IJAREEIE

e-ISSN: 2278-8875
p-ISSN: 2320-3765

International Journal of Advanced Research

in Electrical, Electronics and Instrumentation Engineering

Volume 10, Issue 7, July 2021

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.282

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.282|

|| Volume 10, Issue 7, July 2021 ||

| DOI:10.15662/IJAREEIE.2021.1007044 |

Face Mask Detector Using Raspberry Pi

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ABSTRACT: The end of 2019 witnessed the outbreak of Coronavirus Disease 2019 (COVID-19), which has continued to be the cause of plight for millions of lives and businesses even in 2020. As the world recovers from the pandemic and plans to return to a state of normalcy, there is a wave of anxiety among all individuals, especially those who intend to resume in person activity. Studies have proved that wearing a face mask significantly reduces the risk of viral transmission as well as provides a sense of protection. However, it is not feasible to manually track the implementation of this policy. Technology holds the key here. We launch a Deep Learning based system that can detect instances where face masks are not used properly. Our system consists of a dual stage Convolutional Neural Network architecture capable of detecting masked and unmasked faces and can be integrated with pre-installed CCTV cameras. This will help track safety violations, promote the use of face masks, and ensure a safe working environment.

KEYWORDS: Image processing, machine learning, open CV

I.INTRODUCTION

From year 2020 we are facing big problem of COVID pandemic. Our priorities of life have completely changed due to this pandemic situation. Social distancing, sanitizer and facemask has become the part of our life but after knowing that face mask can reduce the risk many of our literate people are ignoring the use of mask. By understanding this problem, we have decided to develop a project which can help us to detect such people who are not only making their life but also other peoples too. So, we are going to build a raspberry pi based face mask detector. Which will detect whether the person is wearing a mask or not.

II.WORKING

There Are Two Phases
(1) Face Detector
(2) Face Mask Classifier

Face Detector*:* A face detector acts as the first stage of oursystem. A rawRGB image is passed as theinput to this stage. The face detector extractsand outputs all the faces detected in theimage with their bounding box coordinates.The process of detecting faces accurately isvery important for our architecture. Training ahighly accurate face detector needs a lot oflabelled data, time, and compute resources.For these reasons, we selected a pre-trainedmodel trained on a large dataset for easy generalization and stability in detection. Three different pre-trained models were tested for this stage

Intermediate Processing Block*:* This block carries out the refining of thedescry faces and batches them together forclassification, which is carried out by Stage 2.The detector from Stage 1 outputs thebounding boxes for the faces. Stage 2requires the entire head of the person toaccurately classify the faces as masked orunmasked. The first step involves expandingthe bounding boxes in height and width by20%, which covers the required Region ofInterest (ROI) with minimal overlap with otherfaces in most situations. The second stepinvolves cropping out the expanded boundingboxes from the image to extract the ROI foreach detected face. The extracted faces areresized and normalized as required by Stage2. Furthermore, all the faces are batchedtogether for batch inference.

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Face Mask Classifier: The second stage of our system is a face mask classifier. This stage takes the processed ROI from the Intermediate Processing Block and classifies it as either Mask or No Mask. A CNN based classifier for this stage was trained, based on three different image classification models: MobileNetV2 (Sandler et al., 2018), DenseNet121 (Huang et al., 2017), NASNet (Zoph et al., 2018). These models have a lightweight architecture that offers high performance with low latency, which is suitable for video analysis. The output of this stage is an image (or video frame) with localized faces, classified as masked or unmasked.

Datasets: The three face mask classifier models were trained on our dataset. The dataset images for masked and unmasked faces were collected from image datasets available in the public domain, along with some data scraped from the Internet.

The dataset consists of **1,376 images** belonging to two classes

• With Mask: 690 images

• Without Mask: 686 images

Face Mask Classifier Model Training: For the second stage, three CNN classifiers were trained for classifying images as masked or unmasked. The models were trained using the Keras (Chollet et al., 2015) framework. Pre-trained Image Net (Deng et al., 2009) weights were used as a starting point for these models, instead of Glorot Uniform Initializer (Glorot and Bengio, 2010). The dataset was split into train, validation, and test sets in a ratio of 80:10:10. Data augmentation was performed using the Image Data Generator class in Keras. The input image size was set as 224 x 224. We selected an initial learning rate of 0.001. Besides this, the training process included check pointing the weights for best loss, reducing the learning rate on plateau, and early stopping. Each model was trained for 50 epochs and the weights from the epoch with the lowest validation loss were selected.

III.COMPONENT

Raspberry pi: Raspberry Pi 3 is a 64-bit quad core processor running at 1.4GHz, dual-band 2.4 GHz and 5 GHz wireless LAN, Bluetooth 4.2/BLE, 40-pin extended GPIO, faster Ethernet and PoE capability via a separate PoE HAT. For the face recognition system, we used a raspberry pi with a raspberry pi camera module which is connected to the CSI (Camera Serial Interface) port of the Pi.

