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A SOCIAL DISTANCE MONITORING SYSTEM

Various application in different fields and Sectors.

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***Abstract**:* Social distancing strategies are crucial for halting the development of various air born disease and maintain the distance for various causes. To disrupt the cycle of dissemination, social Distancing is often adhered to carefully. This study presents a technique that may be used to detect instances of social distance breaches in public spaces such as ATMs, malls, and hospitals. By using the suggested approach, it would be easy to keep an eye on people to make sure they are keeping their social distance in the monitored area and to notify them when someone does not adhere to the established boundaries. Installing the suggested deep learning technology-based system will allow coverage up to a predetermined, restricted distance.
To complete the task, the algorithm uses real-time IP camera footage. The simulated model employs a YOLO model trained on the COCO dataset to detect individuals in the frame, then deep learning methods with the OpenCV library to estimate the distance between them.

Keywords— *Deep learning, OpenCV YOLO model, COCO dataset, Image processing,*

Introduction

This paper introduces a cutting-edge solution, the Social Distance Monitor (SDM), which harnesses the power of artificial intelligence (AI), computer vision, and deep learning techniques to monitor and enforce social distancing guidelines in real-time. The SDM operates by leveraging a network of cameras strategically deployed in public spaces to capture live video feeds. Through sophisticated computer vision algorithms, the system accurately identifies and tracks individuals within the camera's field of view. Utilizing deep learning models trained on vast datasets, the SDM assesses the spatial relationships between individuals, measuring the distances between them with remarkable precision. Key features of the SDM include its ability to dynamically adapt to varying environmental conditions and crowd densities, ensuring robust performance across diverse settings. Furthermore, the system incorporates advanced AI-driven analytics to detect and analyze patterns of social distancing compliance over time. Upon detecting violations of social distancing norms, the SDM generates real-time alerts, enabling prompt intervention by designated authorities or personnel. These alerts can be customized to trigger notifications as an email.
The integration of AI, computer vision, and deep learning technologies in the Social Distance Monitor represents a significant advancement in public health surveillance and intervention strategies. By providing real-time monitoring, proactive alerts, and data-driven insights, the SDM empowers communities and authorities to uphold social distancing measures effectively, thereby safeguarding public health and well-being in the face of unprecedented challenges.

I. METHODOLOGY

1. Apply object detection to detect all people (and only people) in a video stream Compute the pairwise distances between all detected people.
2. Based on these distances, check to see if any two people are less than N pixels apart.
3. Raise alarm and send email alert when violation count exceeds the threshold

2.1 Human Detection: There are primarily three types of Deep Learning-based object detection models:

• RNN and its types which is Fast RCNN, Faster RCNN and Mask RCNN
• Single Shot Detectors
• YOLO

Each models have their own merits and demerits. The R-CNNs are examples of two-stage detectors and were also the first Deep Learning based object detector models. They required an algorithm that proposed bounding boxes that contained objects and then these regions were passed to a CNN for classification leading to one of the first two stage detectors. The disadvantage of R-CNNs were that they were very slow, obtaining around 5 FPS even on a GPU. To increase the speed of detection sing-stage detectors like SSD and YOLO were proposed. These algorithms treat object detection as a regression problem, taking a given input image and simultaneously learning bounding box coordinates and corresponding class label probabilities.

