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Social Distancing Detector using Deep Learning

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***Abstract*: Social Distancing is the best possible way to detain the spread of Covid-19. Even though vaccine has been found and working effectively in saving the lives of people, social distancing is necessary to reduce the spread of virus to maximum extent which not only saves people from being infected but also reduces the impact of spreading of the disease. In our proposed system, we use Deep Learning with python to monitor social distancing in public places. This is a software tool that monitor if people are maintaining proper social distancing norms or not by analyzing real time video streams from CC camera. We use YOLO Model which is trained by COCO dataset.**
Keywords: Social Distancing, Deep Learning, YOLO, COCO.

I. INTRODUCTION

Covid-19 is the scientific name of corona virus. Till now around 27 crore people were affected by this pandemic including 5 Lakh deaths as per WHO statistics. This disease is considered as a pandemic when it is spread to different countries and caused fatalities. The spread of disease is due to the contact of infected persons with other persons. So, to detain the spread of virus we require an effective monitoring system which monitors people in public places. Monitoring social distancing is very tedious if done manually as it is difficult to monitor continuously by human naked eye. So this is implemented automatically by our software tool which not only monitors people but also highlight the persons who are violating social distancing norms with red color boxes. We use CCTV cameras for automatic monitoring of people.

This toolcan be used in places like Airport, malls etc. The need for developing this tool is to help people and the government to identify and alert people who are being the main cause for the spread of epidemic.Deep learning, a subset of artificial intelligence, has shown remarkable capabilities in various applications, including computer vision. By training neural networks on large datasets, deep learning models can learn intricate patterns and features from visual data, making them well-suited for tasks like object detection and recognition. In the context of social distancing, deep learning algorithms can be trained to detect individuals in crowded scenes and analyze their spatial relationships. This involves identifying people and estimating the distances between them accurately. By employing convolutional neural networks (CNNs) and other deep learning architectures, researchers and developers have made significant strides in creating robust social distancing detection systems.

II. METHODOLOGY

We have used YOLO V3 (Version-3) model which is pre-trained with COCO dataset. We have implemented this project with DNN functionalities like blogFromImage, NMS (Non maxima suppression), dark net. We use blobFromImage functionality for pre-processing of the image, NMS for suppressing the weak signals or weak detections and dark net as a framework of deep neural networks. COCO dataset contains 80 objects but we use only person object out of those objects in the project because we calculate social distancing between persons. If the detected object is person then only we proceed for next steps.

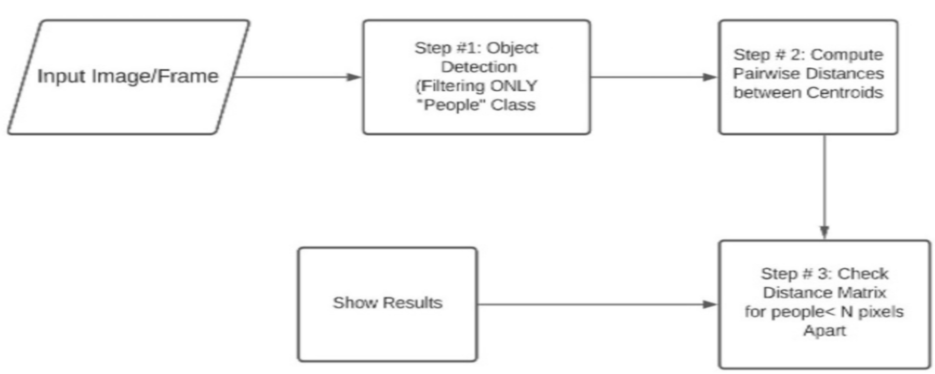

Fig.1.Architecture Diagram

We set minimum distance as 50 pixels with minimum thresh hold as 0.3 and minimum configurations as 0.3 in this project. Libraries used for the project includesOpenCv, imutils, scipy, NumPy, argparse. We have used OpenCv for image processing functionalities. It is an open-source library, some functionalities of imutils used in project are show (for displaying images) and resize. The scipy (scientific python) package is used for importing distance metrics i.e., Euclidean distance, NumPy (numerical python) is used for working with arrays and argparse is used for passing input video as a command line argument.

