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Covid-19 Face Mask Detection Using Convolutional Neural Network: Proposed System

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ABSTRACT

Reports from the World Health Organization (WHO) suggest that the two main ways to transmit COVID-19 virus are respiratory and physical contact Wearing a medical mask can help reduce the spread of COVID-19 and other respiratory illnesses. As a result, it is vital to wear a good mark in public locations like supermarkets. In this paper, a system is developed for detecting if a person is wearing a mask properly or not. Only a few experiments have been done on using streaming video to get a face mask. It contains a two-stage facial mask formulation and will use OpenCV, TensorFlow, Harr-Cascaded classifier and MobileNetV2 to achieve maximum accuracy. Coronavirus is the latest pandemic that has forced a global health emergency. It primarily spreads from person to person via airborne transmission and physical touch. Infectious infections have become more common all around the world. As a precaution, many countries have enacted tight restrictions about wearing a mask in public places. In this paper, a MobileNetV2 model which is CNN architecture are used for face mask detection is introduced.

Keywords: OpenCV, MobileNetV2, TensorFlow, Keras, COVID-19, Face Mask.

INTRODUCTION

As shown in a world Health Organisation (WHO) report, the Corona virus 2019, (COVID-19) has infected over 20 million individuals and killed over 750,000 people globally. It is the broadest classification for a RNA virus. In most cases, determining whether your fever is caused by coronavirus or another cold-causing virus is difficult. These illnesses have become increasingly frequent in recent years. People ought to be worried about their health and respiratory problems as a result. When an infected individual coughs, sneezes, speaks, sings, or breathes, the virus infects in microscopic liquid particles from their mouth or nose. Large pulmonary droplet to smaller aerosols are among the particles. The WHO also said that wearing a face mask could help prevent the spread of coronavirus and that the government has made it necessary for everyone to wear a face mask when leaving public places. And people with respiratory symptoms should definitely wear a face mask.

It is the same with the discovery system where the system detects a certain category of objects. By building this program trying to help ensure the safety of people in public places. Face-mask detection system that determines whether a person is wearing a mask or not. It is a two-stage system where we first train our system and then install the system to get a face. For best results, we used Keras / TensorFlow, MobileNetV2 and OpenCV and trained our model using a large database that covers the faces with and without mask. Faces are detected by the Harr Cascaded classifier

(Object detection model) and model will apply on detected area to check whether face has mask or not and give us probability of face with or without mask.

RELATED WORK

There are only few researches related to Face Mask Detection as it is related to a problem that has arrived recently. Here is the survey of some related work done in this field of study previously:

[1] This research study uses in-depth facial reading techniques and will determine whether a person is wearing a mask or not. The Raspberry Pi BCM2835 CPU processor is used for GPU-based architecture. OpenCV libraries are used for face detection and head tracking. The result is calculated using computer vision by OpenCV framework which shows a person around rectangular shape. For face detection they have used Haar like classifier and Adaboost algorithm to track faces and almost got 90% accuracy in experimental result.

[2] In this paper Convolutional Neural Networks (CNNs) are used for the image recognition model. The proposed method uses Key Component Analysis (PCA) and HAAR Cascade Algorithm. The dataset consists with and without masks 40 to 60 images of a person. Different modules are used for application. Based on the functionality and accuracy of the system, the result of the pairing will be displayed showing a green rectangle. Experimentation methodology for this system is Convolutional Neural Network and Deep Learning for Real Time Detection and Recognition of Human Faces got accuracy 92.74%.

[3] In this paper, the proposed model introduces a lightweight adoption model, developed based on Mobilenet-v2. The proposed real-time detector can be used in embedded systems with limited calculation resources. This is one of the key factors in the development of modern driving assistance systems (ADAS). In addition, the system also integrates the feature pyramid network (FPN) with the proposed object acquisition model in order to successfully improve acquisition accuracy and acquisition stability. Experimental results show that the proposed model for obtaining a lightweight object reaches up to 75.9% mAP accuracy in the VOC database. System used CNN and Mobilenet-V2 for experimentation purpose.

