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COVID-19:Face Mask Detector with Open CV and CNN Algorithm

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Abstract. Now a day, covering our faces with a mask has become a new normal habit in this pandemic, as face masks are effective in preventing the virus outbreak. Masks reduce risk from an infected person whether they have symptoms or not. In this paper, we propose a system that restrict the growth of COVID-19 by finding out peoples with mask and without mask. Where all the public places are monitored with CCTV cameras. A deep learning architecture is trained on a dataset which consists of images of people with wearing mask and without wearing is masks collected from various sources.

By using image processing analysis and machine learning method we can find out face mask wearied or not. Face mask detection can be done using various methods. Mainly convolutional neural network and OpenCV method is used. The accuracy and decision making of CNN algorithm is higher than other algorithms.

Keywords: COVID-19: Corona Virus Disease of 2019, CNN: Convolutional Neural Network, SVM: Support Vector Machine, KNN: K Nearest Neighbor

1. Introduction

India has a high-test positivity rate for COVID-19. In many countries' lockdowns are released when their COVID-19 numbers started reducing. Covering our faces with a mask has become a new normal habit in this pandemic, as face masks are effective in preventing the virus spreading. In so many developed and underdeveloped countries over worldwide have made it compulsory for people to wear masks while leaving home or visiting public places. On the other hand, it will be challenging to recognize faces with masks in monitoring systems. In order to prevent the spread of COVID-19, it is necessary to wear a mask. Therefore, it is very necessary to improve the face recognition performance of the existing technology on masked and unmasked faces.

Face mask detection is a challenging task. It has been getting more attention in the era of covid 19 due to the spreading of disease in large quantity. In the case of medical field, mask reduces the chances of exposure risk from an infected person whether they have symptoms of covid-19 or not. Face mask detection system is used in Airports, Hospitals, Offices and Educational Departments, Industries etc.

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1) Face Recognition

2) Feature Extraction

This paper aims at designing a system to find out whether a person is using a mask or not and displaying the message if person is not wearing the mask. Firstly, CCTV cameras are used to capture real-time image of different public places or at the entrance of office. From that image, facial images are extracted and these images are used to identify the mask on the face. Convolutional Neural Network (CNN) is used for feature extraction from the images then these features are learned by multiple hidden layers.

2. Related Work

There are many techniques are used for face mask detection. Some of them are explained below.

1. Coronavirus disease 2019 has affected the world seriously. One major protection method for people is to wear masks in public areas. Furthermore, many public service providers require customers to use the service only if they wear masks correctly. However, there are only a few research studies about face mask detection based on image analysis. In this paper, we propose Retina Face Mask, which is a high-accuracy and efficient face mask detector.[1].

2. A modern image recognition that has millions of parameters and requires a lot of training data as well as high computing power that is hungry for energy consumption so it becomes inefficient in everyday use. Machine Learning has changed the computing paradigm, from complex calculations that require high computational power to environmentally friendly technologies that can efficiently meet daily needs. We then demonstrate the effectiveness of MobileNets across a wide range of applications and use cases including object detection, face attributes and large scale geo-localization [2].

3. In order to effectively prevent the spread of COVID19 virus, almost everyone wears a mask during coronavirus epidemic. This almost makes conventional facial recognition technology ineffective in many cases, such as community access control, face access control, facial attendance, facial security checks at train stations, etc. Therefore, it is very urgent to improve the recognition performance of the existing face recognition technology on the masked faces. Most current advanced face recognition approaches are designed based on deep learning, which depend on a large number of face samples [3].

4. Deep convolutional neural networks have been successfully applied to face detection recently. Despite making remarkable progress, most of the existing detection methods only localize each face using a bounding box, which cannot segment each face from the background image simultaneously. To overcome this drawback, we present a face detection and segmentation method based on improved Mask R-CNN, named G-Mask, which incorporates face detection and segmentation into one framework aiming to obtain more _ne-grained information of face [4].

5. Faces in the dataset have various orientations and occlusion degrees, while at least one part of each face is occluded by mask. Based on this dataset, we further propose LLE-CNNs for masked face detection, which consist of three major modules. The Proposal module first combines two pre-trained CNNs to extract candidate facial regions from the input image and represent them with high dimensional descriptors. After that, the Embedding module is incorporated to turn such descriptors into a similarity-based descriptor by using locally linear embedding (LLE) algorithm [5].

