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Social Distancing and Face Mask Detection using Yolov4 and CNN

Vedashree Bhat[1], Atharva Jadhav[2], Prajwal Desai[3], Siddhesh More[4], Prof. D.M Ujlambkar[5]

[1,2,3,4]UG Students, Dept. of Computer Engineering, AISSMSCOE, Pune, India
[5]Professor, Dept. of Computer Engineering, AISSMSCOE, Pune, India

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ABSTRACT

Social distancing and wearing face mask is the urge of year 2021 due the spread of coronavirus . Social distancing is one of the possible approach with which we can fight this pandemic. Motivated by this notion, the ground plan proposes a deep knowledge based framework for automating the task of covering social distancing using surveillance tape. We proposed COVID-19 Social Distancing and face mask detector system which is a onestage detector, which consists of a machine learning module for calculating the distance among the different classes,and a CNN model for detecting whether a person is wearing mask or not.YOLO stands for You Only Look Once, this algorithm is employed for Object Finding also as Object Tracking. After we perform recognizing with YOLOv4, we calculate the Euclidean distance between all the detected boxes and filter out or flag the people that are closest to every other indicating that they're at risk. The high the Euclidean distance score would be the better model is within the spotting of objects.For the mask detection a CNN model will be made using Deep learning and OpenCV. Predictive Analysis on the static images as well as in the videos to detect face masks will be done. In addition, the system will use existing IP cameras(web cameras) combined with computer vision to detect people without Mask and violence of social distancing.

Keywords: Machine learning, Object detection, Yolov4, Open CV, Face mask detection, Social distance detection

I. INTRODUCTION

The year 2020, has brought us a lot of challenges, especially in the working sectors. Many establishments are switching to a work from home-based environment[3].The only way to prevent the spread of covid-19 that was suggested by WHO (World Health Organization) was that,people around the world should wear masks to prevent the risk of getting infected by novel coronavirus which would also help in preventing its transmission and also people should maintain social distance of at least 3m among each other to prevent the spread of virus[6].Though government announced lockdown and started taking preventing measures then to people were just carelessly gathering together which led to result of 2nd wave in month of April 2021,and it was a very serious wave.Talking about the current situation of India,though it is good to hear that patients are reducing day by day and recovery rate has also increased due to vaccinations but because of this again people have started gathering and rushing in market as it was earlier and also have forgot to wear mask.Because of all this situation there is again chance that a 3rd wave can hit India as it hit to other countries too.

So this problem can be easily handled and we stop 3rd wave coming to India if we do something by which people will maintain proper distance between them and will also wear masks for their safety.

Thus the goal of this project is to fight against the corona-virus.As social distancing and wearing masks has proven to be a very effective measure to slow down the spread of the disease,thus this can be achieved by providing the monitoring system that keeps track of the peoples by using existing IP cameras and CCTV cameras combined with Computer Vision to detect people without Mask and not following rule of social distancing[1].This research-based on Face Mask Detection & Social Distancing uses computer vision to understand various aspects of the images or videos based on frames that would be provided as an input to the algorithms.*The algorithm used will be YOLO4 which is an Object detection algorithm in machine learning and it will be used to detect people in a frame and check for social distancing by calculating the Euclidean distance between the centroids of the detected boxes[5].*The basic concept behind this is to find the bounding boxes related to the classes, the classes could be anything that would range from a Dog to Car depending on the datasets.*Now for the mask detection a CNN model will be made using Deep learning and OpenCV.*

Predictive Analysis on the static images as well as in the videos to detect face masks will be done. Thus this social

distancing and face mask detector will provide an additional easy-to-access tool during the most delicate phase of the fight against the pandemic.

In consecutive sections of our paper goals and objective, literature survey ,system architecture, and methodology of social distance detector and face mask detector is discussed and research is further concluded with acknowledgement and references.

