A Project Report

on

FACE MASK DETECTION

Submitted in partial fulfillment of the

requirement for the award of the degree of

Bachelor of Technology in Computer Science And Engineering

Under The
Supervision of
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SCHOOL OF COMPUTING SCIENCE AND ENGINEERING
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CANDIDATE'S DECLARATION

I/We hereby certify that the work which is being presented in the project, entitled **"COVID: FACE MASK DETECTION"** in partial fulfillment of the requirements for the award of the **BACHELOR OF TECHNOLOGY IN COMPUTER SCIENCE AND ENGINEERING** submitted in the School of Computing Science and Engineering of Galgotias University, Greater Noida, is an original work carried out during the period of January-2022 to May-2022, under the supervision of Mr. Sreenarayanan NM, Assistant Professor, Department of Computer Science and Engineering of School of Computing Science and Engineering , Galgotias University, Greater Noida

The matter presented in the project has not been submitted by me for the award of any other degree of this or any other places.

Akhand Pratap Singh, 18SCSE1010041

This is to certify that the above statement made by the candidates is correct to the best of my knowledge.

Mr. Sreenarayanan NM
Assistant Professor

CERTIFICATE

The Final Project Viva-Voce examination of Akhand Pratap Singh : 18SCSE1010041 has been held on 14/05/2022 and her work is recommended for the award of BACHELOR OF TECHNOLOGY IN COMPUTER SCIENCE AND ENGINEERING.

Signature of Examiner(s) **Signature of Supervisor(s)**

Signature of Project Coordinator **Signature of Dean**

Date: May, 2022

Place: Greater Noida

ABSTRACT

The COVID-19 pandemic is causing a worldwide emergency in healthcare. This virus mainly spreads through droplets which emerge from a person infected with coronavirus and poses a risk to others. The risk of transmission is highest in public places. One of the best ways to stay safe from getting infected is wearing a face mask in open territories as indicated by the World Health Organization (WHO). In this project, we propose a method which employs TensorFlow and OpenCV to detect face masks on people. A bounding box drawn over the face of the person describes weather the person is wearing a mask or not. If a person's face is stored in the database, it detects the name of the person who is not wearing face mask and an email will be sent to that person warning them that they are not wearing a mask so that they can take precautions.

As we all know that there is an ongoing pandemic of corona virus disease 2019 (COVID-19) which is accelerating day by day, self protection is the only way out which can be done by wearing masks.

In view of this current situation our team decided to make face mask detector. The task in hand is to check whether the person is wearing mask or not through an available image or video. So in this era of automation and artificial intelligence we decided to come up with a project that is going to automate the process of face mask detection using open CV thereby making the life of frontline warriors easy.

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CHAPTER 1
INTRODUCTION

COVID-19 had a massive impact on human lives. The pandemic lead to the loss of millions and affected the lives of billions of people. Its negative impact was felt by almost all commercial establishments, education, economy, religion, transport, tourism, employment, entertainment, food security and other industries. According to WHO(World Health Organization), 55.6 million people were infected with Coronavirus and 1.34 million people died because of it as of November 2020. This stands next to black death which almost took the lives of 60 percent of population in Europe in the 14th century. After the person gets infected, it takes almost fourteen days for the virus to grow in the body of its host and affect them and in the meantime, it spreads to almost everyone who is in contact with that person.

So, it is extremely hard to keep the track of the spread of COVID-19. COVID-19 mainly spreads through droplets produced as a result of coughing or sneezing by an infected person. This transfers the virus to any person who is in direct close contact (within one-meter distance) with the person suffering from coronavirus. Because of this, the virus spreads rapidly among the masses. With the nationwide lockdowns being lifted, it has become even harder to track and control the virus. Face masks are an effective method to control the spread of virus. It had been found that wearing face masks is 96% effective to stop the spread of virus. The governments, all over the world, have imposed strict rules the everyone should wear masks while they go out. But still, some people may not wear masks and it is hard to check weather everyone is wearing mask or not. In such cases, computer vision will be of great help.

There are no efficient face mask detection applications to detect weather the person is wearing face mask or not. This increases the demand for an efficient system for detecting face masks on people for transportation means, densely populated areas, residential districts, large-scale manufacturers and other enterprises to ensure safety. This project uses machine learning classification using OpenCV and Tensorflow to detect facemasks on people.

OPENCV: OpenCV is an open-source library which is primarily usedfor Computer Vision Applications. This contains many functions and algorithms for Motion tracking, Facial recognition, Object Detection, Segmentation and recognition and many other applications. Images andreal time video streams can be manipulated to suit different needs usingthis library.

TENSORFLOW: It is an open-source machine learning framework tobuild and train neural networks. It has a collection of tools, libraries and community resources which helps in easy building of deployment of ML powered applications.

The spread of COVID-19 is increasingly worrying for everyone in the world. This virus can be affected from human to human through the droplets and airborne. According to the instruction from WHO, to reduce the spread of COVID-19, every people need to wear face mask, do social distancing, evade the crowd area and also always maintain the immune system. Therefore, to protect each other, every person should wear the face mask properly when they are in outdoor. However, most of selfish people won’t wear the face mask properly with so many reasons.

To overcome this situation, a robust face mask detection needs to be developed. In order to detect a face mask, the object detection algorithm can be implemented. The state of art of object detection algorithm which has a robust performance is the You Only Look Once (YOLO). As presented in , Susanto, et al., used the YOLO deep learning method to distinguish the white ball and goal which is integrated to humanoid robot soccer. This algorithm has been carried out by using the NVIDIA JETSON TX1 controller board. The other work implemented the YOLO was introduced by Liu, et al. . In this work they implemented the traditional image processing in order to shooting of the noise, blurring and rotating filter in real-world. Then they used the YOLO algorithm to train a robust model to improve the traffic signs detection. On the other hands, Yang, et al., used the YOLO algorithm to detect the face in real-time application with accuracy and fast detection time. In contrast with , in they improved the YOLO algorithm for detecting the face in a video sequence and compared the accuracy of detecting to the traditional approach. They also used the FDDB dataset for training and testing out the model. The improvement of YOLO model also has been done by Zhao, et al . They improved YOLO model to detect the pedestrian which address two issues such as leverage real-time saliency through surveillance camera and extract the detail of distinguished feature. A few years later, YOLO method was improved to YOLO V2 which was able to detect over 9000 object categories. In this version, a novel, multi-scale training method was developed . Thereafter, Kim, et al., implemented the YOLO-V2 for image recognition and other testbenches for a CNN accelerator. In this work, the YOLO V2 method has been applied through the simulation and FPGA experiment . Harisankar, et al. on the other hand, modified the YOLO V2 to detect and localize the pedestrian by adding the Model H architecture. In order to detect the pedestrian precisely, they used ZED camera and created the depth map. We now know from recent research that the vast majority of people with coronavirus have no symptoms (“asymptomatic”) and that even those who end up with symptoms (“pre-symptomatic”) can transmit the virus to others before showing any symptoms, according to counsel. published by the Health Center. "This means that the virus can be spread among people who work closely with each other - for example, talking, coughing, or sneezing - even if those people show no symptoms." Recent data also provides traces of a new type of corona virus, the mutant corona virus, in which the virus has changed its shape and evolved. The new version can't even detect using the RT-PCR tests we are currently using. It is therefore inevitable for humans of a populous country like India to wear a mask and let the work go on. No one can look at everyone coming into the workplace wearing a mask or not. Thus the need for the acquisition of a face mask arose. The model in this paper uses the Convolutional Neural Network. It is a model of deep neural network that is used to analyze any visual images. It captures image data as embedded, captures all data, and sends it to neurons. It has a fully integrated layer, which processes the final output that represents the prediction about the image. The Convolutional neural network model used here is MobileNetV2 Architecture. The MobileNet model is a network model that uses a highly differentiated intelligent solution as its core unit. Its divinely divisive depths have two layers: depth of depth intelligence and point flexibility. It is based on a distorted residual structure where the residual contact is between the layers of the bottle. The central stretch layer uses clever convolutions at lightweight depths to filter out features as a source of non-linearity. In total, the architecture of MobileNetV2 consists of the first fully flexible layer with 32 filters, followed by the remaining 19 bottlenecklayers.

