Irinjalakuda, Thrissur Kerala, India

PROJECT REPORT

AI-Controlled Crowd and Mask Monitoring

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C E R T I F I C A T E

This is to certify that the project report entitled: ***AI-Controlled Crowd and Mask Monitoring*** *is a bonafide record of the Project work done by Agna Xavier (Roll No.CCE17CS002), Angelo Tomy (Roll No.CCE17CS009), Sandra Babu (Roll No.CCE17CS055), Sam Smart (Roll N0.CCE17CS054) under my supervision and guidance, in partial fulfillment of the requirements for the award of the Bachelor Degree of Engineering in Branch Computer Science and Engineering from Kerala Technological University*

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Place: Irinjalakuda
Date: 30-05-2021

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Acknowledgement

We have taken a lot of effort into this project. However, completing this project would not have been possible without the support and guidance of a lot of individuals. We would like to extend our sincere thanks to all of them.

We extend our gratitude and appreciation to our lecturers in Computer Science department who have taught us at one point or the other. We are highly indebted to Mrs. Raisa Varghese for the guidance and supervision. We would like to thank her for providing the necessary information and resources for this project.

We would also like to thank our college for providing us all the necessary support for the project. All in all, we would like to thank everyone involved in this project and helped us with their suggestions to make the project better.

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Contents

Chapter 1

Introduction

In computing, Ambient Intelligence (AmI) refers to electronic environments that are sensitive and responsive to the presence of people. Ambient Intelligence is helping CCTV cameras to analyze what we do in real time, creating a new and powerful form of automated surveillance.The main idea of this project is to ensure that people are not crowded and they properly wear face masks during this prevailing covid-19 situation.This idea utilises CCTV cameras inorder to capture the photos of people who stand in crowds and also those who are unwearing masks.This project helps a lot to prevent the spread of the covid-19 disease to a great extent.Responsible people such as policemen and health workers will get notified through our app if people are found in crowds or unwearing masks with their faces captured through CCTV cameras.Ambient Intelligence to an extended level is utilised to perform this project.

In the wake of these pandemic times, we are trying to make a machine learning trained model for cameras to capture the pictures of people and the area which violates the rules of social distancing. The captured pictures will be directly forwarded to the police station of that area. By this, we can reduce the impact of COVID-19 and also the number of policemen who are aected by COVID-19.

Chapter 2

Motivation

-Lockdown

A lockdown is a restriction policy for people or community to stay where they are, usually due to specific risks to themselves or to others if they can move and interact freely.

-Rapid Increase in Covid-19 cases

-Covid-19 cases among health workers

Reports have said that until 5th June 2020, at least 90,000 healthcare workers have been infected by COVID-19 and more than 260 nurses have lost their lives to the pandemic

-Reducing the risk of getting affected SARS-CoV-2.

-Reducing the risk of getting infected to other communicable diseases in the future.

Chapter 3

Literature Review

Feng Han et al Proposed a paper "3D human face recognition using point signature". In this the face recognition problem is treated as a non-rigid object recognition problem. The rigid parts of the face of one person are extracted after registering the range data sets of faces having different facial expressions. These rigid parts are used to create a model library for efficient indexing. For a test face, models are indexed from the library and the most appropriate models are ranked according to their similarity with the test face.

Amany EI et al,Proposed a paper"GSM/GPRS network".This paper aims to review various specifications such as software description, user interfaces, hardware descriptions which help in tracking.

A. V. Ramprasad et al Proposed a paper Estimating the density of the people and counting the number of people in a crowd environment for human safety.By using improved Adaptive K-GMM Background subtraction method to extract the exact foreground in real time applications to avoid the estimation problem, the number of people in a crowd is counted by using algorithm "canny edge detector", "connected component labelling" method and "bounding box with centroid" method. Also proposes a real time video surveillance system.

Roshita Shishegar et al Proposed a paper "Attention control using fuzzy inference system in monitoring CCTV based on crowd density estimation". Paper mainly focuses on the gradual change of crowd density and risk probability in daily hours and uncertainty in our knowledge in evaluation of crowded places, here they introduce a design based on fuzzy decision making system to make decisions about risk probability. The design of this system is based on the fact that the human visual system tends to direct attention to events that happen with low probability. The efficiency of this system is tested on real data and results are presented to demonstrate the

practical applications of this system to aid the human operator.

Antonio Corradi et al,Proposed a paper "Crowd sensing in Urban Areas for City-Scale Mass Gathering Management: Geo-fencing and Activity Recognition".By using complex signal processing, machine learning, and resource management algorithms to facilitate mobile crowd sensing applications and Mobile Sensing Technology (MoST), for activity detection and geo-fencing, comparing it with the reference implementations provided by Google as part of the Google Play Services library.

Kowcika A.S et al,Proposed a paper "Crowd counting using Pixel Regression Technique".They design the paper on the categories of crowd counting in video falls in two : (a) ROI counting which estimates the total number of people in some regions at a certain time instance (b) LOI counting which counts people who cross a detecting line in a certain time duration. The LOI counting can be developed using feature tracking techniques .And the ROI counting can be developed using two techniques: Detection Based and Feature Based and Pixel Regression Techniques.

Shiming Ge et al,Proposed a paper "Detecting Masked Faces in the Wild with LLE-CNNs".By using Two pre-trained CNNs to extract candidate facial regions, locally linear embedding (LLE) algorithm and the dictionaries trained on a large pool of synthesized normal faces, masked faces and non-faces is used.

Nishika Gupta et al,Proposed a paper " A Literature Survey on Artificial Intelligence" Creating a machine capable of understanding the concepts, it allows for more human like conversations as well as improved translation. There is also fascinating research into detecting human emotions through audio and video cues. In particular, this paper provides a review of recent developments within the field of artificial intelligence and its applications.

Anureet Kaur et al Proposed a paper "Mobile application development" to identify and compare existing test estimation techniques for traditional software (desktop/laptop) and for mobile software/application. Presents and compares estimation techniques used in agile software development for mobile applications. The Agile approach to mobile application development states an iterative and incremental approach comprising self-organizing teams and cross-functioning teams working together to build the software. The testing phase of traditional software development proceeds through additional life cycle called Software Testing Life Cycle (STLC).