II. GOALS AND OBJECTIVES

Primary goals and objectives behind the development of this system are to, prevent the spread of corona virus by promoting the use of face masks with the help of effective technology to detect the face mask,help to take necessary precautions and maintain social distance for the safety of society,ensure safety of people,contribute in less count of daily increasing covid-19 patients.

III. LITERATURE SURVEY

This paper focuses on a detector of social distance and face mask built using machine learning module and a CNN model.It uses Yolov4 algorithm which is an object detection algorithm.Using this algorithm the people will be detected in different boxes.After they are detected we calculate the Euclidean distance between all the detected boxes and filter out or flag the people that are closest to every other indicating that they're at risk. The high the Euclidean distance score would be the better model is within the spotting of objects[2].While the other detector for face mask a CNN model will be made. A convolutional neural network (CNN) is a type of artificial neural network used in image recognition and processing that is specifically designed to process pixel data[3].Because of this model the person wearing a mask will be declared as safe and will be in green box,while the other will be in red box. In recent years object detection techniques using deep models are potentially more capable than shallow models in handling complex tasks and they have achieved great progress in computer vision.

BhavikLimbasiya and ChinmayRaut [1] presented a research paper that used Yolov3 for social and distancing and it did not included the face mask detector. However,the Yolov3 architecture has residual skip connections and an upsampling layer. The key novelty is this algorithm is that it makes its detections at three different scales.While Yolov4 is an improvement on the Yolov3 algorithm by having an improvement in the mean average precision(MAP) by as much as 10% and the number of frames per second by 12%. The Yolov4 architecture has 4 distinct blocks the backbone, the neck, the dense prediction, and the sparse prediction.Thus the use of Yolov4 helps us because YOLOv4 is twice as fast as EfficientDet (an object detection model created by the Google brain team) with comparable performance. In addition, AP (Average Precision) and FPS (Frames Per Second) increased by 10% and 12% compared to YOLOv3.

Vishwesh M S, Nikhil D K [2] used R-CNN algorithm for object detection. Accuracy of R-CNN algorithm comes at the cost of time complexity. It is significantly slower than the likes of YOLOv4.Despite improvements over RCNN and Fast RCNN, it still requires multiple passes over a single image unlike YOLO. YOLO's performance is better than Mask R-CNN.Yolo shown 98.96% and 96.73% precision, and 80.93% and 75.43% recall, respectively. While R-CNN experimental result revealed with mean average precision of 80.12% and 73.39%, respectively.

GokulSudheesh Kumar and Sujala D. Shetty [3] used single shot detector algorithm for social distancing and a CNN model using tensorflow for face mask detection.But the single shot detector failed to detect the small objects(i.e the people who were at a large distance).Single shot detector consists of shallow layer which may not generate enough high level features to do prediction for small objects.Therefore, SSD did worse for smaller objects than bigger objects.The need of complex data augmentation also suggests it needs a large number of data to train.Also we are using Euclidean distance formulae for calculating distance between object here object means persons, this method was accuracy of 93%.While this application proposed a medium to detect the distance of two persons applying smart phone based thermal rear camera that works in poor light environment. This method was as obtained 81% accuracy which is quite less.

AishwaryaRadhakrishan Nair and Amol D Potgantwar [4] proposed a progressive approach for less time consumption using viola jones algorithm to detect the face and wheter the face consists of mask or not.It was an example of supervised learning but it only worked well with the front, upright face.Also they only used CUDA which is a GPU programming tool for NVIDIA GPUs. Compared to OpenCL, which is used in several computed components, it is unable to resolve the imbalanced workload issue experienced during the implementation of the viola jones face detection algorithm in GPUs.
Shuang Li, XinNing, Lina Yu, Liping Zhang, Xiaoli Dong, Yuan Shi, Wei He [5] proposed "Multi-angle Head Pose

Classification when Wearing the Mask for Face Recognition under the COVID-19 Coronavirus Epidemic," .Head pose classification is a preprocessing technique applied prior to the face recognition because it requires a front facing input image. Hence, a new method called HGL is proposed which combines H-channel of HSV (Hue Saturation Vue) with grayscale image of face. CNN is used to train this model for feature extraction. This approach is advantageous to others in terms of accuracy.

