

**A Project Report**  
on  
**Social Distancing Detector**

*Submitted in partial fulfillment of the  
requirement for the award of the degree of*

**Bachelor of Technology in Computer Science and  
Engineering**



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**CANDIDATE'S DECLARATION**

I/We hereby certify that the work which is being presented in the project, entitled “**SOCIAL DISTANCING DETECTOR**” in partial fulfillment of the requirements for the award of the **BACHELOR OF TECHNOLOGY IN COMPUTER SCIENCE AND ENGINEERING** submitted in the **School of Computing Science and Engineering** of Galgotias University, Greater Noida, is an original work carried out during the period of **JULY-2021 to DECEMBER-2021**, under the supervision of **Mr. Abhay Kumar Assistant Professor Department of Computer Science and Engineering** of School of Computing Science and Engineering, Galgotias University, Greater Noida.

The matter presented in the thesis/project/dissertation has not been submitted by me/us for the award of any other degree of this or any other places.

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## **CERTIFICATE**

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## **ABSTRACT**

As we realize that social distancing is a way used to govern the unfold of contagious diseases. As the call suggests, social distancing means that humans must bodily distance themselves from one another, decreasing near contact, and thereby decreasing the unfold of a contagious disease (consisting of coronavirus). Social distancing is arguably the simplest non-pharmaceutical manner to save you the unfold of a disease — by definition, if humans aren't near together, they can't unfold germs. social distancing means that humans must bodily distance themselves from one another, decreasing near contact, and thereby decreasing the unfold of a contagious disease (consisting of coronavirus). This paper provides a technique for social distance detection the use of deep getting to know fashions and algorithms together with YOLO and CNN. Deep getting to know is one of these technology that have substantially improved the general enjoy of the era that people use. Deep getting to know has added a whole lot of adjustments from self-pushed motors made by Tesla to the smallest item detection model. Deep getting to know, synthetic intelligence and gadget getting to know offer a manner so as to positioned matters to use. Pixel distances will be used in our OpenCV social distancing detector. There are three types of object detection that deep learning-based object detection can identify. You'll come across the following detectors: NN and its derivatives, such as R-CNN, Fast R- CNN, and Faster R- CNN, CNN (R) We will also see Detector for a single shot (SSDs), YOLO (You Only Look Once) - YOLO can identify 9,000 different classes with a 95% accuracy rate. Isn't exactly what we'd like. Detect all individuals (and only people) in a video stream using object detection. The cause of this paper is so to implement real time object detection to detect social distancing.

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## Acronyms

CNN	Convolution Neural Network
R-CNN	Region Based Convolution Neural Network
FAST R-CNN	Fast Region Based Convolution Neural Network
FASTER R-CNN	Faster Region Based Convolution Neural Network
YOLO	You Only Look Once
HOG	Histogram of Oriented Gradients
SSD	Single Shot Detector
SPP	Spatial pyramid pooling
R - FCN	Region – based fully convolutional network

# CHAPTER-1

## Introduction

### 1.1 Introduction

Deep mastering is part or subset of device mastering below a website of synthetic intelligence this is able to mastering data from unsupervised data. Deep mastering is likewise referred to as deep neural or deep neural network. Deep mastering uses both established and unstructured data. Deep mastering is utilized in digital assistants, driverless cars, and face recognition. Social distancing, one of the maximum vital regulations to address the worldwide pandemic, COVID-19. The use of era can ease the ability to preserve and modify human beings into following social distancing. One of the most important reasons wherein COVID spreads is touch and if human beings can keep away from touch it'll reduce down the upward thrust of COVID-19 and therefore shop lives. To be capable of use era and assistance is a boon. The goal of this paper is to provide using actual time item detection in actual global scenarios. This paper offers a view in order to use the YOLOv3 for the detection of actual time gadgets and calculate the gap among the detected bounding packing containers to discover the violation with inside the social distance. Social distancing is truly the most straightforward method to save you the spreading of communicable disease, with this belief, inside the historical past of December 2019.

Since the unconventional coronavirus pandemic began, numerous international locations are taking the help of era based totally answers in several capacities to include the herbal event. numerous evolved international locations, in addition to India and Republic of Korea, for example, making use of GPS to hint the moves of the suspected or inflamed humans to observe any hazard in their exposure amongst healthful individuals. In India, the govt. is exploiting the Arogya Setu

App, that labored with the help of GPS and Bluetooth to locate the presence of COVID-19 sufferers inside the locality space. It moreover enables others to live a secure distance from the inflamed person. On the alternative hand, a few enforcement departments are exploiting drones and opportunity police paintings cameras to word mass gatherings of individuals, and taking restrictive movements to disperse the group.

Within the final decade, convolutional neural networks (CNN), place-primarily based totally CNN and faster place-primarily based totally CNN used place notion strategies to give you the objectness rating earlier than its class and later generates the bounding packing containers spherical the object of hobby for visualization and opportunity carried out arithmetic analysis. Though those approaches are economical, but they go through in phrases of large education time necessities. Since those CNN based techniques make use of class, another technique YOLO considers a regression based method to dimensionally separate the bounding packing containers and interpret their class chances.

## **1.2 Object Detection**

First of all, what's item recognition? Object Recognition is the time period which refers back to the imaginative and prescient of the pc or artificial version which identifies gadgets in virtual photographs. Image category entails distinguishing the magnificence of 1 item in a photograph. Object localization is regarding or figuring out one or extra gadgets in a photograph and making that photograph component stand out for identity through drawing containers across the images.

The three computer vision tasks:

1. Image classification
2. Object Localization

### 3. Object Detection

#### **1.2.1 Image Classification-**

It is predicting the which elegance or kind the item in a photograph falls into

1. Input- a virtual photograph is supplied with the item for detection, consisting of a picture of a person.
2. Output- A label is mapped to the photograph.

#### **1.2.2 Object Localization –**

The item with inside the photograph is positioned after which made to face out or diagnosed via way of means of creating a field round the item.

1. Input- a photograph is supplied with one or extra identifiable items, like a picture.
2. Output- one or extra bounding packing containers

#### **1.2.3 Object detection –**

It is finding the photos with the bounding field and the kinds of the items positioned with inside the photograph.

1. Input- An photograph which includes one or extra identifiable items.
2. Output- one or extra bounding packing containers and labels for every bounding field.

### **1.3 Algorithm for Object Recognition:**

Object Recognition is the term which refers to the vision of the computer or artificial model which identifies objects in digital photographs

### **1.3.1 HOG (Histogram of orientated Gradients) feature Extractor and SVM (Support Vector Machine)**

Before the age of deep learning, it absolutely was a progressive methodology for object detection. It takes bar graph descriptors of each positive (those pictures that contain objects) and negative (that image that doesn't contain objects) samples and trains our SVM model on it.

### **1.3.2 Bag of options model:**

Alternatively, like a bag of phrases considers file as companion order less collection of phrases, this technique conjointly represents a photo as companion order less collection of photograph options. samples of this are SIFT, MSER, etc.

