CSE6012– Image Processing and Analysis

J Component - Project Report

Social distancing and mask detection alerting system

By

20MCS1006 A.JAFFLET TRINISHIA

M.Tech

Review III Report

Submitted to

Dr. Asnath Phamila Y
Assistant Professor
Senior, SCOPE, VIT,
Chennai

School of Computer Science and Engineering

VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

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ABSTRACT:

COVID-19, an infectious disease caused by the SARS-CoV-2 virus, was declared a pandemic by the World Health Organisation (WHO) in March 2020. By mid-August 2020, more than 21 million people have tested positive worldwide. Infections have been growing rapidly and tremendous efforts are being made to fight the disease. However, existing studies of the observation system have mainly been utilizing cameras and image analysis techniques for specifying people flow, but the use of cameras is not preferable in actual fields because of the privacy issues. Therefore, in this study, we propose a new people crowd density observation system for people flow observation. In order to avoid social distance issues, the proposed system detect the every individual person under the survilence and calculate the distance between them. the mask protection also has been analysed in the proposed system.

Introduction:

Since the COVID-19 pandemic took the world by storm, tough but necessary measures were taken by governments throughout the world to control its spread. This resulted in bringing normal day-to-day activities to a complete standstill. Months into lock down, when we see the curve flattening in several countries, the community grows restless. Relevant authorities like WHO have laid down certain guidelines to minimise people's exposure to the virus. Some safety measures people are encouraged to follow include wearing masks and maintaining a distance of 3 ft, which is approximately 1m, from another individual

There are several countries in the world that have actually made mask wearing mandatory by law, and it has been observed that certain private organisations in the other countries have also been following in their footsteps. In vast establishments, it's hard to ensure that people are adhering to these crucial social distancing rules. To allow for easy tracking of such violators, an automated system is an absolute need of the hour.

We have recognized this need and have developed a model particularly suited to detect certain violations in real time. The first use of our model is to actually detect people's faces to determine whether or not they're wearing an acceptable mask. The second use is to determine whether or not social distancing is being maintained between 2 individuals, in the most efficient, accurate and simple manner, hence requiring overseeing authorities to take minimum effort.

To implement the above model, we have used object detection to detect exactly 3 classes: masked faces, unmasked faces, and people. While other models that have attempted to differentiate between masked and unmasked faces have favoured object detection networks like Single Shot Detector method, etc. to train on, we found that these were not efficient enough to help communities deal with potential risks in real-time.

The research we have done to add contributions to the analysis of the situation and come up with a solution to detect the violations includes:

- Data Collection from various data-sets, and self-annotations of images to test in difficult scenarios for mask detection, as well as creation of measured video test sets for social distancing.

- Self implementation of face detection using a custom-built data-set comprising of a mixture of MAFA and WIDER-FACE data-sets to determine the accuracy with which masked faces can be detected.

- Thorough examination of methods to determine whether people are maintaining the recommended social distance or not, as well as development of an original method with minimum and user-friendly calibration.

- Study of several object detection methods that give maximum accuracy and FPS, so that the model has applications in real-time usage.

LITERATURE SURVEY:

- **TITILE:** The outbreak of the Novel Coronavirus or the COVID-19 in various parts of the world
- **AUTHOR:** EktaGambhir
- **YEAR:** 2019

- **DESCRIPTION:**

  This has affected the world as a whole and caused millions of deaths. This remains an ominous warning to public health and will be marked as one of the greatest pandemics in world history. This paper aims to provide a better understanding of how various Machine Learning models can be implemented in real-world situations. Apart from the analysis done on the world figures, this paper also analyzes the current trend or pattern of Covid-19 transmission in India. With the help of datasets from the Ministry of Health and Family Welfare of India, this study puts forward various trends and patterns experienced in different parts of the world.
- **TITILE:** Responsiveness is one of dimensions in the concept of responsible research and innovation (RRI).
- **AUTHOR:** Budi Harsanto
- **YEAR:** 2020
- **DESCRIPTION:**

