SOCIAL DISTANCING TRACKER

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ABSTRACT

The W.H.O has declared the COVID-19 a pandemic and was first detected in Wuhan, China in December and everyone’s effort is required in order to prevent the spreading of the virus. Corona viruses cause respiratory diseases and its acts differently on each human being. The symptom of this disease includes cold, fever, cough, fatigue, sore throat, etc. To curb this widespread disease social distancing norms should be practiced in our daily lives and we should use masks, gloves and sanitizers in order to curb the virus. So we thought that by using the concept of deep learning, we developed a model which can be implemented in malls, restaurants or any other public places that will monitor whether people are maintaining social distancing or not and by the help of open cv and yolo object detection the distance in-between the persons is computed. The Euclidean distance in-between individual is computed and is compared with an already specified distance. If the distance is found to be less than the specified value then the local authorities will be alerted.

Keywords: COVID, Social distancing, OpenCv, yolo object detection, deep learning, YOLO, Euclidean distance.

I. INTRODUCTION

Coronavirus is a disease which is very infectious and is caused by an extreme acute respiratory syndrome known as corona virus-2. The disease was first discovered in Wuhan, China in December from which it has spread across the globe[1]. Cough, fever, chills, trouble breathing, body pains, loss of smell, and taste are the most common COVID-19 symptoms. COVID-19 is a virus that can be moderate or severe, and in many cases, it can lead to death. This pandemic has spread to more than 188 nations all across the globe. Corona virus mostly spreads during close contact. Individuals who are very close (within 6 feet) to someone who has COVID-19 or come in direct contact with that person have high chance of catching the infection. When an infected person coughs, sneezes, or speaks, the virus spreads via the air as droplets from their nose or mouth travel through the air and infect neighbouring persons. The droplets enter the lungs via the respiratory system, where they begin to damage lung cells. According to doctors and researchers across the World social distancing is an effective preventive method to stop the virus from spreading. From the word itself it is understandable that people should remain far away from each other so as to avoid close contact with one another which will result in the reduction of the spread of the highly dangerous virus.
Therefore with the increasing number of cases and death count, it is very important to maintain social distancing and use masks and disinfectants to curb the spread of the virus and with the help of this model we can monitor that whether people are adhere to social distancing guidelines or not and it will be very helpful to slow down the spread of corona virus and can be implemented in various public places like malls,restaurants,etc so that the public can be monitored and distance between them can be calculated in pixels by the use of compute distance algorithms. There will be an already specified distance to be followed that is to be maintained by the people and the ones who will not be following the rules and violating the social distancing norms will be reported to the concerned authorities, thereby taking necessary actions. We develop this model by using the concept of deep learning and image processing and will strive to achieve maximum accuracy. Such a system will be very helpful in this epidemic situation

II. LITERATURE SURVEY

Social distancing is an effective method for the preventing the virus from spreading. It has been suggested by many doctors, researchers and organizations, including WHO.

Dr. S Syed Amir Abbas[2] and his colleagues proposed a framework for human tracking and crowd management utilizing raspberry pi and Open-CV in 2017. The entire idea of their thought was to record the packed scene utilizing a camera and Raspberry pi3 that has a quad center ARMv8 CPU which measures the each frame of the video. The head tally is estimated and the crowd is measured by contrasting the value and the threshold and in the event that it exceeds the threshold, preventative measures can be taken accordingly.

Rusel et al[3] researched about the impacts of social distancing methods on the outbreak of Covid19. This paper put forward scientific location contact patterns to generate the trajectory of an outbreak by utilizing ‘susceptible exposed infected removed (SEIR)’

Fig 1. Social distancing

methods. The authors also mentioned that lifting social distancing abruptly might worsen the condition and transmit the illness among people.

Nabil Kahale [4] brings out the effect of social distancing measures. The research planned to infer an estimation that shows how early social distancing measures can minimize the economic loss and the count of new covid cases significantly. When Covid is started spreading across the people and society, research and researchers are trying to discover the best solution to stop the epidemic from spreading. [5,6].

