Social Distancing Detector

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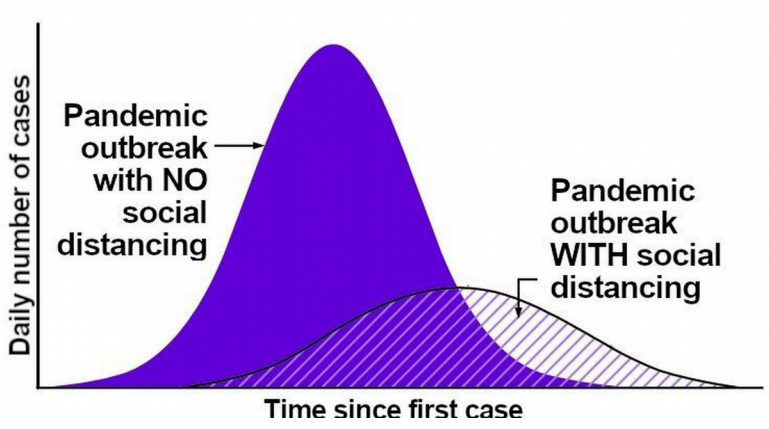
ABSTRACT

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 Social distance** between people in public. This project presents the detection of people with social distance monitoring as a precautionary measure in reducing physical contact between people. Project focuses on detecting people in areas of interest using the Yolo Object detector object tracking model and OpenCV library for image processing,machine learning and computer vision. 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.Some analysis has been performed to test the effectiveness of the program for detecting distance between peoples . From the results obtained, the distance tracking system achieved between 56.5% to 68% accuracy for testing performed on outdoor and challenging input videos.

INTRODUCTION

In December 2019, a novel virus has emerged in Wuhan city. This disease, named coronavirus or COVID-19, has quickly spread throughout China and then to the entire world. As of November 2020, more than 200 countries and territories have been affected and over 50.5 million people have been diagnosed with the virus. Since no cure or vaccine has been found and since tests cannot be applied on a large scale to millions of persons, governments had and still have no choice but to take severe actions such as border closing, travel canceling, curfews, quarantines, and contact precautions (facemasks, social distancing, and self-isolation). The authorities have also implemented strategies that aim to rapidly detect infections using different cutting-edge medical tools (such as thermal cameras, blood tests, nasal/throat swabs, etc.). On the one hand, these measurements, which for the time being constitute the only possible solution, have succeeded to slow down the contagion spreading, but on the other hand, they have also caused considerable economic damages, especially to countries with brittle economies (suspension of all sorts of activities: social, economic, educational, etc.).

The rapid spreading of coronavirus is due to the continuous person-to-person transmission. In addition to this, a recent study has also suggested that a second factor is playing a major causal role in this high virus spreading; namely the *stealth transmission*. The coronavirus can take 14 days before the appearance of symptoms. During this incubation period, asymptomatic patients, called *undocumented patients,* can infect large communities of people. In turn, these newly infected persons, who will remain unaware of their illness (until they eventually develop the symptoms), can also infect larger communities, thus, leading to an uncontrollable domino effect.In the fight against the coronavirus, social distancing has proven to be a very effective measure to slow down the spread of the disease. While millions of people are staying at home to help flatten the curve.



Literature Survey:
Convolutional Neural Networks for object detection:

Object detection is a critical issue for machines. Faster R-CNN; one of the state-of-art object detection methods, approaches real time application. Moreover, computational impends on model and image crop size, yet accuracy is likewise influenced; normally, time and accuracy have inverse relation. By altering input image size in spite downgrading performance, computation time meets criteria for one model.At that point, we contrast changes over models and few picture edit estimates as far as calculation time and location accuracy. Examination information will be used for choosing an appropriate identification demonstration on the off chance that a robot needs to play out a question local assignment. Method CNN based feature extraction, features from RPN and CNN are taken by CNN. The CNN architecture from classification is used by extracting the feature from the image. Now CNN and RCNN are initialized by weights of CNN trained from image classification. Region Proposal Network. CNN features a small convolution network which performs a similar role to a hidden fully connected layer, and collectively thousands of anchors covering most regions of image quality. Non-Maximum suppression is used to get regressed anchors before selecting ROI from anchors. Region based CNN: Each ROI is classified and its box is regressed using the fast R-CNN. The features from CNN are cropped by each ROI and only cropped features are pooled. Then pooled, features pass some hidden fully connected layers. Finally, they gather bounding boxes with scores. Additionally bounding boxes using NonMaximum suppression to avoid duplicate detection. Converting architecture Exchange last pooling layer of CNN with ROI pooling layer. Last Classification layer of image classification with classifier and regression layer of Faster-RCNN.

