

Integration of Deep Learning YOLOv3 and OpenCV Methods for Physical Distancing in Covid19 Transmission Prevention

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Abstract. The current direction of research on the use of sensors and electronic components is a major topic, even the emergence of the concept of machine learning makes the priority of research development in the field of electronics sharper and focuses on algorithms, more complex methods, and sensor capabilities. This research will raise the topic of preventing the spread of the Covid19 virus. The problem in this research is to determine the right algorithm to engineer electronically, so this research chooses the Deep Learning OpenCV and YOLOv3 methods built with Raspberry Pi and Python language based on machine learning to answer hypotheses related to preventing the spread of the Covid19 virus starting from implementing an object recognition system, to calculating real-time physical distancing so that the purpose of this research can display object recognition that can measure physical distancing. From data collection and problems, this research designs a prototype physical distancing tool using OpenCV with the Yolov3 Deep Learning Method. The output of this research is image capture in .jpg and .jpeg formats. Capture of image objects in observation using clear perspective images so that the program can recognize image object captures with red marking when violating physical distancing and this prototype will work if the objects are close to each other in response to detection with an average response time of 9.525133 second Physical Distancing. This is influenced by the size of the file and the number of objects captured.

Keyword. YOLO, Deep Learning, OpenCV, Physical Distancing, Covid-19

1. Introduction

Early 2020 the world is shaken by the COVID-19 virus outbreak. COVID-19 (1–3) is a disease caused by a new type of coronavirus Sars-CoV-2, first reported in Wuhan, China on December 31, 2019. COVID-19 can cause symptoms of acute respiratory disorders such as fever above 38°C, cough, and shortness of breath for humans. It can also be accompanied by weakness, muscle aches, and diarrhea. In severe COVID-19 patients, it can cause pneumonia, acute respiratory syndrome, kidney failure even to death. COVID-19 can be transmitted from human to human through close contact and droplets (splashes of liquid during sneezing and coughing), not through the air. The form of COVID-19 when viewed through an electron microscope (airway fluid / throat swab) and re-described the form of COVID-19 like a virus that has a crown.

The World Health Organization and Health (WHO), recommends keeping more than 1 meter from others. Meanwhile, some health experts advise keeping a distance of at least two meters from others. A few steps can be taken to improve physical space between people, including staying at home more, working from home if possible, restricting guests at home, avoiding large gatherings and public transport.

Physical Distancing is one example and efforts of the government to contain the spread of the COVID-19 virus compared to lockdown or Social Distancing that can harm economic and social activities Physical Distancing activities only do distance, maintain cleanliness, and use masks but it is better not to travel too often to public places and stay home only.

Therefore, in this research built a prototype physical distancing using OpenCV with YOLOv3 (4–6). Development and advancement of rapidly developing technology, especially in visual monitoring using digital imagery and Artificial Neural Networks (ANN) in Deep Learning (DL) (7,8).

According to (9–11) Open-CV Library is an open-source computer vision library for C/C++ programming language, and has been developed into Python, JAVA, MATLAB which has been developed by intel with a focus on the refining of programs related to digital imagery. OpenCV already has many features, including facial recognition, face tracking, face detection, Kalman filtering, etc. And it provides a variety of simple algorithms related to Computer Vision for low level APIs.

According to (12–14) Deep learning is a set of algorithms in machine learning that strive to learn in various levels, according to different levels of abstraction. It usually uses artificial neural networks. The levels in this statistical model are in accordance with different concept levels, where the concept of higher levels is determined from a lower level, and the concept of a lower level can help to define many higher-level concepts.

According to other researchers (15–17) Deep learning is part of machine learning using Artificial Neural Network (ANN). Artificial Neural Network (ANN) is an information process machine that has been modeled on the structure and action of biological neural networks in the brain. The Artificial Neural Network (ANN) is flexible and adaptable on its own to solve obscure complex problems described by mathematical models, such as pattern recognition and classification, function, and control approaches.

According to You Only Look Once (YOLO) is an algorithm developed to detect an object in real-time. The detection system is done by using a repurpose classifier or localizer to perform detection. A model is applied to an image in multiple locations and scales. The area with the highest rated image will be considered a detection. According to another researcher (Redmon, 2016) suggests that Yolo used an ANN approach to detect objects in an image. The network divides the imagery into multiple regions and predicts each bounding box and probability for each region. These bounding boxes are then compared to each predicted probability. Yolo has several advantages compared to the classifier-oriented system, seen from the entire imagery at the time of the test with predictions that are informed globally on the image.

