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SOCIAL DISTANCE DETECTION

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***Abstract*— COVID-19 is an illness caused by the SARS-CoV-2 virus. The majority of COVID-19 patients will have low to normal symptoms and will recover without requiring extra care. Otherwise, some patients will become extremely sick and require medical support. A Deep Learning model is made to track people and measure the distance between them. To prevent the transmission of the infection, making people maintain the minimum distance is the key objective. We apply YOLOv3 and other convolutional neural network-based methods, as well as a distance measurement method, to recognise individuals. This Deep Learning model can determine whether members of a large group maintain their distance from one another. If they maintain a 6 feet distance, it will be indicated in green; if not, it will be highlighted in red. This can help identify social disparities and lessen the spread of COVID-19.**

***Keywords* — COVID-19, SARS-CoV-2, convolutional neural network, YOLOv3, deep learning, social distancing.**

I. INTRODUCTION

The public is apprehensive about the virus's spread if there is no effective cure when the novel coronavirus (Covid-19) pandemic breaks out. A rise in the number of cases reported globally prompted the World Health Organization (WHO) to declare Covid-19 a pandemic. To stop the disease from spreading, a lockdown has been enacted in many nations, ordering residents to remain inside during this crucial time. Avoiding personal contact with other individuals is the most effective way to preventing Covid-19 from spreading, as stated by the Centers for Disease Control and Prevention (CDC) and other public health organisations.

In order to reduce the numbers, people all around the world are isolating themselves from the Covid-19 outbreak. During the quarantine time, travel, meetings, gatherings, workshops, and prayer were all restricted. People were urged to manage and organise activities as much as possible with the help of internet to reduce face-to-face contact. To help prevent the virus from spreading further, people were also encouraged to practise proper hygiene, such as washing their hands frequently, wearing masks, and avoiding being in close proximity to sick people. There is, however, a distinction between knowing what to do and really doing it to stop the disease from spreading.

Individuals, communities, businesses, and healthcare organisations are all part of a community that must collaborate to stop the Covid-19 disease from spreading. Following the resumption of economic activity, it was established that social distancing and self-isolation were the most effective methods for breaking the chain of infections and reducing the effects of the coronavirus pandemic. Many people have been found to be in breach of public health regulations, especially in regards to social segregation. It's reasonable that people underestimate or dismiss the importance of social isolation in their desire to get back to work.

The world is still recuperating from the pandemic, and there is still no cure for Covid-19. To lessen the financial impact of the pandemic, several nations have permitted a specific range of economic activities to pick back up once the quantity of new Covid-19 cases has dropped below a particular threshold. Workplace safety issues have come to light as these nations cautiously begin their economic activity in the post-Covid-19 environment.

In order to increase the effectiveness of enforcing social distance, this study uses a deep learning model to automate the detection of transgressions in public and professional situations. Different machine learning and computer vision techniques can be used for object detection. These techniques may also be employed to assess a person's degree of social isolation.

The following points describe the essential things of this technique:

a. Deep learning has gotten a lot of buzz in the field of object recognition, especially when it comes to human recognition.
b. Create a social distancing detecting system that can detect the distance between people in order to stay safe.
c. Real-time video data from the camera is analysed to assess the categorization findings.

II. LITERATURE SURVEY

Social distancing has become an important factor in reducing the spread and effects caused by Covid- 19. With the help of some earlier studies and researches we try to build a system which measures the minimum distances and shows us who violates it.

In this research, Y. C. Hou et al [1] in their study shows a methodology by which we can identify people, calculate the distance between them in a group and compare it with the minimum distance standard set by the WHO. The video frame from the camera will be used as input and then it uses an

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object detection model which works on the basis of YOLOv3 algorithm.

Pranob K Charles et al [2], in their study deals with tracking multiple persons when people move in big groups. This work is based on CNN by extracting ROI based HOG features to track people better without any obstruction. First, the algorithm gets implemented then a user interface is created. This interface is used to observe the criteria for detection of people by considering thresholding values of the person and with the help of thresholding boxes given to people, we can track them.

J. Redmon et al [3] talks about the YOLOv3 algorithm and its uses and improvements needed to be done. YOLOv3 is a real time CNN based algorithm which is used to detect objects. Object detection method is by creating bounding boxes for every object and within the data available in that, detect what that object is.

J. Redmon et al [4], introduces YOLO, a new approach to detection of objects. This studies about the possibility of approaching object detection as a regression problem for spatially separated bounding boxes and associated class probabilities. Since the whole work takes place in a single network it can be boosted directly on performance detection.

Kruti Goyal et al [5], in this review, deals with an application that can be used for tracking faces as well as detecting them in videos and in cameras that are used for many multipurpose activities. A comparison is performed in a tabular manner in this paper, so that it is easier to understand the algorithms in a better and easier manner.

S. Mukherjee et al [6], in this paper discusses about two different techniques that are used for face detection in frames which contain humans. The old approach of using hand crafted features followed by training a simple classifier and a relatively new approach of learning features form data with the help of neural network.

