Social Distance Detection System

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Abstract: Contagious diseases are controlled by social distancing. Social distancing is the concept that people should physically distance themselves from each other, reducing close contact, and with it, reducing the spread of contagious diseases (like Coronavirus). We developed a social distance detection system to assist officials in identifying areas with the most violations of Covid-19. By detecting how close two people get to each other, this system keeps tabs on violations. By identifying high-risk areas, officials can prepare and allocate resources to areas that are more likely to have an increase in infections.

Keywords— Social Distance, Object Detection, YOLO V4, Python, OpenCV.

I. INTRODUCTION

It is the practice of minimizing contact between potentially infected individuals and healthy individuals in order to reduce the transmission of contagious diseases in a population. This was accomplished through the development of a "Social Distance Detection System" (SDDS). The system separates human movement from object movement for increased accuracy. By detecting and recording all violations, the system can predict hotspots of disease spread based on the total number of violations. COVID-19, which causes the disease, spreads easily from person to person at this time. Healthy people can become infected when they come into contact with respiratory droplets from sneezes and coughs of infected individuals. Following social distancing can reduce the number of infections. Pandemics can be better managed and controlled using this system.

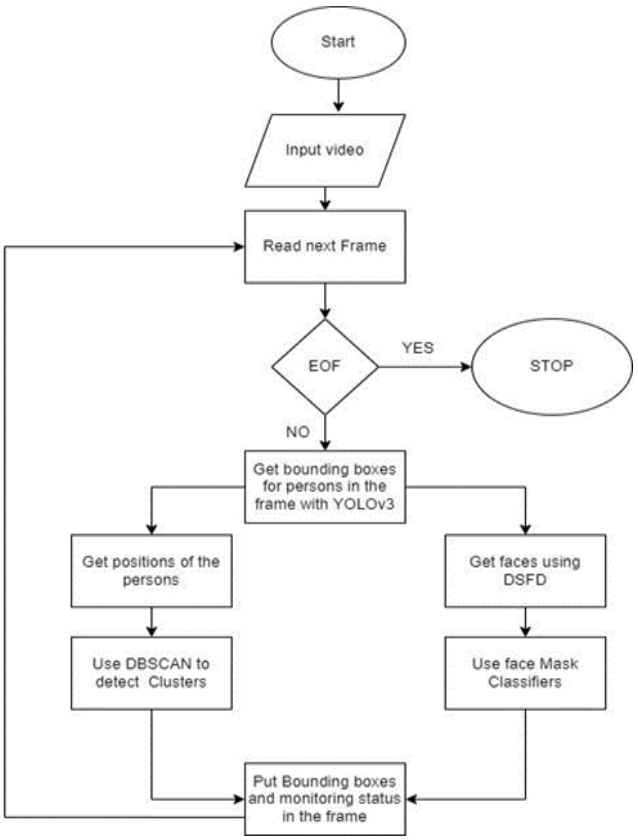
II. LITERATURE REVIEW

Our study aims to estimate the number of COVID19 infections and the extent of their severity (e.g., shelter-in-place and voluntary quarantine) to determine the amount of hospital capacity required under social distancing. The YOLO algorithm is used to detect objects.[1] YOLO is designed to learn very general representations of objects. Image processing helps to help the computer understand the content of an image. It outperforms other methods like DPM and R-CNN when applied to natural images [4]. In OpenCV, programmers can find programming functions primarily for image-processing applications. [5] Euclidean distance allowsfor the calculation of the distance between a set of points in Euclidean space given an incomplete set of distances. Video tracking aims to associate objects in successive frames of video. In terms of frame rate, it works best when the objects move quickly. [7]

III. PROPOSED SYSTEM

Python, OpenCV, and Yolo V3 were used to build the proposed system. Humans and objects are differentiated by the system to increase accuracy. As soon as two or more individuals are close together and violating social distancing protocols, bounding boxes turn red. Also, the system records how many violations were committed in each area so disease hotspots can be determined.

