International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 10 Issue 4 ǁ 2022 ǁ PP. 09-16

Social Distance Analyzer

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ABSTRACT
In addressing the worldwide Covid-19 pandemic situation, the process of flattening the curve for coronavirus cases will be difficult if the citizens do not take action to prevent the spread of the virus. One of the most important practices in these outbreaks is to ensure a safe distance between people in public. This paper presents the detection of people with social distance monitoring as a precautionary measure in reducing physical contact between people. This study focuses on detecting people in areas of interest using the MobileNet Single Shot Multibox Detector (SSD) object tracking model and OpenCV library for image processing. The distance will be computed between the persons detected in the captured footage and then compared to a fixed pixels' values.
The distance is measured between the central points and the overlapping boundary between persons in the segmented tracking area. With the detection of unsafe distances between people, alerts or warnings can be issued to keep the distance safe. In addition to social distance measure, another key feature of the system is detecting the presence of people in restricted areas, which can also be used to trigger warnings. Some analysis has been performed to test the effectiveness of the program for both purposes. From the results obtained, 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. Whereas for the safety violation alert feature based on segmented ROI, it was found to have achieved better accuracy, i.e. between 95.8% to 100% for all tested input videos
Keywords: *yolo v3,open CV,ROI,train,accuracy,meachine learning*

Date of Submission: 04-04-2022 Date of acceptance: 19-04-2022

I. INTRODUCTION:

Coronavirus is a large family virus that harms humans and animals. Covid-19 is known as a family member of coronavirus, first spread to Wuhan, China in December 2019. The outbreak then rapidly affected many countries in the world and had been declared as a pandemic by the World Health Organization (WHO) [1]. While many countries are still battling with Covid-19, the number of cases in Malaysia started to flatten [2]. Towards a flatter curve of Covid-19 cases in Malaysia, Malaysia Government has announced the Recovery Movement Control Order (RMCO) on 10th June 2020. Most of the economic sectors have been reopened and citizen of Malaysia are free to go out to do the daily routine with the terms of new normal. People that go outside must follow the guideline from the Ministry of Health Malaysia (MOH) 1 and WHO to stop the spread of the viruses. One best practice known in stopping the spread of Covid-19 is by implementing social distancing between people with at least one meter away.

Based on the information from WHO, the coronavirus is spreading from a person to a person via small droplets from the nose and mouth. In other words, social distancing is the best practice where people can minimize physical contact with possible coronavirus carriers, by keeping the distance at least one meter away from each other. Figure 1-2 show the social measures taken in public places, with cross markings on the seats, that prevent people from sitting next to each other [3-4].

In addition to social distancing measure, this study also includes detecting people in restricted or dangerous areas that will trigger a warning in the event of safety violation. Heavy transportation pathway, aircraft pathway, personal property, construction area and gas plant can be considered as important or hazardous regions commonly require visual surveillance [5]. Therefore, these areas need to be monitored to reduce the possibilities of people entry that will lead to unwanted incidents

II. RELATED WORK:

This section features and highlights some works related to object detection and person detection using deep learning. A heft of work recently focused on the classification of objects and detecting them involving deep learning are also discussed. Detection of humans done using computer vision is considered as a part of object detection. The detected objects are localized and classified based on their shape with the help of a predefined model [1]. The techniques that use convolutional neural networks (CNN) and deep learning have shown to achieve better performance on visual recognition benchmarks. he It is a multilayered perceptron neural network that contains many fully connected layers, sub-sampling OH) layers, and convolutional layers. It is powerful in detecting different objects from different inputs and it is a supervised feature learning method. Because of the outstanding performance in large datasets such as ImageNet, this model has achieved tremendous success in large-scale image classification tasks [2].

The object detection and recognition have achieved great success due to its neural network structure which is capable of constructing objects on its own with the help of descriptors and can learn distinguished features that are not primarily given in the dataset. But this has its own set of advantages and disadvantages as of speed and accuracy. The real time object detection algorithms which use the CNN model such as Region-Based Convolutional Neural Networks (R-CNN) [3-5] and You Only Look Once (YOLO) are developed for the detection of multiple classes in various regions. YOLO (You Only Look Once) is a prominent technique as to speed and accuracy in deep CNN based object detection. Figure 1 shows how object detection is done based on the YOLO model.

