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Social Distance Detecting using Deep Learning for Present and Future Viral Outbreaks

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Abstract: *This report outlines a deep learning-based method for monitoring social distancing by analyzing the spacing between individuals in shared environments. The aim is to reduce the spread of infectious viruses like, HMPV, and other potential future threats. The system uses video input, applying the YOLOv3 model—a pre-trained neural network—to detect pedestrians. To measure distances between people accurately, the footage is converted into a top-down, two-dimensional perspective. Individuals who don't maintain the required safe distance are flagged with red boxes and connecting lines. The model was tested with pre-recorded pedestrian footage and showed strong performance in identifying distancing violations. This approach can be effectively used in hospitals and other public settings to help control disease transmission..*

Keywords: social distancing

I. INTRODUCTION

The World Health Organisation (WHO) globally endorsed social distancing as one of the main preventative strategies for highly infectious diseases. The same preventative action is necessary for fighting other airborne viruses, including Human Metapneumovirus (HMPV) as well as new viral threats.

The project proposes a deep learning model for automatic people detection, real-time distance measurement, and violation checking in crowded places based on normal CCTV cameras. The system detects areas of higher risk where the likelihood of transmission of diseases is greater and enables enforcement of preventive measures in hospitals, malls, schools, and public spaces.

Whereas image classification classifies objects within images, object detection builds from that by furthermore identifying where those objects are located. Object detection, used on each frame within video surveillance, is object tracking.

Our model seeks to overcome the drawbacks of human monitoring and constructs an automatic surveillance system that can alert authorities for instances of violating distance norms—minimizing the need for constant human observation.

II. RELATED WORK

Scientists globally have sought many medical as well as pharmaceutical interventions for viral infections. Yet, interventions such as social distancing are still essential.

Deep learning, notably using Convolutional Neural Networks (CNNs), has been successful in object detection and classification tasks. A number of such advanced models, such as YOLO (You Only Look Once), provide fast speeds as well as accuracy through object localization as well as object classification. YOLO is well-placed for detecting human movement tracking across video frames given its capabilities of real-time detection.

Nguyen et al. conducted a survey on deep learning based human detection techniques along with descriptors and occlusion issues. Following such research, our framework is employing YOLOv3 for pedestrian detection in real-time, while Euclidean distance calculations are used to determine social distancing violation cases within a crowd of people.

III. METHODOLOGY

The objective is detecting and tracking safe distances between people within public settings through computer vision and deep learning.

Pedestrian Detection:
YOLOv3, as a one-stage deep network model, is employed for detecting pedestrians within frames of video. It makes bounding boxes as well as class probabilities using regression. In detection, only the class "person" is kept, while others are discarded. Individuals are identified with bounding boxes drawn around them for identifying their positions.

Top-Down View Conversion:
In order to precisely measure between individuals, the recorded video is transformed from a view from the perspective of one of the individuals, to a view from above (top-down, bird's-eye view). The ground is assumed as a flat plane. Four manually chosen reference landmarks are transformed from the frame to make a 2D plane.

Distance Measurement:
The bottom center point of each bounding box is mapped onto the top-down view. The Euclidean distance d between two individuals at locations (x1, y1) and (x2, y2) is given by:

$d = \sqrt{(x2 - x1)^2 + (y2 - y1)^2}$.

The individuals are marked with red boxes, with red lines between them, if the measured distance d is less than the specified threshold t. Green boxes and lines are used otherwise for marking compliance.

Fig. 1 Pipeline of social distancing detecting methodology

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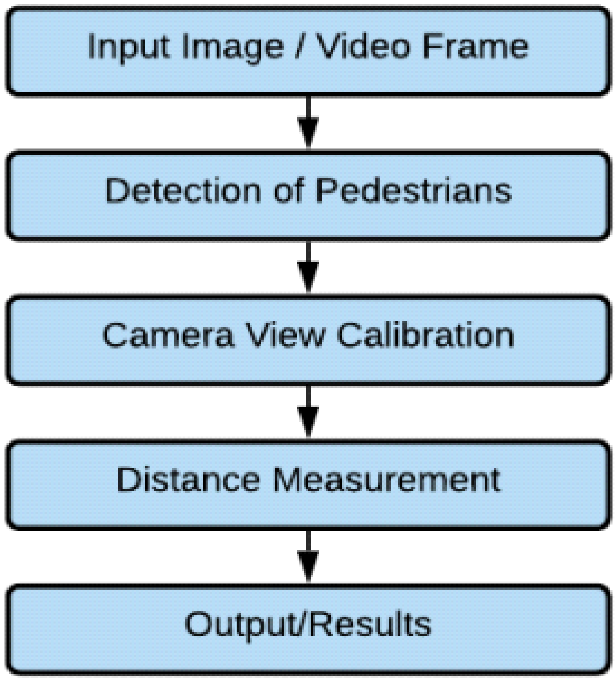

