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Face Mask Detection

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ABSTRACT

The most recent global health emergency is the coronavirus disease epidemic. In most cases, it is spread from one person to another through the air. The spread within communities has contributed to an increase in global incidence. As a measure of precaution, face mask laws have been instituted in many nations. Keeping an eye on the face mask manually in noisy public spaces is a nuisance. As a result, scientists have found reason to develop a fully automated face mask detection system. In this work, we introduce a MobileNet equipped with a global pooling block to detect facial masks. In order to simplify the feature vector, the proposed model uses a global pooling layer. The softmax layer has been used for classification alongside a fully connected dense layer. For two publicly available face mask datasets, our proposed model achieves better results in key performance metrics than competing mode.

Keywords – Detection, Mask, No Mask, Safety

1. Introduction

The newly identified coronavirus COVID-19 has caused the most recent epidemic of coronavirus disease [1]. SARS-CoV-2, the causative agent of COVID-19, is a respiratory virus that causes illness. To a large extent, it is spread from one person to another via airborne transmission, especially in close quarters. Aside from clinical studies, many AI-based research proposals have been reported during this pandemic. The Symptoma digital health assistant was developed by Martin et al. [2]. How to use AI to speed up drug repositioning or repurposing is presented by Zhou et al. [3]. Aman et al. [4] have presented another AI-based tool for drug discovery. DeTraC is a model proposed by Abba et al. [5] for detecting COVID-19 in X-ray images. Community transmission has recently increased the number of cases in most jurisdictions' courts. About 49 million cases have been reported worldwide, as stated by the World Health Organization (WHO) [6]. The World Health Organization (WHO) has issued several precautionary guidelines to combat the spread of coronaviruses in response to the COVID-19 outbreak. The most obvious rules are to keep your distance from others, to clean up your act, and to cover your face. The spread of the corona in a community can be slowed by using a face mask. So, most nations have legislated that citizens must wear face coverings in public [1]. When it comes to image classification and other computer vision tasks, deep convolution neural networks (CNN) have emerged as a powerful tool. The following are a few examples of popular deep CNN models. ResNet-18, ResNet-34, ResNet-50, ResNet-101, and ResNet-152 are the five variants proposed by Kaiming et al. [9]. With ResNet-18/34 and ResNet-50/101/152, their top-1 error rate is 24% and 22%, respectively. It demonstrates that the model's performance and computational time increase as the number of layers increases. ResNet-50 is a variant of ResNet with a similar architecture to ResNet34 that uses less computational time. With the goal of improving the precision of image classification and segmentation, Christian et al. [10] designed an inception network. Convolution with larger spatial filters typically results in a high computational cost. Inception modules have become a popular option for lowering this expense. By identifying optimal regional sparse structures, Inception helps keep costs down. The inception block's concept is to build something from the ground up, layer by layer, while taking into account correlation statistics between the individual layers. Groups are created from the clusters of highly correlated layers. Each filter bank represents a set of layers, where each layer corresponds to a certain part of the input image. The result of this process is the aggregation of numerous smaller filter banks within a given area.

2. Related Work

Sumatra and Chattered [1] proposed a model that could be useful to foresee the spread of COVID2019 by using linear regression, Multilayer perceptron and Vector auto regression model on the COVID-19 haggle data to envision the epidemiological example of the malady and pace of COVID-2019 cases in India. Navares et al. [2] introduced an answer for the issue of anticipating every day medical clinic confirmations in Madrid because of circulatory and respiratory cases dependent on biometeorological markers. Cui and Singh created and applied the MRE hypothesis for month to month streamflow prediction with spectral power as a random variable. A system [4] that restrict the growth of COVID-19 by finding out people who are not wearing any facial mask in a smart city network where all the public places are monitored with ClosedCircuit Television (CCTV) cameras. Firstly, CCTV cameras are used to capture real-time video footage of different public places in the city. From that video footage, facial images are extracted and these images are used to identify the mask on the face. Another model [5] for face detection using semantic segmentation in an image by classifying each pixel as face and non-face i.e. effectively creating a binary classifier and then detecting that segmented area. It works very well not only for images having frontal faces but also for non-frontal faces. The most helpful project for us, proposed [6] a method for automatic door access system using face recognition technique by using python programming and from OpenCV library Haar cascade method. Object Detection using Haar feature-based cascade classifiers is an effective object detection method proposed by Paul Viola and Michael Jones [7]. Another research [8] in which hybrid model using deep and classical machine learning for face mask detection is presented. A face mask detection dataset consists of with mask and without mask images, then using OpenCV to do real-time face detection from a live stream via webcam. Another tutorial [9], had two-phase COVID-19 face mask detector, detailing how computer vision/deep learning pipeline will be implemented. The trained COVID-19 face mask detector, will implement two more additional Python scripts used to detect COVID-19 face masks in images and detect face masks in real-time video streams.

