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Modeling of Social Distancing Detection Using Deep Learning Approach

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ABSTRACT:

Following the COVID-19 pandemic, social isolation has emerged as a key tactic to slow the virus's transmission. Automated methods that can determine if people are keeping a safe distance from one another are required in this situation. In this research, we provide a deep learning method for modeling the detection of social distance. In our approach, key characteristics are first extracted from input photos using a Common Objects in Context (COCO) and then a classifier is used to identify whether people in the image are adhering to social distance rules. On a dataset of annotated photos that is available to the public, we show the efficacy of our methodology. Our findings demonstrate the ability of our algorithm to detect social distance rules breaches with high accuracy.

Key words: Common Objects in Context (COCO), Deep learning and Detection of social distance

I. INTRODUCTION

The COVID-19 pandemic has inspired the implementation of several methods, such as social isolation, to halt the virus' spread. Social distancing is keeping a safe distance from people in order to lessen the risk of infection. Nevertheless, it can be challenging to ensure that these regulations are followed, particularly in crowded public spaces. Deep learning steps in at this point and offers a powerful tool for immediate social distance compliance detection. Social distance detection algorithms have been developed using deep learning techniques to recognize and stop potential viral transmission in this circumstance. The development of such models and potential impacts on public health and safety are looked at. As the COVID-19 pandemic has shown, social isolation is essential to preventing the spread of dangerous diseases.. It might be challenging to make sure that individuals keep a safe distance from one another in open areas. Computer vision methods can be used to identify social distancing violations and notify people to keep their distance in order to get around this problem.

In this project, we suggest utilizing Yolo v3 to implement a deep learning strategy to quickly identify social distance violations. On a data set of annotated pictures of people in public places, we'll train a (COCO) Common Objects in Context algorithm to look for instances when people aren't keeping their distance from other people. The trained model will be put to use on a live video feed from security cameras to spot and warn those who are breaking the laws of social distance.

In order to identify individuals in public settings and decide if they are keeping a safe distance from one another, the suggested system would employ computer vision algorithms. Various environments, including supermarkets, airports, hospitals, and public transit networks, can use this technology. It will make it easier for authorities to efficiently monitor and impose social exclusionary measures.

By putting the system to the test in real-world circumstances and comparing the results to manual annotations, the performance of the system will be assessed. The project's ultimate objective is to offer a dependable and expandable system that may help authorities enforce social distance policies and so lessen the transmission of dangerous illnesses like COVID-19.

The goal of this project is to offer a dependable and automated way to enforce social distance rules in public areas, which can help stop the spread of contagious diseases like COVID-19.

II. EXISTING SYSTEM

The method used for person detection is Mobile Net SSD with a Cafe implementation and a model that has already been trained on MS-COCO. A well-liked object recognition framework called Mobile Net SSD (Single Shot MultiBox Detector) may be used to find and pinpoint items in pictures and videos. This SSD algorithm variation employs Mobile Net as the primary network architecture.

We would first need to train the model on a dataset of photos or videos that feature individuals and their corresponding locations in order to utilize Mobile Net SSD for social distance detection. Once the model has been trained, we can use it to identify individuals in live video broadcasts and determine how far apart they are.

We may establish a threshold distance and compare the distance between each pair of identified individuals with this threshold to identify social distancing violations. We can mark something as a violation if there is less than the threshold of distance between any two persons.

In congested or occluded surroundings, when individuals are partially or entirely concealed from view, Mobile Net SSD may not be able to detect people with sufficient accuracy for social distance detection. In certain situations, it could be required to apply additional methods to increase the detection system's precision, such as stereo vision or depth sensing.

III. SYSTEM REQUIREMENTS

HARDWARE REQUIREMENTS:

- Web Camera/ Surveillance Camera
- RAM - 4GB
- Processor - Intel i5
- System Type – 64 bit OS

SOFTWARE REQUIREMENTS:

- MATLAB
- Algorithm: YOLO V3.

MATLAB IN DEEP LEARNING:

In deep learning, MATLAB is a popular programming language, especially for research and experimentation. It includes pre-built functions for building, training, and verifying models, among other tools for working with deep neural networks. MATLAB's primary capabilities for deep learning include the following:

▪ The Deep Learning Toolbox by MATLAB offers a selection of tools and functions for building and training deep neural networks. Convolution neural networks (CNNs), recurrent neural networks (RNNs), and long short-term memory (LSTM) networks are just a few of the network designs it supports.

▪ Pre-trained deep learning models are available in MATLAB, including well-known models like VGG-16 and Alex Net. These models may be used to a variety of tasks, such as semantic segmentation, object identification, and picture classification.

