A NOVEL APPROACH FOR COVID-19 DEEP LEARNING-BASED SOCIAL DISTANCE MONITORING FRAMEWORK

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Abstract — In this paper, proposes a deep learning based framework for automating the task of monitoring social distancing using surveillance video. The proposed framework utilizes the YOLO v3 object detection model to segregate humans from the background and Deepsort approach to track the identified people with the help of bounding boxes and assigned IDs. The results of the YOLO v3 model are further compared with other popular state-of-the-art models, e.g. faster region-based CNN (convolution neural network) and single shot detector (SSD) in terms of mean average precision (mAP), frames per second (FPS) and loss values defined by object classification and localization. Later, the pairwise vectorized L2 norm is computed based on the three-dimensional feature space obtained by using the centroid coordinates and dimensions of the bounding box. The violation index term is proposed to quantize the non adoption of social distancing protocol. From the experimental analysis, it is observed that the YOLO v3 with Deepsort tracking scheme displayed best results with balanced mAP and FPS score to monitor the social distancing in real-time.

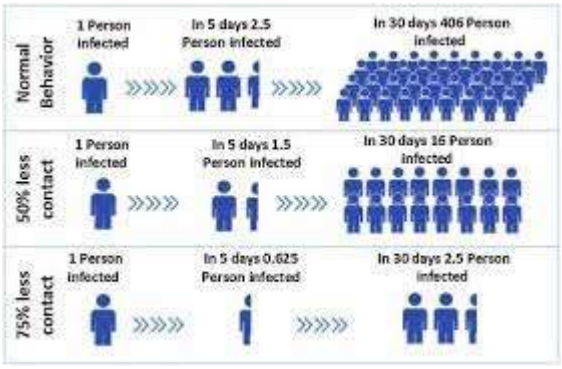
Keywords — Deep Learning, Convolution Neural Network(CNN), Single Shot Detector (SSD) Mean Average Precision (Map), Frames Per Second (FPS).

INTRODUCTION

COVID-19 belongs to the family of coronavirus caused diseases, initially reported at Wuhan, China, during late December 2020. On March 11, it spread over 114 countries with 118,000 active cases and 4000 deaths, WHO declared this a pandemic [1], [2]. On May 4, 2020, over 3,519,901 cases and 247,630 deaths had been reported worldwide. Several healthcare 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.

Many healthcare organizations, scientists, and medical professionals are searching

for proper vaccines and medicines to overcome this deadly virus, although no progress is reported to-date. To stop the virus spread, the global community is looking for alternate ways. The virus mainly spreads in those people; who are in close contact with each other (within 6 feet) for a long period. The virus spreads when an infected person sneezes, coughs, or talks, the droplets from their nose or mouth disperse through the air and affect nearby peoples. The droplets also transfer into the lungs through the respiratory system, where it starts killing lung cells. Recent studies show that individuals with no symptoms but are infected with the virus also play a part in the virus spread.



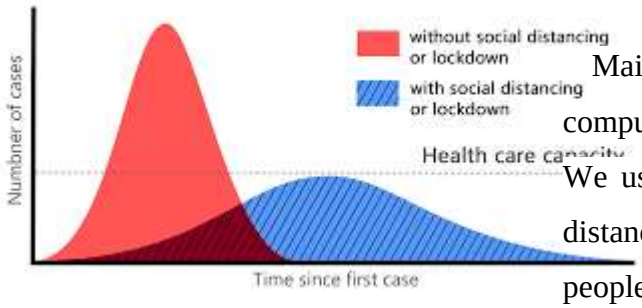
LITURATURE SURVEY

M. W. Fong,H. Gao,J. Y. Wong,J. Xiao, E. Y. Shiu.

We conducted systematic reviews of the evidence base for effectiveness of multiple mitigation measures: isolating ill persons, contact tracing, quarantining exposed persons, school closures, workplace measures/closures, and avoiding crowding. Evidence supporting the effectiveness of these measures was obtained largely from observational studies and simulation studies. Voluntary isolation at home might be a more feasible social distancing measure, and pandemic plans should consider how to facilitate this measure. More drastic social distancing measures might be reserved for severe pandemics.