[4] This introduced an approach for detecting facial masks in videos using deep learning. The proposed framework capitalizes on the MTCNN face detection model to identify the faces and their corresponding facial landmarks present in the video frame. The methodology used in this system is MTCNN (Multi-task Cascaded Convolutional Networks) which is used to detect the faces from the frame and applying Mobilenet architecture for training the mask-detection model. Accuracy obtained
Limitations:

- The OpenCV Haar-based classifier was significantly faster. MTCNN detector has problems with live videos, the video started to lag. It could still run-on real time, but the quality wasn't as good.
- FPS rate >10 in real time detection which is very slow as compare to Haar-classifier.
- In system by using Haar classifier for detecting face instead of MTCNN will increase FPS rate as it is much faster than MTCNN

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[5] This paper proposes a new hybrid method for automatic detection and recognition of the presence or absence of a protective mask on human's face. It combines visual features extracted using Convolutional Neural Network (CNN) with image histograms that convey information about pixel intensity. Several pre-trained models for building feature extraction systems using a CNN and several types of image histograms are considered in this paper.
Limitations:

- Here they are using ResNet-50 which is big CNN architecture which is not suitable for low-end devices which will directly impact on the performance of model. MobileNetV2 is designed to be light-weight. It is much smaller and faster.
- MobilenetV2 architecture and resnet50 both are CNN architecture mobilenetV2 are much faster and lightweight than resnet-50 which will work faster with less resources on devices.

METHODS AND MATERIALS

The following are the some of the methods and tools suggested for the system.

A. TensorFlow

It is an interface for expressing machine learning algorithms, is utilized for implementing ML systems, it includes voice recognition, geographic information extraction, computer vision, text summarization, information retrieval, here the TensorFlow is used for computer vision which has varies functionality to work with computer vision. In the proposed model, the entire Sequential CNN MobileNetV2 architecture (containing a few layers) uses TensorFlow in the backend. TensorFlow in the background. It is also used to increase data size (image) in data processing.

B. Keras

Keras is library which is part of TensorFlow It takes full advantage of the power and cross-platform of TensorFlow. Keras key data structures for layers and models. All layers used in the CNN model are made using Keras. Along with the class vector conversion to a binary class matrix in data processing, it helps to integrate the overall model. Implementation of all required layer in CNN architecture (MobileNetV2) done using Keras. Loading of existing model which is CNN architecture MobileNetV2 done using keras.

C. MobileNetV2

MobileNetV2 is small, low latency, low power parameters models set to meet the device. It is CNN architecture introduced by Google which is already trained on millions of datasets. This model is loaded by using keras and add required hidden layers by using keras to achieve final output here the model is trained on two different classes which has with mask and without mask images.

D. OpenCV

OpenCV (Open-Source Computer Vision Library), an open-source software library, is used for segmentation and face recognition it recognizes objects it is also has many features like group movements in recordings, trace progressive modules. The proposed system makes use of these features of OpenCV in resizing and colour conversion of data images. Here by using OpenCV frames are read from live stream and the frame which is basically image give to Harr-cascaded Classifier which will detect faces from frame which will make task easy for model by directly giving image which has faces and model just required to detect mask on face from images in run time.

