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HORUS - Heuristic Object Recognition Unified System Using YOLO and CUDA

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Abstract: ***The object detection based on deep learning is an important application in deep learning technology, which is characterized by its strong capability of feature learning and feature representation compared with the traditional object detection methods. The paper first makes an introduction of the classical methods in object detection and expounds the relation and difference between the classical methods and the deep learning methods in object detection. Then it introduces the emergence of the object detection methods based on deep learning and elaborates the most typical methods nowadays in the object detection via deep learning. In the statement of the methods, the paper focuses on the framework design and the working principle of the models and analyzes the model performance in the real-time and the accuracy of detection. Eventually, it discusses the challenges in the object detection based on deep learning and offers some solutions for reference.***
Keywords: Convolutional Neural Network, YOLO, CNN, Object Detection, OpenCV

I. INTRODUCTION

Object detection is a computer technology related to computer vision and image processing that deals with detecting instances of semantic objects of a certain class (such as humans, buildings, or cars) in digital images and videos. You can use a variety of techniques to perform object detection. Popular deep learning–based approaches use convolutional neural networks (CNNs) such as R-CNN and YOLO v2. This task is referred as object detection which usually consists of different subtasks such as face detection pedestrian detection and skeleton detection. As one of the fundamental computer vision problems, object detection is able to provide valuable information for semantic understanding of images and videos, and is related to many applications, including image classification human behaviour analysis, face recognition and autonomous driving. Meanwhile, Inheriting from neural networks and related learning systems, the progress in these fields will develop neural network algorithms, and will also have great impacts on object detection techniques which can be considered as learning systems. The problem definition of object detection is to determine where objects are located in a given image (object localization) and which category each object belongs to (object classification). So the pipeline of traditional object detection models can be mainly divided into three stages: informative region selection, feature extraction and classification.

II. OBJECTIVES

1) To use a CCTV camera for the input to the system.
2) To implement fast paced algorithms such as YOLO and faster R-CNN to detect the objects in the images received from the input.
3) To alert the user if a certain user provided objects are detected by the algorithm. • To implement the proposed system such that it is able to detect new objects using deep learning.
4) To analyse speed and efficiency of the algorithms and select the most optimal algorithm for the task.

III. TYPES OF OBJECT DETECTION ALGORITHMS

YOLO (You Only Look Once)

You Only Look Once or YOLO is one of the popular algorithms in object detection used by researchers around the globe. According to the researchers at Facebook AI Research, the unified architecture of YOLO is extremely fast in manner. The base YOLO model processes images in real-time at 45 frames per second, while the smaller version of the network, Fast YOLO processes an astounding 155 frames per second while still achieving double the map of other real-time detectors. This algorithm outperforms the other detection methods, including DPM and R-CNN, when generalizing from natural images to other domains like artwork. The YOLO Detection System. Processing images with YOLO is simple and straightforward.

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Our system resizes the input image to 448 × 448, runs a single convolutional network on the image, and thresholds the resulting detection's by the model's confidence. methods to first generate potential bounding boxes in an image and then run a classifier on these proposed boxes. After classification, post-processing is used to refine the bounding boxes, eliminate duplicate detections, and rescore the boxes based on other objects in the scene . These complex pipelines are slow and hard to optimize because each individual component must be trained separately. We reframe object detection as a single regression problem, straight from image pixels to bounding box coordinates and class probabilities.

IV. SYSTEM OVERVIEW

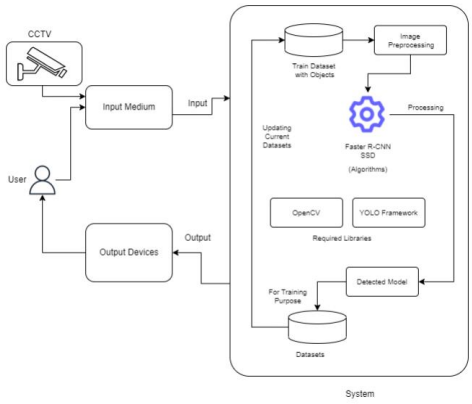


Fig. 3 System Architecture

The proposed system is designed to take input from CCTV cameras and use fast-paced algorithms such as YOLO and OpenCV to detect objects. It will then alert the user if any suspicious objects are detected. The list of suspicious objects can be modified and updated by the user as per their needs. The system will also be able to distinguish between known and unknown objects, helping to identify any potential threats. Additionally, the system will be able to store the data in a secure database for future reference. All in all, the proposed system is designed to be an efficient and reliable solution for detecting any suspicious objects in a given area.

