

# Social Distancing Detection for Covid-19

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## ABSTRACT

*Recently, the outbreak of Corona virus Disease (COVID-19) has spread rapidly across the world and thus social distancing has become one of mandatory preventive measures to avoid physical contact. The term social-distancing (S-D) is a way to stop or slow the spreading of contagious disease. In other words, it means less physical communication between two or more persons. In S-D the gap between two living beings (normally human) is 6 feet (two meters). Social distancing is arguably the most effective non-pharmaceutical way to prevent the spread of a disease by definition, if people are not close together, they cannot spread germs. In this Social Distancing Detector, I will be using the weights of the YOLO Object Detection Algorithm and the COCO dataset. Additionally, the main library being used will be the OpenCV.*

**Keywords:** COVID-19, Social distancing, OpenCV, YOLO, COCO, CCTV.

## 1. INTRODUCTION

Corona virus disease 2019 (COVID-19), is a contagious disease which is caused by severe acute respiratory syndrome corona virus. In December 2019, the first case of COVID19 has been detected at Wuhan the capital of China's Hubei province. Now, this has been spread globally, resulting in the ongoing corona virus pandemic. As per the report published by the World Health Organization (WHO), the virus mainly spread due to close contact. The small droplets produced through talking, sneezing, and coughing are the carrier of the CORONA virus[1]. This COVID-19 also can be spread through touching the infected surface or objects and by touching the face as well. Several health care organizations, medical experts and scientists are trying to develop proper medicines and vaccines for this deadly virus, but till date, no success is reported. This situation forces the global community to look for alternate ways to stop the spread of this infectious virus. Social distancing is claimed as the best spread stopper in the present scenario, and all affected countries are locked-down to implement social distancing.

This research is aimed to support and mitigate the corona virus pandemic along with minimum loss of economic endeavours, and propose a solution to detect the social distancing among people gathered at any public place[2]. The word social distancing is best practice in the direction of efforts through a variety of means, aiming to minimize or interrupt the transmission of COVID-19. It aims at reducing the physical contact between possibly infected individuals and healthy persons. As per the WHO norms it is prescribed that people should maintain at least 6 feet of distance among each other in order to follow social distancing. we can keep a track on humans and compute the distance between them and set the standard maintained distance to be followed and get an overview of people violating the law and concerned authorities can take the actions accordingly.

The spread of COVID-19 Pandemic Disease has created a most crucial global health crisis of the world that has had a deep impact on humanity and the way we perceive our world and our everyday lives. In December 2019 the spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), a new severe infectious respiratory disease emerged in Wuhan, China and has infected 7,711 people and 170 reported deaths in China before coronavirus was declared as a global pandemic, was named by the World Health Organization as COVID-19 (coronavirus disease 2019). According to the World Health Organization (WHO as of July 12, 2020) report, the current outbreak of COVID-19, has infected over 13,039,853 people and more than 571,659 deaths in more than 200 countries around the world, carrying a mortality of approximately 3.7%, compared with a mortality rate of less than 1% from influenza[3]. A novel coronavirus has resulted in person-to-person transmission but as far as we know, the transmission of the novel coronavirus causing coronavirus disease 2019 (COVID-19) can also be from an asymptomatic carrier with no COVID-19 symptoms. Till now there is no report about any clinically approved antiviral medicine or vaccines that are effective against COVID-19.

It has spread rapidly across the world, bringing massive health, economic, environmental and social challenges to the entire human population. At the moment, WHO recommends that people should wear to avoid the risk of virus transmission and also recommends that a social distance of at least 2m be maintained between individuals to prevent person-to person spread of disease. Furthermore, many public service providers require customers to use the service only if they wear. and follow safe social distancing. Therefore, face mask detection and safe social distance monitoring has become a crucial computer vision task to help the global society[4][5]. This paper describes approach to prevent the spread of the virus by monitoring in real time if person is following safe social distancing in public places.

It adopts a combination of lightweight neural network MobileNetV2 and Single Shot Detector (SSD) with transfer learning technique to achieve the balance of resource limitations and recognition accuracy so that it can be used on real-time video surveillance to monitor public places to detect if persons wearing face mask and maintaining safe social distancing. Our solution uses neural networking models to analyze Real-Time Streaming Protocol (RTSP) video streams using OpenCV and Mobile Net V2. We mix the approach of modern-day deep learning and classic projective geometry techniques which not only helps to meet the real-time requirements, but also keeps high prediction accuracy.

