



Social Distance Monitoring Using Drone

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ABSTRACT

Within the present times, the priority and danger of the COVID-19 virus still stand large. Manual looking of social distancing norms is impractical with associate in nursing oversized population moving concerning and with the short task force and resources to administer them. There is a want for a light-weight, robust, and 24*7 video-monitoring system that automates this technique. This paper proposes a comprehensive and effective resolution to perform person detection and social distancing violation detection exploitation object detection, agglomeration and Convolution Neural Network (CNN) based binary classifier. The framework uses the Scaled-YOLOv4 seeing paradigm to identify humans in video sequences. The detection formula uses a pre-trained formula that's connected to an additional trained layer using a frontal human information set. The detection model identifies peoples exploitation detected bounding box information. Exploitation the mathematician distance, the detected bounding box centroid's pairwise distances of individuals unit determined. A threshold is used to estimate the social distance violations between people. Here, we have a tendency to tend to use Associate in nursing approximation of physical distance to pixel to line the sting price. A violation threshold is established to live whether or not the gap price breaches the minimum social distance threshold. To boot, a trailing formula is employed to sight individuals in video sequences such the one that violates/ crosses the social distance threshold is, additionally, being half-track. Experiments unit administered on whole completely different video sequences to ascertain the efficiency of the model. Findings indicate that the developed framework successfully distinguishes individuals UN agency walk too about to and breach/violate social distances.

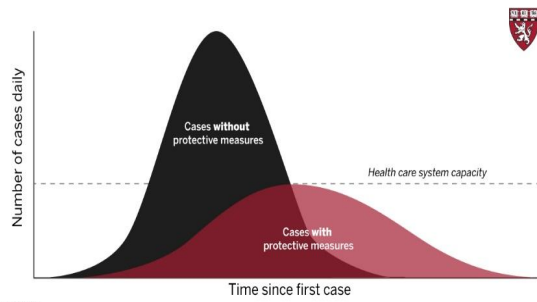
Key words : COVID-19, Deep learning, Social distancing, Side-view, Person detection, Scaled-YOLOv4.

1. INTRODUCTION

China reported a totally distinctive coronavirus in city, China, on legal holiday Eve, 2019 (Gralinski and Menachery 2020). Since then several cases began to rise within the alternative regions of China and overseas. China shared the novel coronavirus respiratory illness sequence on January 12, 2020. As of January 22, 2020, 572 cases of COVID-19 had been reported in twenty five provinces (including districts and cities) in China (Lu 2020). The patients showed typical metabolism symptoms (such as fever, coughing, shortness of breath, and inflammatory respiratory organ infiltration) and alternative symptoms like fatigue, myalgia, and diarrhoea (Huang et al. 2020). Some cases were atypical or showed well symptoms throughout this epidemic. On February 11, 2020, the World Health Organization named this respiratory illness Coronavirus Disease-2019 (COVID-19). As of April 13, 2020, coronavirus respiratory illness cases were confirmed in two hundred countries and regions worldwide. The case death rate (CFR) of COVID-19 was 2.3% (44/1023), a lot of but that of respiratory disorder (10%) and MERS (36%) (de Wit et al. 2016; Wu dialect and McGoogan 2020). suspected COVID-19 patients (with symptoms) are often diagnosed by chest CT and enzyme chain reaction (PCR) kit. However, there are no specific effective antiviral medication for treatment, and thus the vaccinum was still within the experimental stage (Zumla et al. 2016).

The virus in the main spreads in those that area unit in shut contact with associate each other } (within half-dozen feet) for an extended amount. the most reason for transmission is metabolism droplets and shut contact. Recent studies show that people with no symptoms however area unit infected with the virus conjointly play a section within the virus unfold (W. C. D. C. Dashboard). Social distancing concerned keeping a distance of 1.5 m between folks, which can stop the unfold of most metabolism infectious diseases. Social distancing is one among the foremost effective measures to cut back the unfold of the virus, that is transmitted by air droplets.