### **1.3.3 Viola-Jones algorithmic rule:**

This set of rules is broadly used for face detection in the picture or length. It performs Haar-like characteristic extraction from the picture. This generates an oversized variety of alternatives. These alternatives are then surpassed right into a boosting classifier. This generates a cascade of the boosted classifier to carry out picture detection. An image should byskip to each of the classifiers to get a positive (face found) result. The gain of Viola-Jones is that it is a detection time of FPS which is probably applied in a length face reputation system.

## **1.4 You Look Only Once**

YOLO is one of the algorithms for actual time item detection. YOLO is one of the maximum recognized or powerful algorithms for actual time item detection.

There are some one of a kind algorithm for item detection which may be essentially divided into:

1. Algorithms primarily based totally on regression: The algorithms primarily based totally on regression use instructions and bounding packing containers for the image. The pleasant recognized algorithms for this department are YOLO and SSD.

2. Algorithms primarily based totally on classification: These algorithms are a chunk slower than the earlier ones due to the fact they first select reputable areas after which they classify those areas the usage of CNN. Some of the widely recognized algorithms primarily based totally on classification.

Why pick out YOLO over different algorithms? YOLO is extra famous than different algorithms due to the fact it may attain extra accuracy even as additionally going for walks in actual time.

**There are a lot of algorithms for object detection, to a name some of them are:**

**1. Fast R- CNN**

**2. Faster R- CNN**

**3. Histogram of oriented Gradients (HOG)**

**4. Region - based Convolutional Neural Networks (R- CNN)**

**5. Region - based Fully Convolutional Network (R - FCN)**

**6. Single Shot Detector (SSD)**

**7. Spatial Pyramid Pooling (SPP-net)**

## **1.5 Fast R – CNN:**

The Fast R-CNN is written in C++ and Python, this set of rules covers the risks related to R-CNN. Using R-CNN may be high-quality due to the truth that the schooling may be carried out in

an unmarried level which prevents multistage mission loss. It suppresses the usage of storing with inside the disk for caching.

## **1.6 Histogram of Oriented Gradients:**

The HOG set of rules makes use of strategies including the location of interest, sliding detection window and others for the detection of the items in photo processing. One of the benefits of the use of this set of rules is that it is easy and clean to understand.

## **1.7 Single Shot Detector:**

The technique that the set of rules single shot detector makes use of is the unmarried single neural network. The method of this set of rules is to split the output area of the bounding field into a fixed of bins with special factor ratio. Then a scaling technique scales the processing into the map location. Using SSD or Single Shot Detector may be superb as SSD gets rid of the technology and next pixel or characteristic degrees and combines all of the processed computation in an unmarried network.

## **1.8 YOLO algorithm amongst the various algorithms for Real Time Object Detection:**

YOLO set of rules among the diverse algorithms for Real Time Object Detection is used due to the diverse challenges:

1. Unknown range of gadgets: The trouble in item detection is that finding and classifying one-of-a-kind gadgets in an Image may be a hard task.

2. Object class and localization: They each upload to the trouble of Real Time Object detection as in Real Time Object Detection there may be a want to now no longer most effective

become aware of the item however additionally to decide wherein the item is based, this is its position, region etc.

3. The want for pace in Real Time Object detection: The algorithms which can be utilized in Real Time Object Detection want now no longer most effective accuracy however additionally they need to be speedy sufficient to hold up with the velocity of doing things.

## **1.9 Open CV**

OpenCV stands for OpenSource Computer Vision. OpenCV or OpenSource Computer Vision library holds an ocean of functions for Computer Vision. OpenCV or OpenSource Computer Vision incorporates greater than 2000 algorithms. The algorithms which might be found in OpenCV or OpenSource Computer Vision may be used to come across and apprehend one-of-a-kind gadgets which includes humans, their faces, hand gestures, actions etc. These algorithms may be used to song digital Digi-cam actions, produce 3d fashions of gadgets, discover pictures which might be comparable from a given dataset. With the assist of OpenCV it permits to study and write pictures, permits to seize videos, technique virtual pictures, carry out detection of features, come across gadgets which includes faces, eyes, cloth gadgets etc.

## **1.10 Approach for Social Distance Detection**

1. The human motion is detected with the assist of YOLO or You Look Only Once. The actions are then tracked in the frame.
2. The Euclidean distance is calculated among every character and suitable factors of hobbies are maintained by disregarding those now not in use and associating the brand new ones with the brand new distance.



3. The bins then display the crucial situations of whether or not the people are at threat or are safe.

4. This assignment is primarily based totally at the mixture of 3 components of Artificial intelligence which might be item detection, item monitoring and calculation of distance among the gadgets identified.

5. The major magnificence used right here on this assignment is the man or woman magnificence. YOLO has extra than 9000 instructions out of which one is the maximum required on this assignment.

## **CHAPTER-2**

### **Methodology**

The proposed device enables to make sure the protection of the humans at public locations via way of means of routinely tracking them whether or not they keep a secure social distance, and additionally via way of means of detecting whether or not or now no longer and man or woman wears face mask. This phase in short describes the answer structure and the way the proposed device will routinely capabilities in an automated way to save you the coronavirus spread. The proposed device makes use of a switch studying technique to overall performance optimization with a deep studying set of rules and a computer imaginative and prescient to routinely display humans in public locations with a digital digicam included with a raspberry pi4 and to locate humans with mask or no mask. We additionally do excellent tuning, that is some other shape of switch studying, extra effective than simply the function extraction.

#### **2.1 Network Video Recorder (NVR)**

In this manner digital digicam video feeds from the Network Video Recorder (NVR) are streamed the usage of RTSP after which those frames are transformed to grayscale to enhance pace and accuracy and are ship to the version for similarly processing interior raspberry pi4. We have used the MobileNetV2 structure because the center version for detection as MobileNetV2 offers a massive value benefit compared to the everyday 2D CNN version. The manner additionally includes the SSD MultiBox Detector, a neural community structure that has already been skilled on a huge series of pics which includes ImageNet and PascalVOC for excessive exceptional photo classification.

## 2.2 Distance between two persons

To calculate the space among people first the space of character from digital digicam is calculated the use of triangle similarity technique, we calculate perceived focal period of digital digicam, we assumed character distance  $D$  from digital digicam and character's actual top  $H=165\text{cms}$  and with SSD character detection pixel top  $P$  of the character is recognized the use of the bounding field coordinates. Using those values, the focal period of the digital digicam may be calculated the use of the formulation below:

$$F = (P \times D) / H$$

Then we use the real person's height  $H$ , the person's pixel height  $P$ , and the camera's focal length  $F$  to measure the person's distance from the camera. The distance from the camera can be determined using the following:

$$D1 = (H \times F) / P$$

## 2.3 Euclidean distance

Euclidean distance is measured among the mid-factor of the bounding containers of all detected individuals. By doing this, we were given  $x$  and  $y$  values, and those pixel values are transformed into centimeters. We have the  $x$ ,  $y$  and  $z$  (the person's distance from the camera) coordinates for every person in cms. The Euclidean distance among every person detected is calculated using  $(x, y, z)$  coordinates. If the space among humans is much less than 2 meters or 2 hundred centimeters, a red bounding field is proven round them, indicating that they do now no longer preserve a social distance.

