Real Time Human Tracking and Social Separation System Using Yolov5

by

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Introduction

- COVID-19 pandemic has now spread to 188 nations worldwide. WHO says, there have been 247,352,866 confirmed COVID-19 cases and 5,013,900 deaths worldwide as of October 31, 2021.
- It's symptoms include fever and chills. Infected individuals had a high temperature in 99% of cases.
- This project attempts to stop the virus from spreading throughout communities and save people's lives.

Motivation

- Social distancing is the recommended strategy for minimising physical contact with potential COVID-19 carriers.
- Massive impact on numerous economic sectors worldwide.
- Countries that implemented lock-down saw a decrease in COVID-19 cases and deaths.

Literature Survey

- To avoid the spread of disease, social distancing and temperature screening are helpful methods. Many organisations, including the WHO, have recommended them.
- The influence of social distancing tactics was underlined by N. Kahale [3]. The goal of the study was to come up with a rough estimate of how early social distancing techniques can significantly reduce economic loss and the number of new infections.
- J. Berglund [3] proposed using GPS and built-in applications in smartphones to track a person infected with COVID-19. However, this technology has limits when it comes to tracking those who don't have access to Wi-Fi or phone service.

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- S. Saponara, A. Elhanasi [7] proposed an artificial framework for the social distancing grouping of people utilizing thermal pictures. Using the YOLOv2, a detection procedure is produced which is used for distinguishing and tracking individuals.
- Yolov5 received 140 FPS on Tesla P100[16]. therefore in comparison to the other algorithms Yolov5 shows us the possibility of receiving higher fps rates in our system as well.

Objective

The goals in this project are:

- Track Humans present in a video stream and calculate distance between them.
- Improve the FPS rate in comparison to the previous system.

System Architecture

- The system employs the YOLOv5 object detection algorithm for people tracking.
- Using recognised bounding box data, the detection model separates people into groups
- Euclidean distance is used to resolve the pairwise distances between the centroid of the distinct bounding boxes of the individuals.

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- Social distancing detector steps
  - Prepare a video stream from a CCTV camera which contains people.
  - Applying the deep learning object detector to detect people in images or video streams.
  - Check the number of persons that are in the images or video stream.
  - Compute the distance between the centroid of the bounding boxes which are enclosed to the detected people.
  - Finally, the algorithm will decide for safe or unsafe social distancing based on the number of persons and the measured distance between the centroid of bounding boxes.

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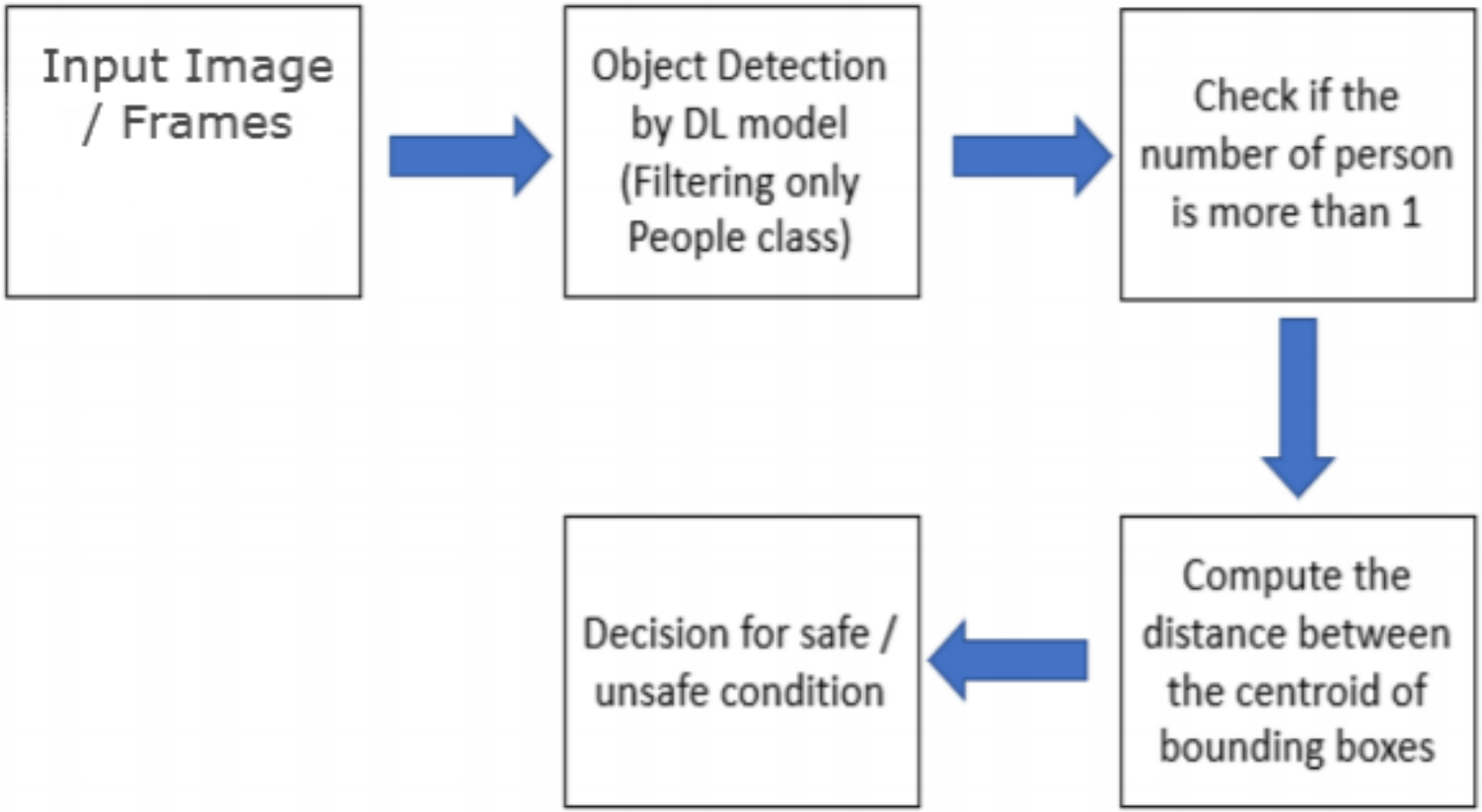