If social distancing is enforced at the start stages, it will perform a crucial role in overcoming the virus unfold and preventing the pandemic disease’s peak, as illustrated in “Fig. 1.1 , 1.2 , 1.3 , 1.4”. This provides an answer for police work folks gathering publicly places like banks, searching malls, clinics, etc. The conception of an individual finding formula is employed to accurately detect a person’s presence in areas of interest and is then followed by measurement the gap between the detected persons.



source: CDC
Figure 1.1 : Effect of social distancing plotted in a graph



Figure 1.2 : Social distance monitoring



Figure 1.3 : Social distance monitoring from a different perspective

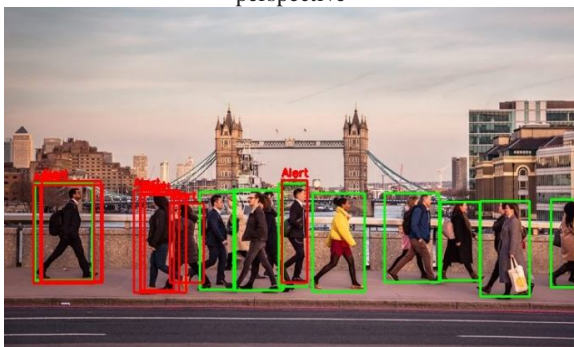


Figure 1.4 : Social distance monitoring on a crowded area

In this work, we tend to used frontal or vista pictures or video sequences shown in Fig.2 to supply associate in nursing economical framework for social distance observance. This work aims to gift a deep learning-based social distance observance framework for the general public field surroundings from a side-view perspective.

A deep learning model, i.e., YOLOv4 (You Only Look Once) is applied for human detection. The present model (pre-trained) is ab initio tested on the frontal or vista knowledge set. The detection model acknowledges humans and provides bounding box data. When human detection, the Euclidian distance between every known center of mass combine is computed victimisation the detected bounding box and its center of mass data. A minimum social distance violation threshold such as victimisation picture element to distance assumptions is predefined. The calculable knowledge is matched with the violation threshold to verify whether or not the calculated distance comes underneath the violation set or not. The bounding box’s color is once initialized as green; if the bounding box comes underneath the violation set, its color is updated to red. In extension, the center of mass chase formula is utilized to trace a personal UN agency desecrated the social distancing threshold.

2. LITERATURE REVIEW

After the increase of the COVID-19 pandemic since late December 2019, the term social distancing has become a often used word. It's one in every of the foremost reliable follows to stop contagious virus transmission and opted as commonplace practice on January 23, 2020 (B. News, 2020). The follow of social distancing proven to be of utmost importance because the decrease within the range of patients was noted in sure countries. Ainslie *et al.* (2020) investigated the association between the region’s economic state of affairs and thus the social distancing strictness. The study unconcealed that moderate stages of exercise can be allowed for evading associate large irruption. So far, several countries have used technology-based solutions to regulate and overcome the pandemic. many developed countries are using GPS technology to observe the movements of infected and suspected people. Nguyen *et al.* (2020) give a survey of assorted rising technologies, as well as Wi-fi, Bluetooth, smartphones, and GPS, positioning (localization), pc vision, and deep learning which can play a crucial role in many sensible social distancing situations. Some researchers utilize drones and alternative police work cameras to sight crowd gatherings (Harvey & uranologist, 2019; Robakowska *et al.*, 2017).

So far, researchers have done extended work for detection. Researchers give effective solutions for social distance measurement victimisation police work videos aboard pc vision,

machine learning, and deep learning-based approaches. Object detection has matured to doable heights, and hence, a lot of experimenting with innovative ideas is finished. Sathyamoorthy, Patel, Savle, Paul, and Manocha (2020) performed human detection in several packed environments^[3]. The model is supposed for those who don't adapt a social distance restriction, ideally, 6feet away. The authors used a mobile mechanism with associate RGB-D camera and a 2-D measuring device to make collision-free navigation in mass gatherings. terribly recently, supported the CSP approach (Constraint Satisfaction Problem), Chien-Yao Wang, Alexey Bochkovskiy, and Hong-Yuan Mark dynasty projected a network scaling approach that modifies not solely the depth, width, resolution however conjointly the structure of the network. The YOLOv4-large model achieves progressive results: 55.5% AP (73.4% AP50) for the MS coconut tree dataset at a speed of ~16 Federal Protective Service on Tesla V100, whereas with the take a look at time augmentation, YOLOv4-large achieves 56.0% AP (73.3 AP50).

As so much as is understood, this is often presently the best accuracy on the coconut tree dataset among any printed work. The YOLOv4-tiny model achieves 22.0% AP (42.0% AP50) at a speed of 443 Federal Protective Service on RTX 2080Ti whereas victimisation TensorRT, batch size = 4 FP16-precision the YOLOv4-tiny achieves 1774 Federal Protective Service. Ideas like Queue Management Approach for Social Distancing and phone Tracing and Safety Violation Alert supported segmental ROI have conjointly been unbroken forward however need a lot of higher levels of collaboration and create a prospect of being abused its options.

