SOCIAL DISTANCE DETECTION USING YOLOV3 ALGORITHM

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ABSTRACT:

As nowadays we all are aware of a deadly virus named corona, after the evolution of such virus the world had changed in many accepts. It belongs to the family of the communicable disease, such a way that the effect of it will be more, there is no proper vaccinefor it. Maintaining social distance place, a major role in decreasing the effect of it.

The main aim, of our project is to detect whether a person is maintaining social distanceor not in a particular area. To do this work it requires a lot of people and even it may not be accurate.

In our project the input is a video signal and it converts the given video into frame anddetects the social distance between people. The distance we should be given as a fixed value totake as reference.

In output we will get the frames with red color bounding boxes and green color bounding boxes, whereas the red one indicates the object present in it is not maintaining socialdistance, where the object present in green box is maintaining social distance.

INTRODUCTION:

As we know that now a days the rise of new deadly diseases are increasing day-by-day. Basically, disease is nothing but change in one's mental health condition. Diseases can be caused by mainly 5 types of micro-organisms. They are

1. Viruses
2. Bacteria
3. Fungus
4. Protozoa
5. Worms

Out of the diseases caused by the micro-organism, they are divided into two categories.One is communicable

disease while the other is non-communicable disease. Among thesetwo types communicable disease is more dangerous than non-communicable disease. By the name itself it is said that communicable disease can be able to transfer from one personto another person while they are in contact like (body contact, through saliva etc.).

We all know the affect that was caused by the corona virus. It belongs to communicabledisease. Till now it doesn't have any vaccine for perfect cure. In such difficult condition allover the world it was declared lockdown, and the adverse effect of it can be minimized bymaintain the social distance with the people who surrounds you and wearing mask while wandering outside.

We all know the well know phrase i.e.

"**Prevention is better than cure"**.

The main motto behind discussing the above information to know about the importanceof social distance. By the help of it the spread of the viruses can be decreased massively.

In this project we are going to measure the distance between person in a particular locality and detect whether they are maintaining social distance or not. In a less populatedarea it is easy to detect whether a person is maintaining social distance or not, but in a highly populated area like malls, markets, colleges, schools e.t.c. it is difficult to check whether they are maintaining social distance, and it requires a lot of

people to check and they may not be confident whether they are maintaining social distanceaccurately.

This problem can be overcome by replacing the place of people with technology and also it is accurate. Through this project we are going to implement a code through which itis easy to detect whether a person is maintaining social distance or not.

LITERATURE REVIEW:

Social distance detection is a crucial task in the current pandemic situation to prevent the spread of COVID-19. In recent years, deep learning algorithms have been successfully applied to various computer vision tasks, including object detection. YOLOv3 (You Only Look Once version 3) is a state-of-the-art deep learning algorithm for object detection.

Social distance detection is a crucial task in the current pandemic situation to prevent the spread of COVID-19. In recent years, deep learning algorithms have been successfully applied to various computer vision tasks, including object detection. YOLOv3 (You Only Look Once version 3) is a state-of-the-art deep learning algorithm for object detection.

Several studies have been conducted on social distance detection using YOLOv3 algorithm. The following is a literature review of some of these studies:

"Social Distance Monitoring System Using YOLOv3 Algorithm" by Bao Duy Tran, Quoc Anh Tran, and Phuoc Vinh Tran: This study proposed a social distance monitoring system that uses YOLOv3 algorithm for detecting people and calculating the distance between them. The system achieved high accuracy and real-time performance.

"Social Distance Monitoring with YOLOv3 and Depth Estimation" by Jiale Shi, Zhengyi Luo, and Jianfei Cai: This study proposed a system that combines YOLOv3 with depth estimation to improve the accuracy of social distance detection. The system achieved high accuracy in both indoor and outdoor environments.

"Social Distancing Detection in Real-time using YOLOv3 and Deep SORT" by Saurabh Agarwal and Aman Sharma: This study proposed a real-time social distance detection system using YOLOv3 and deep SORT (Simple Online and Realtime Tracking). The system achieved high accuracy and was able to track multiple people in real-time.

