Face Mask Detection using Live Video Streaming

Yogita Likhi
Department of Computer Scienece Engineering
St. Francis Institute of Technology
Mumbai, India
yogitalikhi25@gmail.com

Sherwin Mathias
Department of Computer Scienece Engineering
St. Francis Institute of Technology
Mumbai, India
mathiassherwinn@gmail.com

Ujala Maurya
Department of Computer Scienece Engineering
St. Francis Institute of Technology
Mumbai, India
ujalamaurya.um@gmail.com

Nithin Menezes
Department of Computer Scienece Engineering
St. Francis Institute of Technology
Mumbai, India
mark2pm@gmail.com

***Abstract*— COVID-19 pandemic has rapidly affected our day-to-day life disrupting the world trade and movements. Wearing a protective face mask has become a new normal. All most all public service providers ask the customers to wear masks correctly to avail of their services. There are even rules on charging a fine from people who are disobeying the rules that are set. Therefore, an automated face mask detection system from live CCTV camera has become a crucial task to help the society. In this report, we have proposed an automated system which helps authority people to identify the people who is not wearing a mask. The system will also notify to the end user by a sending him alert message. The proposed system in this report is developed with a deep learning algorithm MobileNetV2. We have used Kaggle dataset for face mask detection. The steps for building the model are collecting the data, pre-processing, split the data, testing the model, and implement the model. The face mask model can detect people who are not wearing a mask. This system can later be further extended and then connected to a face recognition system which will help in identifying the persons who are not wearing masks thereby violating the rule.**

Keywords—Mask detection, deep learning, MobilenetV2, Face Recognition

I. INTRODUCTION

The year 2020 has shown mankind some mind-boggling series of events amongst which the COVID-19 pandemic is the most life-changing event which has startled the world since the year began. Recently, a study on understanding measures to tackle COVID-19 pandemic carried by the researchers at the University of Edinburgh reveals that wearing a face mask or other covering over the nose and mouth cuts the risk of Coronavirus spread by avoiding forward distance travelled by a person's exhaled breath by more than 90%.

Further, with the reopening of countries from COVID-19 lockdown, Government and Public health agencies are recommending face mask as essential measures to keep us safe when venturing into public. People wear face masks once they step out of their homes and authorities strictly ensure that people are wearing face masks while they are in groups and public places. To mandate the use of facemask, it becomes essential to devise some technique that enforce individuals to apply a mask before exposure to public places. To monitor that people are following this basic safety principle, a strategy should be developed. A face mask detector system can be implemented to check this. In this project, we will be developing a system for detecting face mask detector that is able to distinguish between faces with masks and faces with no masks.

In this report, we have proposed an automation system for detecting people who is not wearing a mask then in next step recognizing the face of that person for taking certain against him/her.

II. RELATED WORK

In [1] they have trained the model using ResNet50 model which is a convolutional neural network that is 50 layers deep to implement the face mask detection system. For training model, the collected dataset consists of 3833 colour images. Out of which 1918 images are without a mask and the remaining 1915 images are with a mask. All of the images present in this dataset are real-time images with the same kind of dataset and their calculated accuracy for the model is 84.17%.

In [2] they have proposed face mask detection system using YOLOv3 model and darknet repository. They took dataset from the Kaggle which consists of .png files along with .txt annotations. They splitted the dataset into testing data and training data. The model is got trained on GPU since it was computationally expensive. They found accuracy of 87.16% for the trained model. In the paper, the predictions are not based exclusively on the existence of a mask but also on the context around it. The advantage of YOLOv3 is its speed, so we can easily implement it in the video.

Shashi Yadav [3] has proposed the system that ensure the safety of the people at public places by automatically monitoring them whether they maintain a safe social distance, and also by detecting whether or not and individual wears face mask. They have adopted MobileNetV2 with transfer learning technique that can be used on real-time video. They have used custom dataset (3165 images) consisting of different types of face mask which are labelled and divided this dataset into training and testing datasets. Model was developed using 80% of dataset with MobileNetV2. Their proposed model first detects all persons in the range of camera and then detects faces with mask or

without mask. If the mask is not visible in the faces, and if the social distance is not preserved, the system generates a warning and send alert to monitoring authorities with face image. The system detects the social distancing and masks with a precision score of 91.7%

III. IMPLEMENTATION AND RESULTS

The face mask detection model is developed with a machine learning algorithm through the image classification method: MobileNetv2.

