Detection of Face Mask Using Deep Learning

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***Abstract*—Today the biggest problem the world is facing above all the natural disasters is the Covid-19. It's been more than a year but the solution to the issue is still at a far fetch. However, we still have few ways to control the outbreak as instructed by the WHO (World Health Organization). A few among them are wearing a mask and maintaining social distance. The objective of the paper is to detect face masks in a public gathering or an event. The algorithm used in this paper to achieve the objective is MobileNet V2. An image of a few people wearing a mask and without wearing a mask is used as an input dataset. The proposed process includes dataset pre-processing, data augmentation, training, testing and image segmentation. With the help of the Mask R-CNN algorithm, will get a segmented image of the input dataset of people wearing a mask and people not wearing a mask. The proposed algorithm can be merged with real time applications at airports, railway stations, workplaces, schools, and other public places to ensure compliance with the guidelines for public safety.**

***Indexed Terms*—Face Mask, Covid-19, Convolutional Neural Networks, Deeplearning, Mobile Net V2, Twitter.**

INTRODUCTION

The objective of the paper is to develop a model which can be used to detect face masks in a group of people to prevent Covid-19. It is created using MobileNetV2.For the past 2 years, because of the deadly virus Covid-19, the entire world has taken a spin from its routine. The spread of Covid is still evident in most places with new variants of the same virus. One thing that has become common while going out nowadays is the face mask. But still there are many people unaware of the situation and refusing / avoiding to wear a face mask. This project helps in identifying people who are not wearing a face mask. With the one of the common things added like wallet or hand bags, face mask has become the latest one added.

In the middle of Covid-19 crisis, wearing masks is a fundamental need nowadays. In public places because of the large volume of people it becomes tough for security officials to check every person who is not wearing a mask. This model detects a single person wearing a mask or not. Implementing a similar principle to evaluate a group of people wearing masks is the real challenge. CNN model is proposed for face mask detection. Object detection when applied on faces helps in detecting faces in the image. Face mask detection refers to detecting faces in the image and then classifying each face as with mask or without mask.

LITERATUREREVIEW

Kaiming He and Xiang Yu Zhang proposed that Deeper neural networks are more difficult to train. They presented a residual learning framework to ease the training of networks are substantially deeper than those used previously. They explicitly reformulated the layers as learning residual functions with reference to the layer inputs, instead of learning unreferenced functions. They provide comprehensive empirical evidence showing that these residual networks are easier to optimize, and can gain accuracy from considerably increased depth. On the ImageNet dataset we evaluate residual nets with a depth of up to 152 layers---8x deeper than VGG nets but still having lower complexity.

An ensemble of these residual nets achieves 3.57% error on the ImageNet test set. This result won the 1st place on the ILSVRC 2015 classification task. We also present analysis on CIFAR-10 with 100 and 1000 layers. The depth of representations is of central importance for many visual recognition tasks. Solely due to our extremely deep representations, we obtain a 28% relative improvement on the COCO object detection dataset. Deep residual nets are foundations of our submissions to ILSVRC & COCO 2015 competitions, where we also won the 1st places on the tasks of ImageNet detection, ImageNet localization, COCO detection, and COCO segmentation.

Jansi Rani Sella Veluswami 2021, proposed model was trained on a database of over 11,000 images of faces either with or without masks, employing numerous deep learning techniques. A SSDNET model is being deployed for face detection, the output of which is passed to a custom- made Lightweight CNN for mask detection. On two distinct testing datasets, the model obtains a remarkable accuracy of 96%. The model will help government agencies and health officials fight the global pandemic.

Prathmesh Deval, 2021, contemplated developing a detection system for face masks connected with digital healthcare services. By used OpenCV Prathmesh Deval, 2021, contemplated developing a detection system for face masks connected with digital healthcare services. By used OpenCV, to get access to the live video stream and also for image pre-processing. For face detection, Haar-Cascade will be used, as it is a very effective face detection method. Figure4 depicts the system's design, which demonstrate show it works automatically to avoid the expansion of COVID19.