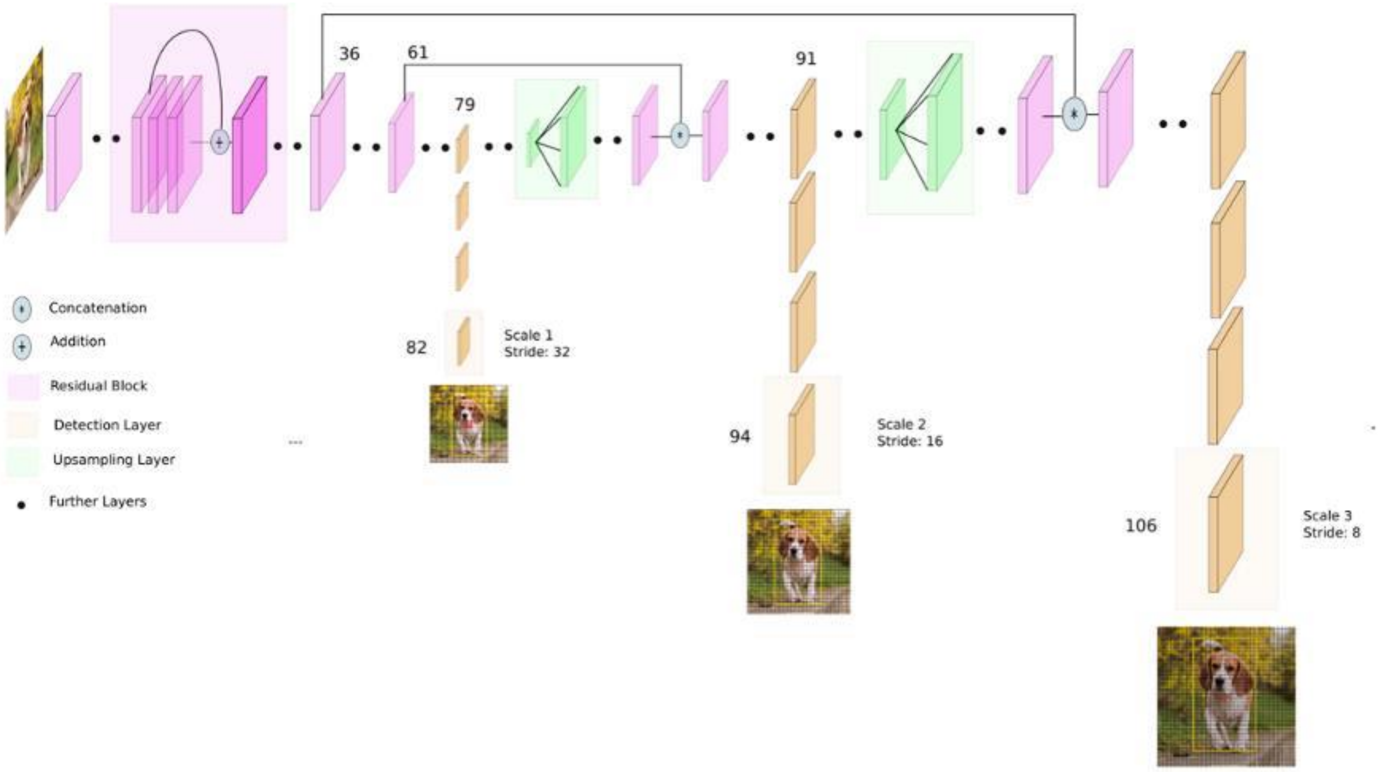
2.2 Yolo v3: The YOLO model was first proposed by Joseph Redmon in 2015. The model could detect in real time as fast as 45 FPS using a GPU and reaching up to 155 FPS on smaller variant of the model Instead of treating it as a classification, YOLO treats the object detection as a single regression problem. This means that the model looks only once at the image to detect what objects are present and where they are, hence it is named YOLO.

The input image provided by the system is divided in to SxS grid. The grid cells individually predict B bounding boxes and calculates confidence scores for these bounding boxes. The confidence score indicates how sure the model is that the box contains an object and also how accurate it thinks the box is that predicts. The confidence score can be calculated using the formula:

$$C = Pr(object)*IoU$$

IoU: Intersection over Union between the predicted box and the ground truth.
The confidence score is zero when no objects exist in the cell.

2.3 Network Architecture: Yolo v3 uses a variant of Darknet, a framework to train neural network, which originally has 53 layers. For the detection task another 53 layers are stacked onto it, accumulating to total of 106 – layer fully convolutional architecture. This explains the reduction in speed in comparison with the second version, which has only 30 layers.



In the convolution layers, kernels of shape 1x1 are applied on feature maps of three different size at three different places in the network. The algorithm makes predictions at three scales, given by down sampling the dimensions of the image by a stride of 32, 16, 8 respectively. Down sampling, the reduction in spatial resolution while keeping the same image representation, is done to reduce the size of the data. Every scale uses three anchor bounding boxes per layer. The three largest boxes for the scale, three medium ones for the second scale and the three smallest for the last scale. This way each layer excels in detecting large, medium or small objects.

II. System Architecture

3.1 **Block Diagram**: A block diagram is a graphical representation of a system or process that uses blocks or boxes to represent individual components or functions, and lines or arrows to indicate the flow of information or signals between them. Each block typically represents a specific function, subsystem, or component of the system, and the connections between blocks illustrate how they interact or depend on each other to achieve the overall objectives of the system.

