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Automatic Detection of Social Distance Violation from Real Time Web Camera Using Open CV with Deep Learning

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ABSTRACT

In current days there is a great demand for social distancing due to covid19 pandemic. As we all know lot of survey reports tell that by maintaining proper social distancing one can able to reduce the spread of covid 19.In this current article, we presents a methodology for social distancing detection using OpenCV with deep learning to identify the distance between people to mitigate the impact of this coronavirus pandemic. The proposed model was designed to alert people to maintain a safe distance with each other by evaluating a video feed. In order to test the model, we try to collect video sequences collected from CCTV cameras and then try to apply some pre-trained CNN models on that input video. Here we try to apply the YOLOv3 algorithm for identifying the persons who are walking on the road.Once the pedestrian detection is completed, now the video file is converted into a top-down view for distance measurement from the 2D plane. If the distance between any pair of people is less than expected length then it is marked in red color frame and identified as social distance violation is clearly seen. If the distance between any pair of people seems more than the expected distance, than those pair of pedestrians are marked with blue or green color. In order to test the accuracy of our current model,we try to test the model on a pre-recorded video of pedestrians walking on the street. The result shows that the proposed method is able to determine the social distancing measures between multiple people in the video. This same model can be deployed as a tool in future for real time applications to detect the social distance violations.

Key Words: Deep Learning, Yolov3, Video Sequences, Pedestrians, Object Detection, Social Distancing Detection

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ISSN: 0011-9342 | Year 2021
Issue: 8 | Pages: 11297-11307

1. INTRODUCTION

In December 2019, the novel Covid showed up in the Wuhan city of China [1] and it is officially noted for the world health organization (W.H.O) on 31st December 2019. This covid infection made a worldwide danger and was named as COVID-19 by W.H.O on eleventh February 2020 [1]. This is formed by group of infections including SARS, ARDS and lot more. The WHO announced officially that this infection is giving flare-up as a general wellbeing crisis [2] and this is mainly spread from one infected person to other person through air when an individual is staying within short distance to the infected one. The infection can spread or communicate between people under different ways, which are presently indistinct and un-predictable. One among the major cause of covid 19 spread is lack of social distancing between one another[3].

The government is taking a lot of effort in communicating the individuals about the importance of wearing mask[4] and maintains social distance in public places. For example if one person is contaminated with covid 19 virus ,the infected person shows indications inside 2–14 days, contingent upon the brooding time of infected person. For some infected persons this can be found in very early stage and for some immune persons it will be identified somewhat late. Hence taking proper precautions from one another will help the individual to avoid this spread of covid 19[5].

From the figure 1, we can clearly identify there are several persons present and all are identified with black color icon. If any person is entered into the group with covid infection, if the users are not maintaining any social distance among each other without any safety measurements.

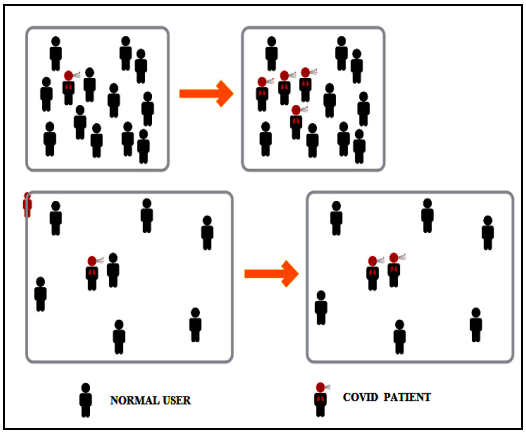


Figure 1. Represent the Spread of COVID 19 due to Social Distance Violation

Then we can see the other users who are very close and nearer to the infected user gets affected and they will also suffer with this covid19 infection. Hence this is one of the main reason why social distance violation leads to serious situation in present days. This motivated me

ISSN: 0011-9342 | Year 2021
Issue: 8 | Pages: 11297-11307

to design the current application in which social distancing takes very important step in preventing the spread of corona virus.

2. LITERATURE SURVEY

Literature survey is that the most vital step in the software development process. Before developing the new application or model, it's necessary to work out the time factor, economy,and company strength. Once all these factors are confirmed and got approval then we can start building the application. The literature survey is one that mainly deals with all the previous work which is done by several users and what are the advantages and limitations of those previous models. This literature survey is mainly used for identifying the list of resources to construct this proposed application.

MOTIVATION

1) An article on social distancing prediction using DL Model

Authors: Yew Cheong Hou

In this paper, the author concentrated on social distancing detection by using deep learning model. This paper presents a methodology for social distancing detection using deep learning to find out the distance between pair of people who stay very closer and then try to find out how many are following social distancing and how many are not obeying social distancing[6].