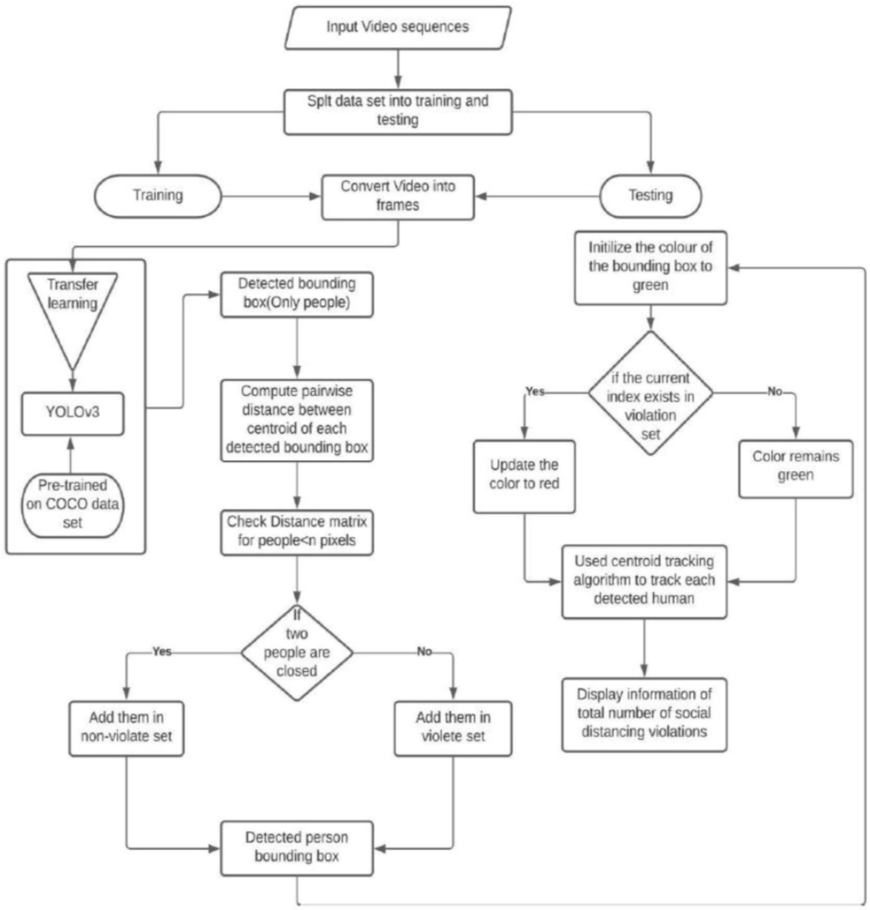

Fig.2 Flow chart

III. IMPLEMENTATION

1) Module 1: Object detection using YOLO V3 algorithm

Here object refers to the person from the COCO datasetwhich is used with YOLO weights for training. From the objects of COCO dataset we consider only person object. If the object is person then only the object will be detected other objects will not be detected.

2) Module 2: Object Tracking using OpenCv

- Step 1: Accepting the bounding boxes and computing the corresponding centroids which means the center of bounding boxes.
- Step 2: Computing Euclidean distance between new centroids (yellow) represented by x, y, z and old centroids (brown) represented by a, b.
- Centroid tracking works on an assumption that the pair of centroids with minimum Euclidean distance or the closest pair is must be the same person. So, unique ID will be generated to that pair i.e., person.
- In the above image there are two existing centroids and three new centroids from the previous frame which describes a new person has been detected in this frame

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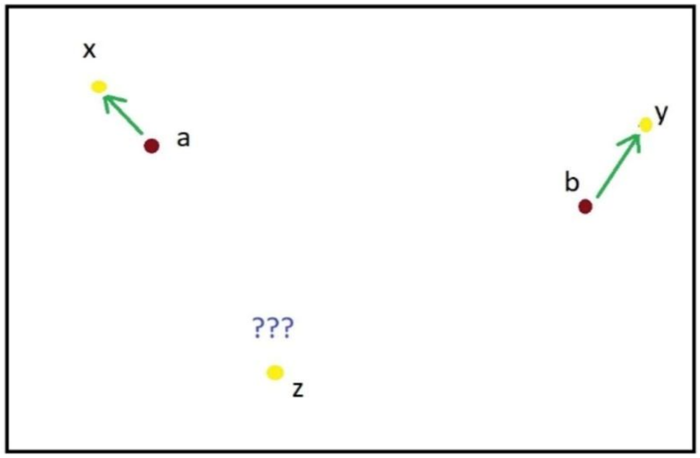
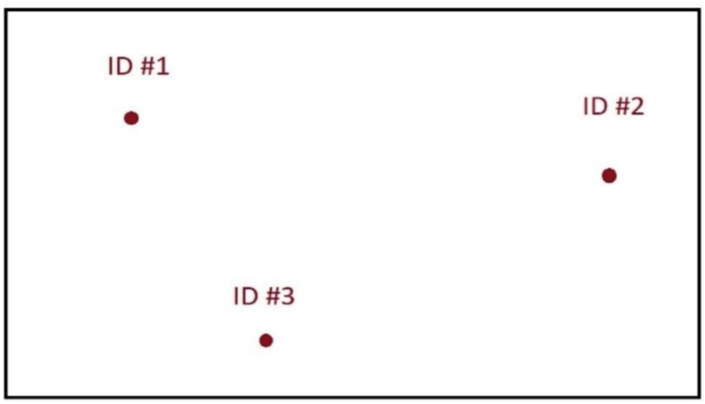
- Step 3: Association of ID's as we know Euclidean distances



Step 3

- Step 4: New ID's will be registered by storing co-ordinates of bounding boxes of new object i.e., person.