3. METHODOLOGY

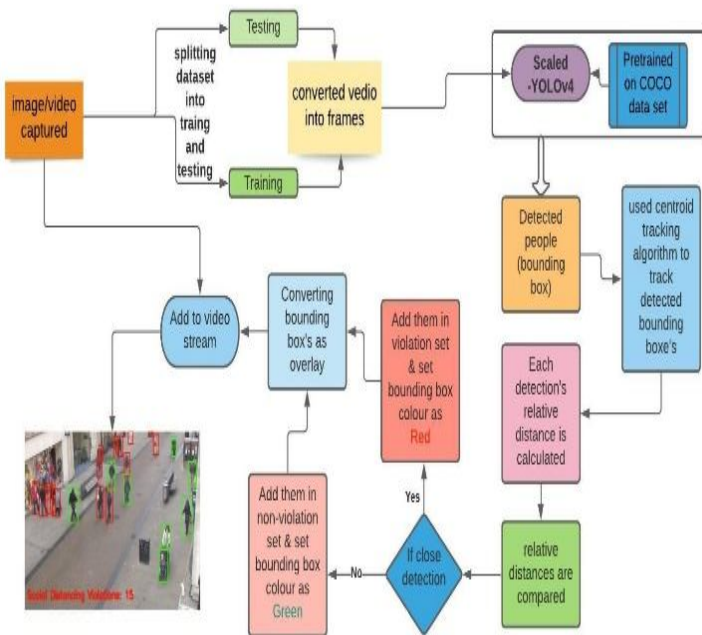


Figure 3.1: Flow diagram of social distance monitoring framework

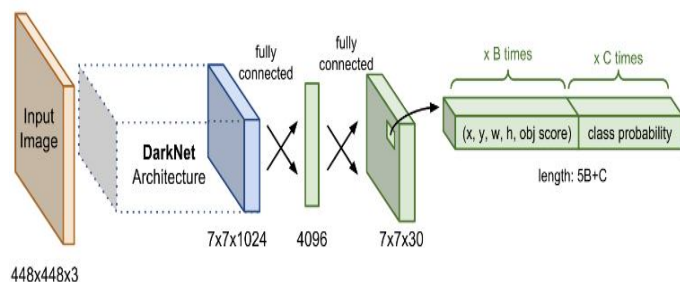


Figure 3.2 : YOLO architecture

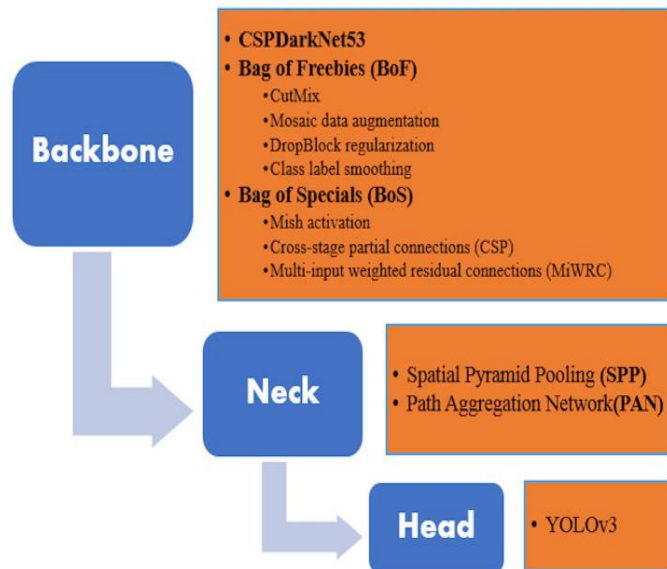


Figure 3.3 : YOLOv4 architecture

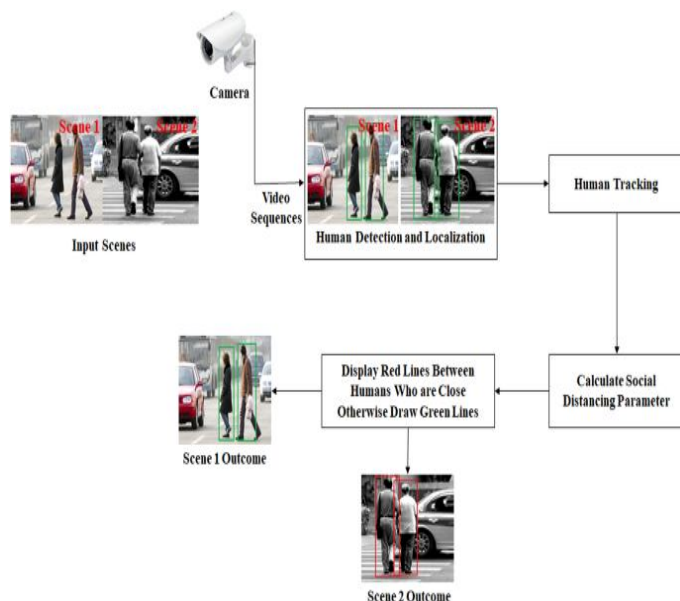


Figure 3.4 : Block diagram of social distance monitoring

In this work, a deep learning-based social distance observation framework employing a frontal or side-perspective has been introduced. The flow chart of the framework is given in Fig. 3.1. The recorded frontal or aspect knowledge set area unit split into coaching and testing sets. A Scaled-YOLOv4 rule is employed for human detection in sequences. The model applies a single-stage network to see the bounding boxes and sophistication chances. The model was originally trained on the palm knowledge set.

The bounding box info is employed then to cypher every bounding box centre of mass distance when detection. The geometric distance and calculated the space is employed between every detected bounding box of peoples. Following computing centre of mass distance, a predefined threshold is employed to envision either the space among any 2 bounding box centroids may be a smaller quantity than the organized variety of pixels or not. If 2 folks area unit on the brink of 1 another and thus the space price violates the minimum social distance threshold. The bounding box info is hold on in an exceedingly violation set, as seen in “Fig. 3.2”, and therefore the color of the bounding box is updated/changed to red. A centre of mass chase rule is adopted for chase in order that it helps in chase those folks that violate/breach the social distancing threshold. At the output, the model displays the data regarding the complete variety of social distancing violations aboard detected folks bounding boxes and centroids^[2].

In this work, Scaled-YOLOv4 is employed for human detection. YOLOv4, as compared with its direct precursor YOLO v3, average preciseness (AP) and FPS multiplied by ten to twelve nothing. In experiments on the MS palm [42] dataset, it obtained a 43.5% AP score and achieved a period of time speed of roughly sixty five FPS on Tesla V100, vanquishing over the foremost correct and