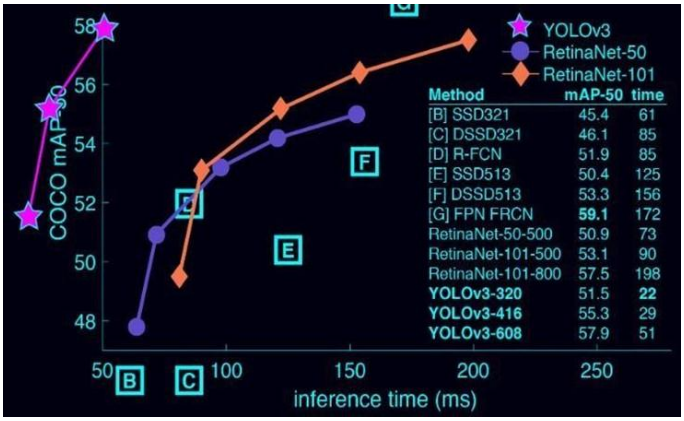
Figure 1: Flowchart



IV. YOLO V3

A real-time object detection system called YOLOv3 (You Only Look Once, Version 3) recognises particular things in films, live feeds, or still photos. To find an item, the YOLO machine learning system leverages features that a deep convolutional neural network has learned. The YOLO machine learning algorithm has three versions, with the third version being a more accurate version of the first ML method. Versions 1-3 of YOLO were developed by Joseph Redmon and Ali Farhadi.

Figure 2: Comparison of YOLO, Resnet 50 and ResNet 150



V. DBSCAN ALGORITHM

In essence, clustering analysis, also known as clustering, is an unsupervised learning technique that separates the data points into a number of distinct batches or groups, with the goal of ensuring that the properties of the data points within the same group are similar and that the properties of the data points within different groups are, at least in part, dissimilar. It consists of numerous various differential evolution-based methodologies.

VI. DSFD

Compared to Haar Cascades, Dlib, MTCNN, and DNN, the open-source Dual Shot Face Detector (DSFD) method detects faces more accurately. It deals with three important aspects of facial detection: feature learning, progressive loss design, and anchor assign based data augmentation. The WIDER FACE Face Detection Benchmark also placed it first overall.

VII. OBJECTIVES

- This tool aims to determine where people are in real-time and display a bounding box that turns red when two people are dangerously close together.
- Secondly, we want to determine how many people are not wearing masks. As a result, governments can be alerted if a situation becomes extremely dangerous by analyzing the movement of people.
- To prevent a widespread pandemic like Covid- 19, it is also essential to curb the spread of contagious diseases.

VIII. PROCESS FLOW

- Input: Live video can be captured via CCTV or prerecorded video can be uploaded for analysis of thevideo to run the system.
- Object Detection: Live cameras and pre- recorded video are used to detect objects using YOLO V4. To ensure that the system only detects violations between humans, we filter out the "PEOPLE" class inthis step.
- In order to calculate the Euclidean distance, we use Open CV to calculate pairwise distances between the centroids.
- Checking whether the distance matrix for a person has a value less than N pixels is done

IX. ADVANTAGES

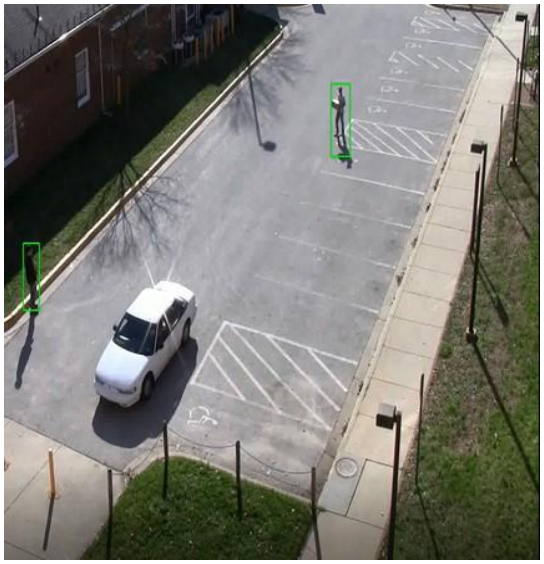
- Detection of social distancing violations is madeeasier by this system.
- Governments and concerned authorities can alsouse it to record violations in different areas
- Detection of users not wearing a mask is done which helps reduce the spread of contagious diseases.

X. IMPLEMENTATION

A. Person Detection

An object detection system that is state-of-the- art, YOLO (You Only Look Once) performs real-time detection of objects. The bounding boxes of individuals in a video frame are obtained using Version 3 (pre-trained on the COCO dataset). Yolo v3 model was used to generate the output layer applicable for person detection. A confidence score of more than 0.5 is required to detect each individual person. It is also possible to optimize the processing speed using the YOLO v3-tiny model or 320x320 resolution. However, the accuracy of detection will be reduced as a result.