2) Monitoring social distancing through human detection for preventing / reducing COVID spread.

Authors: Mohd. Aquib Ansari

In this paper, the author aim to develop a framework that can track humans continuously and then monitor the social distancing followed or not. In order to prove this objective, the author developed a social distance monitoring algorithm using object detection method. Here, we try to apply CNN based object detection method to detect the human presence. The output is calculated based on the distance identified between two individuals[7].

3) Global Disaster prevention using Social Distancing

Authors: Gwanggil Jeon and Sadia Din

In this paper, the author aim to develop a framework to prevent the global disaster with its deadly spreading. As we all know there is no effective remedies present in the real world for stopping the spread of covid disease, a very great loss is occurred due to many viruses. In the current situation, as there is no complete remedy or solution for this covid, therefore, social distancing[8] is thought to be an adequate precaution (norm) against the spread of the pandemic virus. This

ISSN: 0011-9342 | Year 2021
Issue: 8 | Pages: 11297-11307

covid disease spread can be minimized by avoiding physical contact among one another and there should be proper care between one another. The purpose of this work is, therefore, to provide a deep learning platform for social distance tracking using an overhead perspective. If we use deep learning platform, we can able to apply object detection methods and can find out best way to identify social distancing.

3. EXISTING SYSTEM AND ITS LIMITATIONS

In the existing system there was no proper method to identify the person who is following social distancing with minimum 3 to 6 feet distance. All the existing approaches are manual approaches and hence there is no proper method which can guarantee prevention of social distance violation. The following are the main limitations in the existing system.

LIMITATION OF EXISTING SYSTEM

1) Generally all the existing methods use manual approach for identifying social distancing.
2) All the existing methods try to use either Machine Learning classification models to identify those who are following social distancing and those who are not following social distancing.
3) All the existing approaches are failed in identifying the distance between either two static or dynamic objects accurately and efficiently.
4) It is not accurate
5) Existing methods are not effective and efficient.
6) All the existing methods are almost operated by using manual method with the help of lot of man power. There is no single method which can give accurate results by avoiding manual efforts.

4. PROPOSED SYSTEM AND ITS ADVANTAGES

In order to test the model, we try to collect video sequences collected from CCTV cameras and then try to apply some pre-trained CNN models on that input video. Here we try to apply the YOLOv3 algorithm for identifying the persons who are walking on the road.Once the pedestrian detection is completed, now the video file is converted into a top-down view for distance measurement from the 2D plane. If the distance between any pair of people is less than expected length then it is marked in red color frame and identified as social distance violation is clearly seen. If the distance between any pair of people seems more than the expected distance, than those pair of pedestrians are marked with blue or green color.

Design Engineering

ISSN: 0011-9342 | Year 2021
Issue: 8 | Pages: 11297-11307

ADVANTAGES OF THE PROPOSED SYSTEM

The following are the some of the advantages of using proposed system, they are as follows:

1) By using proposed deep learning model we can identify the objects easily and can find out the distance between two or multiple objects accurately.

2) In this proposed model,we can able to check social distance between static objects and dynamic objects.

3) This is very efficient and effective.

4) It is very accurate

5) Here we used YOLOv3 algorithm for identifying the persons who are walking on the road

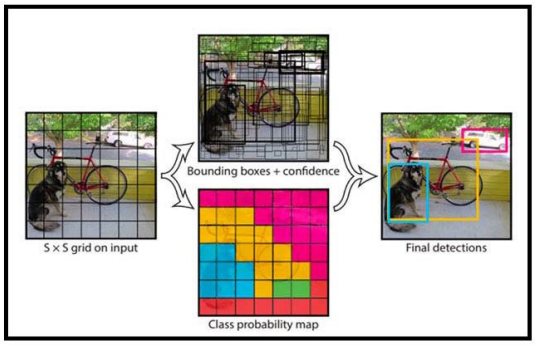


Figure 2. Represent the proposed YOLOv3 Model for Object Detection

5. PROPOSED DEEP LEARNING MODEL

The proposed deep learning **CNN** model **YOLO V3** is developed in order to object detection and finding out the distance between two or multiple objects which follow social distance or not.