Kang Hao Cheong et al,Proposed a paper "Practical Automated Video Analytics for Crowd Monitoring and Counting".By usingPython with the Open Source Computer Vision (Open CV) library. And for object recognition background subtraction and CNN-based image classifiers is used.

Toshanlal Meenpal et al,Proposed a paper "Facial Mask Detection using Semantic

Segmentation"aim to design a binary face classifier which can detect any face present in the frame irrespective of its alignment from any arbitrary size input image. Uses Predefined Training Weights of VGG - 16 Architecture for feature extraction, training is performed through Fully Convolutional Networks to semantically segment out the faces present in that image, Gradient Descent is used for training, Binomial Cross Entropy is used as a loss function.

Sabbir Ejaz et al,Proposed a paper "Masked Face Recognition Using Convolutional Neural Network".By using multi-Task Cascaded Convolutional Neural Network (MTCNN). Then facial features extraction is performed using the Google FaceNet embedding model. And finally, the classification task has been performed by Support Vector Machine (SVM). The performance has been also evaluated within excessive facial masks and found attractive outcomes.

Prateek Khandelwal et alProposed a paper using Computer Vision to enhance Safety of Workforce in Manufacturing in a Post COVID World by using AI.

Shashi Yadav et al Proposed a paper "Deep Learning based Safe Social Distancing and Face Mask Detection" designed an efficient computer vision based approach focused on the real-time automated monitoring of people to detect both safe social distancing and face masks in public places by implementing the model on raspberry pi4 to monitor activity and detect violations through camera. After detection of breach, the raspberry pi4 sends an alert signal to the control center at state police headquarters and also gives an alarm to the public. In this proposed system modern deep learning algorithms have been mixed with geometric techniques for building a robust model which covers three aspects of detection, tracking, and validation.

Shamim Hossain Proposed a paper "detect COVID19 using chest X-ray or CT scan images" using AI and Deep Learning.Functionality to detect COVID-19 using chest X-ray or CT scan images, and to develop a mass surveillance system to monitor social distancing, mask wearing, and body temperature.

Akbar Khan et al,Proposed a paper "Crowd Monitoring and Localization Using Deep Convolutional Neural Network" used to provide the latest development and performance evolution in crowd monitoring by using different machine learning techniques and methods, Scale Driven Convolutional Neural Network (SD-CNN) and DISAM models.

Naveen Jakhar et al, Proposed a paper "AI and Image Recognition",This paper introduce an AI driven indigenous, innovative and plug and play solution relying on Real Time Image recognition and Video .This project utilizes the existing CCTV camera for taking the feed of any CCTV camera installed at public places, identifies all the persons frame by frame through Image/Video processing and utilises the

potential of Artificial Intelligence, the Engine calculates the Real Time distances among all the persons and raises alarm if the distance between any two persons goes below permissible Social Distance limit and also checks whether a person is wearing Face Mask or not, it also provides a check on the number of persons.

Mohan Raj et al Proposed a paper Detecting human beings accurately in a surveillance video".By using Spatiotemporal Filtering.A review of Detecting human beings accurately in a surveillance video is one of the major topics of vision research.

Prasad Mukesh et al,Proposed a real-time monitoring crowd density combined video surveillance system with GIS.This paper designs a system framework of real-time monitoring crowd density combined video surveillance system with GIS.

Julian Balcerek et al Proposed a paper "Visualization techniques to support CCTV operators of smart city services ".By using cylindrical panoramas in order to make long-time video content analysis of a defined area easier and faster. The controlled stereovision option is discussed for quicker and more precise extraction of relevant information from the observed scene. And the thermo-vision is analysed for faultless detection of pedestrians at night. And a high dynamic range (HDR) technique is proposed, dedicated to the CCTV systems, for clear visualization of important and meaningful image details.

Chapter 4

Objectives

4.1 Mask Monitoring

-Building a mask/no mask dataset

-Face detector based on pose estimation.

