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Real Time Face Mask Detection with Deep Learning

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Abstract

The pandemic because of COVID-19 needs no introduction. An all-too-important and successful weapon against it has been the utilization of face masks. A special technique is presented in this paper for detecting automatically whether someone is wearing a mask or not, contingent on the machine learning technique. The findings can be utilized by authorities to warn or fine people for not wearing mask, especially at public places. This work relies on deep learning through neural networks, specifically, MobileNetV2, trained and examined on images of people faces with and without masks, collected from different sources. The accuracy of the detection is 96% on the test dataset whereas the most effective result in the literature is 92% or lower.

Keywords: Automatic mask detection, Deep learning, coronavirus, COVID-19, CNN, mobilenetV2

INTRODUCTION

A major precaution against the spread of COVID-19 is face masks. They have been mandated and emphasized by the governments of various countries, based on the rules by the world Health Organization (WHO). As per the WHO, masks are often used for control of source (worn by infected people to inhibit further transmission) or for the protection of non-infected people. Automatic face-mask detection presently is transpiring as a very interesting problem in image processing and computer vision.

The aim is to notice spontaneously whether someone is wearing a mask or not. We present here a unique model contingent on neural networks, specifically, convolutional neural networks, with an accuracy of 96%. Thanks to our work, governments and forces will be able to find out if there are territories or regions and perhaps even particular timings when people aren't wearing face masks.

LITERATURE REVIEW

1. Jinsu Lee et al. presented a model called "An Ensemble Method of CNN models for Object Detection". This Research focuses on detecting articles of a certain class in digital images and videos. They use deep learning, specifically, CNNs. they divided their work into two phases. Within the first phase, they perform two stage detection where region proposals are generated. In the second phase, there's a one-stage detector that helps to detect and classify the item without generating region proposals. They combine the varied properties of CNN models, up to date methods to detect objects and their unique methods for model selecting and box voting. Overall, with experimental proof, they report an increased model accuracy.
2. Sebastian Handrich et al. presented a technique called "Face Attribute Detection with MobileNetV2 and NasNet Mobile". In their work, they gave two simple and effective methods for evaluating facial attributes in unconstrained photos or pictures, using straight

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forward and fast face-alignment techniques for pre-processing. MobilNetV2 and NasNet-Mobile were utilized to estimate face attributes. They compare the model, with respect to time interval and accuracy, and show that the approach performs faster than the state-of-the-art model. This version was easy to use and install in mobile devices.

3. Amit Verma et al. presented a system “Facial Mask Detection using Semantic segmentation”. the major aim of this paper is to style a binary classifier which will be able to recognize faces in a frame (image). Slope steep is used for training the model. Overall, the model provides great precision.
4. Md.Sabbir Ejaz et al. presented “Implementation of principal component Analysis on masked and unmasked face recognition”, considering safety as the main objective of their research. They specialize in providing security in biometric systems, using faces as the input. They did this by using PCA for identification of faces with and without masks. They reported that faces without masks get perceived better using PCA rather than faces with a mask.
5. Md.Sanzidul Islam et al. presented “A Deep learning based assistive system to classify a face for human safety” using YOLOv3 architecture. Their work focuses on building a custom item recognition and a deep learning framework to detect face masks from a video tape.
6. Aniruddha Srinivasa Jsohi et al. has presented a framework capitalizes on the MTCNN face detection design which recognizes faces and facial landmarks present in a video tape. MobileNetV2 architecture is employed for object detection on the face. The device is tested with a many videos that contain movement of individuals in different areas.
7. Pathasu Doungmala et al. has presented a “Helmet detection in Thailand” using image processing. Two methods are used here: like-feature, which is employed for face detection circle, and Hough transform, for no and half helmets. Their research uses a quick algorithm for detecting helmets in pictures by concentrating on features for recognizing helmet regions like face, nose, eyes etc.
8. Zhelin Li et al.“Ship detection and classification based on SSD_MobilenetV2”. The model proposed by these authors concentrate on ship image detection. Feature extraction of the pictures is allotted using MobileNetV2. “coco” dataset is employed for rehearsal. A constructed dataset is employed for fine-tuning. The results of the model show RCNN_InceptionV2 algorithm has better recognition accuracy.
9. Rohith CA et al. presented a model “An Efficient Helmet Detection for MVD using Deep learning”. Transfer learning and fine-tuning techniques were utilized to create a device for identifying vehicles based on videos and to capture pictures from a frame, to verify whether someone is wearing a helmet or not.

