iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** I **Month of publication:** January 2023

DOI: https://doi.org/10.22214/ijraset.2023.48549

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue I Jan 2023- Available at www.ijraset.com

Real Time Object Detection Using Raspberry Pi

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Abstract: ***Due to recent advances in deep learning, the performance of object detection techniques has greatly increased in both speed and accuracy. This enabled highly accurate real-time object detection in modern desktop systems. This project investigates the applicability of working object detection on Raspberry Pi 3.***
Real-time detection of objects requires a lot of processing power, and achieving real-time speed is a difficult task in a system with limited performance. Many different methods can be used to detect objects. Two methods were implemented in the Raspberry Pi 3 B to determine if they are suitable to work with such weak hardware. An implemented target detector is considered suitable if it achieves a high enough resolution and frame rate to be useful in practical applications. The evaluation performs a number of tests on each detector and measures their performance in terms of detection accuracy, hell time, and frame rate. Raspberry Pi Model B, which is the latest and most powerful product of the Raspberry Pi series, is used as hardware. The camera used is a Raspberry Pi Camera Module v2.
Keywords: Raspberry Pi3, object detection, real time, detection technique, camera module.

I. INTRODUCTION

An essential piece of equipment in today's culture is the closed-circuit television monitoring system. Supermarkets, industries, hospitals, hotels, schools, shopping centres, and organised businesses all have their own CCTV systems for round-the-clock surveillance. Customers can now own their affordable security systems with the little supercomputer known as the Raspberry Pi3 instead of the conventional wireless CCTV surveillance cameras. Due to its ability to send and receive data across computer networks and the internet using the internet protocol, IP cameras can perform better. Additionally, IP cameras have much greater resolution and clarity than CCTV cameras. Effective use of Motion Detection promotes an automated approach to video system reaction, and does not require an individual to start and stop recording sessions. So, we can significantly decrease storage usage and save investment costs.

A camera module attached to the Raspberry Pi will capture all activity in the area being watched, and live streaming may be viewed in real-time from any web browser, including mobile devices.

The picture is blurry, anomalies cannot be detected automatically, and a lot of storage space is required to store the surveillance data, among other issues with the video surveillance system. Additionally, because to its prospective applications in numerous fields, such as video surveillance, traffic monitoring, or sign language identification, Object Detection has recently piqued the interest of computer vision researchers. We use the Object Detection algorithm for live camera streaming to solve the storage capacity problem. This enables the system to analyse incoming camera images and detect movement. The video system can then compile and save the most crucial items for admins to evaluate.

Effective use of Object Detection promotes an automated approach to video system reaction, and does not require an individual to start and stop recording sessions. So, we can significantly decrease storage usage and save investment costs.

II. LITERATURE REVIEW

These days, the main objective in video surveillance applications is object recognition from a video. In order to locate necessary objects in video sequences and group their pixels together, object detection technology is performed. In many applications, especially those used for video surveillance, the detection of an item in a video sequence is crucial. Processes including pre-processing, segmentation, foreground and background extraction, and feature extraction can be used to recognise objects in a video stream.

Humans are able to quickly recognise and locate things in an image. With minimal conscious effort, the human visual system can complete complicated tasks like recognising several objects. It is quick and accurate. We can now readily train machines using vast amounts of data, faster GPUs, and improved algorithms.

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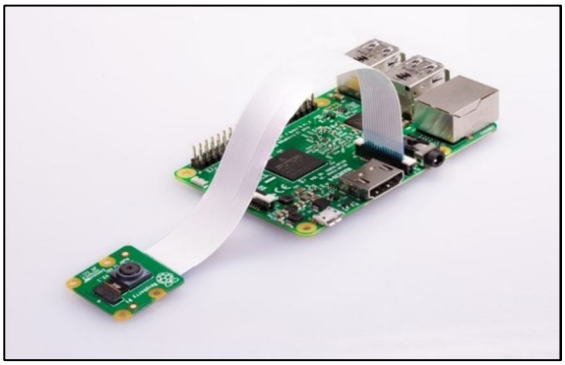
III. METHODOLOGY

Finding and identifying instances of real-world objects, like cars, bikes, TVs, flowers, touchable objects, and people, in photos or videos is a process known as object detection. An object detection technique enables the identification, localisation, and detection of numerous things inside an image, allowing you to comprehend the specifics of an image or video. Applications including image retrieval, security, surveillance, object detection, face detection, and advanced driver assistance systems commonly make use of it (ADAS).

