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Real Time Object Detection and Identification Using TensorFlow

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Abstract

Security plays a major role in today's world. Object detection is mostly used for security purposes. It is also widely used in the world of sports, its users including training staff, broadcasters and sports. YOLO (you only look once) object detection algorithm is used for image classification. Tensor flow objectdetection API, an open source framework for object detection related tasks, was used for training and testing SSD (single shot multibox detector) with Mobile net- model. It detects the objects and displays that object name in the stored video as well as in a live camera. With an object detection model, not only can you classify multiple classes in one image, but you can specify exactly where that object is in an image with a bounding box framing the object. It is also used by the government to access security feeds and match it with their existing database to find any criminals or to detect the robbers' vehicle.

Keywords**:** *YOLO object detection, Tensor flow object detection API.*

1. Introduction:

Object detection is the process of finding real world object instances like car, bike, TV, flowers and humans in still images or videos. Humans can easily detect and identify the objects present in an image. The human visual system is fast and accurate and can perform complex tasks like identifying multiple objects and detect obstacles with little conscious thought. With the availability of a large amount of data, faster GPU's, and better algorithms, we can now easily train computers to detect and classify multiple objects within an image with high accuracy. In this blog, we will explore terms such as object detection, object localization, loss function for object detection and localization, and finally explore an object detection algorithm known as "You Only Look Once" (YOLO).

It is difficult to identify an object moving with high speed for a human eye. Object detection identifies the objects moving with very high speed. The goal of object detection is to determine whether there are any instances of objects from given categories (such as humans, cars, bicycles, trucks, animals, etc.,) in an image and, if present, to return this spatial location and extent of each object instants (e,g., via a bounding box Everinghan et al. 2010; Russakovsky et al. 2015). As the cornerstone of image understanding and computer vision, object detection forms the basis for solving complex or high-level vision tasks such as

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segmentation, scene understanding, object tracking, image captioning, event detection, and activity recognition. Object detection supports a wide range of applications, including robot vision, consumer electronics, security, autonomous driving, human computer interaction, content-based image retrieval, intelligent video surveillance and augmented reality.

There are many problems closely related to that of generic object detection. The goal of object classification or object categorization is to assess the presence of objects from a given set of object classes in an image; i.e., assigning one or more object class labels to a given image, determining the presence without the need of location. The additional requirement to locate the instances in an image makes detection a more challenging task than classification.

The object recognition problem denotes the more general problem of identifying/localizing all the objects present in an image, subsuming the problems of object detection and classification. Generic object detection is closely related to semantic image segmentation, which aims to assign each pixel in an image to a semantic class label. Object instance segmentation aims to distinguish different instances of the same object class, as opposed to semantic segmentation which does not.

2. Related Works:

Dr. P.V. Rama Raju., et al. [8], suggested a method for Detection and Classification of Pests Using Neural Networks. In the current work texture statistics are employed for the detection of pests on the leaves. The input color image is transformed to HSI image because it is the best color descriptor.

Nagaraju G., et al. [4], proposed a Skin lesion risk assessment by segmentation and digital watermarking. Here an Image watermark is the invisible image or data which may be inserted into a digital image. The inserted watermark should not disturb or modify the visual quality of the image and also it is resistant to the signal processing operations, such as cropping, resizing, and compression.

Dr.P.V.Rama Raju, et al. [9], explained a Brain Tumor Segmentation Using Convolutional Neural Networks & Patch Process for MRI Images. The proposed method is a novel CNN-based method for segmentation of brain tumors in MRI images. Proposed method reduces the computation time and also the sensitivity of the proposed method is high compared with another state-of-the-art method.

LirieKoraqi., et al. [7], presented an algorithm for Identification and tracking of objects during the motion. Detection of objects is an important feature of information technology, there are many challenges regarding detection and identification.

G. Nagaraju, et al. [3], suggested a method called Segmentation of MRI Image for the Detection of Brain Tumour. The main technique used was segmentation which is based on thresholding and morphological operators. Segmentation algorithms used were k-means and fuzzy c-means which made segmentation process easy.

Carreira, J., &Sminchisescu, et al. [12], suggested an Automatic object segmentation using constrained parametric min cuts. Here used an algorithm that casts the automatic image segmentation problem as one of generating a compact set of plausible figure-ground object hypotheses. It does so by learning to rank figure-ground segmentations, using ground truth

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annotations available in object class recognition data sets and based on a set of low and mid-level properties

G.Nagaraju, et al. [5], proposed the Text Extraction From Images With Edge-Enhanced Mser And Hardware Interfacing Using Arduino. Here a novel text detection algorithm is proposed, which employs Maximally Stable Extremal regions as basic letter candidates.

