A Social Distancing Monitoring System Using OpenCV to Ensure Social Distancing in Public Areas

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Abstract - *Social distancing measures are important to scale back Covid spread. To interrupt the chain of spread, social distancing must be strictly followed. This paper demonstrates a system that is useful in monitoring public places with regular, high people density like Banks, malls, and hospitals for any social distancing violations. With the assistance of this proposed system, it might be conveniently possible to watch individuals whether they are maintaining the social distancing within the area under surveillance and also to alert the individuals as and when there are any violations from the predefined limits. The proposed deep learning technology- based system is installed for coverage within a particularly limited distance. The algorithm can be implemented on live images from CCTV cameras to perform operations. The simulated model uses a deep learning algorithm with the OpenCV library to estimate distances between people in frames, and a YOLO model trained on the COCO dataset identifies people within the frames. The system must be configured depending on where it is.*

Keywords: **YOLO model, COCO dataset, Image processing, Deep learning, OpenCV, Social Distancing.**

1.INTRODUCTION

In the current scenario of the COVID-19 pandemic, peopleare advised totake care of a distance to confirm that virusesdo not spread from one host to different [1]. Considering the sociocultural environment in India, enforcing the prescribed social distancing measures among varied categories of people could be a challenging task, where manual supervision is also impossible. To search for a remedy for this issue, an automated monitoring system hasbeen designed that may analyze a little area with the assistance of 2D cameras andin turn, will detect any social distance violations. We propose an automated monitoring system with 2D camera technology to detect and alert social distancing violations from a little area. It will calculate the relative distance between everyone in its view and can give an alert if social distancing is violated. It will also display the full number of individuals present in its sight. This monitoring system may be installed in places with less dense crowds like ATMs, banks, small shops, foodstalls, offices, etc. The system must be configured per thelocation to be installed to supply better results.

Corona Virus outbreak has proven to be deadly to everyone including all age groups, gender, and people from different climate regions. Hence, it's vital to scale back thespeed at which COVID-19 is spreading. One of the most effective ways to try that's through social distancing. Contagious diseases and viruses like corona spread from contact within a specific distance. A single affected person could affect the spread exponentially.

In this paper, a comprehensive Social Distance Monitoring System (SDMS) provides a true-time solution to keep up and ensure social distancing publicly areas. Itensures that no one, whether unintentionally or intentionally, doesn't violate social distancing. This methodwill be applied in places like malls, ATM lines, offices,shops, and other small places. This may help in effectively stopping the spreading of contagious diseases and viruseslike Covid-19[2][3]. Few exceptions to SDMS exist such as the caretaker for a physically challenged person, children, patients, or the elderly. The algorithm may be extended for such scenarios by distinguishing the sort of dots within thevisual graph.

2.LITERATURE REVIEW

Social distancing is one of the community mitigation measures which will be recommended during Covid-19 pandemics. Social distancing can reduce virus transmission by increasing physical distance or reducing the frequency of congregation in socially dense community settings, like ATMs, airports, or the marketplace. Covid-19 pandemics have demonstrated that we cannot expect to contain geographically the subsequent influenza pandemic in the location it emerges, nor can we expect to forestall the international spread of infection over a brief period. COVID virus infections are believed to spread mainly through close contact within the community. Social distancing measures aim to scale back the frequency of contact and increase the physical distance between persons, thereby reducing the risks of person- to-person transmission. There are theoretical models explaining the necessity of social distancing, which may make a huge difference in slowing thespread of coronavirus.

During the start of the pandemic, there was an interplay between age, contact patterns, social distancing, and susceptibility to infection which made the pandemic dynamics to be unclear. After the study of the transmission model, it was concluded that by practicing social distancingalone, the outbreak could be brought on top of things, thereby reducing peak incidence by a greater percentage. There are algorithms reported in the literature for the detection of COVID- 19 spread. Deep learning-based CNN (Convolutional Neural Networks) applied algorithm together with geometric techniques combine to make a model covering three aspects such as detection, tracking, and validation of information. The study reports social distancingdata to authorities with a 91.7% precision score.

The modeling studies estimated that workplace social distancing measures produced a 23% median reduction in the cumulative influenza attack rate. Another study analyzes the effect of social distancing on the COVID-19 pandemic in Korea using a mathematical model. The transmission rate for each epidemic stage by fitting into a model, especially for social distancing criteria. An aerodynamic- based CFD simulation study investigates whether the gap is 1.5 m or beyond and the possibility of droplet transfer.

