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Social Distancing Violation Analyzer

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Abstract:- **The Novel Coronavirus outbreak worldwide has made people to consider different ways to perhaps protect themselves from infections. Several safety precautions, including avoiding crowded areas, maintaining hand hygiene, and avoiding touching eyes, mouth, or nose. Researchers, mathematicians, pharmacists, and other professionals have all been challenged by the pandemic to find solutions to the pandemic situation. Algorithms and concepts related to machine learning also find a great place for many scientists. Among all the preventive measures, social distancing is one of the most important protective methods for flattening the COVID-19. An efficient and cogent social distancing violation analyzer tool would play a crucial role in detecting humans if they are not maintaining social distance. The system examines frames it receives as input to find humans in the visual frame. The pairwise distance between each recognized individual is then calculated, and based on the distance value acquired, the system will issue an alert for those who are not maintaining the social distance. To determine how well the system performs, it is tested using a variety of image input acquisition techniques, including camera, video, and image. The proposed system achieves a greater precision for videos, according to experimental findings. Applications like human tracking, pedestrian recognition, and vehicle tracking can all be added to the system.**

Keywords:- *Social Distancing, Pedestrian Detection, Convolutional Neural Network, YOLO, COVID-19, Object Detection.*

I. INTRODUCTION

The SARS-CoV-2 virus is an infectious disease also known as coronavirus disease (COVID-19) [1] [2]. This virus spread throughout the entire world, affecting 213 countries and territories. The number of progressive cases up to February 2023 is estimated to be approximately 67.4 Cr, and the number of deaths is estimated to be around 68.6 L. The World Health Organization (WHO) [3] has declared COVID-19, the SARS-COV2 virus that emerged in Wuhan, China, in December 2019, as a global public health emergency.

To protect against COVID-19, the WHO has advised the population to become acclimated to themselves. They have offered numerous suggestions and preventative steps to be followed to defend oneself against the virus. Some of these include avoiding crowded areas, keeping your hands clean, and refraining from touching your eyes, mouth, or nose. Out of all these precautionary measures, social distancing plays a significant role in downsizing infections. Social isolation and Social Distancing have the biggest impact on reducing infections out of all these preventative methods. To flatten the curve of disease propagation, social distancing must be enforced. Figure 1 displays a case of social distance. The citizens must adhere to the social distance, according to the higher authority. To identify and notify people if they are not maintaining social distance, this study seeks to design a social distancing violation analyzer. The suggested approach focuses on detecting the individuals that may be seen in picture or video streams and calculating the distance between two people to determine whether they maintain social distancing.

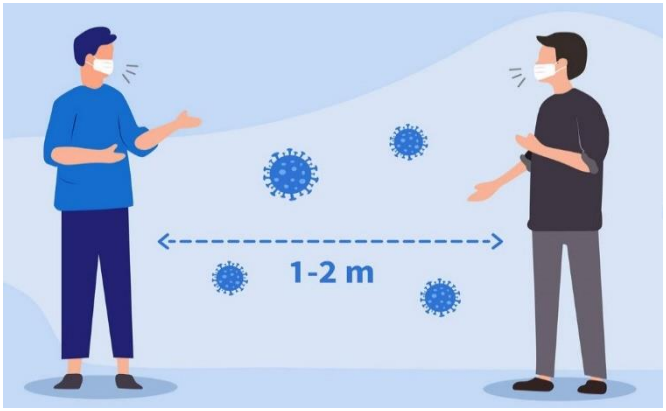

Fig. 1: Sample Social Distancing image

The paper is organized as follows - The relevant work in the identification of social distance is illustrated in Section II. The proposed social distancing violation analyzer is shown in Section III. The methodologies used are explained in Section IV and Software Requirements are provided in Section V.

II. RELATED WORK

Many similar studies on object tracking and identification are being conducted. Various research papers discussed in [4] [5] show how human activity detection can be performed and contact tracing can be done. exploit the YOLO v3 object detection model to detect humans from the background, and the humans are tracked using the Deep Sort approach using bounding boxes. Chakrabarti P. [6] investigated the effect of social distancing while reducing the COVID-19 [8] curve using the Stochastic Simulation Model. The findings indicate that the COVID-19 curve is not flattened by social distance alone. In addition to social distancing, the number of hospital beds also must increase to handle COVID-19. YOLO Object detector [7] is the current prevalent technique of object detection algorithm. The recognized model identifies 80 varieties of images and videos. The main advantage of using this algorithm is its faster computation and efficiency. Gaeta G [5] developed a

social distancing detection system by considering four properties: the developed system never stores the cache data, the individuals should not be targeted, and the high-level human should not be detected.

