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Face Mask Detection Using Image Processing and Deep Learning

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ABSTRACT

In the aftermath of COVID 19 pandemic, people faced lots of disturbances in their day to day lives. The only way to control this is to make people wear masks when they are in public places. The World Health Organization (WHO) is urging people to wear masks to help limit the spread of the virus. The autonomous mask detection and alert system is needed to identify whether someone is wearing a face mask or not. In this proposed system, a face detection model is described that can classify images as either having a mask or not having a mask. The coronavirus has brought a new way of life in which social distancing and the wearing of face masks are important in controlling the spread of the virus. However, the majority of people are not wearing masks in public places, which increases the spread of viruses. This could lead to a problem of increased spread. In order to avoid situations like this, we need to make the people aware of the need to wear face masks. During this global pandemic, Face mask detection has seen an outstanding development in image processing and Computer vision. The technique of detecting people's faces and classifying them into two groups, those with masks and those without masks, is done with the help of image processing and deep learning approaches. The proposed system has utilized as a digitized scanning tool in schools, hospitals, banks, and airports, and many other public or commercial locations, where it takes people face images, follow up by some image preprocessing technique for removal of noise, edge detection in the respective images. At last, all the images are trained and tested with deep learning approaches to predict with masks and those without masks.

Keywords: Convolutional neural network (CNN) · COVID-19 · Deep learning · Real-time face mask detection · Open CV

1. Introduction

Image processing is a method to perform some operations on a picture, so as to get an enhanced image or to extract some useful information from it.

Most of the world's population has been harmed as a results of the COVID-19 (Coronavirus) pandemic. COVID-19 may be a respiratory condition that causes severe pneumonia in those who are affected by it. The disease is acquired via direct contact with an infected person, also as through salivation beads, respiratory droplets, or nasal droplets released when the infected individual coughs, sneezes, or breathes out the virus into an airspace.

As we all know Mask is most important criteria now a days. covid -19 virus is that the global crisis in the world. Today, face detection is more important than ever because it is employed in video applications like real-time surveillance and face detection in videos, not just on photos. High accuracy image classification is feasible now with the advancements of Convolutional networks. Computer vision and image processing have a unprecedented impact on the detection of the face mask. This paper presents a mask detection system based on deep learning. The presented approach are often used with surveillance cameras to detect persons who do not wear face masks and hence restrict COVID-19 transmission

2. Literature Survey

In paper [1] Goyal, H., Sidana, K., Singh, C., Jain, A., & Jindal, S , In this paper ,created a facemask detector implemented in three phases to help in precisely detecting the presence of a mask in real-time using images and video streams. PHASE: - 1.Data pre-processing 2.CNN model training 3.Applying mask detector. The accuracy of a model depends on the quality of the dataset. The dataset is formed available on GitHub that consists of masked and unmasked images. This data set are often used to create new face mask detectors and use them in a variety of applications. The proposed model has used some popular deep learning methods to develop the classifier and gather photos of a private wearing a mask and distinguish between face masks and non-face mask classes. This work is implemented in Python together with Open-CV and Keras. It requires less memory and computational time as compared to other models, which makes it easy to deploy for surveillance.

In paper [2] Sanjaya, S. A., & Rakhmawan, S. A , In this study ,the face mask recognition is developed with a machine learning algorithm through the image classification method: MobileNetv2.MobileNetV2 is a method based on Convolutional Neural Network (CNN) that developed by Google with improved performance and enhancement to be more efficient. This study conducted its experiments on two original datasets. The first dataset was taken from the Kaggle dataset and the Real-World Masked Face dataset. The second dataset was taken from some sources, for instance, public place CCTV, shop, and traffic lamp camera

In paper [3] Habib, S., Alsanea, M., Aloraini, M., Al-Rawashdeh, H. S., Islam, M., & Khan, S. , In this work, developed an effective and efficient model for face mask detection based on the Convolutional Neural Network (CNN).In this study ,after several experiments on different deep learning-based architectures and proposed MobileNetV2 autoencoder model. One deep learning-based architecture among several options is the MobileNetV2. It is efficient and effective. A convolutional neural network design called MobileNetV2 aims to function well on mobile devices. In this work, we used three datasets as Face Mask Detection (FMD), Face Mask (FM), and Real-World Mask Face Recognition (RMFR).In FMD dataset , there are total number of 7553 in which 3725 images are with masks and the remaining is without mask whereas in FM there are 1367 total image in which 690 images are with masks and in RMFR,5000 images with face mask and 90000 images without facemask.