METHODOLOGY

Our method uses the Convolutional Neural Networks (CNN) to analyze images as having a mask or not. A Convolutional Neural Network is a kind of deep learning algorithm which takes an image as input. It then maps the different characteristics of the image, due to which they become differentiable from one another. The purpose to select CNN for categorization over other categorization models is because the number of preprocessing required for CNN is way less

We have designed a model which uses MobileNetV2 for image processing. It’s a CNN (Figure 1) that's 53 layers deep. It can classify images into 1000 categories. It uses depth-wise separable convolutions which constitute as the building blocks. it is the state-of-the-art network for mobile visual recognition which has classification, object detection and semantic segmentation. MobileNetV2 (Figure 2) is launched as a bit of TensorFlow-Slim Image Classification Library.

The intuition behind MobilNetV2 relies on the fact that the bottleneck layers (Figure 2) encode the model’s input and output, whereas the under layers encloses the model’s ability to evolve from low-level concepts to high level concepts. In our case, it's the conversion from pixels to image categories.

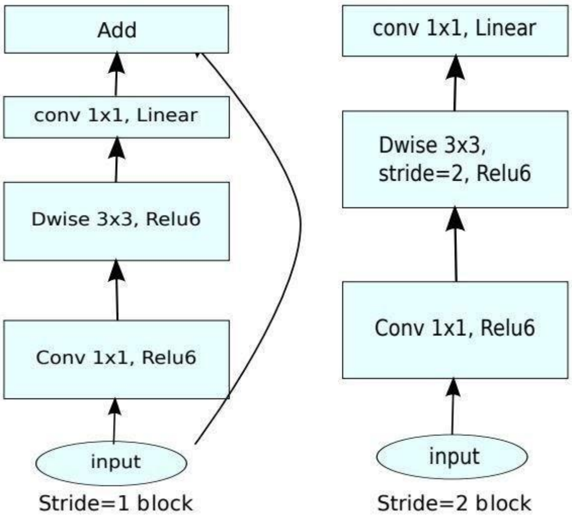

Figure 1. Comparison of MobilNet V1 and V2.