1.1 OBJECTIVE:

The year 2020 has shown mankind some mindboggling 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, COVID19 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 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.In the face of the COVID-19 pandemic, the World Health Organization (WHO) declared the use of a face mask as a mandatory biosafety measure. This has caused problems in current facial recognition systems, motivating the development of this research. This manuscript describes the development of a system for recognizing people, even when they are using a face mask, from photographs. classification model based on the MobileNetV2 architecture and the OpenCv's face detector is used. Thus, using these stages, it can be identified where the face is and it can be determined whether or not it is wearing a face mask. The FaceNet model is used as a feature extractor and a feedforward multilayer perceptron to perform facial recognition. For training the facial recognition models, a set of observations made up of 13,359 images is generated; 52.9% images with a face mask and 47.1% images without a face mask. The experimental results show that there is an accuracy of 99.65% in determining whether a person is wearing a mask or not. An accuracy of 99.52% is achieved in the facial recognition of 10 people with masks, while for facial recognition without masks, an accuracy of 99.96% is obtained. In recent decades, facial recognition has become the object of research worldwide. In addition, with the advancement of technology and the rapid development of artificial intelligence, very significant advances have been made . For this reason, public and private companies use facial recognition systems to identify and control the access of people in airports, schools, offices, and other places.

On the other hand, with the spread of the COVID-19 pandemic, government entities have established several biosafety regulations to limit infections. Among them is the mandatory use of face masks in public places, as they have been shown to be effective in protecting users and those around them. As the spread of the virus occurs through physical contact, conventional recognition systems (such as fingerprints) or typing a password on a keyboard become insecure. Thus, facial recognition systems are the best option, as they do not require physical interaction as in other cases. However, the use of the face mask within these systems has represented a great challenge for artificial vision , because at the time of facial recognition, half of the face is covered and several essential data are lost. This clearly denotes the need to create algorithms that recognize a person when they are wearing a face mask. This has made it necessary to implement new strategies to achieve robustness in the current systems .

In this sense, convolutional neural networks (CNN) belong to a set of techniques grouped under the so-called deep learning . Thus, over the years, this technology has been adapted to the needs of the human being, as established in, developing applications in various fields of knowledge, such as agriculture , military area , and medicine, among others. The contribution of this type of neural network has also been applied to analyze dental images, and this is technically described in the review of. In , a system that analyzes medical images is proposed, through selective data sampling, that detects hemorrhages in color images. On the other hand, in , a technical review of the contributions of the CNN in the mammographic breast cancer diagnosis (MBCD) is shown. Although there are several related investigations, they are still in the initial stages, with the clear objective of providing robust tools in the future. In a review is described that seeks to identify the chronological advancement of CNN in brain magnetic resonance imaging (MRI) analysis.Although its use in medicine is not recent, it has now been directed particularly to applications related to COVID-19. Various methods and procedures are used for the diagnosis of this disease, and one of them is the review of computed tomography scans. For this reason, suggests a rapid and valid method based on AI (10 CNN) for the detection of pulmonary affections. The results show a sensitivity, specificity, and precision of over 99%. Similarly, in , a system for automatic disease diagnosis using the EfficientNet architecture is described. The results denote an average accuracy of over 96%, validating the contribution in situations of health crisis. Taking X-rays is another way to identify the virus affectations in the patient's chest Given this, in a deep learning method based on nCOVnet networks is presented for detection, the results of which show an accuracy of between 98% and 99%. Something similar is done in , where chest X-ray images are analyzed and the various training techniques of the networks are compared, obtaining an accuracy of 98.33% when using ResNet-34.Although in most cases CNNs are used in the diagnosis of COVID-19, they can also be used in other applications, as part of contagion prevention measures . In a system is presented that allows people to be monitored when entering and being inside a certain place, and to evaluate if they are complying with the established biosecurity measures. In the event that this is not complied with, other people can be informed to exercise caution and health personnel to apply the respective measures. They have also been used to develop detection systems for the proper use of face masks. For this reason, in , a system is proposed that differentiates the people who use a mask or not with the algorithms RCNN, Fast RCNN, and Faster RCNN with an accuracy of 93.4%. In , the VGG-16 CNN model is used to implement a detection system with an accuracy rate of 96%. Similarly, inthey propose the SSDMNV2 model based on the MobileNetV2 architecture, which has an accuracy of 92.64% when performing the experimental tests.

On the other hand, describes a system for the detection of face masks using a support vector machine (SVM) algorithm. The datasets are the Real-World Masked Face Dataset (RMFD), the Simulated Masked Face Dataset (SMFD), and the Labeled Faces in the Wild (LFW). The results show an accuracy of 99.64% with SVM in RMFD, 99.49% in SMFD, and 100% in LFW. In InceptionV3 transfer learning is used, obtaining an accuracy of 99.92% during training and 100% during tests with SMFD data. In , a method to identify the correct use of masks is defined by combining classification networks and super-resolution of images (SRCNet). An accuracy of 98.70% is achieved, surpassing conventional image classification methods of this type. The problem of facial recognition due to the use of face masks during the COVID-19 pandemic has caused new horizons to be explored in artificial intelligence, representing a challenge for researchers, which has motivated the development of ocular recognition systems, as a parallel response. In , a facial recognition system using eye information and CNN trained by ImageNet is presented. The results present an accuracy of between 90–95%. Similarly, provides a facial recognition system using SVM with three databases (UBIPr, Color FERET, and Ethnic Ocular). Performance tests show a yield of approximately 92%. In continuity with the works described in the bibliography, this document presents a facial recognition system for people regardless of whether they use a face mask or not. For this purpose, the work has been organized into four sections, contains the materials and methods, shows the results, an presents the discussion.