  This dimension, among others, is manifested through responses to the challenges faced by society. Responsiveness from the scientific community is clearly evident recently in the response to the recent great challenge of the Covid-19 pandemic. The purpose of this paper is to provide an early review to assess publications in the first three months of the pandemic, since December 2019. Scientometrics and descriptive statistics were used to analyse documents indexed in the Scopus academic database. Open access tools from VOSviewer were used to help in visualising the network of countries and research topic density map. On average, 150.33 documents were published every month, with medicine as the main field of research (62.04%). Researchers from China, US, and UK institutions have published the most documents. Analysis of the keywords shows that the main topics of research regarded acute respiratory diseases, contact tracing, and molecular epidemiology. Although fields such as psychology, mathematics, computer science, engineering, nursing, business, management and accounting still have very few Covid-19 related studies at the moment, these fields likely to contribute in the future with regard to the great impact of this pandemic.

- **TITILE:** Coronavirus disease (COVID-19) outbreak has affected billions of people,

- **AUTHOR:** Rajupt Singh
- **YEAR:** 2019
- **DESCRIPTION:**

In addition, to constraint the spread of the virus, economies have been shut down, curfews and restrictions have interrupted the social lives. Currently, the key question in minds is the future impacts of the virus on the people. It is a fact that the parametric modelling and analyses of the pandemic viruses are able to provide crucial information about the character and also future behaviour of the viruses. This paper initially reviews and analyses the Susceptible-Infected-Recovered (SIR) model, which is extensively considered for the estimation of the COVID-19 casualties. Then, this paper introduces a novel comprehensive higher-order, multi-dimensional, strongly coupled, and parametric Suspicious-Infected-Death (SpID) model. The mathematical analysis results performed by using the casualties in Turkey show that the COVID-19 dynamics are inside the slightly oscillatory, stable (bounded) region, although some of the dynamics are close to the instability region (unbounded). However, analysis with the data just after lifting the restrictions reveals that the dynamics of the COVID-19 are moderately unstable, which would blow up if no actions are taken.

- **TITILE:** COVID-19, an infectious disease caused by the SARS-CoV-2 virus
- **AUTHOR:** SiddiqueLatif
- **YEAR:** 2019
- **DESCRIPTION:**

The World Health Organisation (WHO) in March 2020. By mid-August 2020, more than 21 million people have tested positive worldwide. Infections have been growing rapidly and tremendous efforts are being made to fight the disease. In this paper, we attempt to systematise the various COVID-19 research activities leveraging data science, where we define data science broadly to encompass the various methods and tools-including those from artificial intelligence (AI), machine learning (ML), statistics, modeling, simulation, and data visualization-that can be used to store, process, and extract insights from data. In addition to reviewing the rapidly growing body of recent research, we survey public datasets and repositories that can be used for further work to track COVID-19 spread and mitigation strategies. As part of this, we present a bibliometric analysis of the papers produced in this short span of time. Finally, building on these insights, we highlight common challenges and pitfalls observed across the surveyed works.

- **TITILE:** COVID-19, an infectious disease caused by increasing spread rate disease
- **AUTHOR:** RajaniKumari
- **YEAR:**2019
- **DESCRIPTION:**

The novel coronavirus outbreak was first reported in late December 2019 and more than 7 million people were infected with this disease and over 0.40 million worldwide lost their lives. The first case was diagnosed on 30 January 2020 in India and the figure crossed 0.24 million as of 6 June 2020. This paper presents a detailed study of recently developed forecasting models and predicts the number of confirmed, recovered, and death cases in India caused by COVID-19. The correlation coefficients and multiple linear regression applied for prediction and autocorrelation and autoregression have been used to improve the accuracy. The predicted number of cases shows a good agreement with 0.9992 R-squared score to the actual values. The finding suggests that lockdown and social distancing are two important factors that can help to suppress the increasing spread rate of COVID-19