Figure: The steps involved for people detection and social distancing classifcation on thermal images. [7]

Yolov5

- CSPNet is used as a backbone in Yolov5 to extract features from an input image.
- PANet is utilised as the neck in Yolov5 to obtain feature pyramids.
- The head of the Yolov5 model is same as that of the Yolov3 and Yolov4 models.
- Leaky ReLU and sigmoid function are used as activation functions.
- Binary Cross-Entropy with Logits Loss function is used to calculate loss in class probability and object score.

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- YOLO v5 provides a faster surmising speed of up to 40fps with a one-third the model size and a 60-70 percent improvement in exactness in comparison to Yolov3.
- YOLO v5 also has a high level of accuracy when it comes to distinguishing smaller and farther away objects.
- There are 4 different network model for Yolov5 , they are Yolov5s (small network), Yolov5m (medium network), Yolov5l (large network), Yolov5x (extra large network).
- Out of the four organization strategies for Yolov5, we have eperimented on the Yolov5s and Yolov5l.

Results

- Mean average precision for Yolov5s and Yolov5l are 0.925 and 0.930 respectively.
- Precision parameter for Yolov5s and Yolov5l is 0.911 and 0.92 respectively.
- Recall parameter for Yolov5s and Yolov5l are 0.850 and 0.874 respectively.
- FPS received on Yolov5s 31-36.
- FPS received on Yolov5l 29-34.

Results

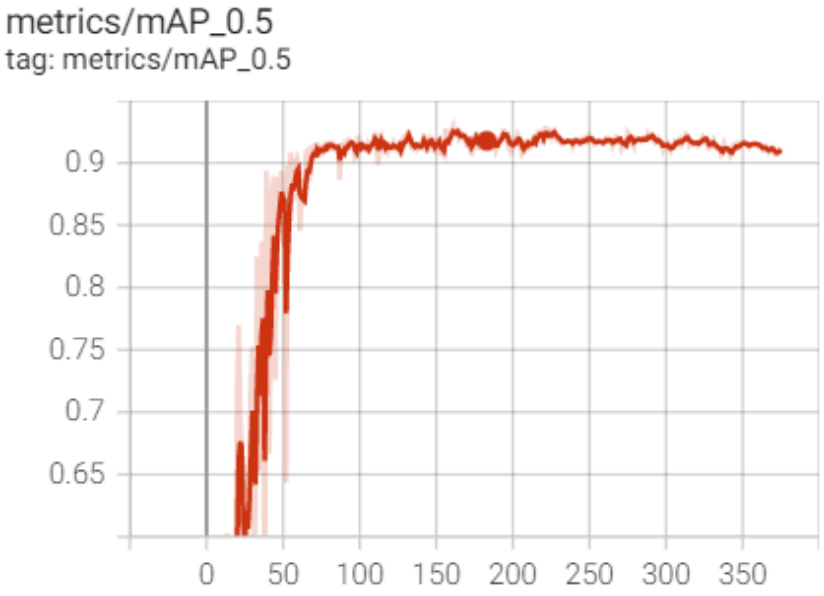

Figure: YOLOv5s mAp.