"Social Distancing Monitoring using YOLOv3 with Transfer Learning" by Shalaka Prakash Bhat and Abhinav Ramachandra: This study proposed a social distancing monitoring system that uses YOLOv3 with transfer learning to improve the accuracy of the model. The system achieved high accuracy and was able to detect people at different distances

Overall, these studies demonstrate the effectiveness of using YOLOv3 algorithm for social distance detection. The combination of YOLOv3 with other techniques, such as depth estimation and tracking, can further improve the accuracy and real-time performance of social distance detection systems.

OBJECTIVES OF THE RESEARCH:

The main objective of social distance detection using YOLOv3 algorithm is to develop a computer vision system that can accurately and efficiently detect whether people in a given scene are maintaining a safe distance from each other in order to prevent the spread of infectious diseases, such as COVID-19. Specifically, the objectives of social distance detection using YOLOv3 algorithm may include:

Detection of people: The first objective is to detect the presence of people in the scene using the YOLOv3 algorithm. This involves training the YOLOv3 model on a large dataset of annotated images to learn how to recognize people in different poses, orientations, and lighting conditions.

Distance measurement: The second objective is to accurately measure the distance between people in the scene. This requires the use of additional techniques, such as depth estimation or triangulation, to estimate the distance between people based on their position and size in the image.

Social distance detection: The main objective of the system is to detect whether people are maintaining a safe distance from each other, typically 2 meters or 6 feet, as recommended by health authorities. The YOLOv3 algorithm can be used to detect people, and the distance measurement techniques can be used to determine whether the distance between people is safe or not.

Real-time performance: The final objective is to develop a system that can perform social distance detection in real-time. This requires optimizing the YOLOv3 algorithm and other techniques to achieve high processing speed and reduce latency.

Overall, the objectives of social distance detection using YOLOv3 algorithm are to develop an accurate, efficient, and real-time system that can detect whether people are maintaining a safe distance from each other, and ultimately help prevent the spread of infectious

PROBLEM STATEMENT:

During the COVID-19 pandemic, social distancing has become an essential measure to prevent the spread of the virus. It is important to ensure that people maintain a safe distance of at least 2 meters or 6 feet from each other in public places. However, it can be challenging for individuals to accurately judge the distance between themselves and others. Moreover, monitoring compliance with social distancing guidelines in crowded public spaces can be difficult for human observers. Therefore, there is a need for an automated system that can accurately detect whether people are maintaining a safe distance from each other.

The proposed system aims to address this problem by using YOLOv3 algorithm to detect people in a given scene and calculate the distance between them. The system will provide real-time feedback to alert individuals when they are not maintaining a safe distance from others. The main challenges in this problem include developing a YOLOv3 model that can accurately detect people and estimating the distance between them accurately. Moreover, the system needs to operate in real-time to provide timely feedback to users.

RESEARCH METHODOLOGY:

Problem identification: The first step is to clearly identify the problem statement and research objectives. This involves defining the scope of the study, the target population, and the expected outcomes of the research.

Data collection: The second step is to collect the necessary data for training and testing the YOLOv3 model. This involves capturing images or videos of people in different settings and labeling them with ground truth data, including the location and distance between people.

YOLOv3 model training: The third step is to train the YOLOv3 model on the collected data using deep learning techniques. This involves preprocessing the data, selecting appropriate hyperparameters, and optimizing the model for accuracy and performance.

Model evaluation: The fourth step is to evaluate the performance of the trained YOLOv3 model on a separate test dataset. This involves measuring the accuracy, precision, recall, and F1-score of the model using standard evaluation metrics.

Performance optimization: The fifth step is to optimize the performance of the YOLOv3 model to achieve

real-time processing speeds and reduce latency. This involves applying techniques such as pruning, quantization, and model compression to reduce the size and complexity of the model.

System integration: The sixth step is to integrate the YOLOv3 model with other components of the social distance detection system, such as depth estimation or tracking algorithms. This involves developing a software system that can process data in real-time and provide visual feedback to users.

System evaluation: The final step is to evaluate the performance of the complete social distance detection system on real-world data. This involves testing the system in different settings and measuring its accuracy, speed, and usability.

Overall, the research methodology for social distance detection using YOLOv3 algorithm involves a combination of data collection, deep learning techniques, performance optimization, and system integration to develop an accurate, efficient, and scalable system for detecting social distancing compliance.

