IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 6, May 2022
Impact Factor: 6.252

Social Distancing Detection Using OpenCV and Machine Learning

Kunal Narayan Gosavi[1], Chetan Shivaji Kawarkhe[2], Sanjivani Ajinath Tandle[3]
Department of Computer Engineering, Sinhgad Institute of Technology, Kusgaon (BK), Lonavala, Maharashtra[1,2,3]

Abstract: - *COVID-19 has terribly affected the world, and it is rapidly spreading every day. Due to this ongoing COVID-19 pandemic, many Governments have implemented various social distancing measures such as travel restrictions, closing public places and warning their citizens to keep a 1-meter distance from each when they have to go outside. The main safety measure suggested by WHO is to maintain Social Distance, to reduce the risk of infection when someone coughs, sneezes or speaks. Therefore, we aim to develop a framework that tracks humans for monitoring the social distancing being practiced. To accomplish this objective of social distance monitoring, an algorithm is developed using object detection methods. Here, a YOLOv3 based object detector is explored to detect human presence. The object detector's output is used for calculating distances between each pair of humans detected. This approach of social distancing algorithm will redly mark the persons who are getting closer than a permissible limit.*

Keywords: - Social Distancing, YOLOv3, OpenCV, Object Detection, etc.

I. INTRODUCTION

COVID-19 has spread rapidly worldwide since it began, greatly affecting people's lives, social economies and medical systems. It was first reported in Wuhan, China, in late 2019. As of Oct 23, 2020, 217 countries and regions around the world are affected by COVID-19 and reported approximately 42 million confirmed cases and 1.14 million deaths. Figure 1 illustrates the total number of cases and the total number of deaths from Jan 22, 2020, to Oct 23, 2020. According to the World Health Organization, a person can become infected with COVID-19 if he comes in contact with other virus-infected persons. Till date, no medicine or vaccine is yet developed to quell this deadly virus. Therefore, there is a need to look for an alternative control measure to prevent the spread of this fatal virus. At present, little is known about the disease, and vaccines are still under development. Therefore, in the face of severe outbreaks, previous effective experience can help people better protect themselves and their families. The aim of this article is to discuss the social distancing measures for COVID-19.

To contain the pandemic, many countries have implemented a lockdown where the government enforced the citizens to stay at home during this critical period. The public health bodies such as the Centres for Disease Control and Prevention (CDC) had to make it clear that the most effective way to slow down the spread of Covid-19 is by avoiding close contact with other people. To flatten the curve on the Covid-19 pandemic, the citizens around the world are practicing physical distancing.

This research is aimed to support and lessen the coronavirus pandemic along with minimum loss of economic practices, and propose a solution to detect social distancing among people gathered at any public place. Social distancing aims to reduce the physical distance between an infected person and a healthy person.

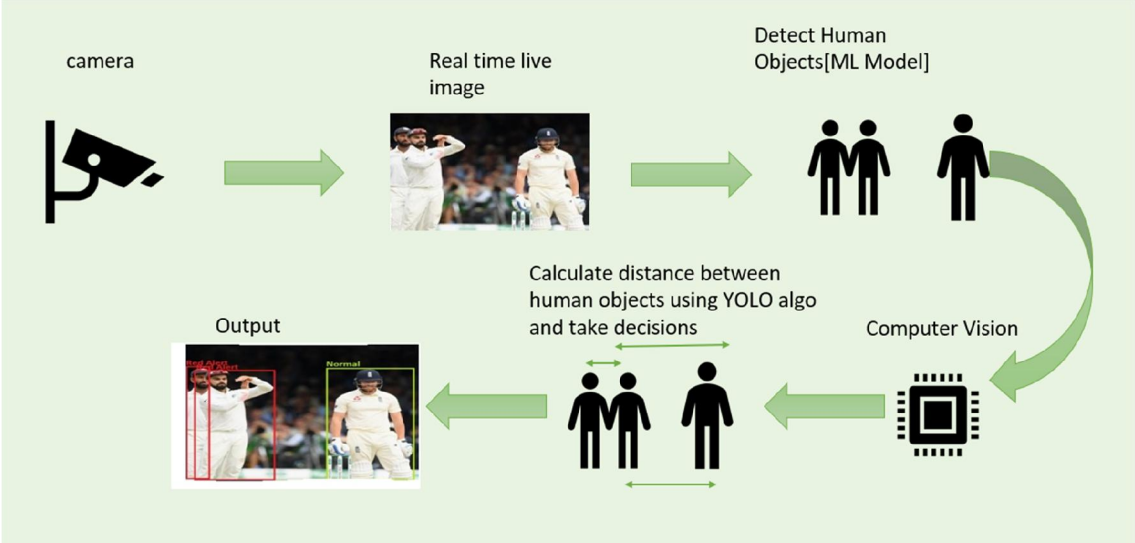
To implement social distancing there are various technologies proposed such as Convolutional Neural Network (CNN), Deep learning, YOLO V3, AI, OpenCV. Convolutional Neural Network, AI is helpful to detect a person in a live camera frame. With the help of YOLO, we can track and calculate the distance between two or more people. The above diagram shows how social distancing is effective in prevention of infections.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 6, May 2022
Impact Factor: 6.252