quickest detectors in terms of each accuracy and speed. Most of the detectors need multiple GPUs for coaching with Associate in nursing oversize batch size; whereas, coaching on one GPU makes the coaching method terribly slow. YOLO v4 resolved this issue by presenting a quick and correct object detector which will be trained with a smaller batch size on one GPU. Scaled YOLO v4 is that the best neural network for object detection and therefore the most correct (55.8% AP Microsoft palm test-dev) among neural network printed. additionally, it's the simplest in terms of the magnitude relation of speed to accuracy within the entire vary of accuracy and speed from fifteen FPS to 1774 FPS. “Fig. 3.3” represents a diagrammatical illustration of YOLO v4 design.

Backbone: It employs CSPDarknet53 as a feature extractor with a graphics process unit (GPU). Few backbones area unit a lot of acceptable for classification than for detection. For instance, CSPResNext50 is healthier than CSPDarknet53 for image classification; whereas, CSPDarknet53 is tested higher in terms

of object detection. For higher detection of tiny objects, the backbone model wants a better network size as input and for higher receptive fields a lot of layers area unit needed^[4].

Neck: It uses Path Aggregation Network (PAN) and spatial Pyramid Pooling (SPP) for feature map extraction. PAN employed in YOLO v4 is that the extended version of the first PAN wherever addition is replaced with concatenation. within the initial version when minimizing N4 size to induce a similar spatial size of P5, they summed this new depleted N4 with P5. This reoccurs in the slightest degree layers of P_{i+1} to form N_{i+1} . In YOLO v4 instead of adding metallic element with every P_{i+1} , they concatenated them^[1].

If we tend to glass SPP it in the main will max-pooling over $19 \times 19 \times 512$ feature map distinct kernel sizes $k = 5, 9, 13$ with a similar artifact to stay the spatial size same. Four feature maps area unit incorporated to make $19 \times 19 \times 2048$ magnitude. This will increase the neck receptive field with improvement within the model's accuracy and lowest rise of illation time.

Head: YOLO v4 utilizes a similar head as YOLO v3 with the anchor-based detection steps.