-Tracking

-Distinguish faces with mask/non-mask

4.2 Crowd Controlling and Social Distance Detection

-Train the AI model

-Crowd counting estimation

-Storage and management of crowd estimation results

-Early warning and decision making

Chapter 5

Implementation

5.1 Algorithms

FACE MASK DETECTION

-Install Dependancies

-Dataset Collection

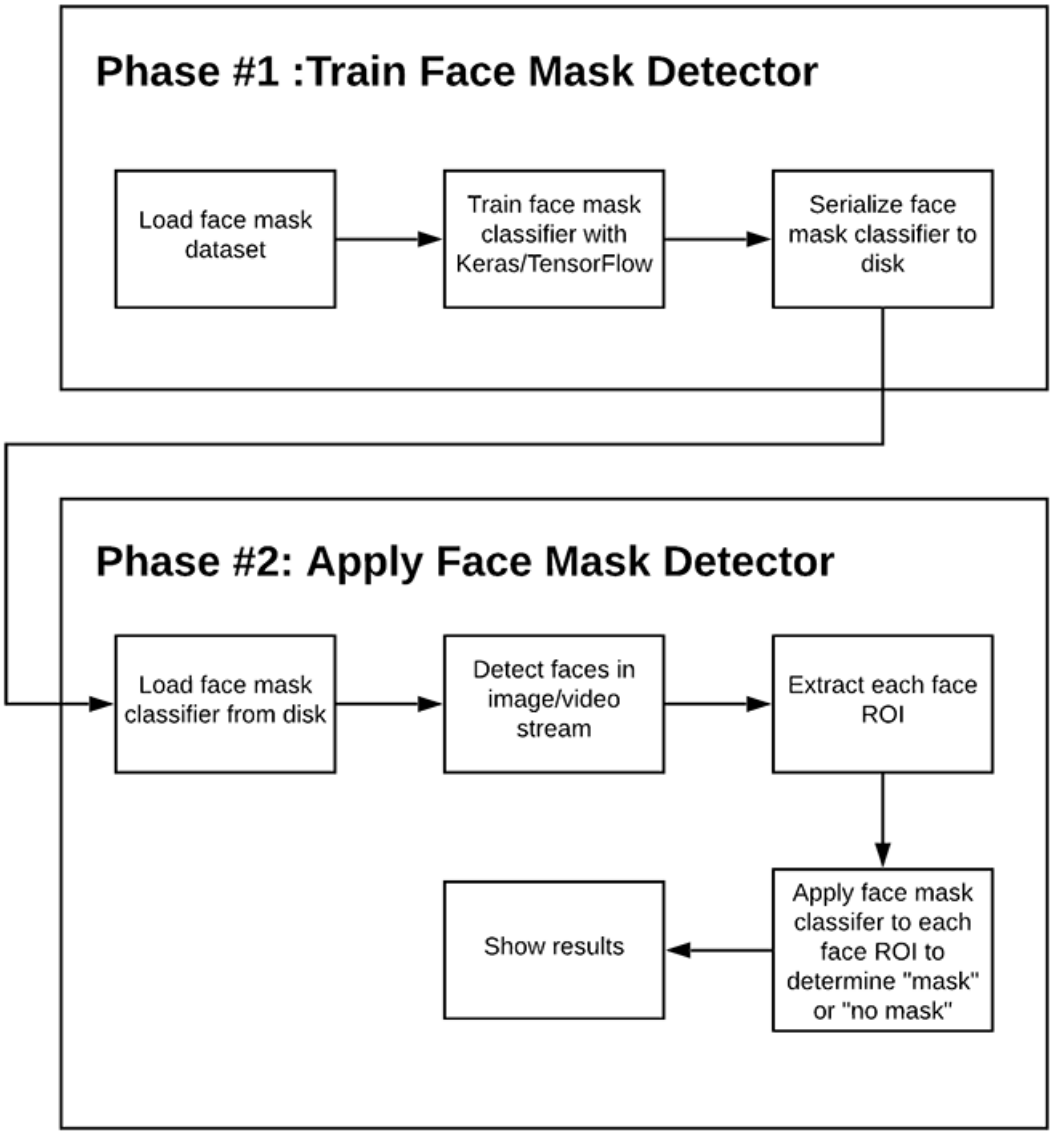
-Data Preprocessing

-Training

-Run and view accuracy

-Use model in Real Time Camera

-Final Result



SOCIAL DISTANCE DETECTION

Yolo Framework Algorithm

YOLO is an abbreviation for the term 'You Only Look Once'. This is an algorithm that detects and recognizes various objects in a picture (in real-time). Object detection in YOLO is done as a regression problem and provides the class probabilities of the detected images.

General steps in the yolo algorithm are:-

-YOLO first takes an input image

-The framework then divides the input image into grids (say a 3 X 3 grid)

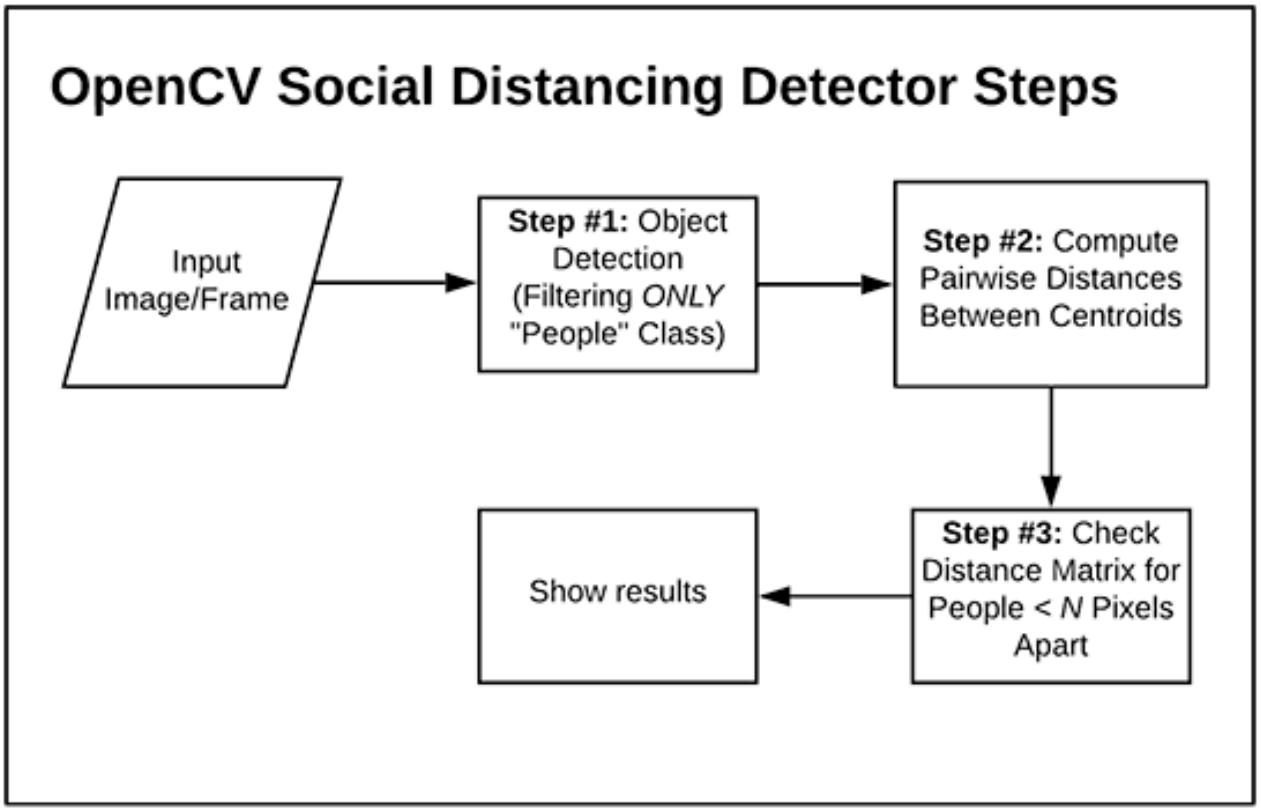
-Image classification and localization are applied on each grid. YOLO then predicts the bounding boxes and their corresponding class probabilities for objects.

In our Project we are mainly using the follwing Three-step Algorithm.

