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SOCIAL DISTANCING DETECTOR USING DEEP LEARNING AND OBJECT DETECTION

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Abstract - *The COVID-19 virus spreads among the people who are in close contact for a long period. The chances of spreading virus is more when a person who is infected with the virus sneezes, coughs or talks near other people. The latest studies indicates that those people who are not infected with the virus is also likely to play a role in the spread of the virus. People can spread the virus even before they know they will fall sick. So it is very important for us to stay at least 6 feet or 2 meters away from other people even if you or they do not have any symptoms. In order to survive from the dangerous COVID-19, social distancing is the best method to be followed to reduce the spread of the virus. People are informed to avoid contact with other people, thereby controlling the spread of the virus. Artificial Intelligence and Deep Learning has shown good results on some daily life problems. In this proposed system Computer Vision and deep learning techniques are used to monitor social distancing between people at public places. To make sure that social distancing guidelines is followed in public places and workplace, the social distancing detection system can be used to monitor people whether they are maintaining safe distance of at least 6 feet from each other by analysing real time video streams or images from the cctv footages. This tool can be used to monitor people at workplaces, factories and shops by integrating it to their security camera systems.*

***Key Words*: Social distancing, COVID-19, OpenCV, Object Detection, You Only Look Once(YOLO).**

1. INTRODUCTION

The pandemic situation has created problems all over the world and has made the conditions worst, as of now there is no vaccines developed for this contagious disease and therefore social distancing has become one of the best methods to prevent the spread of COVID-19. Social distancing means that people should physically distance themselves by maintaining a safe distance of at least 6 feet from one another. The cases have been increasing at a faster rate throughout the world, so it is very important to follow social distancing protocols. To monitor people at public places, this paper provides a promising solution. Using CCTV and drone footages human activities can be tracked at public places and also helps in monitoring the social distancing between people. People who come in large numbers at religious places makes it difficult to maintain social distancing. Due to the rapid spread of the virus many people are staying at their home but gradually people tends to visit public places, any events and tourist places and in those scenarios this system can help in detecting whether the social distancing is maintained or not between the people and will be useful all around the world.

Fig – 1: Social Distancing

With the help of CCTV footages we can monitor people and calculate the distance between the people using deep learning techniques and set the standard distance of 6 feet to be maintained between people and to detect people who violates the law.

Social distancing is one of the non-pharmaceutical approach to reduce the spread of COVID-19. It helps in reducing the spreading of the virus in a region by minimizing the contact between infected people and healthy people. The objective is to reduce the spread of the virus, thereby helping in declining the size of the epidemic peak, and helping the healthcare systems.

Fig – 2: Standard distance for Social Distancing

1.1 Python

Python is a high-level programming language with a easy syntax. Its inbuilt data structures, along with dynamic typing and dynamic binding, can be used in the Rapid Application Development. It supports modules and packages, which improves program modularity and code reuse. It offers readable code. It is widely used in the fields of machine learing and artificial intelligence. Python's simple syntax permits the developers to write down reliable code whereas advanced algorithms stand behind machine learning and AI.

1.2 OpenCV

OpenCV is a library based on computer vision that focuses on the real time applications. It was designed to give a standard infrastructure for computer vision applications. The openCV library includes both machine learning and computer vision algorithms. These algorithms are used to process images and videos to detect and recognize faces, detect objects in the image, identify handwriting of a human, and so on.

1.3 Tensorflow

TensorFlow is a library developed for machine learning and deep learning. It supports running computations on various devices, including CPU and GPU. It performs numerical computations using data flow graphs that are represented by nodes and edges. The nodes and the edges represents the mathematical operations and the multidimensional data arrays (tensors) respectively in the graph.

1.4 Yolo

YOLO (You Only Look Once) is one of the convolutional neural network (CNN) for detecting objects in real-time. YOLO is highly popular because it can achieve higher accuracy and can also runs in real-time. One forward propagation pass through neural network is enough for YOLO to make predictions. The algorithm splits the image into cells where each cell predicts a number of bounding box. It then performs non-max suppression that chooses the bounding box that has highest probability and then eliminates the remaining bounding boxes that are close by performing IoU (Intersection over Union).

2. LITERATURE SURVEY

[13] Optical flowbased person tracking by multiple cameras, IEEE 2001-H. Tsutsui, J. Miura, and Y. Shirai.

This paper explains a method called optical flow-based person tracking method that uses many cameras in indoor environments. When there are many objects, the view of the camera will be blocked while tracking a person. When a single camera is used to track people, sometimes the view may be blocked by any other objects and the tracking of people by the camera will fail. In order to overcome this problem multiple cameras are used. By using multiple cameras, every camera tracks the target person separately. So if the view of the camera that is tracking the person is blocked by any objects, the person is tracked using the information that is shared by other cameras.

