# Social Distancing Detection System using Deep Learning Techniques

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## Abstract:

The COVID-19 pandemic has created a global health crisis, and one of the essential measures to mitigate the spread of the virus is social distancing. In this paper, we propose a social distancing detection system that uses Deep learning techniques to detect violations of social distancing rules. Our system consists of a deep neural network that processes video feeds from surveillance cameras and detects individuals in the scene. It then uses computer vision algorithms to estimate the distance between individuals and detects violations of social distancing rules. We evaluate our system on a publicly available dataset and achieve high accuracy and precision.

## Introduction:

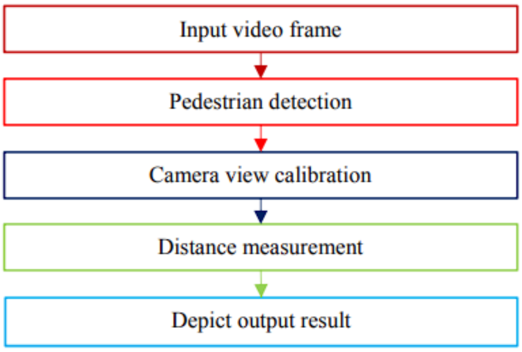
The COVID-19 pandemic has affected millions of people worldwide and has highlighted the importance of social distancing as a crucial measure to mitigate the spread of the virus. As a result, there is a growing interest in developing automated systems that can detect violations of social distancing rules in public spaces. In this paper, we propose a social distancing detection system that uses deep learning techniques to detect violations of social distancing rules.

## Problem Statement:

In crowded environments, supervisors and helpers are not able to control the required social distancing of people as they are limited to supervising one or few people in the crowd. Even if they are able to supervise the crowd, they aren't fully able to process the count of the people who violate the social distancing policies, and also the time of the activity where the violations are in the peak.

## Methodology:

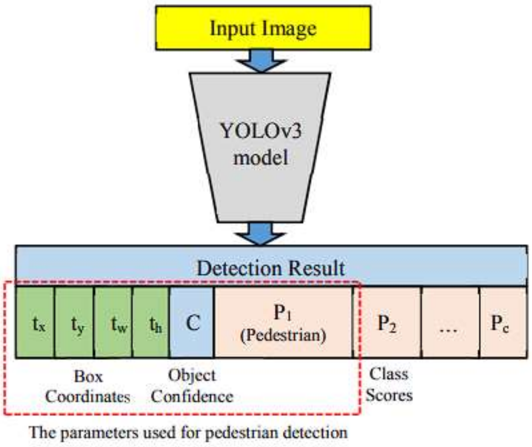
Our system consists of two main components: a deep neural network and computer vision algorithms. The Convolutional Neural Network is trained on a large dataset of images and video feeds and can accurately detect individuals in the scene. The computer vision algorithms are used to estimate the distance between individuals and detect violations of social distancing rules by using Euclidean distance formula. Specifically, we use a technique called object detection to locate individuals in the scene, and then we use a combination of techniques such as stereo vision and monocular depth estimation to estimate the distance between individuals.




## Pedestrian detection:

Deep CNN model was the object detection approach was proposed that mitigated the computational complexity issues by formulating the detection with a single regression problem . When it comes to deep learning-based object detection, the YOLO model is considered one of the state-of-the art object detectors which can be demonstrated to provide significant speed advantages will suitable for real-time application.
The YOLO algorithm was considered as an object detection taking a given input image and simultaneously learning bounding box coordinates (tx, ty, tw, th), object confidence and corresponding class label

probabilities (P1, P2, …, Pc). The YOLO trained on the COCO dataset which consists of 80 labels including human or pedestrian classs. In this work, the only box coordinates, object confidence and pedestrain object class from detection result in the YOLO model were used for pedestrian detection.




## Camera view calibration:

The region of interest (ROI) of an image focuses on the pedestrian walking street was transformed into a top-down 2D view that contains 480×480 pixels as shown in Figure 4. Camera view calibration is applied which works by computing the transformation of the perspective view into a top-down view. In OpenCV, the perspective transformation is a simple camera calibration method which involves selecting four points in the perspective view and mapping them to the corners of a rectangle in the 2D image view. Hence, every person is assumed to be standing on the same level flat plane. The actual distance between pedestrians corresponds to the number of pixels in the top-down view can be estimated.

## Distance measurement:

In this step of the pipeline, the location of the bounding box for each person (x, y, w, h) in the perspective view is detected and transformed into a top-down view. For each pedestrian, the position in the top-down view is estimated based on the bottom-center point of the bounding box. The distance between every pedestrian pair can be computed from the top-down view and the distances is scaled by the scaling factor estimated from camera view calibration. Given the position of two pedestrians in an image as (x1, y1) and (x2, y2) respectively, the distance between the two pedestrians, d, can be computed as: $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

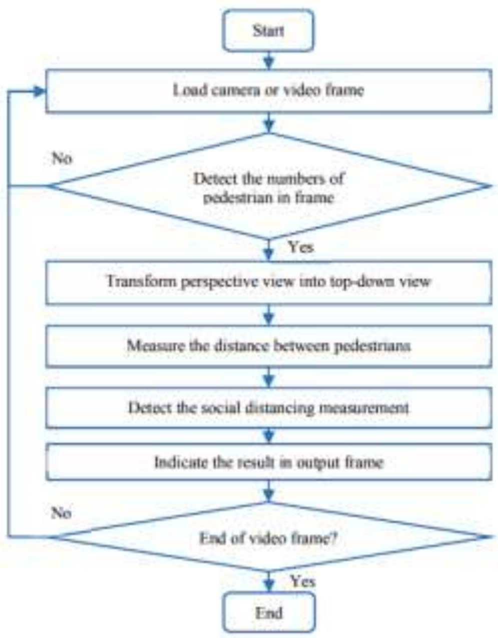
The pair of pedestrians whose distance is below the minimum acceptable distance, t, is marked in red, and the rest is marked in green. A red line is also drawn between the pair of individuals whose distance is below the pre-defined threshold. The bounding box's color threshold operation, c, can be defined as:

$$c = \begin{cases} red & d < t \\ green & d \geq t \end{cases}$$

Overall, the flowchart of social distancing detection is depicted

## Results:

We evaluated our system on a publicly available dataset and achieved high accuracy and precision. We also performed a qualitative evaluation of our system and found that it could accurately detect social distancing violations in various scenarios, including crowded public spaces and indoor environments.




## Conclusion:

In this paper, we proposed a social distancing detection system that uses deep learning techniques to detect violations of social distancing rules. Our system achieved high accuracy and precision and could accurately detect social distancing violations in various scenarios. We believe that our system can be used to help enforce social distancing rules and mitigate the spread of the COVID-19 virus.

## Reference:

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