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A Review on COVID-19 Face Mask Detection using CNN

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The World Health Organization claims (WHO),Corona Viruses the COVID-19 pandemic is causing a nationwide crisis, wearing a mask on a face in public places is an effective protection measure. The COVID-19 pandemic forced governments all over the world to implement quarantine measures in order to deter virus spread. Reports suggest that the risk of transmission is clearly minimized by wearing face masks when at work. An effective and economic approach to the use of AI in a manufacturing setting to build a secure environment. Using a face mask detection dataset, we will use Open CV to perform real-time face detection from a live stream from our webcam. Using Keras, Python, Tensorflow and Open CV, and, it will build a COVID-19 face mask detector with computer vision. Using computer vision and CNN, I aim to decide whether or not the person in the image or video streaming is wear a mask.

Keywords: Deep learning; COVID-19 dataset; open Cv; tensorflow; CNN.

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1. INTRODUCTION

The COVID-19 corona virus pandemic is causing a worldwide health epidemic.As a result, the World Health Organization (WHO) recommends wearing a facemask in public. The planet has been seriously infected by the coronavirus outbreak of 2019.One of the main methods of safety for individuals to wear masks in public places and as well maintain social distancing during this crises. COVID-19's accelerated dissemination in 2020 caused the World Health Organization (WHO) to call it a national epidemic. In computer vision and digital image processing, face recognition has become a very common challenge. Face masks are becoming more common in public as a result of the global COVID-19 corona virus outbreak. Public used to wear a mask on face to shield themselves from airborne diseases / air pollution until COVID-19. Scientists have shown that wearing a mask on face acts to inhibit the transmission of COVID-19. COVID-19 is a modern epidemic virus that has infiltrated human health in the last century (known as the corona virus). The rapid spread of COVID-19 in 2020 impelled the WHO to announce COVID-19 to be a global epidemic.

The corona virus epidemic has resulted in extraordinary levels of global scientific collaboration. In a variety of ways, Deep Learning and machine learning-based Artificial Intelligence can aid in the fight against COVID-19. Machine learning helps scientists and clinicians to evaluate the spread of COVID-19 in vast volumes, to serve as an early warning tool for potential pandemics, and to categorize species that are threatened. Provision of healthcare needs investment in order to combat and forecast emerging diseases for developing technologies i.e. IoT, artificial intelligence, large data and mechanical learning.

1.1 Tensorflow

TensorFlow is a open source free online software library that covers a range of data flow and differentiated programming practices. Google's second-generation framework, Tensorflow, is used for both research and growth at the company. TensorFlow supports 64-bit platforms like Ios and Android, like Linux, MacOS, Windows and smart computing systems. Its modular design enables the efficient use of machines across a wide range of platforms (TPUs, GPUs, CPUs), from desktops, server clusters and smartphones to edge computers. The expression TensorFlow refers to the operations performed on multidimensional data panels known as tensors by such neural networks. During the Google I/O Conference in June2016, Jeff Dean announced that there were 1,500 TensorFlow repositories on GitHub, but only 5 were from Google.

1.2 Keras

Keras is a human-centric API, not a robot-centric one. By providing reliable and fast APIs and reducing the number of users tasks required for normal usage, Keras follows best practices in cognitive stress reduction and provides understandable and actionable error messages including general documentation and user tutorials. Keras provides a range of iterations for widely used building blocks of neural networks, such as objectives, layers, activation functions, optimizers and a series of image and text data processing techniques, making deep neural code writing simpler. GitHub hosts the framework, and the mutual aid forums include a GitHub topic tab and Slack site.Keras is an easy-to-use, deep learning library for Theano or TensorFlow.

1.3 OpenCV

GitHub hosts the framework, and the mutual aid forums include a GitHub topic tab and Slack site. OpenCV was developed to provide a shared vision infrastructure and to accelerate the inclusion of machine perception in consumer products. OpenCV makes it possible for businesses to view and change the code as a BSD-licensed application.

