Real time pedestrian detection (social distancing)

Harshitha Vuucha 20BEE0317

Ancha Yohitha Sai 20BEE0035

Shiva Ramakrishna Y 20BCE2864

***Abstract*:**

The year of 2020 saw the arrival of the Coronavirus(COVID-19) which affected the entire world resulting in a global pandemic. The need to prevent overcrowding and follow social distancing (SD) increased. This real-time pedestrian detection algorithm provides the data/statistics on the number of people at a location in real time which could assist authorities in regulating crowds in the cases where pedestrians per region exceed the optimum number. Deep learning (DL), Convolutional neural networks (CNN) and Transfer learning (TL) were implemented through Jupyter notebook, Open CV, NumPy, Computer Vision, SciPy etc. creating a reliable pedestrian detection system. The YOLO (You Only Look Once) is the real time object detection method used with the COCO dataset.

Keywords :

SD - Social Distance

COVID-19 – Coronavirus

DL - Deep learning

CNN – Convolutional Neural Network

TL -Transfer Learning

I. INTRODUCTION

With recent relaxation of lockdowns and curfews, there has been a steep rise in violations of social distancing norms by the general public. This can further endanger more people and assist in drastically increasing the spread of the Coronavirus. There is also a physical limit as to how much authorities can mitigate and control the situation and having a viable automated system to facilitate easy detection of violations could greatly improve the present scenario. This is where the real time pedestrian detection system comes into play.

CCTV cameras placed in choice locations like near traffic signals, malls and other generally crowded regions can be programmed with this algorithm to demarcate the pedestrians infringing social distancing and provide the total sum of violations in a given region will permit the authorities to quickly and effectively diffuse situations.

In real world applications, the input file in our algorithm can take the form of a live feed/ real time video footage from CCTVs, but for the sake of testing this program we will be using pre-recorded mp4 video files of a crowded regions in our demo. We have understood and verified the results of the algorithm with images in order to see how we can apply each module framewise as well with video files.

II. LITERATURE REVIEW

S.No	Title of the resource (journal paper/conference paper/ title of the web page)	Year	Journal name/ Conference title/ Website link	Methodology (Key algorithms / approach)	Performance metrics	Data set / Data used in the resource	Evaluation observations/ Comments
1	A Vision based Social Distancing and Critical Density Detection System for COVID-19	2021	Journal Name : Sensors https://www.mdpi.com/1424-8220/21/13/4608	Object detection with CNN in region of interest (ROI), interpersonal distances in real time, Faster R-CNN and YOLOv4	Accuracy: (BB= Bounding Box) End-to-end CNN : 79.71 BB-center :79.41 BB-bottom :92.80	Oxford Town Center Dataset, Mall Dataset and Train Station Dataset	
2	Monitoring social distancing through human detection for preventing/reducing COVID spread	2021	International Journal of Information Technology https://link.springer.com/article/10.1007/s41870-021-00658-2#Abs1	CNN object detection, centroid coordinate value	2 different CNN models with different parameters proposed. Accuracy: Model 1: 97% Model 2:98.50%	INRIA Person Dataset	
3	A deep learning based social distance monitoring framework for COVID-19	2020	Journal: Elsevier Public Health Emergency Collection	YOLOv3 object recognition paradigm, Transfer Learning, Euclidean distance, centroid	For 50 epochs: accuracy of around 95%	Overhead view dataset	
4	Person Detection for Social Distancing and Safety Violation Alert based on Segmented ROI	2020	Conference: 2020 10th IEEE International Conference on Control System, Computing and Engineering	MobileNet SSD Caffe model, center point of bounding box, Masked ROIv	Accuracy of alert: Self-taken: 100% CamNeT: 95.8%	COCO dataset	

