ISSN: 0974-5823 Vol. 7 No. 2 February, 2022

International Journal of Mechanical Engineering

Early Monitoring of Social Distancing using Opencv and Deep Learning

C Kishor Kumar Reddy[1], Anisha P R[2], Lingala Thirupathi[3], B Srinivasulu[4] and D Rambabu[5]

[1,2,3] Stanley College of Engineering and Technology for Women, Telangana, India.

[4]Vidya Jyothi Institute of Technology,Telangana, India

[5]Sreendhi Institute of Science & Technology, Telangana, India.

Abstract:

Social distancing is one of the community mitigation measures that may be recommended during influenza epidemics. Social distancing can reduce virus transmission by boosting physical distance or reducing frequency of congregation in socially close community settings, similar as academies or workplaces. This is a common practice which has been carried out over generations to minimize the spread of virus by limiting its reproduction rate among communities. In the battle against COVID-19, social distancing has proved to be a highly successful strategy for slowing disease transmission. People are being advised to minimize their contacts with one another in order to reduce the risk of the virus spreading through physical touch. The social distancing detection system will monitor whether people are maintaining a safe distance from each other in public places and workplaces or not to ensure social distancing protocol. We can see a clear overview of how we can detect social distancing in public places using Python, Computer Vision, YoLov3, and Deep Learning in this proposed framework.

Keywords: Social Distancing, OpenCV, Computer Vision, Yolov3, Deep Learning

1. Introduction

Social distancing measures are an important part of the pandemic influenza mitigation strategy. They work hand in hand with individual approaches to lessen the probability of it spreading. The World Health Organization has declared coronavirus to be a global pandemic due to a rise in the number of coronavirus cases were reported all around world. Numerous regions have imposed severe prohibitions and lockdowns to prevent the pandemic, with both the public authority permitting residents to ensure security in their residences during the epidemic. As per a recent report, maintaining social distancing and wearing masks is an important regulating measure to prevent the growth of SARSCoV-2, considering people with minor or no illnesses may unintentionally carry the virus into the gathering and disseminate it to others. To concentrate regarding information approaches and computational methods [17], which always seem to be the best option. Throughout the battle against with the coronavirus, social distancing has demonstrated to be an effective strategy for slowing the disease's transmission. As both the term indicates, it proposes that individuals keep a healthy physical distance from each other and, limiting strong connections and therefore preventing the outbreak of coronavirus [15-16].

Ever since 2009 swine flu outbreak, significant information concerning that possible influences of human distance and perhaps other similar interventions has indeed been established through biological and clinical investigations, computational mathematics, and individual medical knowledge. Nevertheless, research evidence's overall quality isn't very good. Consequently, social distancing methods have been shown to be fairly effective, and most of them are likely to be understood as transitional remedies, particularly when the socioeconomic consequences are minor. Although educational restriction, if preemptive as well as responsive, appears to be modestly efficient in decreasing infectious diseases spreading and postponing the maximum of an outbreak, it translates into a higher in terms of both wealth and personal consequences. Closings should only be undertaken with in event of a significant epidemic and also for the shortest amount of time. The shutdown of a single institution can be just as impactful as the shutdown of a comprehensive education department [18].

A similar to the previously of closures might be beneficial to the public, particularly had it been slow to act, but it is likely that so many teenagers will keep on making connections thru other activities during the shutdown, negating all or some of the anticipated benefits. Place of work solutions such as work closing and working away from home are also generally Alright and thus are reasonable or perhaps even popular among some colleagues, especially if pay is delivered, according to available but limited research. Furthermore, for quite a significant impact, a high number of existing losses (about 33 percent) would've been required, and industry reductions may cause significant monetary and emotional suffering. Method of self of occasions is also a good and suitable measure, especially where access to anti - viral resources is restricted, but there is still a higher risk of effects of family infection from indexing occurrences to connections, especially if bathroom facilities are shared. Social seclusion is also regarded as an excellent and appropriate approach. Physical distance, often known as "social distancing," entails maintaining a safe distance both for yourself and people who aren't members of your family. Within every interior and exterior place, maintain at least 6 inches (approximately two elbow distances) away from distinct individual humans that are not directly in the families to practice social or physical separation [19].

