

Inter Person Distance Detector and Count Estimation in Crowded Scenes to Ensure Physical Distancing with the Help of Cameras

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Abstract - Physical distancing or social distancing means keep space between yourself and other people. Such types of situations occur when epidemic diseases are spreading out. Though, there are distancing issues the people need to go out for purchasing food products, bank etc. In such cases, the mutual contact between peoples should be monitored regularly by the authorized persons, to avoid severe health conditions. This can be achieved by using live cameras which are able to capture live videos as well as the previous captured videos. This will help to prevent mass gatherings and will help to stay out of crowded places. The inter-person distance is calculated with the help of cameras. A pretrained object detector detects the distance between two persons. Bounding boxes are used in object detection. The next step is to find the centroids of the detected bounding boxes. Then the distance between each centroid is calculated. The pixel distance is also considered in object detection. If the distance is less than a threshold value, a red dot is displayed, which indicates that the social distancing rules are violated.

Key Words: Centroid, Bounding Box, Pixel, Threshold Value

1. INTRODUCTION

Crowd Scene understanding and social distancing is an important challenge in a situation where epidemic and pandemic diseases are spreading out. So it is necessary to take precautions to maintain distance between each other. Even though, conditions are not favorable, people have to move around for different purposes. In such situations, a proper monitoring device should be there to ensure that no mutual contacts had occurred between them. If any such instances had occurred it should be reported. This can be ensured by placing cameras to capture live videos.

1.1 Bounding Boxes in object detection

In person detector, a bounding box is used to describe the target location. A bounding box is defined as a rectangular box that can be determined by the x and y axis co-ordinates in the upper left corner and the x and y co-ordinates in the lower right corner of the rectangle. It is also known as axis-aligned rectangle. In image processing, they are considered as the simplest closed shape type in planar, represented by two points containing the minimum and maximum co-ordinates for each axis. The model works by first splitting the input

image into a grid of cells, where each cell is responsible for predicting a bounding box if the center of a bounding box falls within it. Bounding Box object that completely directly from an arbitrary sequence of points.

1.2 Inter - person- distance

Interpersonal distance describes how far apart individuals are from one another physically. This distance is very important in crucial conditions where different types of diseases are spreading out. The comfortable Interpersonal distance scale is used to measure interpersonal distance preference in individuals. A greater incidence of diseases is transmitted by airborne vectors in countries where people interact at shorter distances from each other compared to countries where people interact at greater distance. So it is necessary to take different actions to ensure social distancing. This is possible through image processing. Pixel, Bounding Box, Centroid are the factors considered to measure the distance and count for the crowd.

2. CENTROID

The arithmetic mean position of all the points in a plane figure is known as centroid or geometric center. It is also known as the mean position of all the points in all the co-ordinate directions. Centroids have importance in all parts of science, especially in mathematics, physics, geography, astrophysics and in astronomy. In geometry the word "barycenter" is a synonym for centroid. If a physical object has uniform density, its center of mass is the same as the centroid of its shape. By using the centroid, it is able to find the distance between two objects. This will ensure social distancing to prevent epidemic and pandemic disease by monitoring the inter person distance in videos. To find the centroid of any triangle, construct line segments from the vertices of the interior angles of the triangle to the midpoints of their opposite sides. These line segments are the medians. Their intersection is the centroid.

In the context of image processing and the computer vision, each shape is made of pixels, and the centroid is simply the weighted average of all the pixels constituting the shape. Clustering is used to provide the updated centroid value according to the distance between the objects.

Table -1: Centroid for common shapes

Centroid for common shapes			
Shape	Area	X-bar	Y-bar
Rectangle	Bh	b / 2	d / 2
Triangle	(bh) / 2	-	h / 3
Right triangle	(bh) / 2	h / 3	h / 3
Circular	(r ²)	(2rsin(alpha) / 3(alpha))	0

Table -1 : Centroid for Common Shapes. X-bar is the distance of the centroid from the y-axis. Y-bar is the distance of the centroid from the x-axis

3. PIXEL IN IMAGE DETECTION

Distance measurement and crowd estimation using image processing is relatively simple task when it comes to personal computers as x86 architecture. However, for embedded systems with a small processing power, this task becomes more difficult. This paper represents a visual approach for distance measurement. Firstly, the live videos are taken as the input. In digital imaging, a pixel, pel or picture element is a physical point in a raster image or the smallest addressable element in all points addressable display device; so it is the smallest controllable element of a picture represented on the screen. The intensity of each pixel is variable. The pixel based distance this system can be used to measure distance between two persons to maintain a social distance using a video input. This proposed system can also be used to identify the number of persons in a crowd, which will provide a warning if the number exceeds a preset count which will be helpful in controlling epidemic and pandemic diseases.

