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Face Mask and Temperature Detection Using Convolution Neural Network

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Abstract: *COVID 19 pandemic is causing a global health epidemic. The most powerful safety tool is wearing a face mask in public places and everywhere else. The COVID 19 outbreak forced governments around the world to implement lockdowns to deter virus transmission. According to survey reports, wearing a face mask at public places reduces the risk of transmission significantly. In this paper, an IoT- enabled smart door that uses a machine learning model for monitoring body temperature and face mask detection. The proposed model can be used for any shopping mall, hotel, apartment entrance, etc. As an outcome a cost-e□ective and reliable method of using AI andsensors to build a healthy environment. Evaluation of the proposed framework is done by the Face Mask Detection algorithm using the TensorFlow software library. Besides, the body temperature of the individual is monitored using a non-contact temperature sensor. This proposed system can detect the users from COVID 19 by enabling the Internet of Things (IoT) technology.*

I. INTRODUCTION

Public use of face masks has been common in China and other nations in the world since the beginning of the new coronavirus disease outbreak. We now know from recent studies that a significant portion of individuals with coronavirus lack symptoms and that even those who eventually develop symptoms ("pre-symptomatic") can transmit the virus to others before showing symptoms, according to the advisory published by the health Centre. "This means that the virus can spread between people interacting in close proximity for example, speaking, coughing, or sneezing even if those people are not exhibiting symptoms".

The recent information also givestrace of a new strain of corona virus, the mutant corona virus which, in which the virus has changed its structure and become mutant. The new strain is not even able to detect using the RT-PCR test we use now. So, it is inevitable for the people of an overpopulated country like India to wear masks and let the work go on. Nobody can keep an eye on every person coming in the work space is wearinga mask or not. So, the need of Face mask detection arose. The model in this paper uses the Convolutional Neural Network. It is a deep neural network model used for analysing any visual imagery. It takes the image data as input, captures all the data, and send to the layers of neurons. It has a fully connected layer, which processes the final output that represents the prediction about the image. The Convolutional neural network model used here is the MobileNetV2 architecture. Mobile Net model is a network model using depth wise separable convolution as its basic unit. Its depth wise separable convolution has two layers: depth wise convolution and point convolution. It is based on an inverted residual structure where the residual connections are between the bottleneck layers. The intermediate expansion layer uses lightweight depth wise convolutions to filter features as a source of non-linearity.

As a whole, the architecture of MobileNetV2 contains the initial fully convolution layer with 32 filters, followed by 19 residual bottleneck layers. Figure 1 shows the framework of MobileNetV2 which is used in the model discussed in this paper Further the different hyper parameters are tried for the model. The hyper parameters tried are learning rate, it is a tuning parameter that is used in optimization models whichdetermines the step size of the model and helps to reduces the loss function. It is a very important hyper parameter as it results in either convergence or overshoots the model. The other hyper parameters used are batch size, epochs etc. The model has used OpenCV to fulfil the purpose of using the video stream for capturing the frames in the video stream.

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II. BRIEF LITERATURE SURVYE

The COVID-19 pandemic has been a worldwide catastrophe. Its impact, not only economically, but also socially and in terms of humanlives, was unexpected. Each of the many mechanisms to fight the contagiousness of the illness has been proven to be extremely important. One of the most important mechanisms is the use of facemasks. However, the wearing the facemasks incorrectly makes this prevention method useless. Artificial Intelligence (AI) and especially facial recognition techniques can be used to detect misuses and reduce virus transmission, especially indoors. In this paper, we present an intelligent method to automatically detect when facemasks are being worn incorrectly in real-time scenarios. Our proposal uses Convolutional Neural Networks (CNN) with transfer learning to detect not only if a mask is used or not, but also other errors that are usually not taken into account but that may contribute to the virusspreading.

The main problem that we have detected is that there is currently no training set for this task. It is for this reason that we have requested the participation of citizens by taking different selfies through an app and placing the mask in different positions. Thus,we have been able to solve this problem. The results show that the accuracy achieved with transfer learning slightly improves the accuracy achieved with convolutional neural networks. Finally, we have also developed an Android-app demo that validates the proposal in real scenarios. Identifying mask misuse is challenging. The limitation in the data sets is the main challenge. Data sets on mask wearing status are generally small and only identify the presence of masks. To solve the problem, we have carried out a campaign to collect images through an app, appealing to citizen participation. The samples obtained have been labelled by a group of health experts [1].