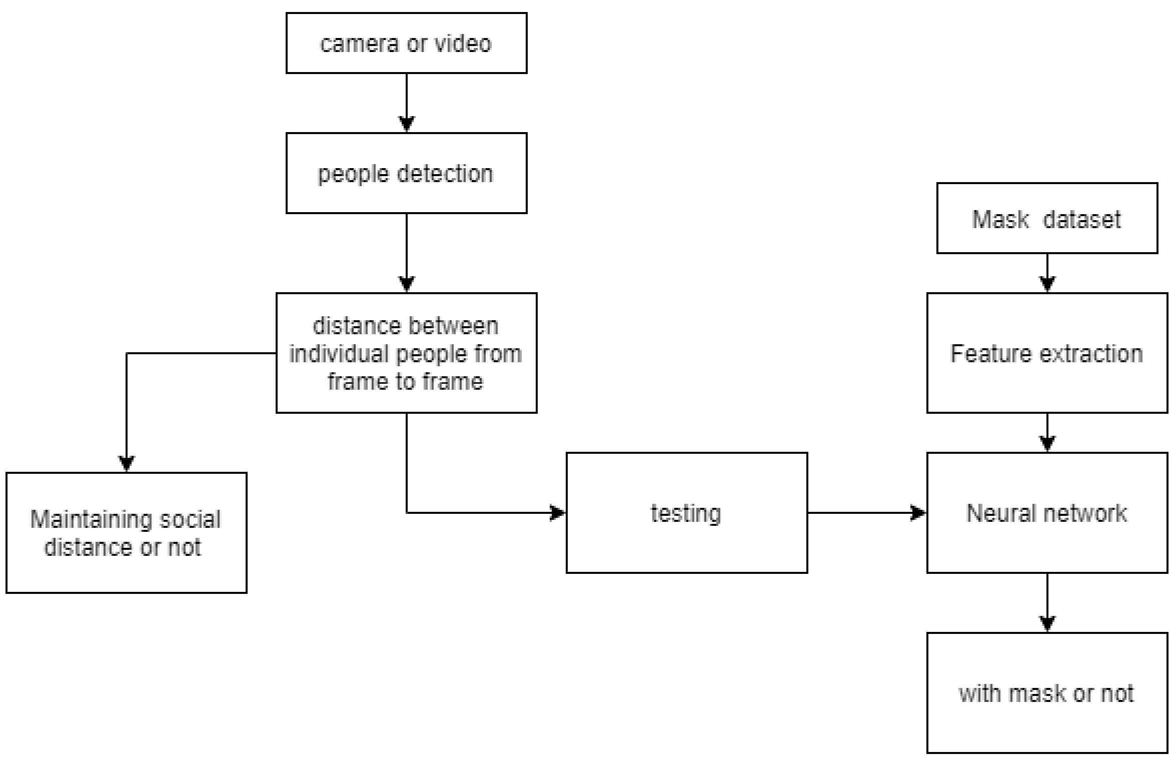
EXISTING SYSTEM:

In this paper introduce Convolution Neural Networks and deep learning model is used for the analysis of crowd scene. In these paper propose, findings the number of people arrived in one group and also finds the crowd density map. People counting in extremely dense crowds are an important step for video surveillance and anomaly warning. The above mentioned works, Several problems becomes especially more challenging due to the lack of training samples, severe blockages, disorder scenes, and modification of perspective. In existing methods estimating crowd count using handcrafted features such as SIFTS and HOG. In current vision most suited method is to predict the better performance of estimating crowd density and crowd count based on deep learning network. Lucas knead optical flow can finds the displacement vector between two consecutive frames. 3D volumes video slices can be arranged in sequential manner. In this crowd scene analysis represents convolutional crowd dataset as 100 videos from 800 crowd scenes and build an attribute set with 94 attributes

PROPOSED SYSTEM:

Infections have been growing rapidly and tremendous efforts are being made to fight the disease. However, existing studies of the observation system have mainly been utilizing cameras and image analysis techniques for specifying people flow, but the use of cameras is not preferable in actual fields because of the privacy issues. Therefore, in this study, we propose a new people crowd density observation system for people flow observation. In order to avoid social distance issues, the proposed system detect the every individual person under the survilence and calculate the distance between them. the mask protection also has been analysed in the proposed system.

BLOCK DIAGRAM:



MODULE DESCRIPTION :

- People Detection
- Distance Measured
- **Mask Identification**

In the new world of coronavirus, multidisciplinary efforts have been organized to slow the spread of the pandemic. The AI community has also been a part of these endeavors. In particular, developments for monitoring social distancing or identifying face masks have made-the-headlines.

But all this hype and anxiety to show off results as fast as possible, added up to the usual AI *overpromising* factor (see AI winter), may be signaling the wrong idea that solving some of these use cases is almost trivial due to the mighty powers of AI.