Using masks, limiting contacting their body with dishonourable wrists, as regularly washing your hands with cleaner and hands for at least 20 seconds should really be practised in dealing with social distance to limit the occurrence of COVID-19. COVID-19 spreads quickly amongst individuals who've been in intimate contact for a long time (within around 6 lines). Whenever an affected individual, coughing and sneezing, or addresses, driblets from their nasal passage fly into the atmosphere and settle in the mouth or tips of people's tongues. The driblets could also be swallowed whole. According to scientific studies, someone who is sick but do not show any symptoms are likely to contribute to the transmission of COVID-19. Because individuals may infect people before they had even realise they're infected, it's crucial to keep at least 6 feet away from everyone whenever necessary, even if visitors — or others — don't start showing symptoms. Individuals who are at high risk of serious disease from COVID-19 should keep their distance from others. Whether you're sick having COVID-19, you must still have signs that are consistent with COVID-19 or have been in regular communication with somebody who has COVID-19. COVID-19 can survive on a skin for hours or even days, environmental parameters such as sunlight, hydration, and the kind of skin.

COVID-19 could be contracted by contacting a face or anything that has been infected with the virus and then contacting their personal mouth, nose, or eyes. Still, this cannot be the primary mode of infection transmission. Just outside of the home, social separation helps restrict opportunities to come into connection with unclean materials and diseased persons. Even though risk of serious sickness varies by individual, everybody can get COVID-19 and spread it. Everyone will have a role to play in slowing the spread of infectious infection and protecting themselves, their families, and local communities. Maintaining distance both for yourself and everyone else has become one of the best weapons people have to prevent being exposed to COVID-19 and slowing its own growth in organizations, in practicing daily ways to prevent COVID-19 [20-21].

As the epidemic situation has taken over the world, social distancing is one of the major preventives which needs to be taken. As people come together in crowds, they're more likely to come into close contact with someone that has contagion and hence World Health Organization has proposed a strict law for maintaining physical distance of 2 cadence in every brace. Therefore, to keep a track of the social distancing among the public this idea of social distancing discovery surfaced, shown in Figure 1,

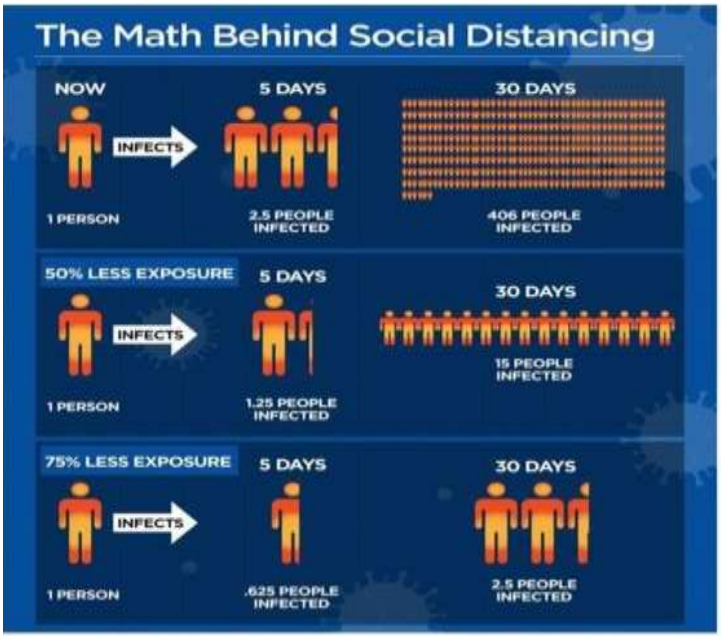

Fig 1 Math Behind Social Distancing

The purpose of the paper is to detect whether the social distance between people is maintained or not. It also counts the people and it displays the people who are in serious, tolerable and safe violation zone. It also keeps a count on serious and abnormal violation of the people.

Table 1: History of Pandemics

Year(s)	Disease	Geography	Deaths
1899-23	Cholera(6th)	Europe, Asia, Africa	80,000
1910-12	China Bubonic Plague	China	40,000
1918-20	Spanish Flu	Worldwide	50,000,000+
1957-58	Asian Flu	Worldwide	2,000,000
1968-69	Hong Kong Flu	Worldwide	1,000,000
1960	HIVIAIDS	Worldwide	30,000,000
2002-04	SARS(Corona virus)	Asia, Canada	<1,000
2009	Flu Pandemic	Worldwide	203,000
2019	Corona virus(COVID-19)	Worldwide	5,10,0000+

2. Related Work

The detection of persons using social distance monitoring as a prophylactic approach in minimizing physical contact between people was presented by Afiq Harith Ahamad et al [1]. The MobileNet Single Shot Multibox Detector (SSD) detection and tracking model and the OpenCV library for image processing are used in this work to detect people in regions of interest. The distances between both the humans detected in the surveillance video will be computed and compared to a set of predetermined pixel values. The distance between humans in the segmented tracking area is measured between both the central themes and the overlapping boundary. If dangerous intervals among people are discovered, warnings or reminders can be issued to maintain the distance safely. Aside from identifying the presence of humans in confined spaces, which may also be used to trigger alerts, another critical aspect of the system is identifying the presence of individuals in confined locations.

