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Raspberry Pi Based Multilayer Classification of Face Mask Detector for Covid-19 Precautions

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ABSTRACT: Everyone has been affected by the COVID-19 coronavirus pandemic on a global scale. It crippled the economic growth of the entire nation around the world. Wearing a mask duringthis pandemic is a critical preventive measure and is most vital step in times when social distancing is hard to maintain. Wearing a mask is essential, particularly for those people who are at a greater risk of severe illness from COVID-19 diseases. It is found that the spread of COVID-19 is mainly among people who are in immediate contact with one another (nearly about 6 feet), it can be spread by people who do not have symptoms and are unaware of the fact that they are infected, face masks are one of the personal protective equipment. FaceMask detection has become a trending application due to the Covid-19 pandemic, which demands a person to wear face masks, keep social distancing, and use hand sanitizers to wash their hands. While other problems of social distancing and sanitization have been addressed until now, the issue of face mask detection has not yet been adequately addressed. People wear face masks once

They step out of their homes and authorities strictly ensure that people are wearing face masks while they are in groups and public places. To monitor that people are following this basic safety principle, a strategy should be developed. A face mask detector system based on Raspberry Pi can be implemented to check this whether a persons wearing a mask or not? It can be used in public places or even outside your house to keep an eye on visitors. This project is beneficial in combating the spread of the virus and avoiding contact with the virus.

KEYWORDS: Masked-face detection, Face-mask classification, Face-mask recognition, COVID-19 Compliant mask detection, Raspberry Pi, OpenCV

I. INTRODUCTION

Recently India along with almost all big and small countries stated emergency conditions for the novel coronavirus (COVID-19). Practically, the whole population of the world is under lockdown and people are maintaining social distances as suggested by the World Health Organization (WHO). This deadly virus has infected tens of lakhs individuals and continues to spread globally. According to recent reports, the next few months are life-threatening in the current efforts to hold COVID-19 spread among communities. Across India, persons are losing jobs, working from home, being hospitalized, and even vanishing life as a result of COVID-19 infections. The epidemic placed great stress on medico professionals. Hospitals are experiencing higher than normal patient loads and treating all patients quickly and effectively now becomes a very challenging task. Due to fear, country-wise lockdown, and suspended OPDs in Hospitals regular patients are also not able to approach doctors.Since there is no vaccine yet available in the market, the only way to be safe is by taking precautions. It is suggested to wear a face mask and maintain social distancing to avoid coming in contact with novel coronavirus. Studies have proven that masks help in slowing down the spread of infection as the virus mainly gets transmitted with the aerosols which come out of an infected person's nose or mouth while coughing or sneezing.).. Additionally, many public service providers require customers to wear face-masks in accordance with predefined rules (e.g., covering both mouth and nose) when using public services. These developments inspired research into automatic techniques for face-mask detection that can help monitor public behavior and contribute towards constraining the COVID-19 pandemic. Although existing research in this area resulted in efficient techniques for face-mask detection, these usually operate under the assumption that modern face detectors provide perfect detection performance (even for masked faces) and that the main goal of the techniques is to detect the presence of face-masks only. Therefore, we are going to build a Raspberry Pi-based face mask detector which detects whether the person is wearing a mask or not?

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1.1 Problem Definition

In this project, we will be developing a face mask detector that is able to distinguish between faces with masks and faces with no masks. It is essential to develop an automatic detection for wearing facemask which will provide individual protection and prevent the local epidemic. It can be used in public places or even outside your house to keep an eye on visitors. This project is beneficial in combating the spread of the virus and avoiding contact with the virus.

