

A COMPUTERIZED SYSTEM TO LIMIT COVID-19 USING FACE MASK AND PHYSICAL DISTANCING DETECTION WITH KERAS/TENSORFLOW, OPENCV, AND DEEP LEARNING*

BY

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ABSTRACT

Since 2019, the rising COVID-19 pandemic has had a lasting impact in many countries worldwide. Face masks and social distancing recognition are significant advances in image processing and deep learning. Many models face detection devices use different algorithms and techniques. The method proposed in this document aims to prevent people without a mask and social distancing from entering required places (i.e., shopping malls, universities, offices, etc.) and connecting to masks by using deep learning, TensorFlow, Keras, and OpenCV to detect and send an alert. Real-time detection of human faces and identification of people wearing masks. This technique is beneficial in decreasing the spread of the virus. The data set provided in this document was collected from Kaggle.

KEYWORDS

Face Mask, Social Distancing, Alert, Alarm System, Deep Learning.

I. Introduction

Coronaviruses (CoV) are an extensive group of viruses that cause an infection that ranges from colds to deadly diseases like Middle East Respiratory Syndrome (MERS) and severe acute respiratory syndrome (SARS) [1]. The first infected patient of coronavirus was found in December 2019 [1]. From that period, COVID-19 has emerged as a plague all around the international. People all around the globe are dealing with harsh circumstances because of this widespread. At the time of writing this paper, nearly 185,030,914 were infected, and 4,002,826

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were dead. This number is growing day by day. Fever, dry cough, tiredness, diarrhoea, lack of taste, and odour are the significant signs of coronavirus, which the World Health Organization (WHO). Many precautionary measures were taken to combat coronavirus. Among them, wearing a mask and maintaining social distance is the most effective one. COVID-19 is a sickness that expands from human to human, which may be managed using a facial mask.

The growth of COVID-19 may be constrained if humans strictly use a facial mask and keep social distancing. Sadly, people are not following these guidelines rightly, which is rushing the spread of this virus. Detecting the humans not following the guidelines and alerting them could decrease the spread of coronavirus. Face mask and social distancing detection is a method to discover whether a person is wearing a mask and maintaining social distancing or not.

Developed by Keras and TensorFlow, the facial mask recognition and social distancing framework use deep learning and computer visualization techniques to recognize facial masks and social distancing from static images and real-time video streams. We will develop a custom object recognition model to perform face mask detection and social distancing using TensorFlow's Object Detection API to recognize person masks and social distancing from a video stream from a webcam. To identify a face, a pre-trained model provided by the OpenCV framework is used. Once we have identified the person using the Object Recognition API and predicted that the person would maintain social distance, we use a powerful library for image processing. The model returns a bounding box mask for each detected object in the image. TensorFlow Object Detection API is a framework for creating deep learning networks to solve object detection problems. The facial mask recognition model is based on a deep learning technique called Convolutional Neural Network (CNN). Viola Jones's algorithm trains slowly but can recognize faces in real-time at impressive speed.

II. Technologies Used

A) Computer Vision:

Computer vision is a field of computer science that focuses on copying some of the complexity of the human visual system and allowing computers to recognize and process objects in images and videos just like humans.

Computer vision and deep learning algorithms touch on all facets of computer science. Computer vision plays a significant role in everything from self-driving cars to robotics to photo-correcting apps. One area in which CV and DL algorithms have an enormous influence is medical computer vision.

A common hypothesis is that our brain relies on patterns to decipher individual objects. Computers try to retrieve visual information, deal with it, and interpret the results with unique software algorithms. Computer visualization includes capturing, processing, analyzing, and understanding digital images and extracting high-dimensional data from the real world to generate numerical and symbolic information.

Turning raw image data into high-level concepts that people and computers can interpret and respond to is the primary goal of computer vision technology. Computer-visual systems translate the essential visual information into images and video data and use contextual knowledge to provide people with insights that can be used to make decisions. Computer vision's basic idea and context analyze and classify images and create detailed and meaningful scene descriptions that provide decision-makers with key elements in real-time.

B) Open-CV:

OpenCV is a massive open-source library for computer vision, machine learning, and image processing that plays a vital role in real-time operations in today's systems [3]. OpenCV focuses on image processing, video capture, and analysis, including facial recognition and object recognition [6]. Open-CV is a cross-platform library that can be used wherever we develop real-time computer vision applications. We can process images and videos with OpenCV to identify objects, faces, handwriting, and people [7].

It is integrated with various libraries such as NumPy and can process OpenCV array structure analyses [7]. It provides simplicity, high standards of analysis, and performance of models based on OpenCV. With OpenCV, you can process images and videos to identify objects, faces, handwriting, and people.