CHAPTER 2

LITERATURE SURVEY

Deep learning techniques are useful for big data analysis and include applications in computer vision, design and speech recognition. Afterreading Z. Wang, G. Wang, (2020), "Masked face recognition dataset and application we recognize that this work will focus on some of the most commonly implemented intensive learning architectures and their applications. Auto- encoder, good neural networks, Boltzmann machines, Deep Trust networks are the networks presented in detail. Deep learning can be used in un-enhanced learning algorithms to process unplugged data. Previously, Khandelwal in his research work (2020) had stated in hiswork about a deep leaming model that binaries an image as a mask isused or not mask. 380 images had a mask and 460) images had no mask and these images were used in the training of the MobileNetV2model.

Qin B. and Li D. has done a face mask recognition project that focuses on capturing real-time images indicating whether a person hasput on a face mask or not. The dataset was used for training purposes to detect the main facial features (eyes, mouth, and nose) and for applying the decision making algorithm. Putting on glasses showed no negative effect. Rigid masks gave better results whereas incorrect detections can occur due to illumination, and to objects that are noticeable out of the face. There are several approaches are used for facial masks detection. For instance, used electromagnetic and radiometry techniques for facial masks detection. employed deep neural networks (ANN) using machine learning techniques in Facial Masks detection. Also comparison was made between ELM ANN and BP ANN based on performance measurements . Neural Networks are used to exacted information from ultrasound to classify the abnormal lesions. An island based model for classification of face mask and distinguishing between various classes of face feature detection using artificial neural network. That artificial neural network to detect the abnormality masks lesions based on edge. characteristics, shape and darkness of a lesion. Ultrasound imaging system in order to reduce the dependency of the operator. Linear Discriminant Analysis to classify the informal face mask feature detection using texture and morph metric parameters. presented a paper on face detection segmentation by using genetic algorithm and ANFIS classifier for locating face feature detection and made comparative analysis between various classifiers. presented a face feature detection method based on Ultrasound RF Time series and SVM Classifier. The characteristics curve of 0.86 using support vector machine (SVM) and 0.81 using RF classification algorithm on 22 subjects was determined.

In the content based image classification using deep learning. Joseph Redmon et al proposed You Only Look Once (YOLO) algorithm for real time object detection. Sanzidul Islam er al 2020. gave a deep learning based assistive System. to classify COVID-19 Face Mask which is implemented in rasbperrypi-3.

Velantina et.al 2020, made an COVID-19 facemask detection by means of using Caffe model.

Senthilkumar et.al 2017, compared the two most frequently used ma chine learning algorithms K-Nearest Neighbour and Support Vector Ma chine in his work for face recognition. Senthilkumar et.al 2018. proposed a new and fast approach for face recognitionN. Ozkaya, S. Sagiroglu this paper titled Intelligent face mask prediction system uses the face mask detection model. In this work, Biometric based individual ID frameworks are utilized to give elective answers for security. Albeit numerous methodologies and calculations for biometric acknowledgment procedures have been created and proposed in the writing, connections among biometric highlights have not been concentrated in the field up until now. In this investigation, they have examined the presence of any connection between biometric highlights and they have attempted to get a biometric highlight of an individual from another biometric highlight of a similar individual. Thusly, they have planned and presented another and keen framework utilizing a novel methodology dependent on fake neural organizations for creating face veils including eyes, nose and mouth from fingerprints with 0.75-3.60 outright percent blunders. Exploratory outcomes have exhibited that it is conceivable to create face veils from fingerprints without knowing any data turns around. Also, it is demonstrated that fingerprints and faces are identified with one another intently. Not with standing the proposed framework is introductory investigation and it is as yet a work in progress; the outcomes are exceptionally reassuring and promising. Likewise, proposed work is significant from perspective on the point that it is another exploration zone in biometrics.

Toshanlal Meenapal, Ashutosh Balakrishnan, Amit Verma They have designed a paired face classifier which can identify any face present in the casing independent of its arrangement. This research work presents a technique to produce exact face division covers from any self-assertive size info picture. Starting from the RGB picture of any size, the technique utilizes Predefined Training Weights of VGG - 16 Architecture for include extraction. Preparing is performed through Fully Convolutional Networks to semantically fragment out the faces present in that picture. Angle Descent is utilized for preparing while Binomial Cross Entropy is utilized as a misfortune work. Further the yield picture from the FCN is handled to eliminate the undesirable commotion and evade the bogus expectations assuming any and make jumping box around the countenances. Besides, proposed model shows extraordinary outcomes in perceiving non-frontal countenances. Alongside this it is likewise ready to recognize numerous facial veils in a solitary edge. Investigations were performed on Multi Parsing Human Dataset getting mean pixel level exactness of 93.884 % for the portioned face covers. Gayatri Deore, Ramakrishna Bodhula, Vishwas Udpikar, Vidya More Security being of most extreme significance, video reconnaissance has become a functioning examination point. Video examination upgrade video observation frameworks by performing assignments of continuous occasion identification and post-occasion investigation. This can spare HR, cost and increment the adequacy of the reconnaissance framework activity.One of the normal prerequisites of Video Analytics for security is to identify presence of a veiled individual naturally. In this paper, they propose a procedure for veiled face recognition utilizing four unique strides of assessing good ways from camera, eye line location, facial part discovery and eye identification. The paper plots the standards utilized in every one of these means and the utilization of usually accessible calculations of individual's recognition and face identification. This interesting methodology for the issue has made a technique less difficult in multifaceted nature subsequently making constant usage plausible. Examination of the calculation's presentation on test video successions gives valuable experiences to additional enhancements in the covered face recognition execution.

Shashi Yadav In this paper, proposed a methodology that utilizes PC vision and MobileNet V2 engineering to help keep up a safe climate and guarantee people assurance via naturally observing public spots to dodge the spread of the COVID-19 infection and help police by limiting their physical reconnaissance work in regulation zones and public regions where observation is needed by methods for camera takes care of with raspberry pi4 continuously.

Hence, the proposed framework will work in a productive way in the current circumstance when the lockout is facilitated and assists with following public places effectively in a robotized way. It is tended to top to bottom the following of social removing and the distinguishing proof of face covers that help to guarantee human wellbeing. The execution of this arrangement was effectively tried continuously by conveying model in raspberry pi4. The arrangement can possibly altogether diminish infringement by ongoing mediations, so the proposed framework would improve public wellbeing through sparing time and assisting with decreasing the spread of Covid. This arrangement can be utilized in places like sanctuaries, shopping complex, metro stations, air terminals, and so on.

Madhura Inamdar, Ninad Mehendale The original copy presents three-class characterization specifically individual is wearing a veil, or inappropriately worn covers or no veil recognized.