COVID-19 pandemic has rapidly increased health crises globally and is affecting our day-to-day lifestyle. A motive for survival recommendations is to wear a safe facemask, stay protected against the transmission of coronavirus. By wearing a facemask, the most effective preventive care must be taken against COVID-19. Monitoring manually if the individuals are wearing facemask correctly and to notify the victim in public and crowded areas is a difficult task. This paper approaches a simplified way to achieve facemask detection and notifying the individual if not wearing facemask. Using Kaggle datasets, the proposed system/model is trained and examined. The system runs in real-time and detects if an individual face has facemask if not then notify the individual personally through text message.

The mask is extracted from real-time faces in public and is fed as an input into convolutional neural network (CNN). In our research we have proposed a system that automatically identifies whether or not a person is wearing a face mask and notify the higher authorities if not wearing a mask. This proposed system uses Computer Vision and Mobile Net to help the public ensure that they are wearing face masks and to keep away from the spread of COVID-19 virus. Our research also helps police or higher authorities that makes it easier to identify whether a person is wearing a mask, if not then they will be also having the victim's photo by which they can take further actions. The proposed system can be implemented in places like railway stations, shopping malls, offices, schools, airports, etc. [2].

COVID-19 pandemic has rapidly acted our day-to-day life disrupting the world trade and movements. Wearing a face mask for Protection has become a new normal. Face detection and recognition will reconsider as one of the most intriguing modalities for biometric models. Therefore, face mask detection has become a crucial task to help global society. For this purpose, we are using some basic Machine Learning packages like TensorFlow, Keras, OpenCV and Scikit-Learn. Here, in this Project a very fast image pre- processing with the mask in the centre over the faces. Our Model is trained on dataset that consists of images of people of two categories that are with and without face masks.

Three levels of work that we carried out are: images pre-processing, extracting crucialpart from images and image classification. Features extraction and Convolutional Neural Network are used for classification and detection of a masked person. This Method attain an accuracyof 99.1%. This paper works along with CNN to detect masked face ina secured way and for establishing a better surveillance. The dataset that we used is quite small but it is giving the better accuracy. This system can be employed in public places like railway stations and malls. It will be of a great help in companies and huge establishments where there will be a lot of workers [3].

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The coronavirus outbreak has affected the whole world critically. Amongst all other things, wearing a mask nowadays is mandatory to avoid the spread of the virus according to the World Health Organization. All the people in the country prefer to live a salubrious life by wearing a mask in public gatherings to avoid contracting the deadly virus. Recognizing faces wearing a mask is often a tedious job as there are no substantial datasets available comprising of masked as well as unmasked images. In this paper, we propose a stacked Conv2D model that is highly efficient for the detection of facial masks. Such convolutional neural networks work effectivelyas they can deduce even minute pixels of the images.

The proposed model is a stack of 2-D convolutional layers with relu activationsas well as Max Pooling and we implemented this model by using Gradient Descent for training and binary cross-entropy as a loss function. We trained our model on an amalgam of two datasets that are RMFD (Real World Masked Face Dataset) and Kaggle Datasets. Overall, we achieved a validation/testing accuracy of 95% and a training accuracy of 97%. In addition to this, we also developed an email notification system that sends an email whenever a person is entering without a mask and it will also prompt the user to wear the mask before entering into the system. Such a system is beneficial to large multinational companies and can be deployed there as the spread of viruses there is high because employees are from different regions.

In this paper we developed a novel Stacked-CNN model to ensure the safety of individuals in surrounding and to decrease the spread of Coronavirus. The practical model can even be deployed in industrial and public areas where the risk of contracting the virus is extremely high. Thus, the proposed system will workeffectively to ease the deleterious effects of the virus. The model is highly trained to achieve the maximum accuracy possible. This system can augment the safety of the public as the spread of virus is continuously rising above. For future work we would liketo concentrate on how to detect the temperature by using ensemble model and detection of sneezing and coughing using a deep learning-based model [4].