▪ Visualisation tools: For use with deep neural networks, MATLAB provides strong visualisation tools such as layer graphs, training plots, and confusion matrices. These resources can aid in the better understanding and debugging of models by researchers and practitioners.

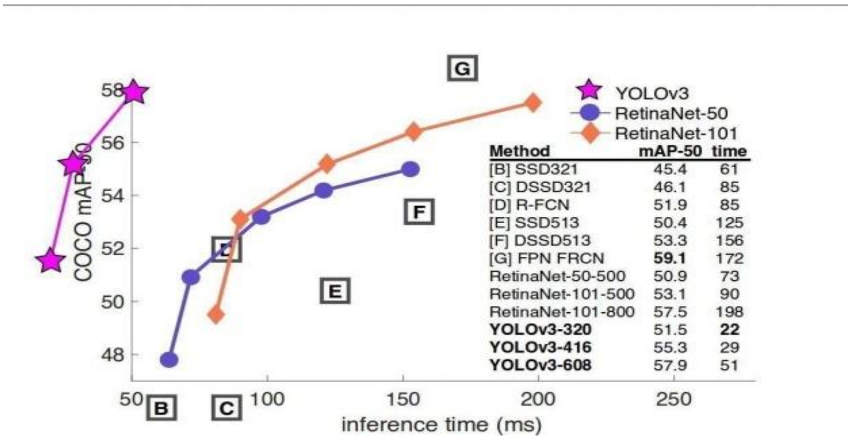
▪ Tool integration: Tensor Flow, PyTorch, and Caffe are a few more deep learning technologies that MATLAB works well with. As a result, switching between various tools and libraries is simple.

With a variety of tools and algorithms for building, training, and evaluating models, MATLAB is a strong platform for dealing with deep neural networks. Researchers and practitioners alike appreciate it because of its user-friendly design and powerful visualisation features.

YOLO V3:

The object detection technique known as YOLO (You Only Look Once) finds things inside a picture and categorizes them. The third iteration of the YOLO algorithm, known as YOLO V3, was released in 2018. The algorithm has improved with YOLO V3, which provides more accuracy and speed. It accomplishes this by employing a feature extraction network, which enables it to recognize objects at various sizes and resolutions. Additionally, YOLO V3 employs a novel technique known as Darknet-53, a 53-layer neural network that is more precise than earlier iterations of the network.

Fig1 - COMPARISON TO OTHER DETECTORS



IV. PROPOSED SYSTEM

The following components make up the deep learning-based system for social distance identification proposed:

Data Gathering: The first stage is to gather data for the deep learning model's training. CCTV cameras and other surveillance systems that are put in public spaces can capture the data. Videos of individuals moving about in public spaces should be included in the data.

Data preprocessing: After the data have been gathered, preprocessing is necessary. Frame extraction, video segmentation, and annotation are all parts of the preprocessing stage. Segmenting videos requires cutting them up into manageable chunks for processing. Frame extraction is the process of removing certain frames from a segmented movie. Annotation entails writing information regarding the existence or absence of social distance on the frames.

Model Training: The annotated data will be used to train the deep learning model. A Common Objects in Context (COCO) architecture, such as YOLO V3, should be used to train the model. Every frame of the video should be educated to teach the model whether social distance is present or absent

Model evaluation: Following model training, the model must be assessed using a test set. A group of frames that weren't utilised throughout the training phase should make up the test set. Metrics like accuracy, recall, and F1-score should be used to underpin the judgment.

Implementation: The model may be implemented to identify social distance in real-time after being trained and assessed.

The system must be connected to the monitoring system and be able to send out alarms when social distance rules are broken.

The final stage involves developing the user interface for the system. It is essential that the user interface is intuitive and easy to use. In order to highlight the moments in which the rules of social distance are being broken, it is necessary to display the video stream.

Overall, the social distance detection system developed using deep learning techniques can help maintain social distance norms in public spaces, hence reducing the transmission of infectious diseases. The accuracy is eventually found to be 98.7%.