Dr.P.V.Rama Raju, et al. [1], discussed a Feature based detection of liver tumour using K-means clustering and classifying using probabilistic neural networks. In this approach, it is very simple to identify the stage and the affected tumor area in the liver tissue. This can be made further effective by improving the database number by including all the types of tumor images into the database.

3. Proposed Methodology:

The main objective of this methodology is to develop an object detection in a video stream.In this, we have used the YOLOv3 model. It is used to predict what objectsare present and where they are present using a single convolutional network. YOLO predicts multiple bounding boxes and class probabilities for those boxes.

YOLOv3 model uses pre-trained weights for standard object detection problems such as a kangaroo dataset, raccoon dataset, red blood cell detection, and others. This model will be used for object detection on new images. Figure 1 shows the block diagram of Object Detection.

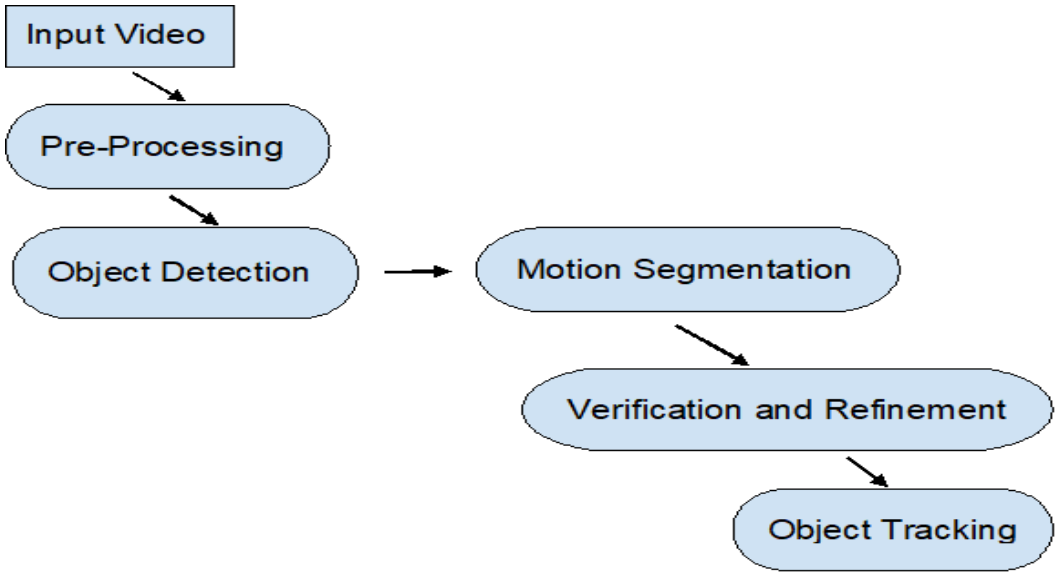

Figure 1: Block Diagram of Object Detection

Object detection blocksare explained in Figure 1.

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3.1.1 Input Video Sequence: Object recognition in computer vision is the task of finding a given object in an image or video sequence. Object recognition is one of the hardest challenges for computer vision systems today. The task is to be able to recognize the object and be able to track it in a video sequence. Some of the challenges posed by this particular task include recognizing the object when looking at it from a different perspective and partially occluded and tracking the object while it is in motion.

3.1.2 Pre-Processing: Pre-Processing entails cleaning up the image and making sure that it is ready to be fed into the image recognition pipeline. Several techniques are used in pre-processing, such as denoising, color enhancement, high dynamic range, artifact removal, image stabilization, and so on.

3.1.3 Motion Segmentation: Motion Segmentation is the task of identifying the independently moving objects (pixels) in the video and separating them from the background motion. If the background consists of a plane, then we can register the various frames onto a common frame perfectly, using projective transformations.

3.1.4 Object detection: Object detection is a computer vision technique that allows us to identify and locate objects in an image or a video. With this kind of identification and localization, object detection can be used to count objects in a scene and determine and track their precise locations, all while accurately labelling them.

3.1.5 Verification and Refinement: This new detection mode is able to simultaneously perform two-step regression and capture accurate object features.

3.1.6 Object tracking: The offline tracker divides the tracking task into two separate tasks of detection of objects in frames and finding the object of interest among the objects of each frame. The tracking-by-detection means the same object is detected in successive frames of the video.