II. MOTIVATION

Social distancing is the most effective technique to stop spreading of infectious diseases. Social distancing has been tremendously useful in COVID situation. some law enforcement departments have been using drones and other surveillance cameras to detect mass gatherings of people, and taking regulatory actions to disperse the crowd. Such manual intervention in these critical situations might help flatten the curve, but it also brings a unique set of threats to the public and is challenging to the workforce. Many research findings have been reported in the last few years. Social distancing is an effective measure against the novel corona virus Disease 2019 (COVID-19) pandemic. However, the general public is not used to keep an imaginary safety bubble around themselves. Every place where there are high chances of crowd gathering such as a mall or movie theatre or an airport can use this application.

III. SYSTEM ARCHITECTURE

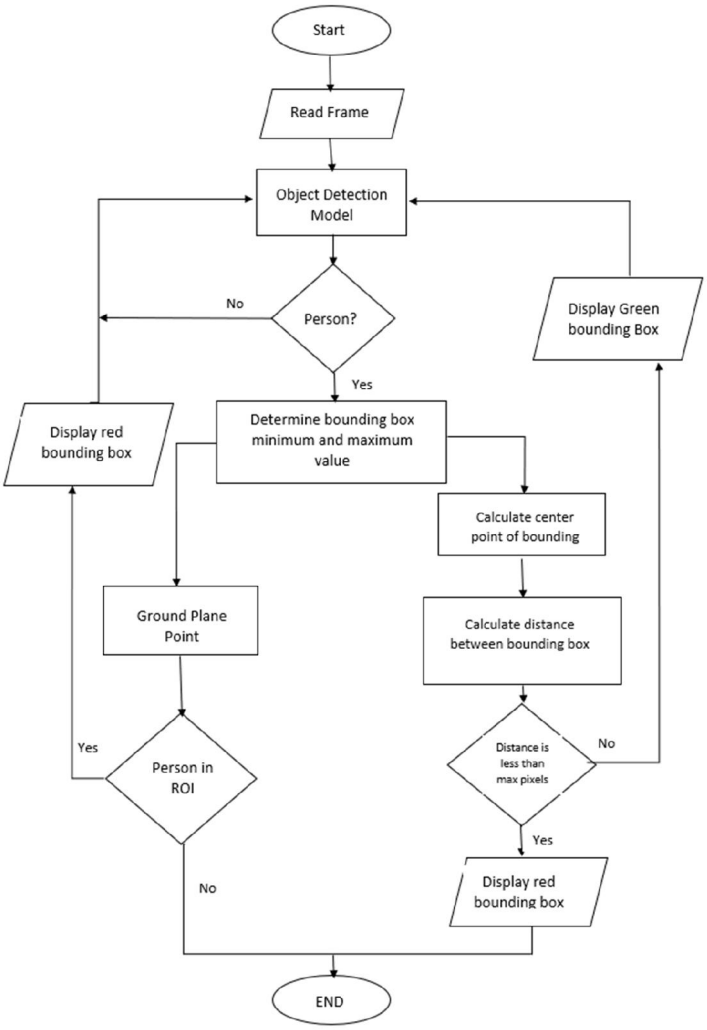


- When the proposed model is run, first of all it starts camera and takes a frame from live video feed.
- Then YOLO processes the image and detects person. YOLO provides good accuracy and speed in object detection.
- Find the number of people in the frame/Image.
- Create Bounding Box over the people identified using YOLO.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 6, May 2022
Impact Factor: 6.252

- A width threshold is set for object among which the distance is measured
- Find the distance between, the centre point of bounding box of one person to another person in meters.
- NMS (Non-maxima suppression) is also used to reduce overlapping bounding boxes to only a single bounding box, thus representing the true detection of the object. Having overlapping boxes is not exactly practical and ideal, especially if we need to count the number of objects in an image.
- Euclidean distance is then computed between all pairs of the returned centroids. Simply, a centroid is the centre of a bounding box.
- Based on these pairwise distances, we check to see if any two people are less than/close to 'N' pixels apart.
- If the distance gets closer as per given threshold, then the bounding boxes will change the colour to red and if the distance is greater than the given threshold the boxes will stay in green colour.
- After detecting violation or social distancing it will alert with a sound.

IV. SEQUENCE DESIGN



IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 6, May 2022
Impact Factor: 6.252

