Email Notification System for Face Mask Detection

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Abstract: The COVID-19 pandemic forced governments across the world to impose lockdowns to prevent virus transmissions. This resulted in the shutdown of all economic and daily activities. While there is an urgency to resume day to day work outside home and in offices, there is an even greater need to ensure the safety of the people in offices and other sites. Reports indicate that maintaining social distancing and wearing face masks while at work clearly reduces the risk of transmission . I have used computer vision on CCTV feeds to monitor worker activity and detect violations which trigger real time email notification alerts to the authorities. This paper describes an efficient and economic approach of using AI to create a safe environment. I demonstrate an approach to build a robust face mask detection alert system using a mix of modern-day deep learning and email notification features. This model can be deployed at offices, shopping malls and railway stations.

KEYWORDS: alert system, email notification, deep learning, facemask detection, convolutional neural network, mobilenetv2, opencv, SMTP libraries

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INTRODUCTION

The spread of COVID-19 [1] virus and the ensuing large scale lockdowns across the globe has given rise to an alarming situation. The resumption of office activities, shopping centers, schools, colleges, and transport across all sectors is a key pre-requisite for kick starting economy of a nation. While there is an urgent need to resume operations, the safety of the people cannot be compromised. Accordingly, processes [2] are being put in place to educate the people regarding new safety regulations which help reduce the risk of virus transmission. However, to help the people transition into a post COVID world, there was a need for us to build solutions that help monitor and alert individuals [3] once a safety violation occurs. All areas should have CCTV installation, with at least a few hundred cameras as part of their security system setup. It is however not practical to monitor all these feeds concurrently due to the manual nature of the task. I have built a system that takes in these feeds and analyzes frames using deep learning models to detect whether violations have occurred or not. Once detected, a real time email notification is triggered to the authorities in the area of the violation. This helps reduce the violations and thus contributes to the overall safety. Given the context of COVID-19, I focused on building features that help reduce the risk of virus transmission. Researches [4] indicated that maintaining social distance between co-workers as well as wearing face masks were effective means of reducing this risk. Hence I built solutions that could monitor these actions through video feeds.

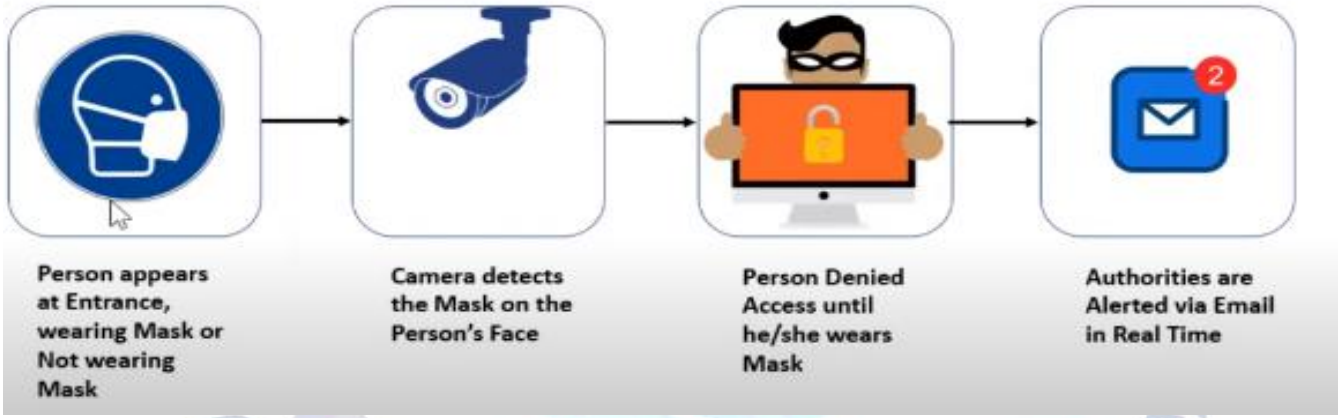

Fig. 1: Email notification system flowchart for face mask detection

WHO has recommended that personnel are encouraged to wear face masks to avoid the risk of virus entering the body through the nasal / oral cavity [5,6]. During the lockdown, it was encouraged by the Indian government for the people to come up with mask substitutes [6] as most countries saw a scarcity of required PPE [7]. Hence, the face masks worn are not of standard type and come in different colors, shapes and sizes. The lack of such diversified data for training purposes makes mask detection a challenging task. The approach taken to overcome this problem, the convolutional neural network model has been discussed.