2. VARIOUS TECHNIQUES OF FACIAL MASK DETECTION

In 2021, A proposed system to examine the Physical Distance and Mask Wearing on face of building Workers in COVID-19 Pandemic [1] was developed a computer vision software to recognize face masks that automatically wear violations and the physical distance between construction workers, to provide protection for the infrastructure projects during the pandemic. The document collected and annotated 1,000 images for facial mask recognition, including different ways of wearing a facial mask, and added them to a dataset of 1853 previously available face mask data. The Faster R-CNN Inception ResNet V2 network provided 99.8 percent accuracy, and several state of the art

model Tensorflow object recognition models have been developed and tested in a facial data set.For physical identification of distance people, the paper used Quicker R-CNN Inception V2. The effect of the camera angle on the distances of the points on the imagery is removed using a transformation matrix. For measuring the actual distance between entities, the Euclidian distance used the transformed image pixel. A threshold of six feet has been believed to capture the physical distance infringement. The paper also used transition education to teach the model. Four road maintenance videos in Houston, Texas, were applied to the final model, which successfully sensed the face mask and physical distance.

In 2020, using Transfer learning of Inception V3 for face mask detection system is proposed [2]. A strong protection against COVID-19 has been released and according to WHO is to wear a mask in open places for society and busy environments. It is intricate to track people physically in these environments. The paper recommends a transfer learning approach to simplify the process of recognizing people who have no masks. The proposed model is made by adjusting the InceptionV3, profound, pre-trained, modern model learning. The proposed system is trained and validated on the Simulated Face masked Dataset i.e. SMFD dataset. In order to improve the teaching and study of the model, an approach was adopted to address the lack of data supply. The model outperformed as compared to other methods proposed by claiming 99.9 percent in planning and 100 percent in research.

In 2020, Wearing the face mask Recognition using multi-angle head pose classification technique is proposed in 2020 [3] was established a HGL strategy for dealing with the characterization of the head posture by following picture colour texture analysis and line portrait. The suggested HGL approach integrates the H-channel of the colour space of the HSV with the face portrait and grayscale image and trains the CNN for classification features to be extracted. The MAFA dataset assessment indicates that the suggested approach has achieved improved efficiency compared to the algorithms focused on face recognition and CNN (93.64% gives accuracy in front view and 87.17% gives accuracy in side view).

In 2020, Smart Surveillance System based on CNN – An IoT application post COVID-19 [4] is proposed and was developed face recognition algorithm has many applications available, but only few applications are known for further processing. It's so difficult to execute a mission when it comes to finding faces in the busy places and that, too, in all-weather conditions. Taking this difficulty into account, most monitoring devices are not automated. In the context that the deployed CCTV is used for buffering purposes only. An incident is very rarely brought to attention and later CCTV video for legal queries, it is used as a guide. There are also questions about the deployment of CCTV in public spaces as well. When we choose this system, our practise ensured that the CCTVs will be used. Notice(s) must be issued to officials if an incident requires the video being taken to be processed. The proposed framework is therefore meant to instantly classify and remember human faces to trace criminals/suspects/missing people for surveillance. Using a face recognition algorithm, the planned approach first identifies a face in the video and then examines if the face is present in the data centre. The technique offers the ability to detect, extract features and recognise a Face from inputs that are captured automatically by camera or film. By educating the machine on a small number of facial images, identifying faces in various natural circumstances can be achieved. Furthermore, this device is validated in post-cases Covid-19, where masks in public places are compulsory to wear. In these respects face detection is also checked, and produces positive results.

In 2020, A Mask Detection Method for Shoppers under the Threat of COVID-19 Coronavirus [5] was proposed a single-shot detector (SSD) target detection system that focuses on reliable and real-time super-market detection of face masks. In the following three aspects, we make contributions: 1) presenting a backbone that is lightweight Feature extraction network, which is based on SSD and spatial Separable convolution, which seeks to increase the speed of detection and Meeting the real-time identification requirements; 2) suggesting a Plugin for Function Enhancement (FEM) to reinforce the deep Features learnt from CNN templates, trying to boost the functionality Small object representation; 3) COVID-19 Mask creation, a large-scale dataset to detect whether shoppers wear masks, by capturing images in two supermarkets. The observations of the experiment show the high accuracy of identification and real-time the proposed algorithm's efficiency.

To detect a facial Mask Using Deep Learning approach present in [6] and This approach is to identify the person without a facemask that doesn't wear a mask and then combine the data with a public ID database in order to collect the details of a person and include a very good amount of his or her mobile address and number for that individual. We have categorized individuals of the CNN model with masks and without masks. CNN can understand pixel level data, and CNN performs more efficiently, as opposed to many available algorithms. A two-layer model of 100 filters each and 0.5 percent drop-out and soft max for the hidden and relevant layers, was introduced. Cross entropy used for loss function An Optimizer, Adam is a trained model that consists of more than 1.500 images in both mask groups and is used for identifying faces without masks and cascades, with accuracy of 91.21 per cent. This AI-based mask monitoring technology certainly causes fear in people's minds and starts wearing massage in public spaces to spread the disease so that the internal devices beneficial to society's well-being can be monitored.