In above system design you can see how the program starts with reading the frame followed by object detection model, i.e., YOLO v3. Once the object detection begins working using the pre-trained models, it is then followed by checking the social distancing of all the person present in the live video frame which will be detected by the webcam. The choices are made on the basis of the applied condition and accordingly the red or green box will surround the person detected by the pre-trained model in the live video frame which is being
currently detected and will send alert on the basis of the count. The alert will be seen by the person that will be monitoring the video at that time and accordingly he or she can take the required actions and ensures to make sure that social distancing is being followed. The total count of people not following social distancing that is the people in the red boxes will be seen in the bottom left side of the screen and as per the count when the certain limit is crossed there will be a notification pop up on the bottom right side of the screen in the laptop.

VI. METHODOLOGY

- Collect data from various sources to train model for object detection. The main source of this dataset would be the COCO Open-Source database of images which is a recognized database for Object detection techniques.
- The next step involves applying various state of the art models for object recognition like Fast R-CNN and YOLO (You Only Look Once) to detect people/pedestrians. The model with the better accuracy will be selected to be used in the project for further use.
- The original images will be then converted into a 2D top to down view to apply the principles of coordinate geometry on it and change the camera perspective. This will be done with the OpenCV library.

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \qquad (1)$$

- The next step would be distance measurement wherein distance between every pedestrian pair can be computed with the distance formula and the pair of pedestrians with the distance below the threshold(t) will be marked red and otherwise green.

$$c = \begin{cases} red & d < t \\ green & d \geq t \end{cases} \qquad (2)$$

- The output visual footage will be displayed with all the detection and analysis.

VII. RESULT

Below are some of the screenshots of the output of the working program model. It is categorized into two stages, stage one is where the two people are detected from a live camera video feed frame. In stage two we have added the warning alert with a sound which can be audible when the alert is triggered.

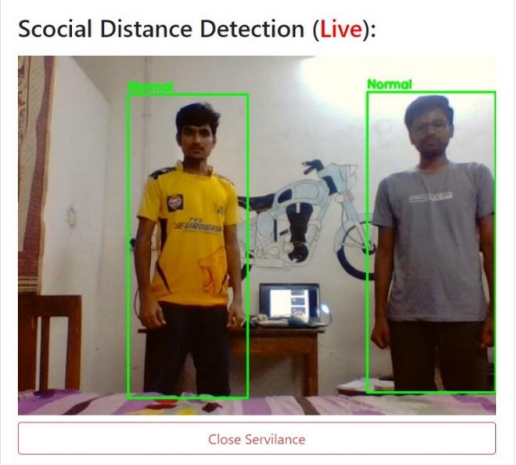


Image 1

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 6, May 2022
Impact Factor: 6.252