"Study of Masked Face Detection Approach in Video Analytics" [6] by GayatriDeore, Ramakrishna Bodhula, Dr. VishwasUdpikar, Prof. Vidya More. This paper focuses mainly on security using video analytics which improves video surveillance systems and hence it saves human resources and performance of such systems is also improved. Calculating distance from camera, line detection, facial part detection, and eye detection are the four steps in the masked face detection technique used in this paper. These steps are useful in finding if a person is wearing a mask or not. Here line detection and eye detection can give some false detections as their detection is not that accurate in poor resolution images.

"Adversarial Examples – Security Threats to COVID-19 Deep Learning Systems in Medical IoT Devices" [7] by Md. AbdurRahman, M. ShamimHossain, Nabil A. Alrajeh, FawazAlsolami. The study looked at nine COVID-19 deep learning applications that can diagnose the virus quickly. They put six open-source applications to the test and watched the models closely to create adversarial cases for each type and pinpoint the flaws in model. The vulnerability of existing DL applications to AE attacks has been realized, necessitating additional research, attention, and installation of proper security mechanisms, safeguards, and controls before these applications are employed in real-world healthcare settings.

So, Object detector models are been consistently developed with the likes of new algorithm yolov4 as compared to their predecessors like yolov3 and many others.Yolov3 algorithm resulted having lesser mean average precision by as much as 10% and the number of frames per second by 12% as compared to Yolov4.All of thepapers mentioned here have used an yolov3 and R-CNN algorithm but with object detection has been more accurate with the enhancement in the algorithm with the introduction of yolov4 which we will discuss in this paper.