## **2.4 Real-time applications**

This gadget may be utilized in real-time applications requiring a stable tracking of social distance among human beings and the detection of face mask for protection functions because of the outbreak of Covid-19. Deploying our version to aspect gadgets for automated tracking of public locations ought to lessen the load of bodily tracking, that is why we pick to apply this architecture. This gadget may be incorporated with aspect tool to be used in airports, railway stations, offices, colleges and public locations to make sure that public protection hints are followed.

## **2.5 Proposed System Monitors**

The proposed gadget video display units public locations constantly and whilst someone without a masks is detected his or her face is captured and an alert is dispatched to the government with face picture and on the identical time the space among people is measured in actual time, if greater than 20 individuals had been recognized constantly breaching secure social distance requirements at the edge time, then alert is dispatched to the manage middle on the State Police Headquarters to take in addition action. This gadget may be utilized in actual-time applications requiring a steady tracking of social distance among human beings and the detection of face mask for protection functions because of the outbreak of Covid-19. Deploying our version to facet gadgets for computerized tracking of public locations may want to lessen the load of bodily tracking, that is why we select to apply this architecture. This gadget may be included with facet tool to be used in airports, railway stations, offices, faculties and public locations to make sure that public protection pointers are followed.

## CHAPTER - 3

### Literature Survey/Project Design

In current years, item detection strategies the use of deep fashions are doubtlessly extra successful than shallow fashions in handling complicated duties and that they have performed incredible development in pc vision. Deep fashions for character detection attention on feature mastering contextual records mastering, and occlusion handling.

Deep mastering item detection fashions can now in particular be divided into families:

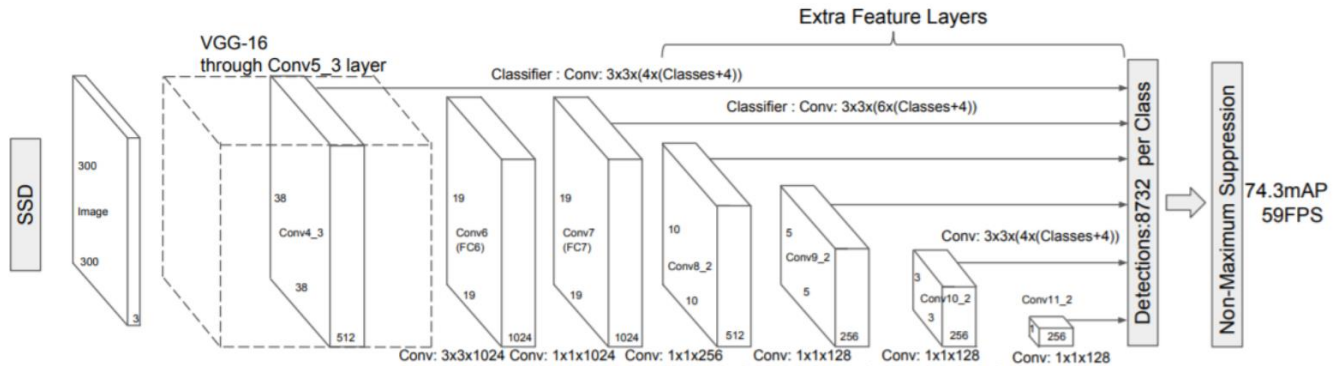
- (i) two – stage detectors together with R-CNN, Fast R-CNN and Faster R-CNN and their versions
- (ii) one - stage detectors together with YOLO and SSD. In -level detectors detection is executed in stages, with inside the first level, computed proposals and labeled with inside the 2nd level into item categories. However, a few methods, together with YOLO, SSD MultiBox, bear in mind detection as a regression trouble and examine the photo as soon as for detection.

In proposed machine we're the usage of Single Shot Detector MultiBox(SSD) which appears to be a great preference for real-time object detection and the accuracy trade-off is likewise very little. SSD makes use of the VGG-sixteen version pre-skilled on ImageNet as its simple version to extract beneficial photograph function. At the pinnacle of VGG16, SSD provides numerous convolutional function layers of reducing sizes.

#### 3.1 SSD

SSD is a single-shot detector. It has no delegated area notion community and predicts the boundary bins and the lessons immediately from function maps in a single unmarried pass. To

enhance accuracy, SSD introduces: small convolutional filters to are expecting item lessons and offsets to default boundary bins.



### 3.2 Viola – Jones Object Detection System

The Viola – Jones object detection gadget may be educated to come across any item, however is specifically not unusual place for facial detection and is extra correct and faster. The Viola and Jones procedure is an instance of supervised learning. Zhu additionally shared every other very huge facial detection set of rules is a neural network-primarily based totally detector. Compared to OpenCV that is utilized in some of computed components, it's miles not able to solve the imbalanced workload issue skilled all through the implementation of the viola-jones face detection set of rules in GPUs. Glass et al. Addressed the significance of social differencing and the way the chance of pandemic increase may be slowly reduced via way of means of efficiently retaining social distance without the usage of vaccines or antiviral drugs.

