ABC CONSULTING

Software Design Specification

SOCIAL DISTANCE DETECTOR

Revision 1.0

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Revision History

Version	**Name**	**Reason For Changes**	**Date**
1.0	*Siddharth Mohanty* *Harshit Goel* *Abhishek Kumar* *Venkanna Dora Palapar*	*Initial Revision*	*03/11/2021*

Approved By

Approvals should be obtained for the project manager, and all developers working on the project.

Name	**Signature**	**Department**	**Date**
Prof. Akila Victor		Department of Software Systems	

1. Introduction

1.1 Purpose

The purpose of this project is to make sure that spread of the pandemic in various sectors like church ,temple,shops etc decreases to a certain extent and also reduces burden on government bodies and hospitals. Since the vaccine has not been discovered yet and the number of cases are rising it is now the only possible solution available along with sanitization.This project will also help in categorizing the dangerous and risk prone areas and enable officials to deploy resources according to the category of the zone.

1.2 System Overview

This is a whole new project which we will be trying to develop. The major component for this project are :-

- Object Detection
- Measurement
- Tracking
- Feature Extraction
- Verification
- Calibration

1.3 Design Map

While we are working on this project we have divided the project into 6 small but relevant modules namely :-

1) Calibration
2) Detection of Objects
3) Measurement of Distance
4) Feature Extraction
5) Tracking
6) Verification

1.4 Definitions and Acronyms

- WBS :- Work Breakdown Structure
- DFD :- Data Flow Diagram
- SDS :- Software Design Specification

2. Design Considerations

Occlusion of pedestrians detected by the camera may happen if there is too much crowd, thus calculation of pedestrian density threshold will be affected. Expensive high definition cameras have to be deployed in numbers depending upon the area of the place to be monitored. People don't want to get monitored as there is a sense of insecurity of data theft due to rising cases of cybercrimes in the world.

2.1 Assumptions

1. For detection purposes we assume any part of the human body like face, lower body etc as a human object.
2. To calculate the distance between the objects we take the distance between the centroid of the objects.(using euclidean formula)
3. Also the prediction which we are making will not always be 100% accurate as it will depend on the various factors of that area like luminance intensity of that area, crowding of people,proximity to make cameras etc. So, there will be roughly a percentage of 2-3%
4. For objects to work properly at night properly there should be a minimum luminance of 25-36MW

2.2 Constraints

- Light constraint is the only one we have encountered till now. (i.e very less efficiency in night)

2.3 System Environment

The system Environment needs a camera, some ML Models , a siren and electricity and just the database for its proper functioning.

- Camera :- For capturing the image and then send the image for further processing
- ML Models :- these are the ones by which we are able to detect the count of violation of social distancing
- Siren :- As soon as the violation occurs , it starts
- Database :- for storing the count of the number of violations that are occurred in the areas for future analysis

2.4 Design Methodology

In this part we would like to cover the module Measurement of Distance :-

- This is the third step of the pipeline, where the (x, y) location of the bounding box for each person has been estimated in the box view.
- The last step is to compute the box view distance between every pair of people and scale the distances by the scaling factor estimated from calibration.

- The people whose distance is below the minimum acceptable distance has been depicted in red, and the rest are coloured as green, and a line is drawn between the people to emphasize this measure.

2.5 Risks and Volatile Areas

Risk Type	Possible Risks
Technology	Insufficient Light
Technology	The inbuilt library support is removed from developer side
Tools	Hardware failure
Estimation	The rate of defect repair is underestimated
Estimation	The time required to develop the software is underestimated

3. Architecture

The architecture provides the top level design view of a system and provides a basis for more detailed design work

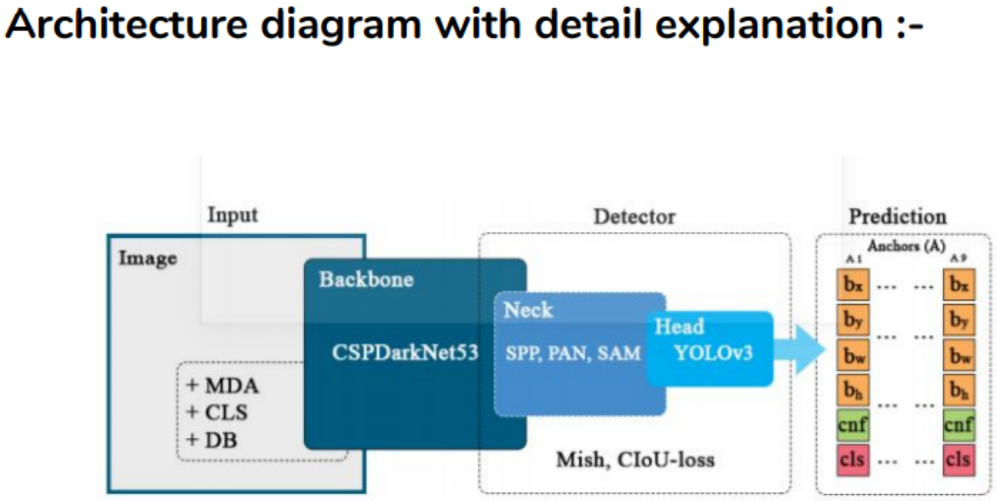


Figure 6. The network structure of the proposed 3-level human detection module.

