A Review on Pedestrian & Social Distancing Rule Violation Detection

[1]Srishti Verma, [2]Prashant Kumar Jain

Department of Electronics & Communication Engineering
Jabalpur Engineering College,
Jabalpur, Madhya Pradesh, India

***Abstract*: The act of social distancing implies staying at home and away from others as much as possible to stop spreading Coronavirus. The act of social distancing that encourages to follow certain alternatives such as online video and phone communication instead of in-person contact. As communities that have been reopen and people are more often in the public, the term "physical distancing" is being used to reinforce the need to stay at least 6 feet from the others, as well as wearing face masks too. Social distancing is a way through which coronavirus can be reduced that should be followed properly. Wear a face mask or covering face when you are not in your home and at when you are around individuals who are not a part of your family or it can be stated as unknown ones. There are several systems which have been proposed that are able to detect social distancing as well as its violations. System uses many techniques to solve the challenges for detecting social distancing rule violations. Here this paper surveyed various researches that automatically detected the social distancing specially in public places with various computer vision techniques. This paper discusses those techniques along with their flaws.**

***Keywords*: Social Distancing Rule Violation Detection, Physical Distancing, CORONA Virus, Machine Learning, Tensorflow, Computer Vision, Artificial Neural Network.**

I. INTRODUCTION

Social distancing is the best approach to stop spreading the corona virus or limit the intrusion or transmission of virus. It targets reducing the genuine contact between maybe infected individuals and normal individuals. As indicated by the WHO norms [1] it is supported that people should stay aware of something like 6 feet of distance among each other to follow social distancing. Another report shows that social distancing is an important guideline measure and key to hinder SARS CoV-2, since people with delicate or no signs may fortuitously pass on crown infection and can infect others [2]. Different model exhibits that real social distancing is the best way to deal with reduce overwhelming genuine contact, therefore diminishes the infection rate [3], [4]. This reduced zenith may definitely arrange with the available clinical consideration system and help to offer better premises to the patients drawing in against the COVID pandemic. The investigation of sickness transmission is the examination of factors and purposes behind the spread of overpowering contaminations. To look at epidemiological miracles, mathematical models are reliably the most preferred choice. Essentially all models jump from the customary SIR model of Kermack and McKendrick set up in 1927. Distinctive assessment works have been done on the SIR model and its expansions by the deterministic system, and in this manner, various researchers thought about stochastic natural structures and scourge models [5]. Social distancing (SD) is an amazing measure to thwart the spread of the overpowering COVID disorder 2019 (Coronavirus). Regardless, a shortfall of spatial care might cause coincidental encroachment of this new measure. Against this foundation, we propose a working observation system to direct the spread of Coronavirus by notice to individuals in a region of-interest. In any case, we present a target based continuous system that can distinguish SD encroachment and send non-interfering general media signs using state of the art significant learning models. We describe an original fundamental social tactics to show that the chance of SD encroachment can be held with zero contacts.

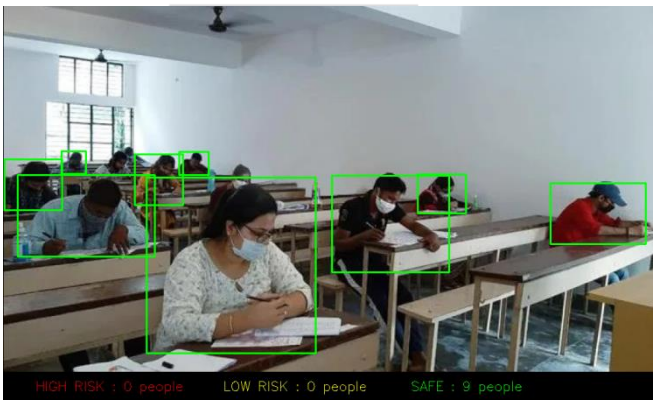

Fig. 1. Social Distancing Detection

The proposed structure is also ethically sensible: it doesn't record data nor target individuals, and no human administrator is accessible during the action. The proposed structure was surveyed across veritable world datasets.

