INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact Factor: 6.078
(Volume 7, Issue 4 - V7I4-1676)
Available online at: https://www.ijariit.com

Social distancing monitoring system using computer vision and YOLOv3

Devanshi Gupta
devanshigupta1304@gmail.com
Bharati Vidyapeeth Deemed University College of Engineering, Pune, Maharashtra

Saumya Srivastava
ssaumya72@gmail.com
Bharati Vidyapeeth Deemed University College of Engineering, Pune, Maharashtra

Sonali P. Dash
spdash@bvucoep.edu.in
Bharati Vidyapeeth Deemed University College of Engineering, Pune, Maharashtra

ABSTRACT

In the fight against COVID-19, social separation has proven to be an extremely successful strategy for slowing the disease's transmission. People are being motivated to limit their interactions with one another to reduce the risk of the virus spreading through physical or close touch. In the past, AI/Deep Learning has showed promise in solving a variety of everyday problems. We shall see a full explanation of how we may utilize Python, Computer Vision, and Deep Learning to detect social distancing in public spaces and workplaces in this suggested system. By analyzing the real-time video streams from the camera, the social distancing detection tool that can determine whether people have kept a safe distance from each other in public settings and the workplace. We can integrate this tool into their security video systems to check if people at work, in factories, and in stores are keeping a safe distance from one another.

Keywords: *COVID-19, Social Distancing, Computer Vision, Birds Eye View, Camera Calibration*

1. INTRODUCTION

To control the transmission of an infectious disease, such as Covid-19, social distance is used. This is not a novel concept; for many generations, most communities have recognized the importance of staying away from those who are sick. To relieve the pressure on the healthcare system, the goal is to limit transmission by postponing the epidemic peak, reducing the size of the epidemic peak, and spreading cases over a longer period of time. It is a method of limiting one's contact with other people. It's been proposed that keeping a gap of around 2 meters between you and another person reduces the spread of most flu virus strains, including Covid-19.

This means that staying away from other people can help to slow the spread of contagious diseases. One of the non-pharmaceutical infection control measures that can stop or reduce the spread of a highly contagious disease is social distance. COVID-19 is a virus that spreads quickly from person to person right now. When a healthy person comes into contact with respiratory droplets from an infected person's coughs or sneezes, they can get sick.

This Photo by Unknown Author is licensed under CC BY-SA-NC

Fig – 1: Social Distancing

"COVID-19 is transferred by droplets and fomites during close unprotected contact between an infector and an infectee," according to the World Health Organization (WHO). A fomite is a potentially infectious object or material, such as clothing, cutlery, or furniture. As a result, illness transmission can be avoided by avoiding contact with other people and avoiding touching infected fomites. By minimizing interaction between possibly infected persons and healthy ones, or between population groups with high rates of transmission and population groups with no or low levels of infection, social distancing tries to reduce or prevent COVID-19 transmission in a population.

Methods of Social Distancing:
- Cancellation of events involving large groups of people, such as weddings.
- Community facilities will be closed; non-essential workplaces will be closed; schools will be closed; colleges and institutions will be closed.
- Self-Shielding - People minimize their face-to-face interactions.
- People avoid going to public places. Methods of Social Distancing
- Cancellation of events which involve large numbers of people gathering

Some measures to stop or reduce the spread of this extremely contagious disease are referred to as "social distancing" by public health specialists. The Health Officer is legally authorized to use social distancing tactics. Because these policies will have a significant influence on our community, any action to begin social distancing policies would be coordinated with local agencies such as cities, police departments, and schools, as well as state and federal partners.

1.1 Artificial Intelligence

The simulation of human intelligence processes by machines, particularly computer systems, is known as artificial intelligence. Expert systems, natural language processing, speech recognition, and machine vision are examples of AI applications. Vendors have been scrambling to showcase how their products and services integrate AI as the hoopla around AI has grown. What they call AI is frequently just one component of AI, such as machine learning. For designing and training machine learning algorithms, AI requires a foundation of specialized hardware and software. There's no denying that technological advancements have improved our lives. AI and other technologies have taken over everything from music suggestions to map directions, mobile banking to fraud protection. The border between progress and destruction is thin. There are usually two sides to every coin, and AI is no exception.

Fig – 2: Artificial Intelligence

1.2 Python

Python is a high-level, general-purpose programming language that is interpreted. Python's design philosophy prioritizes code readability, as evidenced by its extensive use of indentation. Its language elements and object-oriented approach are aimed at assisting programmers in writing clear, logical code for both small and large-scale projects.

Python is garbage-collected and dynamically typed. It supports a variety of programming paradigms, including structured (especially procedural) programming, object-oriented programming, and functional programming. Because of its extensive standard library, Python is often referred to as a "batteries included" language.

Guido van Rossum started working on Python in the late 1980s as a replacement for the ABC programming language.