In paper [4] Kumar, T. A., Rajmohan, R., Pavithra, M., Ajagbe, S. A., Hodhod, R., & Gaber, T. This article presents an IoT-based face mask detection system in public transportations, especially buses through the collection of real-time data via facial recognition devices. The use of IoT and deep learning techniques to classify images with and without face mask and detect the presence of face masks in real-time video streaming. The development of an efficient low-cost face mask detection system that can be used in public transportation. Assembling a dataset of face and other image types and utilising it to test the suggested system.

In paper [5] Jindal, N., Singh, H., & Rana, P. S , The face mask detection system might be put into operation in two stages. The training phase is the initial stage. The gathering of the dataset kicks off this phase. Possessing a sufficient amount and high-quality of data is one of the most important tasks. The trained model is then fed frames from the live video feed or photos in the next stage. The live video feed might be received via a smartphone, camera, or security camera, and as a result, the format could vary, such as H.265, H.264, etc.

In paper[6] Ding, H., Latif, M. A., Zia, Z., Habib, M. A., Qayum, M. A., & Jiang, Q. The system can recognise faces with high accuracy and estimate facial posture roughly using a specified rule. High precision is produced using a quicker RCNN learning process, and the model's decreased computational cost is accomplished on GPU. convolutional neural networks which have at least one layer that uses convolution instead of general matrix multiplication. According to the most recent research, quicker RCNN provided 97% accuracy while being effective and precise.

In paper[7] Addagarla, S. K., Chakravarthi, G. K., & Anitha, P. This used two separate face mask datasets with 680 and 1400 images, respectively, and two different detection models, FMY3 using Yolov3 Algorithm and FMNMobile using NASNetMobile and Resnet SSD300 Algorithms.The RCNN network model, which was tested on benchmark PASCAL VOC datasets, obtained an accuracy of 73.2% using VGG16 as its basic architecture. Compared to the FMY3, FMNMobile achieves superior accuracy with a 98% recall rate.

In paper[8] Suganthalakshmi, R., Hafeeza, A., Abinaya, P., & Devi, A. G. This paper presents a facemask detection model based on deep learning and computer vision. Using Python, OpenCV, Tensor Flow, and Keras, we will develop a COVID-19 face mask detector using the dataset. The suggested methodology enables the identification of persons wearing masks without face masks, which may be combined with surveillance cameras to prevent the transmission of COVID-19. In the system we've proposed, live video will be used, and when someone isn't wearing a mask, an alarm sound will be played. The model's precision will be attained, and the model's optimization is a continual process, thus we are developing a highly accurate solution.

In paper [9] Gupta, S., Sreenivasu, S. V. N., Chouhan, K., Shrivastava, A., Sahu, B., & Potdar, R. M. In this paper, we provide a mask detector that employs a machine learning facial categorization algorithm to identify if a person is wearing a mask or not. It can then be connected to a CCTV system to confirm that only those wearing masks are permitted inside. we utilise for those wearing masks.The dataset we utilised is Celeb Faces Attributes. We used a unique convolutional architecture to do the mask recognition. In essence, it is a classification algorithm that excels in classifying RGB pictures. We are using the Alex Net architecture to classify. This kind of neural network uses convolutions. In essence, it is a classification algorithm that excels in classifying RGB pictures.

In paper [10] Han, W., Huang, Z., Yan, M., & Fu, H. This paper presents a lightweight backbone network for feature extraction, which based on SSD and spatial separable convolution, aiming to improve the detection speed and meet the requirements of real-time detection. The Feature Enhancement Module (FEM) to strengthen the deep features learned from CNN models, aiming to enhance the feature representation of the small objects. The model was successfully evaluated on COVID-19 Dataset, a large-scale dataset to detect whether shoppers are wearing masks, by collecting images in two supermarkets. The new dataset is made up of the 2 types: wear a face mask, didn't wear a face mask. It should be noted that the images without masks were downloaded from the Internet.

3. Data Collection

The below data is collected from the references.

4. Methodology

In this model, we uses the Convolution Neural Network(CNN) which is used to create or generate various layers . Additionally, libraries like Keras, Streamlit, and OpenCV are utilized. The proposed model is designed in three phases: Data pre-processing, CNN model training and Applying face mask detector.