F.A. Ahmad Naqiyuddin et al. [2] presented a wearable social distancing device that employs a microprocessor and an infrared detection to monitor the distance between the two people and alert the authorities if one of them breaks the rule. The technology has the potential to accomplish actual social distancing detection and to aid in the mobility of people in a particular location.

For identifying social distancing from videotaped footage, Savyasachi Gupta et al [3] introduced a new frame called SD- Measure. The study provides the SD- Measure as a new frame for identifying social distancing in videotaped footage. To detect persons in a VHS frame, the suggested frame uses the Mask R-CNN deep neural network. A Euclidean distance work experience algorithm is used to track the disciplines well over the duration of the clips to consistently recognize whether social trying to distance is practiced and during commercial transactions among individuals. Researchers evaluate that whether social distance requirements are now being followed with the use of accurate techniques for addressing people's distances from either the lens as well as between individuals. When evaluated on the Custom Video Footage Dataset (CVFD) and Custom Personal Images Dataset (CPID), the frame achieved a high delicate value in conjunction with a low probability of error, demonstrating its usefulness in evaluating whether social distance standards were practiced.

Meirui Qian and colleagues [4] COVID-19 have had a rapid global spread since its inception, having a significant impact on people's health, social economics, and scientific institutions. Little has been known well about illness at the moment, and medications are still being developed. As a result, in the event of a major outbreak, anticipating wonderful travel can help people better protect themselves and their families. The purpose of this article is to discuss COVID-19's social distancing measures. Because of the way new coronavirus influenza spreads, employing beneficial interpersonal distancing precautions is the most effective method to prevent and manage the condition. Such disaster is unfolding on a worldwide scale. To tackle the disease, people from all walks of life want to come together to see hope emerge.

Manasee Mishra et al. [5] discuss how long-term adherence to social distancing suggestions may have an impact on Indian community. Some of the more commonly observed cultural standards, such as private residence and frequently good, are expected to change. Within the domestic, sexual identity people in the family are capable of exchanging in favor of larger sharing of household responsibilities among males and females. Because of their physical need and emotional sensitivity, older persons may experience stress as a result of social isolation. Working patterns may become more flexible and conducive to social isolation. Interpersonal communication digitally-driven will almost probably increase. The repercussions for public health in India as a result of such changes are also discussed.

Mohd Ezanee Rusli et al [6] presented a ground-breaking solution called MySD, which stands for "My Safe Distance," which allows consumers or the general public to closely check social distance recommendations. It makes use of intelligent phone hardware features such as a Bluetooth transmitter and GPS to determine safe distance and required degree compliance. MySD can give the people a clever response to exhibit and encourage individuals to keep their distance whenever in public locations.

The gadget introduced by G V Shalini et al [7] is for evaluating social distancing by estimating the distance among persons in order to slow down the virus's spread. To minimize the effect of the pandemic, this device uses data from camera frames to determine the distance between people. This is accomplished by analyzing a video stream obtained from a surveillance camera. The video is calibrated to a bird's eye view and put into the Pretrained model, so it is an experienced object detection model. The Common Object in Context is taught to the pretrained model (COCO). A pre-recorded video was used to evaluate the proposed device. The outcomes and outcomes obtained from the device demonstrate the disparity in distance between the two people while determining whether or not restrictions have been broken. The genders are depicted by a red bounding box if the range is less than the lowest threshold level, and by an unfamiliar structuring element if the distance is more.

To lessen the impact of the coronavirus outbreak, Yew Cheong Hou et al [8] propose an approach for social distancing detecting based on deep learning to evaluate the distance between humans. By analyzing a video stream, the framework that assists in identifying was originally designed to warn humans to keep a safe distance from one another. Each and every non - compliance pair of persons in the presentation will be shown with a blue body and red line, and the distance between them can be determined. A pre-recorded video of pedestrians walking down the street was used to verify the theoretical method. The results show that the suggested approach is capable of evaluating the social distancing parameters between two people in a video.

Marco Cristani and colleagues [9] The establishment of so-called Social Distancing is one of the most crucial and beautiful methods to incorporate the latest virus pandemic (SD). Governments are enacting regulations on the minimum inter-personal distance between persons to fit with these constraints. The goal is to genuinely monitor potentially dangerous situations while avoiding false alerts (e.g., a family with small children or relatives, an elderly person with their caregivers), all while adhering to current privacy policies. Later they discussed how VSD connects to previous literature in Social Signal Processing and suggested a path to look for new Computer Vision methodologies that might provide a solution to such an issue.