RESEACH ANALYSIS:

YOLO V3:

The abbreviation or the enlarged from of YOLO V3 is "**You Only Look Once"** andwhereas v3 represents the version of it. It is one of the famous algorithm's used for object detection. The first version of it was introduced to the world by two persons named Joseph Redmon and Ali Farhadi in the year 2016.

Before YOLO came into use, we use various algorithms for the purpose of objectdetection. They are:

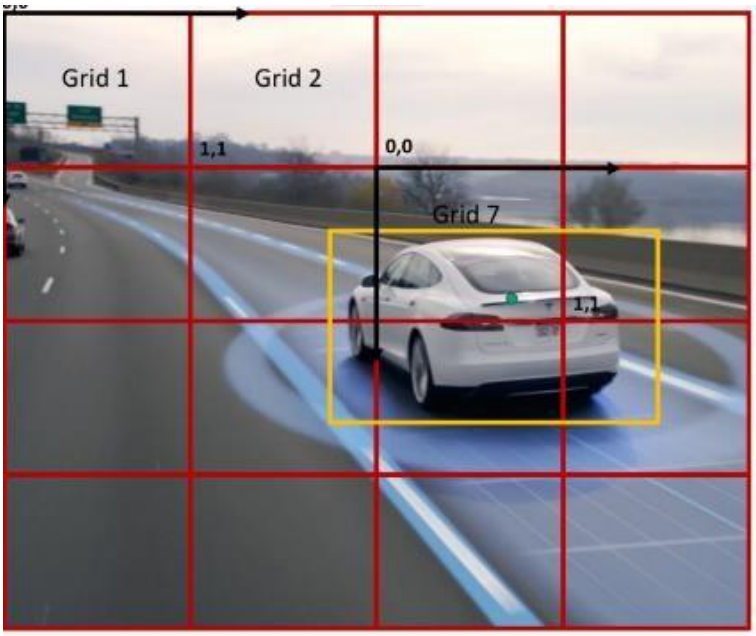
1. Fast R- CNN
2. Faster R-CNN
3. SSDetc..

Till now YOLO has produced 4 types of versions. After the rise of YOLO, the use of other algorithms for object detection has been reduced because YOLO processes with highspeed and high accuracy rate.

The working of the YOLO algorithm can be easily described in three steps. They are:

I. Forming the given image into NxN matrix
II. Formation of bounding box around the objects present in the image
III. Intersection Over Union process for perfect detectionStep 1:

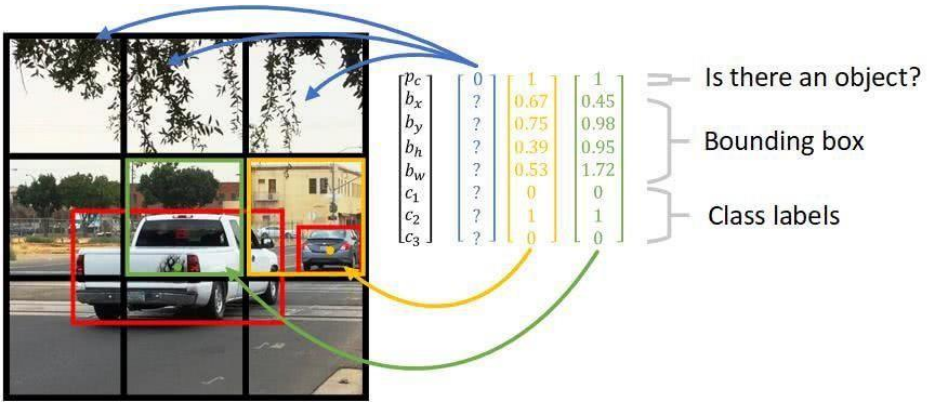
In this process the given image is divided into N x N matrix, where as there is no fixed value of N. It completely dependent on the user who are using, as the N value is highthe accuracy will be more.



Here the given image is divided into 4 x4 matrix, in such a way that it forms 16 grids.From the name itself it suggests that, with the help of this algorithm it only looks the image once and make all the calculations for detection of object in each grid at a time, rather than observing each grid separately.