In an effort to paint a more complete picture, we decided to show the creative process behind a solution for a seemingly *simple* use case in computer vision:

1. Detect people that pass through a security-like camera.
2. Identify face mask usage.
3. Collect reliable statistics (% people wearing masks).

Without further ado, let's see some results so you can grasp an idea about what we're trying to solve here. These are compilations of many results from different cameras in short fragments, but there's also a complete 20 minutes video example at the end of this blog post.

PEOPLE TRACKING:

The next step after the detection phase, is people tracking and ID assignment for each individual. We use the Simple Online and Real-time (SORT) tracking technique73 as a framework for the Kalman filter74 along with the Hungarian optimisation technique to track the people. Kalman filter predicts the position of the human at time t+ 1 based on the current measurement at time t and the mathematical modelling of the human movement. This is an effective way to keep localising the human in case of occlusion. The Hungarian algorithm is a combinatorial optimisation algorithm that helps to assign a unique ID number to identify a given object in a set of image frames, by examining whether a person in the current frame is the same detected person in the previous frames or not. shows a sample of the people detection and ID assignment, illustrates the tracking path of each individual, shows the final position and status Focused gatherings can be further distinguished in common focused and jointly focused In the former case, the focus of attention is common and not reciprocal, for example watching a timetable screen at the airport, watching a map in the metro station, being at a concert. Common focused gathering exhibiting small SDs can be dealt more easily than in presence of unfocused gathering, since in this case the reason of the gathering is easier to be captured, which is the item or event attracting the common attention of people. Jointly focused gathering, finally, entails the sense of mutual, instead of merely common, activity. In this case, the participation is not at all peripheral but engaged: people are – and display to be – mutually involved . Since the presence of a jointly focused gathering depend on the will of people, when this is characterized by a small social distance, it can be discouraged by simply alerting the people about the ongoing critical setup. An exception for this scenario occurs when a jointly focused gathering involves children, elderly requiring care, or anybody with an impairment that have to be accompanied, and are usually at physical contact with their relatives or caregivers. Some combinations of these attributes give rise to specific types of gatherings, some of them addressed by explicit definitions: small gatherings of jointly focused people, mostly static, are dubbed by Kendon free-standing conversational groups , highlighting their spontaneous aggregation/disgregation nature, implying that their members are jointly focused, and specifying their mainly-static proxemic layout. Large gatherings of unfocused people are named casual crowds , commonly focused large gathering refers to spectator crowd and, finally, large gatherings of jointly focused people are demonstration/protest or Acting crowd

PROBLEM STATEMENT:

- Detection Of People
- Calculating Distance from Person to Person distance

Since this application is intended to be used in any working environment; accuracy and precision are highly desired to serve the purpose. Higher number of false positive may raise discomfort and panic situation among people being observed. There may also be genuinely raised concerns about privacy and individual rights which can be addressed with some additional measures such as prior consents for such working environments, hiding a persons identity in general, and maintaining transparency about its fair uses within limited stakeholders.

PERSON DETECTION AND POSE ESTIMATION

Person detection has reached impressive performance in the last decade given the interest in automotive industry and other application fields . Real-time approaches can now estimate people pose even in complex scenarios and even reconstruct the 3D mesh of the person body . The majority of the approaches estimate not only people location as a bounding box but also 2D stick-like figures, so conveying a schematic representation of the pose. Recently, several methods augment 2D poses in 3D or infer directly a 3D pose in a normalised reference system. Capturing diffused small SDs with Computer Vision requires to localize multiple people, realizing the hardest scenario for pedestrian detection techniques. Specific pedestrian detection techniques have been designed to work in crowded scenes, where saliency-based masks are often preferred to skeleton-based representations. When the image resolution becomes too low to spot single people, regression-based approaches are employed, providing in some case density measures. This information, merged with a geometric model of the scene, will directly lead to a measure of the average SD in the field of view. Obviously, regression or density-based approaches cannot provide additional cues on pose which are highly important for capturing human actions and interactions. To fill this gap, ad-hoc approaches individuate general crowd activities, classifying them as normal or not (e.g. a person collapsing and many people getting close). Recently, new efforts address human detection and body pose estimation in crowded environments the very same scenario social distancing is dealing with. Yet, finding the location of people in such cases is necessary for alerting or creating statistics of overcrowded areas. To this end, a people detection module has to be robust to severe self and other objects/people occlusions, different image scales, and indoor/outdoor scenarios. Although a person detection (i.e., without the pose) may be enough for estimating the VSD, finding joints and body parts of pedestrian has certain advantages. This is due the fact that to obtain an approximate metric reference, or even calibrating cameras, usually the person height is used as a coarse proxy as computed from a bounding box or by more precise techniques account for different body poses (e.g., sitting, riding) that might negatively impact the estimate of height and thus a wrong VSD. Another issue is related to occlusions, i.e. how reliable is to extract a person height without having a full body information? This is necessary in the likely case of crowded environments or whenever an object partially hides person body parts (e.g., a person seated at a desk). Given a metric reference from scene geometry and the position/pose of the people in the scene, the SD can be calculated as a distance on the ground plane (feet/body pose centroid) among all the possible detected pedestrians. As previously discussed, this information can be estimated locally or pairwise in order to reduce the complexity of estimating a global reference system for the whole image.