There are many pre-trained models and algorithms available to implement a mask detection model. So, we will study the models like Resnet50[1], Yolov3[2] and Mobilenetv2[3] and analyze their accuracies and see how well our model is performing or will it be efficient to use MobileNetv2 for the purpose.

A. Dataset

We have implemented the Mobilenetv2 model using dataset from Kaggle. The Dataset consists of two folders, namely: with_mask and without_mask. The with_mask folder consists of 1915 images of people wearing mask. The without_mask folder consists of 1918 images of people not wearing mask. For training, we took 80% of the dataset and for testing, we took 20% of the dataset.

B. Training Mask Detection Model

As shown in Fig 1 for the training, we will be using an Image dataset on which our model will train. This dataset will have two sections – Image and Category. For each image in the dataset, we will augment the image and generate multiple varying copies of it. The next step is to convert each image and its corresponding category into a NumPy array. We will append each resultant NumPy array of Image and corresponding category into Input_Data_Array and Category_Array respectively. In this way, we have our training input ready which will be used to train the model.
After this, we will split our dataset into 80:20 ratios. 80% of the input dataset will be used to train the model and 20% of the dataset will be used to test the model. After tuning the hyper parameters for our model, we will begin the training of the model with the help of MobileNet V2 Convolutional Neural Network architecture. Completing the training phase, we will check the accuracy of our model. If the model is having a good and desirable accuracy, we will save the trained Mask Detector Model. Else, we will repeat the step of tuning the hyper parameters and training the model until we get the desirable accuracy.