Step 4

- Step 5: The object which leaves our frame area then we will just deregister the object.

3) Module 3: Distance computation using Euclidean distance as metric
Computation of distance between the pairs of detected persons using Euclidean distance as metric.

4) Module 4: Adding violations and displaying number of violations
The persons who are less than M pixels (M represents minimum distance set by us in the project) distance apart from each other will be considered as violation pair. They will be highlighted with red color bounding boxes and the number of violations at that particular frame will be displayed. The persons who are maintaining more than M pixels of distance will be considered as non-violation pair and they will be highlighted with green color bounding boxes.

IV. RESULTS

We used argparse by which we gave our input video as argument for displaying the output. In output, Social distancing violations will be displayed for that particular frame and violated persons will be highlighted and non-violated persons will also be highlighted.

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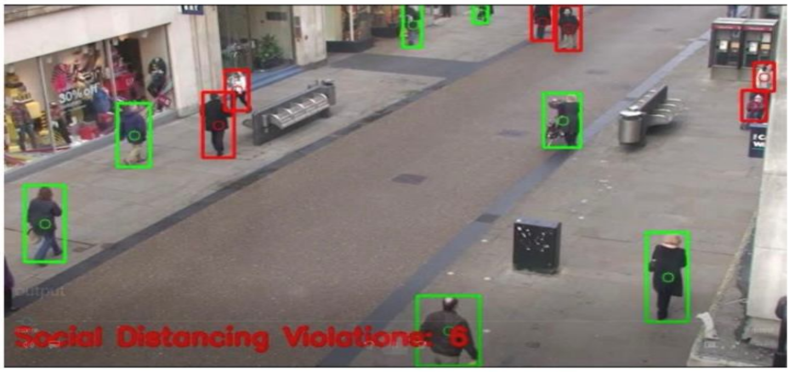
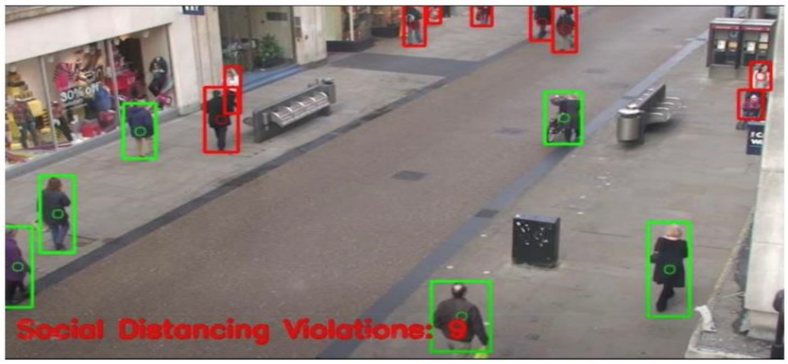
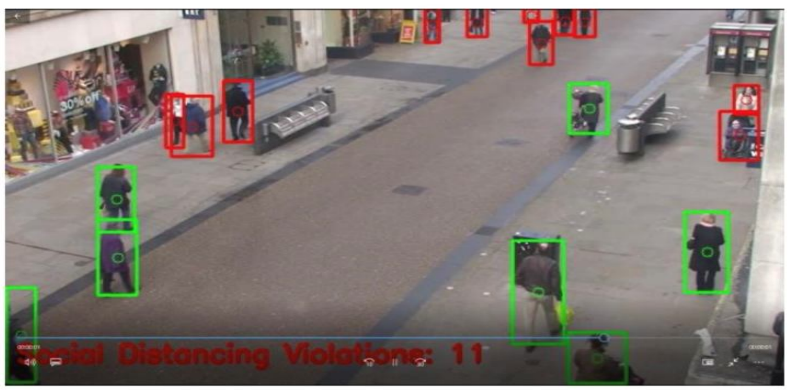
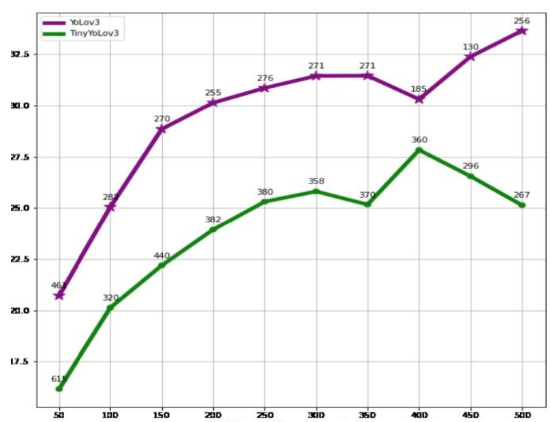






These images are screenshots of output video, After implementing the code for social distancing.

