Face Mask Detection Using Deep Learning Techniques

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Abstract: - The SARSCoV2 that causes coronavirus disease 2019 (COVID-19) was transmitted in Wuhan, China, in December 2019. Later, the virus started to spread from person to person. Face masks are a type of personal protective equipment that can assist to prevent the spread of respiratory illnesses, viruses, and bacteria. Face masks are utilized to prevent the spread of COVID-19 infection. Hence, face mask recognition is still a challenging problem in computer vision. To propose a solution for face mask recognition the proposed system uses a combination of Convolutional Neural Network and specific image pre-processing steps. It describes the innovative solution that provides efficient face mask detection and deep learning with convolutional neural networks (CNNs) comparing various architectures and using LeNet to achieve great success in the classification of face masks, especially for human safety using Anaconda and Jupyter. A variety of neuron-wise and layer-wise visualization methods were applied using a CNN, trained with publicly available datasets and from a given image dataset. So, it's observed that neural networks can capture the colours and textures of lesions specific to the respective face mask, which resembles human decision-making.

Key Words: —*CNN, Face Mask, LeNet.*

I. Introduction

According to the World Health Organization (WHO), coronavirus disease (COVID-19) is caused by acute respiratory syndrome (SARS-CoV2) and has infected over 6 million individuals worldwide, resulting in 379,941 deaths. This virus is disseminated mostly through droplets that erupt from a coronavirus-infected individual and pose a risk to others. This event encouraged the use of various types of face masks all around the world to help limit or prevent the spread of the coronavirus and its variants. Furthermore, with the lifting of the COVID-19 quarantine, government and public health agencies are suggesting face masks as vital precautions to take when going out in public. To make the usage of a face mask mandatory, some methods must be devised that ensure people put on a mask before entering public spaces. As the new normal requires humans to wear masks when they leave their houses, manually verifying whether or not people are wearing masks poses a challenge. Face mask detection is the process of determining whether or not someone is wearing a mask.

Manuscript revised April 17, 2022; accepted April 18, 2022.
Date of publication April 20, 2022.

This paper available online at www.ijprse.com

ISSN (Online): 2582-7898; SJIF: 5.59

In reality, the issue is reverse engineering of face detection, in which the face is detected using various machine learning algorithms for surveillance purposes. Even though many academics have worked hard to develop fast algorithms for face detection and recognition, there is a significant difference between 'detection of the face under mask' and 'detection of mask over face.' According to available materials, relatively little study has been done on detecting masks over faces. As a result, the goal of our system is to create a technique that can accurately detect masks over the face in public places, thereby reducing the spread of Coronavirus and contributing to public health. Furthermore, detecting faces with or without a mask in public is difficult due to the little dataset available for detecting masks on human faces, making the model difficult to train. The proposed method narrows down to one architecture after comparing different models.

II. Existing System

The task of recognizing the mask over the face in the public area can be achieved by deploying efficient object recognition algorithms. When compared to two-stage detectors, YOLO [13] (You Only Look Once) popularized the single-stage approach by exhibiting real-time predictions and reaching exceptional detection speed, but it suffered from low localization accuracy when small objects are taken into account [1]. Convolutional Neural Networks [12] are employed as it is convenient in image processing. Transfer learning achieves good results by allowing the use of a powerful pre-trained model like ResNet 50 that has been trained on a big dataset like ImageNet. The experiment used three of the most common baseline models, ResNet50, AlexNet, and MobileNet, to see if they could be combined with the suggested model to get highly accurate results in less time [2]. Researchers used deep learning frameworks TensorFlow, Keras, and OpenCV libraries to detect face masks in real-time for image categorization [3].