Proposed System

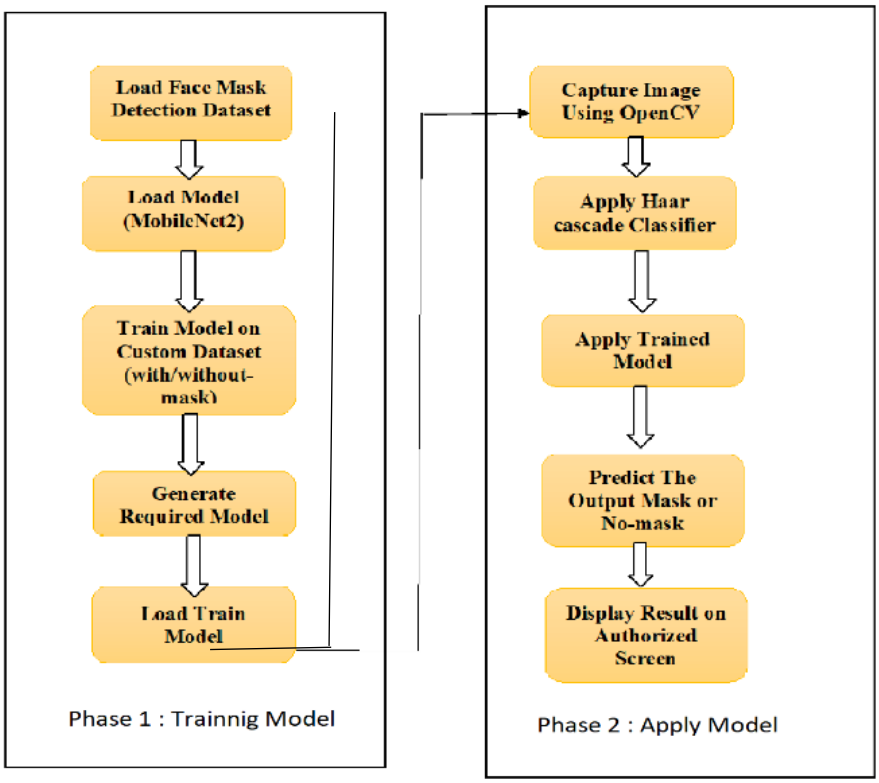

Fig.1 System Architecture

Phase1: Training model

The training phase program is trained in the required database. Here the system train on custom dataset which has two classes i.e., with-mask and without-mask. System has been implemented for face mask detection in order to detect mask on face system need to train on such dataset which has faces with and without mask to predict whether the face has mask or not. So, model (MobileNetV2) is CNN architecture which is already trained on millions of classes so in order to increase accuracy model again trained on dataset with two classes add them to MobileNetV2 architecture to get the final intended output.

Phase2: Apply model

Once the face mask detector is trained, then trained model loading is done in order to perform face detection, and then classifying each face as with mask or without mask and according to the result probability the result will be display on screen with rectangle on faces with label of mask and without mask.

Overall Flow of execution

- In this Module we are able to capture real-time images in videos. this is done with the help of the OpenCV library. A featured image is required from the live stream to proceed to the next stage.

- The input image is captured from a webcam or camera in real-time world. From input images Facial images are captured by HAAR cascade and resized after they have been loaded. In simple word it detects the faces from the frame which is coming from web-cam and give the coordinates for the faces. After detecting the faces from the frame, the all the feces are covert into same size and give the input image to pretrained model and prediction of the face mask is take place whether the face has mask or not and display output on screen.
- HAAR cascade gives coordinates for all faces in frame which is required to display bounded box on face with prediction along with accuracy.

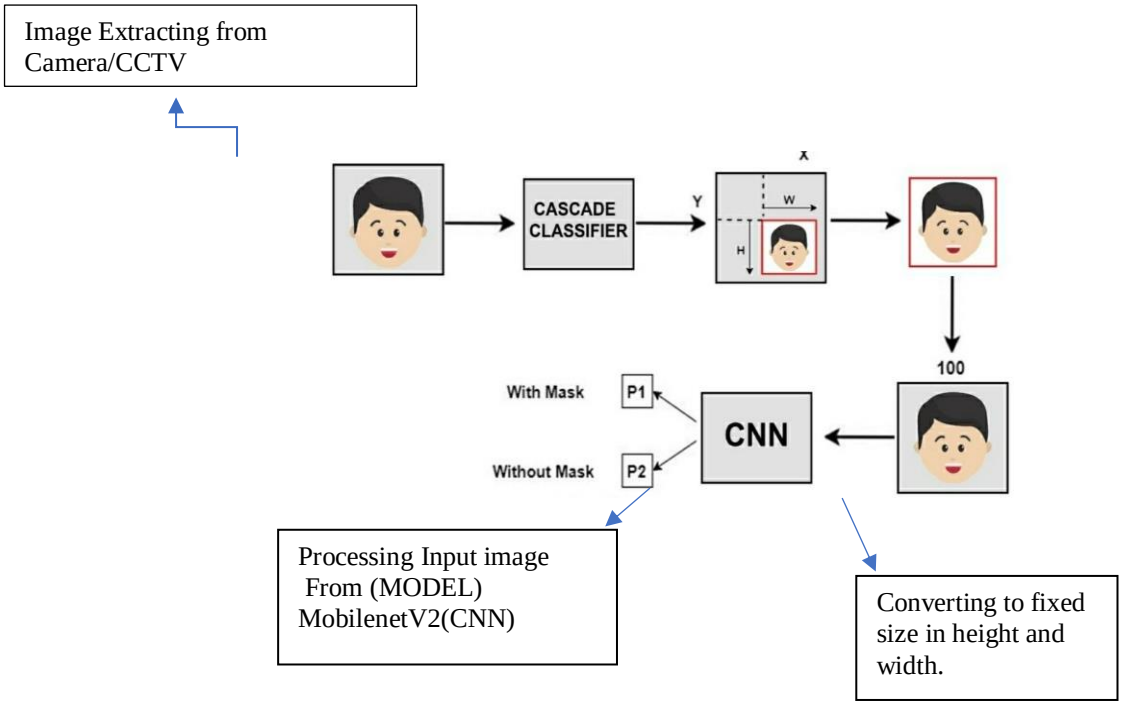

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Fig.2 HAAR cascades model flow of execution

Here in above figure HAAR cascaded module is explained. Which is used for detection of faces from images.