II. RELATED WORKS

A. Related Works

Narinder Singh Punn et al. [6] proposes a viable consistent significant learning based framework to robotize the way toward noticing the social distancing through certain distinguishing methods or classifications and following philosophies, where each individual is perceived in the ceaseless with the help of bouncing boxes. Hopping; the encases for perceiving the bundles or get-togethers of people satisfying the closeness property enlisted with the help of pairwise vectorized approach. The amount of encroachment are insisted by enlisting the amount of social affairs molded and encroachment record term handled as the extent of the amount of people to the amount of get-togethers. The expansive fundamentals were driven with standard top tier object distinguishing proof models: Faster RCNN, SSD, and YOLO v3, where YOLO v3 portrayed the useful execution with changed FPS and Guide score. Since this philosophy is significantly fragile to the spatial space of the camera, a comparative approach can be changed to all the almost certain change with the looking at field of view.

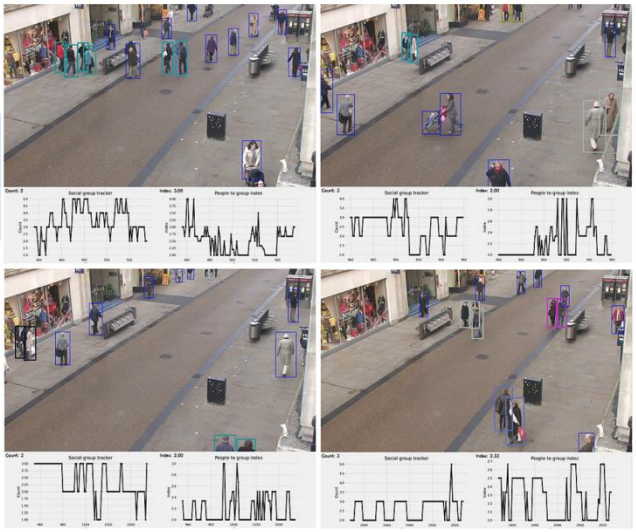

Fig. 2. Frame Work Architecture [6]

Sreetama Das et al. [7] proposed a system where the execution of social distancing visible to every places which is a critical approach for ensuring individual prosperity and workplace security, until antibodies or vaccination and prescriptions become open in volumes for mass uses. This work discusses a computer vision based strategy for social distancing perception, including an automated camera calibration method for basic modulation. Authors propose the use of time based edges to perceive transient and productive encroachment of social distancing methodology and use estimations like encroachment packs to assess risk. Authors have sent the output and achieved continuous execution with satisfactory results under different lighting, amassing, and hindrance. Future preliminaries to additionally foster our philosophy consolidate the usage of a solitary shot trackers or thickness based trackers, re-setting up the model with remarked on video that deals with from the sending locale similarly as testing the templates with more trendy estimations methods like EfficientDet and YOLO, which opened up all through the application improvement. Hendra Adinanta et al. [8] proposed the standard of work that will be recognize individuals, then to assess the physical distancing encroachment from their distance. By far most of the researchers have endeavored to utilize object ID systems, for instance, speedier RCNN, Yolo, and SSD to perceive individuals from the edge. Those procedures rely upon, the assistance of GPU to execute their robust estimation. In this works, authors propose social distancing checking by applying establishment derivation systems subject to Gaussian Mix Models (GMM) for instance Geometric Multigrid (GMG), k-Nearest Neighbor (KNN), Mix of Gaussian (MOG), and Mix of Gaussian 2 (MOG2). These procedures have been used to channel individuals from the packaging with computational connection. A couple of limits evaluation measures have been set out to check the best methodology fitting for this works. To the extent execution, better techniques are situated as KNN, MOG, MOG2, and GMG.