Jennifer Berglund [7], proposed a system following an individual contaminated with COVID-19 using GPS and built-in applications in smart phones. Nonetheless, this innovation has limits on following people who don’t have access to Wi-Fi or phone service. Then again, a few specialists use drones with mounted camorders to follow the social event of people in the public area [8, 9]. This innovation is fitting for checking COVID-19 in the midst of the Covid pandemic.

Adrian Rosebroock[10] wrote an article about a social distancing detector which can be developed by utilizing the concept of computer vision, openCV and deep learning. This article investigates social distancing during the
pandemic, emphasizing on social distance as seen by CCTV cameras mounted in streets, malls, and other public places. The camera measures the distance between individuals in pixels and contrasts it and compare it with standard measurement and thus behaving as a social distancing detector.

III. PROPOSED SYSTEM

Nowadays, the challenges faced during the detection and categorization of the objects in any image is being solved with the support of advanced computer vision and deep learning. Accordingly, computer vision development focuses on several challenging and intriguing aspects like neural style transfer, segmentation, tracking, and in fact detection of objects [11]. Deep learning is an AI function that does data processing and objects recognition in the same way that the human brain does. Artificial neural networks are an area of machine learning that deals with algorithms inspired by the structure and function of the brain.

The origin of the neural network dates back to 1940s [12]. The main objective of the neural network is to ethically solve learning problems [13]. Based on the literature survey done we have developed a robust model that can detect whether people are maintaining social distancing or not with the help of OpenCV and yolov object detector.

OpenCV is an open source computer vision and AI programming library. Providing common framework to computer vision applications and to accelerate the utilization of machine perception within the commercial product is the main purpose of OpenCV. Since OpenCV is a BSD-authorized item, it becomes simpler for institutions to use and also modifying the code and the YOLO framework which stands for You Only Look Once processes the entire picture altogether at once and predicts coordinates for the bounding box and also the class probabilities.

By the application of yolov object detection, determination of what is in an image along with its position can be done easily. The greatest advantage of using YOLO is its impressive speed, it is very fast and is capable of processing 45 frames per second. This is perhaps the most efficient object detection algorithm and has shown a relatively similar performance to the R-CNN algorithms and has been used in a variety of applications to detect and identify various objects in images [14].

The main algorithm of our model is that with the help of YOLO object detector the detection of people through video streaming is carried out and after that the determination of the centroids for every detected person is done. Then, computation of the pairwise distances between all the centroids of the persons and finally it is checked if any of the pairwise distances is less than N pixels apart. If it shows that the pairwise distance is < N pixels then it identifies those pair of individuals who violated the social distancing norms.

IV. IMPLEMENTATION

To develop our social distance tracker, we had used the concept of computer vision and deep learning along with open cv for configuration, and the steps required to be followed to develop social distancing tracker are as follows:

1. Applying yolov object detection to spot all the individuals in the given video stream or image.
2. Then the pairwise distance between all discovered individuals is calculated.
3. After that we’ll check if any two individuals are less than N pixels away based on the calculated distance.

And in order to achieve maximum accuracy, we can synchronize our webcam/cctv through intrinsic/extrinsic parameters in order to map pixels to measurable units and we can also consider to use to use newly released yolov4 detector[15].

Our Social Distancing Tracker Model Consist of following module:

1. Pyimagesearch module-It consists of two python files

i-configuration.py: It's a Python file that stores all of the constants in one location. In this file we have the location of the YOLO object detection model. This file also specifies the minimum distance (in pixels) between
persons in order to comply with social distancing regulations, and the USE_GPU boolean specifies whether or not the NVIDIA CUDA-capable GPU will be utilized to accelerate the process.

**ii-detector.py:** It contains the function to detect people. Our script contains a single function definition for the detection. This function `detect_person` accepts four parameters:

1. *frame:* The frame that was obtained directly from the CCTV/webcam footage or from the video file.
2. *net:* It is the pre-initialized and pre-trained YOLO object detection model.
3. *ln:* Names of the generated layer of YOLO CNN.
4. *personIdx:* The YOLO model can identify a wide range of objects, however this index is only for people because we will not be analyzing other items.