So, from the explanation of research that has been put forward in the background, the idea of this research is to calculate the distance of Physical Distancing with Open CV and Deep Learning around MSMEs culinary tourism. The update proposed in this research is to develop deep learning methods in open-CV and YOLOv3 programming algorithms. The device to be used is raspberry pi and its supporting components until it becomes a prototype. The placement of this prototype will be placed on each table so that it will give a warning if visitors arrive and sit at the table. The way this prototype works is a warning to use buzzers if visitors are known to be close to other visitors and do not heed the restrictions on distance (physical distancing) to reduce the spread of the Covid-19 virus.

The objectives of this research are:

- a. Designing a physical distancing prototype. which can detect the distance between visitors in one dining table.
- b. Knowing the performance of Open CV as a digital image using Deep Learning and YOLOv3 method to monitor the distance between customers in one dining table.
- c. This tool can produce an outer prototype in the lab scale.

2. Research Method

2.1. Path to Novelty Research

The novelty of the research is obtained from carrying out a review of the previous research reference set. The method used to obtain research novelty is to identify problems, hypotheses, method formulation, data collection and analysis to draw conclusions. In this subsection it has been summarized that yolov3 and OpenCV object recognition methods are used as a method to make decisions in calculating physical distancing distance to prevent the transmission of Covid19. From this description, the research has an idea in innovating by connecting the science of information and communication technology with the science of digital technology today.

According to (Punn, et al, 2020) explains that the rampant coronavirus disease 2019 (COVID-19) has brought a global crisis. Motivated by this idea, this article proposes an in-depth learning-based framework for automating the task of monitoring social distances using surveillance video. The proposed framework uses the YOLO v3 object detection model to track people identified with the help of bounding boxes and assigned IDs.

According to (Bhuiyan et al, 2020) explaining about computer vision learning is very concerned because of the global pandemic COVID-19 to improve public health services. Detection of small objects is a more challenging task than computer vision. Compared to other object detections, object detection is very helpful with the superior achievement of face mask detection. with well-done face mask detection by YOLOv3 where it measures performance in real-time. Based on this article it is known that people who wear masks or not are trained by face mask images and non-face mask images. In experimental conditions, real-time video data is completed through detection, localization, and recognition.

According to (Ahmed et al, 2020) explaining about social distance is considered as an adequate preventive measure (norm) against the spread of pandemic viruses. The risk of spreading the virus can be minimized by avoiding physical contact between humans. Therefore, the purpose of this work is to provide an in-depth learning platform for social distance tracking using overhead perspectives. The framework uses the YOLOv3 object recognition paradigm to identify humans in the order of video. Transfer learning methodologies are also implemented to improve model accuracy. In this way, detection algorithms use trained algorithms that connect to extra trained layers using overhead human datasets. The detection model identifies people using detected bounding box information. Using Euclidean distance, the paired distance of the centroid bounding box detected from the specified person. To estimate social distance violations between people, we use estimated physical distance to pixels and set thresholds. A violation threshold is set to evaluate whether the distance value violates the minimum social distance threshold or not. In addition, tracking algorithms are used to detect individuals in the order of video so that people who violate/cross the social distance threshold are also tracked. Experiments are conducted on different video sequences to test the efficiency of the model. The findings suggest that the developed framework successfully distinguishes individuals who walk too close and violate/violate social distance; also, the transfer learning approach improves the efficiency of the overall model.

According to (Zhao, 2020) suggests that the yolov3 model algorithm proposed in Fig.1. is the determination of the width and height of the bounding box (p_w and p_h in the equation (1) and (2), respectively), because it directly affects the performance of the YOLOv3 method.

In the YOLOv3 method, use the k-means grouping algorithm to select the width and height that represent from the bounding box to avoid time in adjusting width and height. The complexity of the k-means clustering method is expressed as $O(n^k d)$ for data based on dimension d and cluster center k , where n is the amount of data. The larger the dataset, the more time-consuming the modeling process. Additionally, the YOLOv3 method is sensitive to the center of the initial cluster. To work around this issue, we implemented the AFK-MC2 method [23] to estimate the width and height of the prior bounding box (Fig 1).