III. PROPOSED METHOD

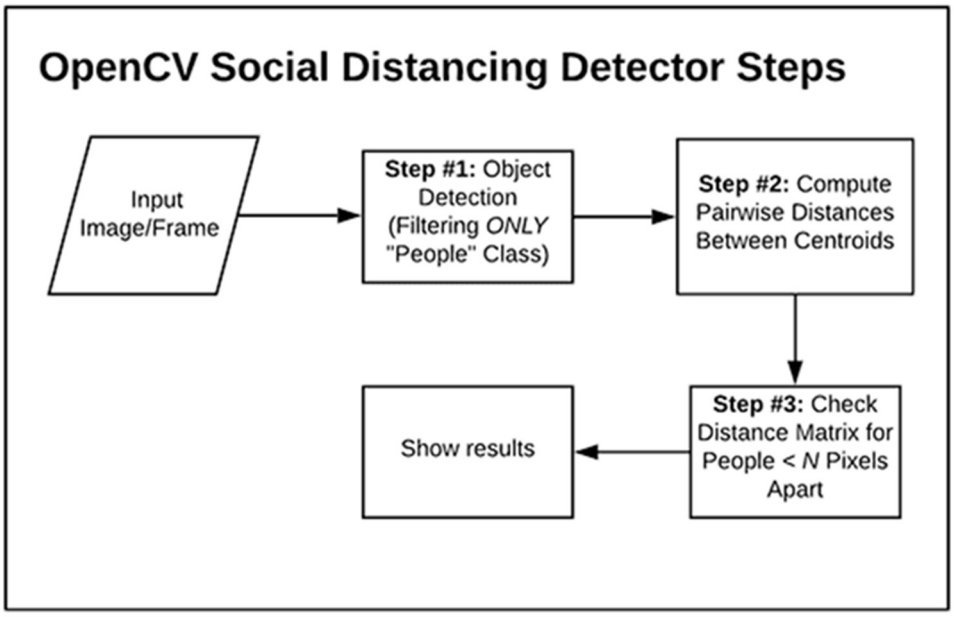


Fig 1. Block Diagram

1 .Pre-processing technique

The pre-processing of the images is taken care of by the YOLO object detector. Loading the images, resizing, storing in an array, scaling pixels and normalization is all done to the images before the actual object detection takes place.

2.Object detection :

We used the YOLO object detector which was trained on the COCO dataset to detect the pedestrians. We took the dimensions of the frame and passed the image object detector YOLO which gave an output image with a bounding boxes around the people.

3.Object Tracking:

Once the video file is taken as input, each person is detected in each frame. As we go from frame to frame, the pedestrians are tracked and the distance of an individual between frames is checked to make sure two people in less proximity to each other are not indexed as a single person.

4.Distance Measurement:

The centroids of the bounding boxes were taken and the pairwise distance amongst the pedestrians was calculated and stored in a list

5.Social Distance Violation:

We set a minimum distance value in case of a social distance violation and checked if the Euclidian distance between any of the pedestrians, stored as a pairwise distance list, fell beneath the minimum requirement or not. If any value did, then those individuals would be demarcated in red while the ones who adhere to social distancing are highlighted in green.

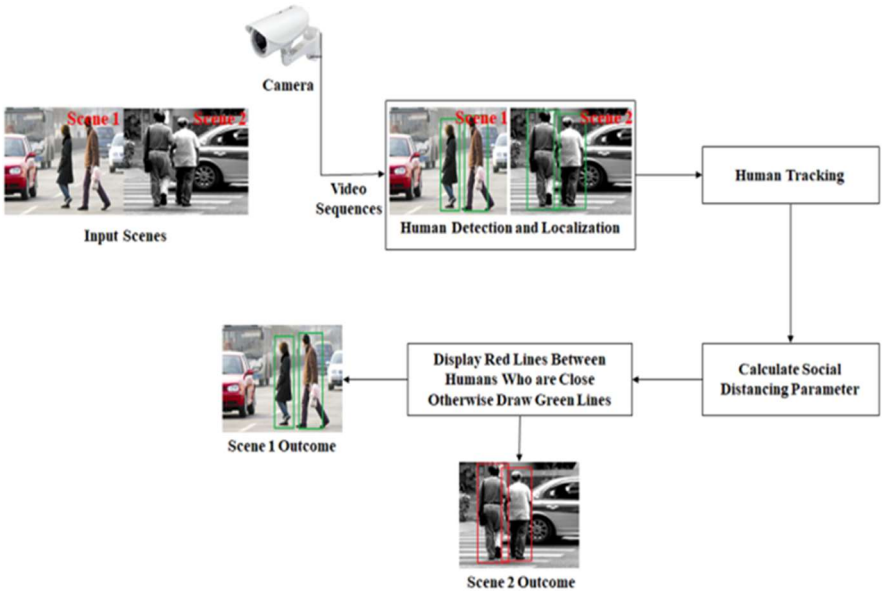


Fig 2. Pictorial representation of block diagram

IV. RESULTS AND ANALYSIS

Original Image:

Image -1

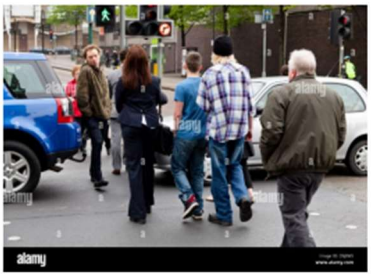
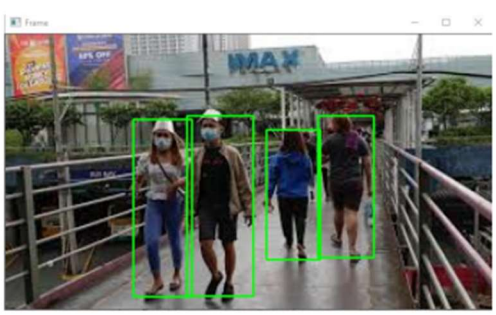
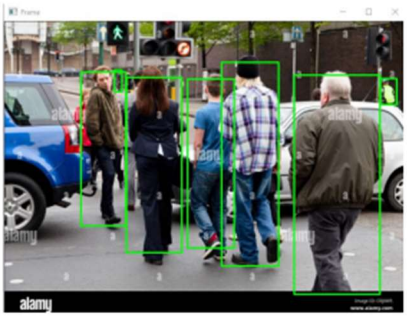