Comparison between existing methods :

These are some of the techniques that are used for the identification of objects in real time application the time taken for per frame and speed of compilation is high compared to yolo and also yolo has the capability to identify small objects and the processing will be in nano seconds

	R-CNN	Fast R-CNN	Faster R-CNN
Test Time per Image	50 Seconds	2 Seconds	0.2 Seconds
Speed Up	1x	25x	250x

Comparison between proposed and existing method :

	YOLO v5	Faster RCNN
Inference Speed	✓	
Detection of small or far away objects	✓	
Little to no overlapping boxes	✓	
Missed Objects	✗	✗

YOLO v5 and Faster RCNN comparison 2

Identifying social distance :

Implementation, in 5 Steps:

1. Calculate Euclidean distance between two points
2. Convert center coordinates into rectangle coordinates
3. Filter the person class from the detections and get a bounding box centroid for each person detected
4. Check which person bounding boxes are close to each other
5. Display risk analytics and risk indicators

Step 1. Calculate Euclidean Distance of Two Points

We need to calculate the Euclidean distance in order to identify the distance between two bounding boxes. The function is_close gets two points, p1 and p2, as inputs for calculating the Euclidean distance and returns the calculated distance dst.

Step 2. Converts Center Coordinates into Rectangle Coordinates

The function convertBack gets parameters x, y—the midpoint of the bounding box—and wand h—the width and height of the bounding box—as inputs. Then it will covert the center coordinates to rectangle coordinates and return the converted coordinates, xmin, ymin, xmax, and ymax.

Step 3. Filtering the Person Class from Detections and Getting a Bounding Box Centroid for Each Person Detection

First, we check whether there is any detection in the image using a len(detections)>0 condition. If the condition succeed, we create a dictionary called centroid_dict and a variable called objectId set to zero. Then it will run through another condition that filters out all the other detection types, except for person. We'll store the center points of all the person detections and append it to the bounding box for persons detected.

Step 4. Check which person bounding boxes are close to each other

First, we create a list that contains all object IDs of the under-threshold distance conditions. Through iteration, we can get all the combinations of close detection to calculate the Euclidean distance using the function from Step 1.