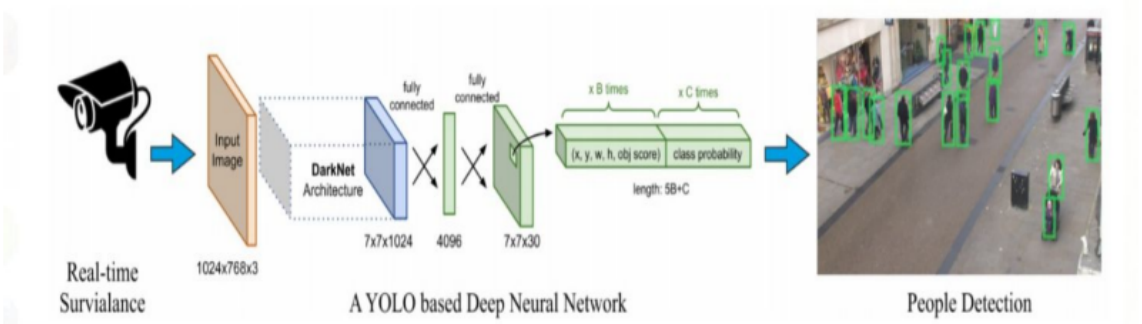
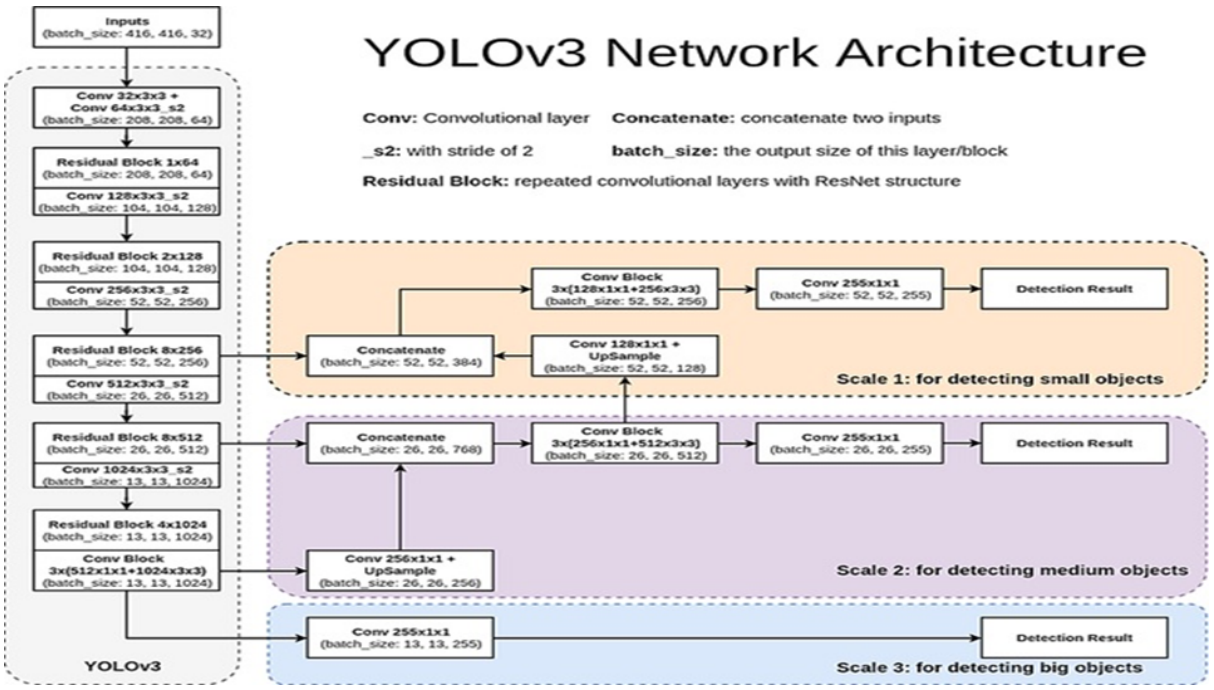
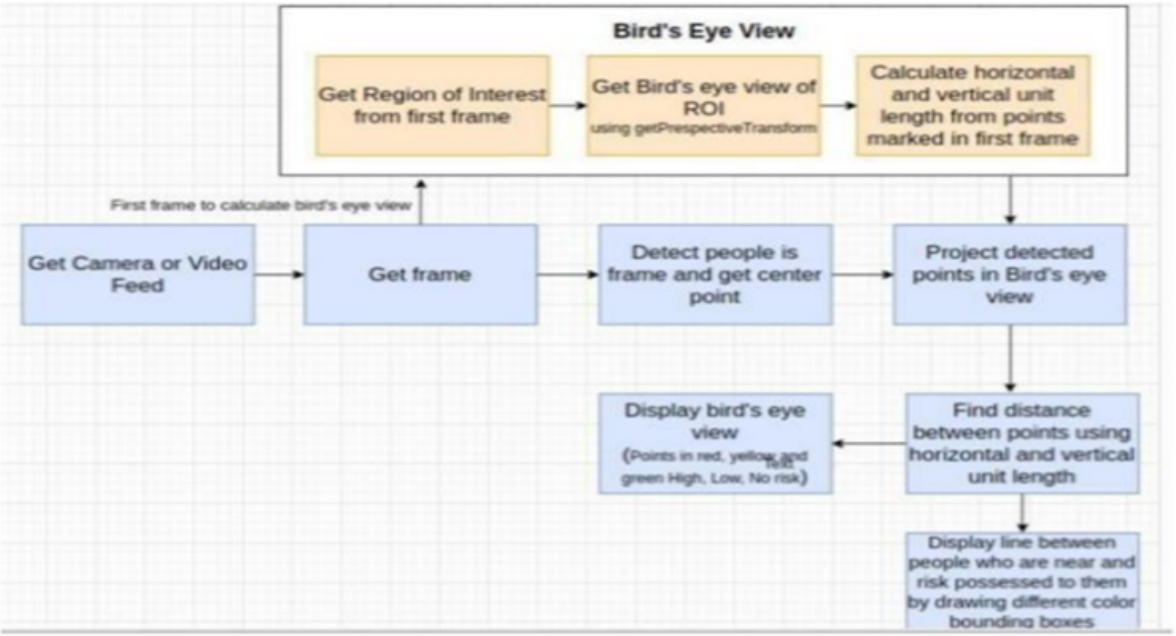


