A SURVEY ON FACEMASK DETECTION USING A CONVOLUTIONAL NEURAL NETWORK

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Abstract:

Coronavirus illness (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus[1].COVID-19 pandemic is continuously advancing all over the world all developing countries have been affected like India, China, the USA, Japan, and Russia. To reduce the transmission of coronavirus in community settings guidelines of CDC, and WHO are followed by people i.e. wearing face masks to protect not only themselves but others. Hence Face detection and recognition will be considered intriguing modalities as detecting certain facial features is a very difficult task since certain parts of the face are hidden. This paper presents a review of various algorithms and different transfer learning approaches used for facemask recognition. This paper describes different types of transfer learning approaches i.e., Haar cascade, Adaboost, VGG-16, Mobilenetv1, and Mobilenetv2are described in this paper. With help of advancing technology and reliable methods which requires less computational power, a good low thermal design power profile and less storage space it can be deployed on IP cameras on an embedded system like raspberry pi and IoT devices. This system has varied applications in community settings which include dense crowded local places. This system will work in public places such as schools, hospitals and bus depots etc. where people need to be monitored with the presence of a facemask and recognize violations and alert local authorities and lower the burden on the healthcare system and law enforcement authorities.

Keywords— Facial Mask Detection, COVID-19, Deep Learning, Convolutional Neural Network, Internet of things. MobileNetV2

1. Introduction

Coronavirus illness (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus[1].Most of the infected patients with the virus will experience mild to moderate respiratory illness also called (acute respiratory distress syndrome) which occurs when fluid builds up in the tiny, air sacs (alveoli) in your lungs. This leads to hypoxia and induces indirect damage to the body organs, especially to the brain, by oxygen starvation and inflammation.[2].Out of the mildly infected patients develop silent hypoxia condition. Due to extremely low oxygen saturation levels, these patients are at exceptionally higher risk. However, the individual does not experience any breathing difficulty. Normally, an increased laboured breathing rate (tachypnoea) is seen in normal hypoxic patients, but it is not typically found in patients with silent hypoxia. Senior citizens with comorbidities like hypertension, cardiovascular disease, diabetes, chronic respiratory disease, autoimmune disease, and cancer are more likely to develop serious illnesses.

[3].By WHO Report Every day, many people are infected and have died. As of now globally, as of 3:39pm CEST, 13 May 2022, there have been 517,648,631 confirmed cases of COVID-19, including 6,261,708 deaths, reported to WHO as of 14 May 2022, a total of 11,657,654,483 vaccine doses have been administered.

[1]. This number is increasing day by day. Fever, dry cough, tiredness, diarrhoea, loss of taste, and smell are the major symptoms of coronavirus which is declared by the World Health Organization (WHO) [4]. Many precautionary measures have been defined to fight against coronavirus. Among them cleaning hands with soap or 70% Isopropyl Alcohol, maintaining a safe distance of at least 6 feet, wearing a facemask, and refraining from touching eyes,

nose, and mouth are the main ones, where wearing a covered mask is of our interest.

[5]. Research at Stanford Medicine and Yale University conducted a large, randomized trial and has found that wearing a surgical face mask over the mouth and nose is an effective way to reduce transmission of COVID-19 in community settings. The major cause of infection was the carelessness of the people and lack of their consciousness. Detecting people violating the rules and informing the corresponding authorities can be a solution to reducing the spread of coronavirus.

Face mask detection is a technique to find out whether someone is wearing a mask or not This kind of recognition is a classification type problem. Now a day's safety system is increasing which leads to a remarkable change in our daily life. Therefore, the safety system has a crucial Rule to safeguard people. Our model and safety system will work for hand in hand face mask recognition is one of the research areas among practical applications. It is similar to detecting an object from a scene. Many systems have been defined for object detection. Deep learning techniques are highly used in such applications as this model is going to work for unstructured data i.e. images, and videos.[6]. Recently various, deep learning architectures [7] have shown a significant role in object detection. These architectures can be used for detecting masked faces. Moreover, a smart city [8] means an urban area that consists of many IoT sensors to collect data and an embedded system to process this data further. This collected data is then passed through our trained model. The growth of COVID-19 can be lowered by detecting violations and sending alerts.

2. Related Works

S.A. Hussain et al. [9] worked for emotion recognition using facial expressions using the haar cascade framework. Their proposed model focused on Imagenet and Resnet-50 frameworks which provided higher accuracy. ResNet-50 is a convolutional neural network which has 50 layers. You can use a pre-trained version of the network that used a million images or more from the ImageNet database. The pre-trained network classifies images into various 1000 categories, such as animals, plants and cars. As a result, the network has learned various feature's for a wide range of images. The network accepts an image input size of 224px by 224px.