3.2 YOLO V3 Architecture:

YOLO algorithm is used in real time applications. With the YOLO algorithm, we're not searching for interesting regions in our image that could contain some object. Instead of that we are splitting our image into cells, typically its 19*19 grid.Each cell will be responsible for predicting 5 bonding boxes (in case there's more than one object in this cell). This will give us 1805 bounding boxes for an image and that's a really big number and with the help of deep CNN architecture, reduction and encoding for an image is done and is shown in Figure 2.

3.2.1 Steps for creating YOLO dataset:

Step 1: Importing the required libraries
Step 2: Create a class weight Reader to load the pre-trained weights for YOLOv3

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Step 3: Create the YOLOv3 model
Step 4: We now create the YOLO model and load the pre-trained weights
Step 5: Setting up the variables. i.e., We set the anchor boxes and then define the 80 labels for the common objects in context (COCO) model to predict.
Step 6: Create a class for the Bounding Box as shown in Figure 2. Bounding Box defines the corners of each bounding box in the context of the input image shape and class probabilities.

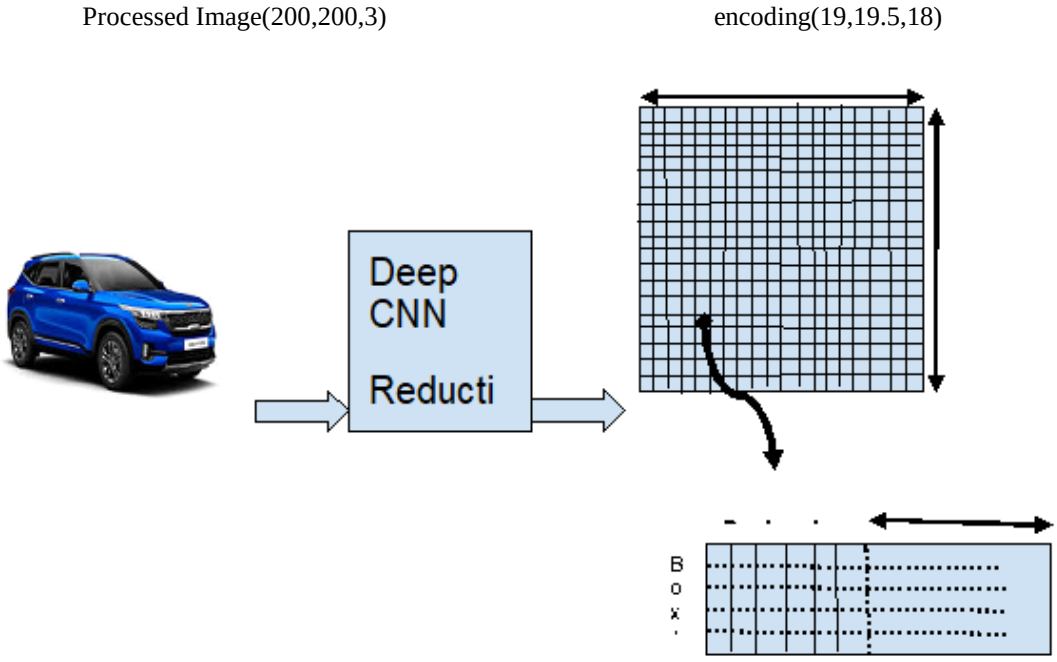

Figure 2: Deep CNN Architecture

4. System Specifications:

Software Required:

4.1. Python IDLE
4.2. Keras
4.3. Anaconda
4.4. Tensorflow
4.5. Image AI

4.1 Python IDLE:

Python is a widely used general-purpose,high level programming language. It was created by Guido van Rossum in 1991 and further developed by the Python sSoftwareFoundation.It was designed with an emphasis on code readability,and its syntax allows programmers to express their concepts in fewer lines of code.The main advantages of python are shown in figure 3. Python is a programming language that lets you work quickly and integrate systems more efficiently.