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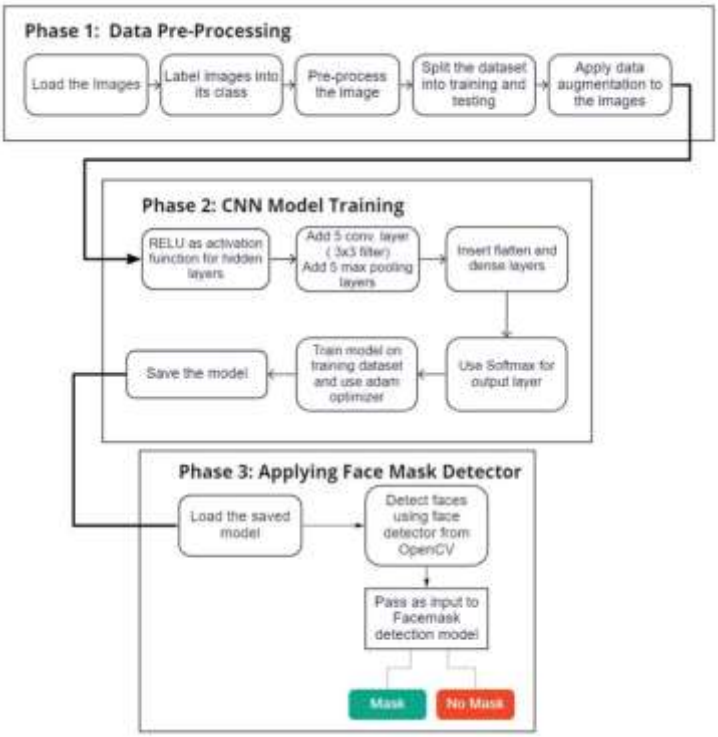

Fig. 1. The proposed architecture.

Data pre-processing: At the starting stage the cleaning of the data is done to discard the faulty or unwanted in the dataset. The quality of the dataset plays an important role in this. The images are then resized to 96x96, to decrease the burden on the system while training. The images are then classified into mask and without masks. The array of photos is then converted to a NumPy array to facilitate faster computation. feature called ImageDataGenerator is used to create many copies of the same image with the proper settings for rotation, zoom, horizontal translation, and vertical translation. Then the given whole dataset is divided into training data and test data in a ratio of 8:2.

CNN model training: The main components involved in this proposed model are 2D convolutional layers(conv2D),pooling layer, activation functions and fully connected layers. The proposed model consists of 5 Conv2D layers and % max pooling layers. Max pooling and average pooling are the two main types of pooling procedures that may be performed. Making the most important value present in the precise region where the kernel sits is what is meant by "max pooling." The mean of each number in that region is computed, however, using average pooling.

The ReLU activation function used for hidden layers and softmax is the output layer and calculates the probability distribution. The main components of the proposed model are TensorFlow and Keras. In this study, the training set comprises 80% of the dataset, while the testing set comprises the remaining 20%. The procedures mentioned above are used to pre-process and enrich the supplied picture. In all, there are 5 Conv2D layers with ReLu activation functions and a 3 x 3 filter, as well as 5 Max-Pooling levels with a 2 x 2 filter. Layers that are completely linked are Flatten and Dense.

Applying face detection model: In this deep learning framework is Caffe which better alternative to the current object detection methods.

After applying the face detection model, we have the total number of recognised faces, which is then fed into the face mask detection model. This face identification algorithm can identify faces in both still images and live video feeds. This model uses few resources and runs quickly and accurately overall.

5. Results and Discussion

Multiple experiments were conducted utilising different hyper-parameter values, including learning-rate, epoch size, and batch size, to produce the final findings, which are displayed in Table 1.

	Precision	Recall	f1-score	Support
dataset/with_mask	0.98	0.97	0.98	400
dataset/without_mask	0.97	0.98	0.98	400
accuracy			0.98	800
macro avg	0.98	0.98	0.98	800
weighted avg	0.98	0.98	0.98	800

Table 1 Classification Report

There are some more architectures such as VGG -19 , MobilenetV2 , ResNet–50 etc. apart from the custom CNN architecture which is implemented in this paper. By training them on the same dataset, other models were compared to this model.

Model	Accuracy [%]	Time Per Epoch [s]	Model Size [MB]
MobilenetV2	97	10.16	11
DenseNet-121	98	10.94	96
Inception-V3	96	9.82	89
VGG-19	95	10.34	79
Proposed Method	98	8.95	33

Table 2 Comparison of different models

The top performer among these models was our proposed model, which shows a significant difference in performance with high accuracy, low time per epoch, and less model size compared to the other models.

6. Conclusion

This manuscript proposes a mask recognition system for static images and real-time video that automatically identifies if a private is wearing a mask (see Fig. 10), which is an effective way to stop the COVID-19 epidemic from spreading. By using Keras , OpenCV, and CNN, the proposed system is during a position to detect the presence or absence of a face mask as a result, the model produces accurate and timely results. An accuracy of about 98% is produced by the trained model. Trials were conducted to match it with other pre-existing popular models illustrates that the suggested model outperforms DenseNet-121, MobileNet-V2, VGG-19, and Inception-V3 in terms of your time interval and accuracy. This methodology may be a superb contender for a real-time monitoring system because of its precision and computing efficiency.

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