Jiayuan Mao et al [7], deals with methods that can be used to boost effectiveness of traditional pedestrian detection techniques. This paper explores the issues by aggregating extra features into CNN based detectors which are used for pedestrian detection and then tries to find results in how this features helps to reduce the problems faced existing systems.

K. He et al [8], deals with deep learning of image recognition which is difficult to be trained. It provides a residual learning approach for training networks that are much deeper than previously utilized networks. Instead of learning unreferenced functions, it explicitly reformulates the layers as learning residual functions with reference to the layer inputs.

K. Simonyan et al [9], investigates the effect of the Convolutional Network Depth on its accuracy in the large-scale image recognition setting. It also contributes a thorough evaluation of networks of increasing depth using an architecture with small convolution filters that show a significant improvement on the prior-art configurations which can be achieved by pushing the depth to 16-19 weight layers.

D.T. Nguyen et al [10], aims to provide a complete survey on the development and challenges of human detection. The main problem of detecting humans in an image or video frame has been actively researched in the past decade. It mainly focuses on human object descriptors.

III PROPOSED WORK

This technique for detecting social distancing was created to assess the safe distance between people in public areas. This research makes use of deep CNN and machine vision methods. The pedestrian in the video frame was initially recognised using an open-source object recognition network based on the YOLOv3 technique. Because only the pedestrian class was used as a result of the detection, all other object types were ignored in this application. As a result, the image may be created to show the bounding box that best fits each detected pedestrian, and distance can be estimated using the data from the detected pedestrians.

In order to calculate distances more precisely, the camera is set up to record video frames at a fixed angle that are later translated into two-dimensional top-down images. It is assumed throughout this process that any pedestrians in the video frame are moving along a level surface. Four filmed plane points are used in each frame to create the top-down perspective. The top-down view can be used to pinpoint each pedestrian's location. It is possible to scale and quantify the space between pedestrians. Any distance between two people that is less than the permitted distance will be highlighted with red lines as a precautionary notice, depending on the predetermined minimum distance between them. The project was finished using the Python programming language.

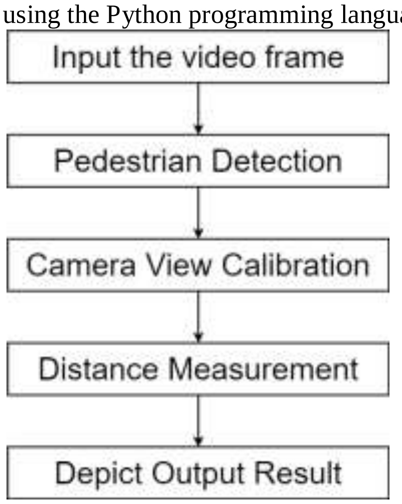

Figure 2 Pipeline for social distancing detection.

A. Pedestrian Detection

By organising the detection as a single regression issue, the Deep CNN model was introduced as an object detection technique that reduced computer complexity. When it comes to deep learning-based object detection, the YOLO model is a cutting-edge object detector that has been shown to give considerable speed improvements and is appropriate for real-time application. As seen in Figure 3, the YOLO model was used in this study to identify pedestrians. The YOLO algorithm was regarded as an object identification algorithm while learning bounding box coordinates (tx, ty, tw, th), object confidence, and associated class label probabilities (P1, P2,..., Pc) (tx, ty, tw, th). The COCO dataset, which contains 80 labels and includes classifications for pedestrians and humans, was used to train the YOLO.

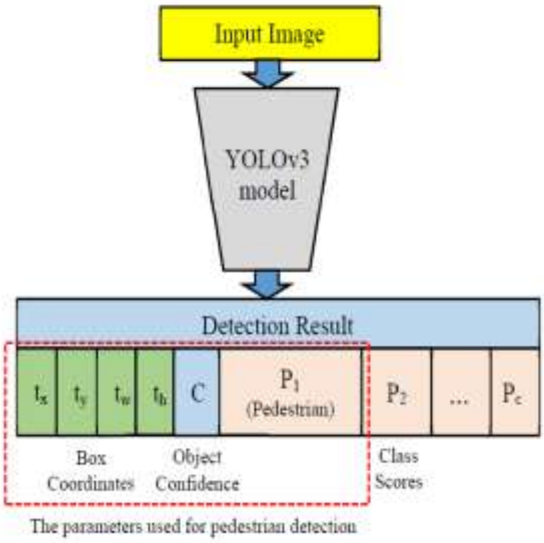

Figure 3 YOLO and it's parameters applied in pedestrian detection.

B. Camera view calibration

Figure 4 illustrates how a top-down 2D display of 480x480 pixels was created using an image's area of focusing attention (ROI) on a pedestrian crossing a roadway. For camera calibration, the change from a perspective view to a top-down view is calculated. The perspective transformation in OpenCV is a straightforward camera calibration technique that entails selecting four points from the perspective view and mapping them to a rectangle's corners in the 2D image view.