Transforming the objective and interpretation from the work [6-8], this system which is proposed presents a method for detecting people using computer vision. Instead of using drone technology, the input is a stream of a video sequence from a CCTV camera installed. The camera's range of view covers the pedestrians passing by in the range of the installed camera. The people in the frame are represented using a bounding box using the deep CNN models. The deep CNN based YOLO algorithm is used to detect the people in the sequence of video streams taken by the CCTV camera. The calculations are done by measuring the centroid distancebetweenthe pedestrians,this will represent whe the . pedestrians in the video follow sufficient so l distance in figure 1

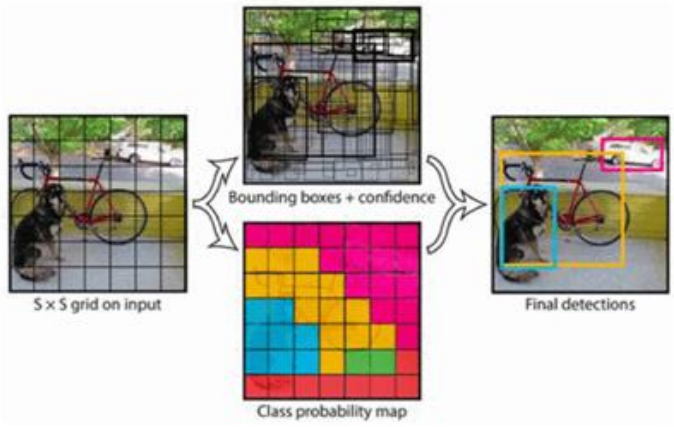


Figure 1: The illustration of yolo model for object detection pipeline

A deep learning-based social distance monitoring
framework for COVID -19 — (Imran Ahamed) -2021 Due to lack of awareness and the practice which was notimplemented initially, starting harm to the public health. However,social distancing influenced economic productivity.Researchers provide effective solutions for social distance measuring usingsurveillance videos along with computer vision, machine learning, and deep
learning-based approaches. proposed a framework using the YOLOv3model to detect humans and the Deepsort approach to track the detected people using bounding boxes and assigned IDs information.

Monitoring social distancing through human detection for preventing/ reducing COVID-I9 spread
(Mohd.Aquid Ansari & Dushyant Kumar Singh) -202I Earlier, object detection frameworks implemented the Sliding Window concept for object localization within an image. According to this approach, an image is divided into a particular size of blocks or regions.Further, these blocks are categorized into their respective classes. Various handcrafted feature extraction techniques like HOG, SIFT, LBP etc. However, this grid-based

archetype requires high computational cost and sometimes yields high false-positive rates. Therefore, an effective object classification & localization framework is needed so Recently,significant advances have been observed in object detection using deep convolutional neural network (CNN). Convolutional neural networks (CNN) are a class of intensive, feed-forward artificial neural networks that have been used to perform accurately in computer vision tasks, such as image classification and detection. convolutional neural network (CR-CNN) with multiple convolutional features to accommodate the local as well as contextual information from the image and has achieved accuracy up to 86%.

Real Time Social distancing detector using deep learning network -(Rinkal Keniya, Ninad Mehendale) – 2020 The model named single shot detector (SSD), discretized the output space of bounding boxes into a set of default boxes over different aspect ratios and scales per feature map location. At prediction time, the network generates scores for the presence of each object category in each default box and produces adjustments to the box to better match the object shape.

PROPOSED SYSTEM:

The proposed system, the social distancing analyzer tool was developed using computer vision, deep learning, and python to detect the interval between people to maintain safety. The YOLOv3 model based on convolution neural networks, computer vision, and deep learning algorithms is employed in the development of this work. Initially, for detection of the people in the image or frame YOLOv3 is used an object detection network based on the YOLOv3 algorithm was used [9-11]. From the result obtained, only the "People" class is filtered by ignoring objects of classes. The bounding boxes are mapped in the frame. The distance is measured using the result obtained by this process

APPROACH: The working of the Social Distancing Analyzer is depicted using a flowchart shown in figure 2

