Face Mask Detection Using Semantic Segmentation

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Abstract
Corona virus disease 2019 has become a major health problem. It is spreading very widely due to its contact transparent behavior. So WHO declared to wear mask in crowded areas as a prevention method. Some of the areas the diseases become widely spread out due to improper wearing of facial mask. So to overcome this problem we required an efficient mask monitoring system. By the development of machine learning and image processing analysis introduce methods for mask detection. By using image processing analysis and machine learning method is used for find out mask detection. Face mask detection can be done through various methods. Mainly convolutional neural network method is used rapidly. The accuracy and decision making is very high in CNN compared to others. Here we are discussed about various deep learning techniques used for face mask detection.

Keywords
Corona virus disease 2019, Face mask detection, CNN, Machine learning

I. Introduction

Face mask detection is a challenging task. It has been receiving more and more attention in this era due to the spreading of corona virus disease. Hence many countries following the rule like "No entry without mask". Face mask detection is very important issue in security purpose and Covid-19 prevention. In the case of medical field, mask reduces potential exposure risk from an infected person whether they have symptoms or not. Face mask detection is used in Airports, Hospitals, Offices and Educational Departments etc.

So face mask detection is become a very critical and challenging issue. The face recognition without mask is easier but face recognition with mask is critical one because feature extraction of masked face is very complicated than normal face. That is so many face features such as nose, mouth and chin are absent in the masked face. In medical field, mask reduces potential exposures risk from an infected person whether they have symptoms or not. So many face mask detection can be concentrated in two steps.

1. Face Recognition
2. Feature Extraction

Face recognition is the first step; here we need to detect the face from an image. Mainly there is a problem such as detecting the multiple mask and unmasked faces in an image. It can be solved by using a traditional object detection method. The traditional face detection algorithms are used Viola-Jones Algorithm, Adaptive Boost Algorithm and HOG (Histogram of Gradient). Here the object detection method is classified as multi-stage detectors and single short detectors (SSD). Faster RCNN is included in multi-stage detectors and YOLO (You Only Look Once) and Single-Short Detection (SSD) included in Single Stage Detectors. Here so many papers are studied about face mask detection. Several techniques are used for mask detection such as video analytic, image semantic segmentation, from finger prints, DWT (Discreet Wavelet transform) and LBP (Local Binary Pattern). All of these techniques are analyzed for checking a person wear mask or not and also identify the face recognition of a person. The section II in this work explains different methods used for face mask detection.

II. Various Face Mask Detection Techniques

There are many techniques are used for face mask detection. Some of them are explained below.
In 2012, Face Detection using Convolutional Networks and Gabor Filters [1] proposed by BodanKwolek used to detecting facial regions by composing a Gabor Filters and a convolutional neural network. Gabor Filter is concentrated on extract the intrinsic facial features. The main advantages of Gabor Filter are allows the signal analysis at different scales and resolution. The convolutional neural network layer consist one or more plane. Totally 6 convolutional neural networks used here. As a result it showed providing better recognition and high rate in face detection than the alone performance of CNN.

In 2015 intelligent face mask detection system [2] proposed by N. Ozkaya, S. Sagiroglu used for the generation of face masks from its finger print. To develop an intelligent system for obtains masked face from fingerprints without having any knowledge about their faces. The multi model database contains 120 persons. The IFPSF contains 4 modules including Data Enrollment and MMDB module (Multi Model Biometric Data Base).

The Face Reconstruction Module consists a pre processing and post processing steps. Here ANN (Artificial Neural Network) analyzes the existence of any relationship between face and fingerprint. As a result of achieve unknown biometric feature from unknown one, here unknown biometric is face mask and unknown one is fingerprint.

In 2016, study of masked face detection approach in video analytics [3] proposed by GayatriDeora and Ramakrishna, here video analytic approach is used for detection. When face detection can be triggered by calculating the distance between a person and camera. Viola Jones Algorithm used for facial part detection, such as detection of eyes, nose and mouth etc. This algorithm provides very high detection rates and low false positive rate. As a result poor image quality leads to high false detection rate.