METHODOLOGY

Face mask detection has been accomplished by adopting Deep Learning techniques. I have designed our project into three phases: training face mask detector, implementing face mask detector and setting up alert system. Fig 2 depicts the training, detection and alert system phases of face mask detector alert system model. The dataset is loaded for the model to be trained and the model is serialized in the training phase.

Further, the trained model is loaded, the faces are detected in images and video streams and then the region of interest (ROI) is extracted. Finally, the face mask detector is applied and the images or faces in the video streams are classified as with a mask, improperly worn mask, without a mask. On these results an email notification system sends out alerts if the face mask is not detected. In order to train a custom face mask detector, project has to be distributed into three distinct phases, each with its own respective sub-steps:

Training: It focuses on loading the face mask detection dataset from disk, training a model [8](using Keras/Tensor Flow) on this dataset, and then serializing the face mask detector to disk using convolutional

neural network[10] and transfer learning . To create the face mask detector, a two-class model of people wearing masks and people not wearing masks has to be trained. MobileNetV2 model [9] has to be fine -tuned on the mask/no mask dataset to obtain a classifier that should have maximum accuracy.

Deployment: Once the face mask detector is trained, the mask detector can be loaded, face detection performed, and classification of each face as with mask or without mask can be done.

The face mask classifier will be applied to both images and real-time video streams by:

1. Detecting faces in images/video
2. Extracting each individual face
3. Applying our face mask classifier

Alert System- In case, of not detection of mask, the system will generate a instantaneous pop-up on the window screen of the surveillance camera at that very instant and also it will e-mail the respective authorities with the address where the intruder and camera were located with the use of SMTP libraries. The whole process is almost instantaneous without any latency, and respective authorities can check the e-mail received on their respective mail platform for the message consisting of time and address of premises such that authorities can take action against intruder without much delay.