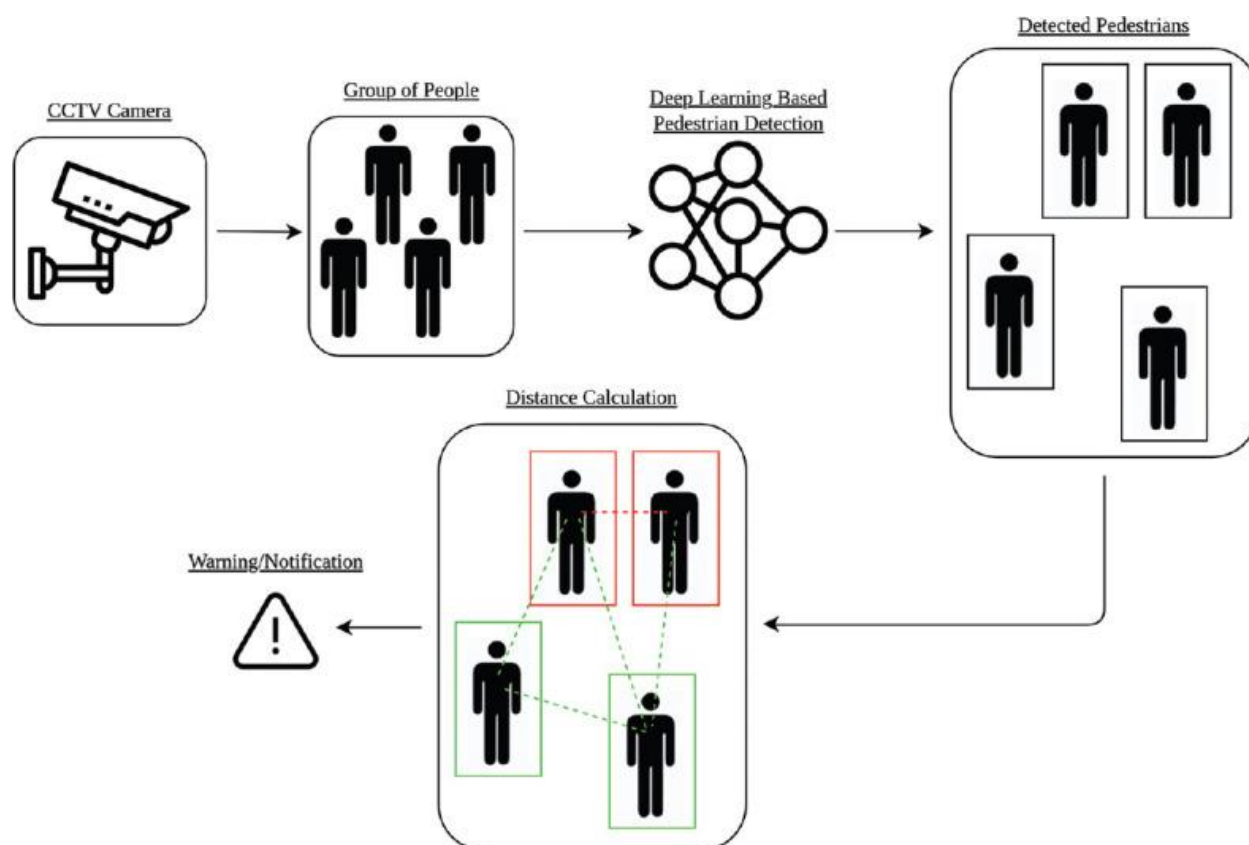
### **3.3 Current Evidence**

The cutting-edge proof indicates that COVID-19 viruses specially transmit thru respiration droplets and phone routes. There is a want to comply with the place of work Standard Operating Procedures to incorporate the unfold of COVID-19, which incorporates social distancing, sporting masks, common hand-washing with soap, respiration etiquettes, and set up and use of Aarogya Setu App via way of means of personnel. Social distancing has validated to sluggish down contamination costs at the same time as nonetheless permitting humans to characteristic of their respective environments. There is a want to installation effective laptop imaginative and prescient fashions, to tune personnel and traffic and notify managers of workspaces and public regions approximately feasible violations. This can assist to both screen the unfold of touch or put in force present guidelines. Numerous research was carried for the software of laptop imaginative and prescient for human face detection the usage of deep learning-primarily based totally Single Shot Detectors. Live digital digicam photos may be fed to one of the light-weight item detection fashions consisting of Mobile Nets, and gadgets may be detected even the usage of lower-cease hardware. Violation of the space under preset threshold restriction may be notified to respective authority. This statistic may be in addition processed for touch tracing, producing facts on social distancing, or informing people of feasible unfold.

### **3.4 Object Identification**

The item identification, together with human identification, may be carried out via way of means of retraining the present deep getting to know fashions on a dataset such as humans in touch with surfaces or via way of means of developing limitations withinside the photograph itself and tracking breaches. Figure 1 indicates the laptop vision-primarily based totally AI approach for the

detection of social distancing. However, care needs to be taken to maintain privateness of humans below surveillance. These facts may be handed onto applicable employees who can fast get on-web website online and disinfect the surface. Emphasis on feasibility and effectiveness of growing robust, cost-effective, scalable systems, deployable withinside the health center surroundings without affecting different clinical gadgets wishes to be explored.



### 3.5 Industrial GPU computers

India is a multiethnic united states with human beings of various bodily characteristics. Hence, the deep gaining knowledge of fashions advanced the use of the Indian records may be used to set up the era globally. The consciousness on such technological answers will assist to combat the COVID-19 and different comparable pandemic effectively. Industrial GPU computer systems with the ability to carry out those neural community algorithms on the threshold are actually available,



permitting large-scale contactless tracking that enables lessen the unfold of the coronavirus and different ability deadly infections. With the revolutionary price of transmission of the pandemic globally, the governments ought to provide it a concern withinside the fitness system, and all groups ought to cooperate with the Ministry of Health and Family Welfare and Healthcare structures to combat COVID-19.

### **3.6 Other Statistics**

According to statistics acquired with the aid of using the World Health Organization, the worldwide pandemic of COVID-19 has severely impacted the arena and has now inflamed greater than 8 million human beings worldwide. Wearing face mask and following secure social distancing are of the improved protection protocols want to be accompanied in public locations in an effort to save you the unfold of the virus. To create secure surroundings that contributes to public protection, we endorse a green pc imaginative and prescient primarily based totally approach targeted at the real-time automatic tracking of human beings to discover each secure social distancing and face mask in public locations with the aid of using enforcing the version on raspberry pi4 to reveal pastime and discover violations via camera. After detection of breach, the raspberry pi4 sends alert sign to govern middle at nation police headquarters and additionally deliver alarm to public. In this proposed gadget current deep mastering set of rules had been blended with geometric strategies for constructing a sturdy modal which covers 3 elements of detection, tracking, and validation. Thus, the proposed gadget favors the society with the aid of using saving time and allows in decreasing the unfold of corona virus. It may be carried out efficiently in present day state of affairs while lockdown is eased to look into individuals in public

gatherings, buying malls, etc. Automated inspection reduces manpower to look into the general public and additionally may be utilized in any place.

### **3.7 Transferring Learning**

Transfer studying is a system studying technique wherein a version evolved for a project is reused because the start line for a version on a 2nd project. It is a famous technique in deep studying wherein pre-educated fashions are used because the start line on pc imaginative and prescient and herbal language processing duties given the sizeable compute and time sources required to expand neural community fashions on those troubles and from the large jumps in ability that they offer on associated troubles. In this post, you may find out how you could use switch studying to hurry up education and enhance the overall performance of your deep studying version.

### **3.8 Public safety**

Monitoring social distancing in real-time eventualities is a tough task. It may be feasible in ways: manually and automatically. The guide technique calls for many bodily eyes to observe whether or not each person is following social distancing norms strictly. This is an onerous method as one can't preserve their eyes for tracking constantly at  $24 \times 7$ . Automated surveillance systems [5, 6] update many bodily eyes with CCTV cameras. CCTV cameras produce video footage, and an automatic surveillance device inspects this footage. The device increases signals whilst any suspicious occasion occurs. In view of this alert, safety employees can take applicable actions. Therefore, the automatic tracking device has passed numerous obstacles of the guide tracking technique.

### **3.9 Main Tasks**

This software is appropriate for each indoor and outside surveillance scenarios. It may be used extensively in diverse locations like railway stations, airports, megastores, malls, streets, etc. The proposed technique may be visible as an aggregate of important tasks, noted as:

- (i) Human detection and tracking
- (ii) Monitoring of social distancing amongst humans

### **3.10 Haar features for features extraction**

A Haar-Feature is similar to a kernel in CNN, besides that during a CNN, the values of the kernel are decided via way of means of training, even as a Haar-Feature is manually decided. Haar-Features are suitable at detecting edges and lines. This makes it especial powerful in face detection. For example, in a small photograph of Beyoncé, this Haar-characteristic could be capable of come across her eye (a place this is darkish on pinnacle and brighter underneath).

### **3.11 Proposed CNN model**

Convolutional neural network (CNN) has drawn lots interest to the studies community's mind-set and may be effectively embedded in a broader photograph type paradigm. It takes a photograph as input, assigns importance to distinctive gadgets inside a photograph primarily based totally on trainable weights & bias, and successfully differentiate every object. This paper introduces CNN primarily based totally sequential fashions to discover the presence of a man or woman inside a photograph. The well-known evaluation of those proposed fashions is proven in Table 1. These fashions encompass a convolutional layer, pooling layer, flatten, absolutely linked layer 1 & 2, and output layer. The best distinction among those fashions is that Model 1 includes convolutional

layers with pooling layers, even as Model 2 includes 3 convolutional layers with 3 pooling layers. Due to this variation, Model 1 produces about 10,402,993 trainable parameters, while Model 2 produces about 2,861,297 trainable parameters.