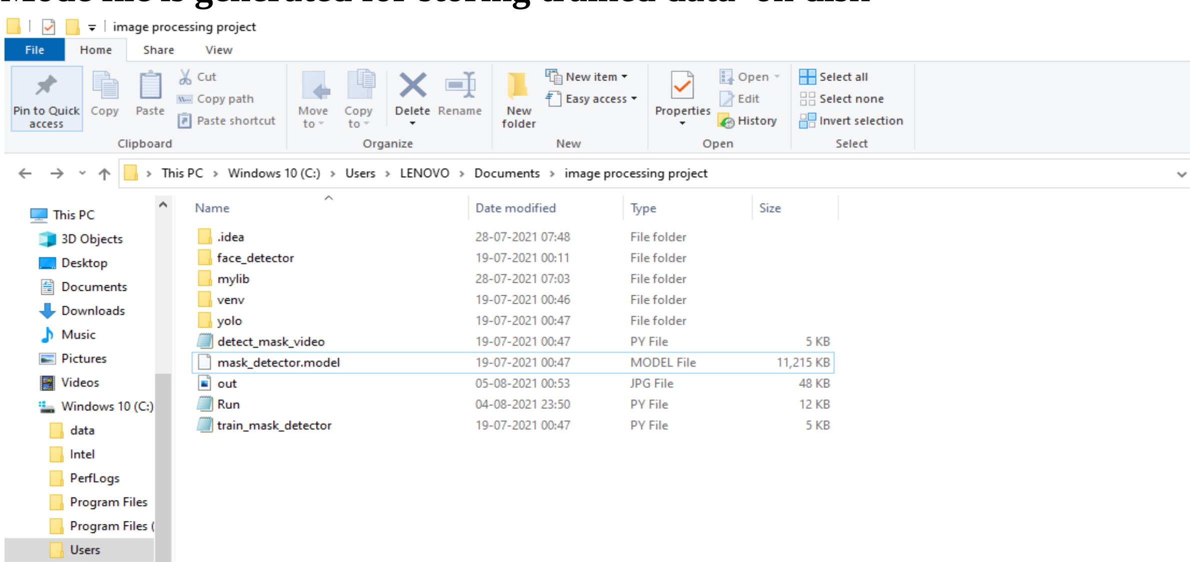
Then we set the social distance threshold (75.0) (equivalent to 6 feet) and check whether it satisfies the condition distance < 75.0. Finally, we set colors for the bounding boxes. Red for an at-risk person and Green for a protected person.

Step 5. Display risk analytics and risk indicators

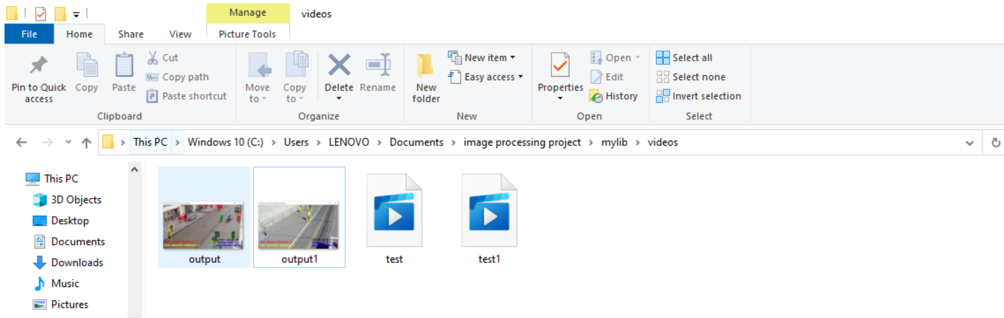
In this final module, we indicate the number of people at risk in a given frame. Starting from the text we want to display with a counted number of people at risk. For better graphical representation, Using for check in range, We tell the application to draw the lines between the nearby bounding boxes and iterate through the red_line_list.

RESULTS AND DISCUSSION :