Step 2:

In this step we are going to find whether any object is present the grid or not, andalong with it we make some calculations to for detection of different objects.



Formation of Bounding box

After we detects any object present in the image, it note the values of the object insuch a way it described in the above image.

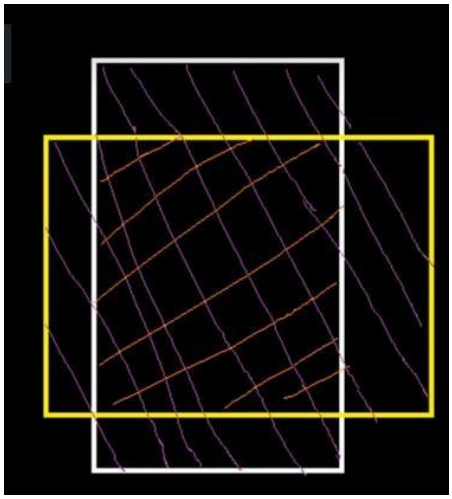
Her P_C represents (probability of presence of any class) it will be 1 when the presenceof any object.

b_x, b_y represents the location of centroid of the object.

b_h, b_w represent the height and width of the bounding box formed around the object.C_1, C_2, C_3…. represents the classes of various objects, let the class represents car is
C_1, if car is present in the given image then it becomes 1, while all the remaining classesbecomes 0.

Step 3:
Sometimes it forms more than one bounding box over a single object. In such case it is difficult to identify the location of the object correctly, in such situation we use the conceptof intersection over area to overcome such problem and detect object accurately.

Intersection Over Area (IOU) = Intersect area / Union area



Imaginary Image of IOU

Where as

Intersect area is the region where both the area of the rectangles will match.Union area is the region other than intersection area.

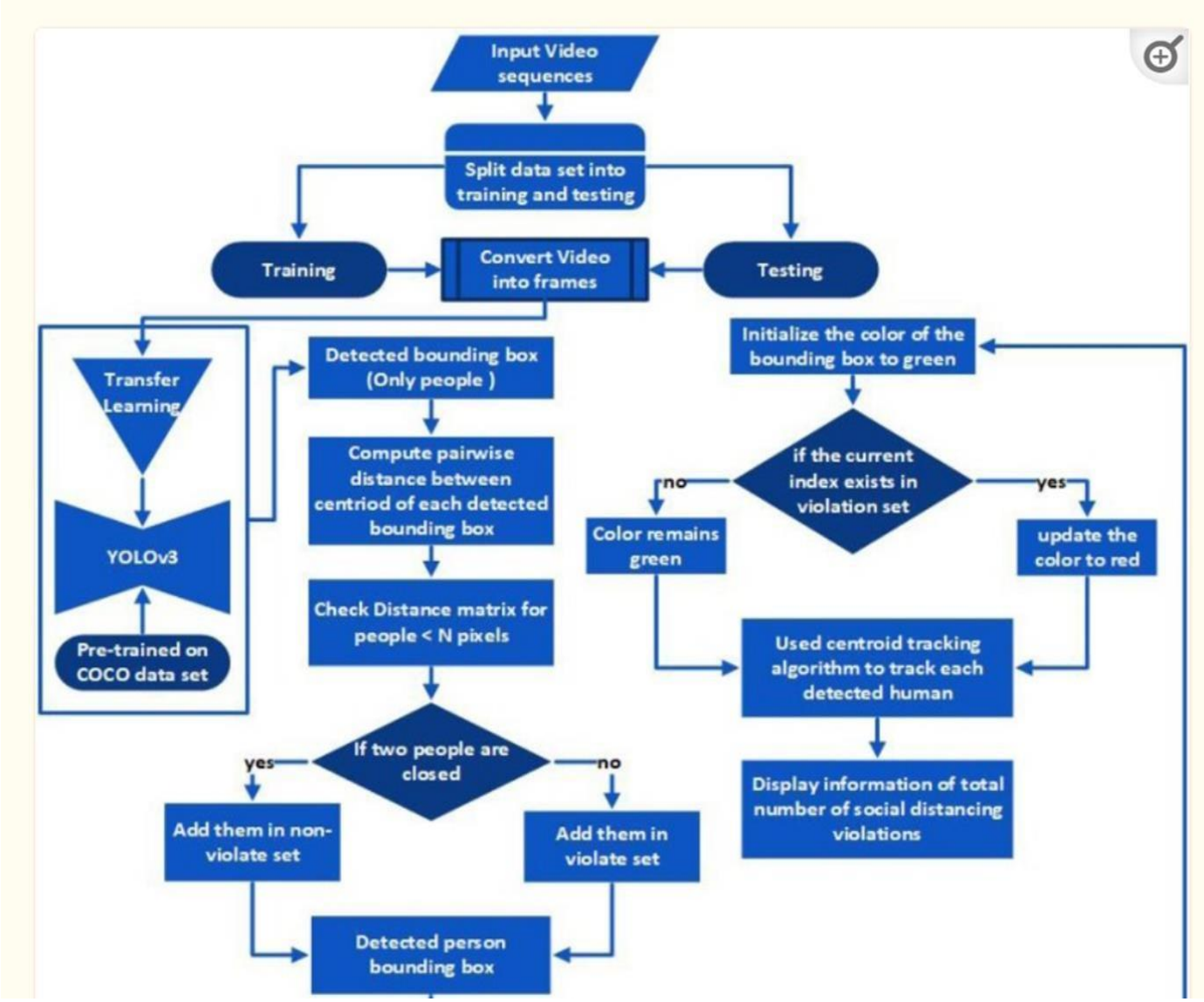
If the IOU is greater than 0.5 then all the bounding boxes will be removed except onebounding box which has greater probability (P_c).