In 2016, Face recognition and authentication using LBP and BSIF [4] proposed by Naveens, Dr. R.S Moni. Here introduce a face recognition and authentication method for the detection and elimination of masks. The local and global facial features are used to realize a real face and masked face. A 3D mask data based 3DMAD used here by the combination of LBP (Local Binary Pattern) and BSIF (Binarized Statistical Image Features) extract textures for face authentication. The steps are included here face detection, feature extraction, face recognition and face authentication. Feature extraction find out the global and local

features for face region. The nose and eye region features are included in local features. By the classification of these features, finds the real or masked face through face recognition process.
In 2017, A Cascade Framework for masked face detection [5] proposed by WeibuJiangejinn Xiao and Chuanhong Zhou used a simple system for mask detection. The architecture consists of cascaded 3 convolutional mask detectors are Mask–12, Mask–24-1 and Mask – 24-2. Here ResNet 5 model–7 layer convolutional layer followed by a pooling layer is used. Mask 1 is the first stage and Mask 3 is the last stage of masked face detector. A masked face dataset is used and it is contained 160 images for testing and 40 images for testing purpose. Training process includes Pre-train model and Fine tune models. Finally use PASCAL VOC for evacuation process. Testing on Masked Face achieved 86.6% accuracy.

In 2017, face detection and segmentation based on improved mask R-CNN [6] proposed by Kaihan Lin and Xiaoyong Liu, used a segmentation method is based on Mask R-CNN. The Convolutional Network Model ResNet101 architecture used for extracts feature. Popular face benchmark dataset, FDDB (Face Detection Data Set and Benchmark) and AFW datasets are used. A fully convolutional layer network followed by a max pooling layer is used for creating a mask. As a result it gives high G-mask accuracy than normal mask accuracy.

In 2018, Detection of 3D mask in 2D face recognition system by using DWT and LBP [7] proposed by ArtiMahore and MeenakshiTripathi, here detection of 3Dmask is based on anti-spoofing. It follows the detection approaches categories such as hardware, software and user collaboration. In hardware method uses an external hardware for creating a mask. Software based method uses texture-base analysis. The input RGB image is covered luminance and chrominance parts, DWT is processed these channel efficiently. Feature extraction process is carried out by using a Local Binary Pattern (LBP). The SVM (Support Vector Machine) classifier is analyzed it is a real or fake image.

In 2019, Implementation of Principle Component Analysis on Masked and Non-Masked Face Recognition [8] proposed by Md. SabbirEjaz and Rabiul Islam, here analyzed a masked and non-masked face recognition accuracy by using a principle component analysis. The dataset used is Olivetti and Oracle Research Laboratory (ORL) face database. Here PCA is used for feature extraction. The steps are used in this work includes Facial Image Acquisition and Facial Feature Extraction using PCA and Eigen Vector Calculation. As a result it gives high recognition rate of face without mask.

In 2019, Facial Mask Detection using Semantic Segmentation [9] proposed by Toshanlal Meenpal, Ashuthosh Balakrishnan and Amit Verma used a facial mask detection based on semantic segmentation. Here the class labels are named as face or non-face. The convolutional neural network VGG-16 architecture followed by fully convolutional network is used for segmentation. As a result it recognizes multiple faces. This method is useful for frontal faces as well as non-frontal faces. As a result it is focused on removal of erroneous prediction.

In 2020, performance evaluation of intelligent face mask detection system with various deep learning classifiers [10] proposed by C. Jagadeeswari, M.UdayTheja. Here the performance of face maskdetection using different deep learning classifiers can be analyzed mobileNet V2, ResNet 50, VGG 16, ADAM, SGD. These are the classifiers used for it. For each classifier followed byu 3 optimizer and evaluate the performance. The optimizers are used here such as ADAM, ADAGRAD, SGD (Stochastic Gradient Descent). As a result ADAM optimizer perormance is very good and also observed that MobileNet V2 classifier has best result with high accuracy.