The YOLOv4 design is trained employing a side-view knowledge set. The model is trained with the palm dataset what is more, the extra knowledge set trained layer is extra with the prevailing design. during this manner, the model takes advantage of the pre-trained and freshly trained info, and each detection results area unit more delivered higher and faster detection results. It is seen from the higher than figure Fig.4 that the design contains the Input image layers that area unit chargeable for obtaining the inputs that might be passed to more layers, the input is any image relying upon the employment cases. Besides the input layer comes the DarkNet design. DarkNet is associate in nursing ASCII text file neural network framework written in C & CUDA and this framework options YOLO for object detection & object tracking.

Further, the design consists of the planate layer that is densely connected with the convolutional layer that is additionally densely connected to pass the info from every node to alternative nodes at intervals the design, similarly, this can be passed to the output layer that provides 4-part values, those four elements describe the expected price for the bounding box, denoted by x, y, w, h , at the side of the article detection score and the likelihood of the expected category. This YOLO is an element of the One-Shot object detector family that is correct & quick.

4. RESULT

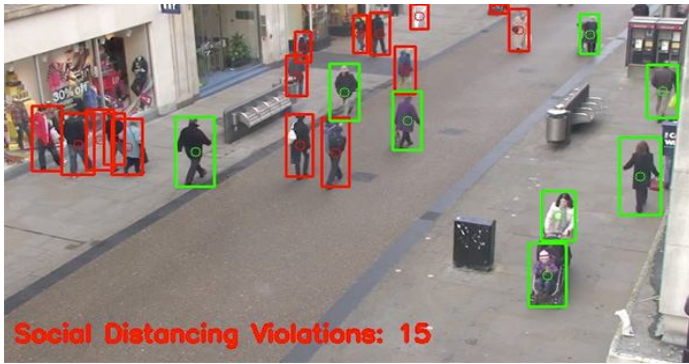


Figure 4.2 : Social distance monitoring using a pre-trained detection model

The elaborated descriptions of varied experiments meted out during this work area unit conferred during this section. For social distance watching, the palm dataset is employed. The information assortment is split into seventieth and half-hour coaching and testing, severally. There's no restriction on the quality of persons throughout the scene. Peoples within the scene move freely; their visual look is plagued by radial distance and camera position. From example frames, it will be determined that the human's visual look isn't identical, and people's heights, poses, scales area unit variable within the knowledge set. For implementation, we tend to used OpenCV. The experimental results of the pre-trained model area unit mentioned below.

Results of social distance watching employing a pre-trained model:-

The testing results of the social distance framework employing a pre-trained model is shown in Fig.7. The testing results area unit evaluated victimization completely different video sequences. Since the model solely considers the human (person) class; thus, solely associate degree object having associate degree look sort of a human is detected by a pre-trained model. The pre-trained model delivers smart results and detects numerous size person bounding boxes. Individuals area unit marked with inexperienced rectangles as they maintain a social distancing threshold. In Fig.7 2 individuals at the centre of the scene area unit marked with red bounding boxes as they violate or breaches the social distancing threshold.

5. CONCLUSION

Social distancing is one among the necessary precautions in reducing physical contact which will result in the unfold of coronavirus. Consequences of non-compliance with these pointers are inflicting higher rates of virus transmission. A system has been developed victimisation Python and OpenCV

library to implement the projected options. The pre-trained YOLOv4 paradigm is employed for human detection. The model is trained on a frontal information set, and also the recently trained layer is appended with the present model. The detection model provides bounding box info, containing center of mass coordinates info. Victimisation the Euclidian distance, the pairwise center of mass distances between detected bounding boxes are measured. To see social distance violations between folks, associate degree approximation of physical distance to the pel is employed, and a threshold is outlined. A violation threshold is employed to visualize if the space price violates the minimum social distance set or not. What is more, a center of mass pursuit rule is employed for pursuit peoples at intervals the scene. Experimental results indicated that the framework with efficiency identifies folks walking too shut and violates social distancing.

6. LIMITATION AND FUTURE STUDIES

Based on the general results, this study is seen to fulfill all of its objectives. However, there square measure some limitations to the results obtained. Supported the tests performed on the system, the results show that the item detection model used for detective work persons has the problem in following objects once they square measure fast-moving. With the raised speed of the drone, the clarity of the video goes down and affects the accuracy. And it needs higher hardware specifications for period high accuracy action and speedy net property for period fast access and method of the videos. The following accuracy of the model is 95%. The work could also be improved within the future for various indoor and out of doors environments. Completely different detection and following algorithms can be accustomed facilitate track the person or people that square measure violating or breaches the social distancing threshold.

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