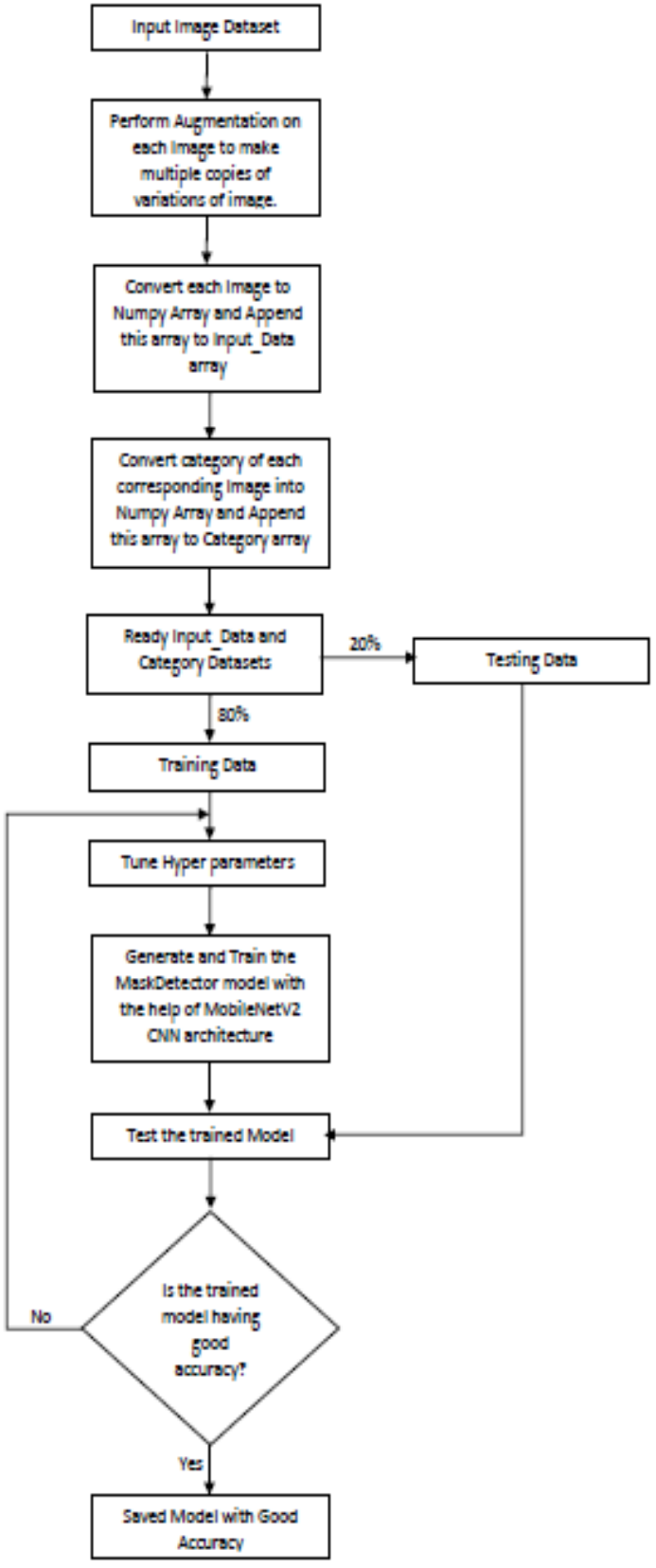

Fig 1. Training Process

C. Workflow of Mask Detection Model

In Fig 2 the live video will be continuously fed to the Mask Detector Model, one frame at a time. We will be using Haar Cascade Face Detector to capture human face from the

video frame. Haar Cascade Face Detector has already pre-trained weights which help in detecting the haar features. Based on alignment of those features, the human face will be detected and captured. This face image will be fed to the Trained Mask Detector Model by us. The Mask Detector Model will come to the conclusion that whether the face is wearing the mask or not. If the face is wearing the mask, the Mask Detector Model will input 'Wearing Mask' else it will output 'Not Wearing Mask'.

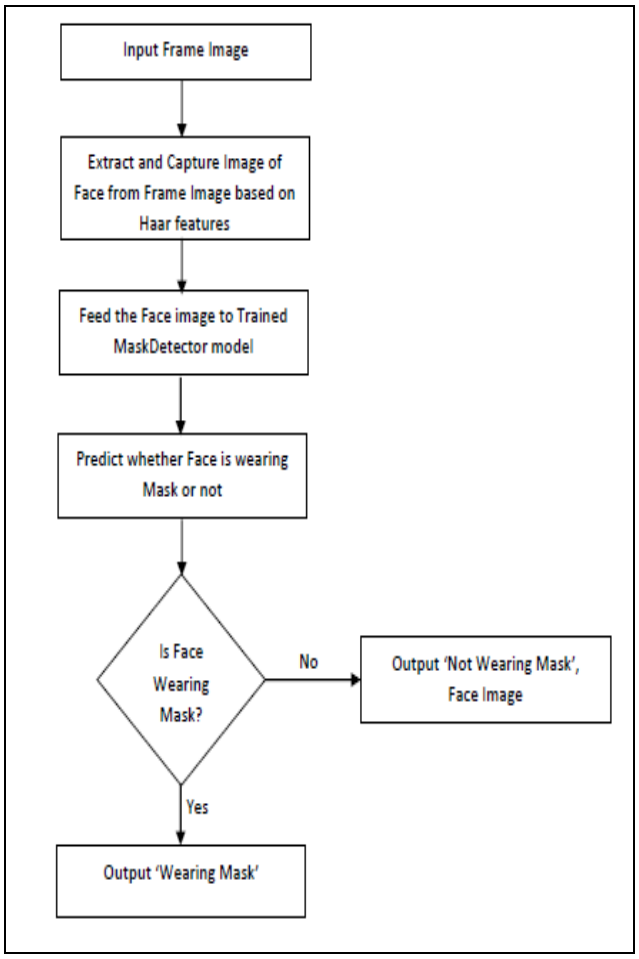

Fig 2: Flow of the model

D. *Results*

Once we have trained the model, we need to test it to find out how well and efficiently it's performing and to also compute its accuracy mathematically.

As shown in table 1, the precision obtained for the with_mask category is 99% whereas the precision for the without_mask category is 83%. This gives an overall accuracy of the model as 89%.

Similarly, the fig 3 is the graphical representation of the same. It shows that our model has a training accuracy of almost 100% and the validation accuracy is 89%. It also gives us an idea about training and validation loss. As it is shown in the graph the training loss is high in the beginning but as we keep on iterating, increasing the epochs, the loss deceases. Validation loss is moreover the same throughout all the epochs.