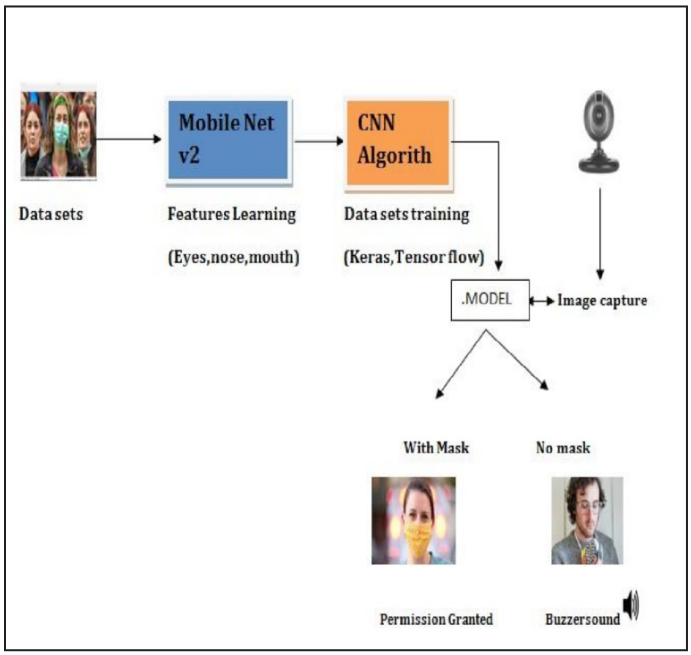
In 2020, Retinal Face Mask Detector [11] proposed by
Mingjie Jiang, Xinqi fan and Hong, here introduces a Retinal Face Mask Detector. It is a One-stage object detector. The dataset contained 7959 images. The ResNet and mobile Net used as BACKBONE. But ResNet is considered as standard backbone. The detection network includes a backbone, a neck and head modules. As a result the ResNet accuracy is very much higher than the Mobile Net.

II. Comparison

So many papers are studied about the face recognition without mask. But a few papers are concentrated about face with mask [8] discussed about the recognition accuracy of masked face and non-masked using PCA (Principal Analysis Component). It gives face without mask provide better recognition rate. The recognition accuracy drops to less than 70% when face is masked. In [12] the authors developed a new face mask wearing condition including correct face mask wearing, incorrect face mask wearing, and no face mask wearing. It achieved 98.70% accuracy in the face detection phase. In [13] the authors developed a system for detecting the presence or absence of medical mask in the operating room. In this approach to trigger an alert only for medical staff who do not wear a surgical mask, by minimizing false positive face detection.

IV. Methodology

The major thing required for implementing the project using the python programming language along with Deep learning, Machine learning, Computer vision and also with python's libraries. The architecture includes of Mobile Net as the backbone, it can be used for highest and lowest computation scenarios. We are using the algorithms of CNN in our proposed system.



In this paper, a deep learning-based algorithm for identifying masks on faces in public places is provided in order to reduce Coronavirus community spread. Using an ensemble of single - phase and two-phase detectors, the suggested model efficiently manages various types of occlusions in crowded situations. The ensemble technique not only aids in reaching high accuracy, but it also significantly increases detection speed.

V. TITLE: "Face Mask Detector"

Single Shot Detector architecture of programming is used for the image detection purpose. In the system face mask detectors can or should be deployed in several areas like malls, airports and other heavily traffic places so that public can be monitored easily monitor the public and to avert the spread of the covid disease by checking who are following rules or basic rules and who is not following. It takes more time for data to load in Google Collab Notebook. It did not allow the access of the camera which was a hurdle in testing the images and a video streams. We have modelled a facemask detector using Deep learning of science. We have processed a system of computationally efficiency using MobileNetV2 which makes it so much easier to extract the sets of data available. Machine learning is a subfield of AI that allows systems to learn on their own without having to be explicitly programmed. To find patterns in a dataset, machine learning can use supervised learning, unsupervised learning, or hybrid learning. Machine learning algorithms under supervision use labelled data to forecast future events. Unmonitored machine learning uses unsupervised learning, and the methodology tries to make sense of it by extracting its own features and labels from the data. A hybrid deep transfer learning model for recognising face masks has been presented that incorporates many machines learning algorithm such as support vector machines (SVM), decision trees, and ensemble approaches.