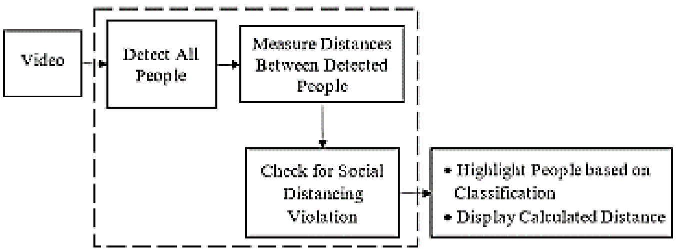


Fig 3.1: Block Diagram

3.2 **Flow Chart:** A flowchart is a visual representation of a process, system, or algorithm using various symbols and arrows to illustrate the flow of steps or activities from start to finish. Each step or activity in the process is represented by a shape, typically a rectangle, circle, diamond, or other geometric form, with arrows indicating the sequence or direction of flow between them.

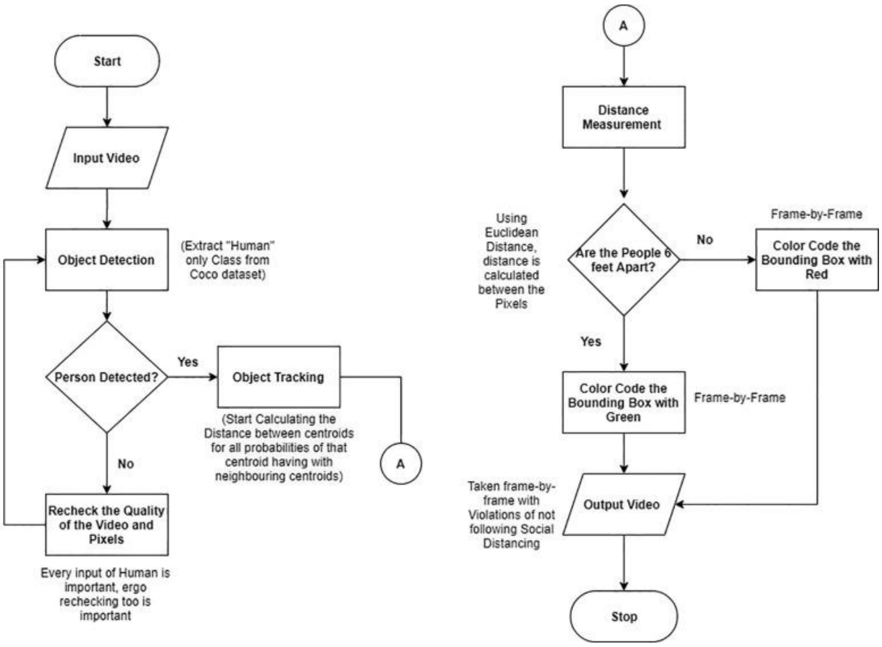


Fig 3.2: Flow Chart

III. ALGORITHM

An algorithm is a set of step-by-step instructions or procedures designed to solve a specific problem or perform a particular task. It is a precise and unambiguous sequence of operations that can be executed by a computer, human, or other computational device to achieve a desired outcome.

Key characteristics of algorithms include:

Finiteness: The algorithm must have a finite number of steps, meaning it eventually terminates and produces a result.

Definiteness: Each step of the algorithm must be precisely defined and unambiguous, leaving no room for interpretation.

Input: An algorithm typically takes one or more inputs, which are processed according to the defined steps to produce an output.

Output: The algorithm produces a result or output, which may vary depending on the input provided and the logic implemented in the algorithm.

Effectiveness: The algorithm must be effective, meaning it should solve the problem or accomplish the task correctly within a reasonable amount of time and resources.

Algorithms serve as the foundation of computer science, mathematics, and various other fields, providing systematic approaches to solving problems and automating processes. They are used in diverse applications, including sorting and searching data, optimizing resource allocation, performing calculations, and executing complex tasks in software development, artificial intelligence, cryptography, and many other domains.

Implementation Algorithm:

Start: Begin the algorithm.

Get the input feed: Obtain the video feed for processing.

Convert video into frames: Split the video into individual frames for analysis.

Use YOLOv3 model for detection: Apply transfer learning on the YOLOv3 model trained on the COCO dataset to classify humans in each frame.

Create bounding boxes and calculate centroids: Identify humans in the frame, create bounding boxes around them, and compute the centroid for each bounding box.

Compute pairwise Euclidean distance: Calculate the distance between centroids of each pair of bounding boxes.