C) TensorFlow:

Machine learning models can be daunting and challenging to implement and apply. Still, machine learning frameworks like Google's TensorFlow can simplify the process of collecting data for training models, providing predictions, and refining future outcomes. TensorFlow is an open-source library developed by the Google Brain team for numerical computation. It bundles a whole range of machine learning, deep learning, neural network models, and algorithms to make them useful in a way familiar to all metaphors.

TensorFlow uses Python to provide a convenient front-end API for building applications while executing applications in C++. It also offers additional convenience for developers who need to

debug and inspect TensorFlow apps. The most significant benefit that TensorFlow offers for the development of machine learning is an abstraction.

TensorFlow has a comprehensive and flexible ecosystem of tools, libraries, and community resources that enable researchers to advance the best of the latest technology in ML and enable developers to develop, deploy and operate applications. In May 2019, Google announced TensorFlow Graphics for deep learning in computer graphics. Google has also released the Colaboratory Tensorflow Jupyter Notebook, an environment that requires no setup [9].

D) Deep Learning:

Deep learning simulates the human brain and allows systems to learn to identify objects, perform complex tasks and increase accuracy without human intervention. Deep learning differs in displaying data, like images, videos, and text, without introducing hand-coded rules or human domain knowledge from traditional machine learning techniques. Deep learning has two significant advantages over machine learning: the best and most obvious approach to real machine intelligence.

Deep learning is a subset of machine learning [4] in which multi-layered neural networks like the human brain function to learn from large quantities of data. Deep learning algorithms use complex, multi-layered neural networks in which the degree of abstraction increases with nonlinear transformations of input data [2]. Through layers of neural networks, deep-learning algorithms perform calculations, make predictions, and learn to improve the accuracy of results over time.

To create a deep learning algorithm, developers and engineers configure the number of layers, the types of functions that link the output of each layer to the input of the next, and so on. For example, a deep-learning algorithm could be given thousands of images, each with a label that matches the image's content. The algorithm guides the pictures through its multi-layer neural network (how many layers it has is called deep learning) and adjusts the weights and variables in the neural activation layers of the network to identify common patterns defined by images with similar names.

E) Convolution Neural Network:

With the advancement of computer vision, deep learning was constructed at the perfect time, and a special algorithm is the convolution neural network. Convolutional Neural Network (CNN or ConvNet) is a class of deep neural networks used to analyze visual images in deep learning [5]. This deep-learning algorithm takes an input image and assigns meaning, learnable weights, and biases to different aspects of the object in the image to distinguish one from the other. To

create a deep learning algorithm, developers and engineers configure the number of layers, the types of functions that link the output of each layer to the input of the next, and so on. For example, a deep-learning algorithm could be given thousands of images, each with a label that matches the image's content. The algorithm guides the pictures through its multi-layer neural network (how many layers it has is called deep learning) and adjusts the weights and variables in the neural activation layers of the network to identify common patterns defined by images with similar names.

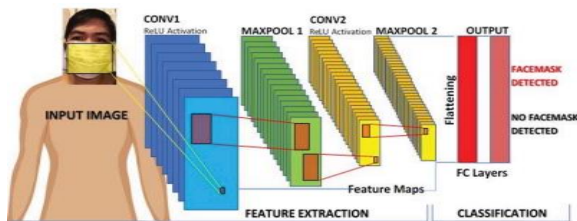


Fig. 1. Process of Convolutional Neural Network in predicting Facemask and not Facemask wearing [8].

The illustration in Figure 1 provides an example of the convolutional layer process. The filter will fully model the image elements in the filter and map it to a new matrix, and then the filter will move to the next position and iteratively perform the same process.

III. Problem It Solves

The main reason increase in Covid patient rates were the people who didn't follow the preventive measures of wearing masks and social distancing. When Covid was in the initial stage, people were unaware of the importance of these two practices. Still, we can see people vaccinated and not following the mandatory preventive measures, and it's all because of incomplete knowledge about the Covid Virus. Maintaining social distance and wearing a mask have become the two most popular terms in life today to protect yourself from the new coronavirus. The researchers concluded that these two approaches are warriors against Covid. Governments across the country are trying to implement both of these practices. As a team, we have proposed a real-time solution that can detect the social distance between people and detect people without masks. Because people are unaware of the face mask + social distance preventive measure, this solution is necessary. Only a mask or only social distancing cannot save you, but the combination of both can.

IV. Conclusion

People were responsible for the spread of covid-19 as they were inattentive about the measures and were unprofessional about the consequences they are currently facing.

Face-mask and Social Distancing Detection system may decrease the spread of this pandemic (Covid-19). It may encourage people to follow the guidelines to keep themselves and the people around them safe by not spreading the virus and not infecting them.

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