Object detection can be done in a variety of ways:

1) Detection of Feature-Based Objects
2) Object detection with Viola-Jones
3) Deep Learn Object Detection and HOG Features in SVM Classifications



A. Hardware Specifications

1) Raspberry Pi3 B+ Model

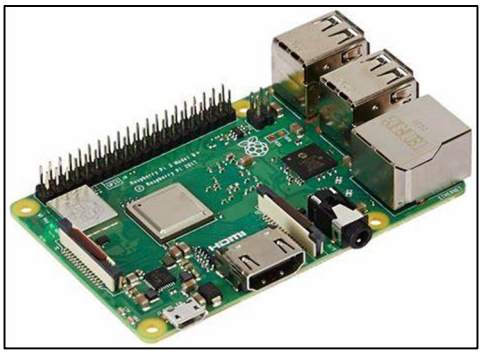


Fig 3.1. Raspberry Pi3

2) Raspberry Pi Camera Module V2

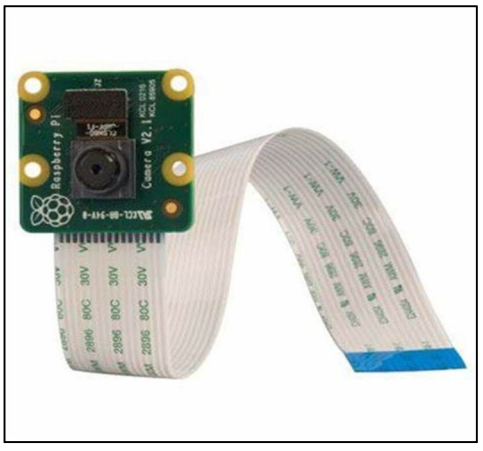


Fig 3.2. Raspberry Pi Camera

3) Ribbon Cable

Fig 3.3. Ribbon Cable

IV. WORKING AND ITS PRINCIPLE

The main working principle is that object detection is no longer a GPU heavy task, as it has been accomplished on an IoT based device like Raspberry Pi. Open CV module is used along with the TensorFlow Object Detection API from Github. We also use COCO API, an open source object detection API that enables us to work with 96 different objects that have been extensively trained by COCO.

The main method working with the detection is the 'Dnn-detection' method. It takes two arguments namely, config-path and weights-path. Config-path is taken from TensorFlow API and the weights-path is given by the COCO names file.

Since, Raspberry Pi does not show output directly, in the project we will be using VNC Viewer client to display the output. VNC Viewer connects to the Raspberry Pi via ip address and let's us interface with the RPi from our desktop computer. VNC Viewer helps us interface with RPi in a headless way.

In further iterations of the project, we will be able to output the objects into another program or into an LCD Screen.

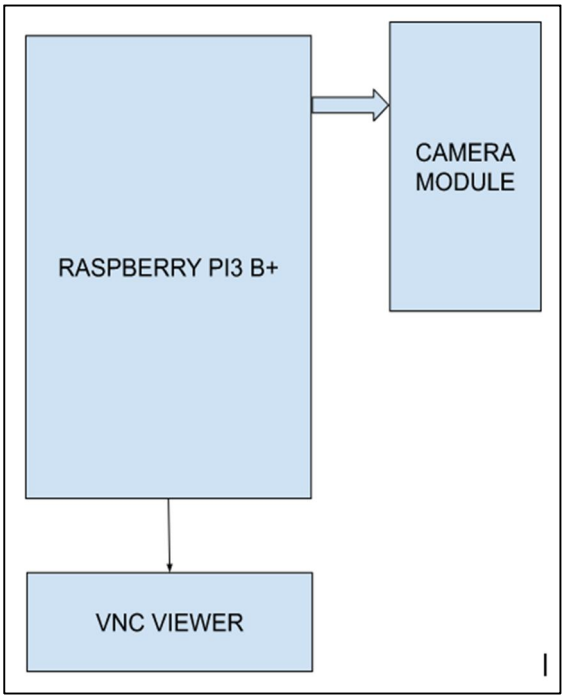


Fig 4.1 Interface of Raspberry Pi with other modules.

