# AI Powered Social Distancing Surveillance System in Office and Public Places

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of
the Degree of Bachelor of Technology in Information and Communication Technology

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AI Powered Social Distancing Surveillance System in Office and Public Places

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# Declaration

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I hereby declare that the project work entitled **"Project Title : AI Powered Social Distancing Surveillance System in Office and Public Places"** is an authentic record of my own work carried out as a part of Hackathon COVID19 activity and requirement of B. Tech dissertation for the award of **Bachelor of Technology in Information and Communication Technology**. I have duly acknowledged all the sources from which the ideas and extracts have been taken. The project is free from any plagiarism and has not been submitted elsewhere for any degree, diploma and certificate.

Signature:.....

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# Abstract

Social-distancing is an important way to slow down the spread of infectious diseases. People are asked to limit their interactions with each other, reducing the chances of the disease being spread with physical or close contact. In the past decade, AI/Deep Learning has shown promising results on several daily life problems. Various daily life tasks have been automated with the help of AI. In this report we will go through in detail as to how can one use python combined with deep learning and computer vision to monitor social distancing. The proposed framework utilizes the YOLO v3 object detection model to detect humans in a video frame and then transforming that video frame to bird's eye view for precise measurement of distance between two persons. This framework also proposes different features for different environments where the system is deployed like keeping track of the areas where people gather more often, notifying people at the end of the day in private workplaces if they do not maintain social distancing etc.



keywords – YOLO v3, Human detection, Bird's eye view transformation, Social Distancing, Post data analysis

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# Chapter 1

# Introduction

COVID-19 belongs to the family of corona-virus caused diseases, initially reported at Wuhan, China, during late December 2020. Several healthcare organizations, medical experts and scientists are trying to develop proper medicines and vaccines for this deadly virus, but till date, no success is reported. This situation forces the global community to look for alternate ways to stop the spread of this infectious virus. Social distancing is claimed as the best spread stopper in the present scenario, and all affected countries are locked-down to implement social distancing. This project is aimed to monitor and somehow maintain social distancing in several environments using the power of AI and Computer-Vision.

## 1.1 Problem statement

AI powered social distancing surveillance system in Office and Public places.

## 1.2 Motivation

Social distancing is claimed as the best spread stopper in the present scenario, and all affected countries are locked-down to implement social distancing. The word social distancing is best practice in the direction of efforts through a variety of means, aiming to minimize or interrupt the transmission of COVID-19. It aims at reducing the physical contact between possibly infected individuals and healthy persons. As per the WHO norms it is prescribed that people should maintain at least 6 feet of distance among each other in order to follow social distancing. As it is hard for a human to manually monitor social distancing at different places, AI could be used to solve this problem effectively.

## 1.3 Literature review

Since the novel corona-virus pandemic began, many countries have been taking the help of technology based solutions in different capacities to contain the outbreak. In India, the government is using the Arogya-Setu App, which worked with the help of GPS and Bluetooth to locate the presence of COVID-19 patients in the vicinity area. It also helps others to keep a safe distance from the infected person. On the other hand, some law enforcement departments have been using drones and other surveillance cameras to detect mass gatherings of people, and taking regulatory actions to disperse the crowd. Such manual intervention in these critical situations might help flatten the curve, but it also brings a unique set of threats to the public and is challenging to the workforce.

Human detection using visual surveillance system is an established area of research which is relying upon manual methods of identifying unusual activities, however, it has limited capabilities. In this direction, recent advancements advocate the need for intelligent systems to detect and capture human activities.

Object detection problems have been efficiently addressed by recently developed advanced techniques. Using pre-trained object detection models like YOLO v3 one can easily detect humans in images.

There are several methods to measure distance between detected humans like directly measuring pixel wise distance and using bird's eye view transformation for distance measurement more precisely. In these methods calibration of the distance is required.

## 1.4 Plan of execution

1. **Project Planning and Project Setup**: Determined the Requirements and Goals of the project. Requirements are robust pre-trained model for human detection, several appropriate videos to work on and methods to measure precise distance between to humans. Goal is to monitor social distancing in several environments.

2. **Data Collection**: Videos were collected from Oxford Town Centre dataset and PETS2009 dataset.

3. **Implementation of proposed method**: YOLO v3 is used for human detection, Open-CV is used to transform the video frame in the bird's eye view, Euclidean distance is used to measure the distance between two humans.

4. **Model Testing**: It was tested on an another video other than video used for implementation time and it showed better results.