The face cover identifier is least intricate in structure and gives snappy outcomes and henceforth can be utilized in CCTV film to recognize whether an individual is wearing a veil impeccably with the goal that he doesn't represent any threat to other people. Mass screening is conceivable and subsequently can be utilized in jam-packed spots like railroad stations, transport stops, markets, roads, shopping center passageways, schools, universities, and so forth By checking the arrangement of the face veil on the face, it very well may be ensured that an individual wear it the correct way and assists with controlling the extent of the infection.

CHAPTER 3

FACE MASK DETECTION ALGORITHM DEVELOPMENT

In this chapter, the algorithm for detection of persons with face masks is discussed in detail. YOLO object detection algorithm is used for detection of persons with face mask and without face mask. Here yolo workflow is discussed in step by step.

3.1 YOLO - object detection algorithm

Deep Learning consists of a very enormous number of neural networks that use the multiple cores of a process of a computer and video processing cards to manage the neuranetwork's neuron which is categorized as a single node. Deep learning is used in numerous applications because of its popularity especially in the field of medicine and agriculture. Here YOLO deep learning technique is used to identify persons wearing and not wearing face masks.Joseph Redmon et al. introduced You look only once also known as YOLO in 2015.

YOLO is a convolutional neural network (CNN) for doing object detection in real- time. The algorithm applies a single neural net work to the full image, and then divides the image into regions and predicts bounding boxes and probabilities for each region. These bounding boxes are weighted by the predicted probabilities. Some improvements were done over years and YOLOv2 and YOLOv3 versions were introduced respectively in 2016 , 2018.Our model uses YOLOv3 and it provides good results regarding object classification and detection. In the previous version of Yolov2 Darknet-19 is used. Yolov3 uses darknet-53. Darknet is a frame- work used for training neural networks written in C language.

3.2 Benefits

- YOLO is extremely fast
- YOLO scans the entire image during training and also during testing. So, it implicitly encodes contextual information about classes as well as their appearance.
- YOLO learns generalizable representations of objects so that when it is trained on natural images and tested, the algorithm performs excellently when compared to other top detection methods.

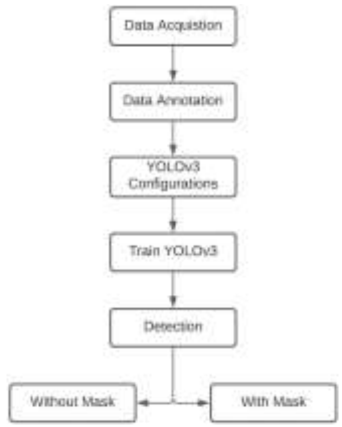

Figure 3.1: YOLO work flow.

3.3 Workflow

Here the workflow of YOLO object detection algorithm is discussed in detail. Initially a dataset of images is collected which are used for training by means of using YOLO. Dataset consists of images of persons with masks and without masks. figure 3.1 shows the work flow of YOLO.

3.31 Data Acquisition

Data is really important for deep learning techniques. If we use more data for training the AI then the result will be better. To train YOLO we need more data and with proper annotation. Using a web-scraping tool we have collected 900 images of both mask and no-mask. These images cannot be used directly so we need to pre-process before feeding into the model. Next step is Data Annotation.

3.3.2 Data Annotation

To train YOLO we need to annotate images for object detection models. Our dataset should be well annotated. There are different types of annotations available. Here a bounding boxes method is used. It creates a rectangle area over images that are present in our dataset. Since Annotation needs more time we are using a tool called LabelIMG to annotate our data.

3.4 YOLOv3 Configuration

The YOLOv3 configuration involved the creation of two files and a cus- tom Yolov3 cfg file. YOLOv3 configuration first creates a ”obj.names” file which contains the name of the classes which the model wanted to detect. Then a obj.data file which contains a number of classes in here is 2, train data directory, validation data, ”obj.names” and weights path which is savedon the backup folder. Lastly, a cfg file contains 2 classes. figure 3.2 shows the configuration steps involved. Next is training of our YOLOv3 in which an input image is passed into the YOLOv3 model.This will go through the image and find the coordinates that are present. It divides the image intoa grid and from that grid it analyzes the target objects features. Here 80 percent data is used for training , and remaining 20 percent is used for val- idation. Now weights of YOLOv3 trained on the dataset are created undera file. Using these trained weights now we can classify the persons wearing and not wearing the mask.

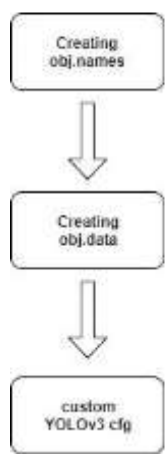

Figure 3.2: YOLOv3 Configuration

3.5 Face Mask Detection Algorithm

Step 1: Start the program.

Step 2: Input image is feeded.
Step 3: YOLOv3 trained weights are loaded from the disk.
Step 4: Persons with and without face mask are detected by means of object detection algorithm.
Step 5: After detection resultant image is displayed along with count of Persons with and without masks.
Step 6: The ratio of with and without face mask is calculated and based upon ratio status is obtained.

Code:-

```
# import the necessary packages
from tensorflow.keras.applications.mobilenet_v2 import
preprocess_input
from tensorflow.keras.preprocessing.image import img_to_array
from tensorflow.keras.models import load_model
from imutils.video import VideoStream
import numpy as np
import imutils
import time
import cv2
import os

def detect_and_predict_mask(frame, faceNet, maskNet):
# grab the dimensions of the frame and then construct a blob
# from it
(h, w) = frame.shape[:2]
blob = cv2.dnn.blobFromImage(frame, 1.0, (224, 224),
(104.0, 177.0, 123.0))

# pass the blob through the network and obtain the face detections
faceNet.setInput(blob)
detections = faceNet.forward()
print(detections.shape)

# initialize our list of faces, their corresponding locations,
```

```
# and the list of predictions from our face mask network
faces = []
locs = []
preds = []

# loop over the detections
for i in range(0, detections.shape[2]):
# extract the confidence (i.e., probability) associated with
# the detection
confidence = detections[0, 0, i, 2]

# filter out weak detections by ensuring the confidence is
# greater than the minimum confidence
if confidence > 0.5:
# compute the (x, y)-coordinates of the bounding box for
# the object
box = detections[0, 0, i, 3:7] * np.array([w, h, w, h])
(startX, startY, endX, endY) = box.astype("int")

# ensure the bounding boxes fall within the dimensions of
# the frame
(startX, startY) = (max(0, startX), max(0, startY))
(endX, endY) = (min(w - 1, endX), min(h - 1, endY))

# extract the face ROI, convert it from BGR to RGB channel
# ordering, resize it to 224x224, and preprocess it
face = frame[startY:endY, startX:endX]
face = cv2.cvtColor(face, cv2.COLOR_BGR2RGB)
face = cv2.resize(face, (224, 224))
face = img_to_array(face)
face = preprocess_input(face)

# add the face and bounding boxes to their respective
# lists
faces.append(face)
locs.append((startX, startY, endX, endY))

# only make a predictions if at least one face was detected
if len(faces) > 0:
# for faster inference we'll make batch predictions on *all*
```

```
# faces at the same time rather than one-by-one predictions
# in the above `for` loop
faces = np.array(faces, dtype="float32")
preds = maskNet.predict(faces, batch_size=32)

# return a 2-tuple of the face locations and their corresponding
# locations
return (locs, preds)

# load our serialized face detector model from disk
prototxtPath = r"face_detector\deploy.prototxt"
weightsPath =
r"face_detector\res10_300x300_ssd_iter_140000.caffemodel"
faceNet = cv2.dnn.readNet(prototxtPath, weightsPath)

# load the face mask detector model from disk
maskNet = load_model("mask_detector.model")

# initialize the video stream
print("[INFO] starting video stream...")
vs = VideoStream(src=0).start()

# loop over the frames from the video stream
while True:
# grab the frame from the threaded video stream and resize it
# to have a maximum width of 400 pixels
frame = vs.read()
frame = imutils.resize(frame, width=400)

# detect faces in the frame and determine if they are wearing a
# face mask or not
(locs, preds) = detect_and_predict_mask(frame, faceNet, maskNet)

# loop over the detected face locations and their corresponding
# locations
for (box, pred) in zip(locs, preds):
# unpack the bounding box and predictions
(startX, startY, endX, endY) = box
(mask, withoutMask) = pred