Advantages: Computation time has been rapid due to use of faster RCNN along with VGG16

Dis-advantages: Enhancing time drastically diminishes performance.

PROPOSED SOLUTION

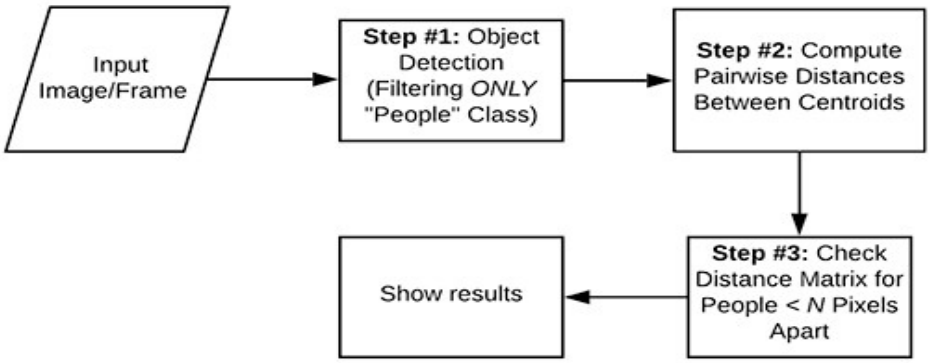
In this study, the proposed idea is development based in Python3,OpenCV and Yolo object detector,Deep learning,Computer Vision.OpenCV is used to utilize the image processing methods that will be explained further while YOLO object detector is used to detect peoples in image or video stream.

The main purpouse of this system is to process campture video footage for person detection and further processing for social distancing or safety violation.S0, the process starts with reading the frames of a video feed one by one.

The most important feature of this study is the object detection framework. This is due to the element of this study that focuses on determining the location of a person from the input frame. Hence, choosing the most suitable object detection model is important to avoid any problems in detecting persons.

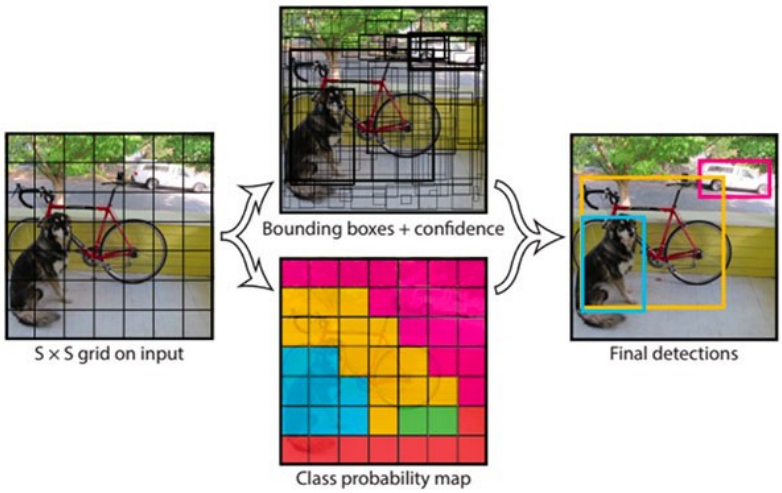
This figure shown below illustrates the whole sequence of activities in a flowchart.

Social Distancing Detector Steps:

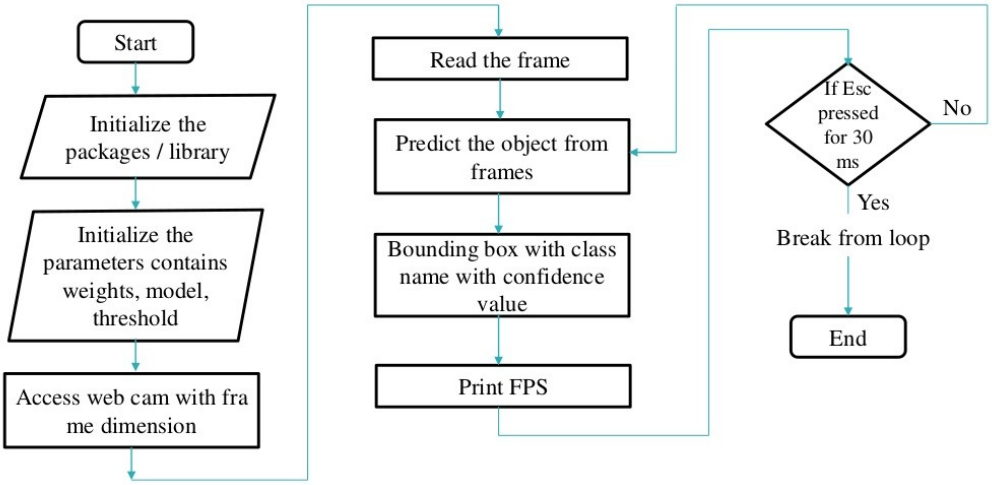


- **Object Detection Model**

In this project,YOLO object detector is used to detect the people in video stream. YOLO object detector splits the input into a $S X S$ grid of cells and each cell directly predicts a bounding box and object classification. The result is a large number of candidate bounding boxes that are consolidated into a final prediction by a post-processing step.