Fig. 2 Supporting image for methodology or architecture

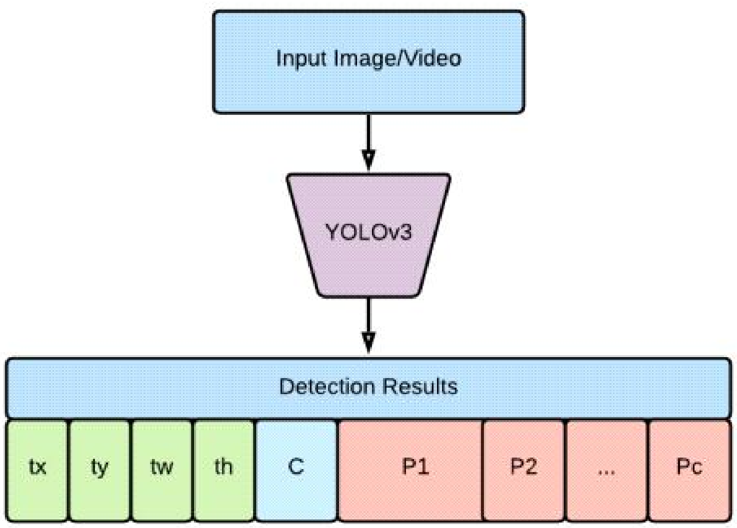

Fig. 3 Supporting image for methodology or architecture

$$\sqrt{(x^2 - x^1)^2 + (y^2 - y^1)^2}$$

Fig. 4 Supporting image for methodology or architecture

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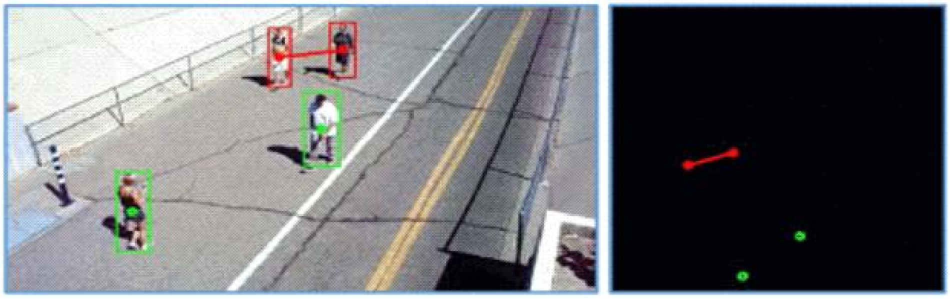

Figure 5: Supporting image for methodology or architecture

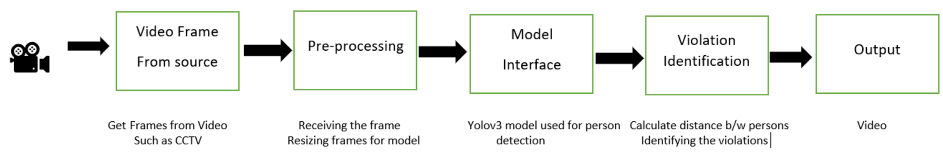

Figure 6: Supporting image for methodology or architecture

IV. CONCLUSION AND FUTURE SCOPE

We introduced a deep learning framework for social distancing monitoring from an aerial view. Based on YOLOv3 and transfer learning, the framework is accurate for person detection and tracking from real-life video sequences.

Key results include:

- 92% accurate detection without transfer learning.
- 95% accuracy with transfer learning
- 95% accuracy for tracking.

This framework can be of critical value in stopping the transmission of highly infectious diseases within crowded public places and healthcare settings. Enhancements for the future might involve:

- Utilizing correct camera calibration for measurements of the real world.
- Accommodation of varied indoor and outdoor lighting and space environments.
- Merging other object tracking models such as Deep SORT or ByteTrack.
- Implementing the system within hospitals for assisting medical staff in upholding safety standards and minimizing risk of transmission from infected patients suffering from contagious diseases such as COVID-19 or HMPV.

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