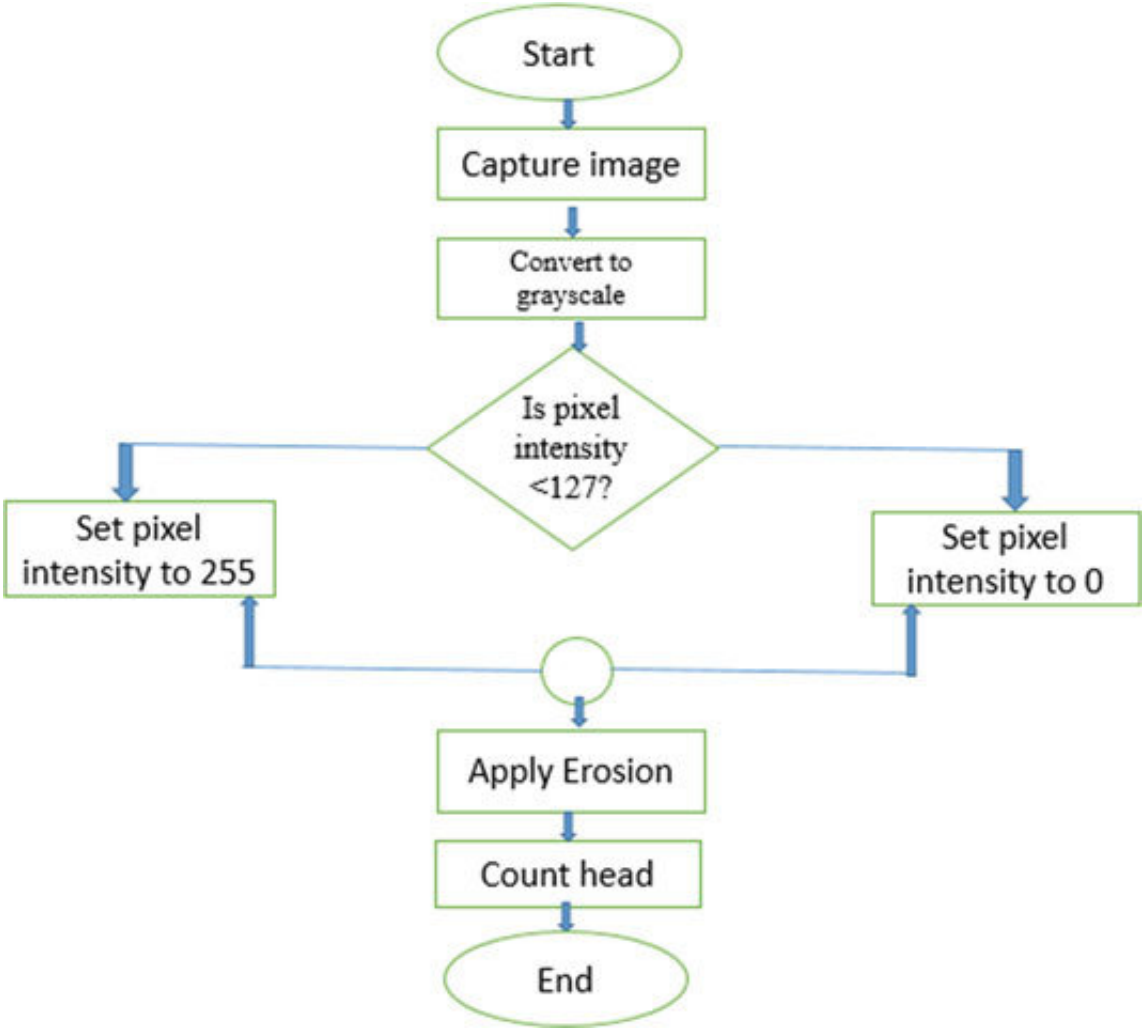
-Setting up the variable names

-Creating the people detection function

-Grab frames from video and make prediction measuring distances of detected people.



CROWD DETECTION



5.2 Methods

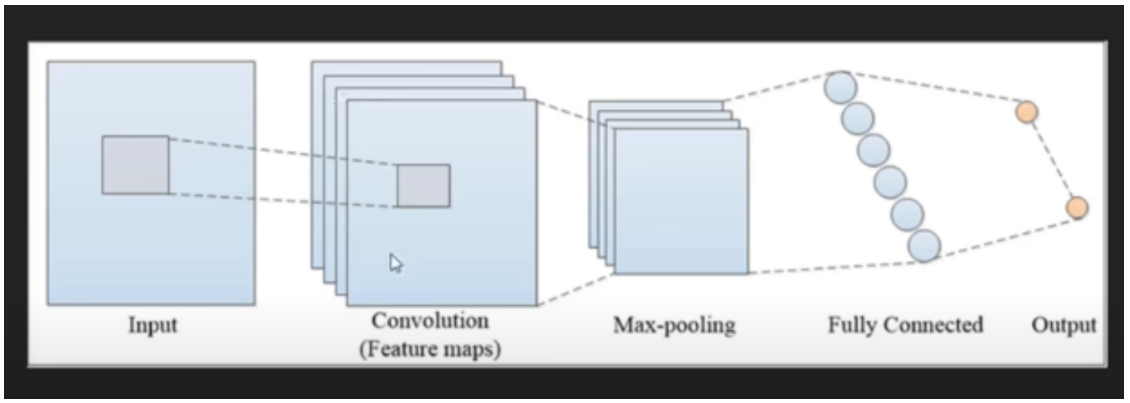
Pose Estimation

Pose estimation is a computer vision technique that predicts and tracks the location of a person or object. This is done by looking at a combination of the pose and the orientation of a given person/object.

LabelBinarizer()

Label Binarizer is an SciKit Learn class that accepts Categorical data as input and

returns an Numpy array.At prediction time, one assigns the class for which the corresponding model gave the greatest confidence. LabelBinarizer makes this easy with the inverse transform method.