6. Face Detection has evolved as a very popular problem in Image processing and Computer Vision. Many new algorithms are being devised using convolutional architectures to make the algorithm as accurate as possible. These convolutional architectures have made it possible to extract even the pixel details. We aim to design a binary face classifier which can detect any face present in the frame irrespective of its alignment.

7. Coronavirus disease 2019 has affected the world seriously. One major protection method for people is to wear masks in public areas. However, there are only a few research studies about face mask detection based on image analysis. The proposed RetinaFaceMask is a one-stage detector, which consists of a feature pyramid network to fuse high-level semantic information with multiple feature maps, and a novel context attention module to focus on detecting face masks. [7].

8. According to data obtained by the World Health Organization, the global pandemic of COVID-19 has severely impacted the world and has now infected more than eight million people worldwide. Wearing face masks and following safe social distancing are two of the enhanced safety protocols need to be followed in public places in order to prevent the spread of the virus. Thus, the proposed system favors the society by saving time and helps in lowering the spread of corona virus. It can be implemented effectively in current situation when lockdown is eased to inspect persons in public gatherings, shopping malls, etc. Automated inspection reduces man- power to inspect the public and also can be used in any place [8].

9. Head pose classification is widely used for the preprocessing before face recognition and multi-angle problems, because algorithms such as face recognition often require the input image to be a front face. But affected by the COVID-19 pandemic, people wear face masks to protect themselves safe, which makes cover most areas of the face. The proposed HGL method combines the H- channel of the HSV color space with the face portrait and grayscale image, and train the CNN to extract features for classification[9].

3. Methodology

We proposed an automated smart framework for screening persons who are not using a face mask in this paper. Office or any public place are monitored by CCTV cameras. The cameras are used to capture images from public places; then these images are feed into a system that identifies if any person without face mask appears in the image. If any person without a face mask is detected then this information is sent to the proper authority to take necessary actions. The block diagram of the developed framework is depicted in Fig. 1.

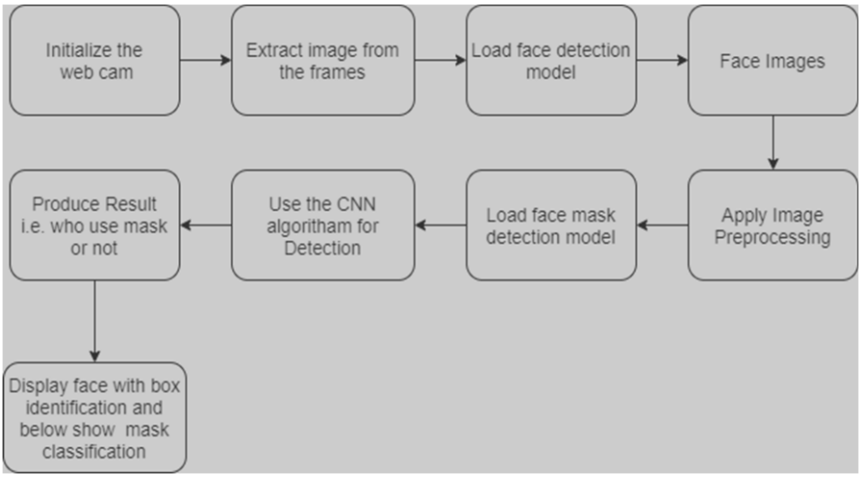

Figure 1. System Architecture

A. Image Preprocessing

The images captured by the CCTV cameras required preprocessing before going to the next step. In the preprocessing 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. RGB color image stored 24 bit for each pixel of the image. On the other hand, the grayscale image stored 8 bit for each pixel and it contained sufficient information for classification. Then, we reshaped the images into (64×64) shape 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

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. To train our deep learning architecture, we collected images from different sources. The architecture of the learning technique highly depends on CNN. All the aspects of deep learning architecture are described below.

i)Dataset Collection

Data from two different sources are collected for training and testing the model. We collected a total of 1400 images of people with masks and 1400 images of people without a mask. 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.