Check distance threshold: Determine if the distance between individuals is less than a predefined threshold (e.g., 6 feet).

Classify individuals: Separate individuals into violating and non-violating sets based on their proximity.

Detect person bounding boxes: Identify the bounding boxes around each person.

Initialize bounding box color: Set the initial color of the bounding box to green.

Update bounding box color: If individuals are in the violating set, change the color of their bounding box to red; otherwise, keep it green.

Count violating individuals: Calculate the number of individuals in the violating set.

Send email and activate alarm: If the count of violating individuals exceeds a predefined threshold, send an email to the specified address and activate an alarm.

End: Terminate the algorithm.

This algorithm provides a systematic approach to monitoring social distancing compliance in real-time and taking appropriate actions, such as alerting authorities, when violations occur. It combines computer vision techniques with distance calculations and threshold checks to achieve its objective.

IV. CONCLUSION

The idea of implementation of the Social Distance Monitor (SDM) marks a pivotal advancement in the realm of public health surveillance and intervention strategies, particularly in response to the challenges posed by the air born diseases such as (COVID-19 pandemic, Ebola). By leveraging artificial intelligence (AI), computer vision, and deep learning technologies, the SDM offers a sophisticated solution for monitoring and enforcing social distancing protocols in real-time.

The SDM's ability to accurately identify and track individuals, assess spatial relationships, and measure distances with precision underscores its efficacy in promoting public safety. Its adaptability to diverse environments and crowd densities, coupled with advanced AI-driven analytics, ensures robust performance and enables proactive intervention when violations occur.

Beyond its immediate application in combating air born diseases, the SDM's versatility extends to various scenarios, including the management of other airborne diseases like Ebola, enforcing social distancing during curfews, and preventing close proximity among students during examinations. This adaptability underscores its potential as a multifaceted tool for safeguarding public health across different contexts.

Moreover, the real-time alert system integrated into the SDM enables prompt intervention by designated authorities, facilitating timely responses to instances of non-compliance. Customizable notification mechanisms further enhance its utility by enabling efficient communication and coordination among stakeholders.

In essence, the integration of AI, computer vision, and deep learning technologies in the SDM represents a significant step forward in enhancing public health surveillance capabilities and promoting adherence to social distancing measures. By empowering communities and authorities with real-time monitoring, proactive alerts, and data-driven insights, the SDM emerges as a crucial asset in safeguarding public health and well-being amidst evolving challenges and uncertainties.

REFERENCES

[1] Scientific Brief: SARS-CoV-2 Transmission | CDC https://www.cdc.gov/coronavirus/2019-ncov/science/science-briefs/sars-cov-2-transmission.html
[2] China Had First Coronavirus Case in November 2019 Itself - The Wire Science https://science.thewire.in/health/china-had-first-coronavirus-case-in-november-2019-itself/
[3] COVID-19 pandemic – Wikipedia https://en.wikipedia.org/wiki/COVID-19_pandemic
[4] Scientific Brief: SARS-CoV-2 Transmission | CDC https://www.cdc.gov/coronavirus/2019-ncov/science/science-briefs/sars-cov-2-transmission.html
[5] What is social distancing and how can it slow the spread of COVID-19? | Hub (jhu.edu) https://hub.jhu.edu/2020/03/13/what-is-social-distancing
[6] Social distancing – Wikipedia https://en.wikipedia.org/wiki/Social_distancing
[7] Leviticus 13 AKJV - And the LORD spake unto Moses and - Bible Gateway https://www.biblegateway.com/passage/?search=Leviticus+13&version=AKJV
[8] How they flattened the curve during the 1918 Spanish Flu (nationalgeographic.com) https://www.nationalgeographic.com/history/article/how-cities-flattened-curve-1918-spanish-flupandemic-
Coronavirus.
[9] A deep learning-based social distance monitoring framework for COVID-19 (nih.gov). By Imran Ahmed, Misbah Ahmad, Joel J.P.C. Rodrigues, Gwanggil Jeon, and Sadia Din https://arxiv.org/abs/1804.02767
[10] [1506.02640] You Only Look Once: Unified, Real-Time Object Detection (arxiv.org). By Joseph Redmon, Santosh Divvala, Ross Girshick, Ali Farhadi https://arxiv.org/abs/1506.02640
[11] [1804.02767] YOLOv3: An Incremental Improvement (arxiv.org). By Joseph Redmon, Ali Farhadi https://arxiv.org/abs/1804.02767