3. METHODOLOGY

We have devised a smart framework for detecting facemask in this paper. As the cases of covid19 are decreasing maximum workplaces are opening with half or full employees. Even the education institutes are planning to be opened. For screening the people not wearing masks, this system can be installed in the entrances of enterprises, educational institutes, public and private offices. If the system detects a person’s face with no mask, it will generate a beep alerting them to wear mask. The block diagram of the developed framework is depicted in Fig.

A. Proposed workflow

We decided to build a very simple and basic Convolutional Neural Network (CNN) model using TensorFlow with Keras library and OpenCV to detect if you are wearing a face mask to protect yourself. All the aspects of our work are described below.

B. Deep learning architecture

The deep learning architecture learns various important nonlinear features from the given samples. Then, this learned architecture is used to predict previously unseen samples.

C. Image Processing

Haar the Cascade Classifier will detect the input from videocam. The images captured by system's webcam required pre-processing before going to the next step. In the pre-processing step, the image is transformed into a grayscale image because the RGB color image contains so much redundant information that is not necessary for face mask detection. Then, we resized the images into (150x150) size to maintain uniformity of the input images to the architecture. Then, the images are normalized and after normalization, the value of a pixel resides in the range from 0 to 1. Normalization helped the learning algorithm to learn faster and captured necessary features from the images.

D. Dataset Collection

To train our deep learning architecture, we collected images. The architecture of the learning technique highly depends on CNN. Data from source[10] is collected for training and testing the model. Dataset contains images of faces only. It consists of about 1,315 images in which 658 images containing people with face masks and 657 images containing people without face masks. For training purposes, 80% images of each class are used and the rest of the images are utilized for testing purposes. Fig. 2 shows some of the images of two different classes

E. Architecture Development

The learning model is based on CNN which is very useful for pattern recognition from images. Neural Network need to see data from both the classes. The network comprises an input layer, several hidden layers and an output layer. The hidden layers consist of multiple convolution layers. The features extracted by CNN are used by multiple dense neural networks for classification purposes. The architecture contains three pairs of convolution layers each.

Followed by one max pooling layer. The convolution layer contains 100 kernels of window size 3x3. Max pooling layer of window size 2x2. This layer will be aggregating the results from the previous convolution layer and will be picking the max value in that 2x2 window. It decreases the spatial size of the representation and thereby reduces the number of parameters. As a result, the computation is simplified for the network. The output of the convolution layers will be flattened and will be converted into a 1-D array. Then there is one dropout layer and two dense layers. The dropout layer prevents the network from overfitting by dropping out units. The dense layer comprises a series of neurons each of them learn nonlinear features. The flattened result this will be fed to the first dense layer of 50 nodes. Then finally second dense layer containing two nodes as there are two classes.

4.CONCLUSION

An outbreak of COVID-19 has forced the majority of the countries to enforce the compulsion of wearing a face mask. Manual observation of the face mask in crowded places is a critical task. Thus, researchers have motivated for the automation of face mask detection system. In this paper, we have proposed a pre-trained Mobile Net with a global pooling block for face mask detection. The pre-trained Mobile Net takes a color image and generates a multi-dimensional feature map. The global pooling block that has been utilized in the proposed model transforms the feature map into a feature vector of 64 features. Finally, the softmax layer performs binary classification using the 64 features. We have evaluated our proposed model on two publicly available datasets. Our proposed model has achieved 99% and 100% accuracy on DS1 and DS2 respectively. The global pooling block that has been used in the proposed model avoids overfitting the model. Further, the proposed model outperforms existing models in the number of parameters as well as training time. Our future work focuses on face mask detection over multi-face images

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