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-wearingposition 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 anRGB 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. 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 [5].

The spread of COVID-19 has been taken on pandemic magnitudes and has already spread over 200 countries in a few months. In this time of emergency of COVID-19, especially when there is still a need to follow the precautions and developed vaccines are not available to all the developing countries in the first phase of vaccine distribution, the virus is spreading rapidly through direct and indirect contacts. The World Health Organization (WHO) provides the standard recommendations on preventing the spread of COVID- 19 and the importance of face masks for protection from the virus. The excessive use of manual disinfection systems has also becomea source of infection.

That is why this research aims to design and develop a low-cost, rapid, scalable, and effective virus spread control and screening system to minimize the chances and risk of spread of COVID-19. We proposed an IoT-based Smart Screeningand Disinfection Walkthrough Gate (SSDWG) for all public places entrance. The SSDWG is designed to do rapid screening, including temperature measuring using a contact-free sensor and storing the record of the suspected individual for further control and monitoring.

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Our proposed IoT-based screening system also implemented real-time deep learning models for face mask detection andclassification. This module classified individuals who wear the face mask properly, improperly, and without a face mask using VGG- 16, MobileNetV2, Inception v3, ResNet-50, and CNN using a transfer learning approach. We achieved the highest accuracy of 99.81% while using VGG-16 and the second highest accuracy of 99.6% using MobileNetV2 in the mask detection and classification module.

We also implemented classification to classify the types of face masks worn by the individuals, either N-95 or surgical masks. We also compared the results of our proposed system with state-of-the-art methods, and we highly suggested that our system could be used toprevent the spread of local transmission and reduce the chances of human carriers of COVID-19. COVID-19 has become a pandemic and it is now spreading rapidly through direct and indirect contacts among individuals. Manual systems of measuring temperature and disinfecting are being used in homes and public places for disinfection, but these systems may become a source of the spread of infection of COVID-19.

Now, this virus will stay in our lives, and we have to live with it, but we need to adopt precautions strictly to break the chain of this virus. This research aims to control the spread of COVID- 19 by preventing and minimizing local transmission carriers. Our proposed model is a practical approach for rapid screening and disinfecting numerous people with an automated [6].

This paper presents the results of a neural convolutional system for recognizing the wearing of a mask by people entering a building. The algorithm is provided with input data thanks to cameras placed in the humanoid robot COVID guard. The data collected by the humanoid – the temperature of people entering the facility, the location of the person, the way the protective mask was applied – arestored in the cloud, which enables the application of advanced image recognition algorithms and, consequently, the tracking of peoplewithin the range of the robot's sensory systems by the administrator and the verification of the security level in the given premises. The paper presents the architecture of the intelligent COVID guard platform, the structure of the sensory system and the results of theneural network learning.

The accuracy rate of the implemented neural network algorithm, responsible for estimating whether a person entering a building has an anti-virus mask on their face, is 90 %. The algorithm does not make mistakes in low light conditions. It was tested in various lighting conditions, both in cloudy weather and shady areas it worked with 70 % confidence. However, the authors want to further develop the algorithm by extending it to check the temperature of the person being tested using a thermal imaging camera. After face detection, the algorithm will be tasked with checking the temperature around the person's forehead via a thermal imaging camera. The use of such a solution will potentially increase the usability of the described biometric platform. It willmake it possible to determine whether the subject has an elevated temperature. This is one of the main symptoms of infection with aninfectious disease, including Covid-19. This algorithm, together with the device, will be further developed and the results of the operation will be published in [7].

III. METHODOLOGY TO IMPLEMENTATION

A python script, tensor flow and CNN as deep learning architecture is used to create an efficient network for the detection of facemasks.Main aim is to train a custom CNN model to detect whether a person is wearing a mask or not. This project able to detect the mask's faces very fast from all possible angle. The model proposed here is designed and modelled using python libraries namely Tensor flow, Keras and OpenCV. The model used is MobileNetV2 of convolutional neural network. is method of using MobileNetV2 is referred as Transfer Learning. It uses some pre trained model to train present model and get the prediction that saves time and in turn makes usingtraining the different models easy.