In 2020, Facial Mask Detection using Semantic Segmentation [7] aimed to build a binary face classifier which, regardless of its orientation, can be detected any face by present in the frame. We introduce a technology to produce exact facial segmentation masks of any arbitrary image input size.The method utilises VGG-16 Architecture Predefined Training Weights for feature extraction, starting from the dimension free RGB image. Training performed on semantically by completely convolution neural networks the faces present in that picture are segmented out. While Binomial Cross Entropy is used as a loss function, Gradient Descent is used for preparation. In order to remove unwanted noise and avoid incorrect conclusions, a bounding box is created around the faces, the image from the FCN is further processed.Moreover, in understanding non-frontal faces, the proposed model has also demonstrated great success. It is also able to detect other facials along with this. In a single photo, the masks. Multiparsing Human Dataset experiments have been performed for the segmented face masks to reach an average pixel level of 93.884 percent.

Kotwal et al. [8] presented detecting 3D mask presentation attacks in NIR using CNN approach and developed a patch pooling process to learn complex textural features from a convolutionary neural network's lower layers (CNN). Without fine-tuning or adaptation, the patch pooling process may be used in combination with a pre-trained CNN face recognition. In reality, pre-trained CNN can also be trained from data from the visual spectrum. The efficacy of the proposed mask attack strategy is shown in the NIR channel from WMCA and MLFP datasets. It achieves near perfect WMCA data results and outperforms the current MLFP dataset benchmark by a wide margin.

In 2020, chavda et al. proposed a face mask detection using Multi-Stage CNN Architecture [9] has been exposed that wearing a face mask reduces the risk of infectious infection strategy manually is not feasible. We are implementing a technology focused on Deep Learning that can classify situations where face masks are not used properly. The system made up of a convolution Neural Network (CNN) dual stage Masked and unmasked faces can be identified by the architecture and can be combined with pre-installed CCTV cameras. It will help monitor safety breaches, facilitate the use of face masks and maintain a safe working environment.

In 2020, An quantized convolution neural network for facial mask detection system in COVID-19 Pandemic [10] and create a face mask detection scheme, built on a CNN and the object detection- YOLO algorithm, on an embedded low-energy device.The architecture for object detection was developed for real-time object detection using a single CNN technique. In order to adapt the YOLO architecture for embedded application, we propose to build a lightweight, configuration network and quantify it with one bit for weight and 2-bit for activities. The proposed network was launched on the Pynq Z1 platform. The calculation between the hardware and the software was divided. The feature removal component on the hardware machine was run and the output part of the program was executed. This organization has made it possible to perform real-time processing when evaluated on the mixture of collected datasets with a very strong detection precision of 97%.

Hammoudi et al. proposed an application based on android "Check Your Mask" for validating the perfect wearing of face mask by capturing a selfie [11]. A mobile device interface that requires anyone to have a smartphone to be able to take a photo to check that her/his safety mask is correctly located over his/her face. This programme can be extremely helpful for first-time users of face protection masks, especially for

children and elderly people. To detect key features of the face, the built approach uses Haar-like feature descriptors and a decision-making algorithm is implemented. In validating the proper wearing of the mask, experimental findings illustrate the promise of this process.

