DETECTION OF FACE MASK FROM THE LIVE VIDEO, USING CNN

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Abstract: The corona virus disease 2019 (COVID-19) has greatly affected the world. One of the most important ways of protection is to wear masks in public areas. In addition, the utility service providers provide the service to their customers, only if they wear masks. The proposed hybrid model is based on CNN, deep learning and machine learning, which are used to provide an efficient approach for the detection of the mask and also gives high accuracy. The approach considers the pictures with mask and without mask, to create a real-time face detection technology with the help of live stream via webcam. The goal of this project is to determine whether or not a person is wearing a face mask or not, with the help of computer vision and deep learning.

IndexTerms - Face Mask Detection, CNN, Deep Learning, Machine Learning.

I. INTRODUCTION

Earlier, in foreign countries, people used to wear masks for protecting their skin and themselves from dust, air pollution, etc., whereas other people used the masks for hiding their emotions. In the public service places, wearing a mask is compulsory for everyone. If a person does not wear mask, one cannot identify them or monitor in the huge crowd. Now, we introduced an automation process for detecting the people without masks, through surveillance cameras. The Face mask detection model is integrated with deep learning and with OpenCV, Keras, Tensor flow, etc… for building Convolution Neural Network (CNN) by extracting the features of the images.

II. RELATED WORK

1) (Ejaz et al. 2019) performed face detection technology on the masked and unmasked faces with the help of Principal component Analysis (PCA). However, the recognition accuracy is reduced by up to as much as 70% of the detected face.
2) Cabani et al. [41] proposed the images of masked men, based on the facial features and produced a large data set of the 137,016 images of masked men, which has more data for the study. However, the data that have been obtained in [41] to some extent, may not apply to the real world scenario, and does not take account of detection speed.
3) Traditional algorithms, such as the Hair-cascading down the Alt key and Jones, 2001), HOG (Dalal and Triggs, 2005), and have been proven to be effective for such the tasks, however, these algorithms are largely based on the feature. In the era of Deep Learning, it is possible to train neural networks that do not need any extra feature development.

III. METHODOLOGY

Convolution Neural Network (CNN) is used as the methodology for image classification and it contains four modules as

1) Data collection : Collection of thousands of images with masks and without masks. Our Dataset consists of 1376 images in which the images with people wearing face masks are 690 and the rest images are with people not wearing face masks, i.e, 686.

2) Preprocessing of data : The images that are collected are converted from a given a format to more meaningful format, i.e, transformed into same size, same image format and the features are also extracted

3) Training and testing the model : At first, build a model using CNN architecture. The CNN architecture consists of multiple layers, such as input, convolution, pooling, flatten, dense and output layers.

i. Convolution Layer: It works as input layer in CNN, which takes 128x128x3 as input size of image, where the image is of 3x3 matrix. This layer is mainly used for image classification and image analysis. This layer consists of set of independent filters, where each filter is convolved with the image that results in 32 feature maps.

ii. Max-pooling Layer: From the above 3x3 matrix which has only the highest weighted feature is converted into 2x2 matrix. This is called as highest weighted feature extraction. This layer is used for reducing the spatial dimensions of the output volume

iii. Flatten Layer: Flatten layer converts the matrix of image into one single dimension array which acts as an input to the dense layer, i.e, this layer transforms the matrix of features into a vector that can be given to a fully connected neural network classifier.

iv. Dense Layer: The Dense layer is a neural network layer that is connected deeply, which means each neuron in this layer receives input from all neurons of its previous layer. It also performs a matrix-vector multiplication. The values used in the matrix are actually parameters and can be trained with the help of backpropagation.