The inter-person-distance can be calculated from the input videos. First the number of person is identified. The features are extracted from the local regions of image by first dividing the image into patches. The local features include size, shape, edge and key points. Size refers to the area of foreground object. The area of object is measured as the count of foreground pixels. Shape is computed by measuring the orientation of perimeter pixels. Perimeter Pixels contain important and useful information about the shape of object.

Edge is computed by taking the histogram of edge pixels of the foreground object. Interest points refer to key points in

the scene and provide useful information about the human crowding.

4. SYSTEM IMPLEMENTATION

The system is implemented on windows 10. The version of Python is 3.6.10. The version of Tensor flow 1.15.0 and OpenCV 4.2.0 is used.

How to run:

Install Anaconda or Miniconda

[<https://www.anaconda.com/products/individual>]

Create virtual environment

```
conda create -n env -name
```

Activate virtual environment

```
conda activate env-name
```

Clone the repository

[<https://help.github.com/en/github/creating-cloning-and-archiving-repositories/cloning-a-repository>]

Move into cloned repository.

Eg :- [<https://help.github.com/en/github/creating-cloning-and-archiving-repositories/cloning-a-repository>]

Move into cloned repository

[cd path-to-directory]

Install the packages. [conda install – files requirements.txt]

If this fails:

```
conda install tensorflow = 1.15.
```

```
pip install opencv – python
```

Download model:

Create a directory by the name model manually or

```
mkdir model
```

Download the model and save it to model

Eg:-[<https://drive.google.com/file/d/1PWZK-k6R-G9TIsJOWMyZaj4ExMvhu9Pz/view?usp=sharing>]

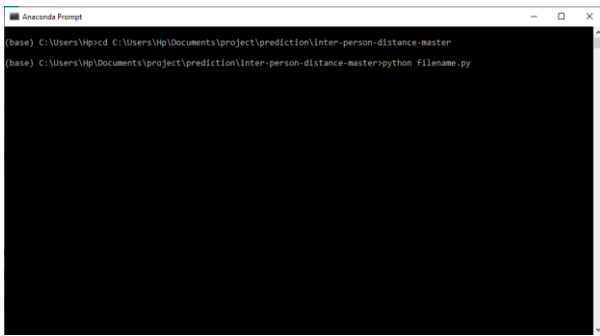
Run

```
python filename.py
```

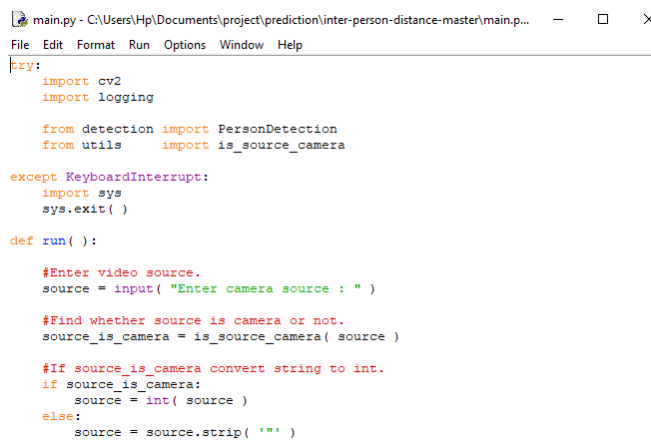
You will be prompted to enter video source. It is either the path to a video file or camera ID represented as 0, 1 etc. Entering 0 will choose bulletin camera. Press enter.

You will also be prompted to enter threshold of the person detector. Press enter.

As the last step enter threshold level for the pixel distance. press enter.

**Fig-2: Anaconda Prompt**

Open the Anaconda Prompt from the windows start menu. Anaconda is the Python distribution and the anaconda prompt is a command line shell.

**Fig-3: Sample source code**

The code accepts video as the input. The Video can be either browsed from the file by specifying the path or live videos can be captured.

The Pixel distance and threshold value can be entered during the execution time. Thresholding is when you classify the pixel values in an image. In OpenCV thresholding is done on gray scale images, which are image which have pixel values ranging from 0-255. When thresholding an image, it is possible to classify the pixels into groups setting a upper and lower bound to each group. In digital image processing, thresholding is the simplest method of segmenting images. From a grayscale image, thresholding can be used to create binary images. Decreasing the threshold value increases the number of person detected. Pixel distance can be increased or reduced depending on the distance of person from camera.

5. CONCLUSIONS

A framework is proposed for counting of crowd and distance measurement which ensures social distancing. This

has been achieved through the videos captured with the help of cameras. The improvement in the accuracy of detection also leads to the improvement in the counting and the inter-distance measurement of crowd. The proposed approach can be used easily incorporated in the real-time monitoring and surveillance applications and as well as high-level scene understanding of crowd.

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