3. METHODOLOGY

3.1System Architecture

The objective is to use object detection employing a YOLO v3 model trained on a COCO dataset that has 80 classes. YOLO uses dark net frameworks to process incoming feed frame by frame. It returns the detections with their IDs, centroids, corner coordinates, and also the confidences within the styleof multidimensional arrays. Once the knowledge is received,the IDs that aren't identified as a "person" are removed. Bounding boxes are drawn to highlight the detections in frames. Subsequently, centroids are calculated to search out the Euclidean distance between required objects in pixels. The following step is to calculate, whether a calculated distance between two centroids is less than the configured value. The system will throw an alert with a beeping sound when the condition is satisfied which also turns the bounding boxes of violators red[7][9][10].

3.2 Experimental Model

Input: Video to be accessed
Output: Detected information displayed in Video withhighlighted boxes
Process: The detailed processing steps are listed below,from which the algorithm is presented.

Import

1. Import all the required modules, libraries, andmethods
2. Parse input, output, YOLO model, threshold,And confidence

Load class names within the list Load trained YOLOobject detector and input the video

1. YOLO object detector is loaded which is trained onthe COCO dataset (80 classes)
2. Input the video with appropriate variables
3. Initialize output video and frame. The number ofviolations are recorded for all frames.

Determine the whole number of frames in the video

1. Loop over the frames and skim every frame untilthe tip
2. Initialize a group called " violate ", to store the number of violations in an exceeding frame Process the frame and store the specified output.

Process the frame and store the required output

1. Grab the scale of this frame say, width and height
2. A blob is constructed from the input frame

3. Perform an aerial of the YOLO object detector returning with bounding boxes and associated probabilities in a list.
4. Time taken to process one frame is calculated andsaved
5. Initialize internal lists to store the data in theoutput list
6. Loop over the output list for processing eachdetection
7. Collect class IDs and calculate probabilities from thedetection within the array, " scores ", for the presentobject
8. From " scores " get the class ID and confidenceassociated with the class ID.
9. Filter detections for class ID 'person' as object and valid confidence
10. Calculate Euclidean distance

Calculate Euclidean distance

1. Extract coordinates for centroids and dimensions of bounding boxes from "detection" into " box "
2. Calculate coordinates for the top left corner ofbounding boxes using centroids and dimensions
3. Verify that a minimum of there are two identifiableobjects
4. Calculate Euclidean distance between the centroidsof all the objects detected
5. Check if any set of centroids has but the advised distance and add them to the " violate" set.
6. Apply non-maxima suppression to narrow downdetections in idxs array
7. Ensure a minimum of one violation by the" if "statement
8. oop over idxs after converting it to a 1-dimensional array Process bounding box entries.

Process bounding box entries

1. Extract bounding box coordinates withrespective centroids.
2. Red color will be assigned to the class ID i.e.,(0,0,255) in BGR when current detection is " violates"
3. Centroids are marked on the drawn boxes
4. Display class ID and confidence over respective boxes
5. Display the number of violations i.e., length of set " violate " at the underside of the frame Write for display

Write for display

1. Initialize Video Writer
2. Display the time taken by one frame to process
3. Display the time to be taken by all frames
4. Write the frame to output the video file
5. finish off and release the pointers

3.2 Algorithm

The following are the steps in the objection detection algorithm based on the detailed steps mentioned in an experimental model.

1. Input the video
2. Determine the whole number of frames in the video
3. Loop over the frames and skim every frame until the tip
4. Construct a blob from the input frame

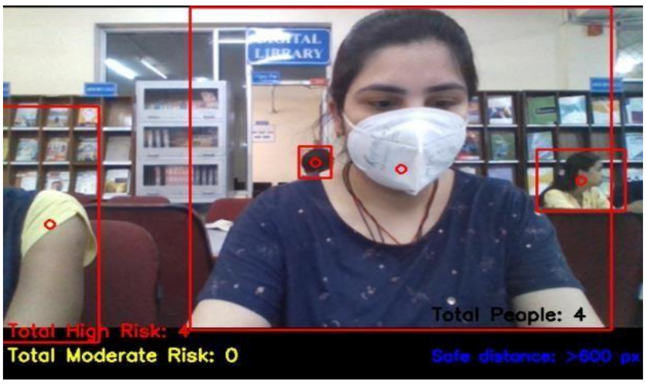
5. Perform a passing game of the YOLO object detection, giving us our bounding boxes andassociated probabilities in a list
6. Filter detections for persons as objects and valid confidence
7. Extract coordinates for centroids and dimensions of bounding boxes from " detection " into " box "
8. Calculate coordinates for the top left corner ofbounding boxes using centroids and dimensions
9. Calculate Euclidean distance between the centroidsof all the objects detected
10. Check if any set of centroids have but the adviseddistance
11. Apply non-maxima suppression to narrow downdetections
12. Ensure a minimum of one violation
13. Red color will be assigned to the bounding boxwhen current detection "violates"
14. Centroids are marked and bounding boxes aredrawn
15. Display the number of violations in the currentframe