COCO DATASET:

The expansion of COCO is Common Objects in Context, and the name dataset refersto collection of data. COCO dataset consists of a large amount of data in it i.e. it consists of 80 different classes like (vehicles, instruments, people, trees, buildings, e.t.c) to identify the class of the object, and consists of nearly 1.5 million objects for detection.

The main function of it is to detect objects in the given frame and differentiate theobjects of one class with respect to another. It provides large-scale datasets for object detection, segmentation, key point detection and image captioning. It detects the objects present in the image and mask it with the different colours base on the classes.

View using COCO dataset


Input Video sequences
Split data set into training and testing
Training
Testing
Convert Video into frames
Transfer Learning
YOLOv3
Pre-trained on COCO data set
Detected bounding box (Only people)
Compute pairwise distance between centriod of each detected bounding box
Check Distance matrix for people < N pixels
If two people are closed
yes
no
Add them in non-violate set
Add them in violate set
Detected person bounding box
Initialize the color of the bounding box to green
if the current index exists in violation set
no
yes
Color remains green
update the color to red
Used centroid tracking algorithm to track each detected human
Display information of total number of social distancing violations

FLOW CHART

WORKING PRINCIPLE:

- The first step of our project starts with, taking video as the input signal.
- After taking the video signal it will convert the given video signal into frames.
- After converting video into frames, the main process starts i.e. to detect the objects present in the frame and mark them with the bounding box and mark centroid.
- Now it will measure the distance between the centroid of every object with respect to each and every object present in the frame.
- If the distance between the two centroids is equals or greater than the fixed value that we have declared then the bounding box corresponding to the particular person will bein green color.
- Whereas, if the distance between the object with respect to all the objects present is less than the reference value then the bounding box of the person will be in red color.
- Now the loop will close and the same process will begin for next frame, as we know that video is divided into a number of frames.