There are other components also be used like keypad, motor wheels, dc motors, battery, lcd screen etc.

Camera Module: The Raspberry Pi camera module can be used to take high-definition video, as well as stills photographs. It’s easy to use for beginners, but has plenty to offer advanced users if you’re looking to expand your knowledge. There are lots of examples online of people using it for time-lapse, slow-motion and other video cleverness. You can also use the libraries we bundle with the camera to create effects. If you’re interested in the nitty-gritty, you’ll want to know that the module has a five-megapixel fixed-focus camera that supports 1080p30, 720p60 and VGA90 video modes, as well as stills capture. It attaches via a 15cm ribbon cable to the CSI port on the Raspberry Pi. The camera module is very popular in-home security applications, and in wildlife camera traps.

Speaker: This is an ultimate heavy duty Bluetooth speaker. It delivers clear sound with a dynamic sound effect which is extremely powerful & loud. It provides hours of entertainment at an affordable price. The BT 99 connects to your mobile phones and other Bluetooth enabled devices with ease. The pairing process is extremely user friendly and quick. Additionally, it also has extra features such as: a USB port through to play your music by connecting a pen drive, an AUX-IN slot to connect various other media devices & a FM radio to catch up with latest tunes playing on the air.

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V. RESULT AND DISCUSSION

We can detect face masks in Static Images as well as in Real-time Video streams.

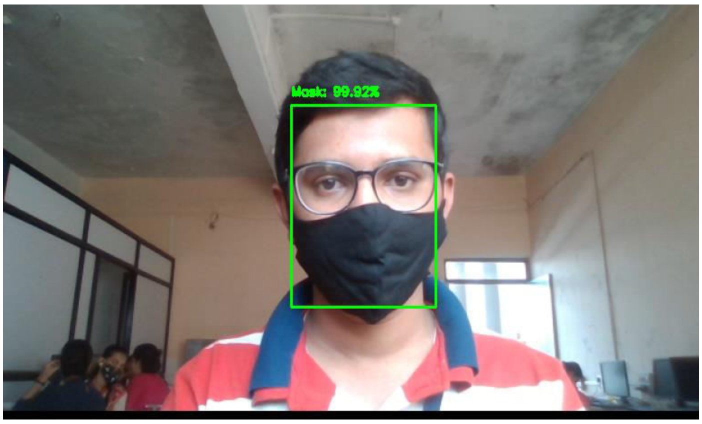

Fig. 1

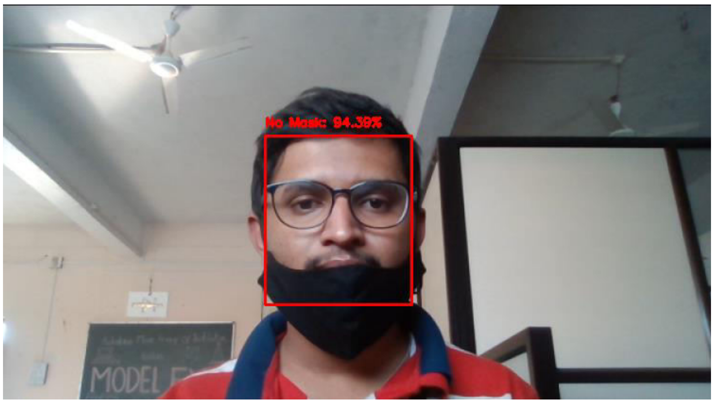

Fig. 2

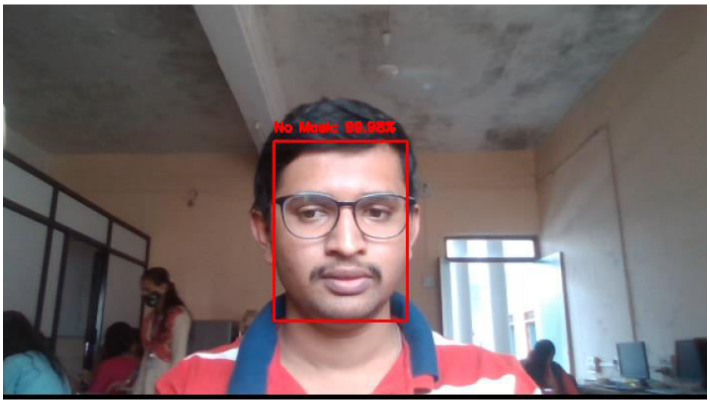

Fig .3

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VI.FUTURE SCOPE

There are number of aspects we plan to work shortly: Currently, the model gives 5FPS inference speed on a CPU. In future, we plan to improve this up to 15 FPS, making our solution deployable for CCTV cameras, without need of GPU. The use of machine learning in the field of mobile deployment is rising rapidly. Hence, we plan to port our models to their respective TensorFlow Lite versions. Our architecture can be made compatible with TensorFlow Runtime (TFRT), which will increase inference performance on edge devices and make our models efficient on multithreading CPUs.