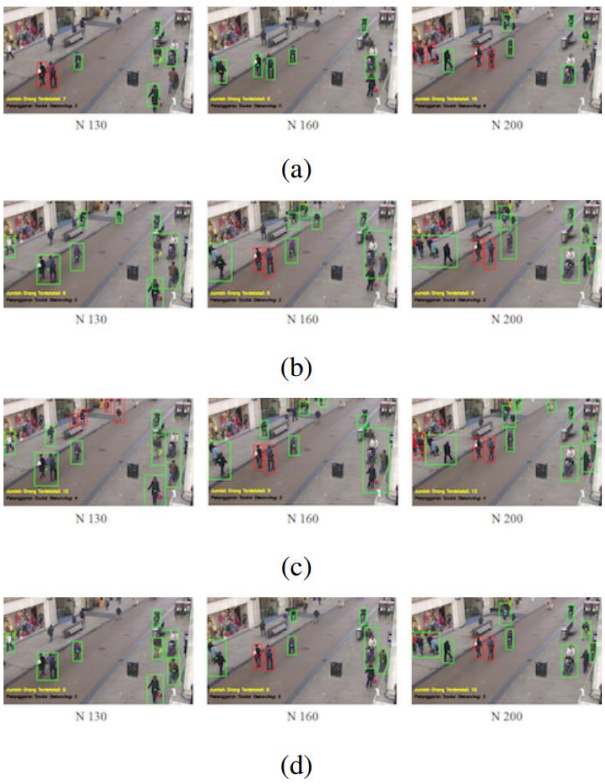

Fig. 3. The output of physical distancing monitoring using (a) MOG, (b) MOG2, (c) GMG, (d) KNN [8]

Zhenfeng Shao et al. [9] proposed a system where individuals are getting recognized using a UAV technique which can unequivocally distinguish humans by their heads, and a not really set in stone the social distancing of each normal on UAV pictures. System contains three areas, PeleeNet, multi-scale spatial thought module and acknowledgment layer. To research the features of small sized object like human head, authors join three sizes of feature maps (19 × 19, 38 × 38, 76 × 76) by de-convolution and connection. The spatial thought module is particularly used to further develop the component information and negligence the immaterial information. Then the space of human head is expected in disclosure layer. Authors differentiated the methodology and the top tier object distinguishing proof procedures (SSD model and YOLOv3 model) on a consolidated human head dataset. The test outcomes show that our procedure achieves 92.22% AP and 76 FPS, which turns out accurate and progressing revelation in genuine applications. Especially, the evacuation tests show that multi-scale feature and spatial thought can altogether chip away at the introduction of walker area. The test results on UAV Head dataset show that our system can in like manner achieve high precision walker acknowledgment on UAV pictures with 88.5% AP and 75 FPS. The insight delayed consequences of the methodology on UAV pictures in like manner show that our strategy can distinguish each individual with different points of view, edifications and scales in various scenes. Moreover, we guided a precision change test to get the change network from moved picture and vertical picture to genuine organize. Considering the specific individual by walking disclosure and the aide relationship from picture to genuine work with structure, the social distancing noticing is cultivated constantly, engaging a modified distance-distinguishing approach for thwarting Coronavirus.

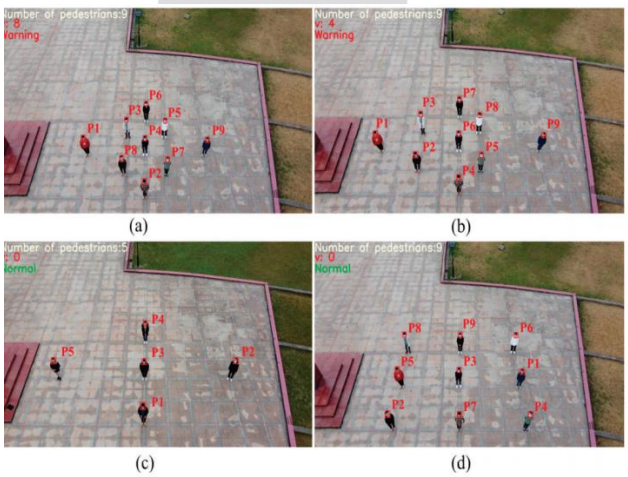

Fig. 4. The results of social distancing monitoring on tilted images with four different pedestrian position patterns [9]