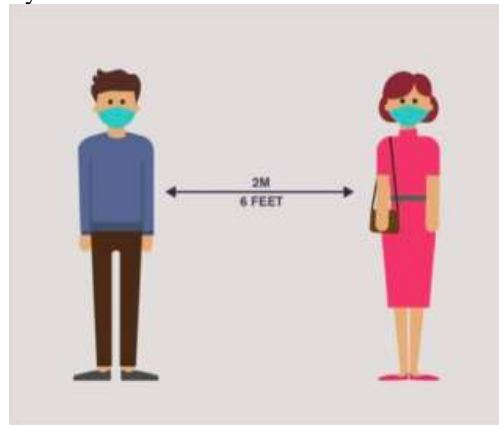


Fig: 1

If the person detected as not following the covid-19 safety guidelines, violation alerts will be sent to the control center at state police headquarters for taking further action. It allows automating the solution and enforces the social distance and follows the guidelines of social distancing. This model was created to run on raspberry pi4 and the accuracy obtained was between 85% and 95%.

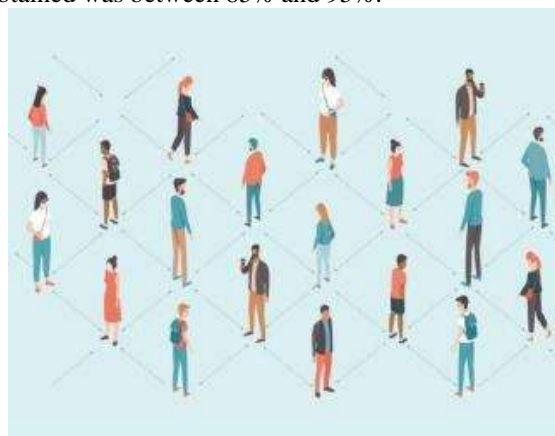


Fig: 2

## 2. LITERATURE REVIEW

Social distancing involved keeping a distance of 2 meter between people, which can prevent the spread of most respiratory infectious diseases. Social distancing is one of the most effective measures to reduce the spread of the virus, which is transmitted by air droplets. The droplets produced by coughing, sneezing or forced speaking have a certain transmission distance. By keeping this distance, we can reduce the spread of the virus. Wearing., washing hands frequently and disinfecting with alcohol also help to prevent the virus from spreading from one person to another. To control the disease, the World Health Organization recommended that countries should strengthen case detection, track and monitor contacts, practice isolation from close contacts and isolate cases as well as implement traffic control and suspend large gatherings. Analysis of the epidemic situation in seven locked down cities in Wuhan, Italy and Spain showed that maintaining social distancing really achieved results[6].

The government quickly adopted the correct strategy, e.g., social distancing, thus controlling the rate of the increase of cases and winning more time for doctors. If this had not been the case, it would have been impossible for medical staff from another provinces to go to Wuhan for support, and Wuhan appeared to be the only outbreak city. In terms of cost, social distancing also saves medical resources, such as ., hand sanitizers, alcohol-based disinfectant, etc[7][8]. This gives our health care professionals, hospitals and other institutions more valuable time to prepare, prevent the disease and help people who have been diagnosed with corona virus.

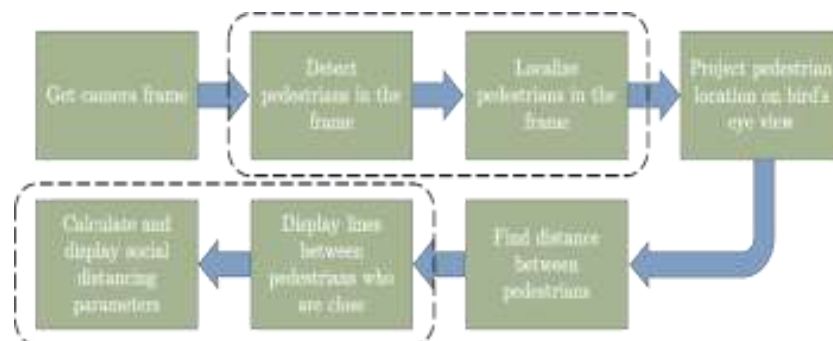
As per the WHO reports, the pandemic situation is classified into four stages. The first stage begins with the cases reported for the people who travelled in already affected regions, whereas in the second stage, cases are reported locally among family, friends and others who came into contact with the person arriving from the affected regions. At this point the affected people are traceable. Later, the third stage makes the situation even worse as the transmission source becomes untraceable and spreads across the individuals who neither have any travel history nor came into contact with the affected person. This situation demands immediate lockdown across the nation to reduce the social contacts among individuals and control the rate of transmission[9].