Mahdi Rezaei and colleagues [10] develop a hybrid Computer Vision-based Deep Neural Network (DNN) model for autonomous people detecting crowds in both interior and exterior settings using regular CCTV security cameras. The suggested DNN mannequin, when combined with a customized inverse point of view mapping (IPM) technique and the SORT monitoring algorithm, results in a powerful human detection and social distancing monitoring system. During the study, the model was tested against two of the most comprehensive datasets: Microsoft Common Objects in Context (MS COCO) and Google Open Image. The produced simulation is a common and accurate personal identification and monitoring solution that can be used in a variety of industries, including self-driving vehicles, gesture recognition identification, outlier detection, athletics, crowd analytics, and any other search areas where human detection is a priority. The machine was once capable of operating in a variety of challenging conditions, including obstruction, light different versions, shades, and partial accessibility, and it managed to prove to be a significant advancement.

Kai Kaspar et al [11] have also already authored major findings. To begin, current trends featured certain key cognitive characteristics that represented people's motive for social isolation and the use of apps to combat the COVID-19 epidemic. However, the shorter mannequin for assessing social distancing motivation identified more linkage disequilibrium variance than the longer model for application use, showing that application use is more strongly influenced by many causes. Secondly, in addition to risk and coping assessment techniques, social trust was discovered to be a relevant component, emphasizing the importance of both interpersonal harmony and records safety issues in the framework of the current epidemic. Finally, the focus of current research used to be on the combined contribution of a number of unrelated variables to reasons for social distancing, app use, and displaying health-related data. As a result, when unbiased variables were considered simultaneously in regression analysis, a handful of multivariate regression associations between indifferent and determined variables vanished.

The proposed system by Narinder Singh Punn et al [12] takes use of the YOLO v3 object detection model to separate people from the past and also the Deepsort approach to organize the identified humans using bounding carrying boxes and allocated IDs. In terms of recommended common precision (mAP), frames per second (FPS), and loss values specified by classification tasks and localization, the YOLO v3 model outperforms other well-known current models, such as faster region-based CNN (convolution neural network) and single-shot detector (SSD). The correlation variable-length Learners standard is then computed based on the three-dimensional characteristic house obtained by employing both centroid positions and based image dimensions. To quantify the non- adoption of the social distancing procedure, the infraction indicator timeframe is provided.

Smart Social Distance (SSD) portable software monitoring was proposed by Geetha A V et al [13], which can anticipate the social trying to distance between two individuals with the help of cellular Bluetooth and cellular camera. To forecast the social distance, SSD uses two main steps: first, the individual within the video frames is recognized using Deep Learning (DL), and then the distance between adjacent pedestrians is evaluated using picture processing techniques. The software can also be customized to estimate the space by computing the received sign intensity of Bluetooth Low Energy (BLE) devices. The software predicts social distancing with an accuracy of 85 percent and uses a buzzer sound or a warning message to alert the person.

Rucha Visal et al [14] focuses on a monitoring approach uses Open-CV, Computer Vision, and Deep Learning to keep an eye on people and avoid overcrowding. Closed - circuit television (CCTV) and drone can be used to carry out the deployment, in which the digital camera detects the gathering with the help of object detection and calculates the distance between them. The Euclidean distance between two people will be estimated in pixels and contrasted to a specified well-known ratio; if it is discovered to be significantly less than the fashionable distance, the local authorities or neighbourhood police will be contacted.

According to Hitesh Varma et al. [15], the covid-19 pandemic has added to the international tragedy and has badly harmed the world, contaminating more than 150 million people worldwide. If people do not follow the key rules to prevent the virus from spreading, it will be difficult to soften the curve of the corona virus. Following social separation and wearing masks are two more effective strategies that must be properly followed to prevent the virus from spreading. The purpose of this paper is to use automation to demonstrate social separation amongst humans. Researchers employ the Yolo v3 object detection model in the proposed method to identify persons in the prior as well as in tracking of detected humans with the help of binding boxes. For object detection, we'll use YOLOv3, which was trained on the Coco dataset.

The study of security issues and the related solutions in internet of things were proposed [22]. The authors were predicted the dengue disease with performance and accuracy elevation patterns [23]. The authors Developed a multi-level protection framework using EDF method was proposed and a protected framework to detect and mitigate attacks [24-25], in the wireless sensor networks and Malwise system for packed and polymorphic malware were discussed [26-27]. The traffic congestion control through vehicle-to-vehicle and vehicle to infrastructure communication, algorithm for detecting cuts in wireless sensor networks, a secure model for cloud computing based storage and retrieval [28-30] were proposed. The authors described the ransomware attack, protection of cloud using different techniques were proposed [31-32]. The experimental authentication mechanism and blockchain technology solution for global economy with AI and IoT is proposed [33-34]. the comparative study on internet of things, early prediction of pneumonia, an improved snow prediction model ,supervised learning using gain ratio as attribute selection measures were proposed and a methodology to predict the presence of snow/no-snow using supervised learning methodologies are discussed in detail [35-39].