Afiq Harith Ahamad et al. [10] proposed a work for identifying people for social distance as a cautious advance in decreasing genuine contact between people. This assessment based on perceiving people in region of interest using the MobileNet Single Shot Detector (SSD) models and OpenCV library for image enhancement. The distance will be enlisted between individuals recognized in a frame and subsequently diverged from a proper pixels' characteristics. The distance is assessed between the principle issues and as far as possible between individuals in the separated after locale. With the acknowledgment of unsafe distances between people, alerts or cautions can be given to secure the premises. Regardless social distance measure, one more basic part of the system is recognizing the presence of people in restricted areas, which can moreover be used to trigger counsels. Some assessment has been performed to test the reasonability of the program for the two purposes.

Fig. 5. Proposed System [10]

From the results procured, the distance worldwide situating system achieved between 56.5% to 68% accuracy for testing performed on outdoors and testing input accounts, while 100% precision was cultivated for the controlled environment on indoor testing. While for the prosperity encroachment prepared component subject to partitioned profit from starting capital venture, it was found to have achieved better accuracy, for instance between 95.8% to 100% for all attempted data accounts [10]. Savyasachi Gupta et al. [11] proposed a framework to utilize the Cover R-CNN significant neural network to perceive people in a video diagram. To dependably perceive whether social distancing is chipped away at during the connection between people, a centroid following estimation is utilized to follow the subjects all through the recording. With the aide of legitimate estimations for approximating the distance of people from the camera and between themselves, authors choose if the social distancing rules are being clung to. The design accomplished a high precision regard identified with a low fake alarm rate when taken a stab at Custom Video Film Dataset (CVFD) and Custom Individual Pictures Dataset (CPID), where it showed its sufficiency in choosing if social distancing rules were cleaned.

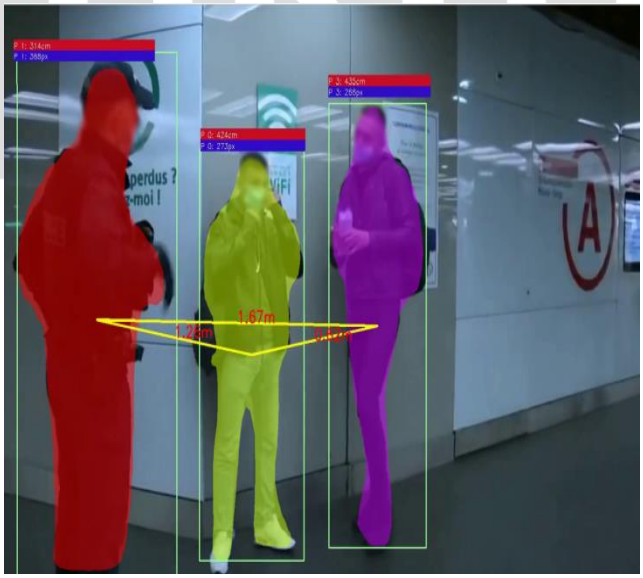

Fig. 6. Visualisation of the results obtained by SD-Measure framework [11]

Yew Cheong Hou et al. [12] proposed a technique of social distancing identifier gadget using a significant learning model. By using computer vision, the distance between people can be surveyed and any safe pair of people will be shown with a red bounding box and a red line. The proposed technique was supposed to showing individuals by walking around a street. The portrayal results showed that the proposed technique is capable to choose the social distancing measures between people which can be moreover established for use in other environment like office, diner, and school. Besides, the work can be also improved by redesigning the

bystander disclosure estimation, organizing other distinguishing proof computations, for instance, cover area and human inner warmth level acknowledgment, further fostering the enrolling power of the hardware, and adjusting the camera perspective.