P. Viola et al. [10] discussed a face detection framework. Their paper, built an efficient classifier by AdaBoost learning algorithm combining cascade classifier Ensemble learning combines many base algorithmic programs to create one optimized prognosticative algorithm. for instance, a typical call Tree for classification takes many factors, turns them into rule queries, and given every issue, either makes a choice or considers another issue. The results of the choice tree will become ambiguous if there are multiple decision rules, e.g. if the threshold to form a choice is unclear or we tend to input new sub-factors for thought. this can be wherever Ensemble strategies come at one's disposal. rather than being hopeful on one call Tree to form the correct decision, Ensemble strategies take many completely different trees and mix them into one final, sturdy predictor.

M. S. Ejaz et al. [11]proposed a masked face recognition system using a convolutional neural network by VGG16 Framework VGG16 is a convolutional neural network trained on a subset of the ImageNet dataset, a collection of over 14 million images belonging to 22,000 categories

[12] I. B. I. B Venkateswarlu et al proposed face mask detection using Mobilenet and global pooling block

MobileNet is a type of convolutional neural network designed for embedded vision applications. They've supported by an efficient design that uses depth-wise dissociable convolutions to make light-weight deep neural networks that may have low latency for mobile and embedded devices.

3. Methodology

We proposed a smart model a real-time monitoring system which evaluates persons who are not using a face mask in this paper. In the smart city, all public places are monitored by CCTV cameras. The cameras are used to capture frames from public places; these images are fed into our model that classifies them into two categories masked face and no mask. If any person is detected without a face mask then alert is triggered and is sent to the law enforcement authority to take necessary actions via email. The block diagram of the developed framework is described in Fig. 1.
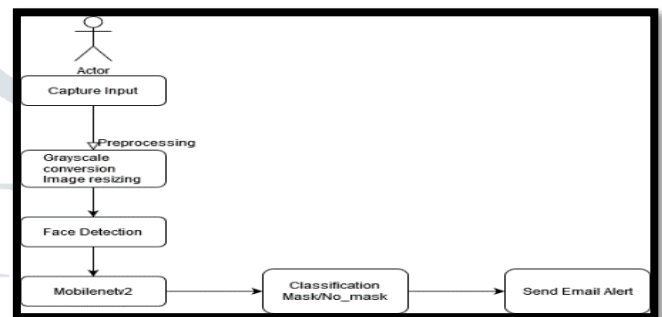
System Architecture

- ### *A Capturing Input:*

To begin with facemask detection, we need to detect frames in real-time. Using OpenCV library cv2.VideoCapture(0) is used to access the camera and cap.read() method is used to get frames and can be stored to process further by our model.

- ### *B Data pre-processing*

The images captured by the CCTV cameras are required for pre-processing before going to the next step. The pre-processing is done to improve the image data and to remove unwanted distortions Which increases the performance and efficiency of the task

i. Grey Scale Conversion: Grey Scale Conversion is used to remove the coloured data that is not useful for further operations. Therefore, decreasing the time to process the image and also improving the performance of the system

ii. Image Resizing: The system needs to capture and process images live, so to improve performance we will apply to pre-process the 1024 pixel images will be converted to 244 pixels.

- ### *C Convolutional Neural Network*

Convolutional Neural Networks (CNNs) are artificial neural networks that are utilised in image identification and object detection. A convolutional layer, a pooling layer, and a fully-connected layer make up the basic structure of CNN.

- ### *D Mobilenetv2*

MobileNetV2 is a significant improvement over MobileNetV1. It introduces a shortcut method between bottlenecks and linear bottlenecks between the layers. Bottleneck encoded models to intermediate inputs and outputs while the innermost layer now encapsulates model ability to transform pixels to image categories. Finally, the results of the shortcut method immediately enable a model with faster training, better accuracy and lower latency.

4. Conclusion

This paper presents a review for a facemask detection to reduce the spread of coronavirus by informing the authority about the person who is not wearing a facial mask via email

which is a precautionary measure against COVID-19. The motive of the work comes from the carelessness of the people and the lack of their consciousness. 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, a balanced dataset was used. It consisted of images labelled as with-mask consisting of 1,915 images with different angles, dark faces and different types of facemasks such as N95, surgical facemask and cloth mask. Without a mask, our dataset consisted of 1,918 images with different kinds of human faces belonging to various races. The proposed model successfully detects all kinds of the mask including homemade cloth masks which can be used in rural areas. The proposed system can detect multiple facemasks and the accuracy is as follows-

Table 4.1 Performance table

Performance	precision	recall	F1-score	Support
With_mask	0.99	0.99	0.99	383
Without_mask	0.99	0.99	0.99	384
Accuracy			0.99	767
Macro avg	0.99	0.99	0.99	767
Weighted avg	0.99	0.99	0.99	767

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