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Social Distancing Detection

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ABSTRACT: *In the fight against the coronavirus, social distancing has proven to be an effective measure to hamper the spread of the disease. While many people are staying reception to assist flatten the curve, many of our customers within the manufacturing and pharmaceutical industries are still having to travel to work every day to ensure that our basic needs are met. To help ensure social distancing protocol in their workplace, Computer vision along with deep learning, machine learning & image processing provides an effective solution to live social distancing among humans across the moving frames. To achieve the above objective, the algorithm was developed which would do person detection & determine the distance between the human using clusters of the pedestrian in a neighbourhood by grabbing the feed from video. This approach of social distancing algorithm will red mark the persons who are closer than an allowable limit. This study is proposed to support the actions on Covid19 spread reduction. It provides an answer for detecting people gathering publicly in places like banks, shopping malls, clinics, etc. The concept of a person detection algorithm is employed to accurately detect a person's presence in areas of interest and is then followed by measuring the space between the detected persons.*

Keywords: COVID-19, Deep Learning, YOLO, CNN

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I. INTRODUCTION

In December 2019, the first of official case of Corona virus was reported in China [1]. Corona virus is a large family of viruses that harms humans and animals. Covid-19 is a family member of the coronavirus, first spread to Wuhan, and then the outbreak rapidly affected many countries in the world and has been declared as a pandemic by the World Health Organization(WHO)[2].

For several months, the World Health Organization believed that corona virus was only transmittable from person to person via small droplets from the nose and mouth and does not linger in the air.

However, on 8th July 2020 [3], the WHO announced that there is emerging evidence that Covid-19 is an airborne disease that will be spread by tiny particles suspended within the air after people talk or breathe, especially in crowded places, closed environments or poorly ventilated settings. Therefore, social distancing now claims to be even more important than thought before, and one among the simplest ways to prevent the spread of the disease additionally to wearing face masks. Almost all countries are now considering it as a compulsory practice.

The covid-19 pandemic took the world by storm, therefore tough but necessary measures were taken throughout the world to control its spread. This resulted in bringing normal day-to-day activities to an entire standstill. Certain guidelines were laid down to minimize people's exposure to the virus that include safety measures like wearing masks and maintain social distance. Also according to the requirements given by the WHO [4], the minimum distance between individuals must be at least 6 feet (1.8 m) to observe an appropriate social distancing among the people. Recent research has confirmed that people with mild and no symptoms can also be carriers of the novel corona virus infection. Therefore, it becomes necessary to observe social distancing among individuals. Social distance has proven to be a successful strategy for reducing the spread of infectious illnesses like SARS and Covid-19, as well as an essential inhibitor.

However, the conventional method of keeping people at a safe distance in the Covid-19 standard operating system could not ensure that everyone obeys the rule. An automatic social distancing system needs to be created to assist and train individuals to stay at a distance of at least 6 feet. Since people require to go out for essential needs such as food, health care, and other necessary tasks and jobs. Therefore, many other technology-based solutions like machine learning and deep learning got to step in to help the health and medical community in fighting with Covid-19 challenges and successful social distancing practices. Hence, this study aims to determine whether or not social distancing is being maintained between two or more individuals, in the most efficient, accurate, and simple manner, hence requiring overseeing authorities to take minimum effort.

II. LITERATURE SURVEY

In various papers, to monitor Social Distance, researchers have proposed various machine learning algorithms. This paper offers several current machine learning-based tools to clarify the significance of the proposed work. Several kinds of research have shown the development of machine learning models to support the actions on Covid-19 spread mitigation.

Yew Cheong Hou, Mohd Zafri Baharuddin, Salman Yussof, Sumayyah Dzulkiy [7] used deep learning methodology to evaluate the distance between people to mitigate the impact of this corona virus pandemic. The deep CNN model was the object detection approach that was proposed, mitigated the computational complexity issues, hence achieving a higher degree of performance and accuracy.