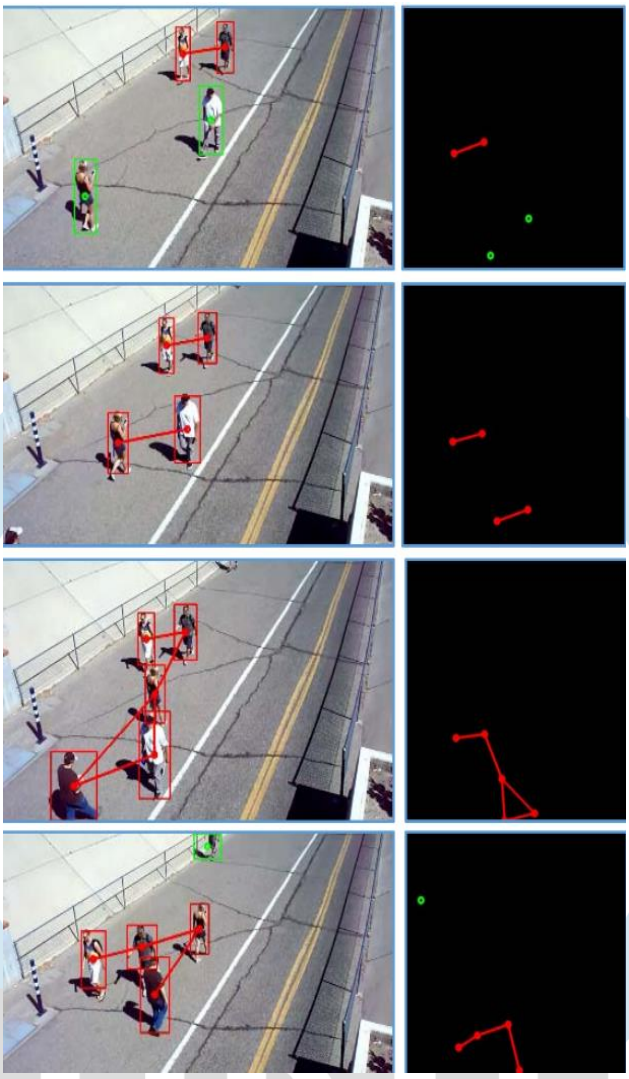

Fig. 7. Social distancing detection in video frame (left) and in topdown view (right). The sequences are depicted from top to bottom [12]

Mohd. Aquib Ansari et al. [13] proposed an article suggests significant learning based human acknowledgment systems to screen social distancing in the continuous environment. These techniques have been made with the help of significant tangled network that has used sliding window. Further, they used the social distancing estimation to measure the distancing among people. This evaluated distancing measures pick two classes for adhering to social distancing. The examinations were performed with CNN based locaters. In experiments, it is found that CNN-based thing disclosure models are endorsed in accuracy. Sometimes, it conveys some counterfeit positive models while overseeing steady video progressions. Later on, different present day object finders like RCNN, Speedier RCNN, SSD, RFCN, YOLO, etc may be passed on with oneself made dataset to construct acknowledgment precision and decline the false certain models. Additionally, a singular viewpoint got from a single camera can't reflect the result even more enough. Thus, the proposed computation may be set for different points of view through various cameras in the future to get more precise results.

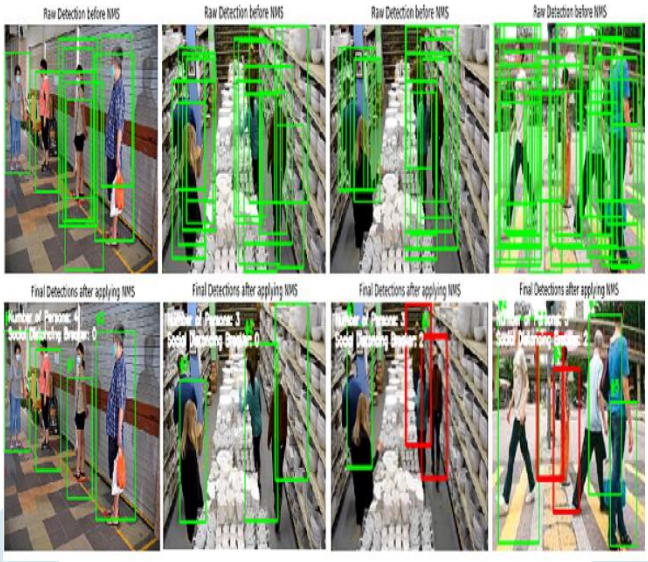

Fig. 8. Outcomes of Model 2 for practicing social distancing [13]