Figure 3. Stage 1- The overall structure of the people detection module.



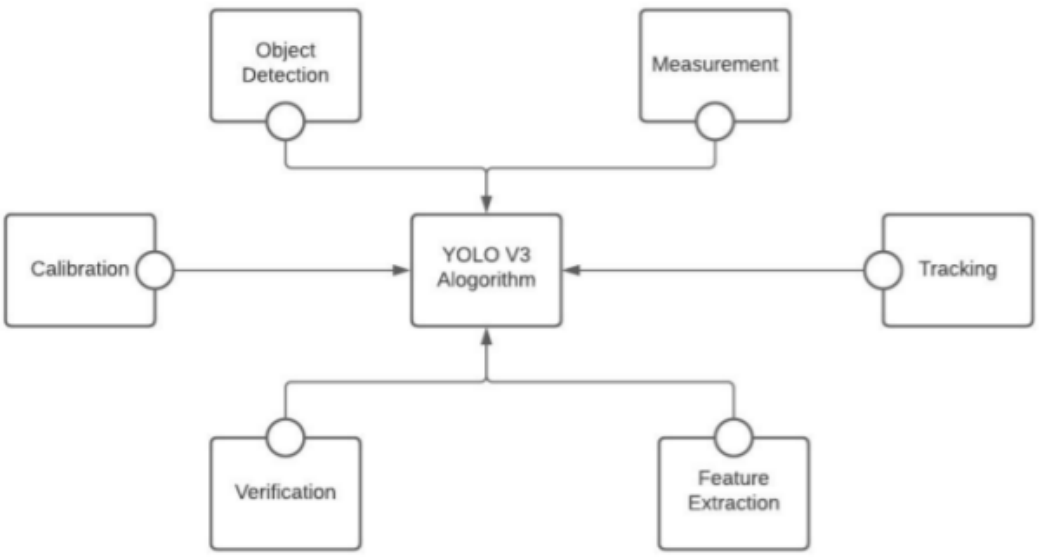


3.1 Overview

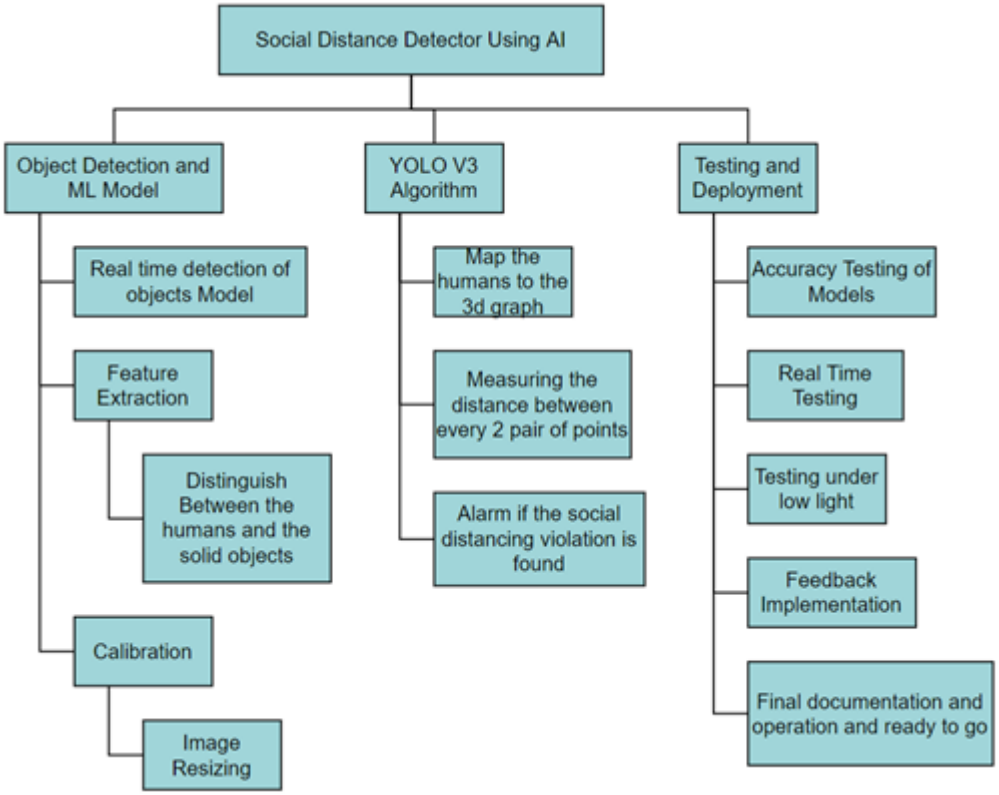
For easy working on the project we have divided the project into the 6 small modules which serve different prospects but are important.

3.2 Subsystem, Component, or Module 1 …N

Component Diagram :-



Phased Based WBS



1) Calibration :-
    a) Calibration is the first step of the pipeline, which works by computing the transform into a box view.
2) Detection of Objects :-
    a) Detection is the second step of the pipeline that involves applying a pedestrian detector to the perspective views to draw a bounding box around each pedestrian.
3) Measurement of Distance :-
    a) This is the third step of the pipeline, where the (x, y) location of the bounding box for each person has been estimated in the box view.
4) Feature Extraction :-
    a) Feature Extraction is the fourth step of the pipeline , which works after objects have been identified .
5) Tracking:-
    a) Tracking is the fifth step of the pipeline . In this module we are assigning the human beings relative spatial 2D coordinates with respect to the closest person i.e. the largest possible image .
6) Verification :-
    a) Verification is the sixth and the last step of the pipeline . As in the above module we have find all the possible edges i.e. n*(n-1)/2 edges with n persons.

3.3 Strategy 1…N

Describe the strategy used or decision made. Include information on the alternatives considered and the reasons for their rejection.

For easy working of the project we have think of the case when Calibration and Detection of objects were in same module, but this was not convenient for us as

- They can be further divided into small ones
- The functioning of the Detection of objects can only be done when the functioning of calibration is done
- The combined module will be less cohesive , which is a bad thing

4. Database Schema

4.1 Tables, Fields and Relationships

4.1.1 Databases

1) COVID Database

4.1.2 New Tables

1) People Coordinates table
2) Distancing Data Table
3) Reports Table

4.1.3 New Fields(s)

Table Name	Field Name	Data Type	Allow Nulls	Field Description
People Coordinates table	x-coordinate	Int	No	Stores the x coordinate of the object
People Coordinates table	y-coordinate	Int	No	Stores the y coordinate
Distancing Data Table	x-distance	Int	No	X distance between the centroid of the objects.

Distancing Data Table	y-distance	int	No	Y distance between the centroid of the objects.
Reports Table	latitude	Int	No	Stores the latitude of the corresponding area
Reports Table	Longitude	Int	No	Stores the Longitude of the corresponding area
Reports Table	Green Box	Int	No	Stores the number of green box in that area on that day
Reports Table	Red box	Int	No	Stores the number of green box in that area on that day
Reports Table	Date	Date	No	Stores the Date