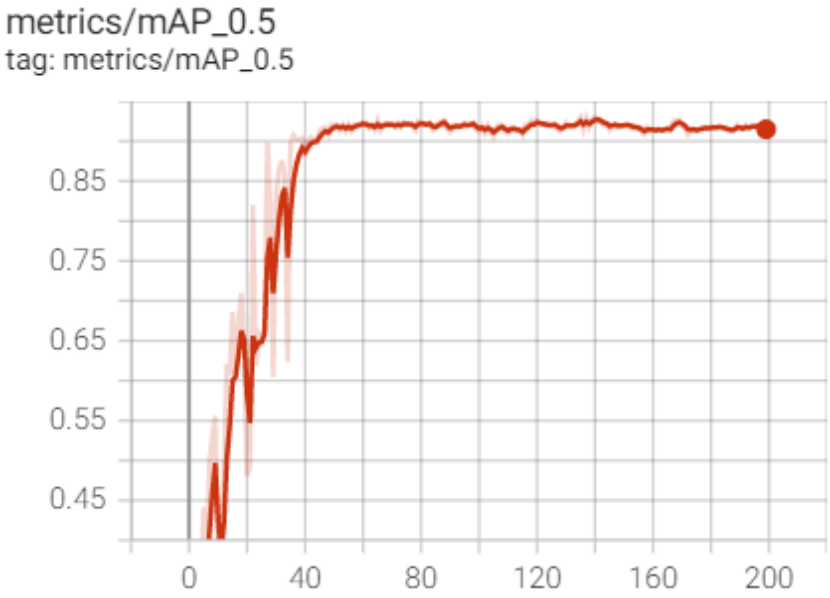

Figure: YOLOv5l mAp.

Results

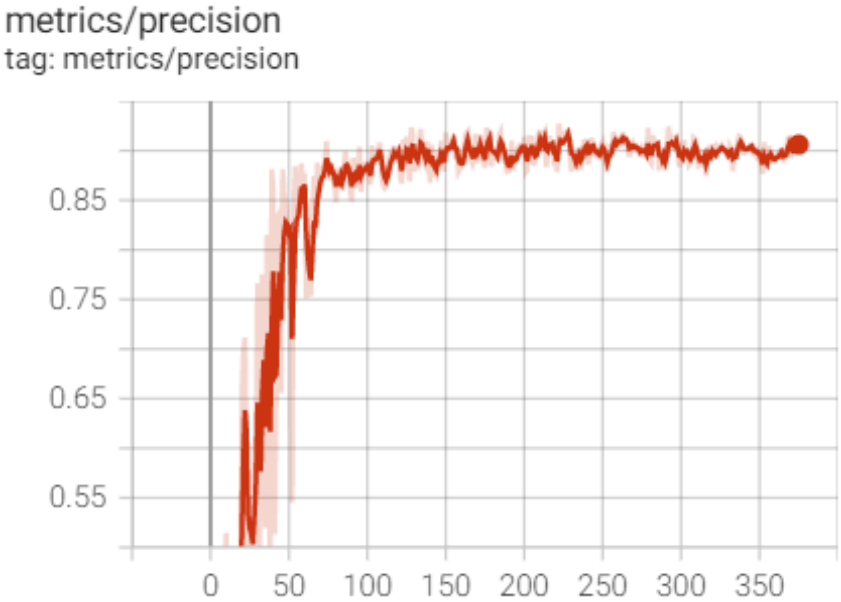

Figure: YOLOv5s precision.