# Chapter 2

# Experimental Methods and Results

In this chapter, we have described Methods, Algorithm and Results of our proposed solution to monitor and maintain social distancing using AI and Computer-Vision.

## 2.1 Methods

**Model selection**: We have used the YOLOv3-416 which has a mAP (detector performance on a validation set) of 55.3, which is quite strong, and an execution speed of 35 FPS.

**People detection** Load and start the model: Open-CV is used to load and start the model for people detection.

Pass every frame through the model and get Bounding boxes coordinates of each object, The confidence of each prediction (0 to 1), Class of the prediction (0 to 90) .Filter out weak predictions and non-relevant objects. One of the many classes detected by the model is a person. The class associated to a person is 1. In order to exclude both weak predictions (threshold : 0.65) and all other classes of objects except from person, we used an if statement combining both conditions to exclude any other object from further computation.

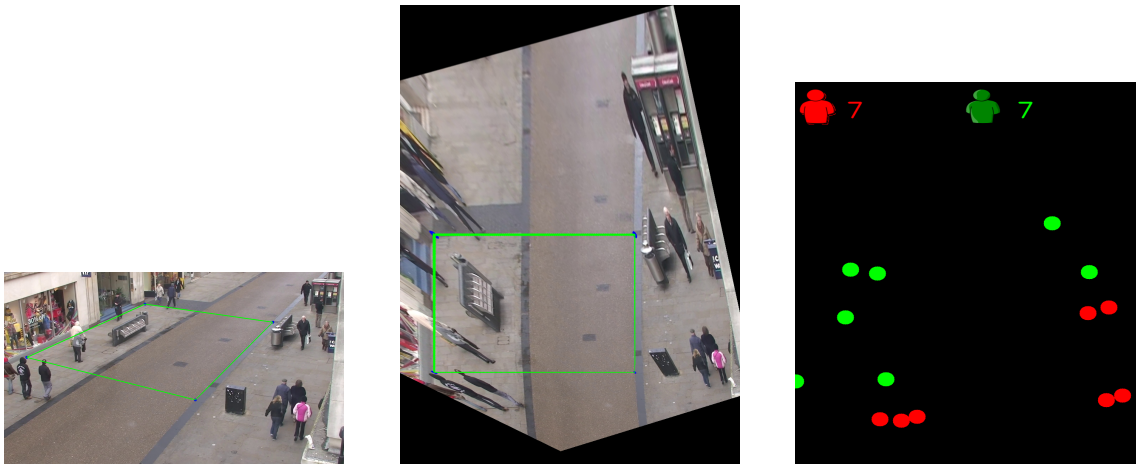


Figure 2.1: 1. Points selection 2. Bird's eye-view transformation 3.Final result

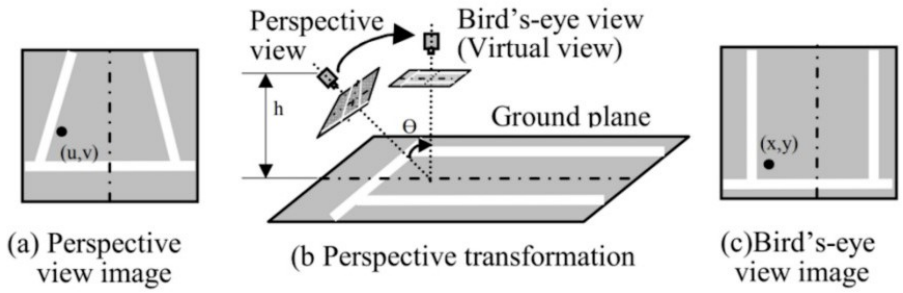


Figure 2.2: Illustration of perspective transformation in a street or road scene

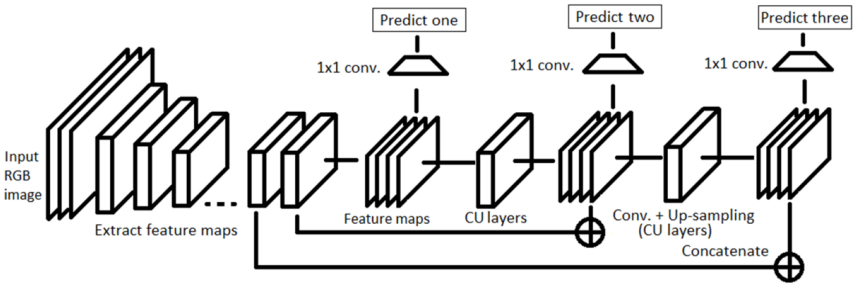


Figure 2.3: Schematic representation of YOLO v3 architecture

## 2.2 Algorithm

1. First, pick the 4 (fig 2.1 1) corner points manually in the video frame and apply the perspective transformation (fig 2.1 2) to get a bird's view(fig 2.2) of the video frame and save the transformation matrix.
2. Using YOLO v3 (fig 2.3), detect humans in the video frame and obtain the bounding boxes of detected people in the original video frame.
3. Using the bounding box, coordinates of lowest point of the bounding box which is the middle of two legs is obtained.