4.1.4 Fields Change(s)

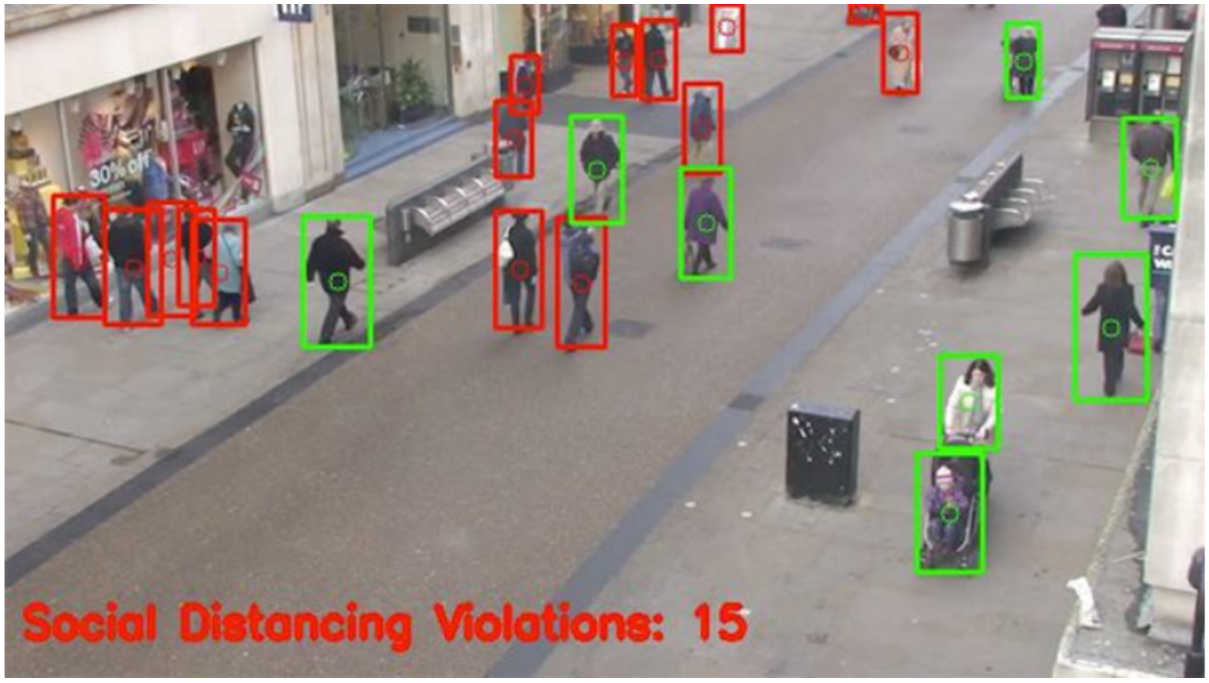
Table Name	**Field Name**	**What to change?**
People Coordinates table	x-coordinate	No
People Coordinates table	y-coordinate	No
Distancing Data Table	x-distance	No
Distancing Data Table	y-distance	No
Reports Table	latitude	No

Reports Table	Longitude	No
Reports Table	Green Box	No
Reports Table	Red box	No
Reports Table	Date	No

4.2 Data Migration

We are trying to make use of the firebase database (i.e working on it) by integrating it with ML and Javascript.

5. High Level Design



5.1 User Interface

In our project, there is nothing much to talk about the User Interface as

- The input which is taken is live that is from the road via the camera :- So no interface required in this