### **3.12 Proposed Social distancing monitoring algorithm**

It is the second one section of our proposed framework. The proposed social distancing tracking set of rules carried major functions. Function1 allows to discover the places of the gadgets in an image. It makes use of the human detection approach and gives the human places withinside the shape of coordinate values like XA (left), YA (top), XB (right), and YB (bottom). From those coordinate values, the centroid values of various gadgets are identified.

### **3.13 Experiments and analysis**

CNN primarily based totally strategies were evolved to come across the presence of people. In addition, the exercise of social distancing is finished from those proposed strategies. All the experimentations were finished on Intel middle i5 processor of 64-bit kind device and Google Colab in Python. We used the INRIA photograph dataset for education purposes. It includes a complete of 6562 pics wherein 4146 pics are poor, and 2416 pics are wonderful. We break up our photograph dataset into education and trying out module, wherein 2316 wonderful and 4046 poor pics are used for education purposes, and one hundred positives and one hundred poor pics are used for trying out purposes. This dataset consists of static pics and consists of versions in people with  $64 \times 128$  resolution.

## **CHAPTER – 4**

### **Functionality**

#### **4.1 Object Detection and tracking**

Object Detection and Image Classification are very famous obligations in pc vision. They have an extensive variety of programs in defense, healthcare, sports, and the distance industry. The essential distinction among those obligations is that photograph category identifies an item in a photograph while item detection identifies the item in addition to its place in a photograph.

Object Detection and Image Classification are very famous obligations in pc vision. They have an extensive variety of programs in defense, healthcare, sports, and the distance industry. The essential distinction among those obligations is that photograph category identifies an item in a photograph while item detection identifies the item in addition to its place in a photograph.

#### **4.2 Evolution of State-of-the-Art (SOTA) for object detection**

Object Detection is one of the maximum hard issues in pc vision. Having stated that, there was an enormous development during the last twenty years on this field. Object detection is the mission of detecting times of items of a sure magnificence inside an image. The modern techniques may be labeled into predominant types: one-degree techniques and degree-techniques. One-degree techniques prioritize inference speed, and instance fashions encompass YOLO, SSD and Retina-Net.

### 4.3 Sliding Window for Object Detection

The best technique to construct an Object Detection version is thru a Sliding Window technique. As the call suggests, a picture is split into areas of a specific length after which each area is **assessed** into the respective classes. Remember that the areas may be overlapping and ranging in length as well. It all relies upon at the manner you need to formulate the problem.

#### Model Workflow

1. Consider an image
2. Divide an image into regions (assume  $10 * 10$  region)
3. For each region:
  1. Pass a region to Convolutional Neural Network (CNN)
  2. Extract features from CNN
  3. Pass features to a classifier & regressor

This approach is clearly easy and efficient. But it's a time-eating procedure because it considers the large quantity of areas for type. Now, we are able to see how we will lessen the quantity of areas for type withinside the subsequent approach. This may be added down via way of means of discarding the areas that aren't probably to comprise the item.

### 4.4 R-CNN for Object Detection

This system of extracting the areas which might be probably to comprise the item is referred to as Region Proposals. Region proposals have a better possibility of containing an item. Many Region Proposal algorithms had been proposed to choose a Region of Interest (ROI). Some of the famous ones are objectness, selective search, category-unbiased item proposals, etc. So, R-

CNN changed into proposed with a concept of the usage of the outside vicinity inspiration algorithm. R-CNN stands for Region-primarily based totally Convolutional Neural Network. It makes use of one of the outside vicinity inspiration algorithms to choose the vicinity of interest (ROI).

### **Model Workflow**

1. Consider an image
2. Select ROI using exterior region proposal algorithm
3. For each region:
  1. Pass a region to CNN
  2. Extract features from CNN
  3. Pass features to a classifier & regressor

The anticipated areas may be overlapping and ranging in length as well. So, Maximum Non Suppression is used to disregard the bounding containers relying upon the Intersection Over Union (IOU) score. Certainly, R-CNN's structure changed into the State of the Art (SOTA) on the time of the notion. But it consumes almost 50 seconds for each check photo at some point of inference due to the wide variety of ahead passes to a CNN for function extraction. As you may look at below the version workflow, each vicinity notion is handed to a CNN for function extraction. For example, if a photo has 2000 areas of proposals, then the wide variety of ahead passes to the CNN is round 2000. This necessarily brought about any other version structure referred to as Fast R-CNN.

## 4.5 Fast R-CNN for Object Detection

In order to lessen the inference speed, a mild alternate within the R-CNN workflow became made and proposed, referred to as Fast R-CNN. The change became achieved within the function extraction of location proposals. In R-CNN, function extraction takes location for every location suggestion whereas, in Fast R-CNN, function extraction takes location most effective as soon as for a unique photo. Then the applicable ROI functions are selected primarily based totally at the area of the location proposals. These location proposals are built earlier than passing a photo to CNN.

### Model Workflow

1. Consider an image
2. Select Regions of Interest (ROI) using exterior region proposal algorithm
3. Pass an image to the CNN
4. Extract the features of an image
5. Choose relevant ROI features using the location of ROI
6. For each ROI feature, pass features to a classifier & regressor

## 4.6 Faster R-CNN for Object Detection

Faster R-CNN replaces the outdoors area notion set of rules with a Region Proposal Network (RPN). RPN learns to advocate the area of hobbies which in flip saves quite a few time and computation compared to a Fast R-CNN.

### Model Workflow

1. Consider an image
2. Pass an image to CNN



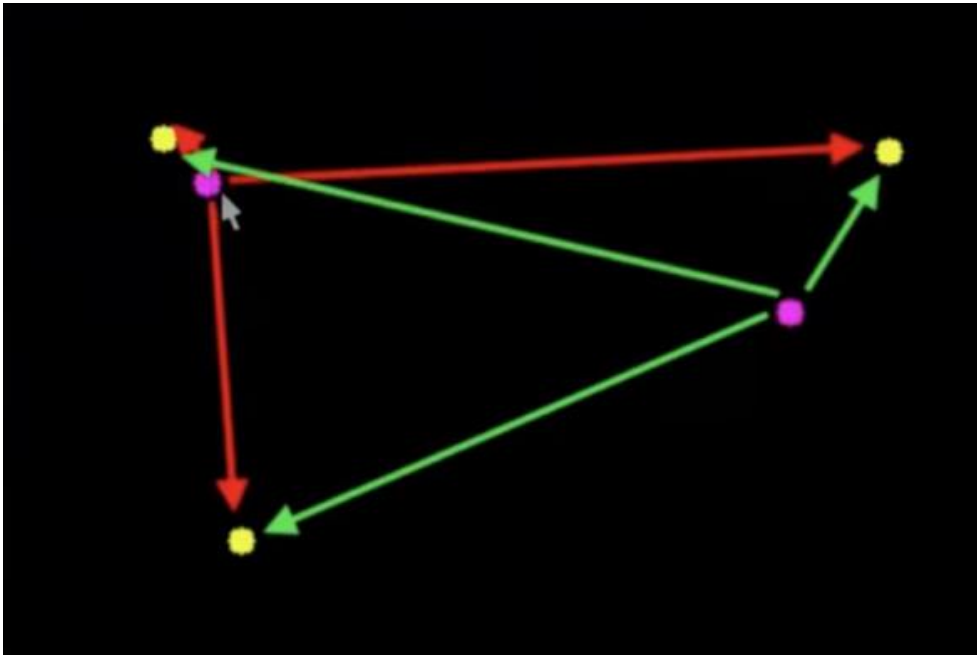
3. Extract the features of an image
4. Select ROI features using Region Proposal Network (RPN)
5. For each ROI feature, pass features to a classifier & regressor