A. Connections

1) Format sd card
2) Download sd card writer
3) Download raspberry pi OS from https://www.raspberrypi.com/software/operating-systems
4) Write Raspberry Pi OS to SD card
5) Complete setup and connect to mobile hotspot
6) Find ip address of rpi by hostname -I
7) Download putty and vnc on laptop
8) Connect raspberry pi using putty ssh
9) Raspi-config and enable vnc viewer
10) Open vnc viewer and enter ip address to connect
11) Install open cv modules and update all modules
12) Pip install --upgrade pip setuptools wheel
13) Sudo apt-get install -y libhdf5-dev libhdf5-serial-dev python3-pyqt5 libatlas-base-dev libjasper-dev
14) Pip install opencv-contrib-python==4.5.5.62
15) Check version of installed OpenCV by cv2.__version__ in python command line
16) Go to raspi-config and enable Camera Module in Interface Options
17) Write the code in Geany IDE and save in a project folder
18) Add the required files to the folder
19) Run the program and check the output

V. RESULTS

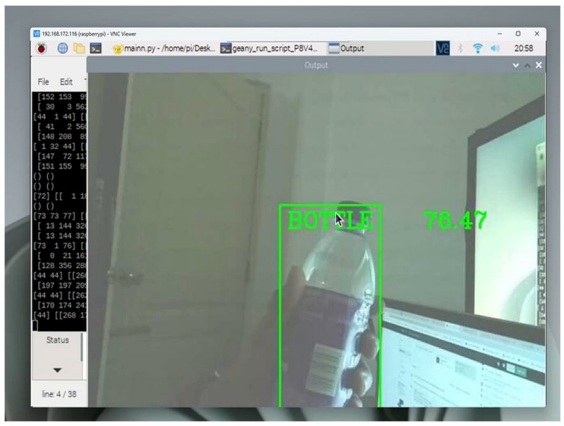


Fig 5.1. Detection of bottle

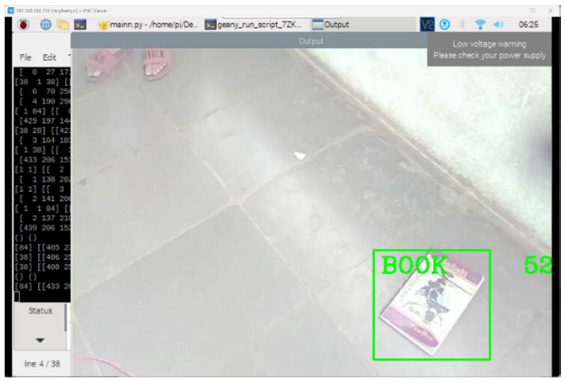


Fig 5.2 Detection of Book

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
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VI. CONCLUSION

Deep learning, OpenCV, and efficient, threaded video streams for object detection. Noise from the camera sensor and lighting conditions can alter the outcome since they make object recognition difficult. Typically, GPUs rather than CPUs are needed for the entire process. However, we've done away with GPUs and it now performs considerably faster, making it efficient. Object detection techniques combine the functions of object localisation with image categorization. It uses the provided video feed as an input and outputs a video with bounding boxes that are appropriate for the number of items visible in the video, each with a category name at the top. It projects the bounding box scenario up the location, height, and width.

An approach for the surveillance monitoring system and the Motion Detection algorithm to decrease storage usage based on Raspberry Pi single board computer was proposed in this paper. This is still far from being final version of the monitoring system and there is lot to improve. The database is limited by the objects from Coco names. In future we plan to improve the Motion Detection algorithm. Because the algorithm depends on threshold value, it's mean value the performance of the algorithm can be enhanced by considering certain conditions. If we have a good solution to get a good threshold value and then the algorithm can detect moving objects precisely, including slow moving or tiny objects.

