-stage detectors use, which makes them quicker but at the sacrifice of some accuracy. The authors of [16] have developed facial recognition on both masked and unmasked faces using Principal Component Analysis (PCA). If the detected face is covered, however, the accuracy of facial recognition falls to under 70%. In the work in [17], a method for identifying face mask wearing situations was put out. Situations where a face mask should be worn were categorized into three groups: when it should be worn properly, when it shouldn't, and when it shouldn't be worn at all. They choose a picture, identify and crop faces, and then utilize SRCNet [18] to super-resolve and classify the images. The [19] suggested a technique for figuring out whether or not a medical mask is present. The main objectives of this technique were to alert people, particularly medical staff who do not use surgical masks, and to reduce the frequency of false-positive face detections without skipping any medical mask detections. The authors of [20] presented a two-part model. The first component uses ResNet50 [21] to extract features. The classification of face masks is then performed using a number of conventional Machine Learning methods. The authors assessed their system and discovered that Deep Transfer Learning methods will yield better results. The authors came to this conclusion because it takes a long time to create, assess, and choose the top model from a collection of conventional machine learning models. Furthermore, our method separates the challenging job of face mask localization and detection into two less difficult tasks, face detection and masked face categorization. This makes inference quicker and ensures that no masked faces are missed when classifying them. There are several methods used to recognize face masks. To recognize face masks, for instance, [12] used electromagnetic and radiometry methods. The [13] used deep neural networks (ANN) and machine learning techniques to recognize face masks. The edge properties, shape, and blackness of a lesion are taken into account by the artificial neural network to detect the ability normality mask lesions. Linear Discriminant Analysis is used to categorize the informal face mask feature detection using texture and morph metric parameters. In [16], a method for detecting face features was introduced, based on ultrasonic RF time series and SVM Classifier. On 22 participants, the characteristics curve was calculated using the support vector machine (SVM) at 0.86 and the RF classification technique at 0.81.

Nizam et al. [21] created a GAN-based method to get rid of any facemasks they found, synthesize missing facial parts with more accuracy, and rebuild areas. In [19], the authors employ the Darknet-53 for facial recognition (YOLOv3 algorithm). Deep learning's primary building blocks are machine learning and artificial intelligence. It has mostly shown to be more adaptable and create more accurate models when compared to machine learning that was inspired by the operation of brain cells. The authors of [9] developed a mobile phone-based detection method. Three components were taken from the micro-images of face masks that were saved in GLCMs. The KNN approach, which had an overall accuracy of 83.87 percent, identified three outcomes. The programme searched for face masks in micro photos by using a matrix of co-occurrences at different grey levels. The paradigm, however, was constrained to cellphones and was inapplicable to other uses. The authors suggested using a pre-trained MobileNet with the global pooling block that may be used for facial recognition and detection. The pre-configured MobileNet creates a multi-dimensional component map from a shaded picture. Over-fitting is not an issue in the proposed model because it uses an overall pooling block. The capacity of deep learning-based [22] object recognition algorithms to tackle difficult tasks has, in theory, increased over the past several years when compared to shallow models. In research studies, authors have used established standard models like VGG16, Resnet, and MobileNet, which use a lot of memory and computing power. The model was modified in this study to reduce memory use, speed up computation, and increase the accuracy of the model's output. This study presents a face mask detection approach based on deep learning. The recommended approach may be used with security cameras to spot individuals who are not using face masks, therefore preventing the COVID-19 virus from spreading. Shaik and Ahlam [14] employed real-time deep learning to categories and discriminate between emotions, whereas VGG-16 was used to categories seven faces. During the present Covid-19 lock-down period, which halts the proliferation of cases, this technique is successful. Ejaz et al. [23] also used major component analysis to discriminate between those with covered faces and those without. Using the pre-configured MobileNet, a multi-dimensional component map is generated from a shaded picture [24]. Over-fitting is not a problem because the recommended model makes use of an overall pooling block.

## 3. Proposed Work

### 3.1 OpenCV

Computer vision applications generally use the open-source package known as OpenCV [6]. For a wide range of applications, such as object detection, face recognition [25], motion tracking, segmentation, and identification, this covers a large number of algorithms and techniques. This module makes it possible to modify live video feeds and graphics [26] to suit different needs. Python is able to handle the OpenCV array structure for analysis when it is combined with other libraries, such as NumPy. We employ vector space and apply mathematical operations on these characteristics to identify the visual pattern and its numerous features. Real-time applications for improved processing efficiency were the primary consideration when OpenCV was developed. Everything is written in C/C++ that has been optimized to take advantage of multi-core processing.

### 3.2 TensorFlow

It is an open-source machine learning framework for building and training neural networks. It provides a variety of community resources, frameworks, and tools that make it easy to develop and deploy ML-powered apps. Google produced and maintains this, and it was launched in 2015. The Google team created the software library or framework TensorFlow to make machine learning and deep learning principles easy to deploy. For the quick calculation of many mathematical equations, it combines computational algebra and optimization methods. TensorFlow has a tonne of machine learning libraries and is well-documented. It provides several key capabilities and techniques for the same. Based on user input, TensorFlow 2.0 was published in October 2019 and made several changes to the framework to make it more efficient and user-friendly (for instance, by adopting the comparatively straightforward Keras API for model training). A new API makes it simpler to execute distributed training, and support for TensorFlow Lite allows models to be deployed on a wider range of systems.