II. OVERVIEW

COVID-19 pandemic has had a lasting impact in many countries worldwide since December 2019. It originated in Wuhan, China. The World Health Organization (WHO) as on March 11, 2020, declared it as a deadly diseases that gained its roots across the globe and severely affected 114 countries .The year 2020 has shown mankind some mind-boggling series of events amongst which the COVID19 pandemic is the most lifechanging event which has startled the world since the year began. Affecting the health and lives of masses, COVID-19 has called for strict measures to be followed in order to prevent the spread of disease. From the very basic hygiene standards to the treatments in the hospitals, people are doing all they can for their own and the society's safety; Face Mask detection has become a trending application due to the Covid-19 pandemic, which demands a person to wear face masks, keep social distancing, and use hand sanitizers to wash their hands. While other problems of social distancing and sanitization have been addressed until now, the issue of face mask detection has not yet been adequately addressed. Wearing a mask during this pandemic is a critical preventive measure and is most vital step in times when social distancing is hard to maintain. Wearing a mask is essential, particularly for those people who are at a greater risk of severe illness from COVID-19 diseases. It is found that the spread of COVID-19 is mainly among people who are in immediate contact with one another (nearly about 6 feet), it can be spread by people who do not have symptoms and are unaware of the fact that they are infected .So Centers for Disease Control and Prevention (CDC)1recommended all people 2 years of age and older to wear a mask in public areas especially when other social distancing measures are difficult to maintain. Hence by reducing the risk of transmission of this deadly virus from an infected person to a healthy, the virus' spread and disease severity can be reduced to a great extent. face masks are one of the personal protective equipment. People wear face masks once they step out of their homes and authorities strictly ensure that people are wearing face masks while they are in groups and public places. To monitor that people are following this basic safety principle, a strategy should be developed. A face mask detector system can be implemented to check this. Face mask detection means to identify whether a person is wearing a mask or not. The first step to recognize the presence of a mask on the face is to detect the face, which makes the strategy divided into two parts: to detect faces and to detect masks on those faces. Face detection is one of the applications of object detection and can be used in many areas like security, biometrics, law enforcement and more. There are many detector systems developed around the world and being implemented. However, all this science needs optimization; a better, more precise detector, because the world cannot afford any more increase in corona cases. 1In this project, we will be developing a face mask detector that is able to distinguish between faces with masks and faces with no masks. In this report, we have proposed a detector which employs SSD for face detection and a neural network to detect presence of a face mask. The implementation of the algorithm is on images, videos and live video streams.Face Mask detection has turned up to be an astonishing problem in the domain of image processing and computer vision. Face detection has various use cases ranging from face recognition to capturing facial motions, where the latter calls for the face to be revealed with very high precision. Due to the rapid advancement in the domain of machinelearning algorithms, the jeopardies of face mask detection technology seem to be well addressed yet. This technology is more relevant today because it is used to detect faces not only in static images and videos but also in real-time inspection and supervision. With the advancements of convolution neural networks and deep learning very high accuracy in image classification and object detection can be achieved. Probably because of the sudden emergence of the COVID-19 pandemic, at present, there are various facial recognition technology applied to people wearing masks. HanvonTechnology reportedthat the accuracy of masked face recognition is about 85 %. An accuracy of over 90% was obtained from Minivision Technology. The face-eye-based multi-granularity model achieves 95 % recognition accuracy. In, the authors used the YOLOv3 algorithm for face Mask detection. This method achieved 93.9 % accuracy. The accuracies achieved were on artificial dataset which was not the case in this paper which uses both real and artificial images.

III. FUNCTIONALITY

The Raspberry Pi is a fully-fledged minicomputer, capable of doing whatever you might do with a computer. It comes with 4x USB, HDMI, LAN, built-in Bluetooth/WIFI support, 1GB RAM, 1.2GHz quad-core ARM CPU, 40 GPIO

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(General Purpose Input Output) pins, audio and composite video output, and more. Rather than not having manychoices, instead, your options are staggeringly large.

