**PHYSICAL DISTANCE MEASUREMENT USING RASPBERRY PI AND OPEN CV**

**INFORMATION SYSTEMS DESIGN AND DEVELOPMENT**

in

**INFORMATION SYSTEMS**

By

**BEKKAM SIDDIGARI SAI BHARATH REDDY KANTA SURAJ VAMSI**

**MUKKISA VAMSHI KRISHNA REDDY**

**PEREPI PARDHAVI**

**PROFESSOR – JAMES CURRY**

**PACE UNIVERSITY**

**ABSTRACT**

We’ll be using the weights of the YOLO v3 Object Detection Algorithm with the Deep Neural Network Social distancing is a method used to control the spread of contagious diseases. As the name suggests social-distancing is an effective way to slow down the transmission of infectious virus (such as corona virus). People are advised to minimize their contact with each other to minimize the risk of the disease being transmitted through direct contact. Maintaining a safe distance is a challenge for many places like factories, banks, buses or railway stations, etc. So here we are going to build a Social Distancing Detector system using Open CV and Raspberry Pi. Using computer vision technology based on Open CV and YOLO -based deep learning, we are able to estimate the social distance of people in video streams module. Raspberry Pi is always a good choice for Image processing projects as it has more memory and speed than other controllers.

**CONTENTS**

***ACKNOWLEDGEMENT iii***

***ABSTRACT iv***

***LIST OF FIGURES viii***

***LIST OF TABLES ix***

***LIST OF ACRONYM x*  Chapter No. Title Page No.**

**1 INTRODUCTION** 01

1.1 OVERVIEW 01

1.2 EXISTING METHODS

1.2.1 04

1.3 PRESENT WORK 06

1.4 LITERATURE SURVEY 07

**2 Hardware/software tools** 09

2.1 09

2.2 10

2.2.1 11

2.2.2 13

2.2.3

2.2.4

14

2.3 14

**3 PROJECT IMPLEMENTATION**

3.1 19

3.2 21

3.2.1 22

3.3 24

3.3.1 24

3.3.2 28

3.3.429

3.3.5 30

3.3.6 32

3.436

3.4.1 36

3.4.2. 37

**4 SIMULATION RESULTS & ANALYSIS** 38

**5 CONCLUSION & FUTUTRE SCOPE** 46

5.1 CONCLUSION 46

5.2 FUTURE SCOPE 46

**BIBLIOGRAPHY APPENDIX**

1. **INTRODUCTION**

**1.1 OVERVIEW**

In the time of Covid-19, Social-distancing is an effective way to slow down the transmission of infectious virus. People are advised to minimize their contact with each other to minimize the risk of the disease being transmitted through direct contact. Maintaining a safe distance is a challenge for many places like factories, banks, buses or railway stations, etc.

So, in continuation of our previous Corona safety projects like Automatic sanitizer machine, Contactless temperature monitoring, here we are going to build a **Physical Distancing Detector system using OpenCV and Raspberry Pi**. We’ll be using the weights of the YOLO

Raspberry Pi is always a good choice for Image processing projects as it has more memory and speed than other controllers. We previously used Raspberry Pi for some complex image processing projects like Facial landmark detection Facial recognition application

**1.2 EXISTING METHODS**

* To track humans position in an outdoor environment based on sensors and gives an alert to person if someone ranges 2 feet around them.
* To identify people in a given frame using SSD (Single Shot Detector). After computing a pairwise distance between the centroids of the detected bounding boxes of people, this value is compared to a predefined minimum pixel threshold.
* This aims to propose a wearable social distancing detector that uses a microcontroller with an ultrasonic sensor to detect the distance between two persons and provides a warning if the person fails to obey the rule.
* Proposed a methodology for monitoring social distancing with person detection and tracking. A deep sort technique was used to track the identified people with the help of bounding boxes and assigned tracking IDs**.**

**1.3 PRESENT WORK**

**1.4 LITERATURE SURVEY**

Rahul Reddy Nadikattu, Sikender Mohsienuddin Mohammad and Pawan Whig, Novel Economical Social Distancing Smart Device for Covid19. International Journal of Electrical Engineering and Technology, 11(4), 2020, pp. 204-217.[1]

Objective: This method aims to track humans’ position in an outdoor environment based on sensors and gives an alert to person if someone ranges 2 feet around them**.**

Drawback: The accuracy of the device is reduced because of using not well-designed sensor**.**

A. Rosebrock, OpenCV social distancing detector, Jun 2020[2].

Objective: In this method he aims to identify people in a given frame using SSD (Single Shot Detector). After computing a pairwise distance between the centroids of the detected bounding boxes of people, this value is compared to a predefined minimum pixel threshold.

Drawback: SSD (Single Shot Detector) runs a convolutional network oninput image only one time and computes a feature map.