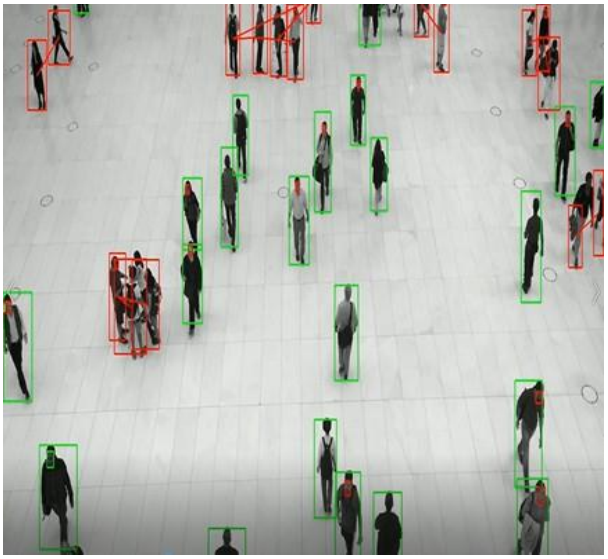
Figure 3: Person Detection Implementation



B. Social Distance Monitoring

After detecting the person, we track the centroid to uniquely identify the individual and use a DBSCAN data clustering algorithm imported from scikit-learn to confirm the person's distance from the nearby individuals. Using the above algorithm, we set the criteria to determine whether or not social distance can be maintained by passing the minimum safe distance in pixels as a parameter. A bounding box is created with the label = "unsafe" if the calculated distance between its centroids is less than the criteria.

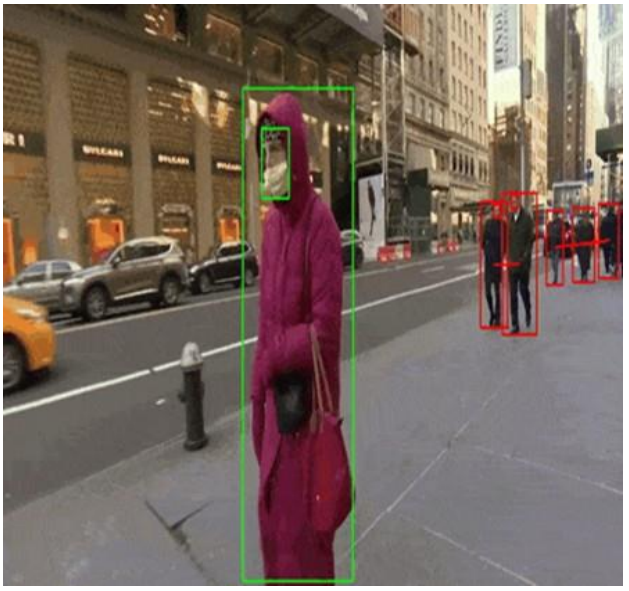
Figure 4: Social Distance Monitoring Implementation



C. Face Detection

Due to its superior performance over the state- of-the-art face detectors, the Dual Shot Face Detector (DSFD) networkis utilized throughout the project. Detecting faces that are covered or with low resolution is not possible with Common Face Detectors such as Haar- Cascades or MTCNN. A large range of orientations can also be detected using DSFD. The pipeline is a bit heavy, but the results are accurate. Further, the mask classification model receives the coordinates of the detected face.

Figure 5: Face Detection Implementation



D. Face Mask Classsifier

In order to classify whether a detected face is properly masked, we use a slightly modified ResNet50 model (with ground layers pre- trained on ImageNet). AIn addition to the base layers, Sigmoid or SoftMax classifiers are applied after some Average Pooling 2D and Dense (with dropout) layers. A confidence score below 0.5 indicates the presence of a face mask, while a confidence score above 0.5 indicates the absence of one. A high-accurate and fast-training model emerged from deploying the ResNet50 pre-trained network. About 96.5% accuracy was achieved by the Mask Classifier model during the experiment.

Figure 6: Face Mask Classifier Implementation

E. Final Output

In the end the system was able to detect and identify humans, measure the distance between these humans and detect if the were violating social distancing norms. It was also able to detect whether people were wearing a mask or not. This system will hence prove very effective in reducing the spread of contagious diseases.

Figure 7: Final Implementation

XI. CONCLUSION

This system will definitely detect violations of Social Distancing on a large scale, allowing experts to take precautions. By employing this system, both current and future pandemics might be kept to a minimum. YOLO (You Only Look Once) is a real-time object detection system that provides state-of-the-art detection of objects. To obtain the bounding boxes of individual persons in a video frame, Version 3 (pre-trained on the COCO dataset) is used. Person detection has been performed using the Yolo v3 model's output layer. A confidence score > 0.5 is used to detect eachindividual. Speed optimization can be achieved by using 320x320 resolution or using the YOLO v3-tiny model. Despite this, the accuracy of detection will be decreased.

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