At the end the model is tuned with the hyper parameters: learning rate, number of epochs and batch size. The model is trained with a dataset of images with two class such as with mask and without mask. The dataset has 993 images ofwith mask class and 1918 images of without mask class for experimentation.

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Proposed Face Mask Detection System

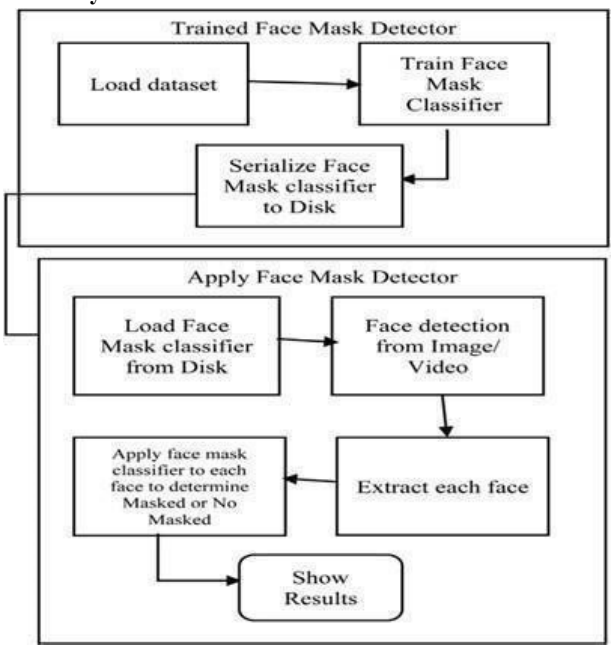

Figure 1: Block Diagram of Proposed Face mask detection System

There are Two important step to follow as shown in figure 1.

- Training the model with the taken dataset.
- Deploying the model

First, we feed the dataset in the model, run the training program, which trains the model on the given dataset. Then we run the detectionprogram, which turns on the video stream, captures the frames continuously from the video stream with an anchor box using object detection process. This is passed through the MobileNetV2 model layers which classifies the image as with or without mask. If the person is wearing a mask, a green anchor box is displayed and red if not wearing a mask with the accuracy for the same tagged on theanchor box.

Data Collection

For mask detection, we used three different datasets with a total of 1340 photographs. Using mobile cameras, webcams, and CCTV video, another 120 photographs were taken. For detecting masks from video used CCTV footage and Webcam, both of the photos are in RGB. To avoid overfitting, we collected data from different datasets and generated our datasets, the Real-World Masked Face Dataset and the Simulated Masked Face Dataset, which we used for training and testing purpose as shown in figure 2.

Figure 2: Sample dataset of with mask and without mask images

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Pre-processing and Augmentation of Data

The images in the dataset are not all the same size, so pre-processing was required for this study. The training of deep learning modelsnecessarily requires a large amount of data. We used Keras' Image Data Generator method to resize all of the images to 256 × 256 pixels. We normalized all images after converting them to 256× 256. For faster calculation, images are converted to NumPy arrays. Increase the amount of data by rotating, zooming, shearing, and horizontal flipping. Images are gathered as well. The images are then resized to 128 x 128 for passing through the second convolution layer, and then to 64 x 64 for passing through the third convolution layer.

Software Considered for Work are:

Python

Python is an interpreted high-level general-purpose programming language. Its design philosophy emphasizes code readability with its use of significant indentation. Its language constructs as well as its object-oriented approach aim to help programmers write clear, logical code for small and large-scale projects.

Library and Packages Keras

Keras is an open-source software library that provides a Python interface for artificial neural networks. Keras acts as an interface forthe TensorFlow library. The core data structures of Keras are layers and models. All the layers used in the CNN model are implemented using Keras.It wraps the efficient numerical computation libraries Theano and TensorFlow and allows you to define andtrain neural network models in just a few lines of code.

TensorFlow

TensorFlow can be used across a range of tasks but has a particular focus on training and inference of deep neural networks. Tensorflow is a symbolic math library based on dataflow and differentiable programming. In the proposed model, the whole Sequential CNN architecture (consists of several layers) uses TensorFlow at backend. It is also used to reshape the image in the imageprocessing. Deep Learning models directly or by using wrapper libraries that simplify the process built on top of TensorFlow.