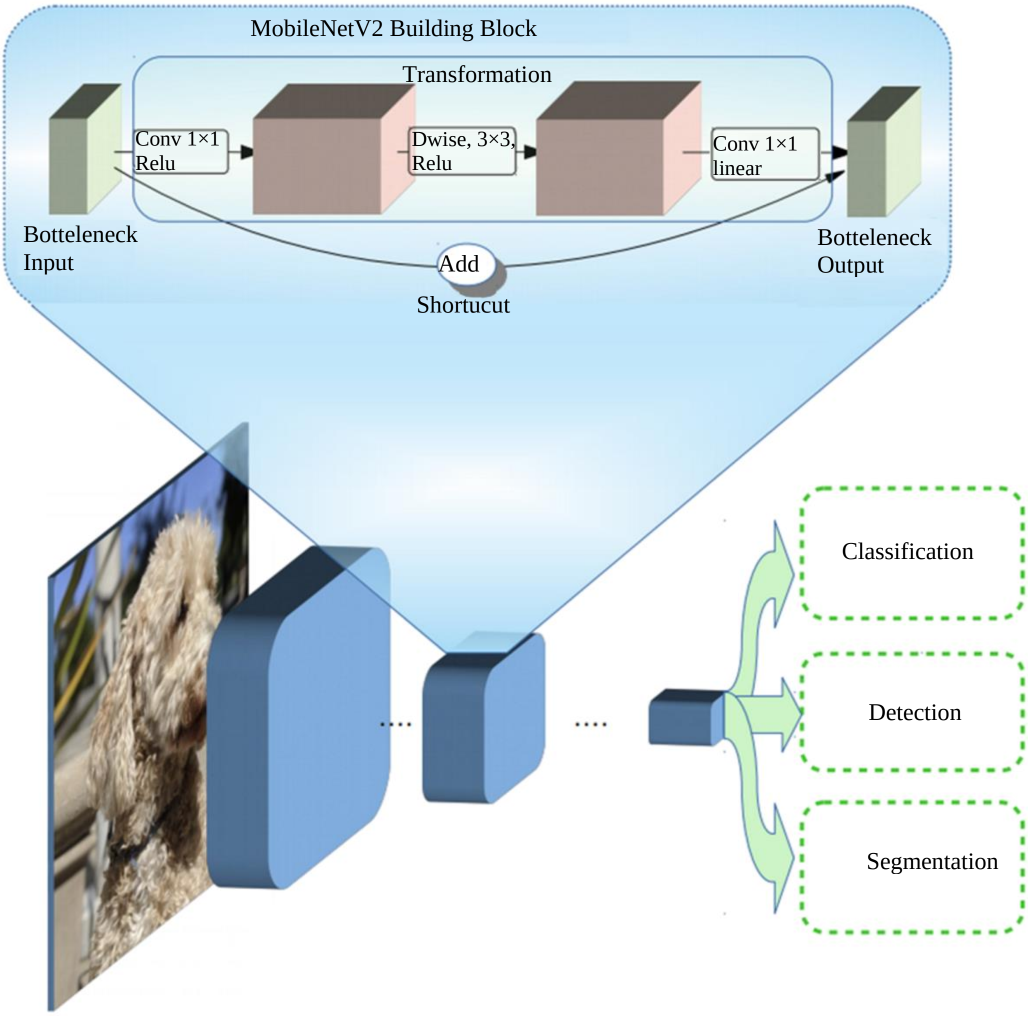

Figure 2. MobilNet V2 Architecture.

It is faster in comparison with MobileNetV1 because it uses much fewer operations and it needs less number of parameters. As a result, it gives higher accuracy for the same latency value as shown in Figure 3.

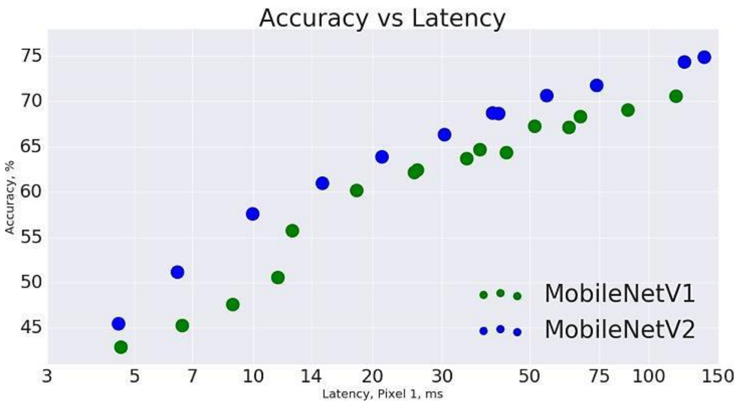

Figure 3. Accuracy Vs Latency.

Average Pooling 2D: This layer calculates the mean value for the patches in a featured map. It then creates a feature map which is down sampled.

Flatten: This layer changes the grouped feature map to one column.

Dense: This layer gives all outputs from the previous layers to the neurons. Then each neuron returns one output to the following corresponding layer.

Dropout: This layer helps to stop over fitting. It sets the initial value to 0 on a random basis throughout the grounding of the model (with reference Figure 3).

Implementation

The presented model focuses on detecting people in images whether they are wearing a mask and not, using Keras, TensorFlow and MobilNetV2. These are open-source libraries implemented in Python. CNNs are Neural Networks that have proven to be very accurate and effective in areas of image classification.

In machine learning, a convolutional neural network is a deep, feed-forward artificial neural networks (referred to as multilayer perceptron), used to analyse visual imagery. They have been existing for an extended time now but became very useful with the provision of massively labeled datasets and high converting capacity. It is a deep learning algorithm in which it extracts input as an image, uses weights and biases and outputs the category of the images.

Our approach consists of the subsequent phases:

Data preprocessing: preparing and examining of the MobileNetV2 model using the corresponding dataset of images.

Classifying new (unseen) images at real-time when a picture or a video is streamed.

Data Preprocessing

The dataset used [Kaggle] contains a complete of 1715 images in which 817 images are people faces without a mask and 898 with a mask each. 75% of the images from the dataset are used for training and 25% of the images are used for testing the model. The images in our dataset are processed as mentioned below:

1. Rescale the input images and crop the image with the pixel value of 224 × 224 × 3 via buildup.
2. Apply colour filtering (RGB) over the channels (Our model MobileNetV2 supports 2-dimensional three-channel images).

3. Normalize images using ImageDataGenerator of the Keras library. Sample the images to a set resolution of 256*256 by extracting random 224*224 patches from 256*256 images.
4. Finally, converting them into tensors, similar to NumPy arrays.

Our goal is to require a replacement image that falls into a category we have trained and run it through a command which will tell us the category during which the image fits--“mask” or “no mask” category (Figure 4).