4. Using the transformation matrix, these points are transformed to plot the human location on the bird's eye view.
5. Euclidean distance function is then used to measure the distance between two person in the video frame.
6. If a social distancing violation is detected (less than 6 feet), the bounding box and point in the bird's eye view are marked red (fig 2.1 3).

## 2.3 Results

Here is the result of the proposed method. We can see 13 people are violating social distancing and 11 people are maintaining social distancing.

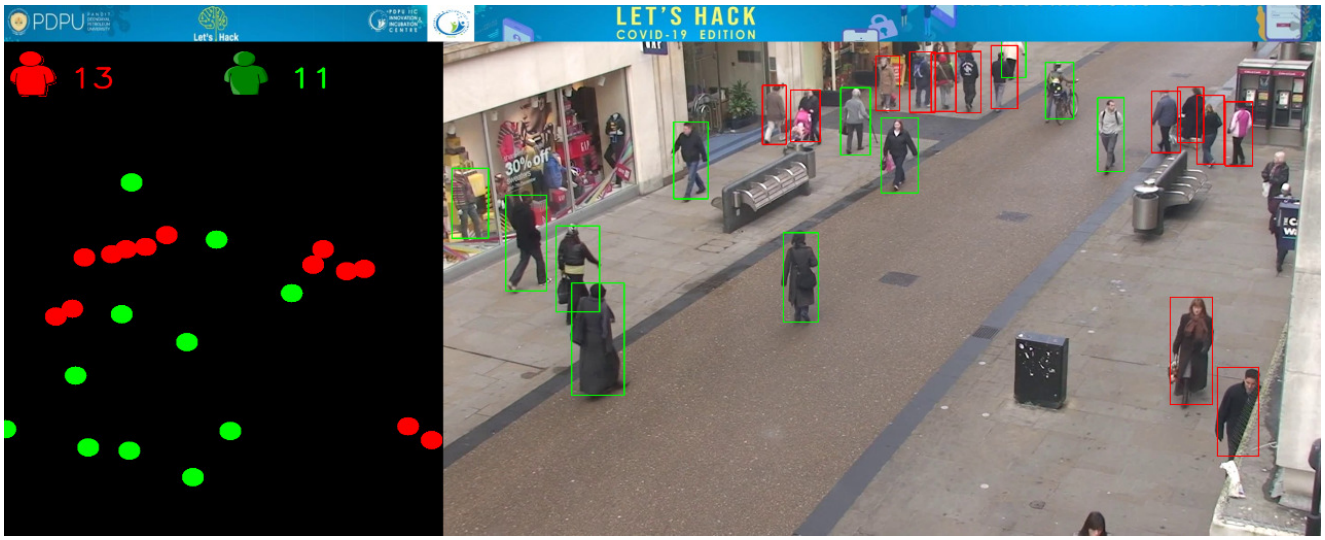


Figure 2.4: Final Result

# Chapter 3

# Discussion and conclusion

Nowadays, social distancing along with other basic sanitary measures are very important to keep the spread of the COVID-19 as slow as possible. The project proposes an efficient real-time deep learning based framework to automate the process of monitoring the social distancing via object detection, where each individual is identified in the real-time with the help of bounding boxes. The generated bounding boxes aid in identifying the clusters or groups of people satisfying the closeness property computed with the help of bird's eye view transformation and euclidean distance approach.

I am well aware that this project is not perfect so these are a few ideas how this application be improved :

- Using a faster model in order to perform real-time social distancing analysis robustly.
- Use a model more robust to occlusions.
- Automatic calibration is a very well known problem in Computer vision and could improve a lot in bird's eye view
- Effective Transformations for different environments like ground with different levels.

# Appendix

As the code is larger in size, here is the link to the **GitHub** repository:
`https://github.com/Vatsalparsaniya/Social-Distance-Surveillance`

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