Table 1: Precision table

	precision	recall	f1-score	support
with_mask	0.99	0.79	0.88	383
without_mask	0.83	0.99	0.90	384
accuracy			0.89	767
macro avg	0.91	0.89	0.89	767
weighted avg	0.91	0.89	0.89	767

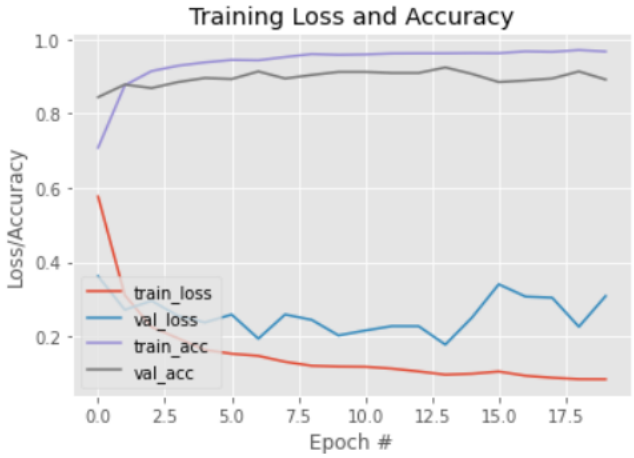

Fig 3: Loss and Accuracy graph

IV. Comparison with other methods

After obtaining the results of accuracy on the MobileNetv2 test, the next step that will be carried out in this study is to compare the MobileNetv2 method with other mask detection methods proposed in other papers. The methods that are compared are:

1) *ResNet50*
2) *Yolov3*
3) *MobileNetv2*

Table 2: Studying different algorithms

Model	**Accuracy (in %)**
Resnet50	84.17
YoloV3	87.16
MobilenetV2	89

As shown in Table 2, we have studied the different algorithms like Resnet50, Yolov3 and MobileNetv2. We have implemented the MobileNetv2 model and then compared it's performance with the models that we have studied in different papers mentioned in Section II of this paper.

We can clearly conclude form the above table that our model that is MobileNetv2 will perform well in implementation of the Face detection system. Since the database that we selected contained all types of images that is single person, multiple persons, front and side profile it is safe to say that this model will be helpful in detetcing people without mask using live video streaming like CCTV.

V. Conclusion

In this paper we have discussed the implementation of Face Mask Detection System. It gives a brief overview about different models that are implemented before to build a face mask detection system. This paper also gives a detailed explanation about using and implementing a face mask detection system using MobileNetv2. Along with all this the study of the performances of different model gives a clear idea why MobileNetv2 will be handy and a good algorithm for the implementation.

Once the system is developed and have a good accuracy it can be used to find out the people not wearing masks. This system then can be further extended, and we can use a face recognition system to identify the people who are violating the rules. Once the person is recognized he/she can be warned using the alert system via a message or mail. If someone is caught doing the same mistake more than five times, he/she will be fined.

Such a system can be easily implemented in places like school, colleges and offices and then by making suitable changes deployed to larger and crowded public places like malls, super-markets and more.

References

[1] Isunuri B Venkateswarlu, Jagadeesh Kakarla, Shree Prakash, “Face mask detection using MobileNet and Global Pooling Block”, 2020

[2] Stefanos Kanellopoulos, “Face Mask Detection using darknet’s YOLOv3”, 12 April 2021

[3] Shashi Yadav “Deep Learning based Safe Social Distancing and Face Mask Detection in Public Areas for COVID-19 Safety Guidelines Adherence”, July 2020.

[4] Mark Sandler and Andrew Howard, Google Research, “MobileNetV2: The Next Generation of On-Device Computer Vision Networks”, Tuesday, April 3, 2018.

[5] Samuel Ady Sanjaya, Suryo Adi Rakhmawan, “Face Mask Detection Using MobileNetV2 in The Era of COVID-19 Pandemic”, 20 January 2021.

[6] Arjya Das; Mohammad Wasif Ansari; Rohini Basak, “Covid-19 Face Mask Detection Using TensorFlow, Keras and OpenCV”, 05 February 2021

[7] Face Mask Detection dataset, Kaggle