Here, CNN based system is researched to perceive human presence. The system is used for determining distances between each pair of individuals perceived. This system of social distancing estimation will red engraving individuals who are moving closer than a threshold limit. Exploratory results show that CNN based article identifiers with the proposed social distancing estimation show promising outcomes for observing social distancing in open areas. Zhiming Chen et al. [14] proposed a framework with respect to the Coronavirus pandemic, creators cultivate a self-administering perception robot structure to progress social distancing. The robot system is predominantly made out of social distance ID, metropolitan and savvy voice cooperation. The legged robot shows extraordinary variety to different region with the objective that they can work commendably in human life circumstances. This current reality attempt furthermore displays that our robot viably keeps human's social distance. In this end, authors successfully pass on the structure in a certifiable environment to hinder the spread of Coronavirus. Concerning use of the made stage in response to the Coronavirus pandemics, there is still freedom to improve with respect to social relationship assessment as social distancing may be affected by various social parts. For example, the robot should not assist a get-together with recollecting members from a comparative family who are intentionally ignoring social distancing. The future work will focus in on distinctive the social relationship of walkers from their evident practices. In addition, outfitting the made stage with temperature sensors and disinfection contraptions would surrender the robot the ability to screen individuals by walking's inward warmth level and help in standard cleaning. An incredibly planned legged stage would be powerful in accomplishing various tasks. Beside the applications due to the Coronavirus pandemic, the made stage might perhaps be applied in a wide extent of social participation practices in human's consistently life. For example, the stage can specialist as a nearby escort in retreat parks, can replace human overseers in routine.

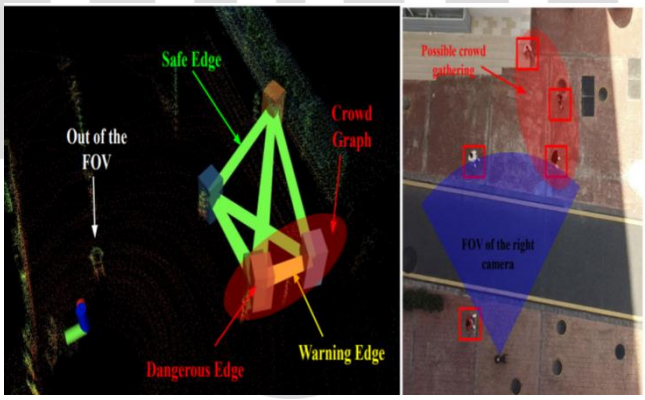

Fig. 9. Illustration of the crowd gathering detection [14]

Meirui Qian et al. [15] proposed a social distancing included keeping a distance of 1.5 m between people, which can hinder the spread of most respiratory overwhelming ailments. Social distancing is maybe the best measures to decrease the spread of the infection, which is imparted through air drops. The drops caused by wheezing or compelled talking that have a particular transmission distance. By keeping this distance, we can diminish the spread of the infection. Wearing cover, washing hands regularly and cleaning with alcohol in like manner help to hold the infection back from spreading beginning with one individual then onto the following. To control the sickness, the World Prosperity Affiliation proposed that countries should support case ID, track and screen contacts, practice separation from close contacts and isolate cases similarly as execute traffic signal and suspend enormous social events. An epic COVID pneumonia estimate model was set up by using the colossal data of the School of Washington Prosperity Record and Appraisal Center. Examination of the plague situation in seven got down metropolitan networks Wuhan, Italy and Spain showed that staying aware of social distancing genuinely cultivated results. Since these metropolitan regions

executed lockdowns, the plague promptly showed up at an apex, so far not climbing again. Erin Mordecai, a researcher at Stanford School, and a gathering of experts encouraged a smart test framework to mirror the spread of Coronavirus as time goes on, showing the piece of social disengagement and social distancing in disease control (Erin 2020). Strikingly, the public position promptly got the right situation, e.g., social distancing, appropriately controlling the speed of the addition of cases and winning greater freedom for trained professionals. In case this had not been the circumstance, it would have been incomprehensible for clinical staff from one more regions to go to Wuhan for help, and Wuhan emitted an impression of being the singular erupt city. To the extent cost, social distancing also saves clinical resources, similar to cover, hand sanitizers, alcohol based sanitizer, etc This gives our clinical consideration specialists, crisis facilities and various establishments more significant opportunity to design, thwart the infection and help with peopling who still up in the air to have Covid.