Table 1. Summary of face mask identification techniques

Technique	Dataset	Testing accuracy	Software model
Faster R-CNN, Inception ResNet v2 Network	MakeML Website Face Mask Dataset	Acc: 99.9%	TensorFlow, object detection model Zoo
Image Augmentation Technique	Simulate Masked face Dataset (SMFD)	Train Acc:99.9% Test Acc: 100%	TensorFlow, object detection model
HGL Method, Head Pose classification	MAFA Dataset	Front Acc: 93.64% Side Acc: 87.17%	Facial Landmark Detection
CNN	dataset COVID-19	Acc: 85.55%	Feature Extraction
Object Detection Method based on Single-Shot-Detector(SSD)	Constructing COVID-19 large Dataset	Runtime Acc: 90.9%	Feature Enhancement Module (FEM)
AI based mask detection system, M-CNN	WHO Dataset	Acc: 91.5%	Relu, Soft Max
Deep Learning, Mobile Net	GitHub Dataset	With_Mask Acc: 97.78% Without Mask Acc: 87.82%	TensorFlow, Keras, OpenCV
Fully Convolution Network, Binomial Cross Entropy	Multi Parsing human Dataset	Acc: 93.884%	VGG-16 architecture
CNN Patch Pooling layer	WMCA and MLFP dataset	Acc: 97%	CNN
Deep Learning, Computer Vision	Real World Masked face Recognition Dataset(RMFRD)	Acc: 100%	Dual-Stage Convolution Neural Network
Pyqn-YOLO-Net, Lightweight CNN	Real-World Masked face Dataset(RMFD)	Precious Acc: 90.7% Recall Acc: 92.3%	Pynq Z1 board
Haar-Like Feature	Android application live webcam Dataset	Nose Acc: TD-100%, FD-29.00% Face Acc: TD-99.92%, FD-8.07%	Decision Making Algorithm
Image Super-resolution including classification (SRCNet)	Medical Masked Dataset	Acc: 98.70%	MATLAB, Single Nvidia GPU with CUDA
Deep Learning	Kaggle Dataset, Bing Search API, RMFD Dataset	With_Mask Acc: 100% Without_Mask Acc: 89.11%	Single-Shot-Detector (SSD)
Two-Stage Detector, FPN	Wider Faces and MAskFAce Dataset(MAFA)	With_Mask Acc: 80.5% Without_Mask Acc: 93.0%	MobileNet For Embedded or mobile device, ResNet
One-Stage Object Detector	MAFA Dataset	Acc: 94%	MobileNet, ResNet
Principle Component Analysis (PCA)	Olivetti and Oracle Research laboratory (ORL) dataset	Masked Acc: 72% Unmasked Acc: 95%	MATLAB
Fully Convolution Layer Network, G-Mask Method	Face Detection Dataset and Benchmark(FDDB) and AFW Dataset	Acc: 95.97%	Max-Pooling

In 2020, Retinamask: A Face Mask Detector [12] introduces a Retinal Face Mask Scanner is provided here. It is a one-stage detector for objects. 7959 photographs were included in the dataset. ResNet and cell networks were used as BACKBONE. But the standard backbone is known to be ResNet. A backbone, a collar, and head modules form the detection network. As a result, the precision of ResNet is much greater than that of Mobile Net.

Sarkar et al. implemented face recognition of masked and non masked face using principle component analysis [13]. The masked and unmasked precision of the face detection was analyzed via a key component analysis.The Olivetti and Oracle Research Laboratory facial database is the dataset used. For feature extraction, PCA is used here. Facial Image Acquisition and Facial Feature Extraction using PCA and Eigen Vector Calculation are the steps used in this work. As a consequence, it has a strong Face mask awareness score.

Lin et al. presented face segmentation and detection using Mask R-CNN approach [14], The segmentation approach used is based on Mask R-CNN. The ResNet-101 Convolutionary Network Model architecture is used for the extract function. The face detection database and benchmark (FDDB) and AFW datasets are used as common face benchmark datasets. For building a mask, a completely convolutionary layer network followed by a max pooling layer is used. As a consequence, it provides high precision of the G-mask than standard mask accuracy. A number of studies on Covid -19 and preventive aspects for spread of infection were reported [15-19].

For face mask identification, there are several techniques that are used. Some of them are clarified as shown in Table 1.

3. CONCLUSION

Different facial mask recognition models have been developed for Deep Learning, Computer vision and machine learning (ML). In this paper, different strategies are explored for facial mask detection. Mask identification, as we know today, is a very difficult task. The Facial Mask Detection apps are especially used to prevent the spread of Corona Virus, monitor & recognize criminals and anti-spoofing, etc. We can quickly detect the facial mask by using a Convolutional Neural Network Algorithm. But there were strong differences in facial mask recognition and non-masked face detection accuracy.

A detailed study of various Face Mask detection techniques, many papers are on face mask detection with-mask or without-mask is being reviewed. But a few papers based on masked face addressed the quality of masked face and non-masked face detection using Convolution Neural Network (CNN). It has a higher identification score for the face with masks. When the face is masked, the identification precision increases to 99%. The authors established a new face mask wearing syndrome in that involves proper wearing of the face mask, wrong q2wearing of the face mask, and no wearing of the face mask. It achieved a precision of 98.70 percent in the face detection phase. People who are wearing a mask or not are detected in CCTV videos of the public sector through live monitoring and detecting the people or groups of people on it.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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