Face Mask and Body Temperature Detection System to Prevent COVID for Work Environment

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Abstract

Due to the COVID-19 pandemic, wearing a mask is mandatory in public spaces, as properly wearing a mask offers a maximum preventive effect against viral transmission. Body temperature has also become an important consideration in determining whether an individual is healthy. In this work, we design a real-time deep learning model to meet current demand to detect the mask-wearing position and head temperature of a person before he or she enters a public space. In this experiment, we use a deep learning object detection method to create a mask position and head temperature detector using an Arduino and temperature sensor. We implement an RGB camera and temperature sensor to generate input images and capture a person's temperature, respectively. The output of these experiments is a live video that carries accurate information about whether a person is wearing a mask properly and what his or her head temperature is. Our model is light and fast, achieving a confidence score of 81.31% for the prediction object and a prediction speed below 0.1s/image.

Keywords:- *neural network, object detection, deep learning, Arduino*

I. INTRODUCTION

A coronavirus is a group of viruses which aims at impacting and infecting the respiratory system of individuals. This group of coronaviruses includes SARS and the other commonly known cold and influenza viruses. [1] However, the global pandemic caused by the well-known COVID-19 has coined a name 2019- nCoV on January 2020 by the World Health Organisation (WHO). It is expected to have its roots from the initial cases that emerged in Wuhan, capital of Hubei Province of China. Multiple nurses and medical workers of the PICC crew are immersed completely into the task of taking care of the infected patients and working around the clock to restore them to their normal health conditions on a global scale. In the United States, out of the first 300 patients admitted to multiple hospitals across the city, it is noted that 60.7% of them are men. 91.3% of them required ventilator support to facilitate the breathing process. The challenge to the process of effective detection and testing is that a sizeable proportion of the population remains asymptomatic to the infection and does not display any visible symptoms of contracting the virus which makes the process of tracking its roots an arduous process.[3] However, normalcy has to be restored even though the COVID situation has left several students, teachers, and working personnel homebound. [4] IoT (Internet of Things) allows for the interconnectivity of multiple devices across several regions to ensure connectivity. [5] It can be effectively deployed in the current COVID scenario to tackle the challenges that occur in restoring normalcy while ensuring that safety and security are not compromised at any cost in organizations and institutions. They invent and boom in the use of mobile phones and smart appliances in the health and welfare sector has paved way for the data about everyone to be assessed and evaluated on a mass scale. By the current COVID-19 scenario, IoT offers multiple applications such as the smart ventilators and masks or the provisions made for the allowance of self-isolation at home while being monitored by the medical facilities. Several modern necessities like secured data storage systems, cloud and edge computing, intelligent data management, sensors for smart health devices. What started as a country level scare in China with several speculations raised about its origin has now manifested into a global pandemic with a multitude of research carried out to determine a cure. As a global pandemic, COVID-19 has been inflicting major casualties and losses to the human population across the world from

all walks of life. Approximately, 31.9 million people have been affected by the SARS-CoV-2 virus with close to 977K deaths reported under the radar. The table is topped by countries namely the US, India, Brazil, and Russia accounting for the maximum number of infected individuals. In India alone, 5.73 million people were and are affected by COVID of which close to 91K people have succumbed to the virus. Maharashtra, Andhra Pradesh, Tamil Nadu have whooping numbers of COVID infected people. While several measures are being taken at the State and Central level to combat the situation, it has become the need of the hour, at least for the working population to step out of the comfort of their homes to sustain their living and as well as to resolve the economical imbalance. With these reasons on the front, the proposed model will certainly help to ensure the safety and health wellness of all the employees when administered in their organizations.

II. LITERATURE REVIEW

Beginning in December 2019, the sudden new type of coronavirus pneumonia (COVID-19) quickly raged across the country and even the world [1]. As of July 15, 2020, more than 13.65 million confirmed cases have been reported in more than 220 countries and regions around the world, and more than 580,000 patients have died. At present, it is still continuing to spread on a large scale [2]. The new type of coronavirus is highly infectious. It can be spread through contact, droplets, aerosols and other carriers in the air, and it can survive for 5 days in a suitable environment [3]-[4]. The "Guidelines for the Prevention of New Coronavirus Infection Pneumonia" issued by the National Health Commission emphasized that when individuals go out to public places, seek medical treatment and take public transportation, they need to wear medical surgical masks or N95 masks to prevent the spread of the virus. Therefore, it is everyone's responsibility to wear masks in public places during the epidemic, but this requires not only the conscious compliance of the individual, but also the adoption of certain measures to supervise and manage. At present, although there is no algorithm specifically applied to face mask wearing detection, with the development of deep learning in the field of computer vision [5-7], neural network-based target detection algorithms are used in pedestrian target detection, face detection, and remote sensing image targets. Detection, medical image detection and natural scene text detection are widely used in fields [8]-[11]. Face recognition algorithms rely on a high degree of recognition accuracy, and have huge application potential in classroom attendance, identity authentication, access control systems, login and unlocking, and social media platforms [12].