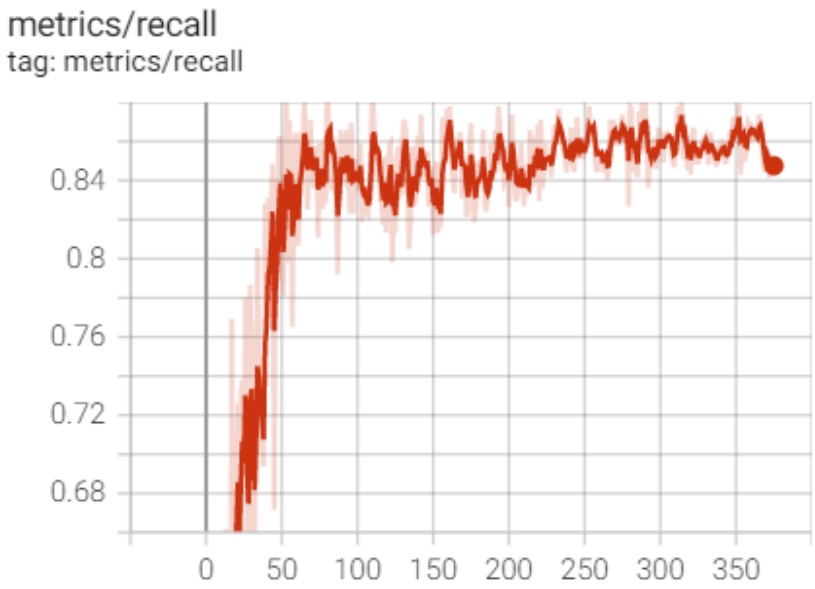

Figure: YOLOv5s Recall.

Results

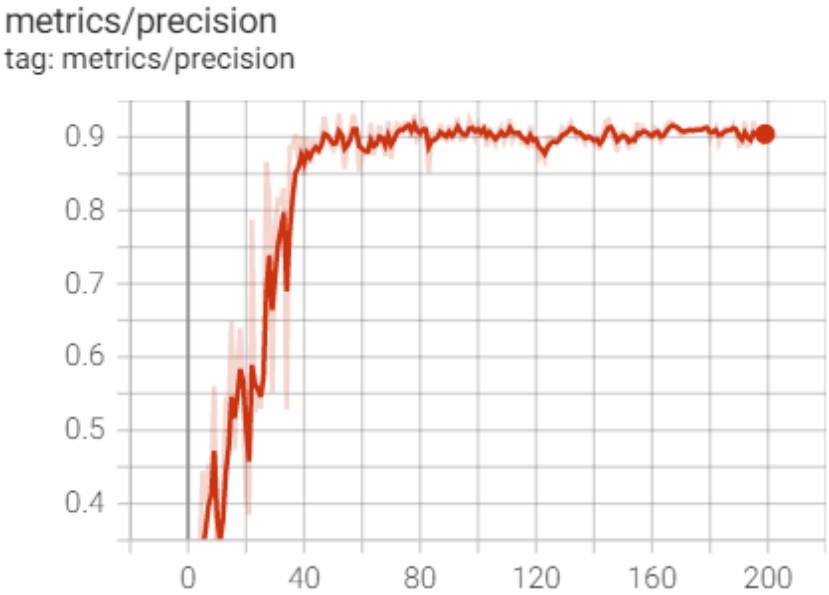

Figure: YOLOv5l precision.

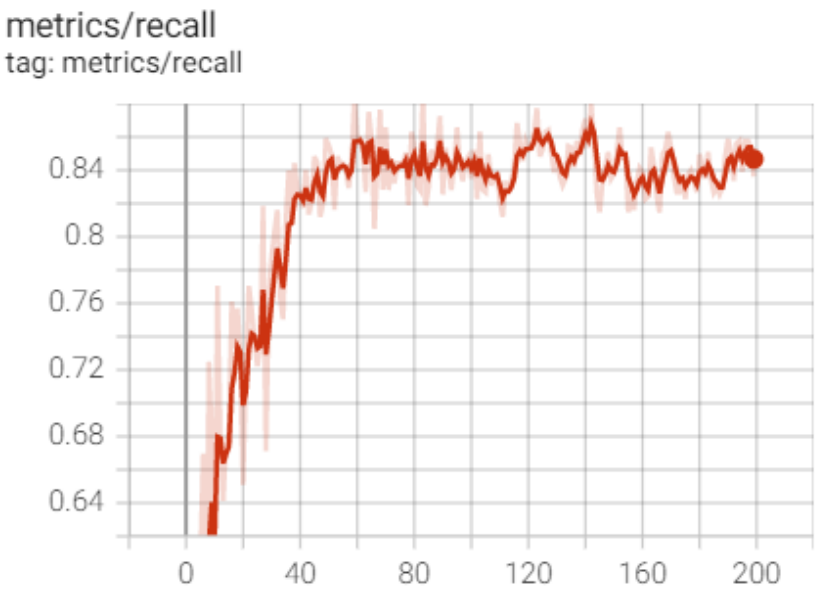

Figure: YOLOv5l Recall.