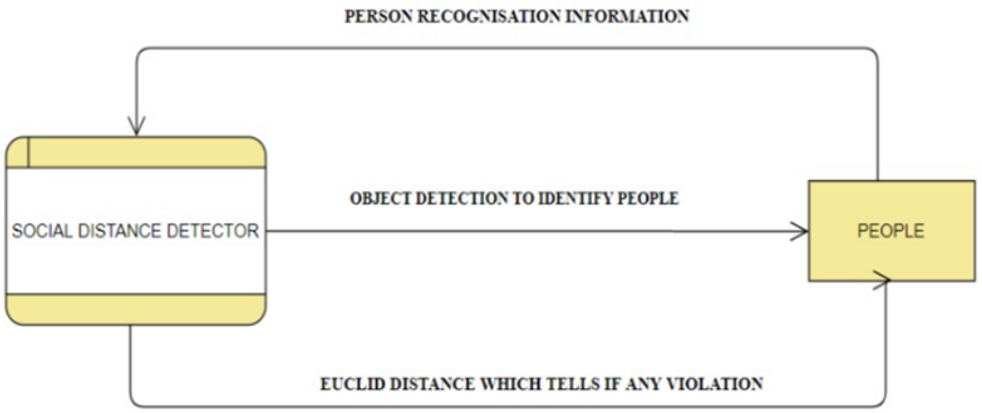
- Internal processing is done :- So no interface required in this
- The result is shown on an another machine which will have same image/video which is taken through the camera but in that all the human beings are surrounded by either Green box or red Box (based on their social distancing violation criteria) :- So in this case just like live monitoring through CCTV camera with modified output.

5.2 User Interface Modifications

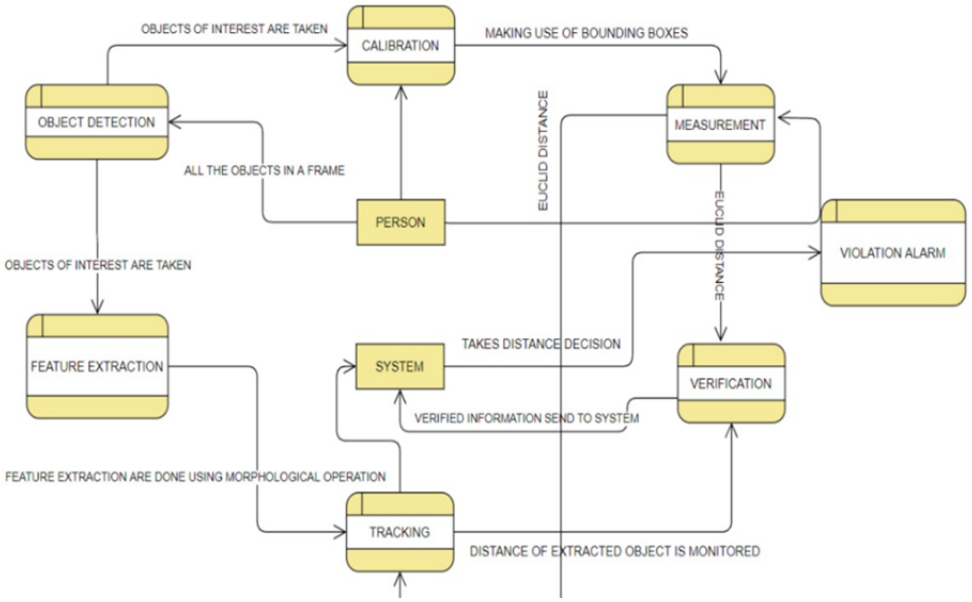
- As in our project as of now we have focused much on the user interface side / almost no interface, therefore no questions of modification in the User interface occurs.