Image 2

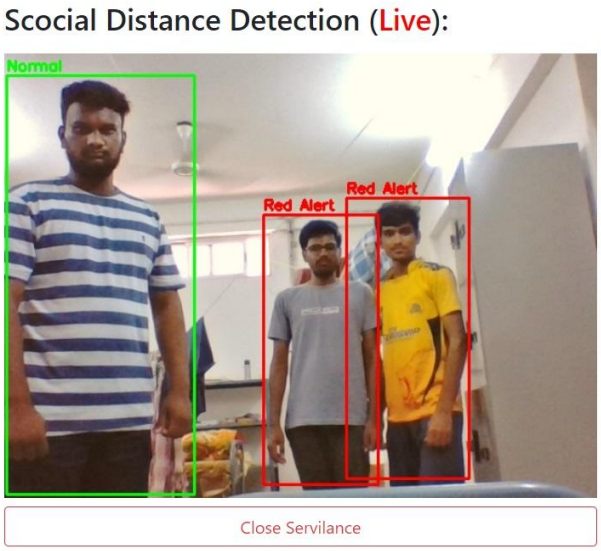


Image 3

VIII. CONCLUSION

In this project, we proposed about social distancing detection tool using deep learning model. The proposed method was validated using a video showing pedestrians walking on a street. Comparing to other classifier algorithms, YOLO algorithm is much more efficient and fastest algorithm to use in real time. The visualization results showed that the proposed method is capable to determine the social distancing measures between people which can be further developed for use in other environment such as office, restaurant, and school. Furthermore, the work can be further improved by optimizing the pedestrian detection algorithm, integrating other detection algorithms such as mask detection and human body temperature detection, improving the computing power of the hardware, and calibrating the camera perspective view.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 6, May 2022
Impact Factor: 6.252

ACKNOWLEDGEMENT

This work is practically supported by the grant from the Sinhgad Institutes of Technology, Lonavala. We thank Prof. R.A. Maske for her guidance in this project.

REFERENCE

[1] Joseph Redmon, Santosh Divvala, Ross Girshick, "You Only Look Once: Unified, Real-Time Object Detection", The IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2016, pp. 779-788.
[2] YOLO Juan Du1," Understanding of Object Detection Based on CNN Family", New Research, and Development Centre of Hisense, Qingdao 266071, China.
[3] Matthew B. Blaschko Christoph H. Lampert, "Learning to Localize Objects with Structured Output Regression", Published in Computer Vision – ECCV 2008 pp 2-15.
[4] Wei Liu, Dragomir Anguelov, Dumitru Erhan, "SSD: Single Shot MultiBox Detector", Published in Computer Vision – ECCV 2016 pp 21-37.
[5] Lichao Huang, Yi Yang, Yafeng Deng, Yinan Yu DenseBox, "Unifying Landmark Localization with End-to-End Object Detection", Published in Computer Vision and Pattern Recognition (cs.CV).
[6] Dumitru Erhan, Christian Szegedy, Alexander Toshev, "Scalable Object Detection using Deep Neural Networks", The IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2014, pp. 2147-2154.
[7] Shaoqing Ren, Kaiming He, Ross Girshick, Jian Sun, "Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks", Published in Advances in Neural Information Processing Systems 28 (NIPS 2015).
[8] Joseph Redmon, Ali Farhadi, "YOLO9000: Better, Faster, Stronger", The IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2017, pp. 7263-7271.
[9] Jifeng Dai, Yi Li, Kaiming He, Jian Sun, "R-FCN: Object Detection via Region-based Fully Convolutional Networks", published in: Advances in Neural Information Processing Systems 29 (NIPS 2016).
[10] Karen Simonyan, Andrew Zisserman, "Very Deep Convolutional Networks for Large-Scale Image Recognition", published in Computer Vision and Pattern Recognition (cs.CV).