IJRAR.ORG E-ISSN: 2348-1269, P-ISSN: 2349-5138

INTERNATIONAL JOURNAL OF RESEARCH AND ANALYTICAL REVIEWS (IJRAR) | IJRAR.ORG

An International Open Access, Peer-reviewed, Refereed Journal

FACEMASK DETECTION USING OPENCV AND MACHINE LEARNING

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Abstract: In late of 2019, a new disease COVID-19 caused by the viral group SARS COV-2, was reported in Wuhan, China. It came in India in early 2020. The disease cause lungs damage and hence oxygen deficiency in an individual. It spread through inhaling the water droplet by an infected person to another. Modern connected world made this virus to spread globally in no time. The World Health Organization (WHO) made everyone to wear mask during outside interactions and meetings. Studies shows that wearing mask can reduce the virus transmission to 96%. In this project, we have made a face mask detection model using open CV and Machine Learning which help in the recognition of persons wearing face masks and differentiate with faces not wearing masks. This model also depicts the percentage of necessary area covered by the face mask. Further the accuracy of the model is also tested in real time and also, we have compared the results of 3-4 models to conclude about the most accurate model for detecting face mask.

Keywords - covid-19, face masks detection, open CV, computer vision, machine learning.

I. INTRODUCTION

Due to outbreak of SARS Cov-2 in china, the government made compulsion to wear face masks. In current fast-moving world, the disease spread with extreme fast rate in every part of the world. The disease is a respiratory tract infection which cause lungs damage and oxygen deficiency in human body. One can easily succumb of this disease by inhaling water droplet, sneezing, coughing and in contact with contaminated things. The virus takes 14 days to shows its symptoms and during this time it already get spread in community. The major concern are the areas with high population density, crowd places and gatherings. By the sudden increase in the corona cases in 2020, the World Health Organization (WHO) declares it a global pandemic in March. Over 200 million people infected while 5 million succumb to death till July 2021.The World Health Organization appeals everyone to wear face mask since it is the only way to stop the transmission and reduce the infection. Study shows the infection risk can be reduced to 96% with face mask wearing. Among all the global protocols, the wearing face mask is the simple and effective way to follow. Ironically, people are not putting face masks and it's very difficult to keep an eye on everyone especially in public and work places. So, the need of face detection is arising. In this paper we use the modal which uses open CV and deep learning for detection of face masks. We use the computer vision and essential machine leaning algorithms with OpenCV, TensorFlow and keras. Later we use the three different algorithms and compare them to check for the highest accuracy.

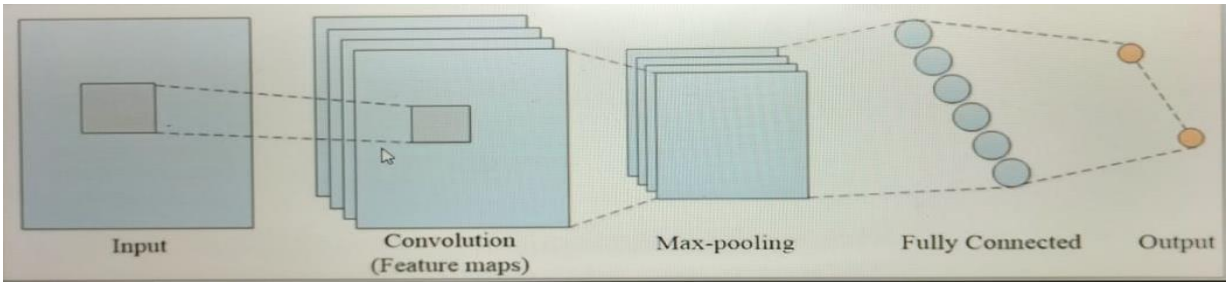
II. RELATED WORK

- An ample amount of work and research has already been done in the field of face and mask detection. In this section, we have review and discuss some research to give to our work.
- We have come up with two data sets for better recognition and improving the performance of face mask detection methods. The data named as follows – With_Mask Dataset and Without_Mask Dataset.
- We have developed a method to correctly detect the faces. This model has an accuracy of about 99%. Its categories face as correct face mask wearing, incorrect face mask wearing and no face mask wearing which we get to know by the percentage it shows on the top-center of the square box either in red or green which indicates without mask and with mask respectively.
- In this, we have used two datasets for detection of face mask and use different machine learning algorithms to compare the accuracy. The result is published using graph and charts of the most accurate machine learning model.
- In this, we have performed MobileNet Model and AlexNet Model. The most accurate was MobileNet Model with an accuracy of 99%. We have gone through few other Models also theoretically. Hence, we have published the results below.