The outbreak of COVID-19 across the nations with the high number of confirmed cases such as US, Italy, Spain, and China based on the WHO reports, whereas figure 3 illustrates the rising characteristic of the number of confirmed, death, and recovered cases in these nations between the period January 22, 2020, to April 1, 2020, taken from Johns Hopkins live dashboard. The worst of all, stage 4 beings when the transmission becomes endemic and uncontrollable. Figure 4 presents the complete stages of the COVID-19 epidemic. Until now, several countries have entered stage 4. China is the first nation that experienced the stage 4 of the COVID-19 transmission. Though, it is claimed that the origin of the virus is Wuhan, China; it affects the other developed countries (USA, Italy, Spain, Britain, etc.)[10]. These countries are now in stage 4 of the transmission and facing more number of infections and deaths compared to China. In the case of China, it is observed that exponential growth of the confirmed cases reaches the saturation stage where the number of cases stopped growing. This follows from the fact that the number of susceptible people, which are exposed to virus, are dramatically reduced. This was made possible due to the reduced social contact among people by segregating the infected individuals in quarantine and a complete lockdown period was initiated by the Chinese government, thereby reducing the possibility of further spread. Machine learning algorithms play an important role in epidemic analysis and forecasting[11][12]. In the presence of massive epidemic data, the machine learning techniques help to find the epidemic patterns so that the early action can be planned to stop the spread of the virus.

Methods of Social Distancing - Cancellation of events which involve large numbers of people gathering together, such as

- Closure of Community Facilities
- Closure of non-essential workplaces
- Closure of schools
- Closure of colleges and universities

Social distancing is a term applied to certain actions that are taken by Public Health officials to stop or slow down the spread of a highly contagious disease. The Health Officer has the legal authority to carry out social distancing measures. Since these measures will have considerable impact on our community, any action to start social distancing measures would be coordinated with local agencies such as cities, police departments and schools, as well as with state and federal partners[13].



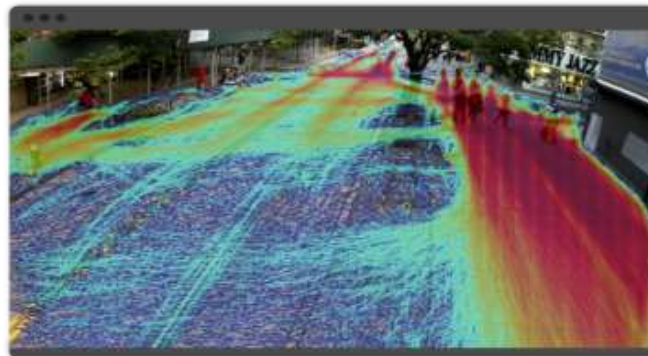
## 2.1 Solution architecture of proposed system

CCTVs and Drones can be used for human detection. Closed Circuit television (CCTV) are being used as a means of surveillance from a long time but due to its limitations it is not completely reliable. The drone thus has a better communication with the rest of the swarm in a particular area to follow the human while also dividing the areas between the drones dynamically so as to not lose track of the human. OpenCV, computer vision and deep learning are used to monitor social distancing across the region[14]. Initially, object detection is applied to detect pedestrians in a video stream. In the next step, the pairwise distances between all detected people are calculated and finally these distances are compared with the standard distance that should be maintained (6 feet or 2 meters) and are represented by red frame if they are violated and green frame otherwise. So, if 5- 6 people gather around in a particular area, the local authorities or the local police stations will be immediately notified. Recently, after the outbreak of this virus, the police Authorities need to patrol across the city and are bound to invest time unnecessarily[15]. Using this concept of social distancing detection, the police will be able to

monitor and reach the exact location and control the scenario immediately. Thus, social distancing can be controlled and indirectly the spread of COVID-19 be prevented. The below figure shows the steps for implementation of a social distancing detector[16]. "Since social distancing is essential to prevent the spread of Covid-19, but it was observed that social distancing was being violated at public places and hence the concept of "social distancing detector" is introduced. In this research we are using object detection to monitor safe distance between people. In the next step, the pairwise distances between all detected people are calculated and finally these distances are compared with the standard distance that should be maintained (6 feet or 2 meters) and are represented by red frame if they are violated and green frame otherwise.