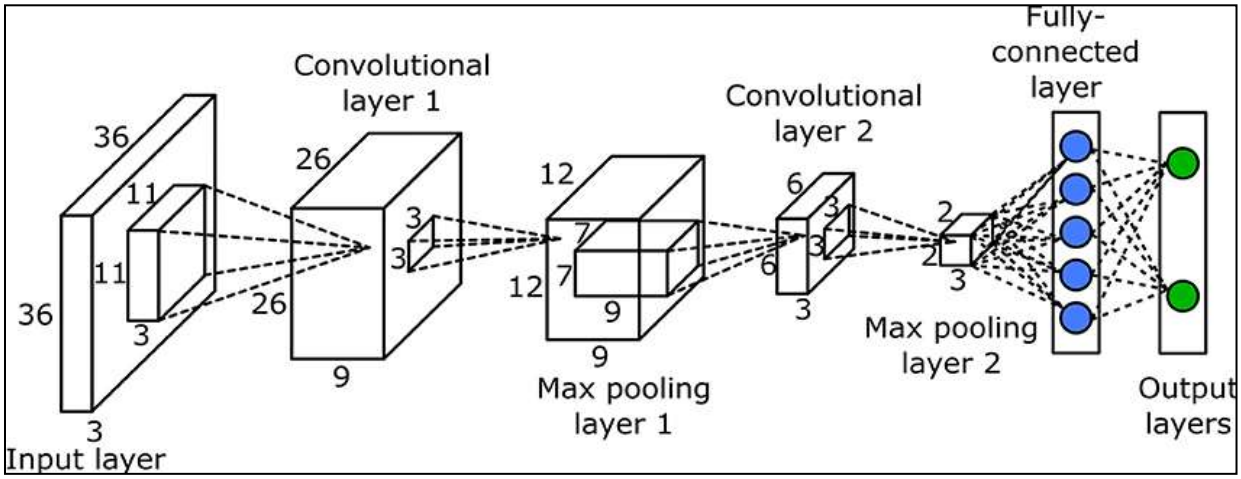


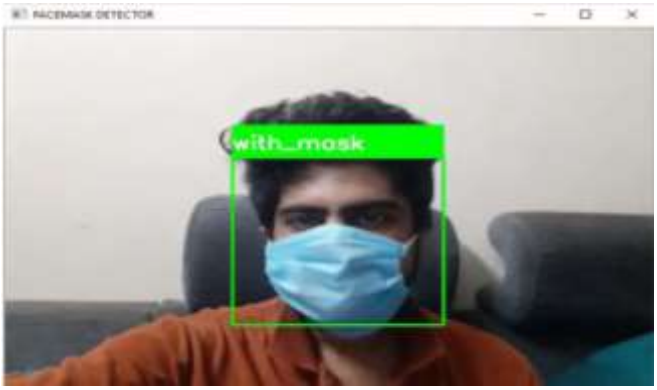
Fig 3.1: Convolution Neural Network

v. Output layer: Softmax layer is the last layer that produces the output of the network, which is also called as sigmoid neuron. It produces the output, depending on the solving task, that can be a binary or multiclass classification. This layer uses the softmax function, which is a mathematical function that is used to normalize the outputs, where the weighted sum values are converted into probabilities that sum to one. After building the model, need to visualize the data, i.e, images with masks and without masks, later the data has to be splitted. The 90% of data undergoes for training and 10% of data for testing.

4) Prediction of model: After train and test, 20% of training data is used as validation data. For predicting, first import the dataset from keras and import tkinter, messagebox. After importing the tkinter, initialize it and load the trained model. After that, camera opens and depicts whether a person is wearing mask or not. In the prediction, the accuracy will be attained, which can be upto 92%.

IV. RESULTS & DISCUSSION

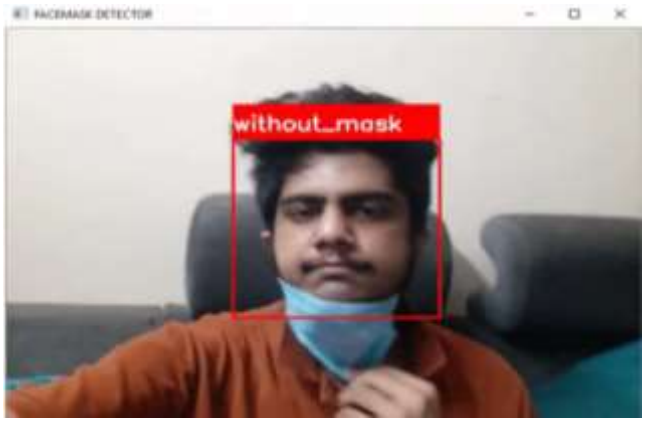
Results: When a person stands in front of a camera or in a surveillance place and wearing a face mask the output is displayed as "with mask". Below is an image of a person wearing a mask.



If a person is not wearing a face mask the output is displayed as "without mask", gives alert message and sends a message to the administrator.

```
In [ ]: SUBJECT = "Subject"
TEXT = "One Visitor violated Face Mask Policy. See in the camera to recognize user.Please Alert the authorities."

while(True):

    ret,img=source.read()
    gray=cv2.cvtColor(img,cv2.COLOR_BGR2GRAY)
    faces=face_clsfr.detectMultiScale(gray,1.3,5)

    for x,y,w,h in faces:

        face_img=gray[y:y+w,x:x+w]
        resized=cv2.resize(face_img,(100,100))
        normalized=resized/255.0
        reshaped=np.reshape(normalized,(1,100,100,1))
        result=model.predict(reshaped)

        label=np.argmax(result,axis=1)[0]

        cv2.rectangle(img,(x,y),(x+w,y+h),color_dict[label],2)
        cv2.rectangle(img,(x,y-40),(x+w,y),color_dict[label],-1)
        cv2.putText(img, labels_dict[label], (x, y-10),cv2.FONT_HERSHEY_SIMPLEX,0.8,(255,255,255),2)

         # If label = 1 then it means wearing No Mask and 0 means wearing Mask
        if (label == 1):
            # Throw a Warning Message to tell user to wear a mask if not wearing one. This will stay
            #open and No Access will be given He/She wears the mask

            messagebox.showwarning("Warning","Access Denied. Please wear a Face Mask")
            # Send an email to the administrator if access denied/user not wearing face mask
            message = 'Subject: {}\n\n{}'.format(SUBJECT, TEXT)
            mail = smtplib.SMTP('smtp.gmail.com', 587)
            mail.ehlo()
            mail.starttls()
            mail.login('ushanvitha@gmail.com','@usha596')
```