```

```
# determine the class label and color we'll use to draw
# the bounding box and text
label = "Mask" if mask > withoutMask else "No Mask"
color = (0, 255, 0) if label == "Mask" else (0, 0, 255)

# include the probability in the label
label = "{}: {:.2f}%".format(label, max(mask, withoutMask) * 100)

# display the label and bounding box rectangle on the output
# frame
cv2.putText(frame, label, (startX, startY - 10),
cv2.FONT_HERSHEY_SIMPLEX, 0.45, color, 2)
cv2.rectangle(frame, (startX, startY), (endX, endY), color, 2)

# show the output frame
cv2.imshow("Frame", frame)
key = cv2.waitKey(1) & 0xFF

# if the `q` key was pressed, break from the loop
if key == ord("q"):
break

# do a bit of cleanup
cv2.destroyAllWindows()
vs.stop()
```

In this project, we have developed a deep learning model for face mask detection using Python, Keras, and OpenCV. We developed the face mask detector model for detecting whether person is wearing a mask or not. We have trained the model using Keras with network architecture. Training the model is the first part of this project and testing using webcam using OpenCV is the second part.

Figure 3.3 With Mask

CHAPTER 4
EXISTING SYSTEM

The existing system deals with CNN (convolutional neural network) inthe face mask detection models, they use clustering, classification, max pooling to train the machine on what is what. The CNN trains the machine with the help of dataset, around 20% of the images in dataset are used to train the machine and the remaining 80% is used for testing the results. The face mask detection model empathizes with the problems faced by people around the globe due to COVID-19. This system helps in a small way to stop the pandemic from spreading and festering into our lives further. The Person Identification model or the face recognition model as it is popularly called, uses the face recognition library of python to compare images by similarity detection technique.

Sujatha and Chatterjee proposed a model that could be useful to foresee the spread of COVID2019 by using linear regression, Multilayer perceptron and Vector autoregression model on the COVID-19 kaggle data to envision the epidemiological example of the malady and pace of COVID-2019 cases in India. Navares et al. introduced an answer for the issue of anticipating every day medical clinic confirmations in Madrid because of circulatory and respiratory cases dependent on biometeorological markers. Cui and Singh created and applied the MRE hypothesis for month to month streamflow prediction with spectral power as a random variable. A system that restrict the growth of COVID-19 by finding out people who are not wearing any facial mask in a smart city network where all the public places are monitored with ClosedCircuit Television (CCTV) cameras. Firstly, CCTV cameras are used to capture real- time video footage of different public places in the city. From that video footage, facial images are extracted and these images are used to identify the mask on the face. Another model for face detection using semantic segmentation in an image by classifying each pixel as face and non-face i.e. effectively creating a binary classifier and then detecting that segmented area. It works very well not only for images having frontal faces but also for non-frontal faces.

The most helpful project for us, proposed a method for automatic door access system using face recognition technique by using python programming and from OpenCV library Haar cascade method. Object Detection using Haar feature-based cascade classifiers is an effective object detection method proposed by Paul Viola and Michael Jones. Another research in which hybrid model using deep and classical machine learning for face mask detection is presented. A face mask detection dataset consists of with mask and without mask images, then using OpenCV to do real-time face detection from a live stream via webcam. Another tutorial , had two-phase COVID-19 face mask detector, detailing how computer vision/deep learning pipeline will be. The trained COVID-19 face mask detector, will implement two more additional Python scripts used to detect COVID-19 face masks in images and detect face masks in real-time video streams.

The effects of COVID-19 on the global economy can be seen with the naked eye, as the confinement of people in the homes brings with it less production and slows down the commercial dynamism. However, it should be noted that in situations of health crisis such as the one that continues to be experienced, it is relevant to put people's health before any productive activity. That is why biosecurity measures and social distancing protocols have been implemented to limit the spread of this dangerous virus. As well as the capacity in public institutions, industries and other establishments has been limited, highlighting the so-called telework (in certain cases). Thus, companies have implemented various methodologies, strategies, and techniques to protect the integrity and health, both when entering and staying in face-to-face work sessions. As previously mentioned, CNN have been an important technological tool during this pandemic. Although most approaches have been taken towards the diagnosis of the disease, monitoring and prevention has also been covered.

Today, the use of a personal face mask is a mandatory preventive measure. Keeping the mouth, nose, and cheeks covered has now made people only recognizable by their eyes, eyebrows, and hair, which is a problem for the human eye, which tends to find similarities in several faces that have similar features. This problem also affects computer systems, as facial recognition systems are now very common. They are used to unlock the smartphone, access sensitive applications, and to enter certain places. Current systems usually process information from the entire face of the person, which is why technology must adapt to these new conditions. All this is done with the purpose of maintaining the biosecurity of the user, but giving them the opportunity to continue with the activities as naturally as possible.

The literature has shown that there are systems that seek to identify whether people use it properly. These works have had very good results. However, facial recognition using biosecurity material has not yet been explored. All of this motivated the present investigation, in which a detection system with two approaches is presented. The first is to develop a face classifier, starting from a database of people with and without a mask. The second describes a facial recognition algorithm in controlled environments, which allows for personnel to be identified automatically, without removing the face mask. This can be implemented as an access system to an institution or a home, but at a low cost. This is ensured by using open-source programming software and simple features that reduce computational expense. For this reason, the possibility of improving the adaptability of current facial recognition systems, in the face of new circumstances, has been established as a starting hypothesis.

