SOCIAL DISTANCING DETECTION WITH DEEP LEARNING MODEL

Kokila.B [1], Muthukumar N [2], Mounikha R [3]

[1] *Assistant Professor, Department of Computer Science & Engineering, Sri Ramakrishna Institute Of technology, Perur Chettipalayam, Pachapalayam, Coimbatore, India*

[2] *Under Graduate Student, Department of Computer Science & Engineering, Sri Ramakrishna Institute Of technology, Perur Chettipalayam, Pachapalayam, Coimbatore, India*

[3] *Under Graduate Student, Department of Computer Science & Engineering, Sri Ramakrishna Institute Of technology, Perur Chettipalayam, Pachapalayam, Coimbatore, India*

ABSTRACT

The ongoing Covid-19 pandemic is a global disaster that disrupted the normal life of the people and caused more than 2 million deaths worldwide. It is important to monitor the social distance and wear masks at public places and take actions accordingly. This tool was developed to alert humans to maintain a safe distance with each other by video feed. Deep learning gained more attention in object detection which is used for human detection purposes. The video frame from the camera is used as input, and the open-source object detection YOLOv3 object detection is used to identify humans in video sequences. Then, the video frame is transferred into Bird-Eye view for distance measurement from the 2D plane. The distance between people can be estimated and any non-compliant pair of people in the video will be indicated with a red bounding box. If the people maintaining the safer distance, then it will show in green bounding box. By calculating the distance among individuals who are identified in the frame, the number of people who are at violating social distance is classified and indicated. The method will be able to determine the distancing measures between multiple people in indoor.

Keyword: - *Social distancing, Computer vision, Pattern Recognition, Deep Learning*

1. INTRODUCTION

The Social distance monitoring system is a real time system which monitors the social distance between each person in public based on real-time image analysis and gives an alert to concerned authorities, if the distance breaches the given limit. The necessity of social distancing detection is explained in the background history of this chapter. The problem to be addressed is discussed in the problem statement section of this chapter. Large number of social interactions being taken place. The Social distance monitoring system is a real time system which monitors the social distance between each person in public based on real-time image analysis and gives a non-intrusive alert to concerned authorities, if the distance breaches the given limit. The system can also calculate the social density within a particular area that gives us real-time statistics which help us in further improving the model.

On March 11, 2020, the World Health Organization (WHO) announced it a pandemic disease as the virus spread through 114 countries, caused 4000 deaths and 118,000 active cases. On October 8, 2020, they reported more than

35,648,543 confirmed COVID-19 cases, including 1,042,798 deaths. The latest number of people are infected due to deadly disease.

2. LITERATURE SURVEY

In recent paper [1] has identified how emerging technologies like AI, thermal, computer vision, ultrasound, and visible light can enable or alert the people to force them to follow social distancing. This work explained the basic concepts, models, practical scenarios and measurements for social distance monitoring.

Deep learning techniques, addressed in paper [2], are applied to construct a classifier to collect images of a person wearing a face mask and not wearing from the database, observed properly including the wearing of the facemask. This paper proposes the use of a CNN to detect the facemask classifier and to include the effect on the predictive performance of the number of the convolution neural layer.

Paper [3] proposed a combined face detection and social distancing in a lite system that does not require GPUs. The benefit of such a system is its ability to deploy locally on mobile devices without requiring constant connection to a cloud server. The first module will be human detection. For this purpose, they proposed to use a lightweight computation model which will initially partition the image. This will be followed by selecting the appropriate features using CNN with the help of the RFB module which aggregates multiple convolutions onto each other. CNNs with transfer learning approach is used. They proposed to use ResNet as the pre-trained model that will perform feature selection and output generation. The third module is based upon the distance calculation between humans using Euclidean distances between centroids. Calculated the L2 norm in a three-dimensional feature space based on a set of bounding boxes with the ID of each person. The closeness will be judged upon the violation of a certain threshold.

In paper [4], the scope is revolving around Edge-Based Social Distancing Detection: the social distancing detection approach is composed of a client and a server application. The most intelligent part of the service is at the server side, which uses the received GPS coordinates of users in order to calculate the distances and generate warning messages if deemed appropriate.