Afiq Harith Ahamad, Norliza Zaini, and Mohd Fuad Abdul Latip [8] used the MobileNet Single Shot Multibox Detector (SSD) object tracking model with the OpenCV library for image processing to detect individuals in regions of interest. The distance is going to be computed between the persons detected within the captured footage then compared to hard and fast pixels' values. From the results gained, the distance tracking system achieved between 56.5% to 68% accuracy for testing performed on outdoor and challenging input videos, while 100% accuracy was achieved for the controlled environment on indoor testing.

Dongfang Yang, Ekim Yurtsever, Vishnu Renganathan, Keith A. Redmill, Umit Ozguner [9] proposed a man-made Intelligence(AI) based real-time social distancing detection and warning system. Deep learning-based real-time object detectors are used to measure social distancing. An unobtrusive audiovisual alarm is emitted if a violation is found, but it does not target the person who violated the social separation measure. Also, if the social density is over a disapproving value, the system sends an impact signal to modulate in ow into the ROI. The proposed method is tested across real-world datasets to live its generality and performance.

Dr. S.V. Viraktamath, Madhuri Yavagal, Rachita Byahatti [10] explains the architecture and dealing of the YOLO algorithm for the aim of detecting and classifying objects, trained on the classes from the COCO dataset. Deep learning techniques like the Faster Regional Convoluted Neural Network (FRCNN), you simply Look Once Model (YOLO), the only Shot Detector (SSD), etc. could be used to identify and classify items to improve the precision of object detection.

Ayoosh Kathuria [11] described YOLO, which is one of the faster object detection algorithms when you need real-time detection, without loss of too much accuracy. The output of a 1 x 1 kernel on a feature map is created by YOLO, which may be a fully convolutional network. The detection in YOLO v3 is performed by using 1 x 1 detection basics on feature maps of three sizes that are different at three distinct locations throughout the network.

Priya Pandiyan [12] utilized deep learning methods to assist developers in analyzing publicly available data such as X-rays, CT scans, and text data from various social media debates, among other things. Image and video processing are frequently used to assess whether or not social distance and mask protection are being monitored. CCTV cameras connectivity within public places, public transports, and hospitals are helping to collect the specied data for monitoring and analysis. Keras and TensorFlow tools were used for the image processing step.

Mohsen Azarmi, Mahdi Rezaei [13] Using standard CCTV security cameras, a Deep Neural Network-Based model is created for automatic people recognition, tracking, and inter-people distance estimate inside the crowd. For reliable people recognition and social distancing monitoring in difficult environments, the suggested model includes a YOLOv4-based structure and inverse approach mapping. It also offers an online risk assessment system based on a statistical analysis of Spatio-temporal data from movement trajectories as well as the rate of social distance breaches. It identifies high-risk zones with the highest possibility of virus spread and infections. This may help authorities to revamp the layout of a public place or to require precaution actions to mitigate high risk zones. The suggested technique is compared to three state-of-the-art algorithms on the Oxford Town Centre dataset, and it outperforms them in terms of accuracy and speed.

On omni directional pictures, Roman Seidel, André Apitzsch, and Gangolf Hirtz [14] proposed a person detection system, an accurate technique for generating minimal enclosing rectangles of people. The fundamental concept is to convert YOLOv2's qualitative detection capability to sh-eye pictures using a convolutional neural network-based approach. The outline of the approach picks up the thought of a state-of-the-art object detector and highly overlapping areas of images with their regions of interest. This overlap decreases the number of false negatives. Based on the raw bounding boxes of the detector they calibrate overlapping bounding boxes by 3 approaches: non-maximum suppression, soft non-maximum suppression, and soft non-maximum suppression with Gaussian smoothing. The assessment was done on the PIROPO database and an own explained Flat dataset, supplemented with bounding boxes on omni directional images. They achieve a mean precision of 64.4 you bored with YOLOv2 for the category person on PIROPO and 77.6 % on Flat.

III. PROPOSED SYSTEM

The system is started within a video stream camera that captures many frames. The system will process the captured frame and confirm if there are persons inside, then calculate the space between each adjacent person and choose if it's accepted or not, then make a green line between the two adjacent persons to classify distance is accepted and redone if not.