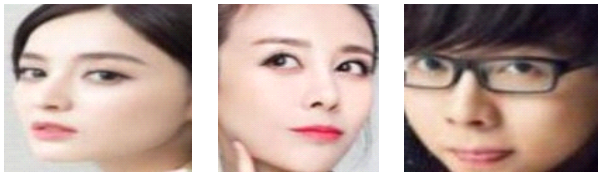

Figure 2 Faces Without Mask

Figure 2. Faces With Mask

ii) Architecture Development

The learning model is based on CNN which is very useful for pattern recognition from images. The network comprises an input layer, several hidden layers and an output layer. The hidden layers consist of multiple convolution layers that learn suitable filters for important feature extraction from the given samples. The features extracted by CNN are used by multiple dense neural networks for classification purposes.

iii) Screening and displaying Message

The main goal of our proposed system is screening persons who are not following guidelines of using a facial mask. The learning architecture identifies whether any input image contains persons without a face mask. If such a person is detected, then system will display message to wear the mask.

4. Algorithm

CNN:

A **Convolutional Neural Network (ConvNet/CNN)** is a Deep Learning algorithm which can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image and be able to differentiate one from the other. The pre-processing required in a ConvNet is much lower as compared to other classification algorithms. While in primitive methods filters are hand-engineered, with enough training, ConvNets have the ability to learn these filters/characteristics.

In deep learning, a convolutional neural network (CNN, or ConvNet) is a class of deep neural networks, most commonly applied to analyzing visual imagery.

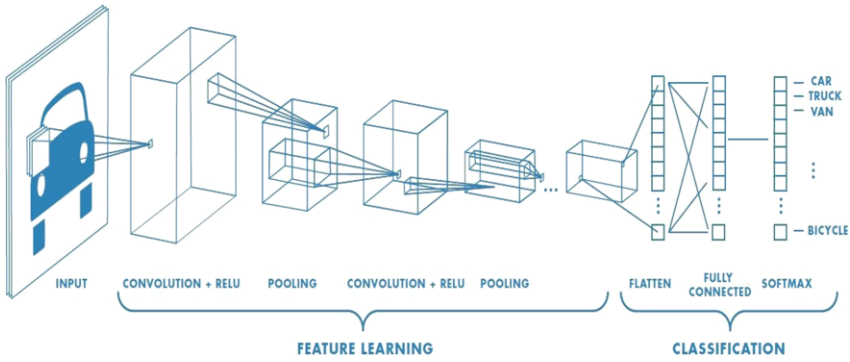

Figure 3. CNN Algorithm Blocks

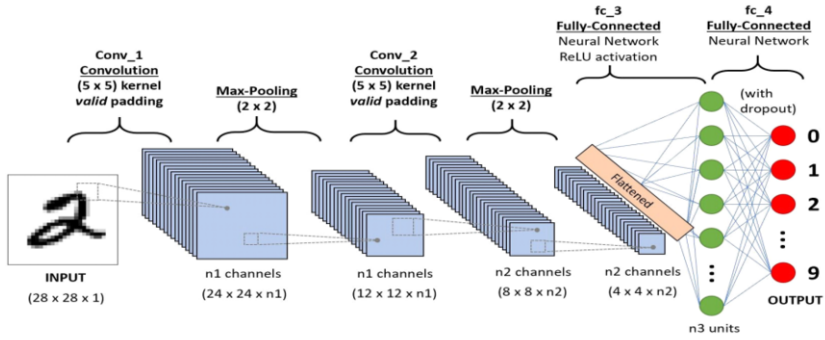

Figure 4.CNN actual Matrix Representation

5. Conclusion

This paper presents a system for a public place e.g., office to reduce the spread of coronavirus by informing the authority about the person who is not wearing a facial mask that is a precautionary measure of COVID-19. The system captures the images of employees and these images are classified using different AI algorithms and a combination of them, then their performance was evaluated to detect the image who wore the mask. These algorithms include a convolutional neural network (CNN), Soft-max, support vector machine (SVM), Random Forest, and K nearest neighbor (KNN). The system contains a face mask detection architecture where a deep learning algorithm is used to detect the mask on the face. To train the model, labelled image data are used where the images were facial images with masks and without a mask.

6. Limitations and Future Work

The developed system faces difficulties in classifying faces covered by hands since it almost looks like the person wearing a mask. For a very densely populated area, distinguishing the face of each person is very difficult. For this type of scenario, identifying people without face mask would be very difficult for our proposed system.

In order to get the best, result out of this system, office entrance should have two or more CCTV cameras to monitor the entrance of office as well as dedicated manpower to enforce proper laws on the violators.

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