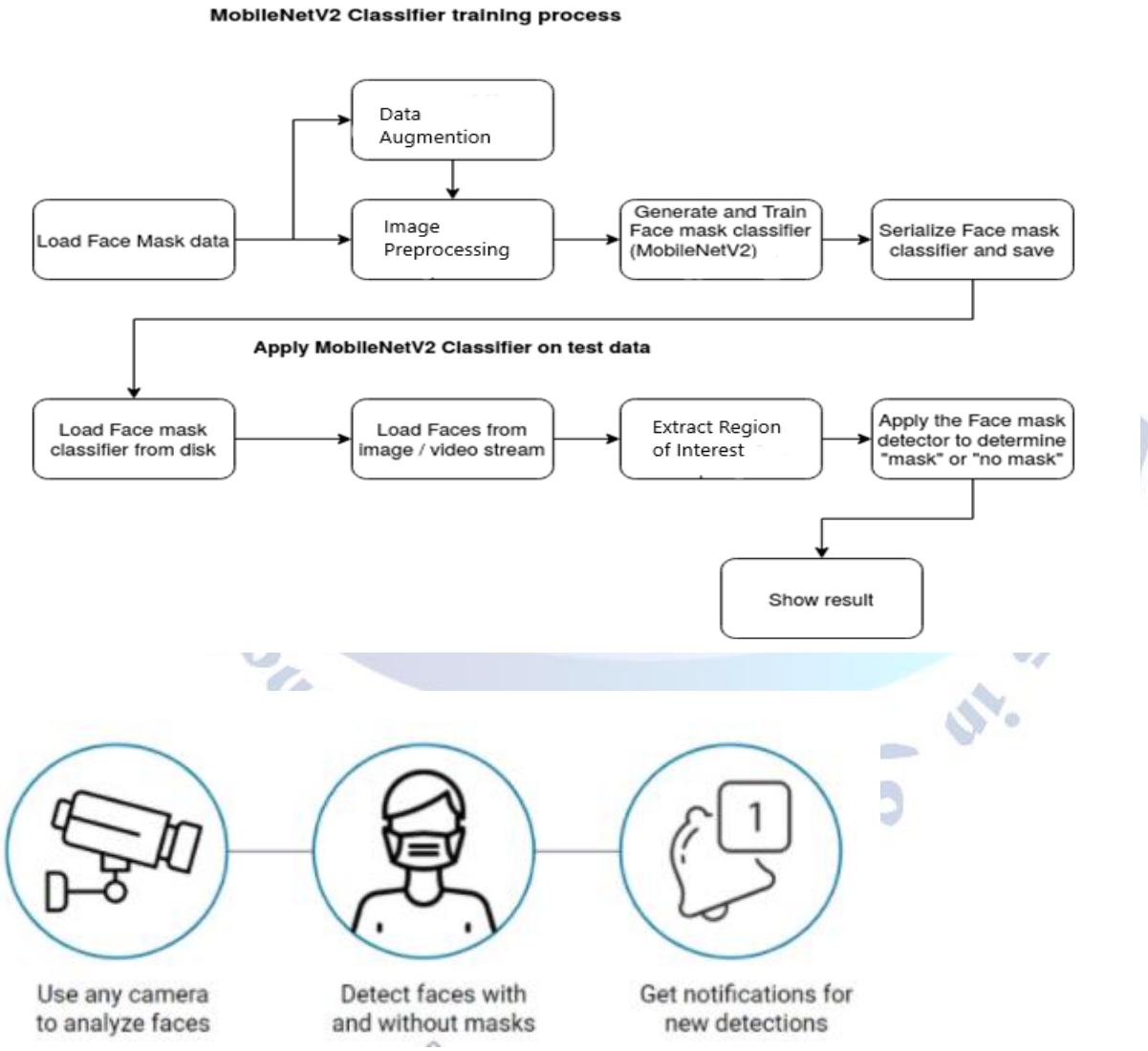

Fig. 2: Training and detection are the two phases of our face mask detector model. The dataset is

loaded for the model to be trained and the model is serialized in the training phase. The trained model is loaded, the faces are detected in images and video streams and then the region of interest(ROI) is extracted. Finally, the face mask detector is applied and the images or faces in the video streams are classified as with a mask or without a mask and send an email Notification alert based on whether face mask is detected or not.

