WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Automated Interpersonal Distance Detection to Prevent the Risk of Covid-19 Using Machine Learning

NusrathJahan A B, Monica T, G.Kalaiselvi

UG Student, Computer Science and Engineering AnjalaiAmmalMahalingam Engineering College Kovilvenni, Thiruvarur,India
UG Student, Computer Science and Engineering, AnjalaiAmmalMahalingam Engineering College, Kovilvenni, Thiruvarur,India
AssistantProfessor, Deparment of Computer Science and Engineering AnjalaiAmmalMahalingam Engineering College Kovilvenni, Thiruvarur,India

A B S T R A C T

COVID- 19 is the most deadly communicable disease which has brought down the world's economy and had drunk many lives irrespective of people's age. The most frequent word that has been heard down during this pandemic is social distancing. Maintaining interpersonal distance is a precaution measure that can be taken to protect our self from this deadly disease. The propose system checks whether inter-personal distance is being maintained among people in a particular area with the help of surveillance camera. This system makes use of YOLOV3 which uses Convolutional Neural Network (CNN) a machine learning technique for detecting people. By estimating the distance among them, the system can deduct whether the particular person is maintaining interpersonal distance or not.

Keywords: Interpersonal distance, Covid-19, YOLOV3

1. Introduction

The terrific Nightmare during the year 2020 2021 is coronavirus which had its origin from Wuhan, China and how spread its wings to the nook and corner of the world. It causes a disease named covid-19. It is an infectious disease which harms our respiratory system and cause irritation starting from common cold to severe breathing problem and may even lead to death. The word that have highest frequency during this pandemic are lockdown, quarantine, stay home, stay safe, hand wash, soap, sanitizer, masks, gloves, vaccines and most importantly social distancing or interpersonal distancing.

Interpersonal distance is the minimum distance of 6 feet between people. It is one of thePrecautionary measures we can take to protect ourselves from covid-19. Maintaining this minimum distance avoids contact of infected persons with health care persons and prevent the spread of covid-19 too. Since these viruses can spread through air and via touch contact maintaining distance with other people would be best solution for safeguarding ourselves. It is the duty of the government to ensure that there is no overcrowding of population in any area and also to ensure that interpersonal distancing is being maintained in all areas. In order to help the government, a system is being developed to monitor an area with the help of surveillance camera which can detect if people arefollowing interpersonal distance or not.

Nowadays, machine learning is used in object detection. The object detection mechanism is the outcome of improved intelligence of computer. Object detection comes under the computer vision. Artificial Neural Network is widely used in case of classification tasks. Similarly, Convolutional Neural Network (CNN) id used for image classification. All the neural networks consist of three layers(Fig:1.1), input layer, hidden layer and output layer. Input will be provided through input layer. Total number of neurons will be based on pixels of an image. The hidden layer will give the matrix computed with

* *Corresponding author.*
E-mail address: monikamaran2000@gmail.com

the help of weights of that layer and with the addition of bias and activation function. Probability score of each classes will be the output from the output layer. YOLO is an object detector based on computer vision. The training classes are pre-defined in YOLO. It consists of training objects that it can detect. YOLO detects objects using CNN machine learning algorithm. The input to YOLO is nxn image and the output will be mxm grid. Thedetected objects will be shown in bounding boxes.

Distance measures play a very important role in machine learning. It is a score that summarizes the difference between the objects in an image. Euclidian distance is used for calculating the distance between two vectors. In other words, Euclidean distance algorithm is used for finding the length of the line between two points. It can be calculated using Pythagorean theorem of with Cartesian points.

In the proposed system, first step is to capture a live video, detect the people in it, calculate the distances and to detect the risk condition.

The content of rest of the paper will be as follows. The section 2 will contain the theories and calculations needed to understand this article and the proposed system. Section 3 will contain the information about procedure of how the proposed system works.Section 4 will contain the result based on the working of the system described. Section 5 will contain the conclusion and the future enhancement of the system. And the last system will contain the references used to make this article.

Fig: 1 Interpersonal distancing

2. Theory and Calculation

A. YOLO

YOLO stand for you only look once. It is an algorithm which can detect objects in field of computer vision. Compared to other object detection algorithms like histogram of oriented gradients(HOG), fast RCNN(FRCNN), YOLO is a fastest object detecting algorithm. It can run 45 frames per second, which means that latency for streaming video in real time takes less than 25 milli0seconds. It makes use of single network evaluation for full image.