Python is routinely one of the most widely used programming languages.

Python manages memory through dynamic typing and a combination of reference counting and a cycle-detecting garbage collector. Dynamic name resolution, which binds method and variable names during program execution, is also included.

1.3 OpenCV

Computer vision is a method for understanding how photos and movies are stored, as well as manipulating and retrieving data from them. Artificial Intelligence relies on or is mostly based on computer vision.

OpenCV is a large open-source library for computer vision, machine learning, and image processing, and it currently plays a critical part in real-time operations, which are critical in today's systems. It may be used to detect items, faces, and even human handwriting in photos and movies. Python can process the OpenCV array structure for analysis when it is combined with other modules such as NumPy. Dynamic name resolution is also included, which binds method and variable names during program execution.

1.4 Tensorflow

Tensor Flow is an open-source numerical computation library. Google created and maintained it, and it's open source under the Apache 2.0 license. The underlying C++ API is accessible, however the API is ostensibly for the Python programming language. Unlike other numerical libraries for Deep Learning, such as Theano, Tensor Flow was created with both research and production systems in mind. It can run on single-processor computers, GPUs, mobile devices, and large-scale distributed systems containing hundreds of units. Computation is represented by data flow and operations in the framework of a directed graph.

Nodes: Nodes are computing nodes with one or more inputs and outputs. Tensors, which are multi-dimensional arrays of real numbers, are used to transport data between nodes.

Edges: The graph describes the data flow, branching, looping, and state updates. Special edges can be used to synchronize behavior within the graph, such as waiting for computation on several inputs to finish.

Operation: A named abstract computation that can take input attributes and produce output attributes is called an operation. You could, for instance, define an add or multiply action.

1.5 Yolov3

YOLOv3 is the latest version of the popular YOLO – You Only Look Once – object detection method. The disclosed model can recognize 80 different items in photos and videos, but it is also much faster and more accurate than Single Shot MultiBox (SSD). It begins by dividing the image into a grid of 1313 cells. The cell size was 3232 for a 416*416 input size that we used in our studies. After that, each cell oversees estimating a certain number of boxes in the image. The network also predicts the confidence that a bounding box truly encloses an object and the likelihood that the enclosed object belongs to a specific class for each bounding box. The majority of these bounding boxes are removed because they have a low confidence score or because they enclose the same object as another bounding box with a high confidence score. Non-maximum suppression is the name for this technique.

Simple and Easy OpenCV Integration - If your application already uses OpenCV and you merely want to use YOLOv3, you won't have to worry with compiling and building any new Dark net code.

The CPU version of OpenCV is 9 times faster: The DNN module in OpenCV's CPU implementation is lightning fast. Dark net inference on a single image, for example, takes roughly 2 seconds on a CPU when used with OpenMP. OpenCV's implementation, on the other hand, takes only 0.22 seconds!

Python compatibility: The dark web is written in C, and Python isn't officially supported. OpenCV, on the other hand, does not.

2. MAIN IDEA

The proposed system employs computer vision and deep learning techniques to recognize individuals in an image/video stream and determine whether or not social distance is maintained using the OpenCV, Tensor flow library.

Method

1. Detect humans in the frame with yolov3.
2. Determines the distance between each person in the image that has been identified.
3. Indicates how many people are breaking the social distance rules.

Camera Calibration:

Because the input video might be shot from any perspective, the first step is to convert the perspective to a **bird's-eye (top-down) view [5]**. Because the input frames are monocular, the easiest transformation strategy is to map four points in the perspective view that indicate ROI where we want to monitor social distancing to the corners of a rectangle in the bird's-eye view (collected from a single camera). When viewed from above (bird's eye view), these sites should form parallel lines in the real world. This is predicated on the premise that everyone is standing on level ground. In this top perspective, or bird's eye view, the points are evenly distributed horizontally and vertically (scales for horizontal and vertical direction will be different). We may be able to derive a transformation that can be used on the this mapping.

Human Detection

The next stage is to identify the people walking and drawing a bounding box around every individual. We can use non-maxima suppression for reducing overfitting. In NMS (non-maxima suppression) is used to select an object/entity out of several entities that are overlapping.

Calculation of Distance

Everyone in the frame now has a bounding box. Next up we will calculate the centroid of every individual in the frame. It can be done by checking the bottom most center point of every bounding box. This will be considered as bird eye's view (the bottom-top view). Now, this way the distance between every individual will be calculated. It will be scaled later using scaling factor via calibration.