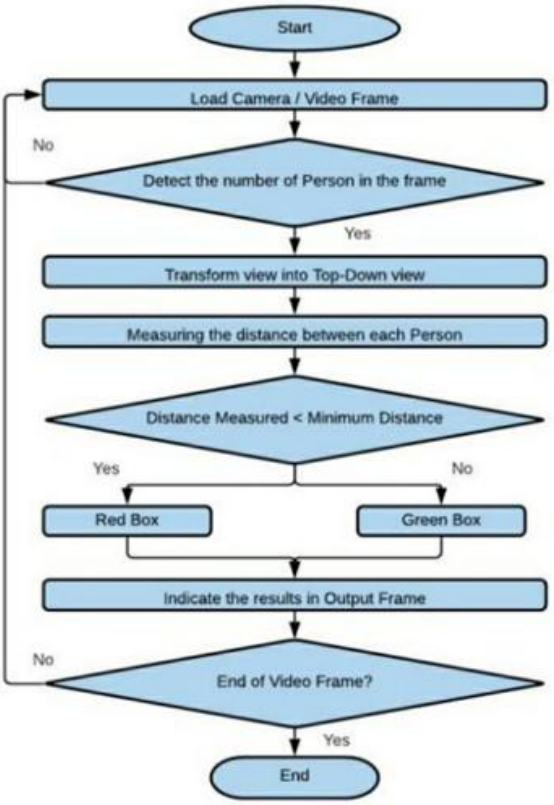
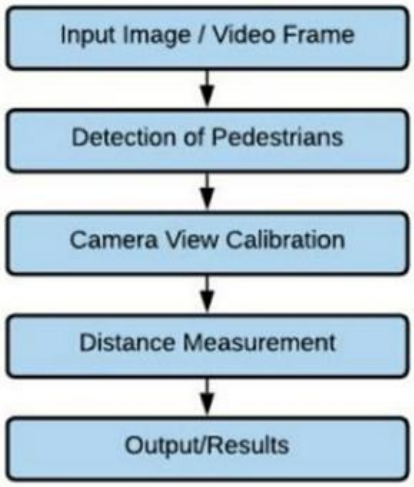


Figure 2: the flow chart for Social Distance Analyzer

PROCESS FLOW DIAGRAM: The process flow pipeline for the Social Distance Analyzer is shown in diagram 3



III. DESIGN METHODOLOGY:

This section discusses the design methodology and working of the Social Distancing Analyzer model. Input Collection:The image captured and video recorded by the CCTV camera is given as the input as shown in Figure 4. The camera is set up in a way it captures at a fixed angle and the video frame's view was changed into a 2D bird's view to accurately estimate the distance between each person. It is taken that the peoplewithin the frame are leveled on the horizontal plane. Then, four points from the horizontal plane are chosen, then it is changed into the bird's view. Now the position of each person can be calculated based on the bird's view Figure 4.v

Figure 4: Sample Image captured by CCTV camera

The interval between people is easily estimated, scaled, and measured by calculating the euclidean distance between the centroids. A threshold value or a preset minimum value for the distance is set. Depending upon this value, any distance lower than the preset minimum threshold value is found, then a warning is shown using red-colored bounding boxes

Calibrating The Camera:The region of interest (ROI) of an image or a video frame focused on the person who is walking was captured using a CCTV camera was then changed into a two-dimensional bird's view. The changed view's dimension is 480 pixels on all sides. The calibration is done by transforming the view frame captured into a two-dimensional bird's view. The camera calibration is done straightforwardly using OpenCV. The transformation of view is done using a calibration function that selects 4 points in the input image/video frame and then mapping each point to the edges of the rectangular two-dimensional image frame. On performing this transformation, every person in the image/frame is considered to be standing on a leveled horizontal plane. Now the interval of each person in the frame can be calculated easily as it corresponds to the total pixels present in between each person in the changed bird's view

Pedestrian Detection:Deep CNN model was the object detection approach was proposed that mitigated the computational complexity issues by formulating the detection with a single regression problem [5]. When it comes to deep learning-based obj ect detection, the YOLO model is considered one of the state-of-the art obj ect detectors which can be demonstrated to provide significant speed advantages will suitable for real-time application. In this work, the YOLO model was adopted for pedestrian detection is shown in Figure 3. The

YOLO algorithm was considered as an obj ect detection taking a given input image and simultaneously learning bounding box coordinates (tx, ty, tw, th), obj ect confidence and corresponding class label probabilities (P1, P2, ⋯, Pc). The YOLO trained on the COCO dataset which consists of 80 labels including human or pedestrian classs. In this work, the only box coordinates, object confidence and pedestrain object class from detection result in the YOLO model were used for pedestrian detection.