The steps in detail are listed below:

-Detects people in video streams.

-Detects center.

-Detects full- edged social distancing.

-Classify the distance.

•Red for not allowed distance.

• Green for allowed distance

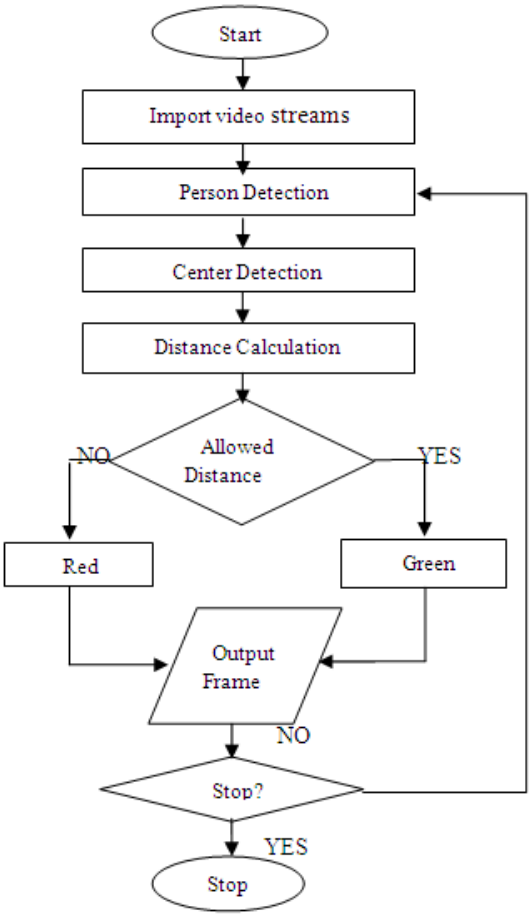

Fig1: Block Diagram for the proposed System

The image classification concept refers to assign each image to its class label, whereas object localization refers to bound the detected object by rectangle, these two challenges cause a new concept called visual perception, in reality, many complex tasks are cooperated for identifying visual perception. If we used visual perception strategy in deep learning, so we should always consider these algorithms:

- R-CNN and their variants, including the original R-CNN, Fast R- CNN [15], and Faster R- CNN
- Single Shot Detector (SSDs).
- You Only Look Once (YOLO) [16].

However, R-CNN's head for top accuracy, but the major drawback with the RCNN is extremely slow, generally, single-stage detectors tend to offer fewer accuracy than two-stage detectors but are meaningfully faster, YOLO may be a good selection for one stage detector, which is in a position to realize an outsized number of object detections by execution combined training for both object detection and classification.

It trains on full images and optimizes detection performance. The most significant benefit of utilizing YOLO is its incredible speed: it processes 45 frames per second in no time. YOLO uses the subsequent steps: - YOLO first takes an input image. The input image is then divided into grids (say a 3X3 grid).

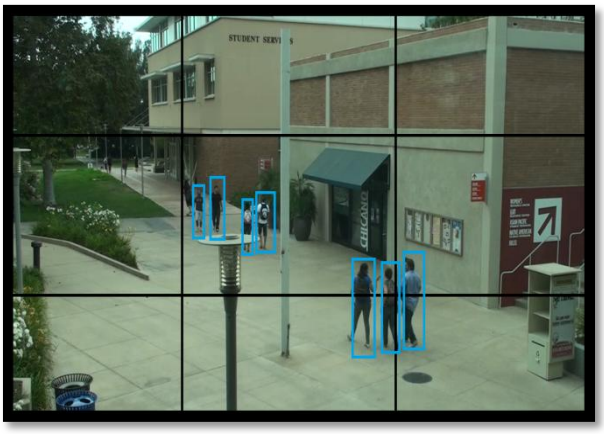

Fig2: Image divided in 3x3 grid

The network predicts 4 coordinates for each bounding box, tx, ty, tw, th. If the cell is offset from the top left corner of the image by (cx, cy) and the bounding box prior has width and height pw, ph, then the predictions correspond to:

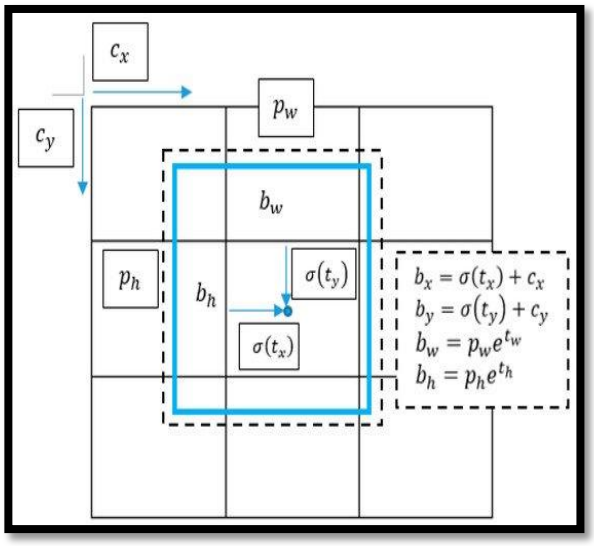

Fig3: YOLO-Bounding Box

Each grid is subjected to image classification and localization [17]. The bounding boxes and their corresponding class probabilities for objects are then predicted by YOLO. We need to pass the labelled data to the model to train it. Then, a vector is generated for every image using the notations to detect objects (if any) within the image. Using multi-label classification, each box predicts which classes the bounding box may include. For category predictions, we employ binary cross-entropy loss during training.

Y=	pc
	bx
	by
	bh
	bw
	C

Fig4: YOLO Vector

If an object is present within the grid, pc specifies if it is there or not, bx, by, bh,bw specifies the bounding box if an item is present, and c species the classes. If the object is a person, the value of c will be 1.

We use a technique called as Non-Max Suppression which ensures only single detection per object. It is used to reduce overlapping bounding boxes to only a single bounding box, thus representing the true detection

of the object. Another technique is introduced to beat multiple detections by the thing detection algorithm. This is called Intersection over Union which helps us to predict bounding boxes. It calculates the intersection over a union of the particular bounding box and therefore the predicted bounding box (IoU = Area of the intersection / Area of the union).
Finally, using these vectors we will identify classes of the thing detected and use them for further application. We generate an appropriate label for the classes.

IV. IMPLEMENTATION

Dataset:
The COCO dataset, which stands for "Common Objects in Context," is a collection of difficult, high-quality datasets for computer vision, with the majority of the datasets being state-of-the-art neural networks.
The COCO Object Detection Task is considered to rise the state of the art in object detection forward, dataset holds pictures of 80 objects, with a total of 1.5 million labeled instances in 328k images. COCO structures two object detection ways first by using bounding box output and the other object segmentation output, in this research, the bounding box technique is used.
Object Detection:
The objective of object detection is to detect objects efficiently and accurately. The model uses both OpenCV and YOLO techniques for object detection to accomplish high accuracy. We used CNN algorithm in the deep learning-based approach for object detection. The neural network is trained on the most challenging and available dataset named (COCO dataset). The resulting system is fast and accurate and the object detection is performed by using python code with OpenCV and YOLOv3. 0 installed, thus aiding the social distance detection application.
Distance calculation:
-Non Maxima Supression:
To depict truth detection of the object, NMS (Non-maxima suppression) is used to scale back overlapping bounding boxes to only one bounding box. Overlapping boxes aren't ideal or practical, especially if we want to count the number of items in an image.

