Social Distancing and Mask Detection By Using Deep Learning

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ABSTRACT: Without a doubt, the COVID-19 pandemic has brought the world to a halt. A few months ago, we lived in a very different world than we do now. The virus is spreading quickly and poses a serious threat to humanity. Since there are no vaccines available, psychological distancing is the only effective method for fighting the pandemic. Because of the seriousness of the case, certain precautions must be taken at all times, the most important of which is social distancing and mask detection. Masks must be worn and social distance maintained during COVID-19 to ensure a slowdown in the rate of new cases. Our study aims to see if those in the vicinity maintain social distance by wearing masks. Detecting a person's frame and displaying labels using our self-developed model, Socialdistancing-20; they are identified as a mask or no mask if the distance is less than a certain value, and voice module warns if the distance is less than a certain value. To separate humans from the background, the proposed framework uses the YOLO v3 object detection model, as well as the Deepsort method to monitor recognized individuals using bounding boxes. Via CCTV video surveillance, this system can be used to keep an eye on people.

Keywords— Safety, social distancing, Deep learning, Mask detection using AI.

I. INTRODUCTION

The use of social distance and masks is effective in preventing the spread of Coronavirus Disease 2019. COVID-19 is a virus that infects people. Individuals, on the other hand, are not used to maintaining the necessary 60cm separation between themselves and their surroundings. An active surveillance system capable of detecting distances between individuals and alerting them could delay the spread of the deadly disease. In addition, calculating social density in a region of interest (ROI) and modulating inflow can minimize the chances of social distance violations. If data is collected and citizens who do not follow the laws are labeled, democratic societies' human rights will be violated. We propose a real-time social distance detection and warning system based on Artificial Intelligence (AI) that considers four major ethical considerations:

1.Data can never be saved or cached by the computer.
2.Warnings should not be aimed at individuals in particular.
3.There should be no human operator in the detection.
4.The code should be open-source and publicly available.

In light of this, we suggest measuring social distancing with a monocular camera and deep learning-based real-time object detectors. A non-intrusive audio-visual alert signal is emitted if a violation is detected, but it does not target the person who violated the social distance measure of data. The device also sends a control signal to modulate inflow into the ROI if the social density exceeds a critical value. We assessed the proposed method's generality and performance using real-world datasets. Our code is open-sourced, and the suggested approach is ready to use.

II. LITERATURE SURVEY

This section of the literature review finally shows the following facts based on a careful examination of several authors' work:

[1] One of the most effective precautions in minimizing physical contact that could lead to the spread of coronavirus is social distancing. Viral transmission rates would be higher as a result of non-compliance with these guidelines. To implement two proposed features, a framework was created using Python and the OpenCV library. The first feature detects social distancing violations, while the second feature detects violations of entering restricted areas. The accuracy of both features has been checked. This thesis seems to have met all of its goals based on the overall findings. The obtained results, however, have some limitations. According to the results of the system's tests, the object detection model used for detecting people has trouble correctly detecting people in the outdoor environment and difficult scenes with distant scenes.

A stronger object detection model can be introduced in the future for further development.

[2] A deep learning model is used to propose a technique for detecting social distancing. The gap between people can be measured using computer vision, and any non-compliant pair of people will be marked with a red frame and a red line.
A video of pedestrians walking down a street was used to validate the proposed process. The visualization results revealed that the proposed method is capable of determining social distancing measures between individuals and that it could be further adapted for use in other settings such as the workplace, restaurant, and school. Furthermore, by optimizing the pedestrian detection algorithm, incorporating other detection algorithms such as mask detection and human body temperature detection, increasing the computational power of the hardware, and calibrating the camera perspective view, the work can be improved even further.

[3] Social distancing has been suggested as a way to prevent the spread of infectious diseases like COVID-19. This article contains a thorough examination of how technology can allow, encourage, and enforce social distancing.