III. Conclusion & Future Scope

This paper reviewed various implemented systems that are able to detect social distancing rule violations using CNN, DNN, SSD Filtration and many more. Most of the system uses CNN and a training model for creating templates that later match for nearest classification. But there is no appropriate model for actual feature extraction, instead of that it can be achieved through Tensorflow or any object classifier along with various pre-processing models. The system can be enhanced in future by implementing it with different techniques and filters, which may acquire good accuracy and minimal false alarm rate. Because as per the ideal system, accuracy is an important parameter, that is why accuracy of system can be enhanced in future with different techniques or filters.

References

[1] L. Hensley, “Social distancing is out, physical distancing is in—here’s how to do it,” Global News–Canada (27 March 2020), 2020.

[2] ECDPC, “Considerations relating to social distancing measures in response to COVID-19 – second update,” https://www.ecdc.europa.eu/ en/publications-data/considerations, 2020, [Online; accessed March 23, 2020].

[3] M. W. Fong, H. Gao, J. Y. Wong, J. Xiao, E. Y. Shiu, S. Ryu, and B. J. Cowling, “Nonpharmaceutical measures for pandemic influenza in nonhealthcare settings—social distancing measures,” 2020.

[4] F. Ahmed, N. Zviedrite, and A. Uzicanin, “Effectiveness of workplace social distancing measures in reducing influenza transmission: a systematic review,” BMC public health, vol. 18, no. 1, p. 518, 2018

[5] M. Zhao and H. Zhao, “Asymptotic behavior of global positive solution to a stochastic sir model incorporating media coverage,” Advances in Difference Equations, vol. 2016, no. 1, pp. 1–17, 2016.

[6] Punn, Narinder & Sonbhadra, Sanjay & Agarwal, Sonali. (2020). Monitoring COVID-19 social distancing with person detection and tracking via fine-tuned YOLO v3 and Deepsort techniques.

[7] Das, Sreetama et al. “Computer Vision-based Social Distancing Surveillance Solution with Optional Automated Camera Calibration for Large Scale Deployment.” ArXiv abs/2104.10891 (2021): n. pag.

[8] H. Adinanta, E. Kurniawan, Suryadi and J. A. Prakosa, "Physical Distancing Monitoring with Background Subtraction Methods," 2020 International Conference on Radar, Antenna, Microwave, Electronics, and Telecommunications (ICRAMET), 2020, pp. 45-50, doi: 10.1109/ICRAMET51080.2020.9298687.

[9] Z. Shao, G. Cheng, J. Ma, Z. Wang, J. Wang and D. Li, "Real-time and Accurate UAV Pedestrian Detection for Social Distancing Monitoring in COVID-19 Pandemic," in IEEE Transactions on Multimedia, doi: 10.1109/TMM.2021.3075566.

[10] A. H. Ahamad, N. Zaini and M. F. A. Latip, "Person Detection for Social Distancing and Safety Violation Alert based on Segmented ROI," 2020 10th IEEE International Conference on Control System, Computing and Engineering (ICCSCE), 2020, pp. 113-118, doi: 10.1109/ICCSCE50387.2020.9204934.

[11] S. Gupta, R. Kapil, G. Kanahasabai, S. S. Joshi and A. S. Joshi, "SD-Measure: A Social Distancing Detector," 2020 12th International Conference on Computational Intelligence and Communication Networks (CICN), 2020, pp. 306-311, doi: 10.1109/CICN49253.2020.9242628.