Ainslie et al. (2020) investigated the relationship between the region's economic situation and the social distancing strictness. The study revealed that moderate stages of exercise could be allowed for evading a large outbreak. So far, many countries have used technology-based solutions.

Nguyen et al. (2020) provides a survey of different emerging technologies, including Wi-fi, Bluetooth, smartphones, and GPS, positioning (localization), computer vision, and deep learning that can play a crucial role in several practical social distancing scenarios. Some researchers utilize drones and other surveillance cameras to detect crowd gatherings.



PROPOSED METHOD

- This article proposes a deep learning based framework for automating the task of monitoring social distancing using surveillance video. The proposed framework utilizes the YOLO v3 object detection model to segregate humans from the background and Deepsort approach to track the identified people with the help of bounding boxes and assigned IDs. The results of the YOLO v3 model are further compared with other popular state-of-the-art models, e.g. faster region-based CNN (convolution neural network) and
- single shot detector (SSD) in terms of mean average precision (mAP), frames per second (FPS) and loss values defined by object classification and localization. Later, the pairwise vectorized L2 norm is computed based on the three-dimensional feature space obtained by using the centroid coordinates and dimensions of the bounding box.
- **ADVANTAGE:** The violation index term is proposed to quantize the non adoption of social distancing protocol. From the experimental analysis, it is observed that the YOLO v3 with Deepsort tracking scheme displayed best results with balanced mAP and FPS score to monitor the social distancing in real-time.

RELATED WORK

Mainly centroid information, is used to compute each bounding box centroid distance. We used Euclidean distance and calculated the distance between each detected bounding box of peoples. Following computing centroid distance, a predefined threshold is used to check either the distance among any two bounding box centroids is less than the configured number of pixels or not. If two people are close to each other and the distance value violates the minimum social distance threshold. The bounding box information is stored in a violation set and the color of the bounding box is updated/changed to red. A centroid tracking algorithm is adopted for tracking so that it helps in tracking of those people who violate/breach the social distancing threshold. At the output, the model displays the information about the total number of social distancing violations along with detected people bounding boxes and centroids. In this work, YOLOv3 is used for human detection as it improves predictive accuracy, particularly for small-scale objects. The main advantage is that it has adjusted network structure for multi-scale object detection.

- Social distancing is surely the most trustworthy technique tostop the spreading of infectious disease, with this belief, in the background of December 2019, when COVID-19 emerged in Wuhan, China, it was opted as an unprecedented measure on January 23, 2020 [13]. Within one month, the outbreak in China gained a peak in the first week of February with 2,000 to 4,000 new confirmed cases per day. Later, for the first time after this outbreak, there have been a sign of relief with no new confirmed cases for five consecutive days up to 23 March 2020 [14]. This is evident that social distancing measures enacted in China initially, adopted worldwide later to control COVID-19.
- Influenza virus infections are believed to spread mostly by close contact in the community. Social distancing measures are essential components of the public health response to influenza pandemics. The objective of these mitigation measures is to reduce transmission, thereby delaying the epidemic peak, reducing the size of the epidemic peak, and spreading cases over a longer time to relieve pressure on the healthcare system.

DISADVANTAGES:

- Since the novel coronavirus pandemic began, many countries
- have been taking the help of technology based solutions
- In different capacities to contain the outbreak [18], [19], [20].
- Many developed countries, including India and South Korea,
- for instance, utilising GPS to track the movements of the
- suspected or infected persons to monitor any possibility of
- their exposure among healthy people. In India, the government
- is using the Arogya Setu App, which worked with the help
- of GPS and bluetooth to locate the presence of COVID-19
- patients in the vicinity area. It also helps others to keep a
- safe distance from the infected person

CONCLUSION

A deep learning-based social distance monitoring framework is presented using an overhead perspective. The pre-trained YOLOv3 paradigm is used for human detection. As a person's appearance, visibility, scale, size, shape, and pose vary significantly from an overhead view, the transfer learning method is adopted to improve the pre-trained model's performance.

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