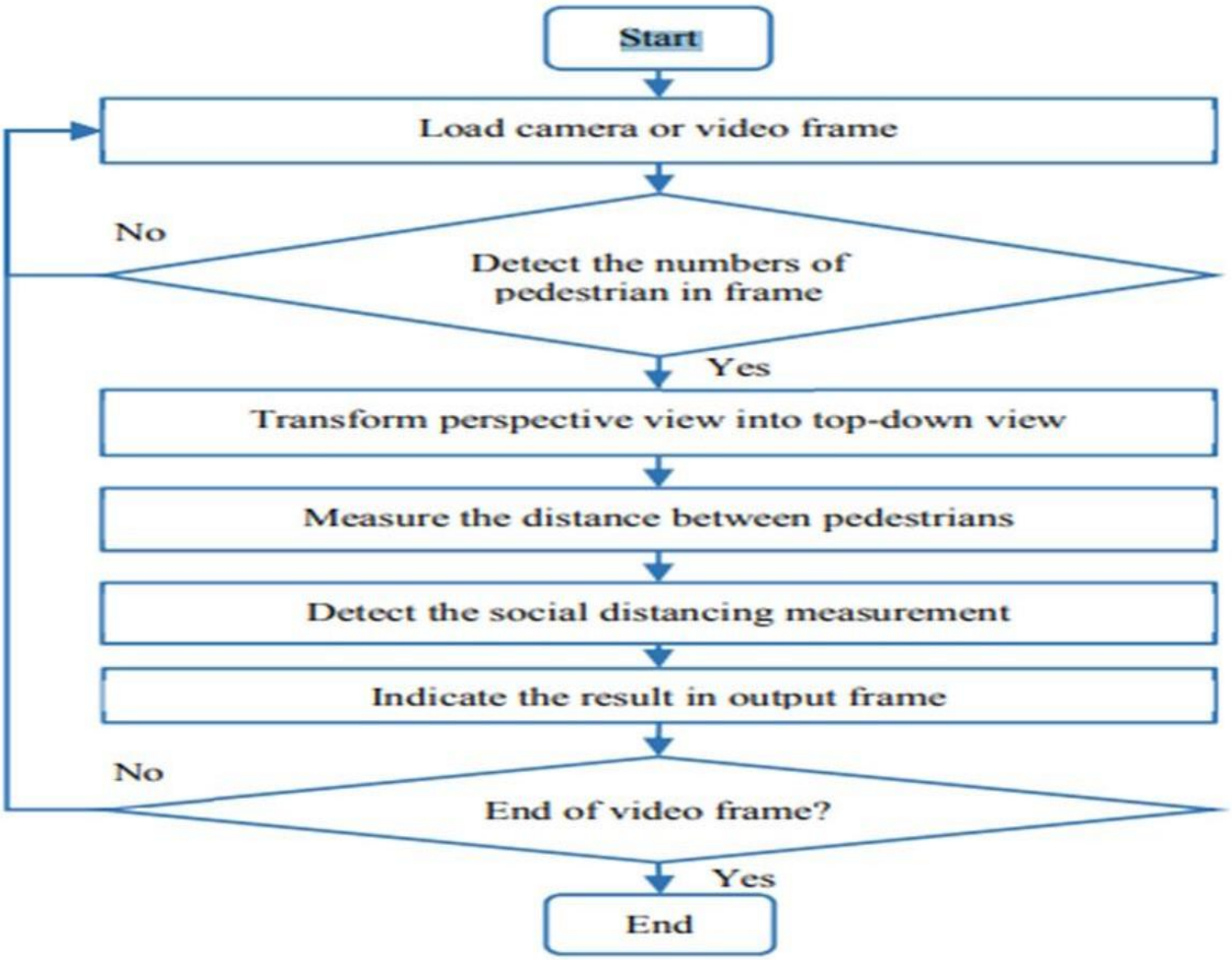


Figure 5 Program flowchart of social distancing detection for each video frame.