Working of YOLO:



Advantages:

- Speed (45 frames per second — better than realtime)
- Network understands generalized object representation (This allowed them to train the network on real world images and predictions on artwork was still fairly accurate).

- **Calculate the center point of a bounding box**

To measure the center point, $C(x, y)$, of the bounding box for the detected person, midpoint equation is used below.

$$C(x,y)=((x_{min}+x_{max})/2, (y_{min}+y_{max}2)/2)$$

Each of the minimum and maximum value for the corresponding width, x_{min} and x_{max}, and height, y_{min} and y_{max}, of the bounding box will be used to calculate the center point of the bounding box

- **Calculate distance between bounding box**

To measure the distance, $C_1(x_{min},y_{min})$ and $C_2(x_{max} , y_{max})$, between each of the detected person in the frame, distance equation is used below.

$$d(C_1'C_2)=((x_{max}-x_{min})_2+(y_{max}-y_{min})\hat{}2)\hat{}(1/2)$$

The center point of the bounding boxes is taken to determine between two different locations of the bounding boxes. After getting the center points value, the algorithm will calculate if the distance is lower or higher than 300 pixels.

RESULT and DISCUSSION

System development for this project has been completed based on Python 3, OpenCV for image processing techniques and Yolo object detector . Based on this developed system, some analysis has been performed to test its effectiveness and results have been obtained. Specifically,Yolo object detector has been used in this study as the key algorithm in person detection. For program tweaking, the main video footage is captured from the scene at Cannaught Place,New Delhi. where the camera is positioned high to gain overhead view.

Scene : 1

Scene : 2

Based on the findings, this model could not maintain the highest accuracy in the social distancing system. This problem is caused by the object detection model that cannot detect the presence of persons in some of the frame. In a difficult environment, the object detection model can hardly detect people’s presence and accurately guess the exact location of a person. This was found to have occurred in several frames in the video involved. Based on the observation made, the object detection model can detect the presence of a person if the camera used to capture the video is placed close to the object or in a controlled indoor environment. Therefore, the social distancing system needs to be improved for the outdoor environment especially for videos that capture distant scenes.

Scene :2 shows the object detection framework fails to locate the person accurately in the frame.This problem is causing difficulties and inaccurately measure the distance between each bounding box beacause of the social distance measurement is depeding on the detection box centre points values.

Limitations of YOLO

YOLO imposes strong spatial constraints on bounding box predictions since each grid cell only predicts two boxes and can only have one class.This spatial constraint limits the number of nearby objects that our model can predict.Our model struggles with small objects that appear in groups,such as flocks of birds.Since our model learns to predict bounding boxes from data, it stuggles to predict bounding boxes from data,it struggles to generalize to objects in new or unusual aspect ratios or configurations.

Our model also uses relatively coarse features for predicting bounding boxes since our architecture has multiple downsampling layers from the input image.Finally,while we train on a loss function that approximates detection performance,our loss function treats errors the same in small bounding boxes versus large bounding boxes.A small error in a large box is generally benign but a small error ina small box has a much greater effect on IOU. Our main source of error is incorrect localizations.

Future Scope of Work

-> We can use a better object detection algorithm like RCNN and more faster versions of RCNN for real time object detection.

-> We can use view transformation to locate objects using bird view because that fits better in our problem description.

-> In future we are looking forward to build a cloud-based application which apply our technique to live cam video inputs.

Conclusion

Social distancing is one of the important precautions in reducing physical contact that may lead to the spread of coronavirus. Consequences of non-compliance with these guidelines will be causing the higher rates of virus transmission. A system has been developed using Python and OpenCV library to implement social distance detector.Based on the overall results, this study is seen to meet all of its objectives. However, there are some limitations to the results obtained. Based on the tests performed on the system, the results show that the object detection model used for detecting persons is having the difficulty in detecting people correctly in the outdoor environment and difficult scenes with distant scenes. For further improvement in the future, a better object detection model can be implemented.

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