5.3 Workflow sub-processes

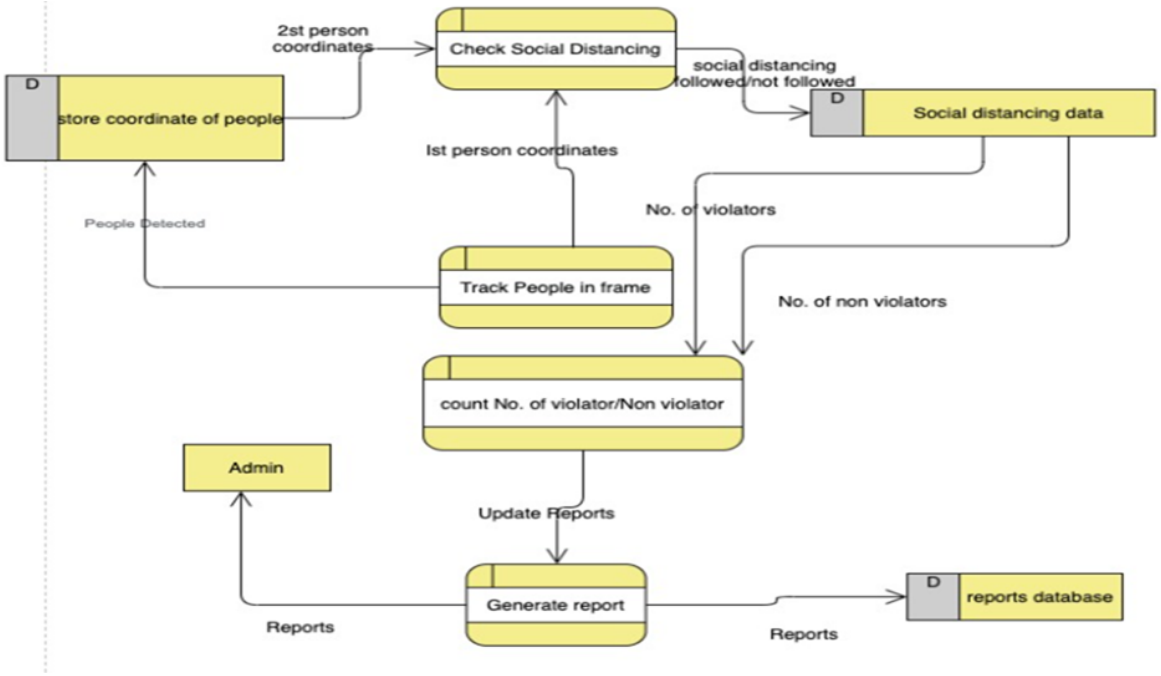
LEVEL 0 DFD :-



Level 1 DFD :-



Level 2 DFD :-



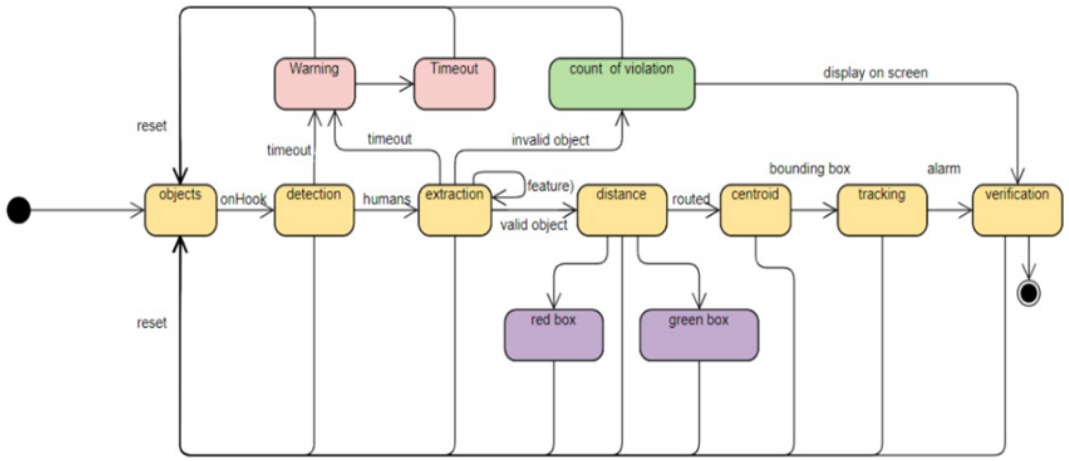
6. Low Level Design

In our project, there is nothing much to talk about the User Interface as

- The input which is taken is live that is from the road via the camera :- So no interface required in this
- Internal processing is done :- So no interface required in this
- The result is shown on an another machine which will have same image/video which is taken through the camera but in that all the human beings are surrounded by either Green box or red Box (based on their social distancing violation criteria) :- So in this case just like live monitoring through CCTV camera with modified output.

6.1 Workflow sub-processes