III. PROPOSED SYSTEM

With the aid of computer vision and deep learning innovation, the proposed method focuses on analysing a person's individuality on an image or video stream and deciding whether they are keeping social distance. The proposed system follows 3 types of approaches -

• Human detection is carried out using yolov3.
• Every person who is visible in the frame is measured in terms of distance.
• Visualisation of individuals at various risk levels, including High, Low, and Safe.

DNN (Deep neural network) algorithm is used in the proposed social distancing violation analyzer. The proposed system first detects the Region of Interest (ROI) from the frame. Secondly, the system detects the people in the frame & takes the centre point of the base of the bounding boxes assigned to the people. Finally, it can describe the violation status using different colours.

A. Camera Calibration

The photos are captured from a random angle. We must first change the viewpoint vision to the prospect. Since it was captured by a single camera, the input framework is monocular; the simplest conversion strategy/arrangement entails identifying four ROI spots in the panorama view. The detected ROI sites are used to measure social distance and calibrate them such that they link in the shape of a rectangle in the view. As seen from the top panoramic view, these edge points link to form parallel boundaries in the real world. The result allows everyone to be seen as being on the same tenement ground plane. These ideas are owned, and those points are uniformly appropriated both vertically and horizontally. The combined viewpoint image is subjected to the transformation processes.

B. Person Detection

The next stage is to keep track of pedestrians by object detection and tracking using bounding boxes. Some heuristics and non-max suppression techniques are applied to avoid overfitting.

Fig 2. Person Detection

C. Distance Calculation

A boundary box is created for all the people detected in the frame. The base point of the bounding frame is taken from the person located in the frame. Consider the centre of the bounding box of the person detected. Now we can calculate the distance between the bounding boxes in the frame using Euclidian Distance Formulae.

D. Working

The Software and libraries used for creating the system are Python, Open CV, and NumPy. When we run the program, it is expected that the system will detect the human in the frame and alert the supervisor if any person is detected violating social distancing norms. The program gives us the ROI for all the detected people and their violation status. After getting ROI, horizontal and vertical views are computed. The next step is to identify the people in the frame and construct a boundary box over each pedestrian.

Red, Yellow, and Green boxes are the different violation statuses that denoted different risk levels. The red bounding box means the people are not following the social distance, and it indicates high danger, the yellow bounding box is low danger, and finally, the Green bounding box means the people are safe.

IV. METHODOLOGY

For a complete solution of a social distancing analyzer, the proposed system uses a two-stage model with person detection and inter-distance computation. With the ability to display and export data in real time, the system may be applied to all CCTV observation cameras with a distant resolution of Full-HD.

A. Person Detection

The visual information is gathered by CCTV cameras and sent to the deep neural network model. This model's output will use a single bounding box to identify all the inhabitants of the unit. By addressing a variety of challenges, including handling fabric differences, view invariance, position invariance, and occlusion, this model seeks to recognize humans. CNN-based models can only agree to accept fixed dimensions of images as input because they are connected layers with the categorization frames. This can result in two different types of issues. The inability to capture low-resolution images is the first problem, followed by the difficulty in accurately detecting small objects.

By using YOLO without Fully Convolutional Networks (FCNs), which accept any surveillance input image sizes, the first issue is resolved. Convolutional neural networks (CNN) are used in YOLO, which stands for "You Only Look Once," to recognise objects. While YOLO functions, it simultaneously predicts the labels of classes and locates objects. Because of this, YOLO can recognise many things in a single image. The name of the algorithm indicates that only one network is used for the entire image. In order to forecast bounding boxes and probabilities for each of these regions, YOLO divides a picture into regions. Additionally, YOLO forecasts the likelihood that an object will belong to a specific

class if it is contained in a given bounding box as well as its confidence.

When confidence is low or there is another bounding box for this region with higher confidence, some bounding boxes are then excluded using a technique called non-maximum suppression. The most recent iteration that employs sequential 3x3 and 1x1 convolutional layers are called YOLO-3. It includes 53 convolutional layers overall, with an architecture similar to that in Fig. 1 below. Batch normalisation and Leaky ReLU activation come after each layer.