3. Proposed Architecture

The proposed architecture, shown in Figure 2, the social distancing analyzer tool, was created with computer vision, deep learning, and Python to determine the distance between people in order to keep everyone safe. This work uses the YOLOv3 model, which is based on convolutional neural networks, computer vision, and deep learning techniques. Initially, an object detection network

based on the YOLOv3 algorithm was employed to recognize persons in the image or frame. By omitting objects of classes, only the "People" class is filtered from the result. The bounding boxes are mapped in the frame, and the Nearest Neighbors method is used to generate three distinct classes of social distancing rule violations.

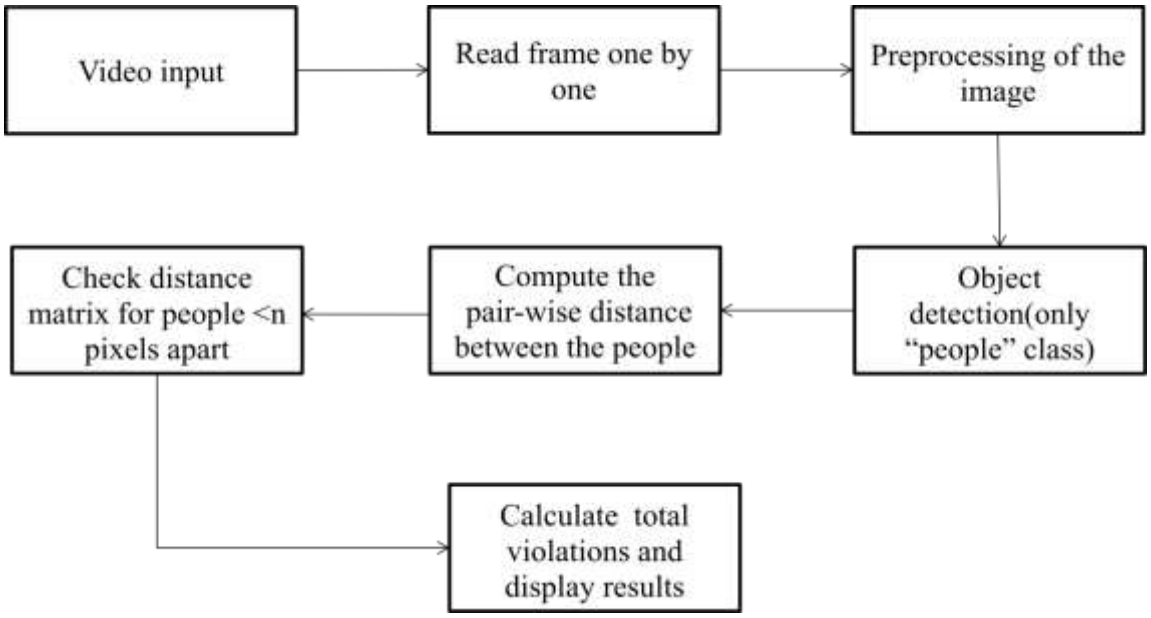

Fig 2: Proposed Architecture

4. Results & Discussion

In this research, YOLOv3 has the benefits of detection pace and accuracy and meets the real-time necessities for detection. However, YOLOv3 has a massive wide variety of spine community parameters and requires excessive hardware performance, which is now not conducive to the popularization of applications. It runs substantially quicker than different detection strategies with same overall performance (hence the title – You only look once)

Object Detection with Other Detection Algorithms

Mask R-CNN has some restrictions. As it only works with static photos, it is unable to investigate temporal information about the object of interest in the same way that dynamic hand gestures can. At low resolution, alternate it often fails to detect objects affected by stir blur.

Yolo has a hard time dealing with little items that appear in clusters, like to flocks of raspberries. It has a hard time generalizing to objects that have new or unusual element costs or combinations. Thus, SSD does worse for lower objects than lesser objects. The want of complicated statistics addition also suggests it wishes a giant range of information to train.

There are two major drawbacks to using this object tracking technique.

1. It necessitates that the object detection step be performed on each and every body of the input videotape.
2. The alternate strike is linked to the centroid monitoring algorithm's supporting hypotheses — centroids must be close together between posterior frames.

- This is usually true, save for the fact that we're representing our 3D environment with 2D frames - what happens when an item overlaps every other bone?
- The answer is that object ID swapping is something you might want to consider.
- Even so, if two or fewer items lap each other to the factor where their centroids cross and rather have the shortest distance to the distinct separate object, the method may (intentionally) change the object ID.
- It's important to note that the lapping/clotted object issue isn't limited to centroid monitoring; it affects a wide range of object trackers, including superior bones.
- Despite this, centroid monitoring appears to be redundant, as we rely just on Euclidean distances between centroids, with no redundant criteria, heuristics, or identified patterns.