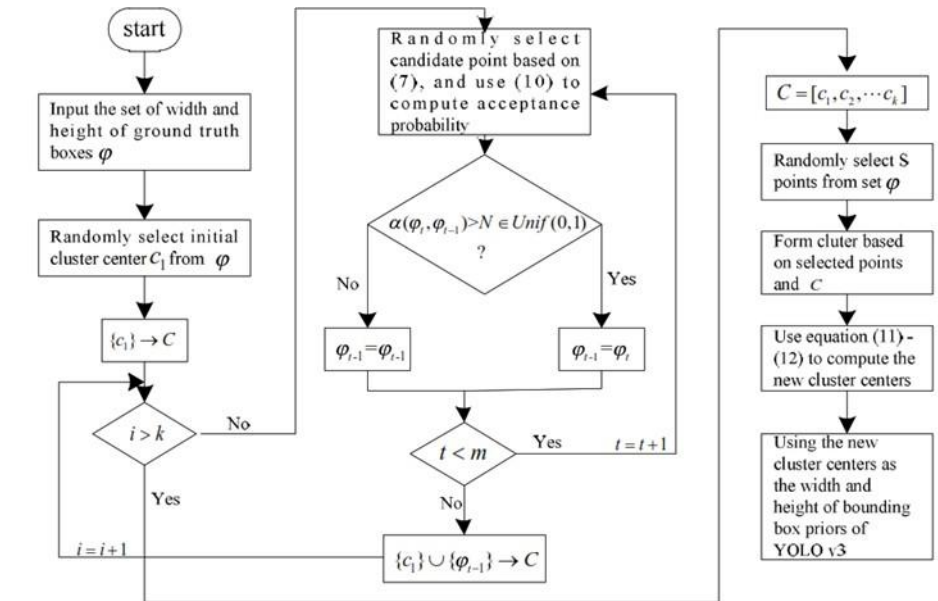


Figure 1. Proposed YOLOv3 method (Zhang,2020)

2.2. Research Method

The prototype design was tested in public places such as crowds and roadside where it consisted of hardware, software, and sampling trials.

Fig.2. shows a diagram of physical distancing hardware design architecture. The plan in the process of detecting the distance between objects required a 5V 3A dc power supply as a voltage source Raspberry Pi 3B+, and Webcam and Monitor Screen to display digital imagery.

In running a physical distancing system is required a controller in the form of a controller program. In the design of physical distancing system required several types of controller programs namely, OpenCV is used to display Digital Imagery, COCO datasheet as object recognition material and YOLOv3 as object detection directly data retrieval method will be done by analyzing the accuracy and time response of an object from the Physical distancing tool how many are able to be detected.

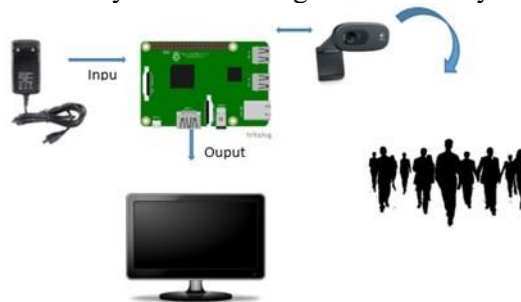


Figure 2. Design architecture diagrams

Based on Fig.3. explaining the process of physical distancing system works. Starting from the active camera, then running the process of object identification carried out by raspberry pi, the processing results are continued by running a human detection program using COCO datasheet and YOLOv3. The two processes are combined to activate the physical distancing system. When physical distancing is active, there will be questions in the form of:

- Is the distance too close?
- Is the object detected?