C. Distance Measurement

In this step of the pipeline, each person's (x, y, w, and h) bounding box in the perspective view is identified and transformed into a top-down view. Using the bottom-center point of the bounding box, each pedestrian's location is calculated from a top-down perspective. In this step of the pipeline, each person's (x, y, w, and h) bounding box in the perspective view is located and changed to a top-down view.

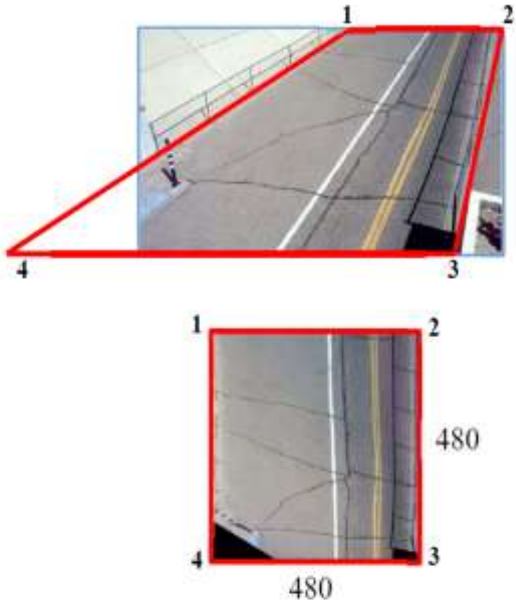

Figure 4 A sample of the top-down and perspective views after calibrating (bottom).

In top-down perspective, each pedestrian's position is estimated by using the bounding box's bottom-center point:

$$d = \sqrt{(x2 - x1)^2 + (y2 - y1)^2} \quad (1)$$

The pedestrians less than the minimum distance, t, are indicated in red, while the others are highlighted in green. When two people are separated by less than a particular distance, a red line is formed between them.

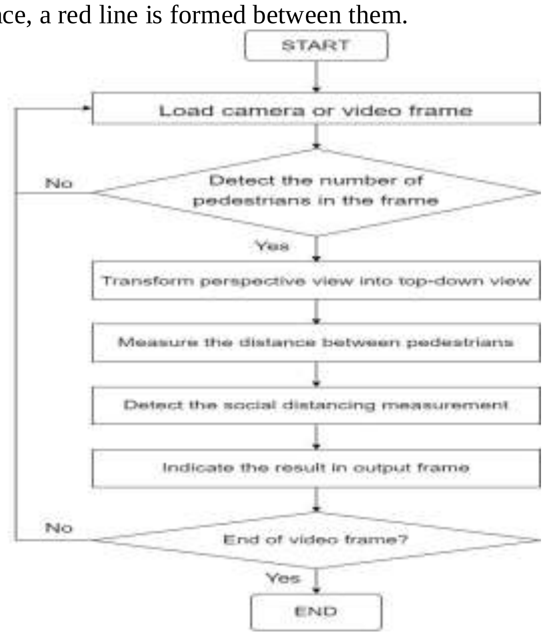

Figure 5 Program flowchart of social distancing detection for each video frames.

IV.RESULT AND DISCUSSIONJ

In the video, people can be seen strolling along a street. The video frame in this composition is tilted in a certain direction towards the street. To estimate distances more precisely, the perspective of the video frame is altered to a top-down viewpoint. In Figure 6, the findings of the top-down perspective and the identification of social separation in a video frame are shown. The sequences are shown in descending order. To assess social isolation, each pedestrian is represented by a single point.

Green points show pedestrians who keep a safe distance from other people while red dots show those whose distance from another pedestrian is less than the permitted threshold. There can be difficulties with detection. These discrepancies might be caused by pedestrians strolling too close to one another and becoming superimposed on the camera image. The pedestrian identification method has an impact on the precision of distance measurements between pedestrians. The YOLO approach may also identify the pedestrian's half body as an item by displaying the bounding box, however the bounding box's estimation of the pedestrian's position is less accurate and corresponds to the midway point of the bottom line.
An interface was created for easier navigation between different aspects of the model. The model provides both recorded video option and live video option. With the help of live video option, we can detect social distance in real time. These can be mainly implemented with CCTV cameras and other video recording devices that is kept at certain elevation.

Figure 6: Social Distance detection for recorded video

Figure 7: Interface of the system

Figure 8: Social distance detection for live video

V. CONCLUSION

A tool for detecting the minimal distance between people in order to provide a clear picture of the social distance maintained and to raise awareness about how keeping social distance can help to mitigate the effects of the COVID-19 disease's spread in our country.
Computer vision can estimate the space between individuals in a crowded area, and those who are not maintaining the fundamental social distance rule will be displayed inside a red frame, with the gap between them being emphasised by a red line. With the aid of a video showing people walking down a street, this method was tested. The final visualisation showed that this approach is effective at identifying social distancing tactics between individuals and that it can be applied in a range of settings. The work may be made even better by enhancing the pedestrian recognition algorithm, adding other detection techniques including mask detection and human body temperature detection, increasing the hardware's computational capability, and adjusting the camera's point-of-view.

VI. REFERENCES

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