In real-life simulations, gaming, and image bracketing, transfer learning has a variety of operations. However, its drawbacks may stymie the widespread abandonment of transfer literacy. As a result, it's critical to investigate those issues and identify solutions so that transfer literacy can become a natural part of AI model training.

If the transfer learning results in a decrease in the new model's performance or delicacy, it's referred to as negative transfer. Transfer learning only works if both models' original and target problems are sufficiently comparable. However, if the first round of training

data for the new task is too far removed from the data for the old task, the trained models may perform worse than expected. And, no matter how similar these two sets of training data appear to be to inventors, algorithms may not always agree with them. There are currently no precise criteria on whether tasks are connected or how algorithms determine which tasks are related, making it difficult to find negative transfer findings.

In order to find optimal AI models with assurance, innovators cannot remove the network layers in transfer learning. However, removing the early layers will have an impact on the thick layers since the number of trainable parameters would decrease.

And while dense layers can be a useful starting point for lowering layers, determining how many layers and neurons to delete without over fitting the model is time-consuming and difficult. For practically all prognosticating methods, over fitting is a significant restriction. It's also one of the most prevalent big data impulses. However, in a transfer learning context, over fitting occurs when a new model learns details and noises from training data that have a negative impact on its labors.

This system is successfully used on saved videos. The end result body will show the precise records like human count, threshold restriction (people violating social distance). You can see the detection by using CCTV on the road. These consequences virtually exhibit that people are efficaciously detected and are enclosed interior the container with its colors in accordance to the distance between every other, shown in Figures 3,4,5,6 and 7 respectively.

Fig 3: Original shot from the video

Fig 4: Output representation with people in safe distance

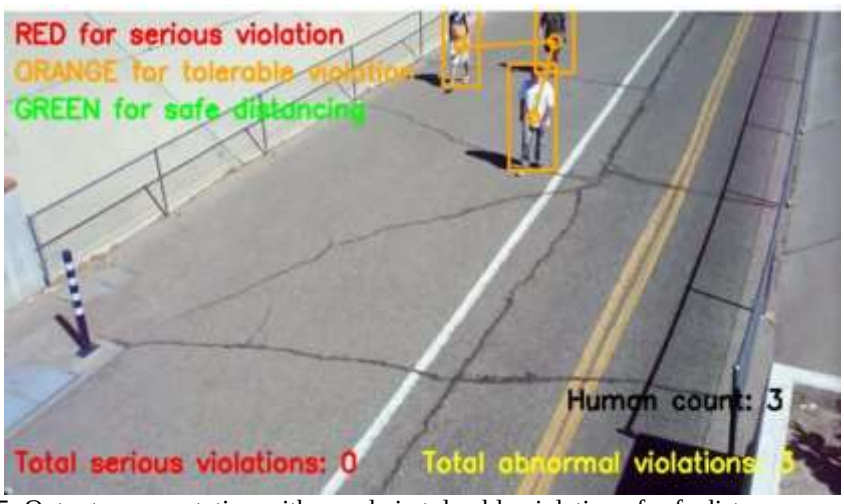

Fig 5: Output representation with people in tolerable violation of safe distance

Fig 6: Output representation with people in serious violation of safe distance

Fig 7 Output representation with people in serious, tolerable and serious violation of safe distance

5. Conclusions

Social distancing is a necessary precaution to lower bodily contact that can cause the spread of the Coronavirus. Globally, the COVID-19 pandemic has disrupted the lives of hundreds of thousands of people. We need to use this pandemic to support our neighborhood as it prepares for the future by addressing a number of research challenges and opportunities. In this work, we aim to provide a vision-based surveillance in all circumstances and plot the distance between every individual captured in the frame. The two proposed features have been implemented through a machine developed using Python and OpenCV libraries. Its first function is to detect violations of social distancing, while its second function is to detect violations of entering restricted areas. Systematically detecting social distancing violations is possible with the proposed machine. The gadget can be used in most of the public locations such as railway stations, non-secular places, marketplaces and hospitals to decrease the unfold of any contagious disease. The proposed approach can be effortlessly utilized in real-world eventualities due to the fact of excessive precision and the low error rate, e.g., in banks to assist the cashier to screen human beings standing in the front of him, in stores to assist shopkeepers to take a look at customers, in instruct stations to assist ticket giver to hold music of humans violating protected distance, etc.

In the future, we can lengthen the device to display social distance at various digital camera distances with the aid of managing objects with the various digicam angles, the boundary stipulations can be carefully monitored in order to supply correct effects in a surprisingly congested and over-populated areas. Same methodology can be carried out on stay detection by way of CCTV cameras, which will provide enhancement in current systems and actual time updates of social distance violations. This machine can be used for danger assessment, information evaluation and site visitors administration insurance policies in future.