	Type	Filters	Size	Output
	Convolutional	32	3 × 3	256 × 256
	Convolutional	64	3 × 3 / 2	128 × 128
1×	Convolutional	32	1 × 1	
	Convolutional	64	3 × 3	
	Residual			128 × 128
	Convolutional	128	3 × 3 / 2	64 × 64
2×	Convolutional	64	1 × 1	
	Convolutional	128	3 × 3	
	Residual			64 × 64
	Convolutional	256	3 × 3 / 2	32 × 32
8×	Convolutional	128	1 × 1	
	Convolutional	256	3 × 3	
	Residual			32 × 32
	Convolutional	512	3 × 3 / 2	16 × 16
8×	Convolutional	256	1 × 1	
	Convolutional	512	3 × 3	
	Residual			16 × 16
	Convolutional	1024	3 × 3 / 2	8 × 8
4×	Convolutional	512	1 × 1	
	Convolutional	1024	3 × 3	
	Residual			8 × 8
	Avgpool		Global	
	Connected		1000	
	Softmax			

Fig. 3 YOLOv3 Architecture

B. Inter - Distance Computation

Stereovision is used to determine how far each person is from the other. When the object is not close, this strategy is ineffective. It ought to be used in all public areas under observation. Hence, a single-view solution is necessary. The perception effect, which prevents us from identifying the uniform distribution of picture distances over the entire image, is caused by the projection of 3-D into a 2-D perception image, which affects impractical pixel length among the objects. For instance, parallel lines are joined at the prospect and appear to be much shorter outside of the camera than they do inside of it.

To measure the social distance between people, following human detection, the identified bounding box and its centroid information are used to compute the Euclidean distance between each detected centroid pair. The centroid of the bounding box is utilised to determine an approximate distance between each pair using the Euclidean distance. Moreover, a pixel to distance calculation is used to specify a social distance violation threshold. using a centroid tracking technique to monitor the person who exceeds the social distance limit.

[Euclidean distance = sqrt ((Bx - Ax) ^2 + (By - Ay) ^2)]

V. SOFTWARE REQUIREMENT

The features and functionalities of our proposed system are described in the software requirements. From the user's perspective, the requirements may be obvious or obscured, known or unknown, and anticipated or unanticipated. There is no need for a separate dataset to identify humans in the frame because the system is trained using the YOLO deep learning technique. It utilizes a smart real-time convolutional neural network (CNN) for object detection.

Computer vision is a method that enables us to comprehend how images and videos are stored, how to change them, and how to extract data from them. OpenCV is a sizable open-source library for image processing, machine learning, and computer vision. It now plays a significant part in real-time operation, which is crucial in modern systems. With it, one may analyse pictures and movies to find faces, objects, and even human handwriting.

The coding language used for the implementation of our system is python 3. Because of its many features, versatility, and simplicity, Python is a favourite programming language. Because of its independent platform and widespread use in the programming world, Python is the programming language that lends itself to machine learning.

For Web Application, our proposed system uses Flask which is a lightweight and flexible web framework for Python that allows developers to easily build web applications. Flask is considered a "micro" framework because it does not require tools or libraries, and it has a minimalistic core with many optional extensions that can be added as needed. Flask is ideal for building medium-sized web applications.

Flask provides several features that simplify web development, including routing, templating, and handling of HTTP requests and responses. It also supports integration with various databases and includes built-in tools for testing and debugging. Flask is widely used in industry and has a large community of developers who contribute to its development and maintenance. Alongside HTML and CSS allows for the creation of dynamic UI and enables a wide range of front-end web development features. Hypertext Markup Language or HTML is the standard markup language for documents designed to be displayed in a browser. To format the layout of a webpage Cascading Style Sheets (CSS) are used. With CSS, one can control the colour, font, size of text, the spacing between elements, element's positions and laid out, background images or background colours to be used, and different displays for different devices and screen sizes.

VI. CONCLUSION

This study has proposed a tool to calculate the distance between the two humans and alert them when they did not maintain the social distance. Efficient deep learning to automate the process of monitoring each individual and identifying in the Realtime. Different modules have been developed for human detection and social distancing recognition. Detection and tracking algorithms used to help track the people who are violating the social distancing threshold. In the future, different modern object detectors like R-CNN, Faster R-CNN, SSD, R-FCN, YOLO, etc. may be deployed to increase detection accuracy. The proposed algorithm may be set for different views through many cameras instead of single camera in the future to get more accurate results. This system can be used in live video streams and images also, CCTV for surveillance of people during pandemics. This study has proposed a tool to calculate the distance between the two humans and alert them when they did not maintain the social distance.

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