In paper [5], Main Focus is towards the object detection, along with human identification, can be achieved by retraining the existing deep learning models on a dataset consisting of people live camera footage can be fed to one of the lightweight object detection models such as MobileNets and objects can be detected even using lower-end hardware.

Paper [6] is focused on detecting people in areas of interest using the MobileNet Single Shot Multibox Detector (SSD) object tracking model and OpenCV library for image classification. In addition to social distance measures, another key feature of the system is detecting the presence of people in restricted areas, which can also be used to trigger warnings. But this system includes a drawback that the object detection model used for detecting persons is the difficult to detect people correctly in the outdoor environment and difficult scenes with distant scenes.

In paper [7] The approach used in this work is interesting but the result does not contain any statistical analysis and any privacy concern rather than violation index. The key goals mentioned in a work based on deep learning [8] are to deploy pre-trained YOLOv3 for human detection and computing their bounding box centroid information and of the bounding box detected. By utilizing a centroid tracking algorithm to keep track of the person who violates the social distance threshold. This work mainly explains the application of transfer learning along with the pre trained model to boost the overall accuracy and efficiency of the model. The accuracy of 92% and 98% were achieved by the detection model without and with transfer learning, respectively.

This paper [9] has proposed a methodology for social distancing detection using deep learning to evaluate the distance between people to mitigate the impact of this corona virus pandemic. The detection tool was developed to

alert people to maintain a safe distance with each other by evaluating a video feed. The video frame from the camera was used as input, and the open-source object detection pre-trained model based on the YOLOv3 algorithm was employed for pedestrian detection.

In another work [10], it proposes a three-stage model including people detection, tracking, inter-distance estimation as a total solution for social distancing monitoring and zone-based infection risk analysis. This work also explains the methodologies to reduce the error in Euclidean distance calculation by eliminating the perspective error caused when converting the 3D space to 2D pixels. This work proposes a Deep Neural Network-Based human detector model to detect and track static and dynamic people in public places in order to monitor social distancing metrics.

3. PROPOSED SYSTEM

Our proposed system uses single stage object detector (YOLO stands for You Only Look Once) which is often considered a competitor of other existing models. It can detect object fastest rate, and can run at more than 170 FPS on a modern GPU.YOLO struggles with smaller objects. But the architecture is constantly evolving from its earlier variants (YOLO v2) while training represents the process of learning the weights of the model from the training dataset. Due to its simpler architecture, YOLO runs a lot faster than faster R-CNN. So, calculating distance by using these coordinates produce results with higher accuracy when compared to calculating distance by using the original frame captured.

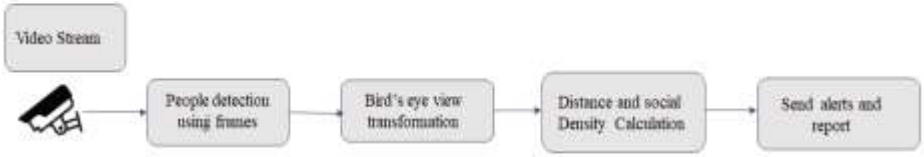

Fig 1: Proposed System

The proposed system, social distancing analyzer tool was developed using computer vision, deep learning, and python to detect the interval between people to maintain safety for detection of the people in the image or frame YOLOv3 is used in object detection network.

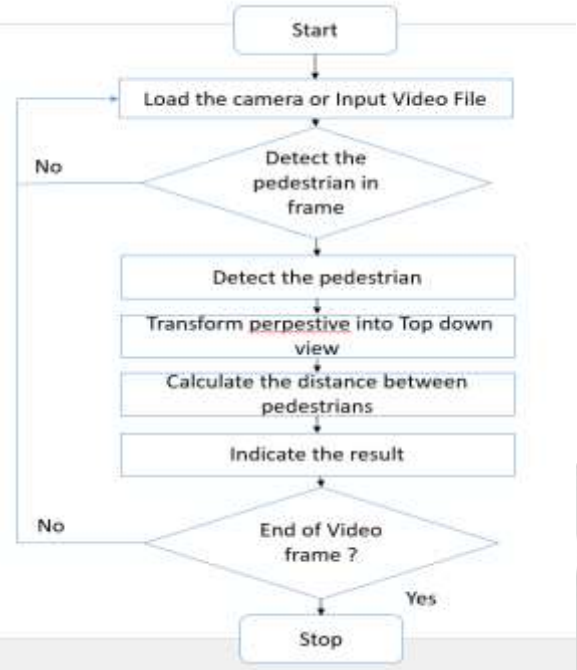

Fig 2: Flow Chart

4. METHODOLOGY

4.1DETECT PEDESTRIANS:

The first step is to detect pedestrians from the real time video stream and draw bounding boxes around each pedestrian detected in the footage. YOLO draws bounding boxes around each person based on the predictions made by the trained model.