References

1. 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.
2. F. A. A. Naqiyuddin, W. Mansor, N. M. Sallehuddin, M. N. S. Mohd Johari, M. A. S. Shazlan and A. N. Bakar, "Wearable Social Distancing Detection System," 2020 IEEE International RF and Microwave Conference (RFM), 2020, pp. 1-4, doi: 10.1109/RFM50841.2020.9344786.
3. 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.
4. Qian, M., Jiang, J. COVID-19 and social distancing. J Public Health (Berl.) (2020).
5. Mishra M, Majumdar P. Social Distancing During COVID-19: Will it Change the Indian Society? Journal of Health Management. 2020;22(2):224-235. doi:10.1177/0972063420935547.
6. M. E. Rusli, S. Yussof, M. Ali and A. A. Abobakr Hassan, "MySD: A Smart Social Distancing Monitoring System," 2020 8th International Conference on Information Technology and Multimedia (ICIMU), 2020, pp. 399-403, doi: 10.1109/ICIMU49871.2020.9243569.
7. Shalini, G & Margret, M & Niraimathi, M & Subashree, S. (2021). Social Distancing Analyzer Using Computer Vision and Deep Learning. Journal of Physics: Conference Series. 1916. 012039. 10.1088/1742-6596/1916/1/012039.
8. 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.
9. M. Cristani, A. D. Bue, V. Murino, F. Setti and A. Vinciarelli, "The Visual Social Distancing Problem," in IEEE Access, vol. 8, pp. 126876-126886, 2020, doi: 10.1109/ACCESS.2020.3008370.
10. Rezaei, Mahdi & Azarmi, Mohsen. (2020). DeepSOCIAL: Social Distancing Monitoring and Infection Risk Assessment in COVID-19 Pandemic. 10.21203/rs.3.rs-68650/v1.
11. Kaspar, Kai. (2020). Motivation for Social Distancing and App Use as Complementary Measures to Combat the COVID-19 Pandemic: Quantitative Survey (Preprint). Journal of Medical Internet Research. 22. 10.2196/21613.
12. Punn, Narinder Singh, Sanjay Kumar Sonbhadra and Sonali Agarwal. “Monitoring COVID-19 social distancing with person detection and tracking via fine-tuned YOLO v3 and Deepsort techniques.”
13. Dr. Neelavathy Pari S , Balaji Vasu , Geetha A V , Jeevitha V K, 2020, Monitoring Social Distancing by Smart Phone App in the Effect of COVID-19, INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH & TECHNOLOGY (IJERT) Volume 09, Issue 09 (September 2020),
14. Rucha Visal, Atharva Theurkar, Bhairavi Shukla, 2020, Monitoring Social Distancing for Covid-19 Using OpenCV and Deep Learning ,International Research Journal of Engineering and Technology (IRJET) Volume: 07 Issue: 06 (June 2020).
15. Hitesh Varma, Chandra Mahesh, Sachin, Umesh, Monitoring Social Distancing using YOLO v3, International Journal of Research in Engineering and Science (IJRES) Volume:9 Issue: 7 (2021).
16. Lingala Thirupathi and Venkata Nageswara Rao Padmanabhuni, “Multi-level Protection (Mlp) Policy Implementation using Graph Database” International Journal of Advanced Computer Science and Applications (IJACSA), 12(3), 2021.

http://dx.doi.org/10.14569/IJACSA.2021.0120350.