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Box Coordinates - tx, ty, tw, th

Object Confidence - C

Pedestrians - P1, P2, ... Pc

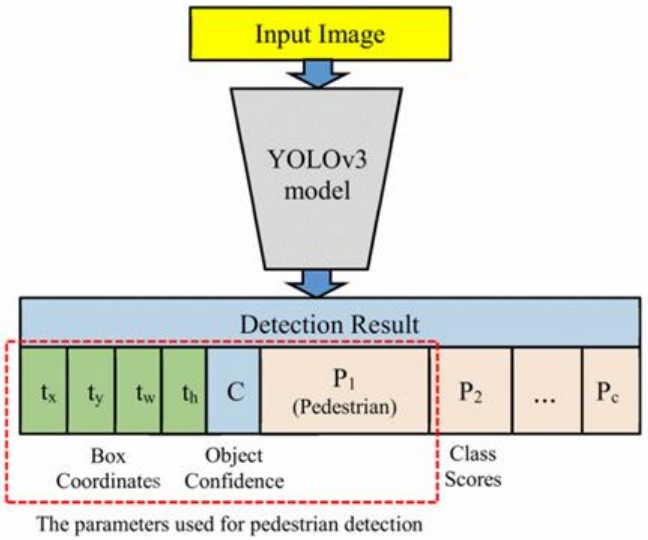
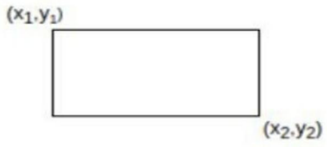
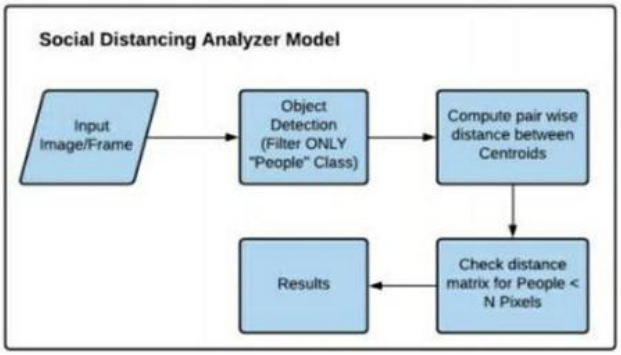


Figure 5:YOLO model applied for pedestrian detection

There are different objects present in a single frame, the goal is to identify "Only Person" class map bounding boxes related to only the people. The code for drawing the bounding boxes is given below and the output of this code is shown in Figure 6. #To identity "Person Only"

```
 class x = np.where(classes==0)[0]
p=box[x]
 count= len(p)
x1,y1,x2,y2 = p[0]
 print(x1,y1,x2,y2)
```





For each person in the input frame, the orientation in the bird's view transformation is calculated based on the central axis point of every person in the input frame. The distance interval of every set of people can be estimated from the bird's view by calculating the euclidean distance between centroids. As the camera is calibrated, more accurate results can be obtained.The set of individuals whose interval is lower than the preset minimum threshold value is considered as violation. The people who violate the condition are marked using a red box, and the remaining people are marked using a green box. The code for computing the centers of the boxes of are given below:

```
#To compute center x_c = int((x1+x2)/2)
y_c = int(y2)
c = (x_c, y_c)
__= cv2.circle(image, c, 5, (255, 0, 0), -1)
plt. figure(figsize=(20,10))
plt. imshow(image)
def mid (image,p,id):
x1,y1,x2,y2 = p[id]
_= cv2.rectangle(image, (x1, y1), (x2, y2), (0,0,255),2)
```

The code to compute the pairwise distances between all detected people in a frame is given below: %%time

```
 from scipy spatial import distance
def dist(midpt,n): d = np.zeros((n,n))
for i in range(n):
for j in range(i+1,n): if il=j:
dst = distance.euclidean(midpt[i], midpt[j])
d[i][j]=dst
return d
```

If the result obtained in the previous method is less than
the minimum acceptable threshold value, then the box around the set of people is represented using red color. The code that defines a function to change the color of the closest people to red is given below:

```
def red(image,p.pl,p2):
unsafe = np.unique(p1+p2)
for i in unsafe:x1,y1,x2,y2 = p[i]
_= cv2.rectangle(image, (x1, y1), (x2, y2), (255,0,0), 2)
return image
```

IV. CONCLUSION AND FUTURE WORK:

A tool for analyzing social distance is proposed. The system uses computer vision and a deep learning model. With the help of computer vision, the distance between each person can be easily calculated. If any set of individuals is found violating the minimum accepted threshold value will be indicated with a red bounding box. The developed system uses a pre filmed video of people on a crowded street. The proposed system is capable of estimating the distance between people. The social distancing patterns are distinguished and classified as "Safe" and "Unsafe" distance. Additionally, it also displays labels as per the object detection and classification. The classifier can be implemented for live video streams and can be used for developing real-time applications. This system can be integrated with CCTV for surveillance of people during pandemics [9]. Mass screening is feasible and hence is often utilized in crowded places like railway stations, bus stops, markets, streets, mall entrances, schools, colleges, work environments, and restaurants. By monitoring the space between two individuals, we can confirm that a safe distance is maintained, this can help us to curb the virus