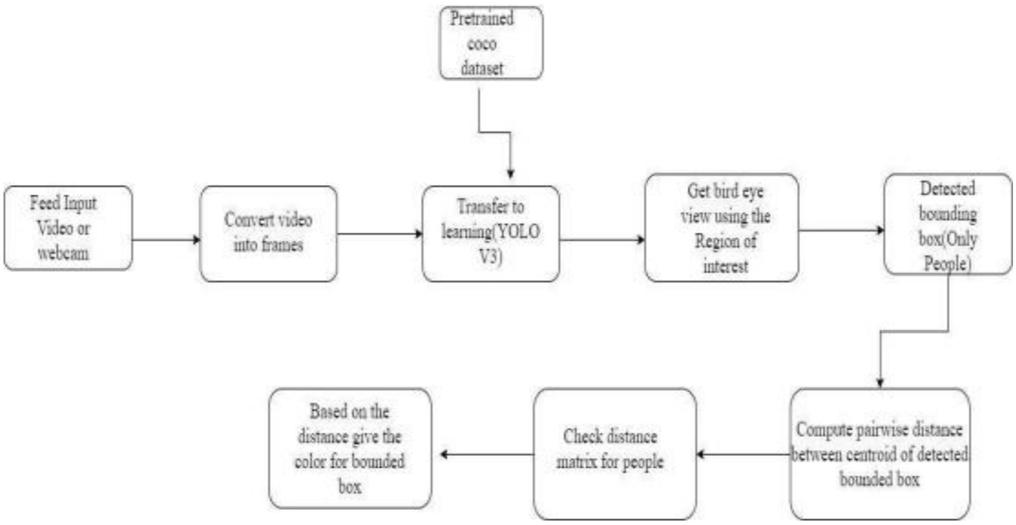


Fig2-FLOW DIAGRAM OF THE PROPOSED SYSTEM:

V. MODULES

Modules includes:

a. Bird’s Eye View Transform

b. Object Detection

c. Distance Calculation

d. Violation Detection

1. BIRD’S EYE VIEW TRANSFORMATION

A bird's-eye view, which is frequently used in the creation of blueprints, floor plans, and maps, is an elevated view of an item from above with a perspective as though the observer were a bird. In Fig. 4.2, a video or surveillance footage will be extracted frame by frame from the input. I wish to make some suggestions in that context to alter the region of interest (ROI) perspective. The viewpoint will switch to a top-down view of the picture from the ROI. Instead of being straight down, the Bird's Eye photographs are tilted at a 45-degree inclination. The coordination of shifting, rotating, and scaling, as well as projection, are the three key phases in changing the viewpoint to a bird's eye view. The first step in coordinate shifting is to choose the image's coordinates, which are also the coordinates you wish to rotate. Consider the picture to be three dimensional by providing the three coordinates during rotation. Then, rotate the image by 45 degrees, then use projection to make the image two dimensions. Additional steps can be taken from the image to find the people in the pictures.

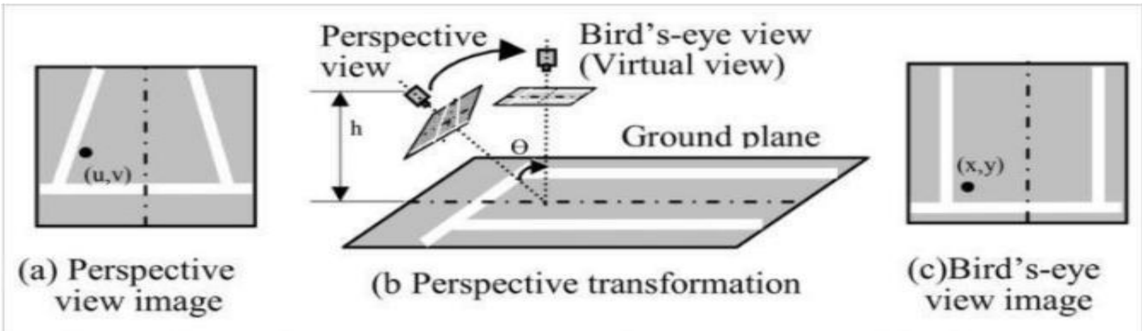
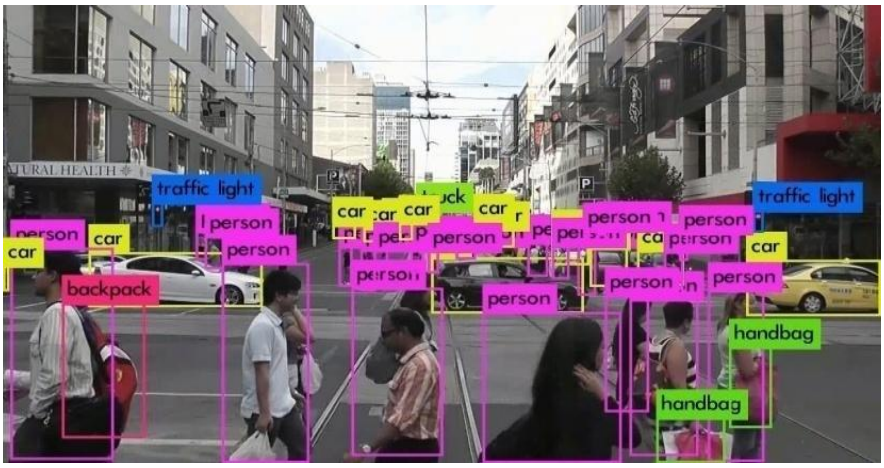


Fig 3- BIRD’S EYE VIEW TRANSFORMATION

2. OBJECT DETECTION

Both the location of the items in the picture and the kind of things that were identified must be predicted. The existence and position of various types of items are detected using an object detection model that has been trained to do so. A model may be trained, for instance, using photographs of various items with labels identifying the class they represent (such as a person, a bottle, or a knife) and information on their locations in the image, The model will provide a list of the things it identifies, the position of a bounding box that includes each object, and a score that represents the confidence in the accuracy of the detection when a picture is later presented to it. However, the social distance detecting technique simply demands the Class of the individual.