## CHAPTER – 5

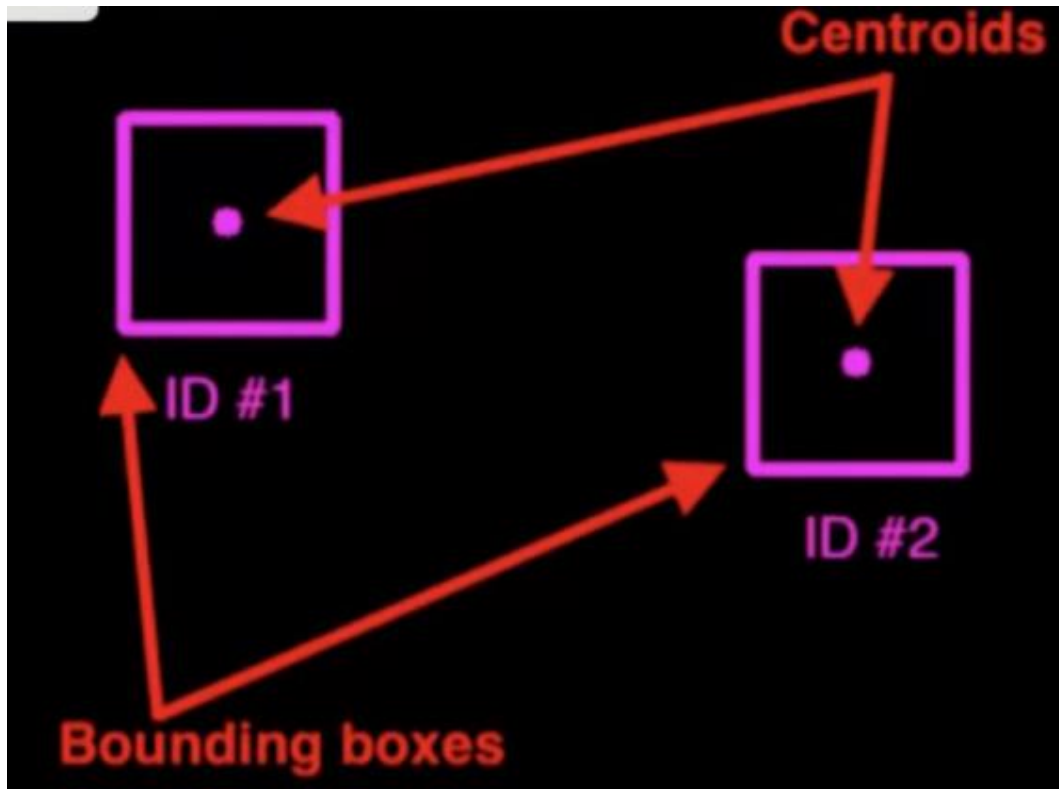
### Working of Project

#### 5.1 Detection

Then comes the part of detection of the human motion withinside the body for the Real Time Object Detection. To come across the motion of the pedestrians, a bounding container is needed for all of the pedestrians in order that their motion may be tracked from one factor to some other. Every time a brand new character seems withinside the body a brand new ID is assigned to the item. If for non-stop 50 frames an item does now no longer alternate function, the ID is re-registered. For detection an ID is assigned to every of the persons. Every time an item actions from one function to some other the ID is re-registered.



The image above portrays the detection of objects with the dots representing the centroids



The image above portrays the use of ID and bounding box around objects for the identification and recognition of the object.

## 5.2 Distance Calculation

After bounding all of the motion inside the box, the space wishes to be calculated so that you can make the selection of whether a character is training or following social distancing or not. Two crucial factors which consist of crucial residences are:

1. The measurement of the item to be identified. That is centimeters, millimeters etc.
2. The image should be easily identifiable. That is either by its appearance or location.

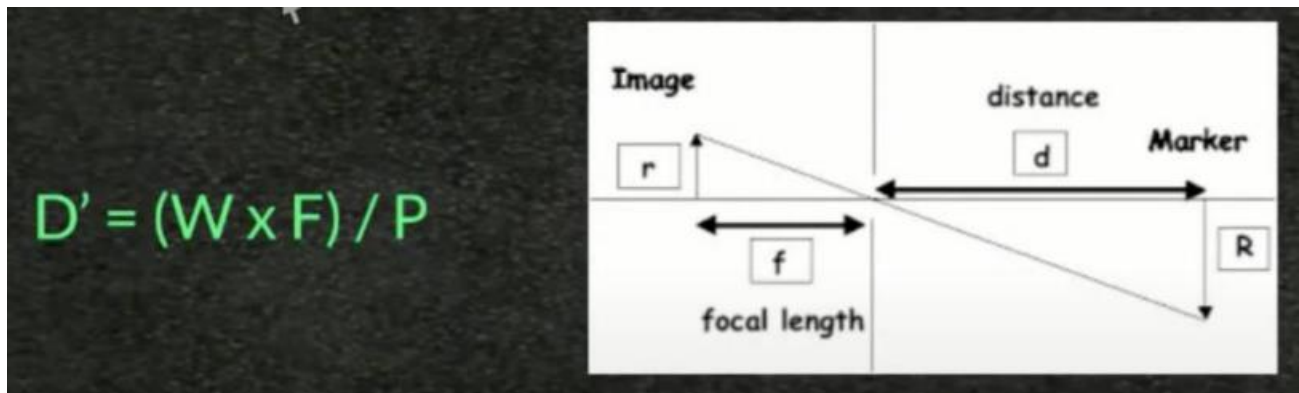
A lot of necessary python packages need to be installed in order to measure the distance between the objects. Some of the necessary packages are:

1. Scipy.spatial and distance
2. Imutils and perspective
3. Imutils and contours
4. CV2
5. Argparse
6. Numpy

OpenCV turned into began out at Intel in 1999 with the aid of using city middle Bradsky. Vadim Pisarevsky joined city middle Bradsky to manipulate Intel's Russian software program package deal OpenCV team. In 2005, OpenCV turned into used on Stanley, the automobile that gained the 2005 authority Grand Challenge. Later, its energetic improvement endured below the aid of Willow Garage with city middle Bradsky and Vadim Pisarevsky main the project. OpenCV presently helps a large number of algorithms related to laptop Vision and Machine Learning and is growing day with the aid of using day. OpenCV helps a very good form of programming languages like C++, Python, Java, etc., and is offered on absolutely unique systems collectively with Windows, Linux, OS X, Android, and iOS. Interfaces for high-pace GPU operations supported CUDA and OpenCV are also below energetic improvement. OpenCV-Python is the Python API for OpenCV, combining the only features of the OpenCV C++ API and additionally the Python language.