Results

Figure: Input Image

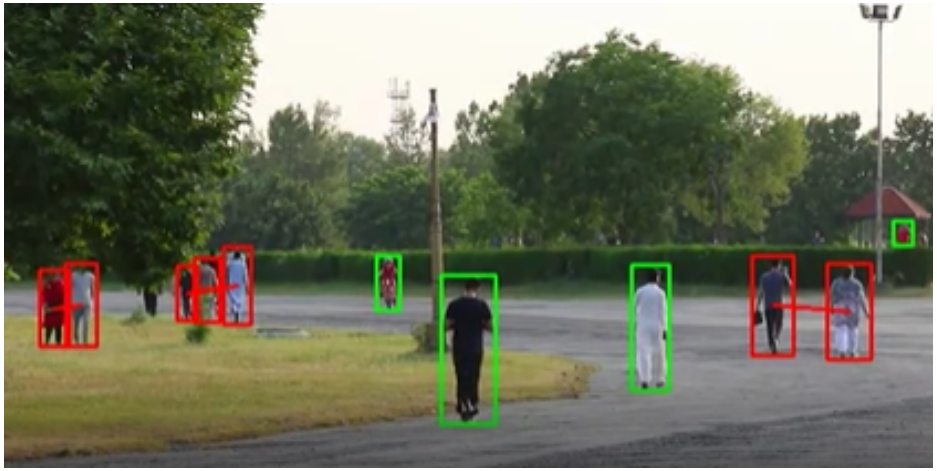

Figure: Resulting Image after Yolov5 and distance detection steps.

Future Scope

- Can be extended to 3D through which we can eliminate the perspective effect.
- The proposed approach can be implemented in a distributed video surveillance system and drones.

References I

- 2021. Computer Vision Object Detection: challenges faced. Exposit. <www.exposit.com/blog/computer-vision-object-detection-challenges-faced/>
- Prem, K., Liu, Y., Russell, T.W., Kucharski, A.J., Eggo, R.M., Davies, N., Flasche, S., Clifford, S., Pearson, C.A., Munday, J.D. and Abbott, S., 2020. The effect of control strategies to reduce social mixing on outcomes of the COVID-19 epidemic in Wuhan, China: a modelling study. The Lancet Public Health, 5(5), pp.e261-e270.
- Kahalé, N., 2020. On the economic impact of social distancing measures. Available at SSRN 3578415.
- Berglund, J., 2020. Tracking COVID-19: there's an App for that. IEEE pulse, 11(4), pp.14-17.

References II

- Georgievski, Borijan, 2020. IObject Detection and Tracking in 2020. Medium.
- Pitts, W. and McCulloch, W.S., 1947. How we know universals the perception of auditory and visual forms. The Bulletin of mathematical biophysics, 9(3), pp.127-147.
- Saponara, S., Elhanashi, A. and Gagliardi, A., 2021. Implementing a real-time, AI-based, people detection and social distancing measuring system for Covid-19. Journal of Real-Time Image Processing, pp.1-11.
- Wang, X., Ng, H.W. and Liang, J., 2017, November. Lapped convolutional neural networks for embedded systems. In 2017 IEEE Global Conference on Signal and Information Processing (GlobalSIP) (pp. 1135-1139). IEEE.

References III

- Kajabad, E.N. and Ivanov, S.V., 2019. People detection and finding attractive areas by the use of movement detection analysis and deep learning approach. Procedia Computer Science, 156, pp.327-337.
- Punn, N.S., Sonbhadra, S.K., Agarwal, S. and Rai, G., 2020. Monitoring COVID-19 social distancing with person detection and tracking via fine-tuned YOLO v3 and Deepsort techniques. arXiv preprint arXiv:2005.01385.
- Manfredi, M., Vezzani, R., Calderara, S. and Cucchiara, R., 2014. Detection of static groups and crowds gathered in open spaces by texture classification. Pattern Recognition Letters, 44, pp.39-48.

References IV

- Alahi, A., Bierlaire, M. and Vandergheynst, P., 2014. Robust real-time pedestrians detection in urban environments with low-resolution cameras. Transportation research part C: emerging technologies, 39, pp.113-128.
- Jocher, G., 2020. <https://github.com/ultralytics/yolov5>
- Rajput, M., 2020. YOLO V5 — Explained and Demystified. Towards AI.
- Chen, W., Liqiang, Z., Tianpeng, Y., Tao, J., Yijing, J. and Zhihao, L., 2021, August. Research on the state detection of the secondary panel of the switchgear based on the YOLOv5 network model. In Journal of Physics: Conference Series (Vol. 1994, No. 1, p. 012030). IOP Publishing.

References V


Nelson,J., Solawetz,J., 2020, YOLOv5 is Here: State-of-the-Art Object Detection at 140 FPS. <blog.roboflow.com>