### 3. MOTIVATION

As the pandemic situation has taken over the world, social distancing is one of the major precautions which needs to be taken. As people come together in crowds, they are more likely to come into close contact with someone that has COVID-19 and hence World Health Organization has proposed a strict law for maintaining physical distance of 1 meter (3 feet) in every pair[17]. Thus, to keep a track of the social distancing among the public this idea of social distancing detector emerged.



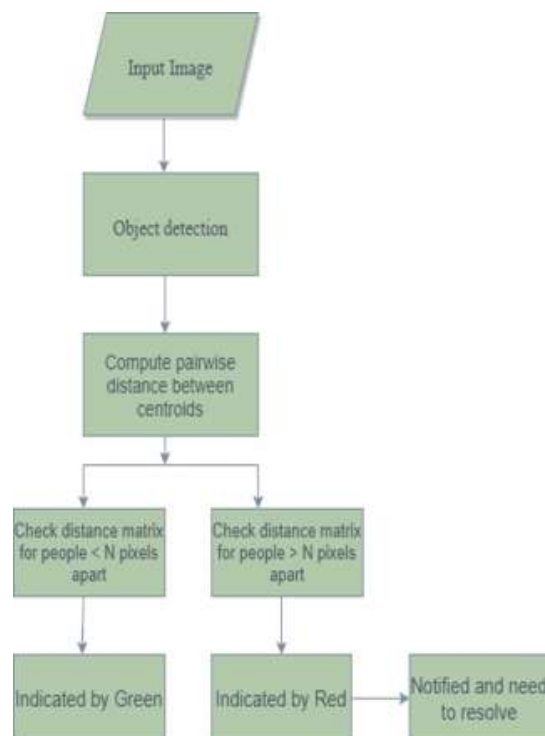
Computer vision of detection

This data helps city planners, mobility companies, and other stakeholders design better systems for people, bicycles, wheelchairs, strollers, and more. Last month, as COVID-19 spread began to peak in New York, they have shown how effectively social distancing is being followed.

Computer vision is also helping answer questions such as:

- Are people maintaining safe social distances?
- What surfaces are people touching that may need cleaning?

### 4. FLOWCHART



## 5. PROPOSED MODEL

The proposed system focuses on how to identify the person on image/video stream whether the social distancing is maintained or not with the help of computer vision and deep learning algorithm by using the OpenCV, Tensor flow library. Approach 1. Detect humans in the frame with yolov3. 2. Calculates the distance between every human who is detected in the frame. 3. Shows how many people are at High, Low and Not at risk. Camera Perspective Transformation or Camera Calibration: As the input video may be taken from an arbitrary perspective view, the first step is to transform perspective of view to a bird's-eye (top-down) view. As the input frames are monocular (taken from a single camera), the simplest transformation method involves selecting four points in the perspective view which define ROI where we want to monitor social distancing and mapping them to the corners of a rectangle in the bird's-eye view[18]. Also, these points should form parallel lines in real world if seen from above (bird's eye view). This assumes that every person is standing on the same flat ground plane. This top view or bird eye view has the property that points are distributed uniformly horizontally and vertically (scale for horizontal and vertical direction will be different). From this mapping, we can derive a transformation that can be applied to the entire perspective image[19].

We draw 8 points on first frame using mouse click event. First four points will define ROI where we want to monitor social distancing. Next 3 points will define 180 cm (unit length) distance in horizontal and vertical direction and those should form parallel lines with ROI [20][21]. In above image we can see point 5 and point 6 defines 180 cm in real life in horizontal direction and point 5 and point 7 defines 180 cm in real life in vertical direction. As we can see ROI formed by first 4 points has different length in horizontal and vertical direction, so number of pixels in 180 cm for horizontal and vertical direction will be different in rectangle (bird's eye view) formed after transformation.

### 5.1 Detection

The second step to detect pedestrians and draw a bounding box around each pedestrian. To clean up the output bounding boxes, we apply minimal post-processing such as non-max suppression (NMS) and various rule-based heuristics, so as to minimize the risk of over fitting.

### 5.2 Distance Calculation

Now we have bounding box for each person in the frame. We need to estimate person location in frame. i.e we can take bottom center point of bounding box as person location in frame. Then we estimate (x,y) location in bird's eye view by applying transformation to the bottom center point of each person's bounding box, resulting in the imposition in the bird's eye view. Last step is to compute the bird's eye view distance between every pair of people and scale the distances by the scaling factor in horizontal and vertical direction estimated from calibration.