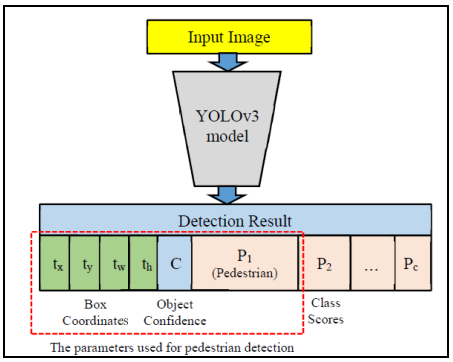


Figure 3. Represent the Architecture Flow of YOLOv3 Model for Object Detection in Social Distance Violation

ISSN: 0011-9342 | Year 2021
Issue: 8 | Pages: 11297-11307

From the above figure 3, we can clearly identify the object detection by using pre-trained CNN model such as YoloV3[9]-[12].This is one of the best pre-trained models used for object detection and classification. Initially we try to load video sequence as input and from that video sequence we will collect some sort of frames/images captured from that video file. Once frames are gathered now we try to apply those frames as input for the YOLO v3 model and then check the detection result. Here we try to find out the box co-ordinates and object confidence of that detected object. Based on these values probability is calculated and we try to identify how many pedestrians are present within the frame.

Box co-ordinates Distance

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Here from the above equation we can clearly identify the distance between two pedestrians either in static or dynamic. The value is assigned or labeled with variable ‘d’.

The boundary box is labeled with two distinct colors such as red for social distance violation and green box for normal users who are far away from each other.

$$c = \begin{cases} red & d < t \\ green & d \geq t \end{cases}$$

These are labeled with variable ‘c’ and of distance is less than expected threshold value. Then those persons are marked with red color box and if the distance ‘d’ is greater than or equal to threshold value then they are marked with green color box in the boundary detection[13].

6. PROPOSED ARCHITECTURE

Implementation is the stage where the theoretical design is converted into programmatically manner. In this stage we will divide the application into a number of modules and then coded for deployment. The front end of the application takes Google Collaboratory and as a Back-End Data base we try to load object detection and boundary classification techniques from UCI machine learning repository. Here we are using Python as Programming Language to implement the current application. The application is divided mainly into following 5 modules. They are as follows:

1. Import Necessary Libraries
2. Load Dataset Module
3. Data Pre-Processing
4. Train the Model Using Yolo V3 Algorithm

ISSN: 0011-9342 | Year 2021
Issue: 8 | Pages: 11297-11307

5. Detect Social Distance Violation

Now let us discuss about each and every module in detail as follows:

IMPORT NECESSARY LIBRARIES

In this module initially we need to import all the necessary libraries which are required for building the model. Here we try to use all the libraries which are used to convert the data into meaningful manner. Here the data is divided into numerical values which are easily identified by the system, hence we try to import numpy module and for loading the categorical data and deploy the neural networks we try to import CNN packages[14].

LOAD DATASET MODULE

In this module the we try to load the dataset which is downloaded or collected from UCI repository. Here we store the dataset which contains several images which are classified very clearly level by level and then try to find out which image is matched with humans or living beings and which is non-living object. Here in our current application we try to use pedestrians as main source of input in order to check whether they are maintaining social distance or not[15]-[18].

DATA PRE-PROCESSING MODULE

Here we try to pre-process the input image or frame which is collected from a sample CCTV video sequence and then try to pre-process that images.

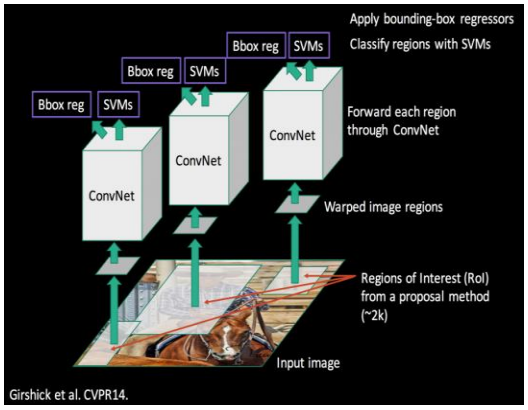


Figure 4. Represent the Architecture Flow of Data Pre-Processing

Preprocessing input raw image in the context of face recognition involves acquiring the face region and standardizing images in a format compatible with the CNN architecture employed. Each CNN has a different input size requirement.

ISSN: 0011-9342 | Year 2021
Issue: 8 | Pages: 11297-11307

TRAIN THE MODEL USING YOLO V2 MODEL

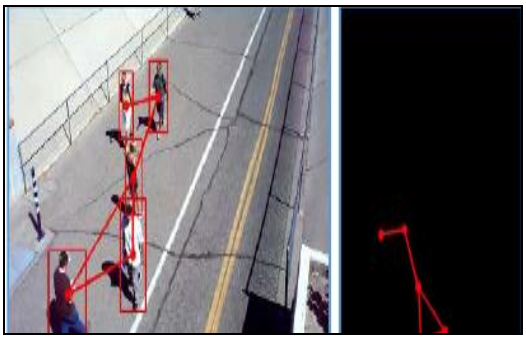
Here we try to train the current model on given dataset using CNN model and then try to identify or classify the objects from the sample video sequence. Once if any object is captured from web cam,now it is cross check with pre-defined images which are present in the Yolo V2 dataset and then finally try to classify the best one.