[7] **You Only Look Once: Unified, Real-Time Object Detection, IEEE 2016- Joseph Redmon, Santosh Divvala, Ross Girshick, Ali Farhadi.**

Here object detection is performed using YOLO. Previously object detection was performed using classifiers. Here, it is solved as a regression problem that creates a bounding box around the detected object and generates the class probabilities. Here, a single neural network is used for detecting the objects, so its performance is optimized. YOLO generates more localization errors but predicts less false positives on the background. YOLO is more accurate than other object detection methods as it learns from the general representation of the objects.

[4] Object detection with deep learning: A review, IEEE 2019- Q. Zhao, P. Zheng, S.-t. Xu, and X. Wu.

The normal object detection methods are built on basic features from the image and by using neural networks that has less hidden layers. Here object detection frameworks are reviewed that begins with concept of deep learning and convolutional neural network concept is explained. Here main focus is done to improve the performance of object detection. A survey is done on various detection tasks. Here some analysis is performed on various detection methods and specific guidelines are given to improve object detection.

[3] Crowd analysis for congestion control early warning system on foot overbridge, IEEE 2019- N. S. Punn and S. Agarwal.

When people come together in large number in any events, marathons, public places they form crowd. To stop

any problems that may occur in a crowd, the crowd analysis is very important with respect to safety and surveillance. The congestion in the crowd creates a panic among people. The increasing crowd count causes congestion which increases the density of the crowd and creates irregular crowd movement. Here a software-based method called as Congestion Control Early Warning System (CCEWS) is used. This approach uses object detection and tracking techniques to control overcrowding. To perform object detection a faster R-CNN architecture is used.

[1] SD-Measure: A Social Distancing Detector, IEEE 2020- Savyasachi Gupta, Rudrakshi Kapil, Goutham Kanahasabai, Shreyas Srinivas Joshi, Aniruddha Srinivas Joshi

Here a framework called SD-Measure is proposed that helps to detect whether people are maintaining social distancing using the cctv footages. The framework uses the Mask R-CNN architecture for object detection to detect people in the frame. Here a centroid tracking method is used to identify centroid of each detected people. The Distance calculating methods are used to calculate the distance between centroids and based on the distance this framework determines whether people are following social distancing rules.

3. PROPOSED SYSTEM

The system that is proposed focuses on how to identify the person in the image or video stream and to detect whether the social distancing is maintained or not using computer vision and deep learning techniques and object detection algorithms like YOLO algorithm.

The approach for this model is:

1. Detect people in the frame using yolov3.

2. Calculating centroids of each detected people.

3. Perform perspective transformation of detected people.

4. Calculate the distance between centroids of each people detected in the frame.

5. Shows whether social distancing is maintained or not.

3.1 Methodology

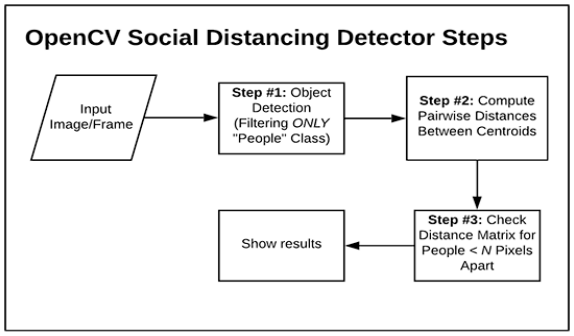

Fig – 3: Steps involved in OpenCV based social distancing application

The steps for building a social distancing detector tool are:

1 Apply object detection to detect all the people in an image or video stream.

2 Pairwise distances are computed between each detected people.

3 Based on the distance computed, check whether two people are less than N pixels apart.

3.2 Process

An image is given as an input to the system to detect people. The YOLO algorithm splits the image into grids and assigns the bounding box to the grids that contain the mid-point of the object to be detected. Intersection Over Union is performed to know whether the predicted bounding box is correct or not. Then if a single object is detected more than once, non-max suppression method is used that chooses the bounding box that has highest probability and then eliminates the remaining bounding boxes that are close by performing IoU.

After bounding box is obtained for each detected object, we then calculate the centroid for each bounding box. Then perspective transformation or bird eye view transformation is applied which gives a top view of the centroids. This transformation makes the distance calculation between the centroids easier. Then we calculate the distance between the centroids. If the distance is greater than the mentioned distance in the program, the bounding box turns green else the bounding box turns red.

Fig – 4: Social Distancing Detector Tool

4. CONCLUSION

As we picture the world after COVID-19 pandemic the need of self-responsibility should be developed among the people. The world would focus on accepting the precautions and guidelines provided by WHO. The responsibility of an individual depends completely on themselves and not on the government. Social Distancing will be the important factor to reduce the spread of the virus. To control huge crowd, an effective solution is needed and in our project we mainly focus on that. Using Camera or CCTV footages, the authorities can monitor people and can also control overcrowding in any events and thus helps in maintaining social distance. If people maintain a safe distance of at least 6 feet they would be indicated with green boundary box, and if not red.

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