Fig5: Non maxima Suppression

-Accept bounding box coordinates and compute centroids:
Each identified item in the centroid tracking technique has a set of bounding boxes (x, y)-coordinates in every frame. We must compute the "centroid" or the central (x, y)-coordinates of the bounding box after we know the bounding box coordinates.
We'll give them unique IDs because they're the first set of bounding boxes submitted to our algorithm.
-Euclidean Distance:
We then compute the Euclidean distances between each pair of original centroids and new centroids.
$D(C1,C2) = \sqrt{(X_2 - X_1)^2 + (Y_2 - Y_1)^2}$

V. RESULT:

This project has been completed based on python3, OpenCV, for image processing technique, and YOLO object detection model framework. The code is tested using the COCO dataset and pedestrian.mp4 video dataset.
The proposed system has worked well and shows satisfying results in person detection and social distancing detection as shown in the figure below:

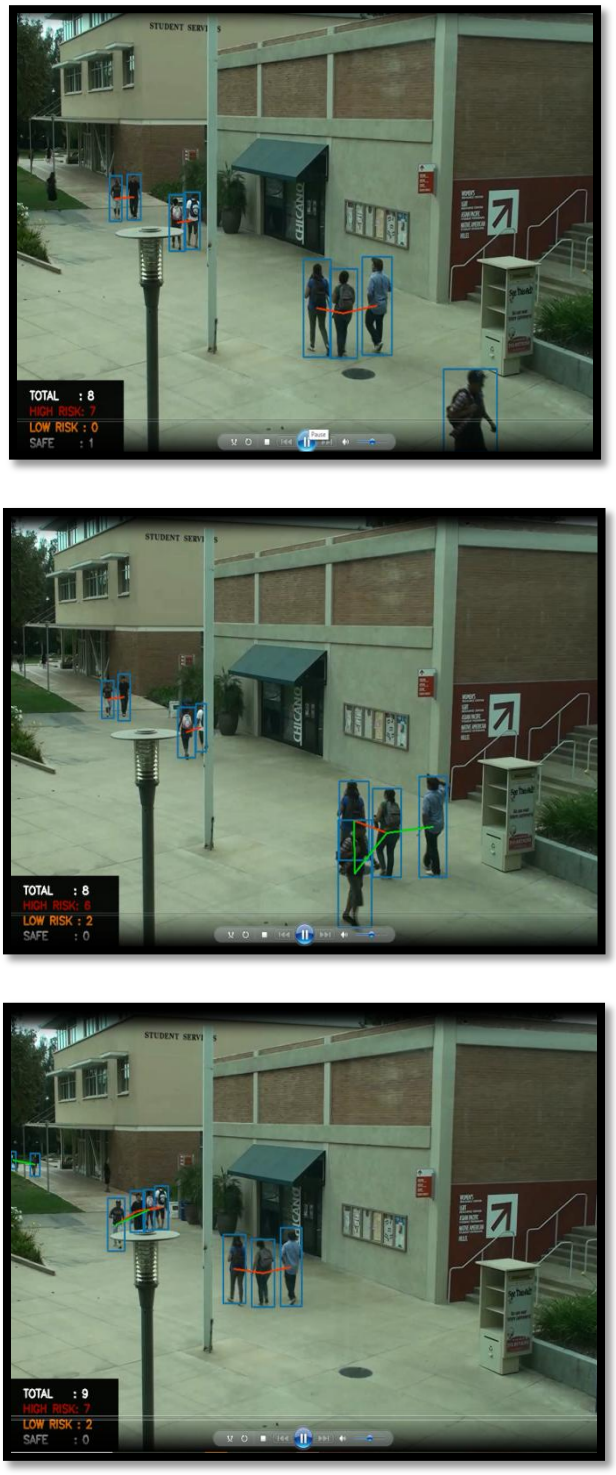

Fig6: Social distancing Detection

VI. CONCLUSION:

This paper used deep learning and YOLO methodology to mitigate the impact of the corona virus pandemic by evaluating the distance between people and any pair failing to act in accordance with rules and regulations will be indicated with a red line. The proposed method was validated using a video showing pedestrians walking on a street. The results showed that the tools used are capable to monitor and detect pedestrians in a video frame and determine whether the pedestrians are maintaining a safe distance or not. The model could also be used in other environments like offices, restaurants, and schools. Furthermore, the work can be improved by optimizing the pedestrian detection algorithm by using better and fast-performing algorithms other than YOLO in the future, and also by other detection algorithms like mask detection and human body

temperature detection. Improving the computing power of the hardware and better camera calibration could increase the effectiveness of the model.

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