ISSN 2321 3361 © 2021 IJESC

Research Article Volume 11 Issue No.05

Face Mask Recognition using TensorFlow a Deep Learning Framework

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Abstract:
The corona virus, COVID-19 pandemic is causing a global health crisis , one of effective protection method is wearing a face mask in public areas according to the World Health Organization (WHO). The rapid transmission of corona virus forced the governments across the world to impose lockdowns to prevent its transmissions. Many health reports indicate that wearing face masks while at work and in public clearly reduces the risk of transmission during this pandemic. This encourages us to explore face mask recognition technology to monitor people wearing masks in public places. Most advanced technology that is Deep Learning is used in face mask recognition. In this proposed method, two state-of-the-art object detection models namely TensorFlow and CNN are used to achieve this task. The model is trained on dataset which consists of two sets of images, with and without face masks. The goal of proposed method is to identify whether the person on image/video stream is wearing a face mask or not with the help of computer vision and deep learning.

Keywords: Covid-19, Deep Learning, Face Mask Recognition, Convolutional Neural Network, TensorFlow, Computer Vision.

I. INTRODUCTION

The rapid and uncontrolled transmission coronavirus disease 2019 (COVID-19) has brought global crisis with its deadly spread to 213 countries and territories around the world and 2 international conveyances, and about 163,312,429 confirmed cases along with 3,386,825 deaths globally as of May 11, 2021. The lack of dynamic medicinal specialists, facilities and the absence of resistance against COVID19 built the vulnerability of the population. WHO pronounced this as pandemic [1]. The virus seems to be transmitted mostly through the minute respiratory droplets via coughing, sneezing or when people interact with each other for some time in close proximity. These droplets can then be inhaled, or they can land on surfaces .that others may come into touch with, who can then get contaminate when they contact their eyes, mouth, or nose.

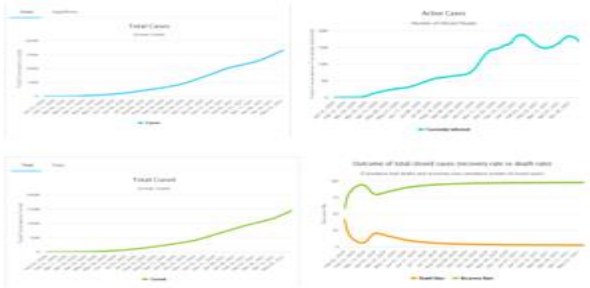

Figure.1. COVID-19 Statistics published by WHO [3] . (A) Total Number of COVID-19 world-wise cases (B) World-wide total number of COVID-19 active cases (C) Total world-wide coronavirus cured cases (D) Closed cases (Death Vs Recovery rate)

Wearing a face mask is the main attainable way to deal with the battle against this pandemic. The knowledge wearing face mask has gained popularity in the general population [2].We have to learn way keep us safe without disturbing our work space. Several methods are available for identifying mask faces Include different angles [4]. This paper involves building a system for mask face detection using several classifiers available on CNN. For security purposes mask face detection is faster than other security systems since multiple faces can be analyzed or detected at the same time. Work with the CNN gives higher accuracy to detect the mask face in a particular area and it's a little bit sensitive when the face comes into the area of the webcam, so it's faster than others.

II. RELATED WORK

In face detection process, a face is identified from an image that has several attributes or features in it. According to author [5], research into face detection technique involves tracking of face , recognizing the expression and pose estimation. For the input image it is challenging task to identify face from that because images are having different shape, color , dimension etc and they are not immutable. Authors in [6] reported two major challenges in occlusive face detection: 1) unavailability of sizably voluminous datasets containing both masked and unmasked faces, and 2) exclusion of facial expression in the covered area. According to the reported in work [7], convolutional neural network (CNNs) in computer vision comes with a strict constraint regarding the size of the input image. The prevalent practice reconfigures the images before fitting them into the network model to surmount the inhibition. In the article[8] author proposed a efficient way to detect multiple faces wearing mask using deep learning technology to automate process of identifying masked faces. Fasten RCNN and YOLOv3 models are used in experiment. Experimental results shows that F-RCNN has better precision, but for applying this in real-world surveillance cameras. YOLOv3 performs better if speed/accuracy tradeoff are the metric. Author suggests to use faster R-CNN if high end GPU's are available on deployed devices.