Fig 4- OBJECT DETECTION USING YOLO V3



c. DISTANCE CALCULATIONIn the distance calculation module, find the object (human) in the frame using the object detection, draw the bounding box around the human and then find the centroid of that object:

Centroid of x-axis = length/2

Centroid of y-axis = length/2

From the centroid will be detected at the bottom of the bounding box then find the distance between the every two objects is

Distance of two objects = sqrt(((x2-x1)^2)+((y2-y1)^2)))

From the distance between the two objects can be calculated by using the above Euclidean distance formula.

d. VIOLATION DETECTION

This module uses the distance between each pair of persons in the frame to determine the colour for the bounding box depending on the risk factor. If there is less than 150 cm between any two individuals, the covid-19 virus, which is symbolized by the colour red, is exceedingly hazardous. Then, if the distance is less than 180 cm and more than 150 cm, it may indicate a low risk for the yellow-colored virus. Additionally, the green colour at the bounding box will indicate that there is no possibility that the distance between humans will be larger than 180 cm. . The persons at high, low, and no danger are then displayed at the bottom of the frame.

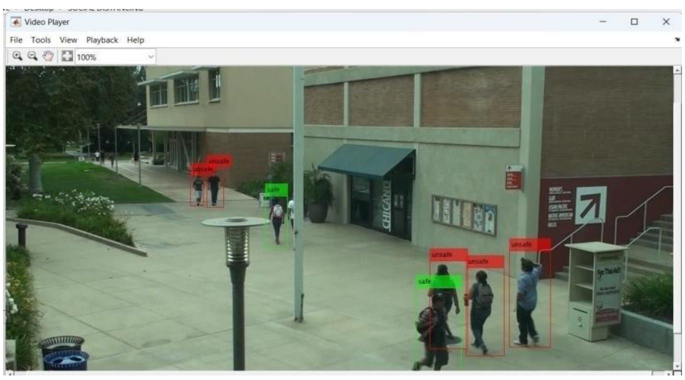
VI. RESULT AND FUTURE SCOPE:

Fig 5- INPUT VIDEO FOR DETECTION

In the above figure, the pedestrians in a mall are moving here and there which has been given as an input for detection. In this video some people are gathering at the same place, creating a crowd and not maintaining proper social distance.

Fig-6 VIOLATION DETECTION OUTPUT VIDEO

The pedestrians in the preceding Fig. 5 who are not maintaining appropriate social distance are denoted by red colour boxes and tagged as dangerous. Similar to this, persons who maintain appropriate social distance are designated as safe and signified by green colour boxes.



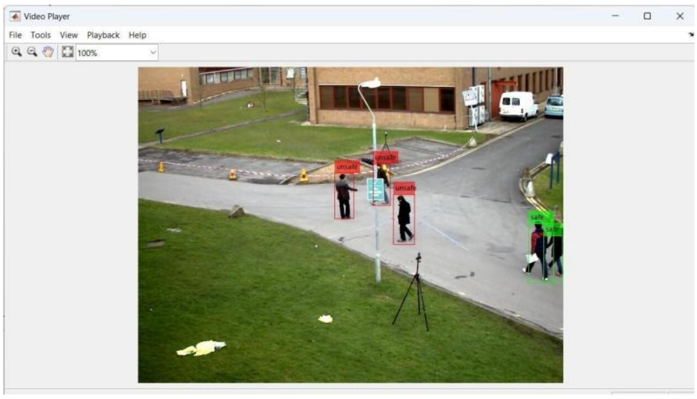


Fig7- DISTANCE DETECTION IN VARIOUS PLACES

The previous two figs demonstrate where social distance can be found. People in the picture who keep their distance from one another appropriately are marked as safe and denoted by green colour boxes, while those who do not keep their distance appropriately are marked as unsafe and shown by red colour boxes.

FUTURE SCOPE

1. Multiple cameras will be deployed in future for 3D distance measurement.

2. Integration with face mask detection.

Overall, the future scope of social distancing detection technology is vast, and it has the potential to play a significant role in our ongoing efforts to control the spread of infectious diseases.

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