III. Proposed Model

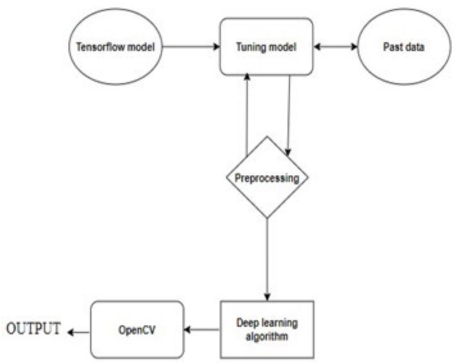

Fig.1. ER Diagram of Proposed Model

To detect the face mask classification, it is planned to design a deep learning technique – Convolutional Neural Network [11] so that even a person with lesser expertise in software is also able to use it easily. It explains the experimental analysis of the methodology [7]. Samples of more number images are collected that comprised of different classes such as masked, No_masked face from various publicly available sources as datasets [5]. This dataset consists of images of humans from various races, and sizes, hence contributing hugely to the diversity and reliability of the dataset [4]. A different number of images is collected for each class that was classified into database images and input images. The primary attributes of the image rely upon the shape and texture-oriented features [8]. A large amount of the input images is used for testing to improve the prediction rate. Initially, various architectures such as AlexNet, LeNet, and ManualNet are used to narrow down the architecture with fewer errors and more scope for future enhancement [9]. Face mask detection using a color-based deep learning model is used for processing the images and producing a credible output [10]. As soon as the camera detects a human face, using the knowledge from training and testing it detects whether a person is wearing a face mask or not. The output appears in a box format with the text displaying 'Mask' or 'No Mask' [6].

IV. Simulation Results

We have to import our data set using Keras preprocessing image data generator function also we create size, rescale, range, zoom range, and horizontal flip. Then we import our image dataset from the folder through the data generator function. Here we set to train, test, and validate from this function we have to train using our own created network by adding layers of CNN.

Fig.2. Dataset of faces with a mask.

Fig.3: Dataset of faces without masks.

Figure.2. and Figure.3 are samples of how the data is classified such as 'mask' or 'no mask' datasets for training and testing. The availability of diverse images is essential to ensure that the model is ready to predict the outcomes for any given input which is also why it is essential to train a large dataset to cover all possible scenarios.

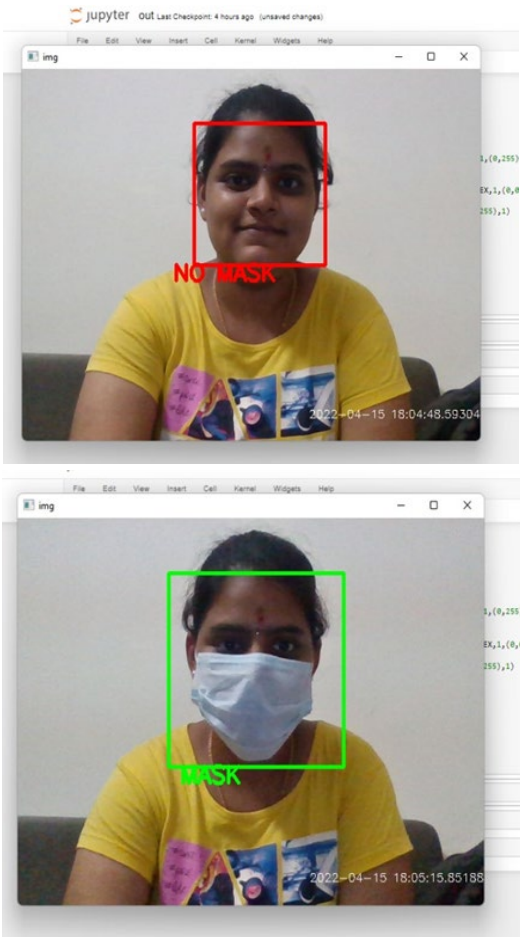

Fig.4. Output Sample

Figure.4. shows how the model classifies and detects whether a person is wearing a mask or not. This shows the reliability of the model and thus makes it desirable to use in real-time scenarios.

V. Conclusion

In this project, a model to classify facial masks over static facial images using deep learning techniques was developed. This is a complex problem that has already been approached several times with different techniques. While good results have been achieved using various other techniques, this project focuses on feature learning. While feature engineering is not necessary, image pre-processing boosts classification accuracy. Hence, it reduces noise in the input data. After comparing various architectures, it is narrowed down to an architecture that produces the desired output. Nowadays, facial mask detection software includes the use of feature engineering. A solution completely based on feature learning does not seem close because of a major limitation. Thus, mask detection is achieved utilizing deep learning techniques.

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