IV. SYSTEM ARCHITECTURE

a)For social distance detector

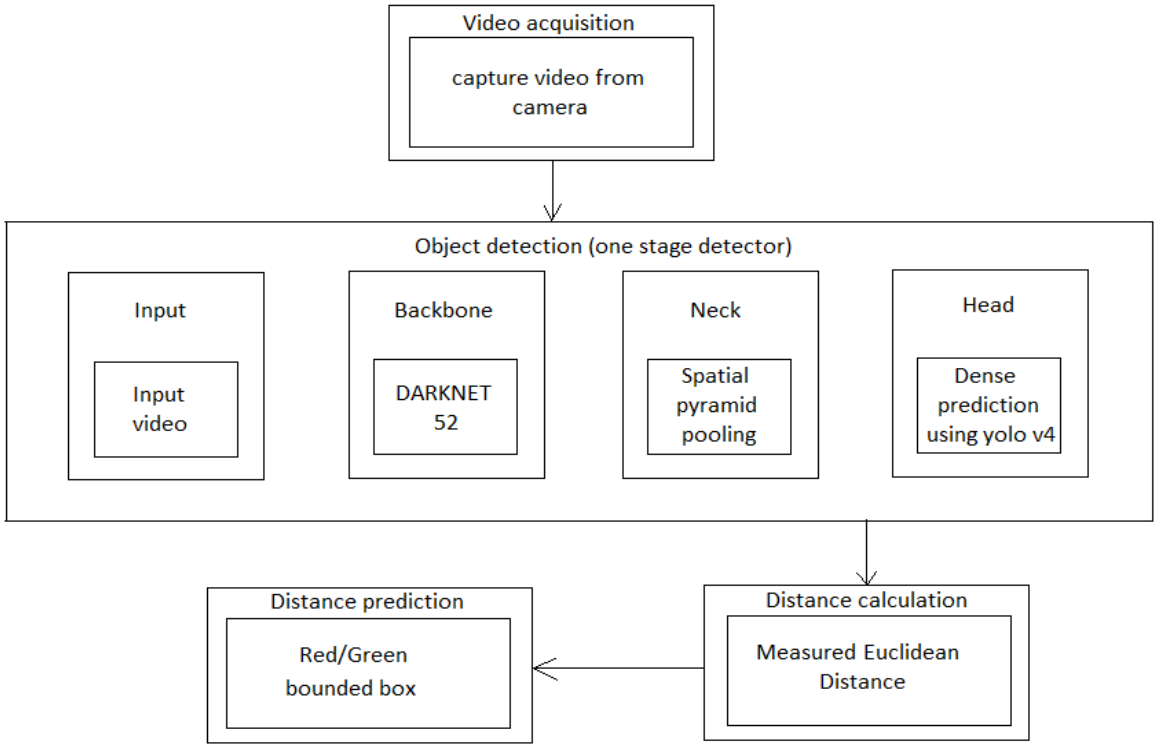

Fig – 1 : Social Distance Detector Architecture

In social distance detector architecture there are total 4 steps,Video Acquisition,Object detection(one stage detector),distance calculation,distance prediction which predicts the result of safety.In first step Camera will be capturing a video and acquisition means firstly capturing a video and then sending it to local storage.After that whole architecture of one stage detector comes into picture.A one stage detector consists of input video,backbone(Darknet 52),neck(spatial pyramid pooling) and head(yolov4).Input consists of input video which we give,backbone refers to the network that takes as an input your image and extract the feature map.The neck(spp) removes the fixed-size constraint of the network i.e CNN does not require a fixed-length output,which are then fed into fully connected layers,and finally the role of head in case of a one stage detector is to perform dense prediction.The dense prediction is the final prediction which is composed of a vector containing the coordinates of predicted bounding box(center,height,width)the confidence score of prediction and the label.