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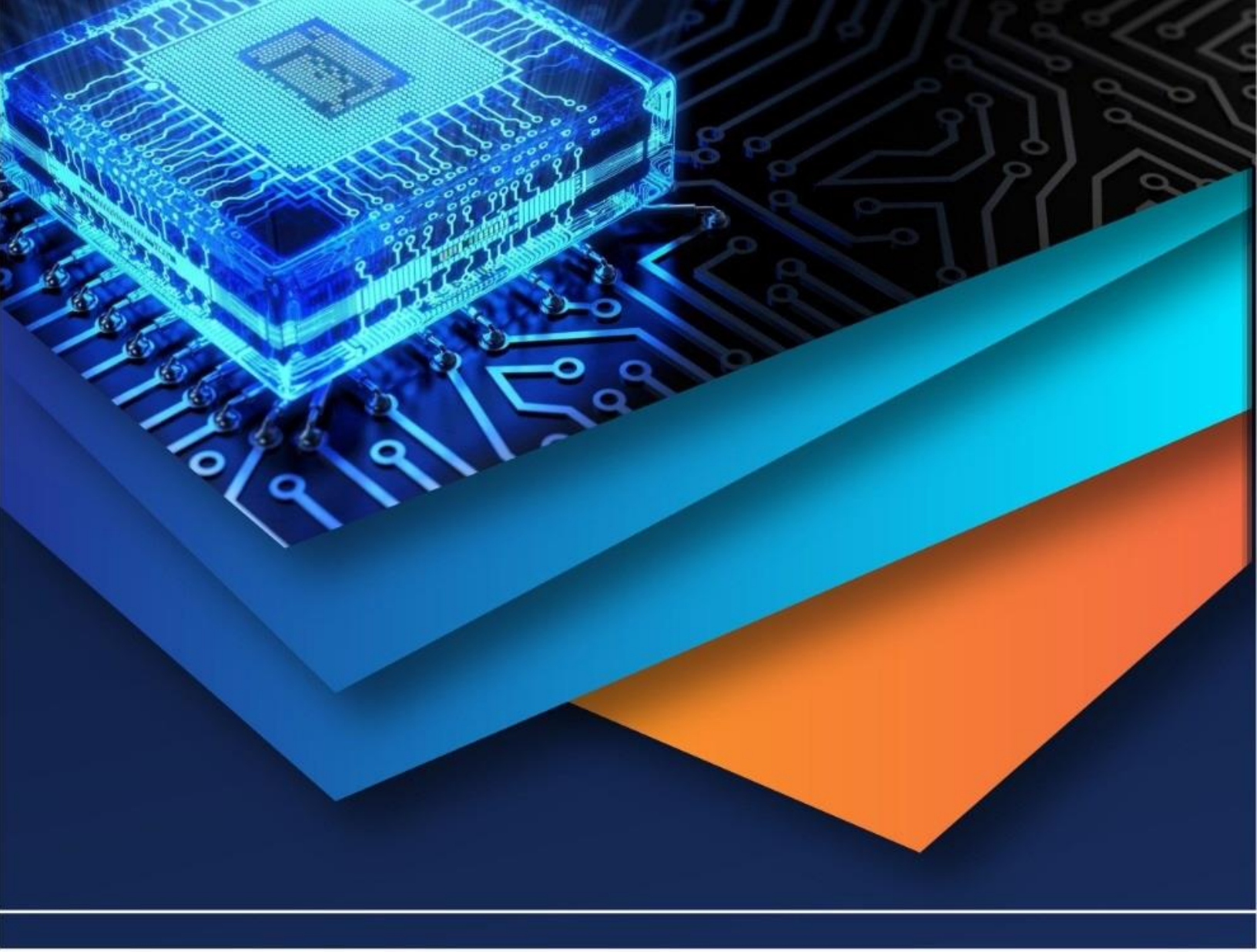

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