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COVID-19 FACE MASK DETECTION USING MACHINE LEARNING

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ABSTRACT

The COVID-19 pandemic is caused due to novel coronavirus. When an infected individual coughs, sneezes, or exhales, the virus is spread mostly via droplets. One can get infected by breathing in this virus if you are in close proximity with someone who has COVID19 or by touching contaminated surfaces. This pandemic has been a global crisis with infecting 111 million people and around 2.5 million deaths worldwide. It has been made mandatory to wear a mask to slow down the infection rate with a strict social distancing strategy. Enforcing this new norm, we will develop a machine learning project. Using OpenCV, Keras/TensorFlow, and Machine -learning, a real-timeCOVID-19 face mask detector was created. This system can detect if a person has worn a mask or not by giving an alarm. It is hoped that our study would be help reduce the spread of viruses in many countries.

Keywords: Deep Learning, Open CV, TensorFlow, COVID-19, Social Distancing.

I. INTRODUCTION

The COVID-19 pandemic is defining global health crisis affecting almost affecting 11 million people and around 2.5 death worldwide. The majority of persons infected with the COVID-19 virus have mild to severe respiratory disease and recover without the need for medical attention. People over the age of 65 and those with underlying medical conditions such as cardiovascular disease, diabetes, or chronic respiratory illness and cancer are more likely to develop serious illness. The virus is transmitted through the droplets when infected person sneezes, coughs or exhales. To prevent the transmission of the virus, it has made it essential to follow specific standards such as keeping social distance, cleaning and sanitizing your hands, and wearing masks in public places. Face masks have been demonstrated in many studies to lower the danger of viral transmission while also providing a sense of security.

However, it is infeasible to manually detect whether the norms are being followed or not. Computer Vision and Deep Learning provide a better alternative to this. To implement face mask detection using machine learning we are going to break our project into two distinct phases:

1.**Training**:

i. Load the face mask dataset.

ii. Train face mask classifier with Keras/ TensorFlow.

iii. Serialize face mask classifier to the disk.

2.Deployment:

i. Load the face mask classifier from the disk.

ii. Detect faces in image or video stream.

iii. Extract ROI (Region of Interest) of each face.

iv. Apply face mask classifier to each face ROI.

v. Show results and gives alarm based on that.

II. LITERATURE SURVEY

Object detection in [1] entails locating and categorizing things in pictures using techniques such as Haar Cascade and HOG. Modern object detection algorithms are classified into 2 categories: MultiStage detectors and Single Stage detectors. Multi-Stage detector is split into two stage detectors like RCNN i.e., Fast RCNN and Faster RCNN. Single-Shot detector performs detection by directly dense sampling of possible locations. A proposed model is used which includes intermediate processing block which helps in extracting the ROI. The study [2] has developed a novel method of combining SR network with classification network (SRCNet) in order to enhance categorization, a person's condition must be assessed and low-quality facial image using a proposed algorithm. It helps in improving the SR network structure by including the activation function and density of skipped connections and utilizes deep learning for automatic identification of face masks. In [3] proposed methodology is used by splitting it into two phases. The first phase deals with over-sampling with data augmentation and the next phase deals with detection of face mask using transfer learning of Inception V3. In study conducted based on [4] model was designed based on deep transfer learning and classical machine learning classifiers. ResNet50 is used in feature extracting phase while the traditional machine transfer learning model used in the training, validation and testing phase. Paper [5] CNN model is used with two phases for training face mask detector and applying the face mask detector. In paper [6] a proposed method of obtaining segmentation masks directly from the images containing one or more faces in different orientation. The input image of any arbitrary size is resized and fed to the FCN network for feature extraction and prediction. The feature extraction and prediction are performed using pre-defined training weights of VGG16 architecture. Convolutional layer convolutes the input image with another window while the max pooling operation ensures that the size of the feature vector being produced in every layer is halved so as to reduce the number of parameters. In [7] Viola-Jones detector, which helps in achieving real time detection. The algorithm extracts feature by Haar feature descriptor with integral image method. Retina Facemask combines the high-level semantic information using several feature maps and a feature pyramid network. In the first stage, a two-stage detector provides region proposals, which are subsequently finetuned in the second stage. In another study [8] a proposed model uses a transfer learning approach for performance optimization with deep learning algorithm and a computer vision to automatically monitor people. Real-time detection of an individual is accomplished with the aid of Single Shot Object Detection using MobileNetV2 and OpenCV, outperforming the comparable state-of-the-art Faster RCNN model. In the proposed system transfer learning is used on the top of the high performing pre-trained SSD model for face detection with mobileNetV2 architecture as backbone to create a lightweight model that is accurate and computationally efficient making it easier to deploy. In [9] presented the KNN-CNNs for masked face identification, which are made up of three primary components. First is the proposed module, which retrieves face initiatives and describes them using noisy descriptors; the second is the KNN module, which refines these descriptors in relation to their immediate neighbors recovered from a huge pool of produced faces and non-faces The final module, the validation module, utilizes a unified CNN to perform classification and regression operations in order to identify potential face areas and modify their exact coordinates. The high-level procedure of downloading and pretrained models, as well as downloading and converting datasets to the KTTI format for usage with TLT, is shown in Paper [10]. The DeepStream SDK is then used to install the TLT model in order to recognize masked and non-masked faces.