We then initialize the results list, which the function has to return. The results of the function `detect_person` consist of the person prediction probability, bounding box coordinates for the detection, and the centroid of the object.

**2. Social distancing detector.py:** This script contains the logic for our social distance detector application and carries out the process of looping over frames of a video stream. It ensures that everyone maintains appropriate distance from each other whilst the pandemic. It is compatible with both video records and live camera or CCTV streams. The most notable imports in this file include configuration, `detect_person` function, and the Euclidean distance metric which is shortened to `dist` and will be used to calculate the distance between centroids.

This script requires the subsequent arguments to be given through the terminal or command line:

- **--input:** The path of the video file. If video file path is not given, then the system’s camera will be used automatically.
- **--output:** It is the optional path for the already processed video file. The processed video will not be sent to disk if this argument is not given.
- **--display:** By default, as we process each frame, we'll display our social distance application result on the monitor.
Here, we specify our YOLO pathways as well as load our COCO labels.

By using the OpenCV’s DNN module, the YOLO net will be loaded into the memory

Using the detect_people function which is applied in the detection.py, the results of YOLO object detection is gathered.

We then initialize our violation set. It is a set which maintains a list of people who violate social distancing norms which are issued by public health experts.

Now, let’s suppose that a minimum of 2 persons are detected within the frame then we proceed to:

- Calculation of Euclidean distance in-between all the pairs of centroids.
- Loop over the upper triangular of distance matrix
- Verify if the distance is violating the minimum value set by the public health experts. On the off chance that 2 persons are extremely close, then they are added to the violation set

Then, in the next step, extractions of the bounding box and centroid coordinates is carried out and then initialize bounding box’s color to green.

- Now verify if the present index is already present in the violation set, and if so, update the color to red.

When the results are looped over, we proceed to:

- Extraction of bounding box and centroid coordinates.
- Then initializing the bounding box’s color to green.
- After that we will verify if the current index already presents in our violation set and if it exists we will update the color to red.
- Then bounding box of each person is drawn and as well as the bounding box for their object centroid. Every person is color-coordinated, so that we can verify which individual are in close proximity to one another.
- Then we show the total number of violations which is the size of the violation set.

To conclude, we, show the frame on the screen until q (quit) key is not pressed and then the processed video is written on the disk.
V. RESULT AND DISCUSSION

We tested our model using a live video stream and various images. Of which, we could see the proper detection of people according to the distance between a pair. The frames were also labeled as safe and unsafe accordingly. Also, the count of the violations made were counted and constantly updated. The results obtained by the model are displayed in the given figure. The red and green colored box created around the person indicating the person is maintaining social distancing or not.

The proposed new idea of social distancing tracker is addressed in depth in the previous section. There are a lot of cases which show the real life covid-19 situations yet it will be very challenging when it comes to implementation of the model. Designing a system that is responsive to change and flexible for all the environments is a difficult task and is a challenge in itself. The proposed model could be deployed in major public areas to watch people, but violations are expected at all costs.

VI. CONCLUSION

Tracking is an important problem in Deep learning with tons of applications. One such application is detecting social distancing violations. Social distancing is apparently the most effective non pharmaceutical method of preventing the spread of the virus, if people do not come close to each other, they cannot spread the virus. With the help of installed CCTV and drones, authorities can keep an eye on public activities and keep a huge crowd from congregating and breaking the law. As long as public are maintaining a safe distance, they'll be marked within a green frame, however, as more and more crowds are recorded by CCTV, a red frame will be constructed around them, and the area's designated authority will be contacted, and the issue may be brought under control. Our model can be found very helpful for cities, shops, restaurants etc to assess public health risk and re-open safely and can help to reduce the widespread of Covid-19 virus. Our model was able to execute in real-time and with the help of NVIDIA CUDA-capable GPU and an OpenCV module compiled with NVIDIA GPU support, making it a useful as a proof-of-concept social distancing detector.

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