3.3 Flowchart

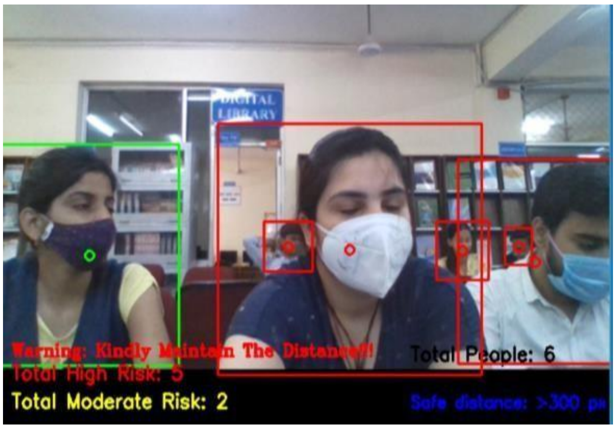
The flowchart is depicting the complete algorithmic process is provided. The video is imported for processing. For the entire number of frames, the processing parameters are computed to calculate the gap. Centroid is calculated. If thereis a distance violation marked, a box is marked as red otherwise green. Once all the frames are processed for theirdistance, the program is ended after the video is written forits violation markings.

4. RESULT

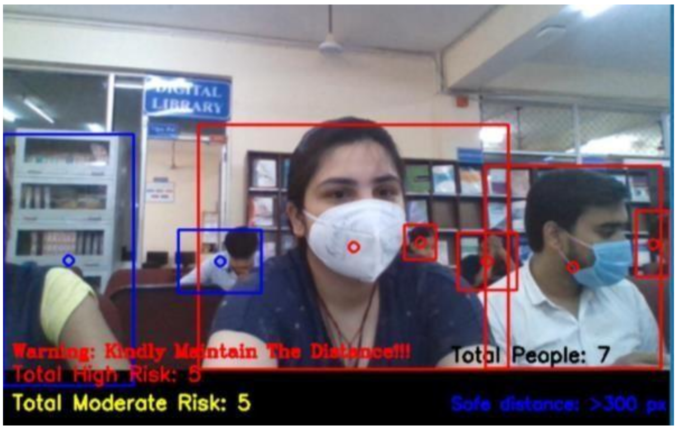
If (p1,q1) and (p2,q2) are the coordinates of the Euclidean Distance. The social distance threshold is reported as 0.6. Table 1 presents the number of violations together with centroid and distance. The gap is given in pixels. Distance iscalculated based on the input frame image threshold in pixels. The violation is calculated supported by the centroid calculation. All distance calculations are aggregated to search out the number of violations, which is reported and writtenin video finally. After processing the frames they're forwarded as real-time output.



The Output displays all the pedestrians detected and highlighted with their Class IDs and therefore the confidence corresponding to detections. Also, every case in violation of social distancing i.e., when distance in pixelsis over the configured one, ishigh lighted in an exceedingly red color bounding box. The Total Number of violations detected is displayed at the bottom of the frame.



The violations are marked in red between two persons and the distance is displayed. Otherwise, the calculated distance is additionally given. The full video will be analyzed for every and each frame for its contents and calculated violations using centroid calculations. The importance of this algorithm is very useful in the pandemicperiods to implement in crowded areas, schools, parks, and other public places. The performance parameter such as detection which there's high as per the extensive testing. Fig. presents the figures representing before and after the implementation of the SDMS algorithm. Fig 6b shows four distancing violations highlighted. Similarly, the results may be interpreted for Fig. where two violations are reportedbased. The social distance threshold is set as 0.6. The spaceis calculated supported equation. The result clearly implies the detection of violation scenarios for various real-time images. The objective of highlighting the social distancing regulation and identifying people within the frame iseffectively attained.



4. CONCLUSION

This concludes the system for social distancing and helping world fight corona virus through non-medical measure.

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