The programming language used here is Python. For optimal operation, a high-processing equipment (GPU) is needed. However, we received no external financing, so we chose to work with free Google servers, which are available in Google Colab. Another of the essential requirements is to have the necessary databases in order to carry out the training and obtain the classification and recognition models. Taking into account that building the database of these databases requires a high investment of time when working with artificial intelligence and especially with convolutional neural networks.

Additionally, it is necessary to develop a consent form for the people who will allow for taking photographs for the facial recognition algorithm database. This is necessary because there are currently no databases for the recognition of people with face masks. For this, it is necessary to rely on Art 6.1d of the European General Data Protection Regulation (RGPD), in connection with article46.3 of the LOU. Here, it is mentioned that the data of a person will be treated in accordance with the exercise of public powers conferred on the universities as responsible for the treatment of the data of the students. As well as biometric data ((article 9.2.a) of the RGPD), in which consent will be needed so that it can be part of the exams where facial recognition techniques are applied. The collection, filing, processing, distribution, and dissemination of these information data will require the authorization of the owner and the mandate of the law.

Issues in existing system:

In these existing systems it was impossible for the machine to know who is not wearing a mask and the real-world application for these existing systems were minimal.

Drawbacks in existing system:

The major limitations of existing schemes are as follows: - CNN used in existing system are slow and resource hungry, which makes the training process slow. The existing scheme does not detect multiple faces. The existing system does not detect faces from all angles.

CHAPTER 5
SYSTEM DESIGN

We use Convolutional Neural Network and Deep Learning for Real Time Detection and Recognition of Human Faces, which is simple face detection and recognition system is proposed in this paper which has the capability to recognize human faces in single as well as multiple face images in a database in real time with masks on or off the face. Pre-processing of the proposed frame work includes noise removal and hole filling in colour images. After pre-processing, face detection is performed by using CNNs architecture. Architecture layers of CNN are created using Keras Library in Python. Detected faces are augmented to make computation fast. By using Principal Analysis Component (PCA) features are extracted from the augmented image. For feature selection, we use Sobel Edge Detector.

1. The Input Image

Real-time input images are used in this proposed system. Face of person in input images must be fully or partially covered as they have masks on it. The system requires a reasonable number of pixels and an acceptable amount of brightness for processing. Based on experimental evidence, it is supposed to perform well indoors as well as outdoors i.e. passport offices, hospitals, hotels, police stations and schools etc.

2. The Pre-processing Stage

Input image dataset must be loaded as Python data structures for pre- processing to overturn the noise disturbances, enhance some relevant features, and for further analysis of the trained model. Input image needs to be pre- processed before face detection and matching techniques are applied. Thus pre-processing comprises noise removal, eye and mask detection, and hole filling techniques. Noise removal and hole filling help eliminate false detection of face/ faces. After the pre-processing, the face image is cropped and re- localised. Histogram Normalisation is done to improve the quality of the pre- processed image.

3. The Face Detection Stage

We perform face detection usingHAAR Cascade algorithm.This system consists of the value of all black pixels in greyscale images was accumulated. They then deducted from the total number of white boxes. Finally, the outcome is compared to the given threshold, and if the criterion is met, the function considers it a hit.In general, for each computation in Haar-feature, each single pixel in the feature areas can need to be obtained, and this step can be avoided by using integral images in which the value of each pixel is equal to the number of grey values above and left in the image.

4. The Feature-Extraction Stage

Feature Extraction improves model accuracy by extracting features from pre-processed face images and translating them to a lower dimension without sacrificing image characteristics. This stage allows for the classification of human faces.

5. The Classification Stage

Principal Component Analysis(PCA) is used to classify faces after an image recognition model has been trained to identify face images. Identifying variations in human faces is not always apparent, but PCA comes into the picture and proves to be the ideal procedure for dealing with the problem of face recognition. PCA does not operate classifying face images based on geometrical attributes, but rather checks which all factors would influence the faces in an image. PCA was widely used in the field of pattern recognition for classification problems.PCA demonstrates its strength in terms of data reduction and perception.

6. Training Stage

The method is based on the notion that it learns from pre- processed face images and utilizes CNN model to construct a framework to classify images based on which group it belongs to. This qualified model is saved and used in the prediction section later. In CNN model, the stages of feature extraction are done by PCA and feature selection done by Sobel Edge Detector and thus it improves classification efficiency andaccuracy of the training model.

7. Prediction Stage

In this stage, the saved model automatically detects theoftheface maskimagecaptured by the webcam or camera. The saved model and the pre-processed images are loaded for predicting the person behind the mask. CNN offers high accuracy over face detection, classification and recognition produces precise and exactresults.CNN model follows a sequential model along with Keras Library in Python for prediction of human faces.

CHAPTER 6
MODULES DESCRIPTION

The proposed system contains the following modules:

- Pre-processing Images
- Capture image ( )
- Upload image ()
- Classifier(image)
- Prediction(image)
- Pre-processing Images

The input image is captured from a webcam or camera in real- time world. The frames (images)from the dataset are loaded. Face images are cropped and resized after they have been loaded. Later, noise distortions in the images are suppressed. Normalization is then done to normalize the images from 0-255 to 0-1 range.

- Capture image ()

In this Module we are able to capture real time images. We do this by the help of Flutter and applying in to the Classifier Model.

- Upload image ()

Here we can browse the image and upload for finding the Plant disease. We need to fetch the image. And this image passes to Classifier Module.

- Classifier(image)

Following data Prepossessing of the images, will apply to the Classifier. Here it will find out the feature of the images. Mainly in this module feature extraction occurs. Image similarity features will be stored in to the model which gets created.

- Prediction(image)

In this Module prediction of person take place. Here the browsed image will be placed in to the model and output will be shwn as based on which label its get matched the most.

6.1SYSTEM ARCHITECTURE

6.1.1 Mask Detection

For Mask Detection, we use a sequential CNN model along with inbuilt Keras Library in Python. The sequential CNN model is trained from dataset of human faces with or without masks on the faces. It forms a logic from the pre-processed images like a human brain, then the model detects the face along with mask using feature extraction and feature selection. After identification of the mask along with face of the person, it forwards to the prediction or identification stage.

6.1.2 Person Identification

In this stage, the trained model predicts the face of the person behind the mask according to the trained model. The prediction is based on the number of images trained by the model and its accuracy. Finally, the system displays that the person name along with the indication of he or she wearing a mask or not.

6.1.3 User

User refers to person standing in front of a webcam or camera in a real world scenario.

6.1.4 Capture Images

The webcam or camera captures images which are then used as dataset to train the model. If the dataset captures human faces in different masks and in different backgrounds along with large number of human face images, then the accuracy of the training model increases.

6.1.5 Face Detection

For face detection, we use HAAR Cascade algorithm. In this method all black pixels in greyscale images was accumulated. They then deducted from the total number of white boxes. Finally, the outcome is compared to the given threshold, and if the criterion is met, the function considers it a hit.