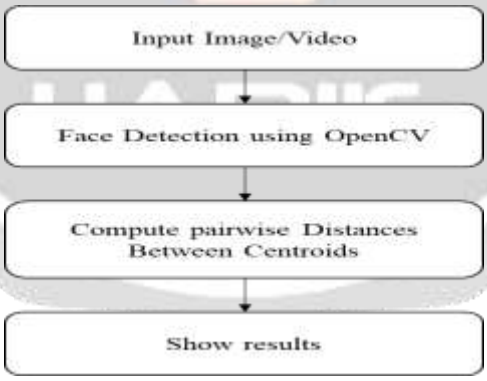

Fig 3: Detect Pedestrians

4.2 BIRD EYE VIEW TRANSFORMATION:

The second transformation method involves selecting seven points. First four define ROI where we want to monitor social distancing and mapping them to the corners of a rectangle in the bird's-eye view. This assumes that each person is standing on an equivalent flat ground plane.

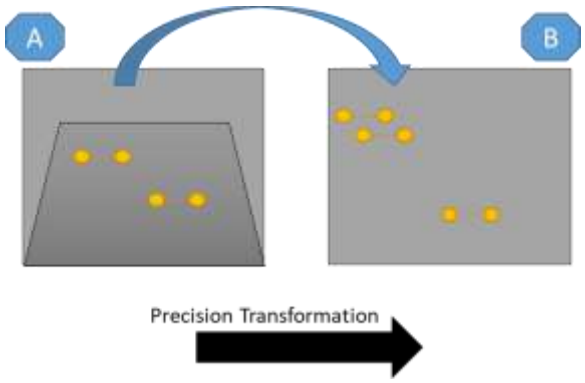

Fig 4: Bird eye view transformation

4.3 DISTANCE CALCULATION:

To estimate the person's location in frame, we can take the bottom center point of the bounding box as a person's location in frame. Then we estimate (x,y) location within the bird eye view (perspective view) by applying transformation to rock bottom center point of every person's bounding box, leading to their position within 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 in horizontal and vertical direction estimated from calibration

This distance calculation is done by using centroid tracking algorithm. CompCuting the Euclidean distance between the centroids of the input bounding boxes and the centroids of existing objects that already have calculated.

$$F = (P \times D)/W$$

$$D' = (W \times F)/P$$

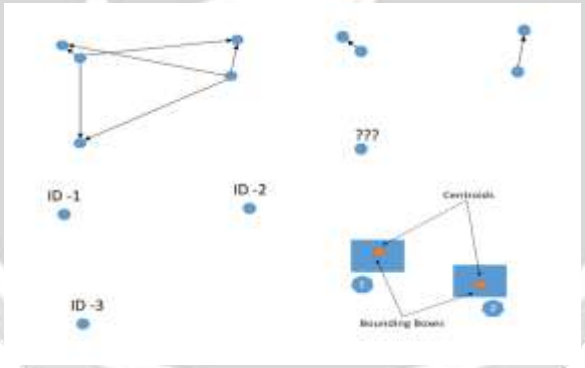

Fig 5: Distance Calculation

5. CONCLUSION AND FUTURE WORK

In this project, a social distance monitoring system which uses deep learning technique such as deep learning is presented. This work is the first attempt that makes use of transfer learning for a deep learning-based detection paradigm, used for overhead perspective social distance monitoring. Using the Euclidean distance, the centroid distances between two bounding boxes is measured. Based on the distance between the centroids, the system determines whether the social distance is being violated or

Furthermore, this tracking algorithm is used for tracking humans in the video. These results indicated that the framework continuously identifies people walking too close and violates social distancing. The Deep learning methodology increases the detection model's overall efficiency and accuracy. For a pre-trained model without

transfer learning, the model achieves detection accuracy of 92% and 95% with transfer learning. Different detection and tracking algorithms might be used to help track the person or people who are violating or breaches the social distancing.