Table 1: Comparison of YOLOv3 performance curve



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IV. CONCLUSION

Centroid tracking algorithm is used for calculating pairwise distances between the objects. To automate the process of monitoring the social distancing it is an efficient real-time deep learning based framework. The bounding boxes aid in identifying group of people satisfying the closeness property computed using pairwise vectored approach. With Euclidean distance as metric we calculated pairwise centroid distance between detected bounding boxes. The violations are displayed in the output along with violated persons

V. FUTURE ENHANCEMENTS

This tool can be installed in CC cameras for monitoring social distancing in public places like malls, airports etc. We can also Use advance version of YOLO for faster detections in future and we can make GPU as true if we install required packages this will increase speed of execution of output.

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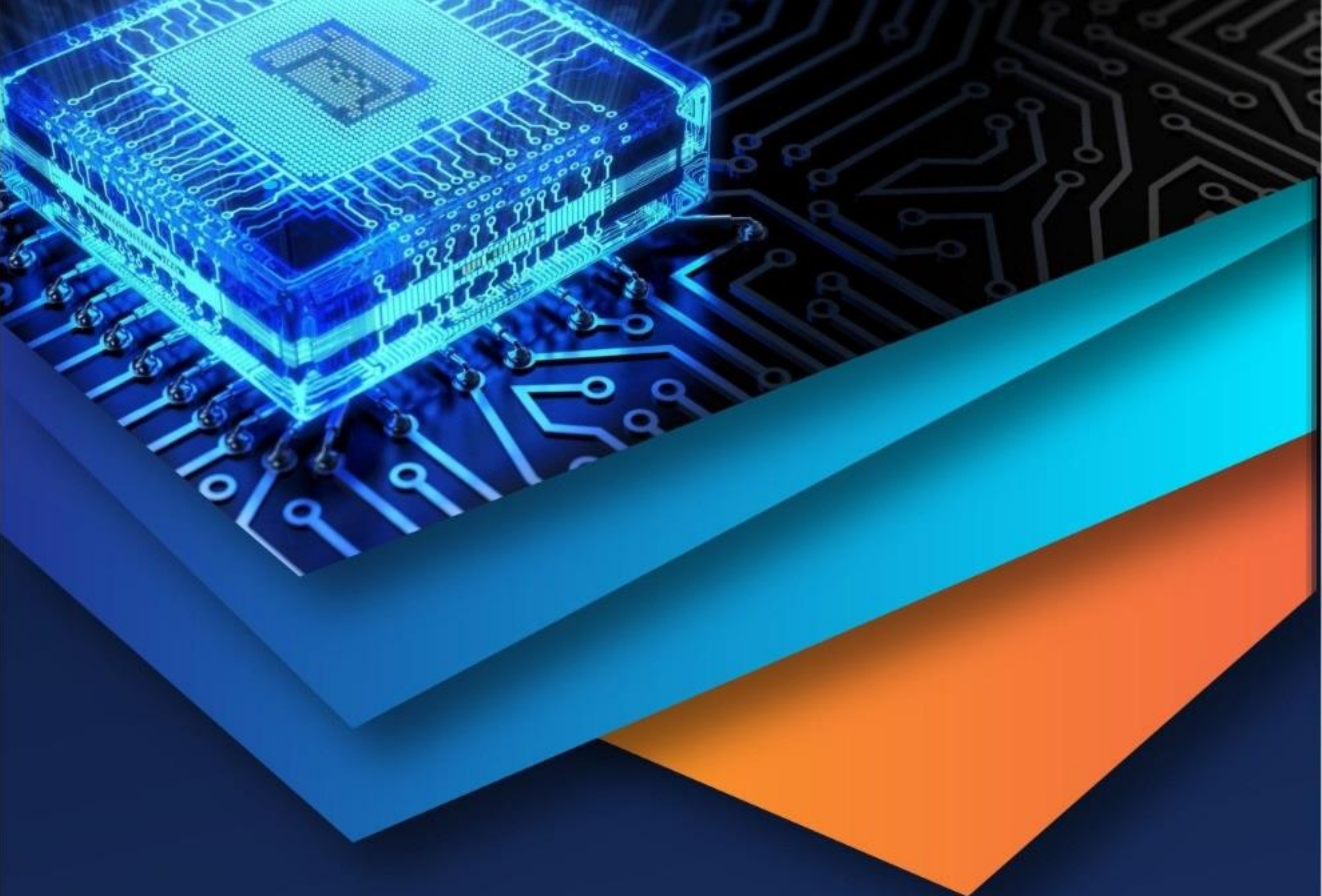

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