V. CUDA (COMPUTE UNIFIED DEVICE ARCHITECTURE)

The need for enhanced computation power is increasing day by day. Manufacturers across the globe are now facing challenges to further improve CPUs due to limitations i.e. size, temperature, etc. In such a situation, solution providers have started to look for performance enhancement elsewhere. One of the solutions that allow a drastic increase in performance is the use of GPUs for parallel computing. The number of cores in a GPU is far more than that of a CPU. A CPU is designed to perform tasks sequentially, a set of tasks can be offloaded on the GPU which allows parallelization.

Within the supported CUDA compiler, any piece of code can be run on GPU by using the global keyword. Programmers must change their malloc/new and free/delete calls as per the CUDA guidelines so that appropriate space could be allocated on GPU.

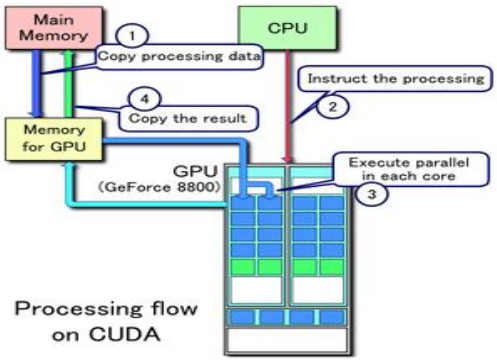
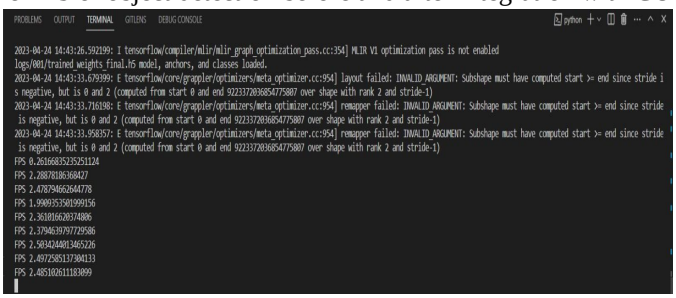
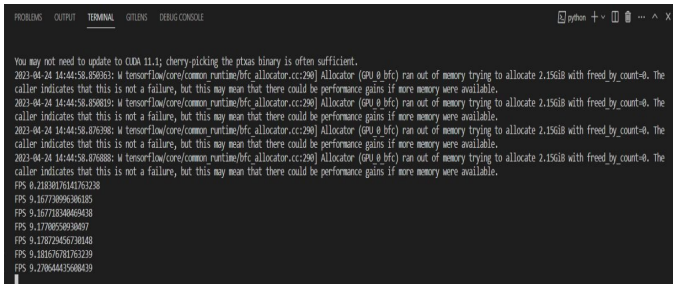


Fig. 4 Processing Flow of CUDA

In the proposed system we observed that the system gets performance improvement of upto 3.5 times when it is integrated with CUDA. Below screenshots show the FPS of object detection before and after integration with CUDA.