The research uses advanced learning algorithms to recognize various facial features and determine whether or not person is employing the face mask. The system deals with Face Mask detection in real-time and also helps in reducing the transmission rate. The system also provides few digital facilities for receptionists and doctors.

A. Krizhevsky, I. Sutskever and G. E. Hinton trained a large, deep convolutional neural network to classify the 1.2 million high-resolution images in the ImageNet LSVRC-2010 contest into the 1000 different classes. On the test data, they achieved top-1 and top-5 error rates of 37.5% and 17.0% which is considerably better than the previous state-of-the-art. The neural network, which has 60 million parameters and 650,000 neurons, consists of five convolutional layers, some of which are followed by max-pooling layers, and three fully-connected layers with a final 1000-way soft max. To make training faster, they used non-saturating neurons and a very efficient GPU implementation of the convolution operation. To reduce over fitting in the fully-connected layers they employed a recently-developed regularization method called "dropout" that proved to be very effective. They also entered a variant of this model in the ILSVRC-2012 competition and achieved a winning top-5 test error rate of 15.3%, compared to 26.2% achieved by the second-best entry.

PROPOSEDSYSTEM& RESULTS

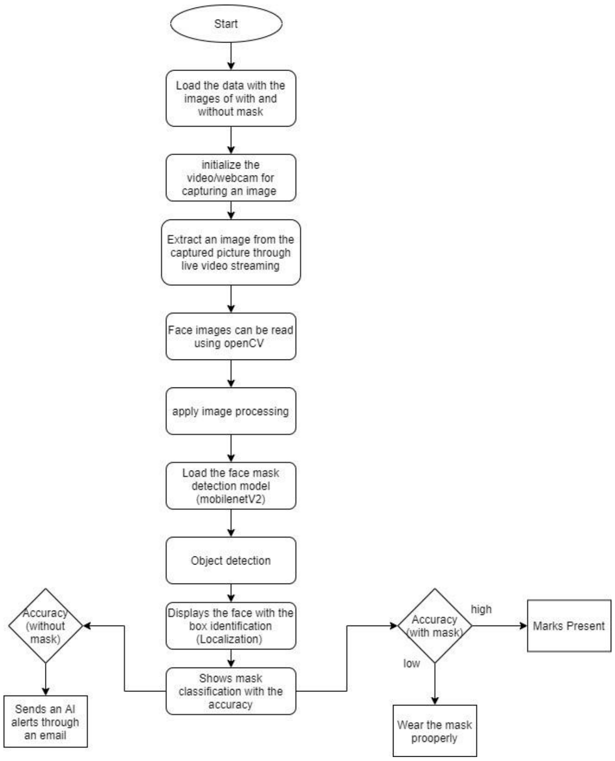
The proposed CNN, classifies faces with and without masks as the output layer of proposed CNN architecture contains two neurons with SoftMax activation to classify the same. Categorical cross-entropy is employed as loss function. The proposed model has Validation accuracy of 96%. If anyone in the video stream is not wearing a protective mask a Red coloured rectangle is drawn around the face with a dialog entitled as NO MASK and a Green coloured rectangle is drawn around the face of a person wearing MASK.

The model proposed here is designed and modeled using python libraries namely Tensorflow, Keras and OpenCV. The model we used is the MobileNetV2 of convolutional neural network. The method of using MobileNetV2 is called using Transfer Learning. Transfer learning is using some pre trained model to train your present model and get the prediction which saves time and makes using training the different models easy. We tune the model with the hyper parameters :learning rate, number of epochs and batch size. The model is trained with a dataset of images with two class, with mask and without mask. The dataset has 993 images of with mask class and 1918imagesofwithoutmask class.

(i) Training the model with the taken dataset.

(ii) Deploying the model

In this paper we have developed a model using the above mentioned libraries. We have tested the model for different conditions with different hyper parameters, for which the results are mentioned in the next section. First we feed the dataset in the model, run the training program, which trains the model on the given dataset. Then we run the detection program, which turns on the video stream, captures the frames continuously from the video stream with an anchor box using object detection process. This is passed through the MobileNetV2 model layers which classifies the image as with or without mask. If the person is wearing a mask, a green anchor box is displayed and red if not wearing a mask with the accuracy for the same tagged on the anchor box. Figure.1 shows the flowchart of the Face Mask Detection model used in this paper.