Detectiondone by YOLO is based on regression. It divide the image into regions and predict the probability of all combination of region closer to each other for being an object. The input to YOLOis NxN image is sent to the fully conventional neural network FCNN and the output will be MxM grid.The objects detected will be shown in bounding boxes. YOLO makes use of 3 files:

i. Differential rate for conference production for boxes that contain object and boxes that have no object during training.
ii. YOLO contains a file named Coco.names that consists of list of all the objects that YOLO can detect.
iii. The file named yolo.cfg describes the layout of the network. The number of channels of the layer is given by filters as each filter produces one channel.

YOLOV3 can detect up to 80 objects classes.It not only tells what object is being present in an image but also shows the position of the object with the help of bounding boxes.YOLO returns x,y,w,h where x and y are the co-ordinates, w and h are the width and height respectively.To avoid multiple bounding boxes for a single object, the box with maximum probability is considered.The vector of object direction will be as shown in the figure.

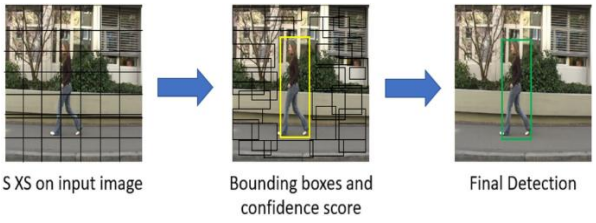

Fig: 2 Steps for bounding the object in an image by YOLO

$$\begin{bmatrix} P_c \\ B_x \\ B_y \\ B_w \\ B_h \\ C_1 \\ C_2 \end{bmatrix} \begin{bmatrix} 1 \\ 50 \\ 70 \\ 70 \\ 50 \\ 1 \\ 0 \end{bmatrix} \begin{bmatrix} P_c \\ B_x \\ B_y \\ B_w \\ B_h \\ C_1 \\ C_2 \end{bmatrix} \begin{bmatrix} 0 \\ - \\ - \\ - \\ - \\ - \\ - \end{bmatrix}$$

Fig:3 The former is the vector given by YOLO for an image with object and the latter for an image without object.

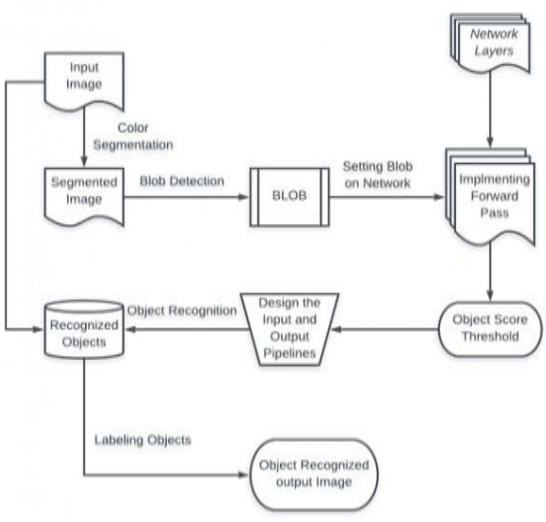

Fig: 4 Object detection flow in YOLO

B. ANN

The Artificial Neural Network is the field of Artificial Intelligence where the computer can

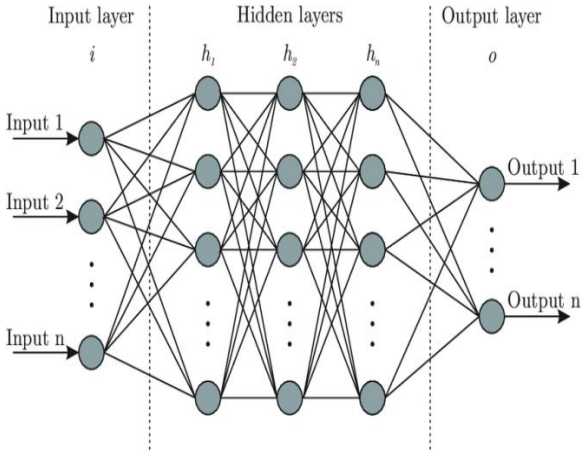

Fig:5 Layers of Artificial Neural Network

think and make decisions like human beings. The computations of ANN would be the weighted sum of the input including the bias.

$$\sum_{i=1}^{n} Wi * Xi + b$$

ANN has capability forParallel processing, capability to work without prior knowledge, it has fault tolerance, has memory distributionand it also have the capability to store data in network rather in a database.