To begin, we discussed social distancing in general. addressed the technology's role in the current COVID-19 pandemic, as well as a variety of practical social distancing situations in which it could be used. We then went through a range of wireless technologies that can be used to facilitate and encourage social distancing and discussed them.

We gave a summary of each technology, looked at the state-of-the-art, and explored how it could be used in various social distancing scenarios.

III. PROPOSED SYSTEM

The scope of this project is basically where lots of people work together like companies, banking systems, and other crowded places.

As this system is fully automated we don't need more manpower to keep an eye on every single individual
Automated alerts if social distancing isn't maintained
Complete voice-based module with auto alerts

The use of object detection and tracking models to help in the social distancing remedy for coping with the escalation of COVID-19 cases is proposed in a deep learning-based context.

To maintain a balance of speed and precision, the YOLO COCO model is used as object detection and tracking approach, with bounding boxes surrounding each detected object.

The proposed framework is a deep learning solution that trains the model using OpenCV and TensorFlow. For a fast and efficient deep learning solution for real-time human detection, we combine the deep learning MobileNetV2 modal with the SSD system in video streams and use a triangular similarity technique to measure the distance between persons detected by the camera in real-time in public places and comprises customized data collection to resolve a face mask detection model with variance in the types of face masks are worn by the public in real-time by means of a transfer of learning to a pre-trained SSD face detector.

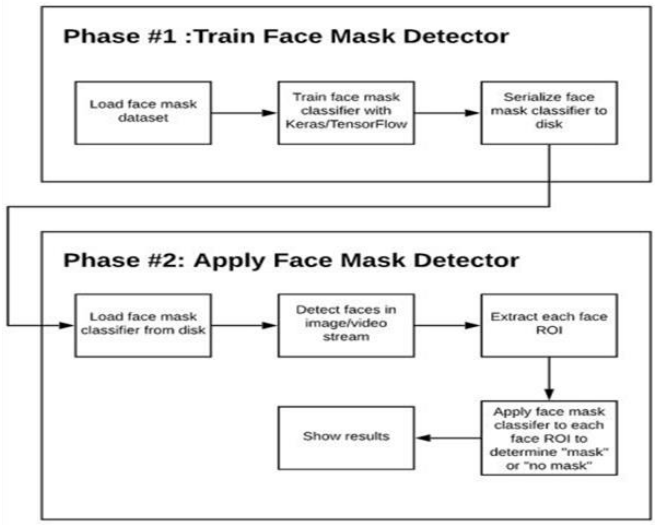

Fig. 1 System Architecture Diagram

Data Collection and Pre-processing

A custom data set consisting of face images with various types of face masks that are labeled and used for the training of our models is used in the proposed framework. In the pre-processing stage, we use the current background subtraction algorithm. The SSD performs real-time automated social distance maintenance identification and verification of people wearing masks or not.

3165 images compose the dataset used to train our proposed face mask detector. The data set is split into the training data set and the testing data set until the custom face mask image dataset is labeled.

Model building and Training

In order to train the algorithm efficiently and for prediction accuracy, the training data set should consist of

80 percent images and the testing data set should consist of 20 percent images to test the algorithm's prediction precision. The photos are divided into two categories in the training data collection: mask and no mask.

Our proposed system would fine-tune the MobileNetV2 model, which is a highly efficient architecture that can be applied to edge devices with limited computing resources, such as the Raspberry Pi4, to detect people in real time using the transfer learning approach.

We trained our model with a single shot detector, which uses only one shot to detect multiple objects in an image using multibox, using 80% of our total custom data collection. In the project directory, the custom data set is loaded and the algorithm is trained based on the labelled images.

The image is resized to 224 * 224 pixels in pre-processing steps, converted to numpy array format, and the corresponding labels are applied to the images in the dataset before using our SSD model as input to create our custom MobileNetV2 model as the backbone and use the TensorFlow Object Detection API to train our model.

Tensorflow helps to increase data and download pre-trained ImageNet weights before model training starts, to make the prediction efficiency of the algorithm accurate.