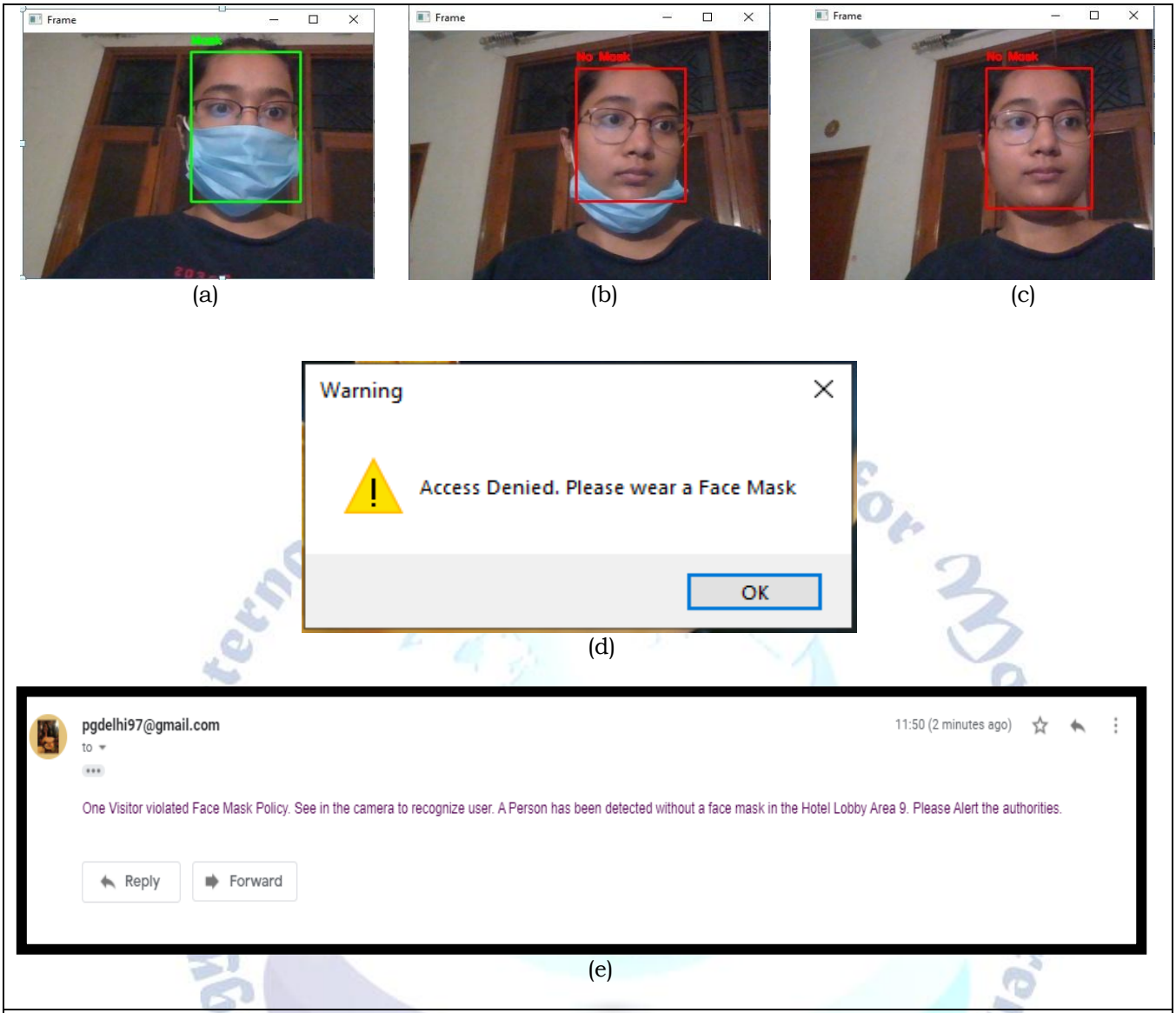

Fig.3: Performance of model and Results (a) Using Mask; (b) Partial Mask; and (c) Without Mask

(d) If case b, c are encountered then Warning is shown and (e) Email Notification Alert is sent to authorities

RESULTS

Mask detection using Convolutional Neural Network (CNN)

The images of the detected face are analyzed for the presence and absence of the mask as in fig. 3 (a), (b), (c) The mask detection using CNN classifies the given image into with_mask and without_mask categories with an accuracy of almost 99 %.

Email notification Alert System

A webcam or CCTV camera surveillance is being monitored all the time and it checks whether the person is wearing a mask, if the person doesn't wear a mask then the system gives a security alert with a instantaneous pop-up on the window along with an email is sent to respective authorities as seen in Fig.3 (d), (e), thus will be helping authorities find out the intruder as early as possible, and impose penalties upon that person.

CONCLUSION

This paper successfully proposes a model which is used to send instant email notification alerts .The study used Keras/TensorFlow using Deep Learning, Computer Vision and CNN to detect whether people wore face masks or not. The models were tested with images and real-time video streams. The face mask detector was accurate, and since the MobileNetV2 architecture was used, it was computationally efficient,

making it easier to deploy the model to embedded systems (Raspberry Pi, Google Coral, etc) in future works ,still the optimization of the model is a continuous process. The current implementation through SMTP libraries and CNN serves as a very simple and lightweight Alert system that provides fast and fairly accurate mask detection and instant email notifications. . Successful implementation of an email notification alert system has been set up for real time video.

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