OpenCV

OpenCV is a library of programming functions mainly aimed at real-time computer vision. OpenCV is utilized to differentiate and recognize faces, recognize objects, group movements in recordings, trace progressive modules, follow eye gesture, track camera actions, expel red eyes from pictures taken utilizing flash, find comparative pictures from an image database, perceive landscape andset up markers to overlay it with increased reality.

Algorithm HaarCascade

It is a machine learning based approach which uses a lot of positive and negative images for training the classifier. Positive images contain images that we want to classify for our classifier and negative images contain of anything else that doesn't involve the entity that we want to find. OpenCV also includes several pre-trained classifiers for eyes, face, smile etc. Firstly, we loaded haarcascade frontal face default xml classifiers and after that loaded A Grayscale mode of input image. Then we have the faces throughout the image. If features are identified, the coordinates of the face region are retrieved as Rect(x, y, w, h). If we have those positions, we will be able to build a face ROI.

Finally, on detected face ROI, a trained classifier is applied to determine if a person wears a mask ornot. Here we will deal with detection. OpenCV already contains many pre-trained classifiers for face, eyes, smile etc. Those XML files are stored in OpenCV/data/haarcascades/ folder. Let's create a face and eye detector with OpenCV. We use the function: detect MultiScale (image, objects, scaleFactor = 1.1, minNeighbors = 3, flags = 0, minSize = new cv.Size(0, 0), maxSize = new cv.Size(0, 0)) are considered.

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Hardware Raspberry Pi

The Raspberry Pi is a low-cost tiny computer that connects to a computer monitor or television and operates with a regular keyboard and mouse It is a handy little gadget that focuses on teaching people of all ages about scripting languages like Scratch and Python. It has a 1.2-GHz quad-core chipset BCM2387 with a GPU support of a dual-core and a video core multimedia co-processor and the GPU, which includes dual core multimedia co-processor, including a Blue-tooth 4,1 (Bluetooth and Bluetooth Classic). With Bluetooth Low Energy (BLE) and BCM43143 Wi-Fi, the Raspberry Pi 3 o□ers an up-grade to-wards a new main processor and improved networking. Furthermore, the power management of Raspberry 3 has been improved, with an up- graded power supply with 3.5 Ampsthat can handle more powerful external USB devices. The built-in USB ports of Raspberry Pi 3 provide su□cient connectivity to linkthe mouse or anything else to Rpi.

Temperature Sensor

LM35 is an integrated analog temperature sensor whose electrical output is proportional to Degree Centigrade. LM35 Sensor does notrequire any external calibration or trimming to provide typical accuracies. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy.

LCD Display

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi- segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

Face Mask and Temperature Detection using Raspberry Pi

In the Figure. 3 we draw the block diagram for face mask and temperature detection system. Which show the connection ofraspberry pi to different hardware components.

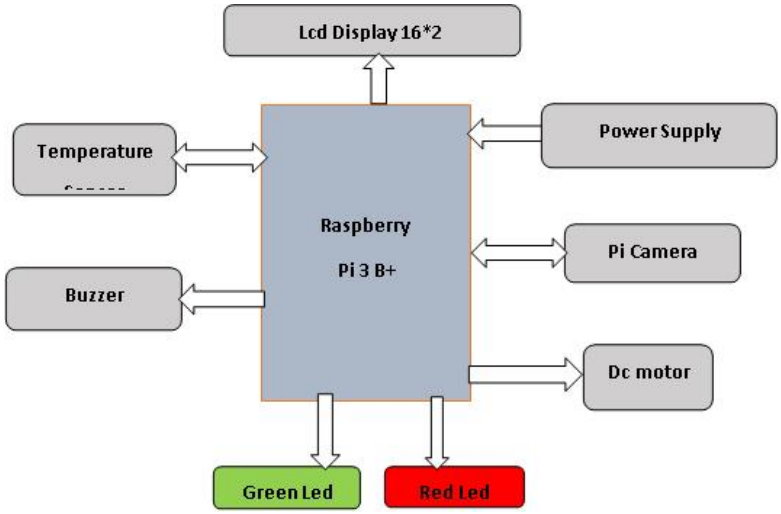

Figure 3: Block Diagram of Connection to raspberry pi

Here python programming language is used to write our code and by using the TensorFlow and OpenCV. At the end train our facemask detector model and with the help of temperature sensor we are going to detect the temperature Figure as shows.