ImageDataGenerator()

ImageDataGenerator generates batches of tensor image data with real-time data augmentation.The output images generated by the generator will have the same output dimensions as the input images.

blobFromImage()

blobFromImage creates 4-dimensional blob from image. Optionally resizes and crops image from center, subtract mean values, scales values by scalefactor , swap Blue and Red channels. ... : This is the input image we want to preprocess before passing it through our deep neural network for classification.

5.3 Technologies used

Artificial Intelligence

Artificial intelligence (AI) is intelligence demonstrated by machines, unlike the natural intelligence displayed by humans and animals, which involves consciousness and emotionality. The distinction between the former and the latter categories is often revealed by the acronym chosen. 'Strong' AI is usually labelled as artificial general intelligence (AGI) while attempts to emulate 'natural' intelligence have been called artificial biological intelligence (ABI).

Leading AI textbooks define the field as the study of "intelligent agents": any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals.Colloquially, the term "artificial intelligence" is often

used to describe machines that mimic "cognitive" functions that humans associate with the human mind, such as "learning" and "problem solving".

Deep Learning

Deep learning (also known as deep structured learning) is part of a broader family of machine learning methods based on artificial neural networks with representation learning. Learning can be supervised, semi-supervised or unsupervised. The adjective "deep" in deep learning refers to the use of multiple layers in the network. Early work showed that a linear perceptron cannot be a universal classifier, but that a network with a nonpolynomial activation function with one hidden layer of unbounded width can.

Deep learning is a modern variation which is concerned with an unbounded number of layers of bounded size, which permits practical application and optimized implementation, while retaining theoretical universality under mild conditions. In deep learning the layers are also permitted to be heterogeneous and to deviate widely from biologically informed connectionist models, for the sake of efficiency, trainability and understandability, whence the "structured" part.

Object Detection

Object detection is a computer technology related to computer vision and image processing that deals with detecting instances of semantic objects of a certain class (such as humans, buildings, or cars) in digital images and videos.Well-researched domains of object detection include face detection and pedestrian detection. Object detection has applications in many areas of computer vision, including image retrieval and video surveillance.

It is widely used in computer vision tasks such as image annotation,activity recognition,face detection, face recognition, video object co-segmentation. It is also used in tracking objects, for example tracking a ball during a football match, tracking movement of a cricket bat, or tracking a person in a video.

Digital Image Processing

Digital image processing is the use of a digital computer to process digital images through an algorithm.As a subcategory or field of digital signal processing, digital image processing has many advantages over analog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and distortion during processing.

Since images are defined over two dimensions (perhaps more) digital image processing may be modeled in the form of multidimensional systems.The generation and development of digital image processing are mainly affected by three factors: first,

the development of computers; second, the development of mathematics (especially the creation and improvement of discrete mathematics theory); third, the demand for a wide range of applications in environment, agriculture, military, industry and medical science has increased.

OpenCV

OpenCV (Open Source Computer Vision Library) is a library of programming functions mainly aimed at real-time computer vision.Originally developed by Intel, it was later supported by Willow Garage then Itseez (which was later acquired by Intel). The library is cross-platform and free for use under the open-source Apache 2 License. Starting with 2011, OpenCV features GPU acceleration for real-time operations.

OpenCV is written in C++ and its primary interface is in C++, but it still retains a less comprehensive though extensive older C interface. All of the new developments and algorithms appear in the C++ interface. There are bindings in Python, Java and MATLAB/OCTAVE. The API for these interfaces can be found in the online documentation.Wrappers in several programming languages have been developed to encourage adoption by a wider audience. In version 3.4, JavaScript bindings for a selected subset of OpenCV functions was released as OpenCV.js, to be used for web platforms.