Experiment Result

Model	Average Precision	Inference Time
YOLOv3	55	.045 s
Faster R-CNN	62	.15 s

M. Loey et al.[9] proposed model contains two main deep learning components, that is GAN and deep transfer model respectively , for the corona virus infection using chest X-ray images. The lack of datasets for COVID-19 in chest X-rays images was the challenging task to perform this research. Deep transfer model Google net achieved 100% in testing accuracy and 99.9% in the validation accuracy. P. Gupta et al. [10] used CNN in experiment which is able to detect and recognize a human face at a time. Proposed system uses Yale's face detect dataset and showed 97.05% accuracy.L.Wang et al. [11] proposed facial Recognition system with the help of LBPH for surveillance and antitheft security purposes. Research also involved drone technology systems to give an extra boost to their surveillance.

Table.1. Limitations of existing system

Serial Number	Reference Number	Limitation
01	12	Explains the use and importance of wearing mask no methodology for detecting face mask .
02	13	Paper focuses on how to prevent transmission of COVID-19 by wearing face mask, no detection methodology explained.
03	14	YOLOv3 model is used for detecting face. Face mask detection was not area of research.
04	15	Explains real time face emotion recognition system. No work with face masks detection.

III. DATASET

For the proposed system two sets of data , with mask and without mask images are used in the experiment . 853 images are collected from kaggle[17]. Another dataset is from [16] containing 1376 images in which 690 images are with face masks and the rest 686 images with people who do not wear face masks.

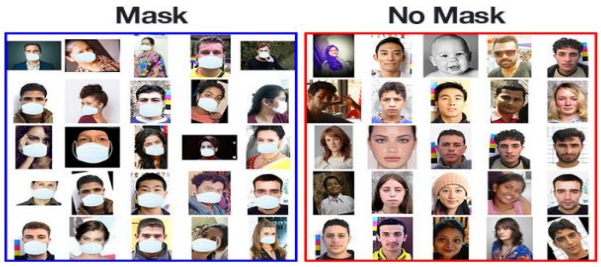

Figure.2. Samples from Dataset 1 including faces without masks and with masks

IV. INCORPORATED PACKAGES

A. TensorFlow

TensorFlow is an open source library developed by Google team in the year 2015 for internal use of team, later(2017) it was made as open source. It used in production and research at Google. TensorFlow can be deployed on multiple CPU's and GPU's and supports 64bit t Linux, macOS, Windows, and mobile computing platforms including Android and iOS. Provides more features in Linux platform than windows. Basic idea behind the invention is to reduce computation time in deep learning networks during training and deploying the model.It has been used many research areas like sentiment analysis, voice recognition, geographic information extraction, computer vision, text summarization, information retrieval, computational drug discovery and flaw detection to pursue research . In the proposed model, the whole Sequential CNN architecture (consists of several layers) uses TensorFlow at backend. It is also used data processing stage .

B. Keras

Keras gives fundamental reflections and building units for creation and transportation of ML arrangements with high iteration velocity. It takes full advantage of the scalability and cross-platform capabilities of TensorFlow. The core data structures of Keras are layers and models . All the layers used in the CNN model are implemented using Keras. Along with the conversion of the class vector to the binary class matrix in data processing, it also helps to compile the overall model.

C. OpenCV

OpenCV (Open Source Computer Vision Library), an open source computer vision and ML software library, is utilized to differentiate and recognize faces, recognize objects, group movements in recordings, trace progressive modules, follow eye gesture, track camera actions, expel red eyes from pictures taken utilizing flash, find comparative pictures from an image database, perceive landscape and set up markers to overlay it with increased reality and so forth [20]. The proposed technique makes use of these features of OpenCV for resizing and color conversion of data images.

D. MobileNetV2

MobileNetV2 builds upon the ideas from MobileNetV1, using depth wise separable convolution as efficient building blocks. However, V2 introduces two new features to the architecture:

1) Linear bottlenecks between the layers, and
2) Shortcut connections between the bottlenecks.

