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AN INTELLIGENT SYSTEM FOR SOCIAL DISTANCE DETECTION USING DEEP LEARNING TECHNIQUES

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Abstract - Social distancing and wearing mask properly are the most effective ways to reduce the infection in current pandemic situation. So, we are developing a model that automatically detects the Social Distance violation prescribed by WHO (which includes maintaining a minimum of 6 ft distance and wearing the face mask). The solution includes developing a model that predicts social distance violation for that, a camera is used as input for frame of video and YOLO-V3 objection detection model which detects people for calculating social distance by applying distance measurement formula and individual identification of face mask violation by notifying them.

Index Terms -YOLOv3((You Only Look Once),MobilenetV2,FPS(Frame Per Second), CNN(Convolutional neural network).

I. INTRODUCTION

The COVID-19 virus spreads among people when they came into contact for a long time with the infected people. The chances of spreading virus are more when a person who is infected with the virus sneezes, coughs or talks near other people. The latest studies indicate that many of the infected people have no symptoms of infection. Thus, it is very important that, everyone should maintain minimum social distance from others whether they have or not have any symptoms. In order to survive from the dangerous COVID-19, social distancing is the best method to be followed to reduce the spread of the virus. People are informed to avoid contact with other people, thereby controlling the spread of the virus.

Artificial Intelligence and Deep Learning has shown good results on some daily life problems. In this proposed system Computer Vision and deep learning techniques are used to monitor social distancing between people at public places. To make sure that social distancing guidelines is followed in public places and workplace, the social distancing detection system can be used to monitor people whether they are maintaining safe distance of at least 6 feet from each other by analysing a real time video streams or images from the CCTV footages. This tool that we developed can be used to monitor people at schools and colleges by integrating it to their security camera systems.

II. RELATED WORKS

Monitoring Social Distancing by Smart Phone App in the Effect of COVID-19, in this paper Dr. Neelavathy Pari S, Balaji Vasu, Geetha A V, Jeevitha V K have implemented to methods to detect social distance through smart phones. On is to detect people using deep learning algorithm through camera and then calculate social distance using Euclidean Distance formula. Second is to calculate inter person distance using Bluetooth signal strengths between two mobile phones.

The Visual Social Distancing Problem, in this paper Marco Cristani, Alessio Del Bue have presented the Visual Social Distancing Problem as the detection and calculation of distance between people from images. This Visual Social Distancing Problem will help to analyse the behaviour of people and to reduce the risk of spreading infection.

A Comprehensive Survey of Enabling and Emerging Technologies for SocialDistancing — Part I: Fundamentals and Enabling Technologies, in this paper Cong T. Nguyen, YurisMulyaSaputra have discussed how technologies can be used to enable and enforce social distancing among people to reduce the rate of spreading infection.Firstly they have discussed the importance of social distancing in the current pandemic situation and then different real time social distancing implementation scenarios, using various different technologies.

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Social Distancing as p-Dispersion Problem, in this paper Jakub Kudela have argued that efficient use of p-dispersion problem can model an effective social distancing monitor. They used discretization that is builds on top of decremental clustering method and found that it works really well even for the smaller values of p.

Monitoring COVID-19 social distancing with person detection and tracking via fine-tuned YOLO v3 and Deepsort techniques, by Narinder Singh Punn, Sanjay Kumar Sonbhadra and Sonali Agarwal. Here for object detection and object tracking they introduced a framework based on deep learning, which is efficient in real time tracking of people through the bounding boxes. The generated bounding boxes will help to calculate the distance between each individual in the video frames using pairwise vectorized approach.

A deep learning-based social distance monitoring framework for COVID-19[6], in this paper Imran Ahmed, Misbah Ahmad, Joel J.P.C. Rodrigues, Gwanggil Jeon, Sadia Din they have presented a frame work for social distance monitoring using deep learning techniques. Here they used YOLO V3 to pretrain the model to detect human beings. As in video input movement is continues, this technique helps to continuously track the human beings.

III.SYSTEM ARCHITECTURE

Figure 1: Proposed Approach.

Our approach works in two stages: first, persons without mask will be identified and notification send to them. Second, if individuals violating social distance is detected continuously in threshold time, an alarm will be generated to instruct people to maintain social distance.