SOCIAL DISTANCE DETECTOR STATE DIAGRAM



7. User Interface Design

This section provides user interface design descriptions that directly support construction of user interface screens.

7.1 Application Controls

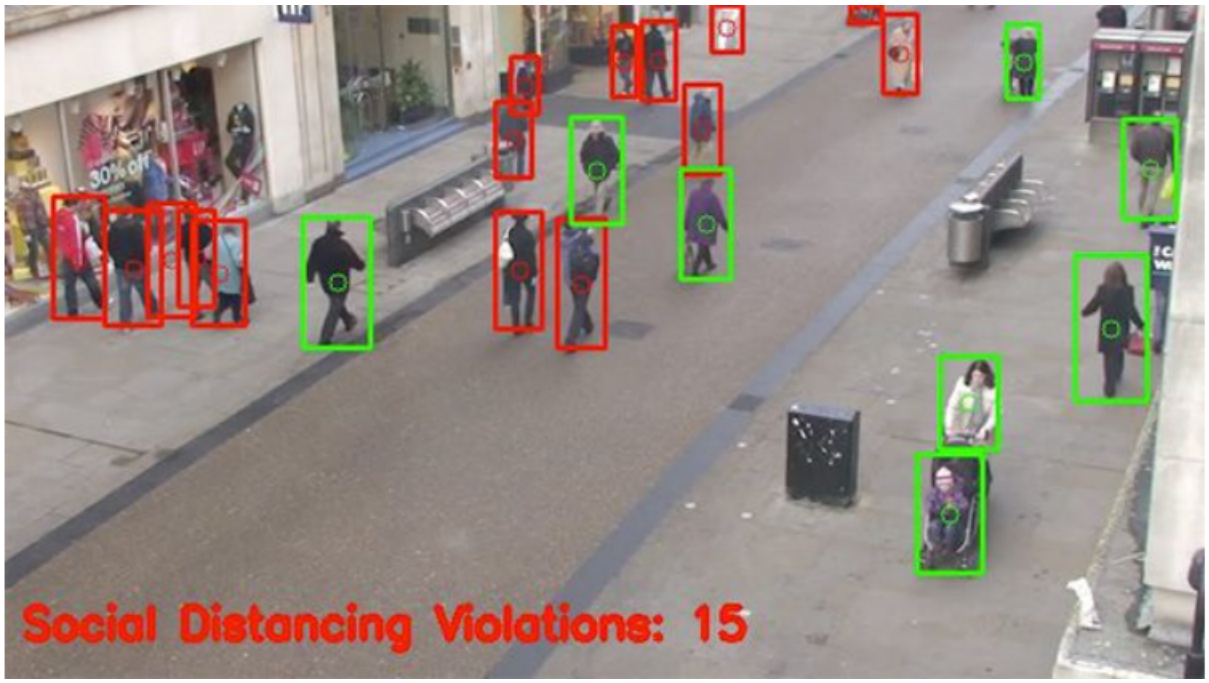
In our project, there is nothing much to talk about the User Interface as

- The input which is taken is live that is from the road via the camera :- So no interface required in this
- Internal processing is done :- So no interface required in this
- The result is shown on an another machine which will have same image/video which is taken through the camera but in that all the human beings are surrounded by either Green box or red Box (based on their social distancing violation criteria) :- So in this case just like live monitoring through CCTV camera with modified output.