Libraries required –

1. Python
2. OpenCV
3. NumPy
4. argparse
5. scipy.spatial

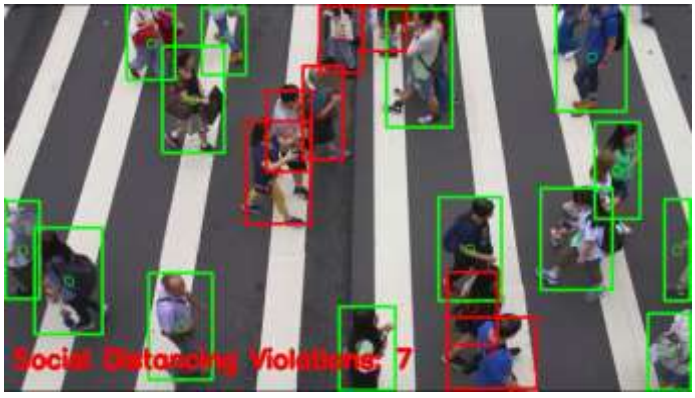
3. WORKING

When you run the application, you will be given a frame (the first frame) where you must draw the ROI and distance scale. From the first frame, obtain the ROI and distance scale points. In Bird's eye view (Top view), code to convert perspective to Bird's eye view (Top view) and calculate horizontal and vertical 180 cm distance

For the first frame, choose the ROI and Scale points. The next stage is to identify pedestrians and draw a bounding box around each one. Detecting humans in video and obtaining bounding box information.

A bounding box has been placed around everyone in the frame. We have to figure out where everyone is in the picture. i.e., the person in the frame can be found at the bottom center point of the bounding box. We then estimate (x,y) location in bird's eye perspective by applying transformation to the bottom center point of each person's bounding box, resulting in their position in the bird's eye view. To find the lowest center point for each bounding box and project those points in a bird's eye view. The next step is to compute the distance between each pair of people from a bird's eye view (Point) and scale the distances in both horizontal and vertical directions using the scaling factor calculated.

Fig – 5: Social distance detector detecting the number of people risk and safe in a video steam.



Finally, we can create a Bird's Eye View for an area of interest (ROI) and draw bounding boxes for persons in a frame based on risk factor, as well as draw lines between boxes based on danger factor between two humans. Red indicates a high risk and green indicates no risk.

4. CONCLUSION

Emerging trends and the availability of clever technologies force us to create new models to meet the needs of the developing globe. As a result, we've created a revolutionary social distancing detector that could help with public healthcare. The model shows a real-time deep learning-based framework for automating the process of monitoring social distancing through object recognition and tracking approaches, in which each participant is identified in real-time using bounding boxes. Identifying clusters or groups of persons who satisfy the closeness property using the bird's eye view approach. This is also known as camera calibration. The number of violations is derived by multiplying the number of groups formed by the violation index term, which is calculated as the people-to-group ratio. This approach can be fine-tuned to better align with the matched field of vision because it is highly sensitive to the camera's spatial positioning. Since this approach is particularly sensitive to the spatial location of the camera, the same approach can be fine-tuned to better adjust with the corresponding field of view, the comprehensive trials were conducted using popular state-of-the-art object recognition models Faster RCNN, SSD, and YOLO v3.

This device is extremely successful at detecting social distance between people and sending out an alarm that can be handled and monitored.

5. REFERENCES

[1] P. Dollar, V. Rabaud, G. Cottrell, and S. Belongie, “Behavior recognition ´ via sparse spatio-temporal features,” in 2005 IEEE International Workshop on Visual Surveillance and Performance Evaluation ofTracking and Surveillance. IEEE, 2005, pp. 65–72.

[2] 1 - D. Ganiger, K. A. Patil, P. Patil and M. Anandhalli, "Automatic Control of Power Supply in Classroom Using Image Processing", Proceedings - 2017 International Conference on Recent Advances in Electronics and Communication Technology ICRAECT 2017, pp. 230-234, 2017.

[3] Q. Zhao, P. Zheng, S.-t. Xu, and X. Wu, “Object detection with deep learning: A review,” IEEE transactions on neural networks and learning systems, vol. 30, no. 11, pp. 3212–3232, 2019.

[4] A. Krizhevsky, I. Sutskever, and G. E. Hinton, “Imagenet classification with deep convolutional neural networks,” in Advances in neural information processing systems, 2012, pp. 1097– 1105.

[5] https://blog.usejournal.com/social-distancing-ai- using-python-deep-learning-c26b20c9aa4c.

[6] N. S. Punn and S. Agarwal, “Crowd analysis forcongestion control early warning system on foot over bridge,” in 2019 Twelfth International Conference on Contemporary Computing (IC3). IEEE, 2019, pp. 1–6.

[7] Pias, “Object detection and distance measurement,” https://github.com/ paul-pias/Object-Detection- and-Distance-Measurement, 2020.

[8] A. Brunetti, D. Buongiorno, G. F. Trotta, and V. Bevilacqua, “Computer vision and deep learning techniques for pedestrian detection and tracking: Asurvey,” Neurocomputing, vol. 300, pp. 17–33, 2018.