[12] Y. C. Hou, M. Z. Baharuddin, S. Yussof and S. Dzulkifly, "Social Distancing Detection with Deep Learning Model," 2020 8th International Conference on Information Technology and Multimedia (ICIMU), 2020, pp. 334-338, doi: 10.1109/ICIMU49871.2020.9243478.

[13] Ansari, M., Singh, D.K. Monitoring social distancing through human detection for preventing/reducing COVID spread. Int. j. inf. tecnol. 13, 1255–1264 (2021). https://doi.org/10.1007/s41870-021-00658-2

[14] Z. Chen et al., "Autonomous Social Distancing in Urban Environments Using a Quadruped Robot," in IEEE Access, vol. 9, pp. 8392-8403, 2021, doi: 10.1109/ACCESS.2021.3049426.

[15] Qian, Meirui; Jiang, Jianli (2020). COVID-19 and social distancing. Journal of Public Health, (), –. doi:10.1007/s10389-020-01321-z

[16] W. H. Organization, “WHO corona-viruses (COVID-19),” https://www. who.int/emergencies/diseases/novel-corona-virus-2019, 2021, [Online; accessed July 12, 2021].

[17] WHO, “Who director-general’s opening remarks at the media briefing on covid-19-11 march 2021.” https://www.who.int/dg/speeches/detail/, 2021, [Online; accessed July 12, 2021].

[18] L. Hensley, “Social distancing is out, physical distancing is in—here’s how to do it,” Global News–Canada (12 July 2021), 2021.

[19] ECDPC, "Considerations relating to social distancing measures in response to COVID-19 – second update," https://www.ecdc.europa.eu/ en/publications-data/considerations, 2021, [Online; accessed March 23, 2021].

[20] M. W. Fong, H. Gao, J. Y. Wong, J. Xiao, E. Y. Shiu, S. Ryu, and B. J. Cowling, "Nonpharmaceutical measures for pandemic influenza in nonhealthcare settings—social distancing measures," 2020.

[21] F. Ahmed, N. Zviedrite, and A. Uzicanin, "Effectiveness of workplace social distancing measures in reducing influenza transmission: a systematic review," BMC public health, vol. 18, no. 1, p. 518, 2018.

[22] W. O. Kermack and A. G. McKendrick, "Contributions to the mathematical theory of epidemics–i. 1927." 1991.

[23] C. Eksin, K. Paarporn, and J. S. Weitz, "Systematic biases in disease forecasting–the role of behavior change," Epidemics, vol. 27, pp. 96– 105, 2019.

[24] M. Zhao and H. Zhao, "Asymptotic behavior of global positive solution to a stochastic sir model incorporating media coverage," Advances in Difference Equations, vol. 2016, no. 1, pp. 1–17, 2016.

[25] P. Alto, "Landing AI Named an April 2020 Cool Vendor in the Gartner Cool Vendors in AI Core Technologies," https://www.yahoo.com/ lifestyle/landing-ai-named-april-2020-152100532.html, 2020, [Online; accessed July 12, 2020].

[26] A. Y. Ng, "Curriculum Vitae," https://ai.stanford.edu/~ang/ curriculum-vitae.pdf.

[27] L. AI, "Landing AI Named an April 2020 Cool Vendor in the Gartner Cool Vendors in AI Core Technologies," https://www.prnewswire.com/ news-releases/, 2020, [Online; accessed April 22, 2020].

[28] B. News, "China coronavirus: Lockdown measures rise across Hubei province," https://www.bbc.co.uk/news/world-asia-china51217455, 2020, [Online; accessed January 23, 2020].

[29] N. H. C. of the People's Republic of China, "Daily briefing on novel coronavirus cases in China," http://en.nhc.gov.cn/2020-03/20/c 78006. htm, 2020, [Online; accessed March 20, 2020].

[30] K. Prem, Y. Liu, T. W. Russell, A. J. Kucharski, R. M. Eggo, N. Davies, S. Flasche, S. Clifford, C. A. Pearson, J. D. Munday et al., "The effect of control strategies to reduce social mixing on outcomes of the covid19 epidemic in wuhan, china: a modelling study," The Lancet Public Health, 2020.