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The flow chart of system

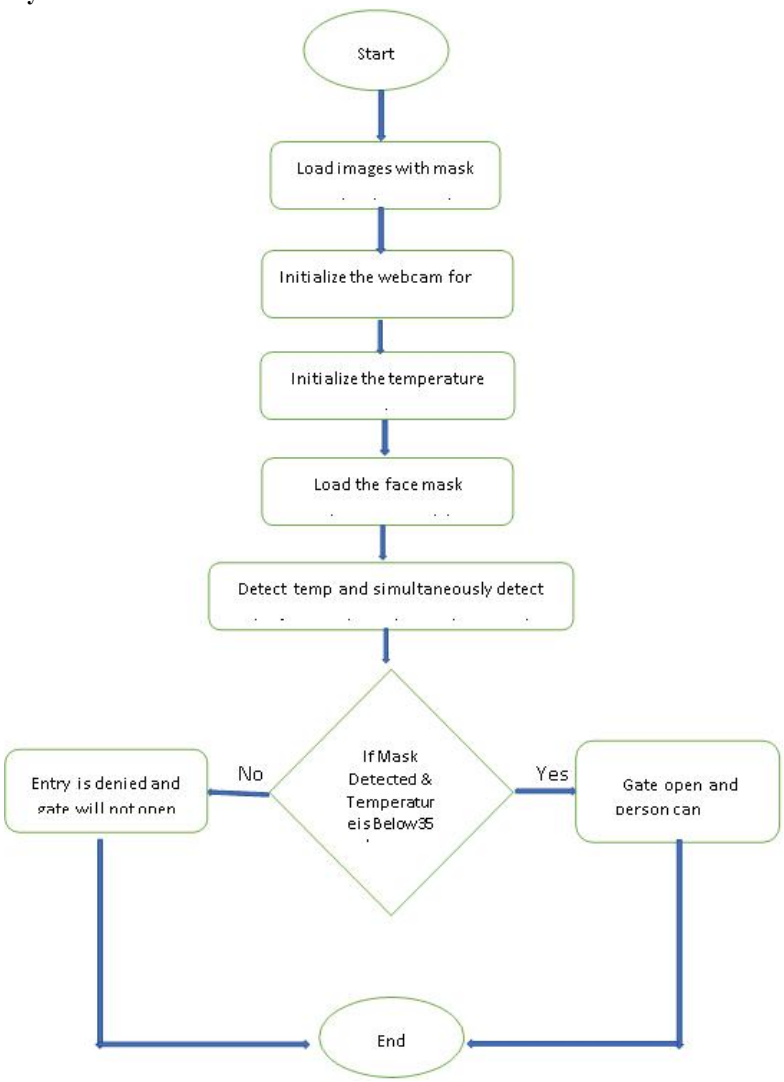

Figure 4: Flow chart of face and temperature detector system

We are going to input two dataset's folders name as Face mask and without face mask. With help of this datasets, we are going totrain our model.

Input

Power supply to raspberry pi64-bit Raspbian OS.
Face mask, without face mask images.
Import necessary library to start the camera and temperature sensor.
Declare command that define the working of camera and temperature sensor.

Output

After initializing all the input, we are going to declare the output of our program.The box identification around a face showing person wearing mask or not.
The temperature capture by temperature sensor.

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Step1 Initialize all the input and start the program.
Step2 Place your hand in front of the temp sensor
Step3 Temp sensor checks body temp
Step4 Simultaneously the camera checks for face mask and display the face with box identification.
Step5 Gate opens only if you are wearing a mask and have normal body temperature.
Step6 Buzzer goes off if body temp above normal (above 35 degree Celsius).
Step7 Gate remains shut for all cases except for step 5.