A. Fig. 5 Before CUDA



B. Fig. 6 After integration of the system with CUDA

VI. CONCLUSION AND FUTURE WORK

A. Conclusion

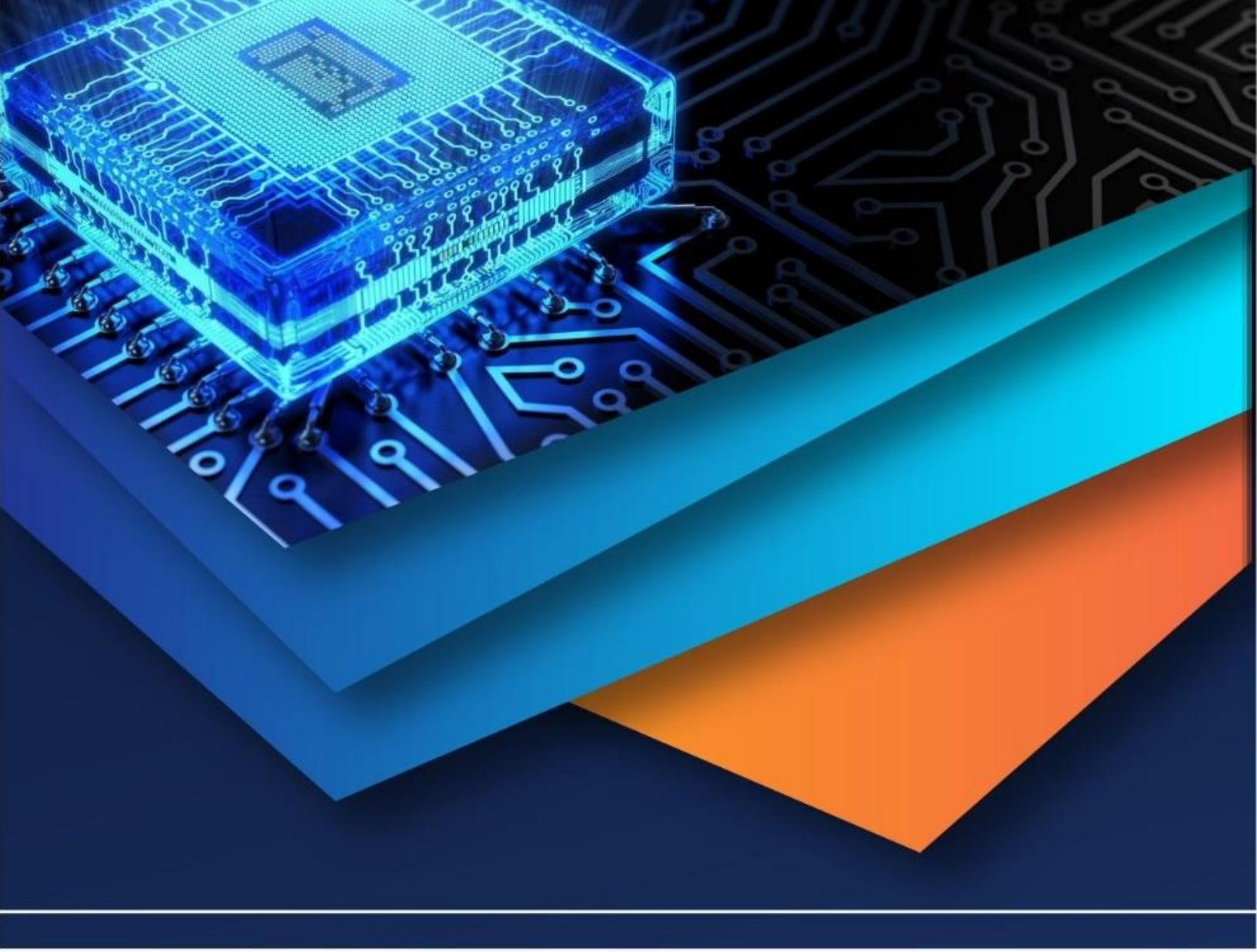
Thus, the proposed system has the potential to detect real time objects using deep learning. The proposed project will use advanced and state-of-art libraries and algorithms to implement the object detection technology into a real time system. The proposed system will be able to alert the user if certain items are detected. It will also improve automatically over the time as user provides new items to the algorithm for detection.

B. Future Work

The work of the system can be extended to provide remote perimeter security. The alert that is to be generated can be sent to the user via Internet. The user can then use his/her mobile phone to see the alert generated. To achieve this scope, the current system is needed to be integrated with Internet of Things (IoT) devices.

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