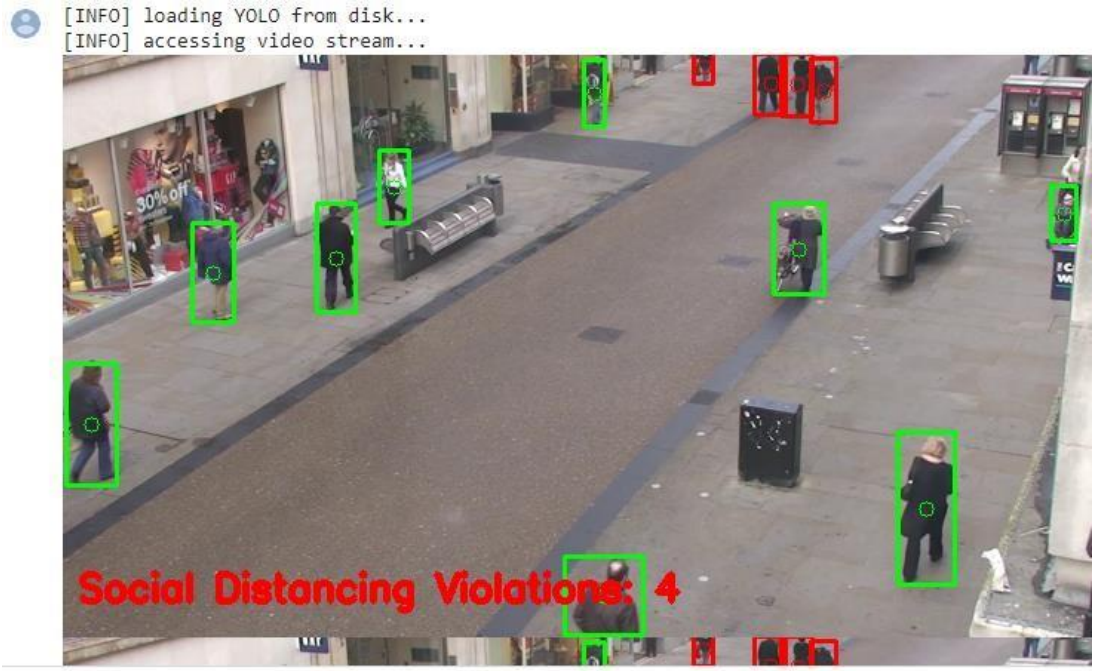
WORK FLOW

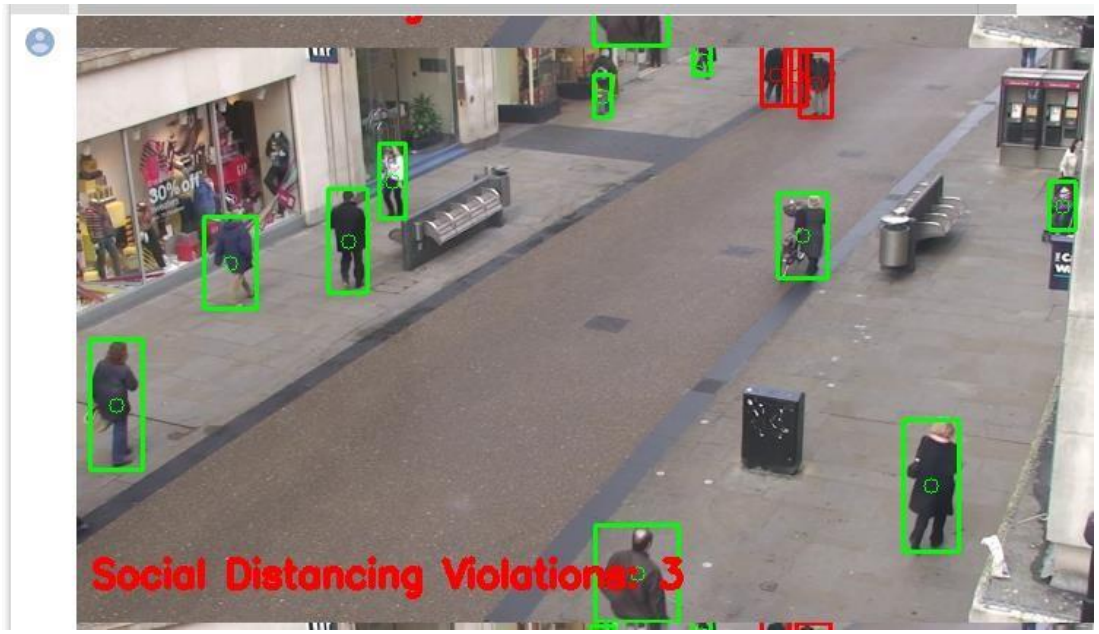
FINDINGS:

One of the primary advantages of YOLO is its **fast inference speed**, which allows it to process images in real time. It's well-suited for applications such as video tracking, self-driving cars, and augmented reality.

Previously, all other used convolutional neural networks to detect image and track the image necessary things.But due to its slowness I used yolov3 algorithm to do this.Because of its fastness its more accurate than convolutional neural networ

OUTPUT :


[INFO] loading YOLO from disk...
[INFO] accessing video stream...
Social Distancing Violations: 4


Social Distancing Violations: 3