III. PROPOSED METHODOLOGY

In this, we have used Convolution Neural Network (CNN) and Machine Learning model i.e. MobileNet for detecting the face mask of the face of the human in real time with single or multiple persons in one frame. We have devised a very smart and effective system which uses basic convolution neural network (CNN) model using TensorFlow, Keras library and OpenCV. In the very first step we have collected the dataset from the Kaggle. In next step we have applied image preprocessing to improve and train our model performance now train the model and expected for final output. Now OpenCV library used to detect the real time (live video streaming) to check whether correct face detection is done or not. Image pre-processing is most significant and important object detection method and image classification to improve image data to enhance image features for further processing task. The image pre-processing is used to change the position, increase the brightness of image and most importantly to create a new dataset if there not sufficient dataset is available. A base model is generated using keras and MobileNet along with a Head model. Head model features a network of 128 layers with activation function of 'ReLu' and a dropout of 0.5 followed by another network with 2 layers and have an activation function of 'SoftMax'. These three will combined to administer model.

- **Convolution steps:** The first objective of convolutions is extracting local features from the high input file and make point-wise multiplication of the N x N matrix. The Conv2D, within the case of image classification, used some parameters like filters, input shapes, kernel size, activation function with the values.
- **Max pooling layer:** The max-pooling is employed for extracting maximum features and reduce the dimensionality reduction within the case of deep learning algorithms. The pooling layer is employed to regularize the overfitting problem and minimize the number of parameters by simply taking the average values of the given features.
- **Fully Connected layer:** This layer is employed to map pooling layer's out, which is flattened then fed the input file for the subsequent layer. The fully connected layer is important in a very convolutional neural network to perform the classification part. in line with our classification type, the subsequent classification result is going to be performing with help of the activation function (SoftMax, Sigmoid).
  Another model is trained with the human faces with the assistance of OpenCV. The output of the primary model is is input for the second model and performs adds real time. A square box will draw to point the face and shows whether person is wearing mask or not and at what extent.



Basic Structure of MobileNet using CNN

In this, we have got divided the entire project into five stages:

- **Input Stage:** During this stage we've got input the dataset to the training model of the project using python read library. we've used two datasets named as with_mask and without_mask datasets which incorporates images with mask and pictures without mask respectively. Both datasets contain around 2000 images each i.e. total of 4000 images. For better results we've done segmentation of images using python function (ImageDataGenerator), it'll create many images with help of 1 image using different functions like rotate, shift, angle shifter, zoom, etc.

- **Pre-processing Stage:** During this stage Input image dataset must be loaded as Python data structures for pre-processing to form the input be able to be used for training and video detection stage. Input image must be pre-processed before face detection. Here datasets are going to be processed during a way that it'll give more accuracy to the results. during this we've got given a hard and fast size of images by which each and every image are taken therein size(coordinates) only by which all the rubbish data will get deleted and essential data will remain with us.

- **The Face Detection Stage:** During this stage, we've got used OpenCV and webcam of system by this it recognizes the face of human then it detects the mask thereon. If it's mask on face then it'll show Mask (with percentage of how accurately mask is wore) and if not, it'll show No Mask (with percentage of how inaccurately mask is wore). Also, the face of human is going to be surrounded by a square shape of either green or red color, which indicates that human is wearing a mask or not respectively.

- **The Training Stage:** During this stage, we've got used MobilNet Machine Learning model working with Convolution Neural Networks (CNN). during this we've two models, first, a base model of this project and, second, Head model of this project by which when initially base model starts training it gives it outputs and people outputs are basically inputs for head model. We are working like this because it helps us to create our model more accurate. Hence, during this we trained the info 25 times for best accuracy.

- **Prediction Stage:** In this stage, the saved model automatically detects the mask image captured by the webcam. The model and the images are loaded for predicting the human in the camera. CNN is a highly accurate over face mask detection, and produces to the point and best results. CNN model has a sequential model with Keras, TensorFlow, OpenCV Libraries in Python for prediction of human faces.