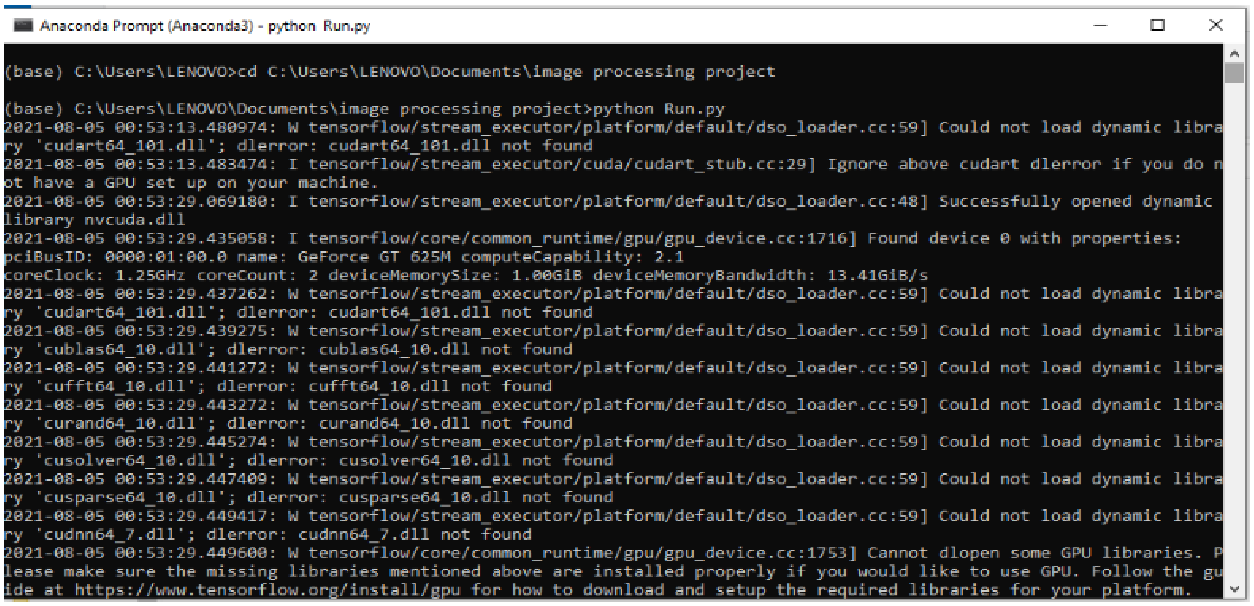
- **Mode file is generated for storing trained data on disk**