C. CNN

Convolutional Neural Network is the class of Deep Neural Network, mostly used in analysing images. It is made up of multiple layers of artificial neurons. It is mainly made up of three layers. Namely, convolutional layers, pooling layers, and fully-connected layers. Stack of all these layers forms the Convolutional Neural Network.As an image move deeper and deeper into layers, many enhanced features of the image can be examined. It is widely used in image prediction and object detection.

D. EUCLIDEAN DISTANCE ALGORITHM:

Calculation of distance being a major part of machine learning algorithms, there are many algorithms like Hamming Distance, Euclidean Distance, Manhattan Distance, Minkowski Distance. In this paper we will be discussing about Euclidean distance algorithm.

The distance or the difference between two points can be calculated using Pythagorean distance formulae which is also been called as Euclidean distance formulae. The formula varies for different dimensions, ranging from 1-Dimension to n-D. The formulae for 1-Dimension, that is for a real line is:

$$d(p,q) = \sqrt{(p-q)^2}.$$

The formulae for 2-Dimension, that is for a Cartesian plane is:

$$d(p,q) = \sqrt{(q_1-p_1)^2 + (q_2-p_2)^2}.$$

The formulae for 3-Dimension id:

$$d(p,q) = \sqrt{(p_1-q_1)^2 + (p_2-q_2)^2 + (p_3-q_3)^2}.$$

The formulae for n-Dimension is:

$$d(p,q) = \sqrt{(p_1-q_1)^2 + (p_2-q_2)^2 + \cdots + (p_i-q_i)^2 + \cdots + (p_n-q_n)^2}.$$

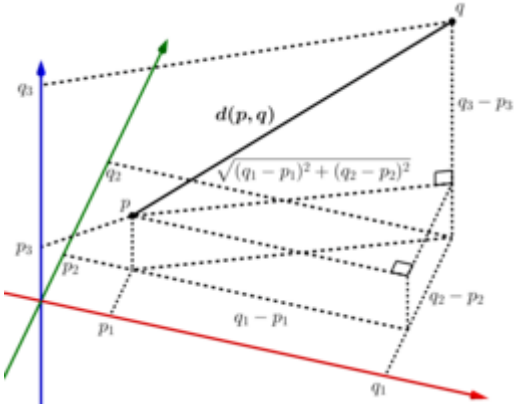

Fig: 6 This image shows the derivation of Euclidian distance formulae by iteratively applying Pythagorean theorem.

3. Working Methodology

The video from live camera is sent as input to the YOLO. YOLO divide the video into sequence of images. Each images are sent to the Convolutional Neural Network as input.YOLO will also be using the pre-trained model that is coco.names, wights and configuration files for detecting the objects. The image will then be converted into blob for further proceedings. CNN will predict a vector with eight values. These eight values gives the detected object's confidence score, object's position, co-ordinates of bounding box of the object, and the predicted object. The extracted image will be divided into mxm grid. The grid containing the object is called bounded box region. The actual rectangle bounding the region is called Ground truth region. The confidence score will be calculated as follows:

Confidence score = P(object)*IOU

Where IOU is the Intersection of Union. IOU can be calculated as:

$$IOU = \frac{\text{Area of intersection}}{\text{Area of union}}$$

The probability that the predicted object will be person can be determined with the help of conditional probability:

P(person)=P(person|object)

P(person|object)=P(person∩object)/P(object)

Thus, the confidence score can be calculated, with the help of which only people can be filtered out. Only if the confidence is greater than 0.5, the object will be detected. There may be multiple bounding boxes around a single object. Non-max suppression, finding the box with highest probability removes multiple bounding boxes.

Once only people have been filtered out, the centroid, the center point of each bounding rectangle will be calculated with respect to the co-ordinates, width and height generated in the vector by CNN.