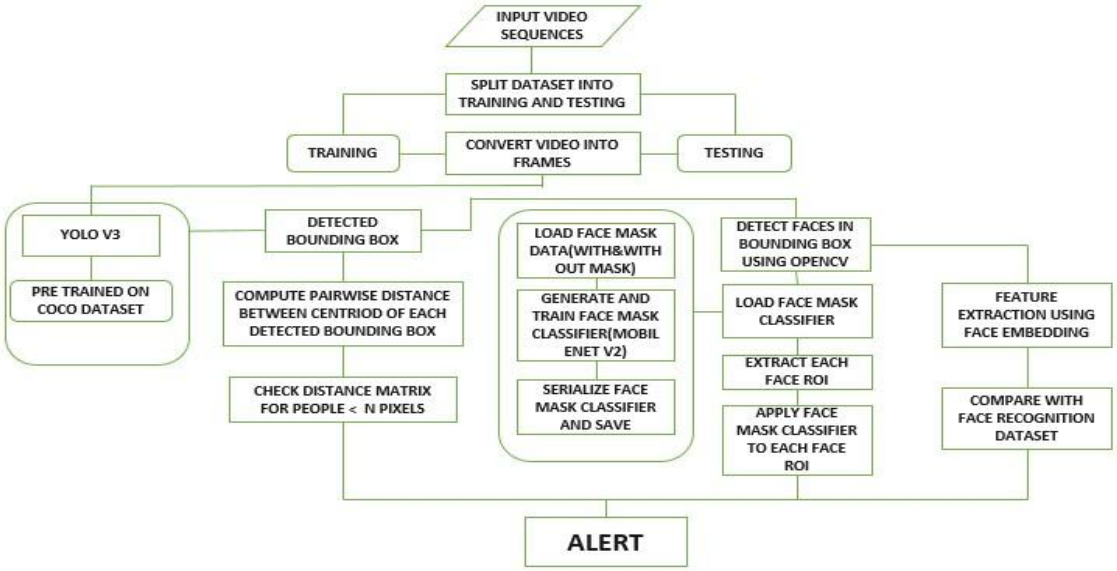

Figure 2: System Design

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Here to detect and classify the human beings in the input video frame we are using Yolo V3 object detection framework. In this method system camera continuously monitors the surroundings and captures the image frames. When an image frame with social distance violation or face-mask violation detected, an alarm will be generated.

IV. METHODOLOGY

The proposed system has 3 modules

1) Social distance detection module
2) Face mask detection module
3) Face recognition module

1. SOCIAL DISTANCE DETECTION MODULE:

This module is responsible for detecting the social distance violation. Here the video frames are taken as input to the module. The first step in the social distance detection is detecting the objects in the given input of video frames hence it is necessary to incorporate any one of the object detection algorithms available, for example

- Fast R-CNN
- Faster R-CNN
- Region-based Convolutional Neural Networks (R-CNN)
- Region-based Fully Convolutional Network (R-FCN)
- Single Shot Detector (SSD)
- YOLO (You Only Look Once)

After a series of study of above algorithm's, we arrive at a conclusion that the YOLO is better choice for the object detection technique in the real time scenario. YOLO can read 45 fps (frames per second) and can classify 80 categories of object trained on the MS-COCO dataset.
YOLO divides the input image in to an S x S grid and the cell predicts some number of bounding boxes for each grid cell and then YOLO predicts confidence, corresponding class probabilities of objects in each grid.
YOLOuses theconvolutional layers and YOLO v3 consist of 53 Convolutional Neural Network Layers (Darknet-53) and it is stacked with additional 53 more layers making it 106 layers of CNN for YOLOv3, YOLOv3 make detections at three different scales.

A. POSITION OF CAMERA:

The input is taken from the CCTV/Camera the position and placement of input device is critical step as if the input is wrong the model fails to detect the accurate results. For this a Bird eye view transformation is considered.

B. LIGHTING CONDITIONS:

The model may fail to detect the objects under various low light conditions even if the camera orientation is correct hence it is necessary to train the model with the dataset that contains the various lighting conditions like low-light, dark and other lighting conditions. For this ExDARK dataset is considered which focuses on the low-light environment and it contains 12 different classes like ambient, object, strong, twilight, low, weak, screen, window, shadow, and single.

We will load the YOLOv3 weights for detecting the objects (only 'people' class) in the video frames then the YOLOv3 will detect the objects i.e people in the video frame and applies the bounding boxes around the detected objects. Then the centroid is calculated for each bounding box detected in the video frame and Euclidean distance formulae is used to calculate the distance between the detected objects a pair wise and triangle distance is calculates around the detected objects, if the distance matrix is less than the predefined N pixel value the violation alert is displayed.

Steps:

1. Input image/Frame.
2. Object detection (Filtering only "people" class).
3. Compute pairwise distances between centroids.
4. Check distance matrix for people<N pixels Apart.

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2. FACE MASK DETECTION MODULE:

The face mask detection module includes two parts

A. Training Phase.

B. Deployment Phase.

A. TRAINING PHASE:

The first step in this process is to have the dataset to train the model, the dataset can be downloaded from the Kaggle i.e the face mask dataset which has with_mask (1916) and without_mask (1919) images.After acquiring the required dataset, the raw dataset needs to be pre-processed, the images are resized into 224X224.as machine learning model understands only numerical data the needs to be converted to array format and labels to NumPy arrays. The data is segmented into 80% for training and 20% for testing.The next step is to classify the images as with or without mask as it is a classification problem. So MobileNetV2 a fine-tuned model with pre-trained ImageNet weights is used. Then the model is trained with dataset and resulting model is tested with the training dataset for validation.Once the model is trained. The model is serialized into a disk for deployment utilization.

B. DEPLOYMENT PHASE:

In deployment Phase, first we will load the real time sequence of images from the input device. The object detector will detect the persons in the video frames Then the ROI (region of interest) is to be selected here ROI refers to face region, so we will extract the face ROI through NumPy slicing.After this mask detector model is applied to detect whether the person is wearing the mask or not, then the alert displayed for the persons who are not wearing the mask.The alert is displayed like with_mask and without_maski.e the model will classify them into probability of with or without mask.