- **Sample input video and corresponding output video**



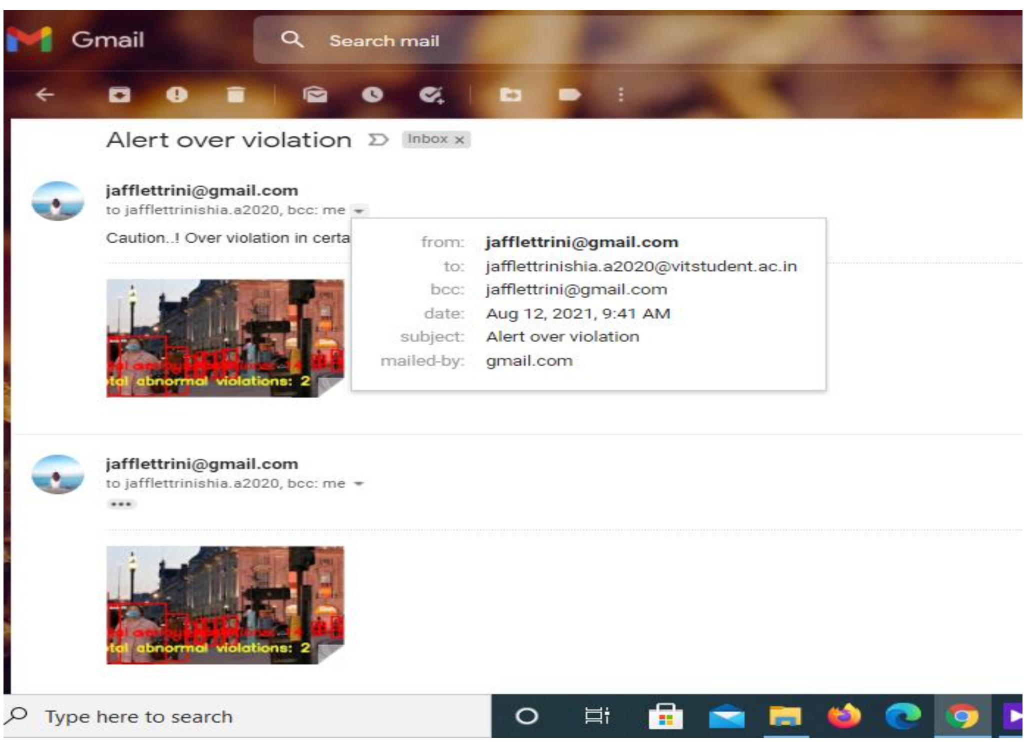
- **EXECUTING CODE**



- **Detecting social distance and mask in crowd area along wit frame value**

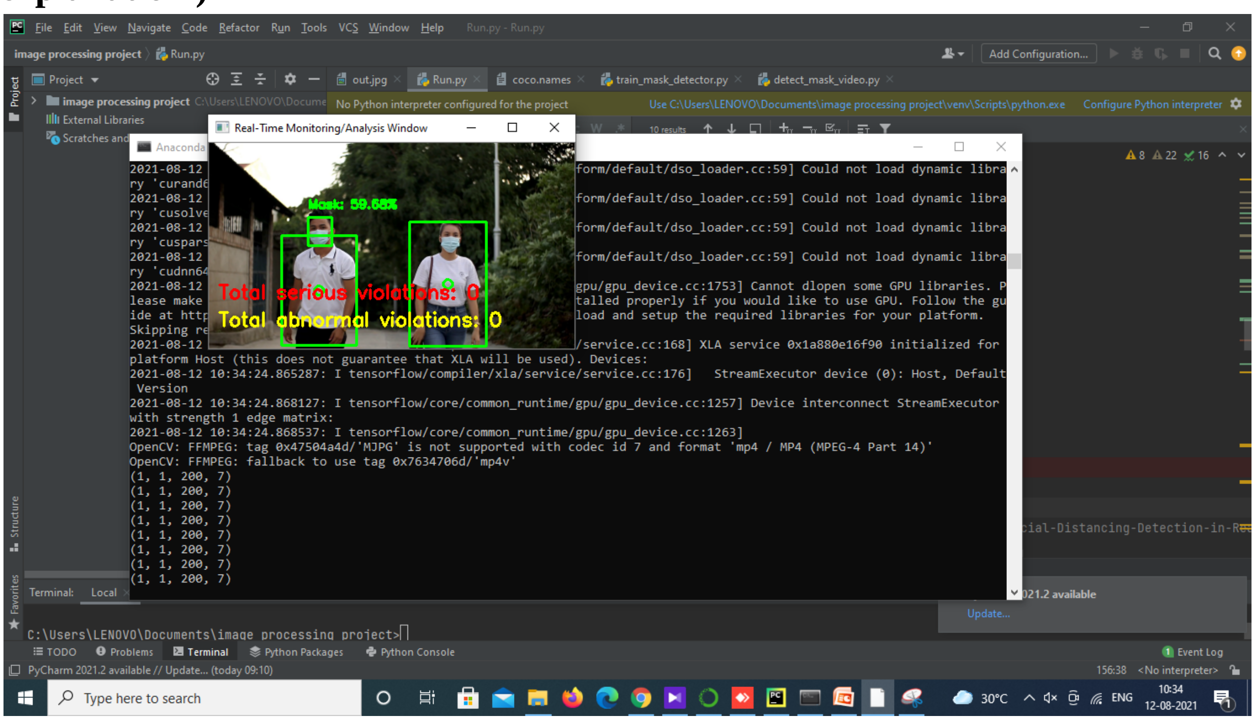
- **Corresponding output is with respect to long view of focus**

- **When over violation is identified the mail will be forwarded to respective higher official so that the crowed in particular area can be cleared**



- **Mail will be shared along with the snap proof so the respective location along with the peoples violating the rules the mail will be forwarded whenever the peoples are violating the rules for every 30 sec**

- **Identification of mask and social distance (zoomed view for better explanation)**



- **Elapsed time :**

CONCLUSION:

The importance for video-based monitoring systems is on the rise leading to the growth of interest in the field of computer vision. With the increase of human population, crowd needs to be monitored, be it in a public place or in a building. Human monitoring can be quite tiresome and expensive, making way for the upcoming of automated crowd monitoring systems. Crowd analysis comprises of detection, tracking, behavioral analysis, etc. In this paper a framework for the detection of crowd, tracking and counting is proposed. The goal is to create a robust system with utmost accuracy in its results. Contrasted with sensor-based arrangements and human-based, the video-based ones take into account more adaptable functionalities,

FUTURE WORK :

- As a future study, we can work on finding a pattern to detect or predict the time at which it gets crowded the most
- An android app can be developed which will notify every time a violation is detected, and the detected images can also be viewed through the app.

- the proposed technique can be integrated into any high-resolution video surveillance devices and not limited to mask detection and social detection only
- Secondly, the model can be extended to detect facial landmarks with a facemask for biometric purposes.

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2. Application Development for Mask Detection and Social Distancing Violation Detection using Convolutional Neural Networks - Gokul Sudheesh Kumar and Sujala D. Shetty
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