IV. RESULT & DISCUSSION

Here, model is tested for different scenarios. The table shows the results of those scenarios with number of epochs 20 and batch size32 constant for all the three situations that uses average Pooling for capturing smooth image. The training was carried out on a computer running the 62-bit Windows10 operating system and equipped with an Intel Core i5 CPU running at 1.60GHz and 8 GB of RAM. Python 3.7 is being used as the application development language. The model is developed and trained using Keras as the backend and the Tensor-flow platform.

Training Loss and Accuracy

To generate mask detector model input dataset and fine-tune MobileNetV2 is accepted using the training python script. A training history plot.png with accuracy/loss curves is also generated. Validation accuracy is a better indicator of model performance than trainingaccuracy. Epoch 17 has better validation accuracy out of 20 epochs. So, this model-17 is used in the testing phase. At the end of 20 epochs the proposed CNN model has 96.40% accuracy.

Validation loss >>training loss: Overfitting. Validation loss >training loss: some overfitting. Validation loss << training loss: some underfitting. Validation loss < training loss:
underfitting.
Validation loss == training loss: perfect fitting.
Validation loss must be as minimum as possible. No: of epochs versus loss graph is plotted for both training loss, validation loss.

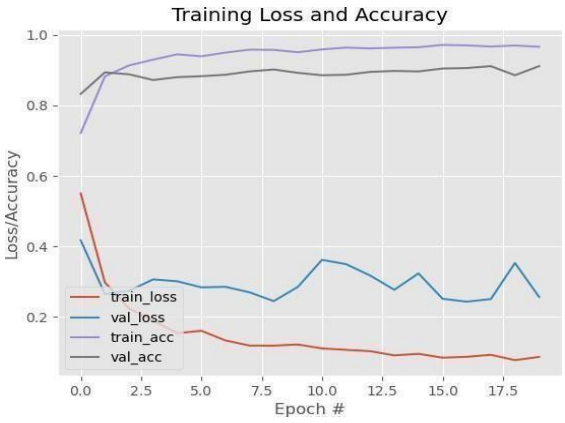

Figure 6.1: Training loss and accuracy graph with number of epochs in X-axis and loss/accuracy in Y-axis

This is a result/output we get after the model training. the number of epochs to train for is 20 and the batch size is 32 with learningrate le-4.
Train for 32 steps, validate on 1276 samples.
Epoch 1/20 Loss: 0.6431 - Accuracy: 0.6676 - Val-loss: 0.3696 – vale-Accuracy: 0.8242
Epoch 2/20 Loss: 0.3507 - Accuracy: 0.8567 - Val-loss: 0.1964 - vale-Accuracy: 0.9375

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Epoch 3/20 Loss: 0.2792 - Accuracy: 0.8820 - Val-loss: 0.1383 - vale-Accuracy: 0.9531
Epoch 4/20 Loss: 0.2196 - Accuracy: 0.9148 - Val-loss: 0.1306 - vale-Accuracy: 0.9492
Epoch 5/20 Loss: 0.2006 - Accuracy: 0.9213 - Val-loss: 0.0863 - vale-Accuracy: 0.9688
Epoch 16/20 Loss: 0.0767 - Accuracy: 0.9766 - Val-loss: 0.0291 -vale-Accuracy: 0.9922
Epoch 17/20 loss: 0.1042 - Accuracy: 0.9616 - Val-loss: 0.0243 - vale-Accuracy: 1.0000
Epoch 18/20 Loss: 0.0804 - Accuracy: 0.9672 - Val-loss: 0.0244 - vale-Accuracy: 0.9961 Epoch 19/20Loss: 0.0836 - Accuracy: 0.9710 - Val-loss: 0.0440 - vale-Accuracy:0.9883 Epoch 20/20 Loss: 0.0717 - Accuracy: 0.9710 - Val-loss: 0.0270 - vale-Accuracy: 0.9922

Table 6: Result Comparison Table

Model	Learning Rate	With Mask Distance	Without Mask Distance	Blur Image Quality	Multiple People Capturing
1	1e-4	161 cm	190 cm	Good	4 people
2	1e-3	155 cm	187 cm	Average	3 people
3	1e-2	146 cm	179 cm	Bad	3 people

Two dictionaries' labels_dict and color_dict are created to indicate the label to be entitled and the color of rectangle to be drawn aroundthe face.
labels_dict={0:'MASK' ,1:'NO MASK'} color_dict={0:(0,255,0),1:(255,0,0)}
If anyone in the video stream is not wearing a protective mask and a red colored rectangle is drawn around the face with a dialog entitled as NO MASK. Similarly, a green color rectangle is drawn around the face of a person wearing MASK. Text is added to image using putText( ) command and percentage of accuracy in both the cases is determined as shown in figure 5a and 5b.