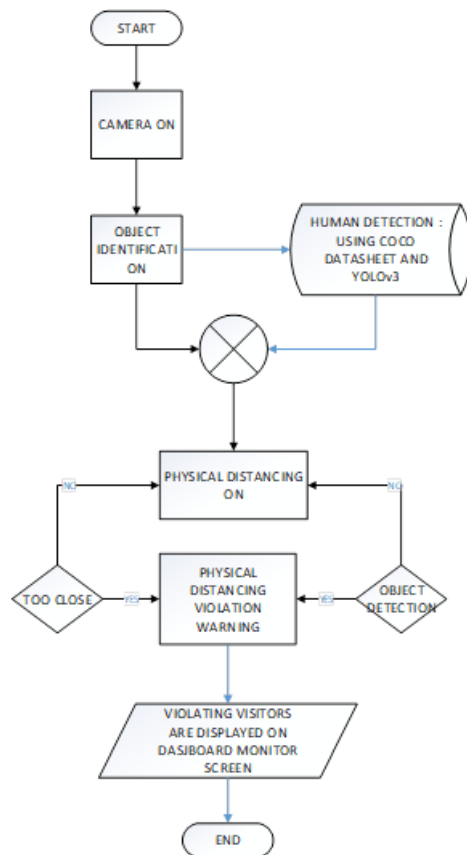


Figure 3. Flowchart system design

If both conditions are "YES" then the system will issue a physical distancing violation warning order whose results are displayed directly on the monitor dashboard screen. If one or both conditions are "NO", then the system will assume that normal conditions and physical distancing systems continue to work. The design of physical distancing system consisting of hardware and software, is tested with several working steps as follows:

- a. Preparation of datasheets that will be used as an introduction to objects where the object selected here is human as the object and tested for 15-20 minutes.
- b. Data analysis with several stages to be carried out, namely Sample Testing and Conducting Analysis.
- c. Processing external data from physical distancing tools will be done by retrieving some data in the form of distance and response recognition between objects that have been tested this aims at whether this tool works properly as expected.

3. Result And Discussion

3.1. Program Data Structure

After passing the design stage, the next step is to analyze the data structure of the program so that it is known the file parts contained in the Physical distancing tool program as shown in Fig.4. Here is the explanation of the program data structure on the prototype designed:

- | | | |
|---|------------------------------|----------------------------------|
| 1 | coco. Names | list of object names in database |
| 2 | Image | folder for storage sample test |
| 3 | Physical Distancing_image.py | Program Physical Distancing |
| 4 | yolov3.cfg | Configure labels |
| 5 | yolov3.weights | Set weights into layers |

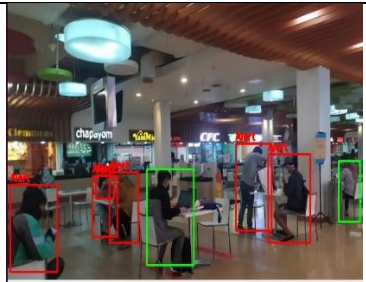
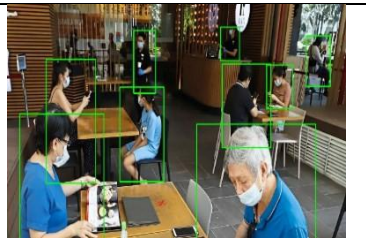
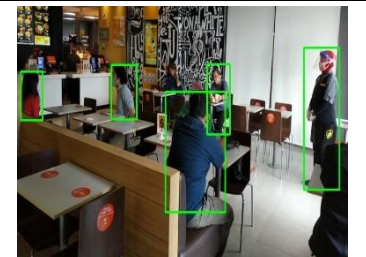


Figure 4. Program data structure

3.2. Prototype Testing

Prototype testing was conducted to test image capture via Webcam/USB camera. The thing that is analyzed is the process of reading the image or not with the provisions using the image test as shown in Table 1. From the test results of Physical Distancing tool with several sample images that each test has different time results in responding to detection with an average response time value of 9.52 second. This is influenced by the size of the file and the number of objects that are in the image.

Table 1. KPI RSRP standard

No	Testing	Number of Captures of People in Pictures	Pixel Image	File Size (KB)	Response Time	Capture Image
1	Test 1	7	700x394p	73.8	8.85	
2	Test 2	9	1240x824p	205	9.72	
3	Test 3	5	640x360p	46.7	10.76	

4	Test 4	6	1231x710	142	9.18	
5	Test 5	2	700x394	100	10.39	
6	Test 6	3	859x713	148	8.69	
7	Test 7	3	859x713	183	8.88	
Average response time					9.52	

4. Conclusion

After going through the design and testing stages both in terms of installation and programming. Finally, with some review of the observations and testing of prototype tools, it can be concluded that the use of motionless images in jpg and jpeg format can be identified objects by processing from the OpenCV and Yolov3 programs. Objects in observation must use a clear perspective image so that the program can recognize the object, red marking when breaking Physical Distancing will work when between objects close to each other. X96 Max Plus TV Box can work just as well as a computer for programming and data processing.

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