REAL-TIME CLASSIFICATION OF STREAMED IMAGES

This is achieved by creating separate classes. The steps involved are as follows.

1. Get the image stream from a webcam.
2. Detect faces with OpenCV and add bounding boxes.
3. Convert the faces to grayscale, rescale them and send them to our pre-trained network.
4. Get the predictions back from our network and add the label to the webcam image. Figures 5, 6, 7 and 8 illustrate it.
5. Return the final image stream. The accuracy on the validation dataset is 96%

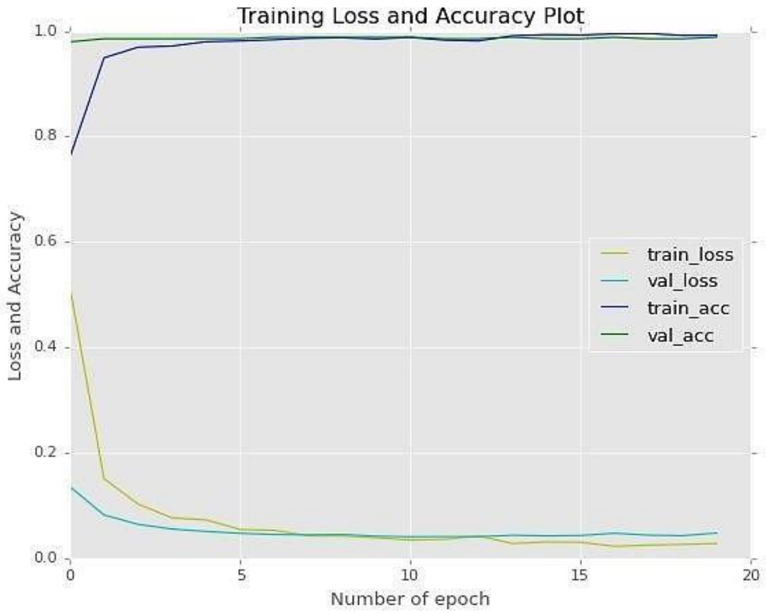

Figure 4. Training Accuracy Plot.

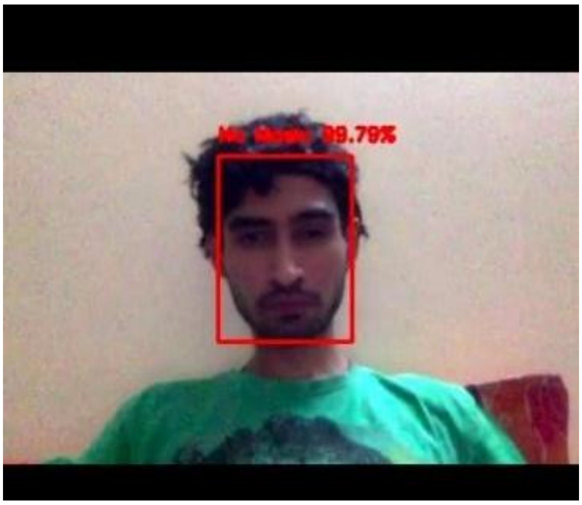

Figure 5. Real time image with no mask.

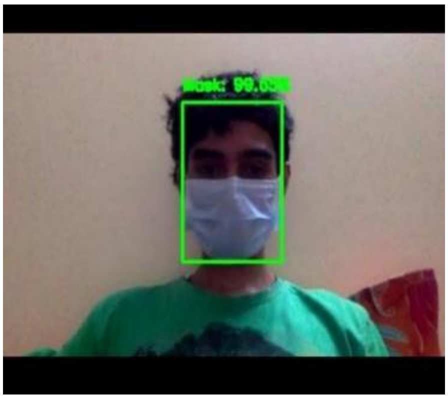

Figure 6. Real time image with a mask

Figure 7. Real time image with no mask.

Figure 8. Real time image with a mask.

RESULTS

Results of this Study is presented in Figure 4–8

CONCLUSION AND FUTURE WORK

As the world is fighting the COVID-19 pandemic, we have developed a unique solution for detecting whether a given image of an individual contains a facemask on or not. Our solution detects this even on streaming images in real-time. The accuracy on the test dataset is 96%, the most to our knowledge. this may greatly aid public and clinical administrations. Our solution uses MobileNetV2, OpenCV, TensorFlow, Keras and CNN. this could be used especially at public places where we can identify automatically if an individual isn't wearing a mask and should prevent their entrance. In ongoing work, we extend this work to photographs containing over one face.

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