Once the centroids are being calculated, the distances among people are computed. This is done by using Euclidean distance algorithm.The distance among all the centroids with all possible combinations is estimated.All the

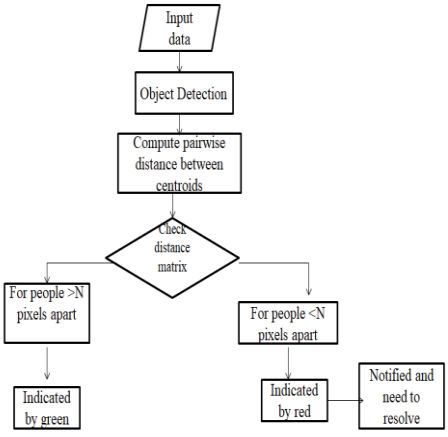

Fig: 7 Flowchart of interpersonal detection system

calculated distance is compared with the minimum threshold. If any of the distance is found to be less than the minimum threshold, the particular person will be bounded within red rectangle and others in green rectangle. If the number of red rectangle increases, the supervisor can intimate the people in that particular region to maintain interpersonal distance or can take steps to reduce the crowd if overcrowded.

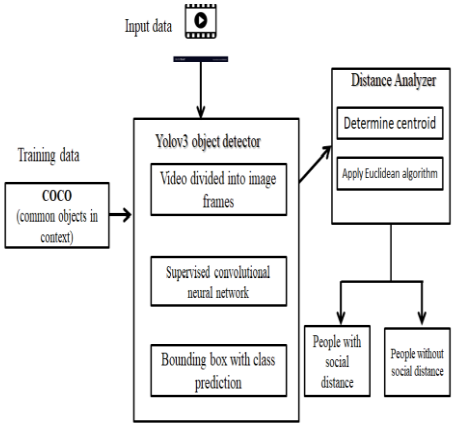

Fig: 8 System Architecture of automatic interpersonal detection system

4. Results

The proposed system identifies the people who are not following the interpersonal distance so that they could be given an alert. This system helps in controlling the spread of covid-19. This system can prevent an area to be prone to the deadly disease.

Fig:9 Final result of automatic interpersonal detection system

5. Conclusion and Future Enhancement

Thus, this article explained about the automatic detection of interpersonal distance using machine learning technique, where the interpersonal distance among people are monitored with the help of surveillance camera and by using YOLOV3 for detecting the people. The distances among the people are calculated with the help of Euclidean distance. And with the help of estimated distance and with predefined threshold value, the people who are following interpersonal distance and those who are not following so can be found.

For the future enhancement, the performance speed and the efficiency of the system shall be increased irrespective of system compatibility. Furthermore, the most practical problem in finding out the actual distance is that, a person behind another person appears to more closer to the one who is in front from top front, and backside view. Thus, it is worth to explore a algorithm that overcomes this complexity.

REFERENCES

[1] Keniya R, Mehendale N. Real-Time Social Distancing Detector Using Socialdistancingnet-19 Deep Learning Network. Available at SSRN 3669311. 2020 Aug 7.

[2] Rezaei, Mahdi, and Mohsen Azarmi. "Deepsocial: Social distancing monitoring and infection risk assessment in covid-19 pandemic." *Applied Sciences* 10.21 (2020): 7514.

[3] Punn NS, Sonbhadra SK, Agarwal S. Monitoring COVID-19 social distancing with person detection and tracking via fine-tuned YOLO v3 and Deepsort techniques. arXiv preprint arXiv:2005.01385. 2020 May 4.

[4] Ahmed, Imran, et al. "A deep learning-based social distance monitoring framework for COVID-19." *Sustainable Cities and Society* 65 (2021): 102571.

[5] Ahamad, AfiqHarith, NorlizaZaini, and MohdFuad Abdul Latip. "Person Detection for Social Distancing and Safety Violation Alert based on Segmented ROI." *2020 10th IEEE International Conference on Control System, Computing and Engineering (ICCSCE)*. IEEE, 2020.

[6] Ghorai, Arnab, Sarah Gawde, and DhananjayKalbande. "Digital Solution for Enforcing Social Distancing." *Available at SSRN 3614898* (2020).

[7] Visal, Rucha, AtharvaTheurkar, and BhairaviShukla. "Monitoring Social Distancing for Covid-19 Using OpenCV and Deep Learning." (2008).

[8] Cristani, M., Del Bue, A., Murino, V., Setti, F. and Vinciarelli, A., 2020. The visual social distancing problem. *IEEE Access*, *8*, pp.126876-126886.