6.1.6 Dataset

The proposed model has datasets captured from individuals person. The dataset of faces is classified into with masks and without masks and is stored in different databases. Each folder consists 40 to 60 images of an individual person respectively. The individuals person face images should have images captured from different masks and different backgrounds so the accuracy of training model increases The dataset is integrated with Keras Library in Python. Larger the dataset more accurate the training model. So dataset images are directly congruent to accuracy of the training model.

6.1.7 Data Pre-Processing

This module is used for read image. After reading we resize the image if needed me rotate the image and also remove the noises in the image. Gaussian blur (also known as Gaussian smoothing) is the result of blurring an image by a Gaussian function. It is a widely used effect in graphics software, typically to reduce image noise. Later normalization is done to clean the images and to change the intensity values to pixel format. The output of this stage is given to training model.

6.1.8 Segmentation

Segment the image, separating the background from foreground objects and we are going to further improve our segmentation with more noise removal. We separate different objects in the image with markers.

6.1.9 Edge detection

Sobel edge detector is using. It is based on convolving the image with a small, separable, and integer valued filter in horizontal and vertical direction and is therefore relatively inexpensive in terms of computations. 2-D spatial gradient measurement on the image is performed by Sobel operator. Each pixel of the image is operated by Sobel operator and measured the gradient of the image for each pixel. Pair of 3Ã—3 convolution masks is used by Sobel operator, one is for x direction and other is for y Direction. The Sobel edge enhancement filter has the advantage of providing differentiating (which gives the edge response) and smoothing (which reduces noise) concurrently.

6.1.10 Localization

Find where the object is and draw a bounding box around it.

6.1.11 Feature Selection

The biggest advantage of Deep Learning is that we do not need to manually extract features from the image. The network learns to extract features while training. You just feed the image to the network (pixel values). What you need is to define the Convolutional Neural Network architecture and a labelled dataset. Principal Component Analysis (PCA) is a useful tool for doing this. PCA checks all the factors influencing the faces rather just checking its geometrical factors. Thus using PCA gives accurate and precise detection and recognition result of faces.

6.1.12 CNN Architecture creation

A sequential CNN model is designed specifically for analyzing the human faces with mask on it or not. The Convolutional Neural Network Architecture layers will be created using the Keras library in Python. The convolutional layer is used for mask detection. It extracts the features of face images using Principal Component Analysis(PCA) and converts them into a lower dimension without losing the image characteristics. The output of the convolutional layer will be the input of then ext Batch Normalization layer. The Batch Normalization layer standardizes the inputs to a layer for each mini-batch. This has the effect of stabilizing the learning process and dramatically reducing the number of training epochs. After this, the face images undergo classification. If the images are tested, then model accuracy calculations and predications takes place. If non-test images come, then first the images are trained along with it its validation testing is also done. If it is validating, then the model is trained and saved for further calculations. Otherwise, if it is non- validate, then it undergoes network training and calculations are done for losing weights and are adjusted accordingly. Finally, the CNN model gives accuracy and prediction of the human face behind the mask.

6.1.13 Training

The pre-processed face images are directed to the CNN model for training. Based on the dataset given, a logic is formed in the CNN to categorize the faces according to their features. This trained model is saved. The trained model is capable of categorizing human faces based on with or with out masks on it. Training model is done with the help of a sequential CNN model and HAAR Cascade Algorithm.

6.1.14 Predication

In this phase, when a person comes in front on a webcam, the image is captured and predicted by the CNN model according to the logic learned by the sequential model. The image undergoes pre-processing. This pre-processed images and the saved CNN model are then loaded. Based on the algorithm interpreted by the system predicts and detects the human faces according to trained model. The proposed system develops classification and predictive model that can account for accurate classification grouping and prediction of Facemasks on the face of a person. The proposed system will focus on enhancing the prediction by increasing its accuracy and detection probability. This is done by using MobileNet_V2. This system also hasthe ability to identify the persons who are not wearing the masks and send them a mail notification. proposed training model for the predictive modelling of face mask detection. The data set for the face masks is loaded into the training script.

The data is then pre processed for being fed to the classifier model. For the training purpose, a keras/TensorFlow library named MobileNet is used, this classifier remains a better version for the CNN neural networks as in this the training procedure is relativelyfaster with a minimal increase in accuracy.

The classification of the images is done by training the model in 2 phases:

Phase 1-Training

Training the model on the dataset using Tensorflow & Keras with classifier likeMobileNetV2 is used to generate a trained model.

Phase2-Deployment

Loading the trained model and applying detector over images/live videostream.

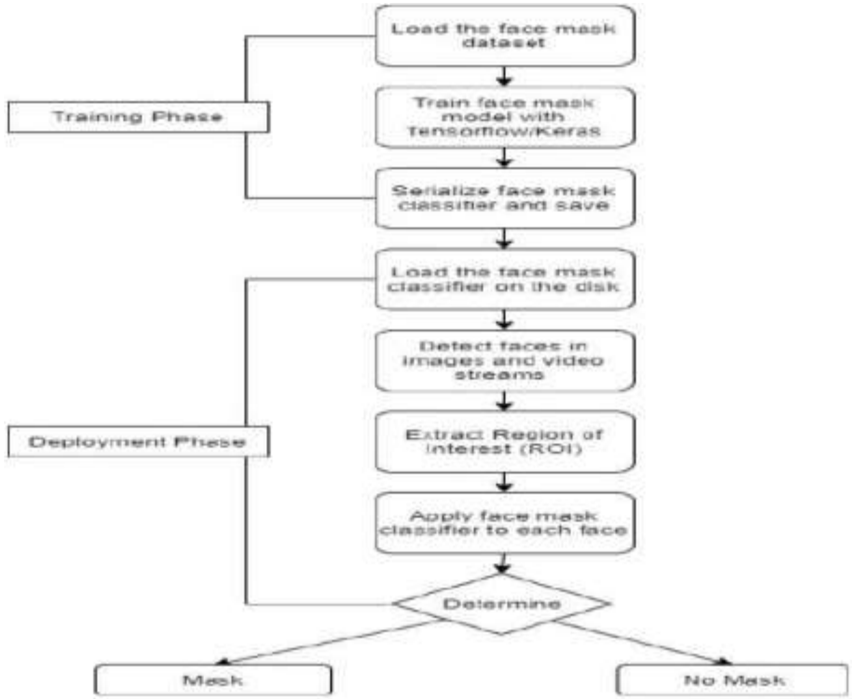

Figure 6.1 Determining the mask

It is proposed to design a system that is capable of identifying a person's face, even if it is with or without a mask. For the system to work properly, it is necessary to use two databases: the first is for classifier training and consists of a large number of images of people who wear a face mask and others who do not. The second is used for training the facial recognition system, and here there are people with and without the biosafety material (face mask). The input data are obtained either from an image, or a video and the architecture used is MobileNet, with the aim of having a better precision and robustness. This project is divided into three stages, which are described below.