After which the magnificence ID and self-belief this is the possibility is calculated. There may be instances with this that there's a present magnificence ID or a brand new ID might be

created. If a present ID is matched, then the self-belief or the possibility is calculated once more and the self-belief wishes to be above the minimal conf. Then the containers are drawn across the image. Non - maxima suppression enables in figuring out the appropriate container this is drawn across the object.



### 5.3 Prediction on the basis of the distance calculated

After bounding all of the motion in the box, the gap wishes to be calculated so that you can make the selection of whether a man or woman is working towards or following social distancing or not. Two crucial factors which encompass crucial homes are:

1. The size of the item to be identified. That is centimeters, millimeters etc.
2. The photo must be effortlessly identifiable. That is both through its look or location. The distance library is used for calculating the Euclidean distance among the humans for the detection of the appropriate distance among them. The Euclidean distance is then measured and checked if the space is extra than the minimum distance

In the above picture all of the human beings withinside the crimson field are violating social distancing. The overall variety of violations also are portrayed withinside the picture above.

## CHAPTER – 6

### Project Design

#### 6.1 We can use OpenCV, pc vision, and deep mastering to put into effect social distancing detectors.

The steps to construct a social distancing detector include:

- Apply item detection to locate all humans (and most effective humans) in a video stream (see this academic on constructing an OpenCV humans counter)
- Compute the pairwise distances among all detected humans
- Based on those distances, take a look at to peer if any humans are much less than N pixels apart for the maximum correct results, you need to calibrate your digital digicam thru intrinsic/extrinsic parameters so you can map pixels to measurable units.

For the maximum correct results, you ought to calibrate your digital digicam via intrinsic/extrinsic parameters so you can map pixels to measurable units. A less difficult alternative (however much less correct) approach might be to use triangle similarity calibration (as mentioned on this tutorial). Both of those strategies may be used to map pixels to measurable units. Finally, in case you do now no longer want/cannot observe digital digicam calibration, you could nonetheless make use of a social distancing detector, however you'll should depend strictly at the pixel distances, which won't always be as correct. For the sake of simplicity, our OpenCV social distancing detector implementation will rely upon pixel distances — I will depart it as an workout for you, the reader, to increase the implementation as you notice fit.

## 6.2 Project Structure

Faster R CNN, Mask R CNN, and Retina-Net for solving different computer vision tasks, such as:

1. Object Detection
2. Instance Segmentation
3. Key point Detection
4. Panoptic Segmentation

The baseline fashions of Faster R-CNN and Mask R-CNN are to be had with three kind of combinations.

## 6.3 Install Dependencies

```
# install
dependencies:
(use cu101
because colab
has CUDA
10.1)

!pip install cython pyyaml==5.1

# install detectron2:
```

## 6.4 Import Libraries

```
# You may
need to
restart your
runtime
prior to
this, to let
your
```

installation

take effect

```
# Some basic setup:
# Setup detectron2 logger
import detectron2
from detectron2.utils.logger import setup_logger
setup_logger()

# import some common libraries
import numpy as np
import cv2
import random
from google.colab.patches import cv2_imshow
import matplotlib.pyplot as plt

# import some common detectron2 utilities
from detectron2 import model_zoo
from detectron2.engine import DefaultPredictor
from detectron2.config import get_cfg
from detectron2.utils.visualizer import Visualizer
from detectron2.data import MetadataCatalog
```

## 6.5 Read a video and save frames to a folder:

```
%%time
!rm -r frames/*
!mkdir frames/

#specify path to video
video = "sample.mp4"

#capture video
cap = cv2.VideoCapture(video)
cnt=0
```



```

# Check if video file is opened successfully
if (cap.isOpened()== False):
    print("Error opening video stream or file")

ret,first_frame = cap.read()

#Read until video is completed
while(cap.isOpened()):

    # Capture frame-by-frame
    ret, frame = cap.read()

    if ret == True:

        #save each frame to folder
        cv2.imwrite('frames/'+str(cnt)+'.png', frame)
        cnt=cnt+1
        if(cnt==750):
            break

    # Break the loop
    else:
        break

```

## 6.6 Check the frame rate of a video

```

#frame
rate
of a
video
FPS=cap.get(cv2.CAP_PROP_FPS)
print(FPS)

```

## 6.7 Download the pre-trained model for object detection:

```
cfg =
get_cfg()

# add project-specific config (e.g., TensorMask) here if you're not running a model
in detectron2's core library
cfg.merge_from_file(model_zoo.get_config_file("COCO-
Detection/faster_rcnn_R_50_C4_3x.yaml"))
cfg.MODEL.ROI_HEADS.SCORE_THRESH_TEST = 0.9 # set threshold for this model

# Find a model from detectron2's model zoo. You can use the
https://dl.fbaipublicfiles... url as well
cfg.MODEL.WEIGHTS = model_zoo.get_checkpoint_url("COCO-
Detection/faster_rcnn_R_50_C4_3x.yaml")
predictor = DefaultPredictor(cfg)
```

## 6.8 Read an image and pass it to model for prediction

```
#read
an
image
img = cv2.imread("frames/30.png")

#pass to the model
outputs = predictor(img)
```

## 6.9 Visualizer

```
# Use
`Visualizer`
```

to draw the predictions on the image.

```
v = Visualizer(img[:, :, ::-1], MetadataCatalog.get(cfg.DATASETS.TRAIN[0]),
scale=1.2)
v = v.draw_instance_predictions(outputs["instances"].to("cpu"))
cv2_imshow(v.get_image()[:, :, ::-1])
```

## 6.10 Draw a bounding box for one of the people

```
img =
cv2.imread('frames/30.png')
_ = cv2.rectangle(img, (x1, y1), (x2, y2), (255,0,0), 2)

plt.figure(figsize=(20,10))
plt.imshow(img)
```

Our closing purpose is to compute the space among humans in an image. Once we understand the bounding container for every person, we are able to without difficulty compute the space among any humans. But the venture right here is to pick out the proper coordinate for representing someone as a bounding container is withinside the shape of a rectangle.