IV. RESULTS AND DISCUSSION

Accuracy: It is the ratio of number of correctly predicted values to the all number of values. Its value lies between 0 and 1. Higher the value higher is the accuracy means TP and TN must be high.

$$\text{Accuracy} = \frac{Tp+Tn}{Tp+Tn+Fp+Fn}$$

Precision: It's defined as the ratio of true positive values to the all positive values. Precision is used to measure the correctness of classifier.

$$\text{Precision} = \frac{Tp}{Tp+Fp}$$

Recall: It's defined as number of true positive results to the number of all positive result.

$$\text{Recall} = \frac{Tp}{Tp+Fp}$$

F1-Score: Basically, it combines the results of precision and recall and gives us test's accuracy in a single matric.

$$\text{F1-Score} = \frac{Tp}{Tp+1/2(Fp+Fn)} = \frac{2*Precision*Recall}{Precision+Recall}$$

Table 1: Values

Parameters	Values
Epoch	25
Pooling size	2
Filters	64 and 32
Batch size	125
Dropout	0.5
Input size	(120,120,3)

Table 2: Training Results

Parameters	Precision	Recall	F1-Score	Support
With_Mask	0.99	1.00	0.99	383
Without_Mask	1.00	0.99	0.99	384
Accuracy			0.99	767
Macro Average	0.99	0.99	0.99	767
Weighted Average	0.99	0.99	0.99	767

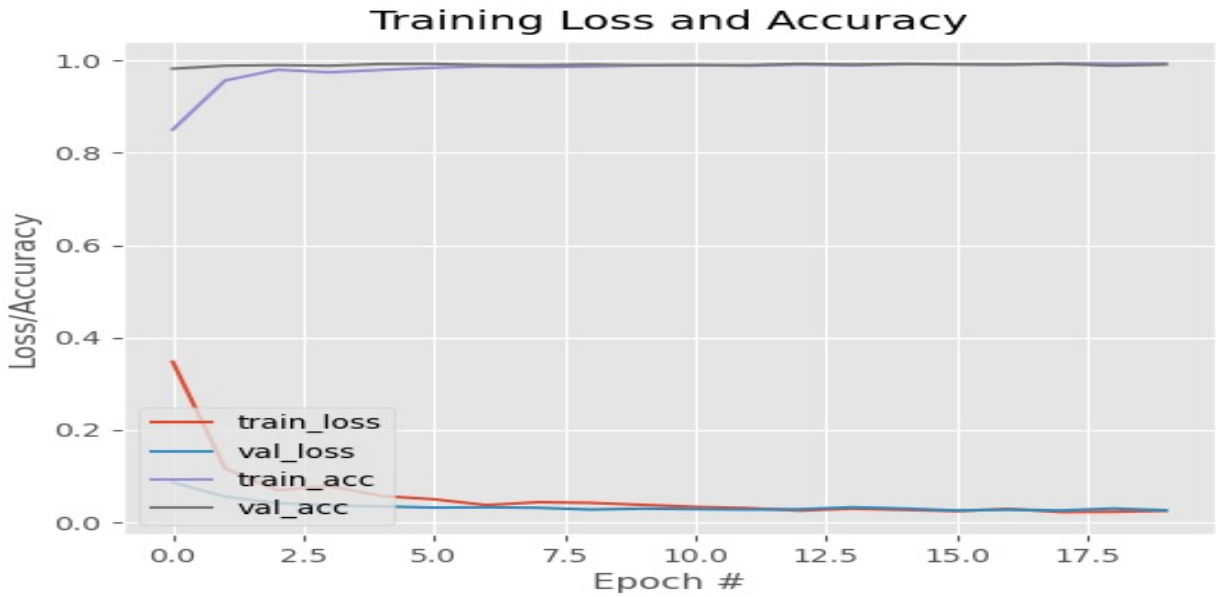


Figure 2: The training loss and accuracy graph with respect to Epoch is given as above for our model.