We used CNN architectures for the better performance. We can try to fix it in any kind of cameras easily available. We humans have not tremendous type of ability for identifying different faces for rather than machines, so automatic face detection system developed by machine learning plays a pivotal role in the face recognitions, and also head pose estimation etc. It has few problems such as face occlusion, and an uniform type of illumination. We use Neural Network to detect the face in the Live and playback video stream. Tensor flow mentioned earlier is also used in this type of system. In past they use Adaboost algorithm, we used mob type of net CNN Architecture model in the proposed system of ours. We will try to overcome all the hurdles in the paper.

Face mask detection is a process of determining if or not someone is wearing a mask. In reality, the issue is decrypting of face detection, in which the face is identified using various machine learning techniques for security, authentication, and surveillance purposes. In the discipline of Computer Vision and Pattern Recognition, face detection is a crucial component. In the past, a great deal of research has developed powerful face detection algorithms. Face detection was first studied in 2001, using the use of typical machine learning methods and the construction of handicraft features to train successful models for recognition and detection.

Benefits

- Manual Monitoring is tedious task for the officers on duty to check whether the crowd are wearing masks or not. So, in our technique, we are using a developed web cam to detect the people's faces and try to prevent them from virus transmission.
- It has a very fast and high degree of accuracy.
- This system can easily be implemented in the ATMs, Banks etc
- We can try to keep peoples safe from this technique.
- It also provides a buzzer sound which acts as an alert to wear mask.

Implementation:

We have four modules

1. **Datasets Collecting:** We collect number of data sets with some face masks and without no face masks. We try to get high accuracy which depends on the collecting the numbers of images.
2. **Datasets Extracting:** We try to extract the features of using a mobile net v2 of mask and no mask sets all.
3. **Models Training:** We will train a model using the open cv, karas (python library).
4. **Facemask Detection:** We can detect a Pre-processing image.

Conclusion

By the development and arrival of a face mask detection, we can and will detect if the person is wearing a face mask properly and allow the people their entry and this would be of a great helper society. The accuracy of our model will only be achieved and the optimization of our model is a continuous process which goes on and so we are trying to build a highly accurate solution for this. We can prevent a lot of people from Virus Transmission covid through this System.

Despite the success of AI models in other areas of computer vision systems, its use in identifying COVID-19 face masks in the actual world is still in its early stages. Face mask detection was a difficult task in the area of image processing, particularly during the COVID-19 pandemic, due to a variety of mask types, camera angles pixels, various degrees of obstacles, various variations balancing different model detection accuracy or mistakes and realtime requirements and deployment of classification algorithm on computers with limited computational resources. The suggested method uses a convolution neural network to categorise face mask detection in photos and videos using COVID-19 precaution. Extensive dataset testing and performance assessment of the offered methodologies are shown. We also used a symbolic technique to successfully retain inter and intra class variability of face mask detection. We looked at several classifiers such as the Support Vector Machine and the Symbolic Classifier. The idea is being created as just a prototype to track temperature measurements and recognise persons wearing masks. The goal of the project is to create a safety mechanism for people to prevent contracting COVID-19. By using Deep learning idea, we proposed constant monitoring of people's circumstances and storing their data on the server.

VI. Conclusions

The artificial intelligent (AI) and machine learning (ML) are developed various models for face mask detection. In this article, discussed about various methods are used for facial mask detection. As we know nowadays mask detection is a very challenging task. The applications of Facial Mask Detection are used especially for the prevention of spreading Corona Virus, tracking & identifying criminals and anti-spoofing etc. By using a Deep Convolutional

Neural Network Algorithm, we can easily detect the facial mask. But the facial mask detection and non-masked face detection accuracy provided high variations.

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