V.CONCLUSION

Our project used OpenCV, Keras/TensorFlow using Deep Learning and Computer Vision concepts to detect whether people were wearing face masks or not. The models were tested with images and real-time video streams. Even though the accuracy of the model is around 90%, the optimization of the model is a continuous process. The current scenario, government and private organizations want to make sure that everyone working or visiting a public or private place is wearing masks throughout the day. Our face mask detection system can quickly identify the person with a mask, using cameras and analytics.

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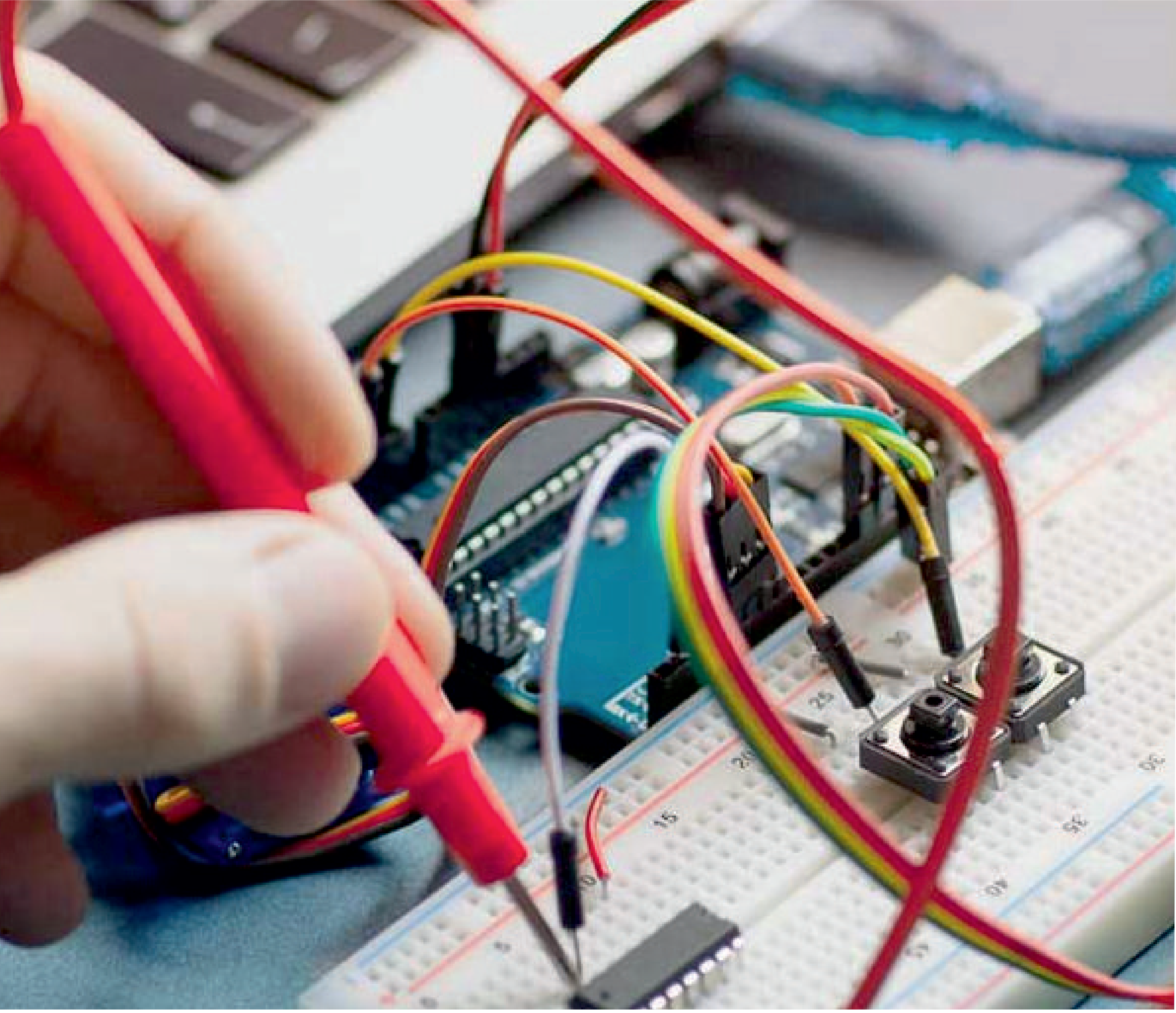

INNO SPACE
SJIF Scientific Journal Impact Factor
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