17. Lingala Thirupathi et al 2021 J. Phys.: Conf. Ser. 2089 012049; DOI: 10.1088/1742-6596/2089/1/012049.
18. Thirupathi Lingala et al 2021 J. Phys.: Conf. Ser. 2089 012050; DOI: 10.1088/1742-6596/2089/1/012050.
19. S. Pratapagiri, R. Gangula, R. G, B. Srinivasulu, B. Sowjanya and L. Thirupathi, "Early Detection of Plant Leaf Disease Using Convolutional Neural Networks," 2021 3rd International Conference on Electronics Representation and Algorithm (ICERA), 2021, pp. 77-82, doi: 9.1109/ICERA53111.2021.9538659.
20. Padmaja P, Sophia IJ, Hari HS, Kumar SS, Somu K, et al., (2021) Distribute the Message over the Network Using another Frequency and Timing Technique to Circumvent the Jam-mers. J Nucl Ene Sci Power Generat Techno 10:9.
21. Lingala Thirupathi, Dr. Venkata Nageswara Rao Padmanabhuni, "protected framework to detect and mitigate attacks": International journal of analytical and experimental modal analysis, volume XII,Issue-VI,(2020) Page No: 2335-2337, DOI:18.0002.IJAEMA.2020.V12I6.200001.0156858943.
22. Shashi Rekha, Lingala Thirupathi, Srikanth Renikunta, Rekha Gangula, Study of security issues and solutions in Internet of Things (IoT), Materials Today: Proceedings, 2021,ISSN 2214-7853, https://doi.org/10.1016/j.matpr.2021.07.295.
23. Rekha Gangula, Lingala Thirupathi, Rajashekar Parupati, K. Sreeveda, Saritha Gattoju, Ensemble machine learning based prediction of dengue disease with performance and accuracy elevation patterns, Materials Today: Proceedings, 2021, ISSN 2214-7853, https://doi.org/10.1016/j.matpr.2021.07.270.
24. Lingala Thirupathi and P.V. Nageswara Rao, "Developing a MultiLevel Protection Framework Using EDF", International Journal of Advanced Research in Engineering and Technology (IJARET),2020,volume:11, Issue: 10, Pages: 893-902.
25. Lingala Thirupathi, Dr. Venkata Nageswara Rao Padmanabhuni, " protected framework to detect and mitigate attacks": International journal of analytical and experimental modal analysis, volume XII,Issue-VI,(2020) Page No: 2335-2337, DOI:18.0002.IJAEMA.2020.V12I6.200001.0156858943
26. L. Thirupathi, G. Rekha, "Future drifts and Modern Investigation Tests in Wireless Sensor Networks" , International Journal of Advance Research in Computer Science and Management Studies, Volume 4, Issue 8 (2016).
27. L Thirupati, R Pasha, Y Prathima, “Malwise System for Packed and Polymorphic Malware”, International Journal of Advanced Trends in Computer Science and Engineering, Vol. 3 , No.1, Pages : 167– 172 (2014).
28. Thirupathi Lingala, Ashok Galipelli, Mahesh Thanneru, “Traffic Congestion Control through Vehicle-to-Vehicle and Vehicle to Infrastructure Communication”, (IJCSIT) International Journal of Computer Science and Information Technologies, volume 5, Issue 4, Pages :5081-5084 (2014).
29. M.Swathi, L.Thirupathi, “Algorithm For Detecting Cuts In Wireless Sensor Networks” in International Journal of Computer Trends and Technology (IJCTT) – volume 4 Issue10 (2013).
30. L Thirupathi, Y Reddemma, S Gunti - SIGCOMM Computer Communication Review, “A secure model for cloud computing based storage and retrieval”, volume 39, Issue 1, Pages: 50-55 (2009).
31. L. Thirupathi and R.P.V. Nageswara, "Understanding the Influence of Ransomware: An Investigation on Its Development Mitigation and Avoidance Techniques", Grenze International Journal of Engineering & Technology (GIJET), vol. 4, no. 3, pp. 123-126, 2018.
32. Sunanda Nalajala, Lingala Thirupathi, N.L.Pratap,”Improved Access Protection of Cloud Using Feedback and De-Duplication Schemes “, Journal of Xi'an University of Architecture & Technology, Volume XII, Issue IV (2020).
33. V.Srividya, P.Swarnalatha, L.Thirupathi, “Practical Authentication Mechanism using PassText and OTP” in Grenze International Journal of Engineering and Technology, Special Issue,Grenze ID: 01.GIJET.4.3.27,© Grenze Scientific Society, 2018.
34. Anisha P R , Kishor Kumar Reddy C and Nguyen Gia Nhu, “Blockchain Technology: A Boon at the Pandemic Times – A Solution for Global Economy Upliftment with AI and IoT”, EAI/Springer Innovations in Communication and Computing, 2022.
35. Kishor Kumar Reddy C, Anisha P R, Shastry R, Ramana Murthy B V, “Comparative Study on Internet of Things: Enablers and Constraints”, Advances in Intelligent Systems and Computing, 2021
36. Kishor Kumar Reddy C, Anisha P R, Apoorva K, “Early Prediction of Pneumonia using Convolutional Neural Network and X-Ray Images”, Smart Innovation, Systems and Technologies, 2021
37. Kishor Kumar Reddy C and Vijaya Babu B, “ISPM: Improved Snow Prediction Model to Nowcast the Presence of Snow/No-Snow”, International Review on Computers and Software, 2015
38. Kishor Kumar Reddy C, Rupa C H and Vijaya Babu B, “SLGAS: Supervised Learning using Gain Ratio as Attribute Selection Measure to Nowcast Snow/No-Snow”, International Review on Computers and Software, 2015
39. Kishor Kumar Reddy C, Rupa C H and Vijaya Babu B, “A Pragmatic Methodology to Predict the Presence of Snow/No-Snow using Supervised Learning Methodologies”, International Journal of Applied Engineering Research, 2014