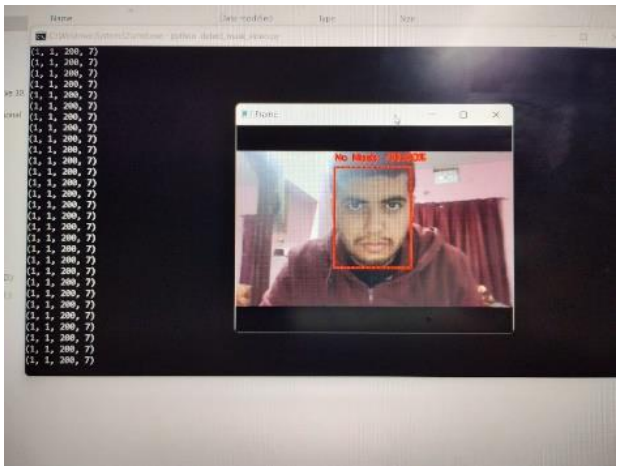


Figure 3: Showing 100% uncovered face

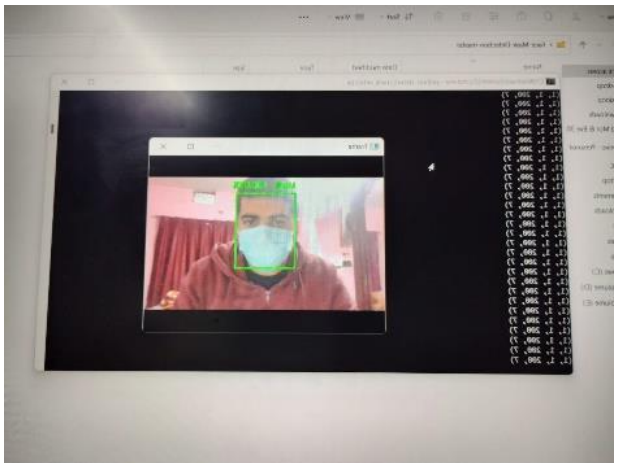


Figure 4: Showing 100% covered face

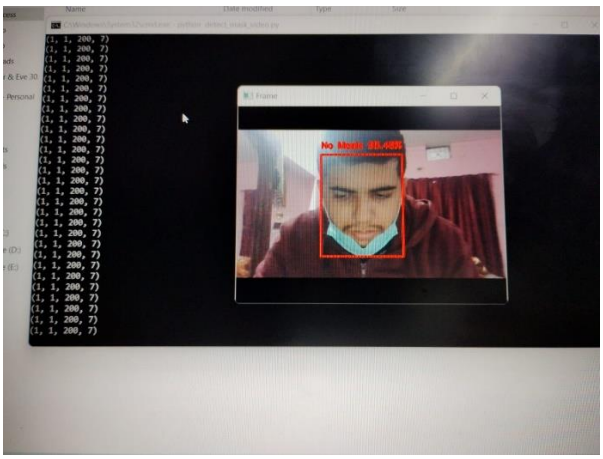


Figure 5: Showing 95.48% uncovered face

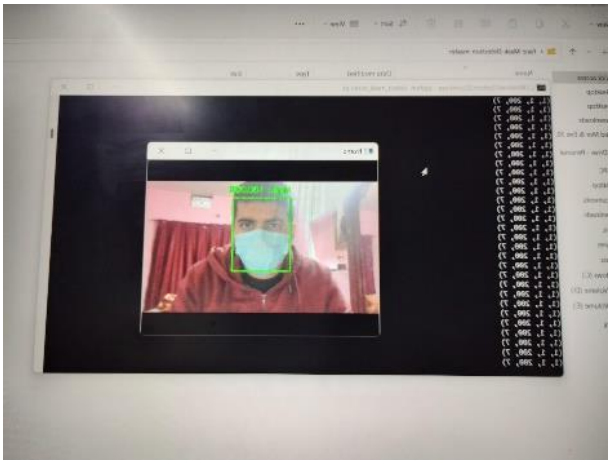


Figure 6: Showing 100% covered face

V. Limitation and Future Works

The model detects the faces from the live videos streaming unlike camera it does not keep a record. The given model can be connected to a database where the persons data could be fetched and mark the person with no face mask. From the database we can send them an alert along with their picture. The model gives a good accuracy with a single face and also giving satisfactory performance with multiple faces. Future work can be done to improve image quality and hence the overall accuracy of the model.

VI. CONCLUSION

To minimize the risk of COVID-19 a proper measure should be taken. wearing mask is the primary thing to avoid the same. We implement the facemask detector to which can contribute to the health sector. We develop this model using CNN and MobileNet. The dataset is collocated from open sources like Kaggle from the Internet. It also uses the keras, TensorFlow and OpenCV to detect face mask. The given model has an accuracy of 99%. The proposed model can be implemented to the high gathering places such as railway stations, offices, shopping complexes, malls, etc. in order to efficiently detect the face mask.

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