F. A. A. Naqiyuddin, W. Mansor, N. M. Sallehuddin, M. N. S. Mohd Johari, M. A. S. Shazlan and A. N. Bakar, "Wearable Social Distancing Detection System," 2020 IEEE International RF and Microwave Conference (RFM), Kuala Lumpur, Malaysia, 2020, pp. 1-4, doi: 10.1109/RFM50841.2020.9344786[3].

Objective: This aims to propose a wearable social distancing detector that uses a microcontroller with an ultrasonic sensor to detect the distance between two persons and provides a warning if the person fails to obey the rule.

Drawback: Here by using ultrasonic sensor we get limited testing distance, inaccurate readings, and inflexible scanning methods.

N. S. Punn, S. K. Sonbhadra and S. Agarwal, Monitoring covid-19 social distancing with person detection and tracking via fine**-**tuned deep sort techniques, 2020.[4]

Objective: He proposed a methodology for monitoring social distancing with person detection and tracking. A deep sort technique was used to track the identified people with the help of bounding boxes and assigned tracking IDs.

Drawback: This approach doesn’t measure the distance between each pair of people. As the authors themselves acknowledge, it could have achieved better precision if they had used YOLOv3

**2.HARDWARE/SOFTWARE COMPONENTS**

* 1. **HARDWARE COMPONENTS**

1. Raspberry Pi 4
2. HDMI Cable
3. Power Adapter
4. Memory Card
5. Monitor
   * 1. **RASPBERRY PI OS**

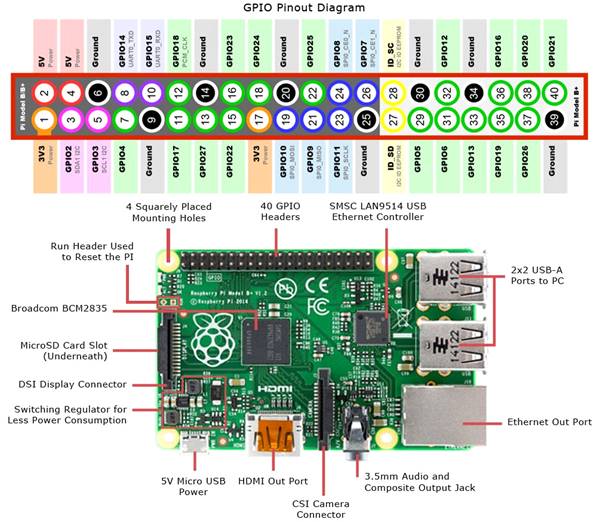
**Raspberry Pi OS** (formerly **Raspbian**) is a Debian -based Operating system for Raspberry Pi. Since 2015, it has been officially provided by the Raspberry Pi foundation as the primary operating system for the Raspberry Pi family of compact single-board computer. The first version of Raspbian was created by Mike Thompson and Peter Green as an independent project. The initial build was completed in June 2012.

Raspberry Pi OS is highly optimized for the Raspberry Pi line of compact single-board computers with ARM CPUs. It runs on every Raspberry Pi except the Pico microcontroller. Raspberry Pi OS uses a modified LXDE as its desktop environment with the Openbox stacking window manager, along with a unique theme. The distribution is shipped with a copy of the algebra program Wolfman mathematician and a version of Minecraft called *Minecraft: Pi Edition*, as well as a lightweight version of the chromium.

web browser. **Raspberry Pi** is a series of small single-board computers developed in the united kingdoms by the Raspberry pi foundation in association with Broadcom.The Raspberry Pi project originally leaned towards the promotion of teaching basic computer science in schools and in developing systems. The original model became more popular than anticipated, selling outside its target market for uses such as robotics. It is widely used in many areas, such as for weather monitoring, because of its low cost, modularity, and open design. It is typically used by computer and electronic hobbyists, due to its adoption of HDMI and USB devices.

The raspberry pi board comprises a program memory (RAM), processor and graphics chip, CPU, GPU, Ethernet port, GPIO pins, Xbee socket, UART, power source connector. And various interfaces for other external devices. It also requires mass storage, for that we use an SD flash memory card. So that raspberry pi board will boot from this SD card similarly as a PC boots up into windows from its hard disk.

Essential hardware specifications of raspberry pi board mainly include SD card containing Linux OS, US keyboard, monitor, power supply and video cable. Optional hardware specifications include USB mouse, powered USB hub, case, internet connection, the Model A or B: USB WIFI adaptor is used and internet connection to Model B is LAN cable.



The raspberry pi model Aboard is designed with 256MB of SDRAM and model B is designed with 51MB.Raspberry pi is a small size PC compare with other PCs. The normal PCs RAM memory is available in gigabytes. But in raspberry pi board, the RAM memory is available more than 256MB or 512MB.

The Central processing unit is the brain of the raspberry pi board and that is responsible for carrying out the instructions of the computer through logical and mathematical operations. The raspberry pi uses ARM11 series processor, which has joined the ranks of the Samsung galaxy phone.