### 3.3 Dataset Collection

The dataset was taken from the Kaggle Repository and split into training and testing data after processing. The teaching a model to spot masks on faces. The default OpenCV module was used to first collect faces, after which a Keras model was trained to do so. An open CV model was trained to locate the names of people who aren't wearing masks by using the database to find the person who isn't wearing one. This project employs OpenCV, a Caffe-based face detector, Keras, TensorFlow [27], and MobileNetV2 to identify face masks on people. 3835 images make up the dataset being utilized, 1916 of which show people wearing masks and 1919 of which do not. The generated model is trained on the data after splitting the labeled dataset into two halves. The percentage of pictures in a training component is 75%. The remaining portion is used to assess the model's accuracy and contains the final 25% of pictures. Once trained, the model may be used to recognized facemasks on human faces. The face mask detector is used, the CNN model is trained [28], and the data is pre-processed in the manner indicated in figure 1. The accuracy of a model depends on the quality of the dataset. To get rid of the problematic photographs that were discovered in the dataset, the initial data cleaning is done. The photos are shrunk to a predetermined size of 96 96 to reduce the load on the machine while training and to boost performance.

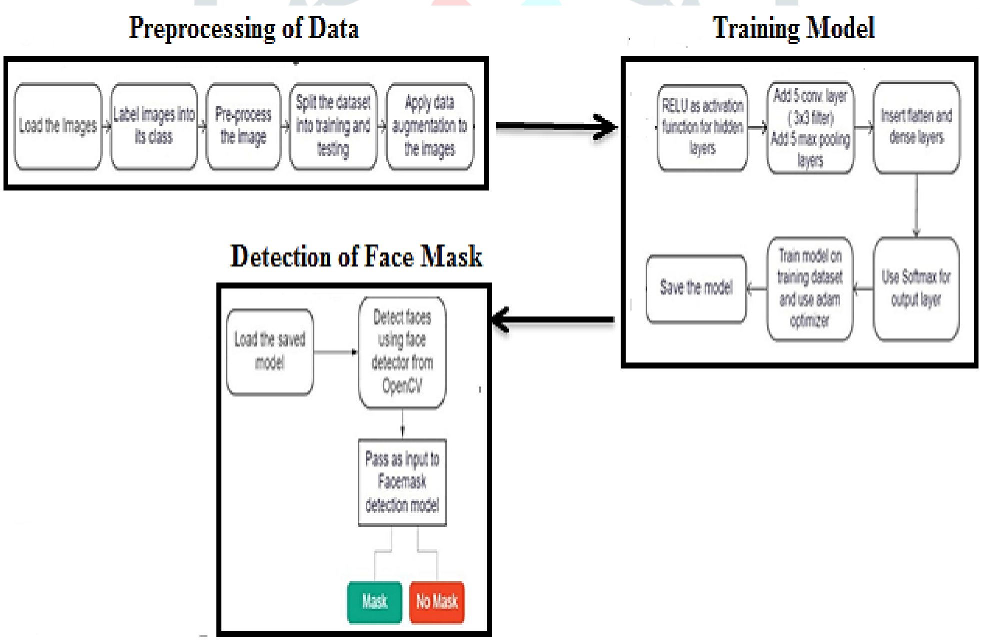


Figure 1 The Proposed Model

After then, the images are categorized as having masks or not. To speed up computation, the photos array is next transformed into a NumPy array. Additionally, the preprocess input function of the MobileNetV2 is used. The training dataset is then expanded both in quantity and quality using the data augmentation approach. The CV model recognizes [29] the face of a person in an input image and requests the user to enter the individual's name and email address when it does so that individual who will be kept in the database.

## 4. Result

In comparison to previous models, our technique for face mask identification has the greatest detection rate. when the mask's wearer takes it off. In figure 2, a box around the person's face denotes whether or not they are donning a mask. If the person's face is stored in the database, it can identify [30] their name even if they are not wearing a face mask.

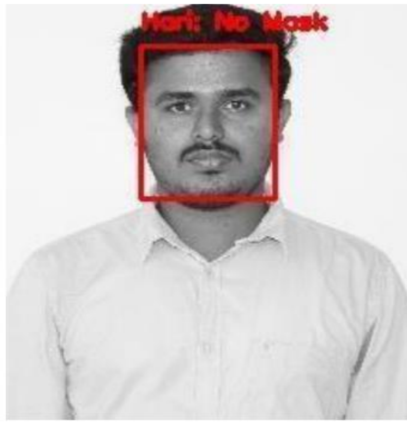

Figure 2 No Wearing a Mask

It tries to match faces in the database when someone observes that a person is not wearing a mask and that their information is not in it. In figure 3, whether or not a person is wearing a mask is indicated by a box drawn around their face.

Figure 3 The Mask Detected

## 5. Conclusion

Given the growing number of COVID cases worldwide, a system that can replace humans in the process of examining people's faces for masks is urgently required. This system satisfies that desire. This strategy may be used in public places like malls and train stations. It will be very useful in huge organizations and companies with lots of employees. Since this technology makes it simple to gather and keep information about the people who work there, it will be quite helpful at that location. Additionally, it will be easy to spot anyone who is not using a mask, in which case a cautionary email will be issued to that person. In this study, a dual-stage Face Mask Detection architecture was presented. The first step includes a pre-trained Retina face model for accurate face detection. Comparing its results to those from other models, such as Dlib and MTCNN. We created a dataset that had both masked and unmasked data faces that was devoid of any biassed representations. Three different Face Mask Classifier models were trained as an example, stage. We may infer from the data that the machine learning based topology is better at producing accurate results and is more successful at containing the COVID-19 epidemic.

## 6. Future Works

To improve public safety, this idea may be integrated in a variety of circumstances. Identify the type of mask the person is wearing first, and then listen for coughing and sneezing. Screening for temperature comes in third. Last but not least, a face mask can be used to identify criminals.

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