First Stage

This stage focuses on finding the location and dimension of one or more faces, regardless of whether or not they wear a mask, within an image. For this, the OpenCV Deep Learning-based face detection model is used and, as a result, the region of interest (ROI) is obtained, which contains data such as the location, width, and height of the face.

Second Stage

A diagram of the operation of the second stage . This is where the classifier training is performed to detect faces with a mask and without a mask. For this, the “Real-World-Masked-Face-Dataset” database available on Git-Hub is used.

Unzipping the files makes available a large number of images of people of Asian origin wearing a mask. From this database, the training of the classifier of the first stage is carried out.

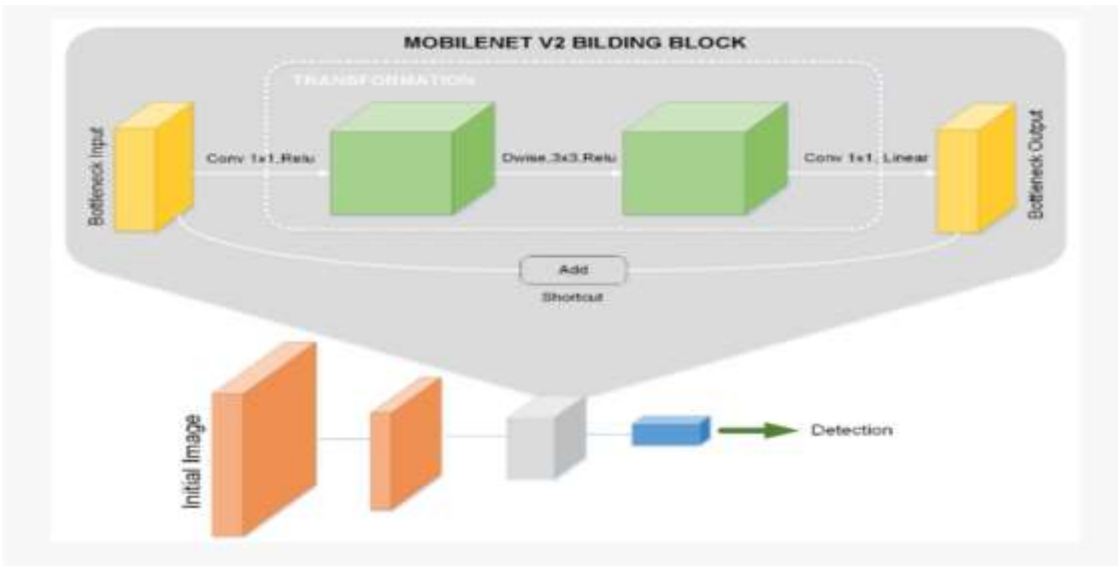

Figure 6.2 Second Stage

For the classifier, MobileNet V2 architecture is used, as it uses smaller models with a low latency and low parameterization power. This improves the performance of mobile models in multiple tasks and benchmarks, resulting in a better accuracy. It also retains the simplicity and does not require any special operator to classify multiple images and various detection tasks for mobile applications. MobileNetV2 is 35% faster at object detection compared with the first version, when combined with Single Shot Detector Lite. It is also more accurate and requires 30% fewer parameters, as the Bottleneck encodes the intermediate inputs and outputs.

CHAPTER 7
Future Scope and Advantage of the System

7.1 Advantages of Proposed system

The accuracy will be more and the time complexity will be less due to the MobileNet algorithm implementation. This proposed system uses existing IP cameras of the large institutions to monitor the people, so it is economically feasible as no extra investment is required. Proposed system detects multiple faces and face masks from all anglesin a small-time frame.

7.2 Future Scope:

Future Work More than fifty countries around the world have recently initiated wearing face masks compulsory. People have to cover their faces in public, supermarkets, public transports, offices, and stores. Retail companies often use software to count the number of people entering their stores. They may also like to measure impressions on digital displays and promotional screens. We are planning to improve our Face Mask Detection tool and release it as an open- source project. Our software can be equated to any existing USB, IP cameras, and CCTV cameras to detect people without a mask. This detection live video feed can be implemented in web and desktop applications so that the operator can see notice messages. Software operators can also get an image in case someone is not wearing a mask. Furthermore, an alarm system can also be implemented to sound a beep when someone without a mask enters the area. This software can also be connected to the entrance gates and only people wearing face masks can come in.

- Perform the classification efficiently Using multiple data sets which could attain the optimum prediction. \
- Database creation and addition of people in that database who are frequent defaulters.
- Improve the overall time complexity of the entire workflow.
- Integrate the Person identification model and face masks detection model into a single detection algorithm.

CONCLUSION

As the technology are blooming with emerging trends the availability so we have novel mask detector which can possibly contribute to public healthcare. The architecture consists of Mobile Netas the backbone it can be used for high and low computation scenarios. In order to extract more robust features, we utilize transfer learning to adopt weights from a similar task face detection, which is trained on avery large dataset. We used OpenCV, Tensorflow, Keras, Pytorch andCNN to detect whether people were wearing face masks or not. The models were tested with images and real-time video streams. The accuracy of the model is achieved and, the optimization of the model isa continuous process and we are building a highly accurate solution by tuning the hyper parameters. This specific model could be used as a usecase for edge analytics. Furthermore, the proposed method achieves state-of-the-art results on a public face mask dataset. By the development of face mask detection we can detect if the person is wearing a face mask and allow their entry would be of great help to thesociety.

Our proposed system can detect and recognize human face(s) in real-time world. Compared to the traditional face detection and recognition system, the face detection and recognition based on CNN model along with the use of Python libraries has shorter detection and recognition time and stronger robustness, which can reduce the miss rate and error rate. It can still guarantee a high test rate in a sophisticated atmosphere, andthe speed of detection can meet the real time requirement, and achieve good effect. The proposed CNN model shows greater accuracy and prediction for detecting and recognising human faces. The results show us that the current technology for face detection and recognition is compromised and can be replaced with this proposed work. Therefore, the proposed method works very well in the applications of biometrics and surveillance.

To mitigate the spread of COVID-19 pandemic, measures must be taken. We have modeled a face mask detector using SSD architecture and transfer learning methods in neural networks. To train, validate and test the model, we used the dataset that consisted of 1916 masked faces images and 1919 unmasked faces images. These images were taken from various resources like Kaggle and RMFD datasets. The model was inferred on images and live video streams. To select a base model, we evaluated the metrics like accuracy, precision and recall and selected MobileNetV2 architecture with the best performance having 100% precision and 99% recall. It is also computationally efficient using MobileNetV2 which makes it easier to install the model to embedded systems. This face mask detector can be deployed in many areas like shopping malls, airports and other heavy traffic places to monitor ththe public and to avoid the spread of the disease by checking who is following basic rules and who is not.

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