The GPU is a specialized chip in the raspberry pi board and that is designed to speed up the operation of image calculations. This board designed with a Broadcom video core IV and it supports OpenGL.

The general-purpose input & output pins are used in the raspberry pi to associate with the other electronic boards. These pins can accept input & output commands based on programming raspberry pi. The raspberry pi affords digital GPIO pins. These pins are used to connect other electronic components. For example, you can connect it to the temperature sensor to transmit digital data.

The XBee socket is used in raspberry pi board for the wireless communication purpose.

The power source cable is a small switch, which is placed on side of the shield. The main purpose of the power source connector is to enable an external power source.

The Universal Asynchronous Receiver/ Transmitter is a serial input & output port. That can be used to transfer the serial data in the form of text and it is useful for converting the debugging code.

The connection options of the raspberry pi board are two types such as HDMI and Composite. Many LCD and HD TV monitors can be attached using an HDMI male cable and with a low-cost adaptor. The versions of HDMI are 1.3 and 1.4 are supported and 1.4 version cable is recommended. The O/Ps of the Raspberry Pi audio and video through HMDI, but does not support HDMI I/p. Older TVs can be connected using composite video. When using a composite video connection, audio is available from the 3.5mm jack socket and can be sent to your TV. To send audio to your TV, you need a cable which adjusts from 3.5mm to double RCA connectors.

* 1. **SOFTWARE COMPONENTS**

1. Open CV
2. YOLO (You only look once) convolution neural network
   * 1. **OPEN CV**

OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products. Being a BSD-licensed product, OpenCV makes it easy for businesses to utilize and modify the code.

The library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state-of-the-art computer vision and machine learning algorithms. These algorithms can be used to detect and recognize faces, identify objects, classify human actions in videos, track camera movements, track moving objects, extract 3D models of objects, produce 3D point clouds from stereo cameras, stitch images together to produce a high resolution image of an entire scene, find similar images from an image database, remove red eyes from images taken using flash, follow eye movements, recognize scenery and establish markers to overlay it with augmented reality, etc. OpenCV has more than 47 thousand people of user community and estimated number of downloads exceeding 18 million. The library is used extensively in companies, research groups and by governmental bodies.

Along with well-established companies like Google, Yahoo, Microsoft, Intel, IBM, Sony, Honda, Toyota that employ the library, there are many start-ups’ such as Applied Minds, VideoSurf, and Zeitera, that make extensive use of OpenCV. OpenCV’s deployed uses span the range from stitching street view images together, detecting intrusions in surveillance video in Israel, monitoring mine equipment in China, helping robots navigate and pick up objects at Willow Garage, detection of swimming pool drowning accidents in Europe, running interactive art in Spain and New York, checking runways for debris in Turkey, inspecting labels on products in factories around the world on to rapid face detection in Japan.

It has C++, Python, Java and MATLAB interfaces and supports Windows, Linux, Android and Mac OS. OpenCV leans mostly towards real-time vision applications and takes advantage of MMX and SSE instructions when available. A full-featured CUDA and OpenCL interfaces are being actively developed right now. There are over 500 algorithms and about 10 times as many functions that compose or support those algorithms. OpenCV is written natively in C++ and has a templated interface that works seamlessly with STL containers.

These instructions are specific to OpenCV library documentation, other projects can use different layout scheme and documenting agreements. Documentation locations. Whole documentation is gathered from many different places: **source code entities, like classes, functions or enumerations, should be documented in corresponding header files,** right prior entity definition.

* + 1. **YOLO (YOU ONLY LOOK ONCE)**

YOLO, Also Known as You Only Look Once is one of the most powerful real-time object detector algorithms. It is called that way because unlike previous object detector algorithms, like R-CNN or its upgrade Faster R-CNN it only needs the image (or video) to pass one time through its network. These old methods were successively examining several regions of the image to find the objects present in it. YOLO changed that by reasoning at the level of the overall image. To do so, YOLO uses a unique neural network using the characteristics of the entire image to predict multiple boxes, each containing a specific object. All this simultaneously. To achieve this, the image is divided into ‘S’ x ‘S’ region. Then, if the center of an object is in one of these regions, the region in question is responsible for detecting the object. Each of the cells in this grid is responsible for predicting ‘B’ boxes all containing an object as well as a score representing the level of confidence for the object present in the box. If there are no objects in the cell, this score should be zero. Otherwise, if an object is in the cell, the score will be equal to the intersection over union (IOU) between the predicted box and the ground truth of the image. Then, we need the class-specific confidence scores for each box which is done using a convolutional neural network based on the Google Net network. The output of this algorithm will be the image (or video), sent as the input, with the objects localized and the class attached to it. As previously discussed, YOLO reasons at the level of the overall picture, rather than examining successively several regions. This allows a huge increase in detection speed but causes a small decrease in the accuracy of object detection compared to the other detection methods seen previously. It is actually one of the most powerful and used object detector algorithms right now in multiple fields like autonomous vehicles, poker cheat detection, and more.