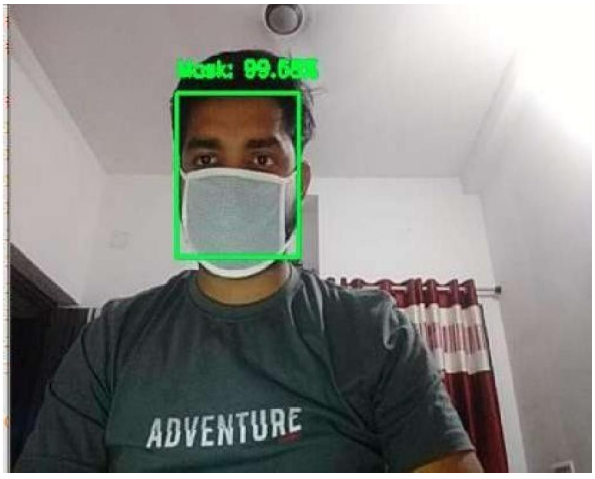

Figure 5a: Result for image with mask in green bounding

The developed system is to avoid the spread of COVID-19 in public places such as shopping malls, o□ces, and so on. The system canmonitor an individual's body temperature and can perform face mask detection. The count of the people inside the room will be shown when the facemask detector model is loaded. When an individual passes through, the temperature sensor detects their body temperature, and if it is less than the set limit, the Pi cam activates and checks if they are wearing a mask.

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The door automatically opens if the mask is detected, otherwise, the person is not allowed. The table 6.2 shows all the condition which are possible.

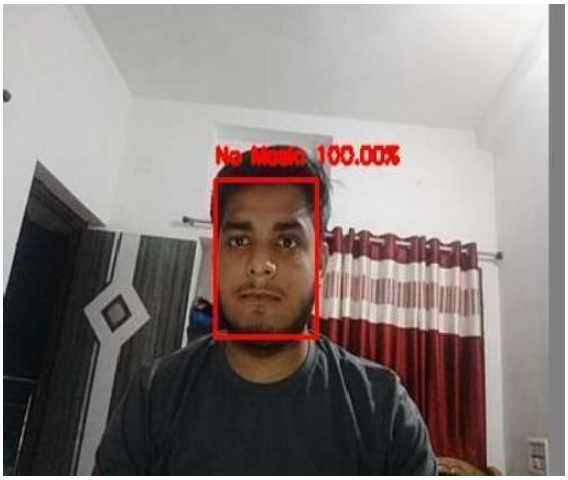

Figure 5b: Result for image without mask in red bounding box

Table 2: Conditions Comparison Table

Person Count Up to 4 People	Temperature Check	Mask detection	Door Open/Close
Count < 4	Temp < 35°c	Mask detected	Open
Count > 4	Temp < 35°c	Mask detected	Close
Count < 4	Temp > 35°c	Mask detected	Close
Count < 4	Temp < 35°c	Mask not detected	Close
Count > 4	Temp > 35°c	Mask not detected	Close

V. CONCLUSION AND DISCUSSION

As the technology are blooming with emerging trends the availability so we have novel face mask detector and Temperature detection model which can possibly contribute to public health care department. The architecture consists of Haar-cascade classifier and TensorFlow, OpenCV as the backbone. It can be used for high and low computation scenarios. Our face mask detection is trained on CNN model and we used OpenCV, Tensor Flow, Keras and python to detect whether person is wearing a mask or not. To train, validate and test the model, we utilized the dataset that consisted of 993 masked faces pictures and 1918 without mask faces pictures. These pictures were taken from different assets like Kaggle datasets. we use non-Contact temperature sensor to detect person temperature. Also, we use buzzer to alert the responsible authority if person temperature exceeds 35 degrees or he/she is not wearing face mask. The model was tested with image and real- time video stream.

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