b) For face mask detector

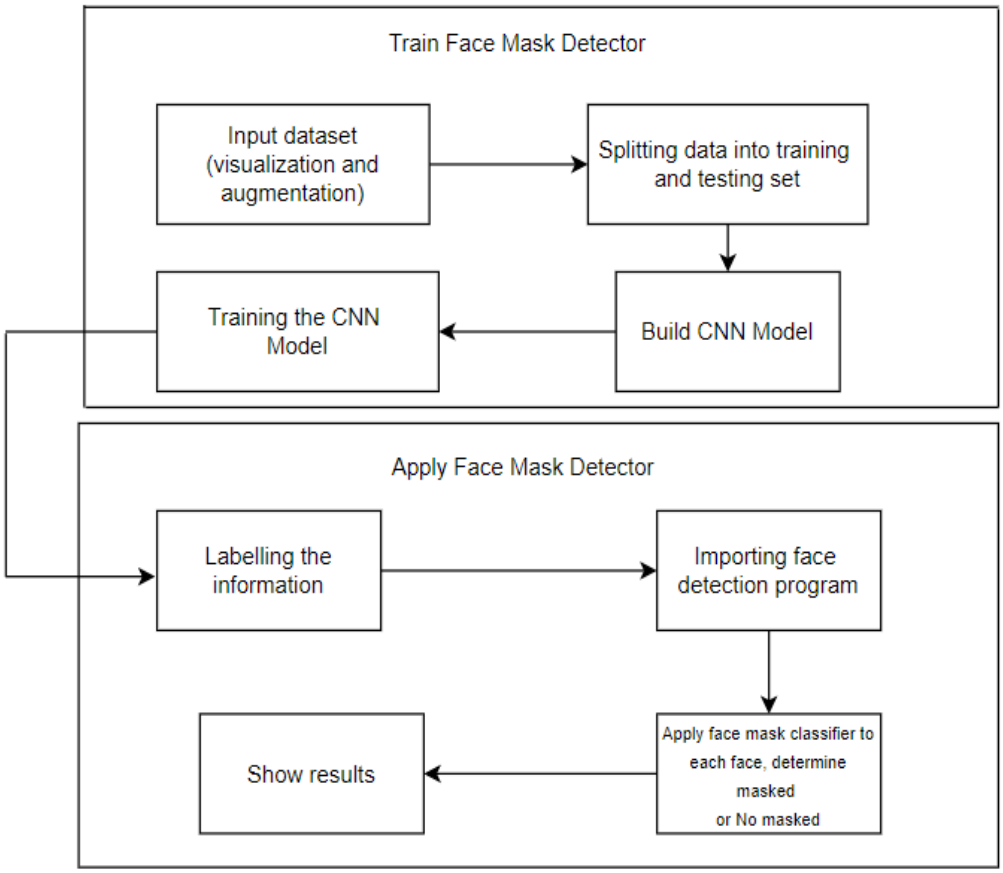

Fig – 2: Face Mask Detector Architecture

The face mask detection architecture is divided into two main parts:-

1)When mask detector will be trained
2)When mask detector will be applied

In this firstly,data visualization and data augmentation will take place.Visualization visualizes the total number of images in the dataset in both categories and augmentation will augment the dataset to include more number of images for our training.In next step data will be splitted into training set which will contain the images on which our model will be tested.Then a sequential CNN model is built.The next step is training the built CNN model and it is the main step where we fit our images in training set and test set to our sequential model,which will be built using Keras library.Then labeling of information will be done with the probabilities 0 and 1.

After this we intend to use it to detect if we are wearing a face mask using our IP cameras.

V. METHODOLOGY

A. Social Distance Detector

The methodology works here is using algorithm used for object detection as well as object tracking. In this figure image layers which are responsible for taking the inputs that would be passed to further layers,input can be any image or video depending upon the cases.Along the input layer comes the darknet architecture,this is an open-source neural network for which framework is created and this framework features Yolo for object detection and object tracking.

Further,the figure consists of the flattered layer which is densely connected with the convolutional layer which is also densely connected to pass the data from each node to other nodes in this architecture.Similarly,this is posted to the output layer which gives 4-port values,there 4 ports describe the predicted value for the bounding box,denoted by x,y,w,h along with the object detection score plus the probability of the predicted class.This Yolo is part of the one-shot object detector family which is accurate and fast.

B. Face Mask Detector

The methodology works here is to build a CNN model using TensorFlow to detect if you are wearing a face mask by using the webcam of your PC.The detection of face and telling whether a person is wearing a mask or not is done in 7 main steps,they include :-

1. Data Visualization :- In the first step, the total number of images in our dataset in both categories i.e person with and without masks are visualized.

2. Data Augmentation :- In the next step, we augment our dataset to include more number of images for our training. In this step of data augmentation, we rotate and flip each of the images in our dataset.

3. Building the model :- In the next step, we build our Sequential CNN model with various layers.

4. Training the CNN model :- This step is the main step where we fit our images in the training set and the test set to our Sequential model .

5. Labeling the information :- After building the model, we label two probabilities for our results,'0' as without mask and '1' as with mask.

6. Importing the face mask detection program :- After this, we intend to detect if we are wearing a face mask using our PC's webcam.

7. Detecting the faces with and without masks :- In the last step, we use the OpenCV library to run an infinite loop to use our web camera in which we detect the face with and without masks.

VI. CONCLUSION

The study of this research is to understand the social distancing & face mask detection for the events of Covid-19.The social distancing will be done using Yolov4 algorithm which is a machine learning module for calculating the distance among the different classes. Here the classes include different people on streets while the face mask detection will be done by creating a CNN model using OpenCV which helps to identify whether people are wearing mask or not using red box- indicating a person is not wearing a mask and a green box – indicating person is not wearing a mask

The research work is helpful in new normal social and industrial life.The researchers could study prominent ML algorithms and suggested usability of CNN and Yolov4 as the simplest and appropriate methods to build an application on.Due to strong library support and being apt language for machine learning,Python language can be used for implementation.

A web application will be created using the above mentioned methodology that will help the end-user to check the whether the people are following the covid safety norms in order to prevent from infections .A social distance detector and a face mask detector will thus help the cause of reduce in number of covid-19 patients at some extend.

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