Steps:

1. Load Face Mask Data.
2. Augment the face mask data using PyTorchtorchvision.
3. Image pre-processing using PyTorch transforms and OpenCV.
4. Generate and Train Face Mask Classifier (MobilenetV2) by PyTorch.
5. Serialize face mask classifier and save.
6. Load face mask classifier from disk.
7. Detect face in bounding box.
8. Image pre-processing using PyTorch transforms and OpenCV.
9. Apply Face Mask Detector to Determine “mask” or “no Mask”
10. Show result.

3. FACE RECOGNITION MODULE:

For the purpose of giving the individual alert for the people who violates the social distancing and not wearing face mask the facial recognition technology is needed but it is difficult to implement this module for the crowd and public places instead it can be implemented in the places like work places and educational institutions where the number of people is limited.
The various face detection techniques available are:

- Haar Cascades Classifier:
- Histogram of Oriented Gradients (HOG):
- Multi-task Cascaded Convolutional Networks (MTCNN):

V. RESULT

The main aim of our project is to monitor the social distance detection and to notify the people who are violating the social distance.
Our system overcomes existing systems drawbacks by,

- Automating social distance monitoring system.
- Detecting the person even if wearing the mask.

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VI. CONCLUSION:

In the proposed system we have tried to overcome the drawbacks of existing system by introducing automation in social distance monitoring system, and detect the person who is violating the rules even if he wearing mask, where in existing system person detection wearing mask is not implemented.
Our system takes the input as video and stream the video frames with violations to output Thus by using this system we can reduce the current impact of COVID effectively.

REFERENCES

[1] Monitoring Social Distancing by Smart Phone App in the Effect of COVID-19 by Dr. Neelavathy Pari S, Balaji Vasu, Geetha A V, Jeevitha V K.
[2] The Visual Social Distancing Problem by Marco Cristani, Alessio Del Bue.
[3] A Comprehensive Survey of Enabling and Emerging Technologies for Social Distancing — Part I: Fundamentals and Enabling Technologies by Cong T. Nguyen, YurisMulyaSaputra.
[4] Social Distancing as p-Dispersion Problem by Jakub Kudela.
[5] Monitoring COVID-19 social distancing with person detection and tracking via finetuned YOLO v3 and Deepsort techniques by Narinder Singh Punn, Sanjay Kumar Sonbhadra and Sonali Agarwal.
[6] A deep learning-based social distance monitoring framework for COVID-19 by Imran Ahmed, Misbah Ahmad, Joel J.P.C. Rodrigues, Gwanggil Jeon, Sadia Din.
[7] Hoanh Nguyen, "Fast Object Detection Framework based on MobileNetV2 Architecture and Enhanced Feature Pyramid", Journal of Theoretical and Applied Information Technology, March – 2020, Vol.98, No.05.
[8] Haoxiang Li, Zhe Lin, Xiaohui Shen, Jonathan Brandt and Gang Hua, "A Convolutional Neural Network Cascade for Face Detection", Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, June - 2015, pp.5325 - 5334.
[9] Shaoqing Ren, Kaiming He, Ross Girshick, and Jian Sun, "Faster R-CNN: Towards RealTime Object Detection with Region Proposal Networks", Advances in Neural Information Processing Systems, June - 2015, pp. 91 - 99. [10] Mingjie Jiang, Xinqi Fan and Hong Yan, "RetinaMask: A Face Mask Detector", .org, May - 2020, arXiv: 2005.03950.
[11] Bosheng Qin and Dongxiao Li, "Identifying Facemask-Wearing Condition Using Image SuperResolution with Classification Network to Prevent COVID-19", Sensors, September - 2020, Vol.20, No.18, pp.5236.
[12] Paul Viola and Michael Jones, "Rapid Object Detection using a Boosted Cascade of Simple Features", Proceedings of the 2001 IEEE Computer Society Conference on Computer Vision and Pattern Recognition, February – 2001, pp.I-511.
[13] Zhongyuan Wang, Guangcheng Wang, Baojin Huang, ZhangyangXiong,, Qi Hong, Hao Wu, Peng Yi, Kui Jiang, Nanxi Wang, Yingjiao Pei, Heling Chen, Yu Miao, Zhibing Huang and Jinbi Liang, "Masked Face Recognition Dataset and Application", arXiv.org, March - 2020, preprint arXiv: 2003.09093.
[14] Rajeev Ranjan, Vishal M Patel and Rama Chellappa, "Hyperface: A Deep Multi-Task Learning Framework for Face Detection, Landmark Localization, Pose Estimation, and Gender Recognition", IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI), December – 2017, pp. 121 - 135.
[15] Mohamed Loey, Gunasekaran Manogaran, Mohamed Hamed N Taha and Nour Eldeen M Khalifad, "A Hybrid Deep Transfer Learning Model with Machine Learning methods for Face Mask Detection in the era of the COVID19 Pandemic", Measurement, Jan - 2021, Vol.178, ArtNo.108288.