## 6.11 Define a function

```
#define
a
function
which
return
the
bottom
center
of every
bbox
```

```

def mid_point(img, person, idx):
    #get the coordinates
    x1,y1,x2,y2 = person[idx]
    _ = cv2.rectangle(img, (x1, y1), (x2, y2), (0,0,255), 2)

    #compute bottom center of bbox
    x_mid = int((x1+x2)/2)
    y_mid = int(y2)
    mid = (x_mid,y_mid)

    _ = cv2.circle(img, mid, 5, (0, 0, 255), -1)
    cv2.putText(img, str(idx), mid, cv2.FONT_HERSHEY_SIMPLEX, 1, (255, 255, 255), 2,
cv2.LINE_AA)

    return mid

```

## 6.12 Identify the closet people in each frame and change the color to red:

```

from
tqdm
import
tqdm

thresh=100
_ = [find_closest_people(names[i],thresh) for i in tqdm(range(len(names))] ]

```

## 6.13 Identifying the closest people in each frame

```

%time
frames = os.listdir('frames/')
frames.sort(key=lambda f: int(re.sub('\D', '', f)))

frame_array=[]

```

```
for i in range(len(frames)):

    #reading each files
    img = cv2.imread('frames/'+frames[i])
    img = cv2.cvtColor(img,cv2.COLOR_BGR2RGB)

    height, width, layers = img.shape
    size = (width,height)

    #inserting the frames into an image array
    frame_array.append(img)

out = cv2.VideoWriter('sample_output.mp4',cv2.VideoWriter_fourcc(*'DIVX'), 25, size)

for i in range(len(frame_array)):
    # writing to a image array
    out.write(frame_array[i])
out.release()
```

## **CHAPTER-7**

### **Results and discussion**

#### **7.1 Points to remember**

Keep in thoughts that the projection of the digital digicam additionally topics lots whilst computing the space among the gadgets in an image. In our case, we actually have now no longer taken into consideration the projection of the digital digicam because the effect of the digital digicam's projection at the predicted distance is minimum. However, the frequent method is to transform a video right into a pinnacle view or birds' eye view after which compute the space among gadgets in an image. This undertaking is called Camera Calibration. Keep that during thoughts in case we need to discover this in addition and customize your very own social distancing detection tool.

#### **7.2 End Notes**

This article shows deep mastering primarily based totally human detection strategies to screen social distancing withinside the real-time environment. These strategies were advanced with the assist of deep convoluted community that has used sliding window idea as a location proposal. Further, they may be used with the social distancing set of rules to degree the distancing standards amongst people. This evaluated distancing standard determine whether or not peoples are following social distancing norms or not. The great experiments have been accomplished with CNN primarily based totally item detectors. In experiments, it's miles discovered that CNN-primarily based totally item detection fashions are higher in accuracy than others. Sometimes, it produces a few fake wonderful times while coping with real-time video sequences. In the destiny,

distinct cutting-edge item detectors like RCNN, Faster RCNN, SSD, RFCN, YOLO, etc. can be deployed with the self-created dataset to boom detection accuracy and decrease the fake wonderful times. Additionally, a unmarried standpoint received from a unmarried-digital digicam can't mirror the end result extra effectively. Therefore, the proposed set of rules can be set for distinct perspectives thru many cameras withinside the destiny to get extra correct results.

### **7.3 Limitations**

There are some barriers of the social distancing detector that are indexed as below:

1. The first aspect that may be advanced is the digital digicam calibration, which eases the mapping of the space in pixels to the real gadgets of measurements of distance.

2. The 2d aspect that may be advanced is the digital digicam perspective, a higher technique might be to apply the bird's eye view perspective which is likewise called the top- down transformation.

### **7.4 Advantages of deep learning models**

Image type includes dispensing a class label to a picture, while item localization includes drawing a bounding field round one or a number of gadgets in a picture. Object detection is harder and combines those 2 responsibilities and draws a bounding field round each item of hobby in the photo and assigns them a class label. Together, all of these problems square degree noted as seeing.

1. Deep studying fashions have the functionality to generate new functions from the constrained dataset that they to begin with were educated with.

2. The fashions on being educated constantly emerge as bendy and adapt to extrude quickly.

3. The deep studying fashions are able to studying via unlabeled records which reduces a number of price for labelling records to assist the system to research without difficulty as in case of supervised studying.

4. Deep studying fashions as soon as educated effectively are able to acting repetitions without taking tons' time and do now no longer get tired.



## CHAPTER – 8

### Conclusion and future scope

#### 8.1 OpenCV social distancing detector results

Social distancing can lessen contamination costs in respiration pandemics together with COVID-19, specially in dense city areas. To check pedestrians' compliance with social distancing policies, we use the pilot web page of the PAWR COSMOS Wi-Fi edge-cloud testbed in New York City to layout and compare an Automated video-primarily based totally Social Distancing Analyzer (Auto-SDA) pipeline. Auto-SDA derives pedestrians' trajectories and measures the period of near proximity events. It is based on an item detector and a tracker, however, to attain fairly correct social distancing evaluation, we layout and include three modules into Auto-SDA: (i) a calibration module that converts 2D pixel distances to 3-d on-floor distances with much less than 10 cm error, (ii) a correction module that identifies pedestrians who have been neglected or assigned replica IDs with the aid of using the item detection-tracker and rectifies their IDs, and (iii) a set detection module that identifies affiliated pedestrians (i.e., pedestrians who stroll collectively as a social group) and excludes them from the social distancing violation evaluation. We implemented Auto-SDA to films recorded on the COSMOS pilot web page earlier than the pandemic, quickly after the lockdown, and after the vaccines have become extensively available, and analyzed the effects of the social distancing protocols on pedestrians' behaviors and their evolution. For example, the evaluation suggests that once the lockdown, much less than 55% of the pedestrians violated the social distancing protocols, while this percent improved to 65% the vaccines have become available. Moreover, after the lockdown, 0-20% of the pedestrians have been affiliated with a social group, as compared to 10-45% as soon as the vaccines have become

available. Finally, following the lockdown, the density of the pedestrians on the intersection reduced with the aid of using nearly 50%.

## **8.2 Conclusion**

A device for detecting social deviations the usage of an in-intensity mastering version is proposed. Using laptop vision, the gap among human beings may be measured and any individuals who do now no longer obey the regulation can be proven in purple Frame and purple line. The proposed method changed into showed the usage of a video displaying pedestrians strolling down the street. The visible outcomes confirmed that the proposed approach is It is capable of decide measures of social isolation that may be evolved for use in different environments consisting of office, eating place and school. In addition, the paintings may be progressed with the aid of using expanding the pedestrian detection algorithm, integrating different detection algorithms consisting of masks detection and human body temperature detection, enhancing laptop hardware power, and measuring digital digicam view.

## **8.3 Future Scope**

Social distancing indicator desires guide calibration for picture detection proper now. In instances wherein extra human beings are in a 3-D space, it's far tough to suggest and mark the images. Potential answers may be running on a overhead picture (basically a 2D picture of human heads) which detects human heads and calculates distances among the detected home windows without difficulty with the aid of using locating the vector distance among coordinates on picture. An extra modern method in the direction of social distancing indicator could be to encompass AR (Augmented Reality) libraries from openCV and use them.

Due to time restrictions, we could not do it however it's far may be completed with openCV. Counting human beings in a given body may be made extra dynamic with the aid of using

taking pictures video. The modern-day trouble with video changed into it is length and we did not have loose reminiscence on our microprocessor. If a SD card of length 128 GB or above is in beagle bone, it might offer extra application in recording the video. (After a while the video may be deleted) We are doing face detection now no longer reputation proper now. It could be desirable to encompass a few face statistics and perform reputation as well (may be used for actual time attendance as indicated in above section) Microprocessor is doing all of the processing paintings proper now which may be quite in depth for it is processor and can take a while. To lessen this latency, we are able to shift the processing paintings from microprocessor to a cloud computer. Microprocessor can simply be used as a tutorial tool for sending/receiving statistics.

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