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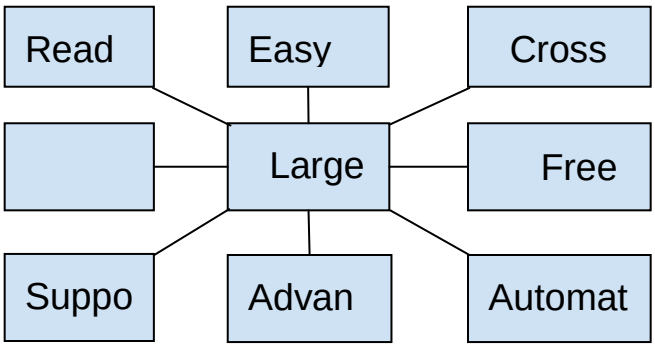

Figure 3: Advantages of Python IDLE

4.1.1 The description for blocks in Figure 3 are described below.

Readable: Python is a very readable language.

Easy to learn: Learning python is easy as this is an expressive and high-level programming language, which means it is easy to understand language and thus easy to learn.

Cross Platform: Python is available and can run on various operating systems such as Mac, Windows, Linux, Unix etc., This makes it a cross platform and a portable language.

Open source: Python is an open source programming language.

Large standard library: Python comes with a large standard library that has some handy codes and functions which we can use while writing code in python.

Free: Python is very freely download and use. This means you can download it for free and use it in your application. See: Open source python license. Python is an example of a FLOSS (Free/Libre Open Source Software), which means you can freely distribute copies of this software, read its source code and modify it.

Supports exception handling: If you are new, you may wonder what is an exception? An exception is an event that can occur during program exceptions and can disrupt the normal flow of the program. Python supports exception handling which means we can write less error prone code and can test various scenarios that can cause an exception later on.

Advanced features: Suppose generators and list comprehensions. We will cover these features later.

Automatic memory management: Python supports automatic memory management which means the memory is cleared and freed automatically. You do not have to bother clearing and memory.

4.2 Keras:

Keras was created to be user friendly,modular,easy to extend,and to work with Python.The Keras offers the advantages of broad adoption,support for a wide range of production deployment options,integration with at least five backend engines and strong support for multiple GPUs and distributed training.Keras provides the VGG16 pretrained model directly.Keras will download the modal weights from the Internet,which are about 500 Megabytes.

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4.3 Anaconda:

Anaconda Navigator is a desktop graphical user interface (GU)included in Anaconda distribution that allows you to launch applications and easily manage conda packages,environments,and channels without using command-line commands. Navigator can search for packages on Anaconda Could or in a local Anaconda Repository.It is available for Windows,macOS,and Linux.Navigator is an easy point-and-click way to work with packages and environments without needing to type conda command in a terminal window.You can use it to find the packages you want, install the, in an environment,run the packages,and update them all inside Navigator.

4.4 TensorFlow:

TensorFlow is Google's open-source Machine Learning framework. It allows for dataflow and differential programming across several kinds of tasks. TensorFlow was originally developed by researchers and engineers from the Google Brain team, which is a part of Google's AI (Artificial Intelligence) organization.The TensorFlow Object Detection API is an open-source framework that's been built on top of TensorFlow. It is an easy to use tool that allows people to build powerful image recognition software. Even people without a background in machine learning can use this tool.

4.5 Image AI:

It provides many more features useful for customization and production capable deployments for object detection tasks.Some features supported by Image AI are:

4.5.1 Adjusting minimum probability: By default, objects detected with a probability percentage of less than 50 will not be shown are reported. You can increase this value for high certainty cases or reduce the value for cases where all possible objects are needed to be detected.

4.5.2 Custom objects detection: Using a provided custom object class, you can tell the detection class to report detections on one or a few numbers of unique objects.

4.5.3Output types: You can specify that the detect Objects From imagefunction should return theimage in the form of a file or Numpy array.