- In step 1 image is extracted from CCTV or camera while streaming open-Cv give the frame as image input to haar-classifier.
- After capturing the images, it will pass to cascade classifier.
- Cascade classifier algorithm helps to capture facial images by giving coordinates of faces from given frame input of opencv image.

All images are converted into fixed size and passed to CNN algorithm for processing and to give prediction of resulting output

Expected Result Analysis

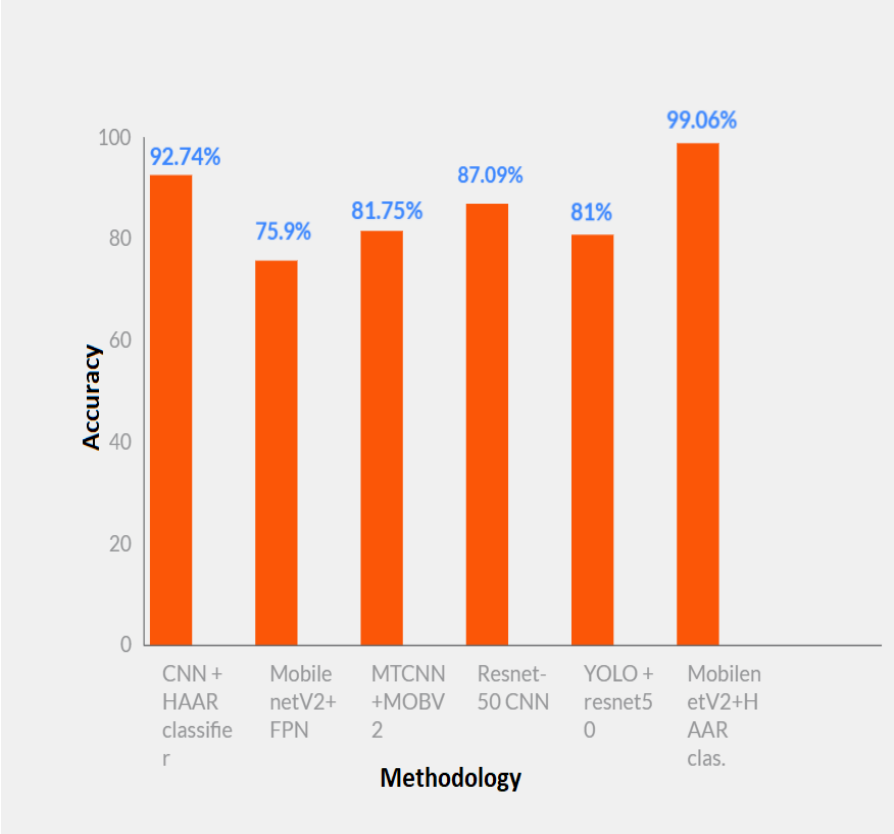

Fig.3 accuracy comparisons

- Above figure shows the comparison of different object classification methodology and their accuracy.
- First methodology is CNN+HAAR which is based on CNN algorithm for training which is very efficient in object classification.
- In second methodology MobilenetV2 module is used which is light weight architecture combined with FPN which is feature extraction and takes single stage image.
- MTCNN is a framework for face detection and MobilenetV2 for classification which give pretty good accuracy.
- Resnet-50 and CNN is residual learning which is which is more accurate than MobilenetV2+FPN and MTCNN+MOBV2
- YOLO+resnet50 YOLO is used for detection of face mask where resnet50 YOLO is used for feature extraction process combination of both modules decreased the accuracy.
- Last architecture is combination of MobilenetV2 and HAAR cascade where MobilenetV2 is used for image classification model and HAAR is for facial image extraction. Combination of these two models increases accuracy as both are lightweight and more efficient.

CONCLUSION

In this paper we have introduced a method which can detect a face mask in real time world. System predicts output which shows that a person is wearing a mask or not and shows a live image of person on the screen. Facial classifier is built using Deep learning method. Haar cascade classifier is used for face detection and in this system Mobile net version 2 architecture introduced by google which works better on low-end devices and gives much good accuracy which is also the CNN architecture. Proposed CNN system gives greater accuracy and expected improved result for this system.

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