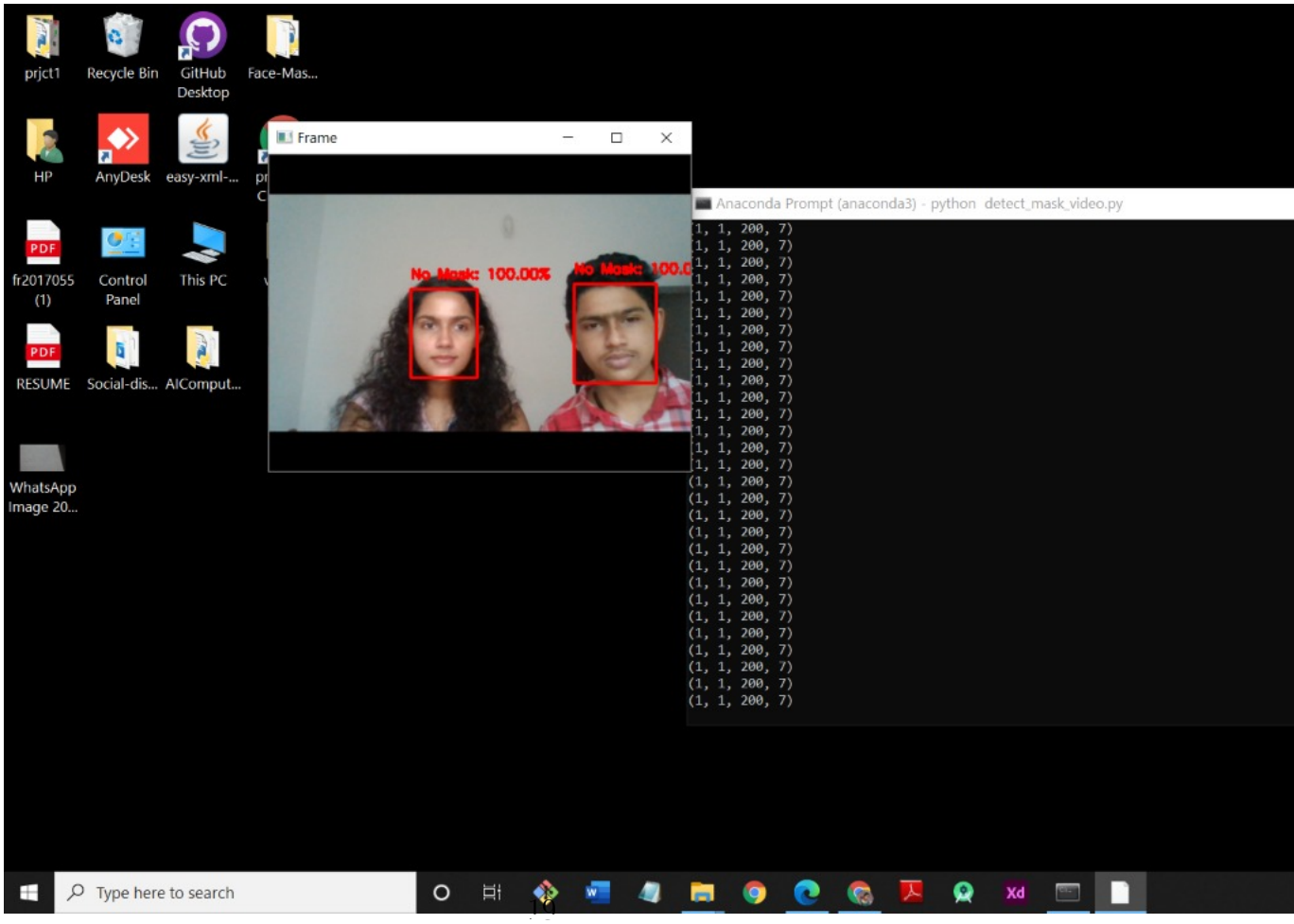
MobileNet

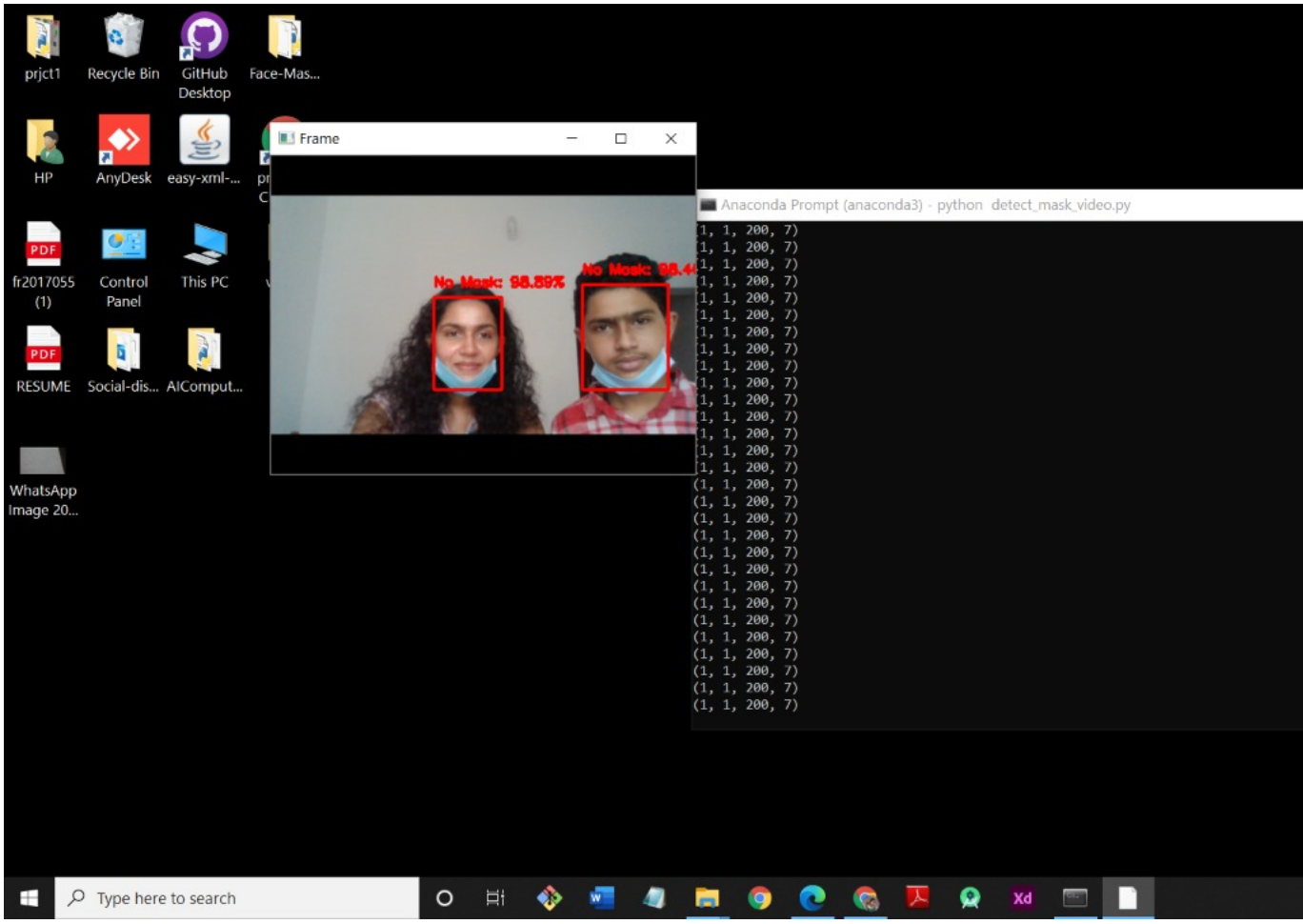
MobileNet is a streamlined architecture that uses depthwise separable convolutions to construct lightweight deep convolutional neural networks and provides an efficient model for mobile and embedded vision applications.MobileNet uses depthwise separable convolutions. It significantly reduces the number of parameters when compared to the network with regular convolutions with the same depth in the nets. This results in lightweight deep neural networks. A depthwise separable convolution is made from two operations.