6. REFERENCES

[1] Nguyen, C.T., Saputra, Y.M., Van Huynh, N., Nguyen, N.T., Khoa, T.V., Tuan, B.M., Nguyen, Chatzinotas, S., 2020. A comprehensive survey of enabling and emerging technologies for social distancing—Part II: Emerging technologies and open issues. IEEE Access, 8, pp.154209-154236.

[2] Militante, S.V. and Dionisio, N.V., 2020, October. Deep Learning Implementation of Facemask and Physical Distancing Detection with Alarm Systems. In *2020 Third International Conference on Vocational Education and Electrical Engineering (ICVEE)* (pp. 1-5). IEEE.

[3] Ikram, T., Saeed, A., Ayn, N., Tahir, M.A. and Mumtaz, R., 2020, December. A review of the prevalent ICT techniques used for COVID-19 SOP violation detection. In 2020 IEEE 17th International Conference on Smart Communities: Improving Quality of Life Using ICT, IoT and AI (HONET) (pp. 194-198). IEEE.

[4] Ksentini, A. and Brik, B., 2020. An Edge-Based Social Distancing Detection Service to Mitigate COVID-19 Propagation. *IEEE Internet of Things Magazine*, *3*(3), pp.35-39.

[5] Hameed, B.Z., Patil, V., Shetty, D.K., Naik, N., Nagaraj, N. and Sharma, D., 2020. Use of artificial intelligence-based computer vision systems to practice social distancing in hospitals to prevent transmission of COVID-19. *Indian journal of community medicine: official publication of Indian Association of Preventive & Social Medicine*, *45*(3), p.379.

[6] Ahamad, A.H., Zaini, N. and Latip, M.F.A., 2020, August. Person Detection for Social Distancing and Safety Violation Alert based on Segmented ROI. In 2020 10th IEEE International Conference on Control System, Computing and Engineering (ICCSCE) (pp. 113-118). IEEE.

[7] Razavi, M., Alikhani, H., Janfaza, V., Sadeghi, B. and Alikhani, E., 2021. An Automatic System to Monitor the Physical Distance and Face Mask Wearing of Construction Workers in COVID-19 Pandemic. arXiv preprint arXiv:2101.01373.

[8] Chen, Z., Fan, T., Zhao, X., Liang, J., Shen, C., Chen, H., Manocha, D., Pan, J. and Zhang, W., Autonomous Social Distancing in Urban Environments Using a Quadruped Robot. IEEE Access, 9, pp.8392-8403

[9] Punn, N.S., Sonbhadra, S.K. and Agarwal, S., 2020. Monitoring COVID-19 social distancing with person detection and tracking via fine-tuned YOLO v3 and Deepsort techniques. arXiv preprint arXiv:2005.01385.

[10] Ahmed, I., Ahmad, M., Rodrigues, J.J., Jeon, G. and Din, S., 2021. A deep learning-based social distance monitoring framework for COVID-19. Sustainable Cities and Society, 65, p.102571.

[11] Hou, Y.C., Baharuddin, M.Z., Yussof, S. and Dzulkifly, S., 2020, August. Social Distancing Detection with Deep Learning Model. In 2020 8th International Conference on Information Technology and Multimedia (ICIMU) (pp. 334-338). IEEE

[12] Rezaei, M. and Azarmi, M., 2020. Deepsocial: Social distancing monitoring and infection risk assessment in covid-19 pandemic. Applied Sciences, 10(21), p.7514.

[13] Cristani, M., Del Bue, A., Murino, V., Setti, F. and Vinciarelli, A., 2020. The visual social distancing problem. IEEE Access, 8, pp.126876-126886.

[14] Yang, D., Yurtsever, E., Renganathan, V., Redmill, K.A. and Özgüner, Ü., 2020. A vision-based social distancing and critical density detection system for covid-19. arXiv preprint arXiv:2007.03578, pp.24-25.

[15] Khandelwal, P., Khandelwal, A. and Agarwal, S., 2020. Using computer vision to enhance safety of the workforce in manufacturing in a post covid world. arXiv preprint arXiv:2005.0528