The SSD algorithm is trained with both the pre-trained ImageNet weights and the annotated images in the custom data set by tuning the head layer weights without updating the weights of the base layers after downloading the pre-trained weights and generating a new fully-connected.

To practice our model for 1000 stages, we used the Adam optimizing algorithm, the learning decay rate for updating network weights, and the binary cross-entropy for mask structure classification.

Parameters were set for an initial learning rate of INIT LR = 1e-4, an epoch number of EPOCHS = 20, and a batch size of BS = 32. We used a webcam for social distance tracking with cv2, starting with bounding box coordinates and computing the midpoint between the top-left and bottom-left points, as well as the top-right and bottom-right points after a human has been identified. We use the Euclidean distance between the points to measure distance between people in the picture.

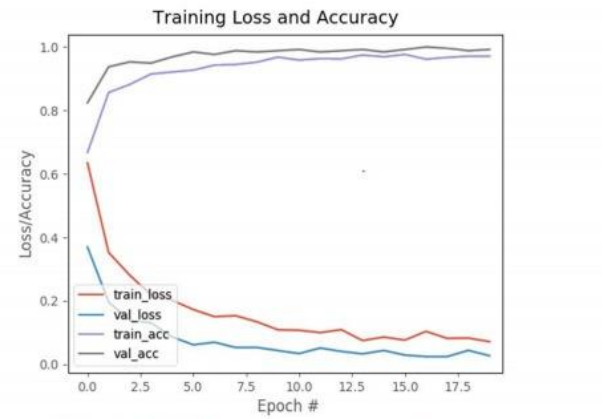

Fig 4: Model training accuracy/loss curves

Model Testing

The suggested method is computer-assisted and assists in the execution of the social distance inspection process in an automatic manner. After the model has been trained with the custom data set and the pre-trained weights, we present the bounding box with the name of the tag and the confidence score at the top of the box to verify its accuracy on the test dataset. Face mask identification is achieved by showing bounding boxes on the face of the identified individual with a mask or non-mask written on it, as well as confidence ratings. The unit produces an alarm and sends a message to the monitoring authority with a face picture if the mask is not visible on the face and the social gap is not established.

The computer detects social distancing and masks with FPS = 28.07. It has a precision score of 91.7 percent, a confidence score of 0.7, a precision value of 0.91, and a recall value of 0.91.

Model Implementation

The proposed system uses a Raspberry Pi 4 with a camera to automatically monitor public spaces in real-time in order to prevent the spread of Covid-19. The qualified model with the custom data set is installed and the camera is attached to the Raspberry Pi4. The camera sends real-time video of public spaces to the Raspberry Pi 4 model, which continuously and automatically monitors public spaces.

It determines whether or not people maintain safe social distances and whether or not those people wear masks.
When a person without a mask is identified, his picture is taken and sent to a control center at the State Police Headquarters; and when a social distance violation is

detected continuously in threshold time by individuals, our solution works in two stages.

A sign will be displayed, instructing people to keep their distance from one another and wear face masks.

Result & Discussion

The proposed architecture is a deep learning approach that employs OpenCV and TensorFlow to train the model. We combine the deep learning MobileNetV2 modal with the SSD framework for a fast and efficient deep learning solution for real-time human detection in video streams, and use a triangular similarity technique to measure the distance between people identified by the camera in real time in public spaces.Via a learning transfer[20] to a pre-trained SSD face detector, a face mask detection model of variance in the styles of face masks worn by the general population is solved in real time.

CONCLUSIONS:

The article proposes a real-time deep learning-based system for automating the process of monitoring social distancing via object detection and tracking approaches, in which each person is detected in real-time using bounding boxes.

The developed bounding boxes assist in identifying clusters or groups of people that satisfy the pairwise vectorized approach's closeness property. The number of breaches has been checked. A deep learning-based approach can be useful in detecting and limiting these threats.

By combining our suggested approach with body gesture research, we can determine whether someone is coughing and sneezing in public spaces while violating face masks and social distancing rules, and law enforcement officers can be notified as a result.

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