Chapter 6

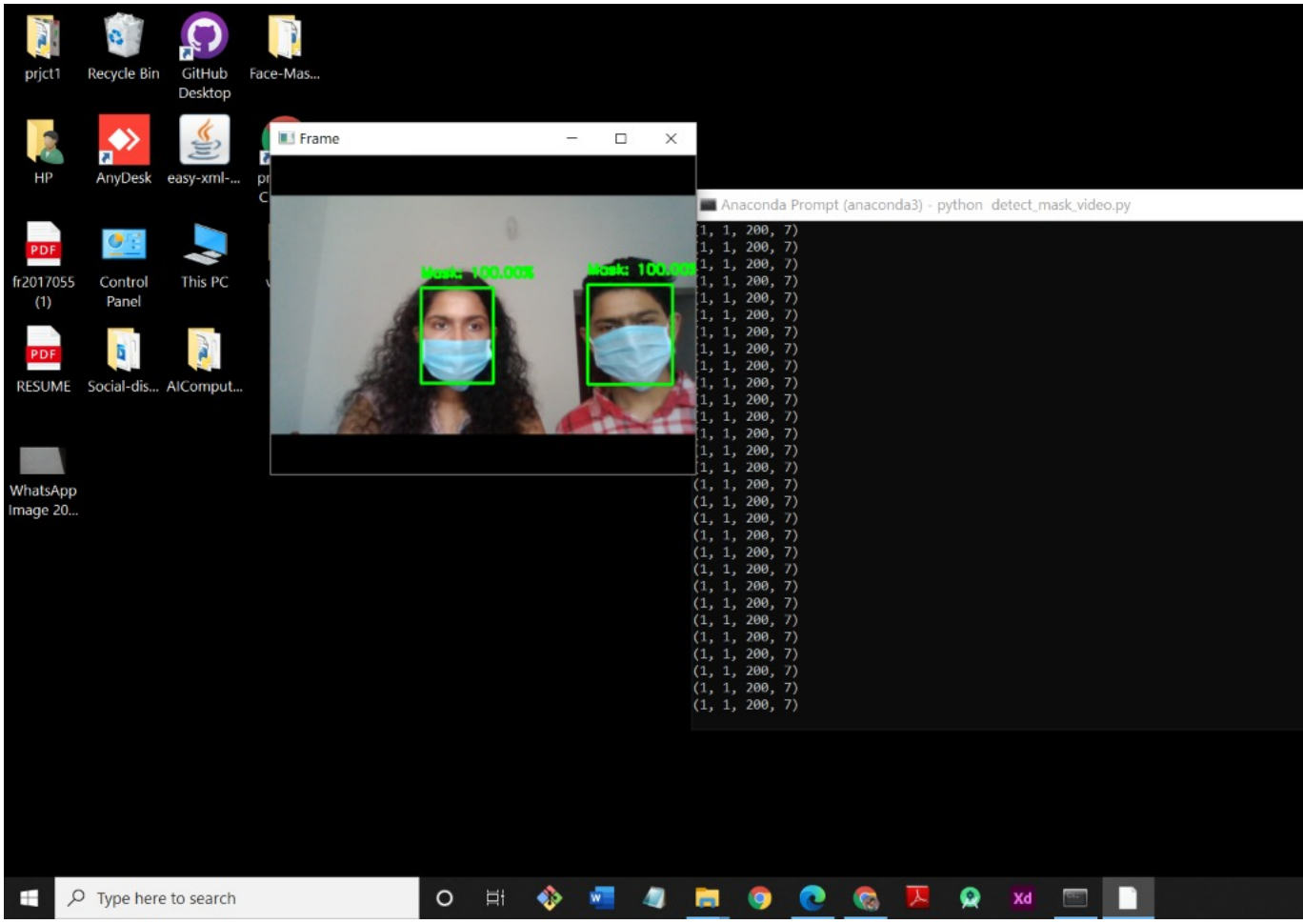
Experimental Results and Discussion

6.1 Face Mask Detection





In this case we can see that even if the masks are present in the face the system will not detect it and mark it as "No Mask" because it is inappropriately weared.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Anaconda Prompt (anaconda3) - python detect_mask_video.py
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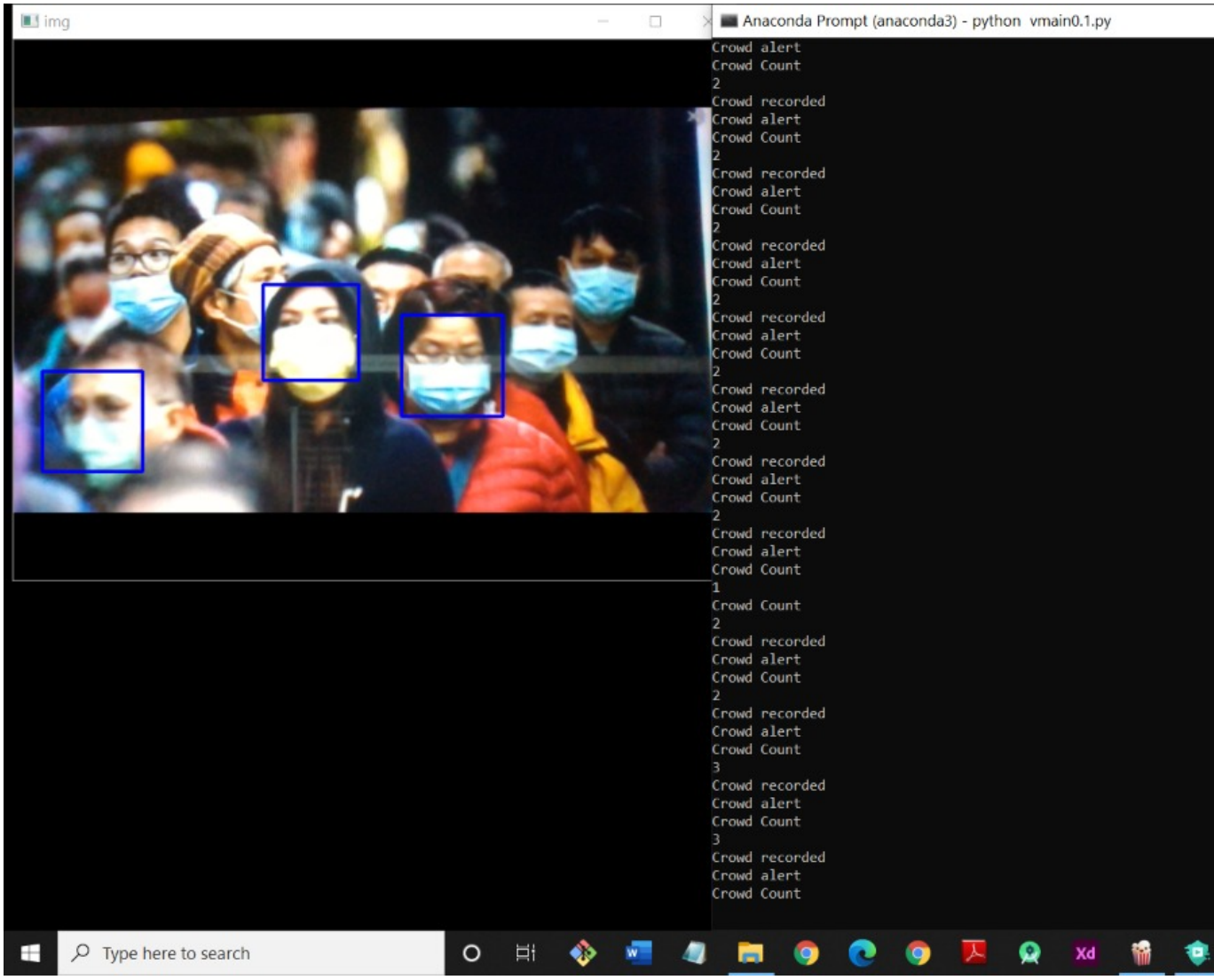
6.2 Social Distance Detection