7.2 Screen 1… N

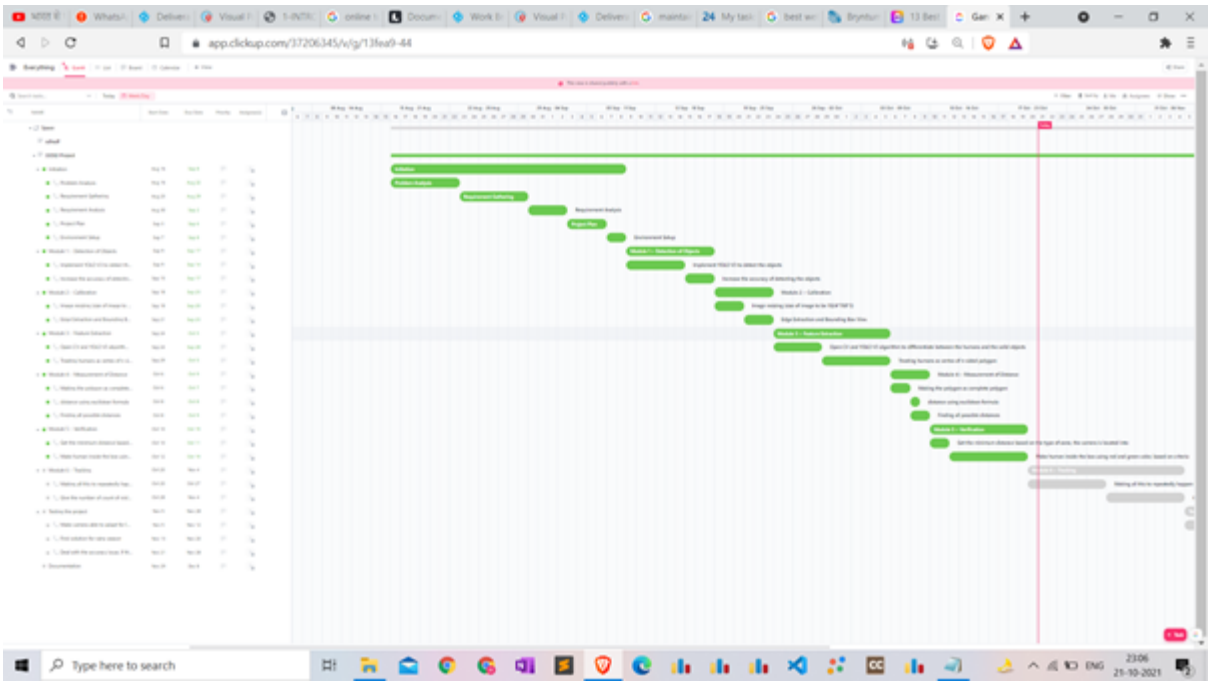
There is only 1 screen and it is just like viewing the video recording of CCTV footage.

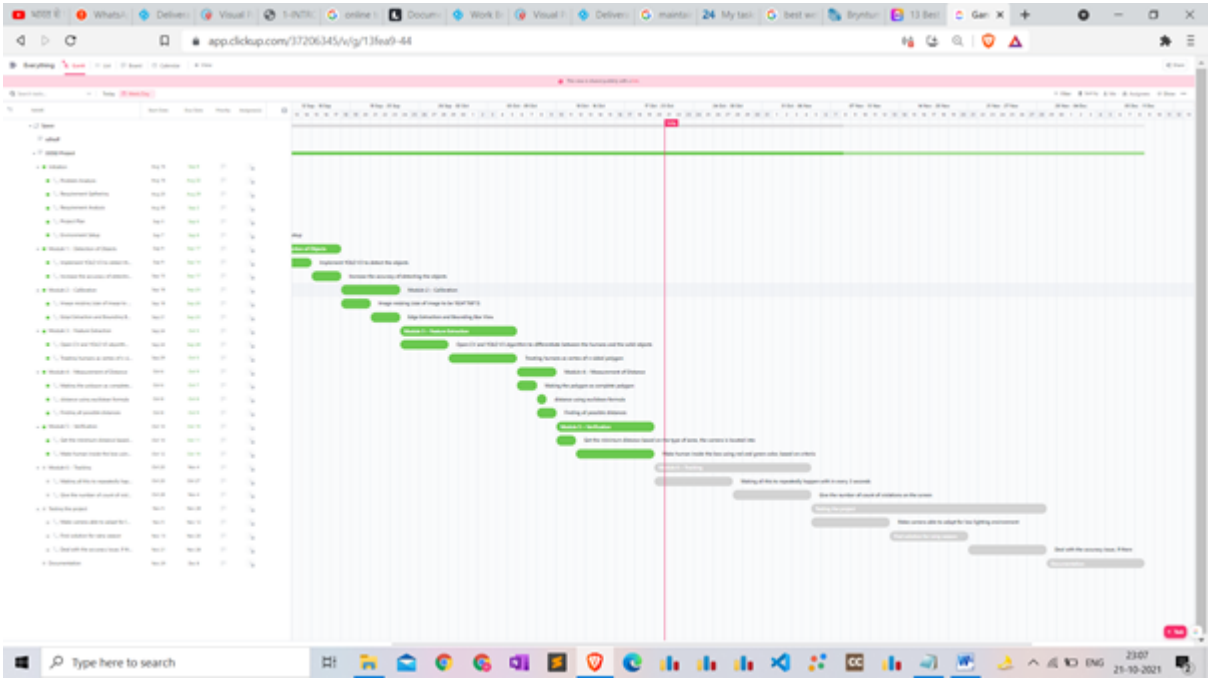
7.2.1 Workflow Reports



Appendix A: Project Timeline

Gantt Chart

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