III. METHODOLOGY

Illustration of Data

To begin, we visualize the total number of images in our dataset from both categories, i.e., the number of images with and without face mask. We expand our dataset to include a larger number of images for our training.

Optimization of data

We rotate and flip each image in our dataset as part of data augmentation.

Data segmentation

We divide our data into two sets: the training set, which contains the pictures that will be used to train the CNN model, and the test set, which contains the images that will be used to test the model. After dividing, we see that both the training and test sets have received the desired percentage of pictures. We'll pick split size =0.8, which implies that 80 % pictures will go to the training set, while the remaining 20% will go to the test set.

Designing the model

We add layers like Conv2D, MaxPooling2D, Flatten, Dropout, and Dense to our Sequential CNN model. We utilize the 'softmax' function in the final Dense layer to get a vector that represents the likelihood of each of the two classes.

Pre-Training the CNN Model

Following the construction of our model, we will pre-train it by developing the 'train generator' and 'validation generator' and fit them to our model in the following step.

Training the CNN Model

Now, in order to train the CNN model, we must fit our pictures in the training and test sets to our Sequential model that we constructed using the Keras library.

Adding tags to information

After building the model, we label two probabilities for our results. ['0' as 'without mask' and '1' as 'with mask']. I am also setting the boundary rectangle color using the RGB values. ['RED' for 'without mask' and 'GREEN' for 'with mask] and will give an alert if a person is not wearing a mask.

Face mask detectors are being imported.

After this, we intend to use it to detect if we are wearing a face mask using our PC's webcam. For this, first, we need to implement face detection. In this, we are using the Haar Feature-based Cascade Classifiers for detecting the features of the face. This cascade classifier is designed by OpenCV to detect the frontal face by training thousands of images.

Detecting masked and non-masked faces

We use the OpenCV library to run an infinite loop to use our web camera in which we detect the face using the Cascade Classifier.

IV. SYSTEM FEATURES

• Ease of implementation: The technology is simple to integrate into any current organization culture. Customized alerts: Customized alerts can be delivered to people wearing or not wearing a face mask, or to those whose faces are unidentifiable in the admin system.

• Existing technology can be used: There is no need to install any hardware because the system can simply be connected to your existing surveillance system.

• Easy integration with existing technology: The solution works with any camera or hardware, such as surveillance cameras.

• Restricts the access: Access is restricted for individuals who are not wearing masks, and the system informs the authorities.

• Allows flexible customization: The face mask detection system may be customized to meet your specific company needs.

• Insightful: You may examine the analytics using the reports provided by the system.

• Simple to control and use application: Face mask recognition apps are simple to operate and utilize, allowing you to access and control motions from any device.

• Detecting faces with or without masks: Faces that are partially obscured, whether by a mask, hair, or a hand, may be easily identified.

V. RESULTS AND DISCUSSION

Study Areas

The following libraries which are used in the project have been studied.

● OpenCV

● NumPy

● Matplotlib

● sklearn

● Tensorflow

● Keras

Implementation

The project has been successfully implemented.

Evaluated Results

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The results have been evaluated and various tests have been performed to make the software robust and reliable.

	precision	recall	f1-score	support
with_mask	0.99	0.99	0.99	383
without_mask	0.99	0.99	0.99	384
accuracy			0.99	767
macro avg	0.99	0.99	0.99	767
weighted avg	0.99	0.99	0.99	767

Figure 1: Model Accuracy

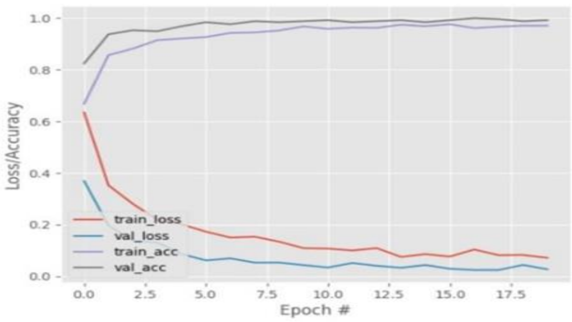

Figure 2: Accuracy Graph

Figure 3: Some examples of dataset without mask(total-1919)

Figure 4: Some examples of dataset with mask(total-1916)

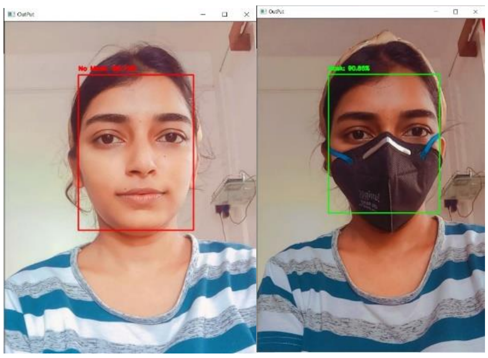

Figure 5: Some examples of results

VI. CONCLUSION

In this paper, we present a method for detecting whether or not someone is wearing a mask in public places. So that the coronavirus can be contained. The system contains the face mask detection architecture where the CNN model is used to detect masks on the face. The motivation for this work comes from people disobeying the new norms and not wearing masks properly. This system will help people to wear a mask in public areas and help in reducing the spread of COVID-19. It will detect if a person is wearing a mask using a video stream or a snapshot, and will notify if a person is not wearing a mask or if the mask is not adequately concealing his or her face.

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