I have also used Raspberry Pis as home security cameras, server monitoring devices, cheap headless machines (basically running low-weight scripts 24/7 with a low cost-tome). others have used them for media centers and even for voice-enabled IoT devices. The possibilities are endless, but first we need to get acquainted! Beyond the Raspberry Pi, it can be wise, but not required, to get a case. Make sure that, if you do get a case, it has openings for the GPIO pins to be connected, otherwise you're ruining all of the fun. You will also need a 1000mA+ mini usb power supply and at least an 8GB micro SD card, but I would suggest a 16 GB micro SD card or greater.You will also want to have a spare monitor (HDMI), keyboard, and mouse handy to make things easier when first setting up. You wont will eventually be able to control your Pi remotely, so you wont always need a separate keyboard, mouse, and monitor. If you don't have a monitor with HDMI input, you can buy something like an HDMI to DVI converter.This is all assuming you're going to be using a Raspberry Pi 3 Model B. If you're using an older version board, please see what you might need to change, for example, the older Rasbperry Pitake a full-sized SD card, but the latest model requires a micro SD card. Also, the Raspberry Pi 3 Model B has built-in wifi, where the older models will require a wifi dongle.Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation in association with Broadcom. The Raspberry Pi project originally leaned towards the promotion of teaching basic computer sciencein schools and in developing countries. The original model became more popular than anticipated, selling outside its target market for uses such as robotics. It is widely used in many areas, such as for weather monitoring,[20] because of its low cost, modularity, and open design. It is typically used by computer and electronic hobbyists, due to its adoption of HDMI and USB devices.After the release of the second board type, the Raspberry Pi Foundation set up a new entity, named Raspberry Pi Trading, and installed Eben Upton as CEO, with the responsibility of developing technology. The Foundation was rededicated as an educational charity for promoting the teaching of basic computer science in schools and developing countries. The Raspberry Pi is one of the best-selling British Computers. As of December 2019, more than thirty million boards have been sold. Most Pis are made in a Sony factory in Pencoed, Wales, while others are made in China and Japan.

3.1 Processor

The Broadcom BCM2835 SoC used in the first generation Raspberry Pi[44] includes a 700 MHz ARM1176JZF-S processor, VideoCore IV graphics processing unit (GPU), and RAM. It has a level 1 (L1) cache of 16 KB and a level 2 (L2) cache of 128 KB. The level 2 cache is used primarily by the GPU. The SoC is stacked underneath the RAM chip, so only its edge is visible. The ARM1176JZ(F)-S is the same CPU used in the original iPhone,although at a higher clock rate, and mated with a much faster GPU.The earlier V1.1 model of the Raspberry Pi 2 used a Broadcom BCM2836 SoC with a 900 MHz 32-bit, quad-core ARM Cortex-A7processor, with 256 KB shared L2 cache. The Raspberry Pi 2 V1.2 was upgraded to a Broadcom BCM2837 SoC with a 1.2 GHz 64-bitquad-core ARM Cortex-A53 processor, the same SoC which is used on the Raspberry Pi 3, but underclocked (by default) to the same 900 MHz CPU clock speed as the V1.1. The BCM2836 SoC is no longer in production as of late 2016.The Raspberry Pi 3 Model B uses a Broadcom BCM2837 SoC with a 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor, with 512 KB shared L2 cache. The Model A+ and B+ are 1.4 GHz The Raspberry Pi 4 uses a Broadcom BCM2711 SoC with a 1.5 GHz 64-bit quad-core ARM Cortex-A72 processor, with 1 MB shared L2 cache. Unlike previous models, which all used a custom interrupt controller poorly suited for virtualisation, the interrupt controller on this SoC is compatible with the ARM Generic Interrupt Controller (GIC) architecture 2.0, providing hardware support for interrupt distribution when using ARM virtualisation capabilities.

The Raspberry Pi Zero and Zero W use the same Broadcom BCM2835 SoC as the first-generation Raspberry Pi, although now running at 1 GHz CPU clock speed.The Raspberry Pi Pico uses the RP2040 running at 133 MH.A Raspberry Pi Zero with smaller size and reduced input/output (I/O) and generalpurpose input/output (GPIO) capabilities was released in November 2015 for US$5. On 28 February 2017, the Raspberry Pi Zero W was launched, a version of the Zero with Wi-Fi and Bluetooth capabilities, for US$10. On 12 January 2018, the Raspberry Pi Zero WH was launched, a version of the Zero W with pre-soldered GPIO headers.

IV. CONCLUSION

After building a object detection model myself, I find structuring a deep learning project is definitely more than parameter tuning and designing the neural network architecture.The most tedious and time-consuming part was

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collecting and preprocessing the data. Setting up TensorFlow environment can also be tricky, which hopefully will be resolved in the near future as TensorFlow becomes more automated. The main takeaways are:

1. The real-life data are complex. We should select the representative images of each class
2. Transfer learning is useful when we have a small dataset
3. We should stick to the guideline of fast prototyping and refining the model iteratively
4. And finally, without doubt, wear a mask at public places no matter which kind

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