Below is an image of a person, not wearing or removing the mask.



As the person is not wearing the mask or removing the mask, a mail is sent to the administrator to recognise and alert the authorities.

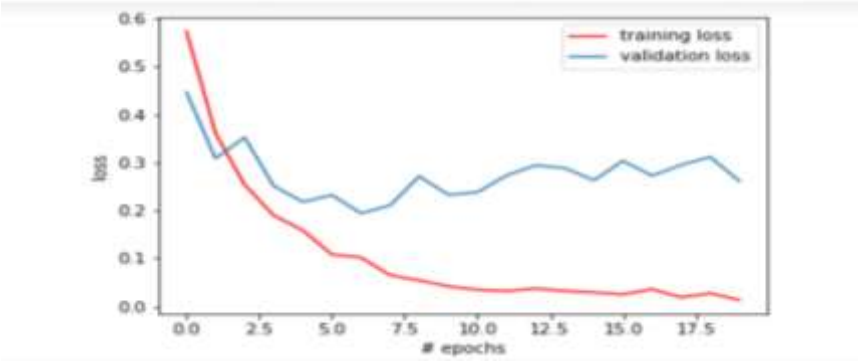
Discussions: The Convolutional Neural Network (CNN) is a very powerful and robust algorithm that is widely used for image classification and object recognition tasks. The CNN model created in this study is mostly suited for mobile devices because it has

low latency, maintains high accuracy, and takes less computational power. CNN automatically detects the important features without any human supervision. CNN gives the best accuracy for image classification among all the other algorithms.

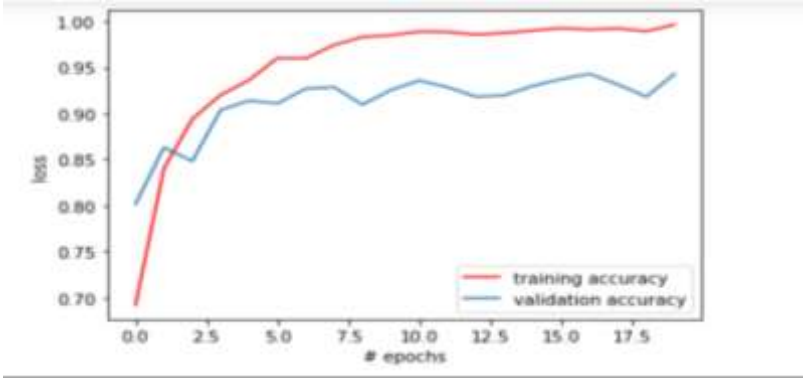
After execution of the project, the output on each epoch shows the loss and accuracy on both the training dataset and the validation dataset.

```
In [7]: print(model.evaluate(test_data,test_target))

381/381 [==============================] - 15s 40ms/step
[0.22893743595387053, 0.9212598204612732]
```

The following diagram shows epochs and the loss.



The following diagram shows the accuracy.



V. CONCLUSION

By wearing the mask, one can prevent the public from the virus transmission. So, developing an efficient approach that uses Convolutional Neural Network (CNN) and considers the pictures with and without masks and detects whether a person is wearing a mask or not, through the live stream via webcam. This model gives the high accuracy solution.

VI. FUTURE WORK

People should cover their faces in public places, supermarkets, public transport, offices, and retail stores. Retail businesses often make use of the software to count the number of people entering their stores, who just wants to enjoy watching the show on the digital display and advertisement screens. We are going to improve the face detection tool and the release of an open source project. We try to be the same as an existing one, USB cameras, IP cameras and CCTV cameras to detect people without a mask. This is a simple case of detection that can be implemented in a web, and desktop apps, so that the operator will be able to see the messages and notification. Program providers can also provide an image, in this case, if the person was not wearing a mask. In addition, an alarm system can also be implemented, when a person without a mask is recognised. It can also be plugged into the entrance gateways and only people wearing face masks can come in.

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