At present, face recognition devices on the market have relatively single functions and have relatively high requirements on faces. When the face is in a state of large-area occlusion, the recognition accuracy drops rapidly. Especially in the face of the current epidemic situation where all people wear masks, the capabilities of traditional face recognition systems appear to be stretched. Considering that we will try our best to resume production and work while ensuring people's safety, we have designed a smart detection and recognition system for mask wearing. The system is mainly composed of face mask detection algorithm and face recognition algorithm. The main functions of the system can be divided into three parts: face mask detection, face recognition, and voice prompts. When multiple pedestrians pass by the camera, the camera equipped with this algorithm will first detect the pedestrian's face mask. When the pedestrian wears the mask normally, it will not give a voice prompt. When a pedestrian wears a mask incorrectly, the voice will announce to remind him to wear the mask correctly. When a pedestrian is not wearing a mask, the system will trigger the face recognition module to speak his name and remind him to wear a mask. The system can be used in high-speed rail stations, subways, shopping malls and other crowded areas. Through researching related target detection algorithms, it is found that the deep learning model used for face detection can be applied to the task of mask wearing detection. In this paper, the more accurate face detection algorithm RETINAFACE [13] is used as the basic algorithm for mask face detection, and on this basis, the network structure of the RETINAFACE algorithm is improved, and the attention mechanism is introduced to meet the needs of new functions; In this system, we calculate the mask and the key point positions of the face, and the confidence that the mask is worn on different faces is returned to determine whether the person wears the mask in a standard manner. The calculation is fast and accurate, and the algorithm is stable and efficient; for the current popular ones For the face recognition method, we use the DEEPFACE [14] algorithm. The algorithm divides the face recognition problem into several related subproblems.

III. PROPOSED ARCHITECTURE

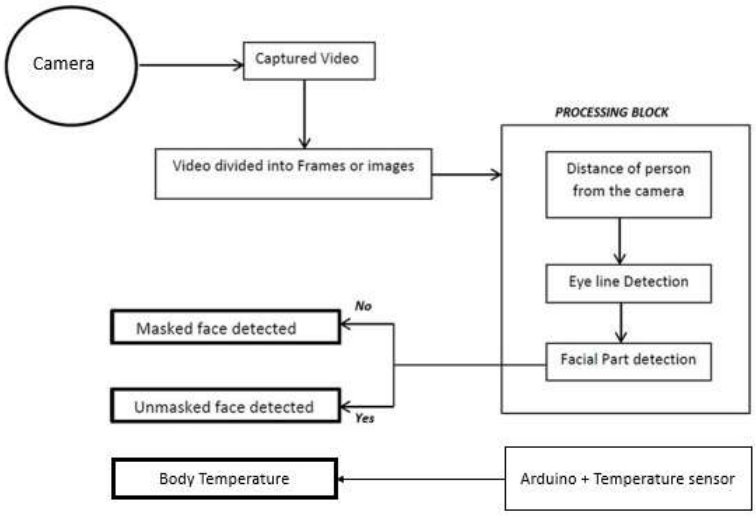

Figure 1 System Architecture

Step 1: Data Visualization

In the first step, let us visualize the total number of images in our dataset in both categories i.e. with face mask and no face mask.

Step 2: Data Augmentation

In the next step, we augment our dataset to include a greater number of images for our training. In this step of data augmentation, we rotate and flip each of the images in our dataset.

Step 3: Splitting the data

In this step, we split our data into the training set which will contain the images on which the CNN model will be trained and the test set with the images on which our model will be tested.

Step 4: Building the Model

In the next step, we build our Sequential CNN model with various layers such as Conv2D, MaxPooling2D, Flatten, Dropout and Dense. In the last Dense layer, we use the 'softmax' function to output a vector that gives the probability of each of the two classes.

Step 5: Pre-Training the CNN model

After building our model, let us create the 'train_generator' and 'validation_generator' to fit them to our model in the next step.

Step 6: Training the CNN model

This step is the main step where we fit our images in the training set and the test set to our Sequential model we built using keras library.

Step 7: Labeling the Information

After building the model, we label two probabilities for our results. [‘0’ as ‘without_mask’ and ‘1’ as ‘with_mask’].

Step 8: Detecting the Faces with and without Masks

In the last step, we use the OpenCV library to run an infinite loop to use our web camera in which we detect the face using the Cascade Classifier. The code webcam = cv2.VideoCapture(0)denotes the usage of webcam.

The model will predict the possibility of each of the two classes ([without_mask, with_mask]). Based on which probability is higher, the label will be chosen and displayed around our faces.

IV. CONCLUSION

In this work, we successfully construct a face mask detection system to detect and capture the temperature of a specific point inside a predicted bounding box. learned how to create a COVID-19 face mask detector using OpenCV, python, and Deep Learning. To create our face mask detector, we trained a two-class model of people wearing masks and people not wearing masks. We fine-tuned MobileNetV2 on our mask/no mask dataset and obtained a classifier that is ~99% accurate.

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