### 5.3 Working

Running the program will give you frame (first frame) where you need to draw ROI and distance scale. To get ROI and distance scale points from first frame Code to transform perspective to Bird's eye view (Top view) and to calculate horizontal and vertical 180 cm distance in Bird's eye view ROI and Scale points' selection for first frame. The second step to detect pedestrians and draw a bounding box around each pedestrian. To detect humans in video and get bounding box details. Now we have bounding box for each person in the frame. We need to estimate person location in frame. i.e. we can take bottom center point of bounding box as person location in frame. Then we estimate (x, y) location in bird's eye view by applying transformation to the bottom center point of each person's bounding box, resulting in their position in the bird's eye view. To calculate bottom center point for all bounding boxes and projecting those points in Bird's eye view. Last step is to compute the bird's eye view distance between every pair of people (Point) and scale the distances by the scaling factor in horizontal and vertical direction estimated from calibration.

## 6. RESULT SCREENSHOTS



Fig: 3 [FPS 2:01]





Fig: 4 [FPS 2:02]



Fig: 5 [FPS 2:03]

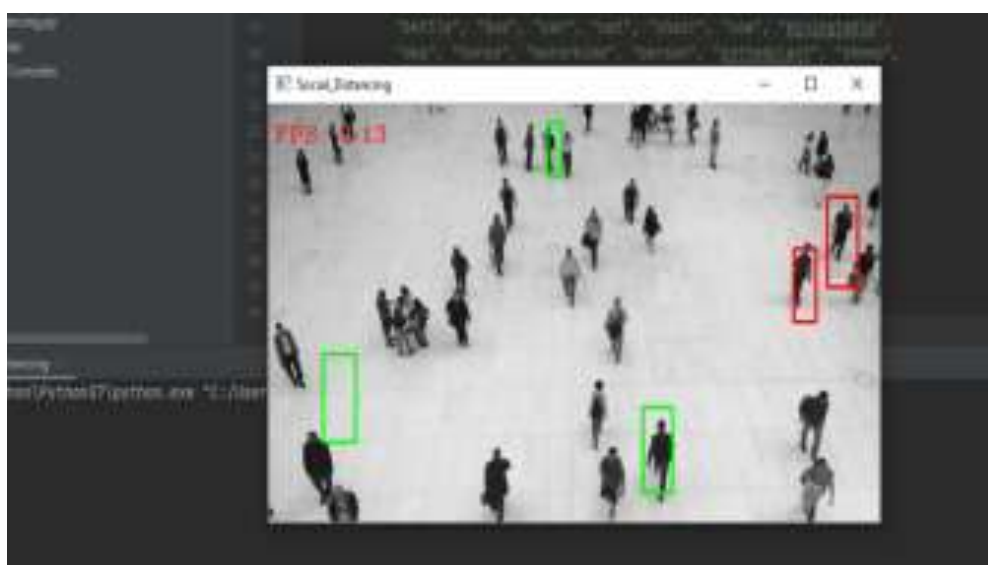


Fig: 6 [FPS 2:13]

## 7. CONCLUSION

In this paper, we just tried to help the society to fight against COVID-19. In the absence of a vaccine for COVID-19, social-distancing is the only solution left with human beings. As we envision the world post COVID-19 pandemic the need of self-responsibility emerges irrefutably. The scenario would mostly focus on accepting and obeying the precautions and rules that WHO has imposed more precisely as responsibility of one will totally embark on themselves and not government. Social Distancing would undoubtedly be the most important factor as COVID 19 spreads through close contact with infected ones. In order to supervise large mobs, an effective solution is important and this survey paper focuses on that. Using installed CCTV and drones, authorities can keep a track of human activities and control large crowd to come together and prevent violating the law. As far as people are maintaining a safe distance they would be indicated with green light, and as the CCTV captures more and more crowd gathering, red light would pop-up and the allocated police of that area will be notified and the situation can come under control immediately [6]. As controlling large mob is not an easy task, using this survey, conditions can be managed before situation goes out of control. Thus, implementing this idea can reduce the on-ground efforts of the police and they can entirely focus on supervising conditions exclusively on those areas where conditions are unfavorable and thus, they can utilize time wisely and save energy for equitable situations.

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