5. Flow Chart:

Figure 4: shows the algorithm in object detection

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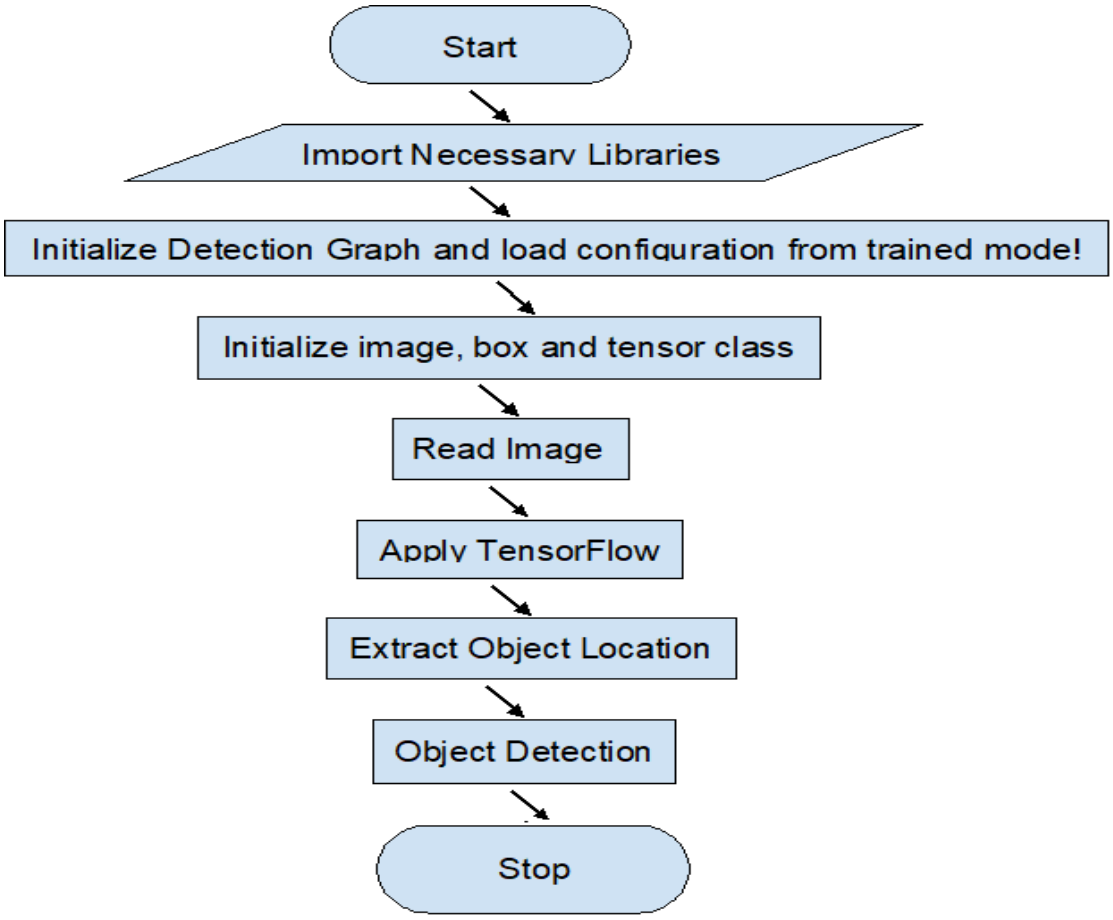

Figure 4:Flow chart of Object Detection

6. Experimental Results: Figure 6(a),6(b),6(c) shows the final detection of the objects in the video.

Figure:6(a)

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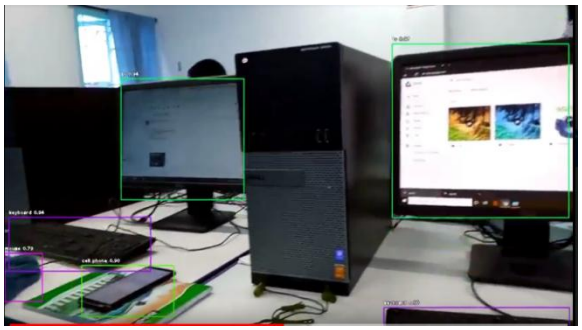

Figure:6(b)

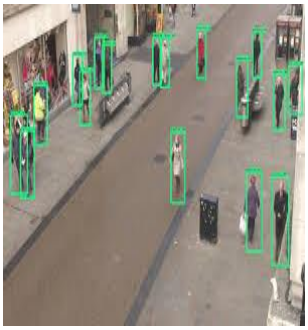

Figure:6(c)

7. Conclusion:

Object detection is breaking into a wide range of industries, with use cases ranging from personal security to productivity in the workplace. Object detection and recognition is applied in many areas of computer vision, including image retrieval, security, surveillance, automated vehicle systems, Face Detection and Face Recognition, Automated CCTV, Object Recognition As Image Search And Machine Inspection. Significant challenges stay in the field of object recognition. The possibilities are endless when it comes to future use cases for object detection.The scope of this project is to incrementally learn, detect new classes, or to incrementally learn to distinguish among subclasses after the "main" class has been learned. If this can be done in an unsupervised way, we will be able to build new classifiers based on existing ones, without much additional effort, greatly reducing the effort required to learn new object classes. As humans are continuously inventing new objects, fashion changes, etc., and therefore the detection system will need to be continuously updated, adding new classes, are updating existing ones.

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