DETECT SOCIAL DISTANCE VIOLATION MODULE

In this module we try to test the accuracy of our current model, by taking some pre-recorded video of pedestrians walking on the street. The proposed work tries to define the distance between the multiple people who are walking on that road. The proposed model in future can be used for deploying some more applications. This same model can be deployed as a tool in future for real time applications to detect the social distance violations.

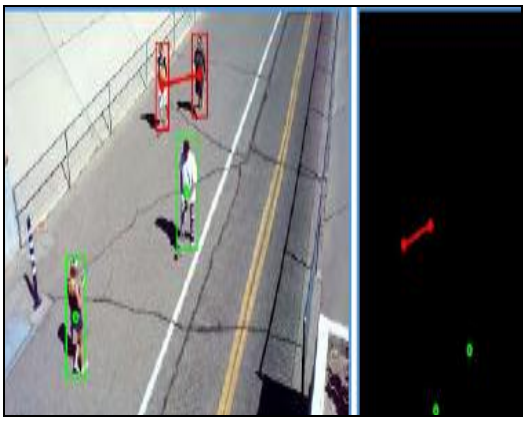
7. EXPERIMENTAL RESULTS

For showing the performance of our proposed application, we try to deploy the current application using Python as programming language.First we used below dataset to train deep learning CNN model.



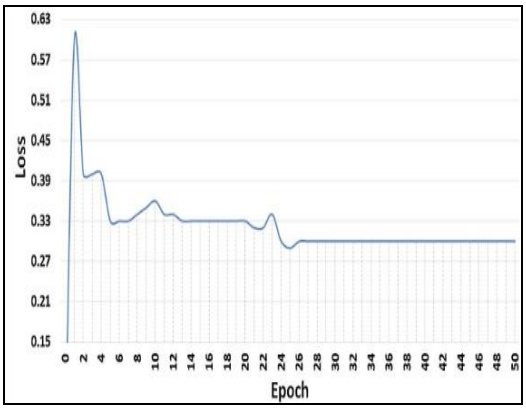
In the above window we can clearly see there are almost 5 pedestrians who walk on the road and we can see our proposed model identified all the 5 are very closely each other and hence everyone is marked with red color boxes and the corresponding distance between each other is marked separately in the beside of that sample input.

ISSN: 0011-9342 | Year 2021
Issue: 8 | Pages: 11297-11307

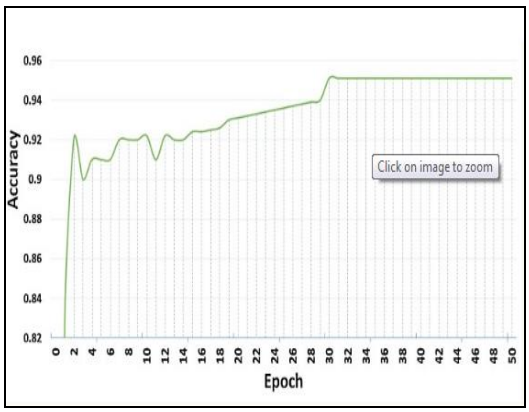


In the above window we can clearly see there are almost 4 pedestrians who walk on the road and we can see our proposed model identified that two are close to each other and two are far away from each other. Hence our proposed model tries to mark the closely associated users with green color and far away users with red color.

TRAINING LOSS WITH OVERHEAD



TRAINING ACCURACY WITH OVERHEAD



ISSN: 0011-9342 | Year 2021
Issue: 8 | Pages: 11297-11307

From the two above graphs we can able to identify the training loss as well as training accuracy of input data by using YoloV2 Model.

8. CONCLUSION

In this proposed work, we for the first time developed a new method for social distancing using Open computer vision with DL model. By using the CV, one can easily identify objects and also calculate the distance between two or multiple objects which are present within the input image. The proposed method was verified and tested by taking video as sample input for training the mode. For this we need to collect only video sequence which is collected from CCTV camera in which a group of pedestrians walking on a street. By conducting several experiments on our proposed model, we finally came to an conclusion that our proposed method is very good in identifying the social distance violation very efficiently and accurately. The same model can be applied on some other working environments such as offices, schools, hospitals and so on. In future we want to extend the same work by using some advanced models for by reducing the time and increase the accuracy of current model.

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ISSN: 0011-9342 | Year 2021
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