The basic structure is shown below

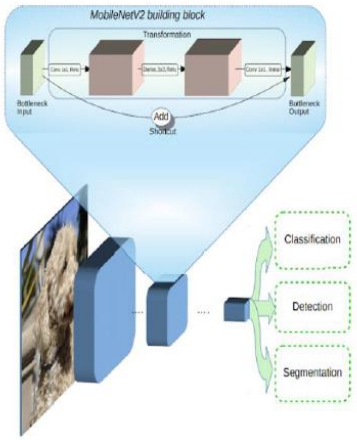

Figure.3. Basic structure of MobileNetV2

V. PROPOSED SYSTEM

This proposed model works to detect masked face in this pandemic situation to occupy a significant part in order to transform coronavirus from person to person. CNN algorithm is used in our project which gives higher accuracy to detect the mask face the. The model is able to detect the mask's faces very fast from every possible angle. While a person comes to the surveillance area without wearing a mask .

Proposed model involves two stage process for detecting person wearing face mask or not using webcam
1. Identifying faces from the input frame.
2. Detecting mask on the recognized face region and classifying accordingly

Flow chart

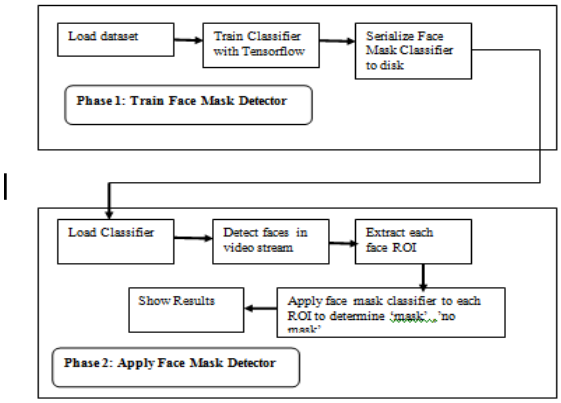

Figure.4. Flow diagram of Face Recognition system system

Dataset has been divided as the training and the testing datasets. To train efficiently and effectively, we have considered 80% of total images as training dataset and the 20% of total images as testing data set to test the prediction accuracy. For simplicity, the images in our training data collection are classified into two categories as "with mask" and "without mask". used a lightweight image classifier, MobileNetV2, which gives high accuracy and is well suited for mobile devices. In pre-processing steps, resized image to 224 × 224 pixels to maintain consistency.

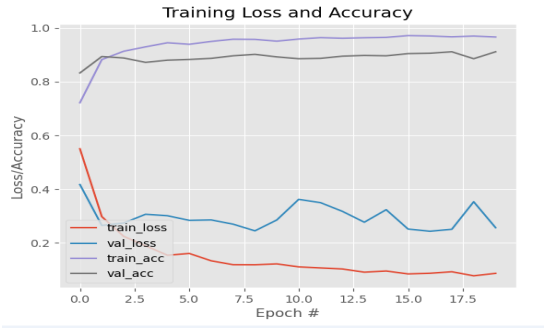

Figure.5. Training Loss and Accuracy of system

Trained model is deployed using OpenCV , many deep learning frameworks TensorFlow,Caffe and Torch use OpenCV for deployment. Model is applied on the real time video frames captured using webcam to detect people in the frame wearing mask or not.

VI. CONCLUSION

Advancement in the field of machine learning and deep learning shows a pathway for providing solutions to most of the problems in health care domain. But these learning techniques alone cannot work independently to handle this pandemic situation. Human intervention along with deep learning skills can help to provide more strength to fight against corona virus. During this COVID-19 pandemic situation many research trying to work about face mask detection and wearing masks. Proposed experiment is carried out with limited dataset , in that 90% of images are used for training the model and 10 % are used for testing the model. CNN proved its significant accuracy in the field of face recognition. .Proposed system can successfully classify a person wearing mask or not and can able to detect multiple people in frame from the web camera.MobilenetV2 architecture is used in this project that can be applied to embedded devices such as RaspberryPi,Google Coral etc with limited computational capacity. The future scope of this.

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