Firure.1. Flow Chart of the proposed model

Sample Python code for Face Mask Detection:

```
# load the face mask detector model from disk
print("[INFO] loading face mask detector model...")
maskNet = load_model(args["model"])
# initialize the video stream and allow the camera sensor to warm up
print("[INFO] starting video stream...")
vs = VideoStream(src=0). Start ()
time. sleep(1.0)
# loop over the frames from the video stream
while True:
   # grab the frame from the threaded video stream and resize it
   # to have a maximum width of 400 pixels
   frame = vs. read ()
   frame = imutils. resize (frame, width=800)
   # detect faces in the frame and determine if they are wearing a
   # face mask or not
   (locs, preds) = detect_and_predict_mask (frame, faceNet, maskNet)
# loop over the detected face locations and their corresponding
   # locations
   for (box, pred) in zip (locs, preds):
      # unpack the bounding box and predictions
      (startX, startY, endX, endY) = box
      (mask, withoutMask) = pred
# determine the class label and color we'll use to draw
      # the bounding box and text
      label = "Mask" if mask > withoutMask else "No Mask"
      color = (0, 255, 0) if label == "Mask" else (0, 0, 255)
      # include the probability in the label
      label = "{}: {:.2f} %". format (label, max(mask, withoutMask) * 100)
# display the label and bounding box rectangle on the output
      # frame
      cv2.putText(frame, label, (startX, startY - 10),
         cv2.FONT_HERSHEY_SIMPLEX, 0.45, color, 2)
  cv2.rectangle(frame, (startX, startY), (endX, endY), color, 2)
   # show the output frame
   cv2.imshow("Frame", frame)
   key = cv2.waitKey(1) & 0xFF
```

Test Results:

The proposed algorithm identifies the persons who are not wearing the mask as shown in the figure.2.

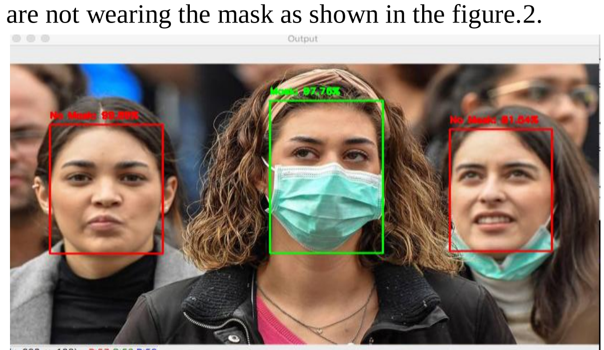


Figure.2. Test Results- identified the persons who did not wear the mask

IV.CONCLUSION

The spread of Covid-19 is increasing every day in every corner of the world. This needs to be controlled to get back to our normal lives. While the specialists take care of the vaccine part, we can help them by following the guidelines provided by WHO to remove/control the spread of this virus. The objective of the project is to recognize people wearing and not wearing masks using MobilenetV2. This algorithm is used to convert an input image of a crowded place into our expected output which is identifying people not wearing a mask. Finally evaluating the numerical results. With the help of this project implemented in proper circumstances, it can help to detect people who are not wearing masks. This could help health and sanitary officials to implement the WHO guidelines in a much better way. This project is tested in a webcam using the above discussed methods and the results are as expected. With wide use of this project in public gatherings and crowded localities, it will be easier to detect people violating the use of masks.

As the technology is blooming with emerging trends, the availability of the novel face mask detector can possibly contribute towards public healthcare. The architecture consists of Mobile Net as the backbone and it can be used for high and low computation scenarios. In order to extract more robust features, we utilize transfer learning to adopt weights from a similar task face detection, which is trained on a very large dataset. We used OpenCV, tensor flow, and NN to detect whether people were wearing face masks or not. The models were tested with images and real-time video streams. The accuracy of the model is achieved and, the optimization of the model is a continuous process and we are building a highly accurate solution by tuning the hyper parameters. This specific model could be used as a use case for edge analytics. Furthermore, the proposed method achieves state-of-the-art results on a public face mask dataset.

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