Image – 2

1 . Object Detection:

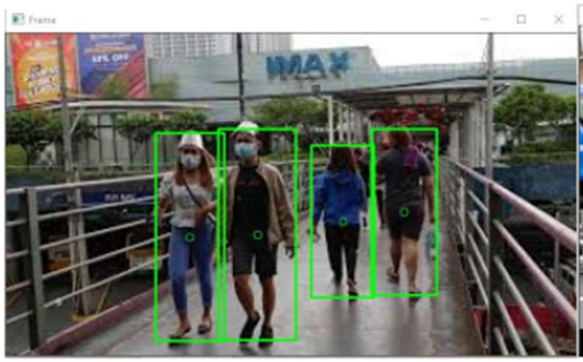


Object dedection of image -1



Object dedection of image -2

2 . Distance Measurement:



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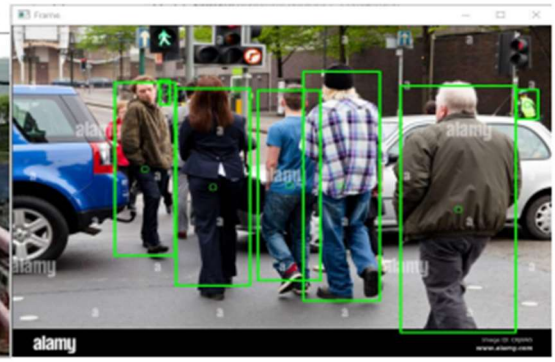
 [106.21205205 188.95766722   0.          75.95393341]
 [182.16476059 264.82069406  75.95393341   0.        ]]
```



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  332.02409551 215.33694527]
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  426.35431275 158.61904047]
 [188.663722    92.34717104   0.         256.32206304 410.706708
  504.80293185 120.83045974]
 [ 68.00736254 167.01197562 256.32206304   0.         155.23208431
  270.60118255 270.51247661]
 [222.10857944 319.81244504 410.706708   155.23208431   0.
  183.96195259 420.47592083]
 [332.02409551 426.35431275 504.80293185 270.60118255 183.96195259
    0.         469.38470363]
 [215.33694527 158.61904047 120.83045974 270.51247661 420.47592083
  469.38470363   0.        ]]
```
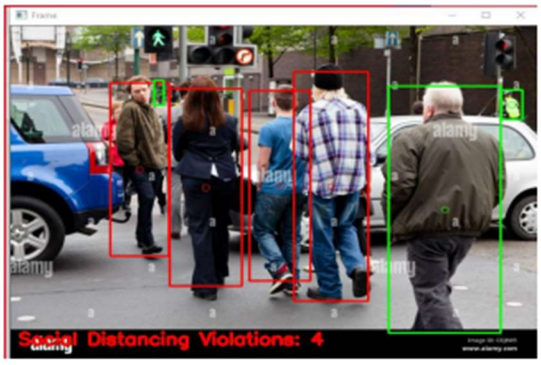

Distance measurement of Image – 1

Distance measurement of Image - 2

3 . Social Distance Violation :



Social distance violation in Image – 1

Social distance violation in Image - 2

Limitations:

Though this system helps us to detect the violations of social norms, some limitations in this type of area can occur especially if :

A low resolution camera is used which may result in bad image quality.

A device with low graphics processing unit is used which may lead to slower object detection process.

When two or more people walk/stand close to each other it can become difficult for the algorithm to detect it correctly which results in a generating a bigger box and interpret it as a single object.

V. CONCLUSION

The overall system never stores personal information. Only the processed average results, such as the number of violations and pedestrian density, are stored. This is more helpful in crowded places such as malls, roads, restaurants. etc. to monitor social distancing.

From the results we can clearly see that the YOLO object detector was accurate in detecting the pedestrians and the algorithm does catch the social distancing violations up to a certain degree of accuracy although there are some limitations in terms of the angle of the CCTV placement and how the distance is viewed from that perspective but that can be neutralized by setting the right minimum distance for social distancing violation values.

Video Drive Link:

https://drive.google.com/file/d/1oCWoFohLVVph0JIh_snS2fTPYq1WipiT/view?usp=sharing

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