INPUT

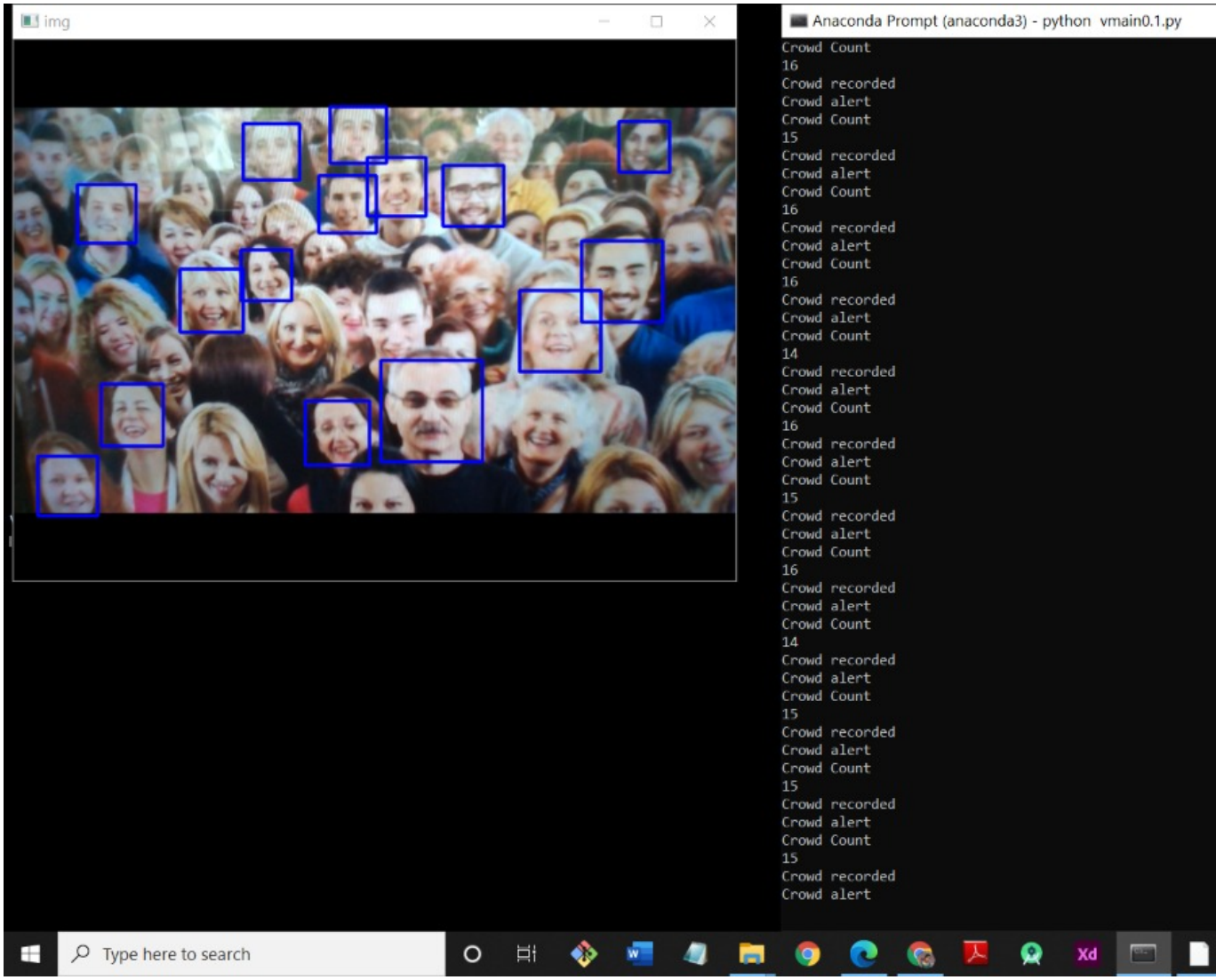
OUTPUT

Each person in the video frame is marked as "Green" only if he/she is more than 2-metre distant from all other persons.Else he/she is marked as "Red".

6.3 Crowd Detection



We have devepoled this to get a rough count of persons in the image/video frame to detect whether crowd is present or not.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Chapter 7

Conclusion

This System presents a people counting system as a way to manage crowds by keeping the count of people. Keeping in mind the Pandemic situation Mask-Detection feature is added if the count exceeds the prohibited count or if the model recognizes whether people are not wearing masks then the alarm gets alerted. This system will reduce the time taken for humans for counting or checking purposes and ensure them, this work is done by the system itself in no time. By this model human errors will be reduced to great extents as the system itself gets trained through large datasets. This process requires comparatively less time and provides great accuracy. As the system trains itself by doing the same tasks of mask detection so that there is less loss and provides a better accuracy. As this system is still under progress so we can't predict accurate accuracy but it offers better accuracy. By this, we can reduce the impact of COVID-19.

Chapter 8

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