# Real-Time Object Detection Using OpenCV

Abstract

Real-time object detection of common objects can be achieved through this project with the aid of an integrated webcam and OpenCV. The Object Detection OpenCV method perfectly balances speed as well as accuracy. Unlike many other object detection methods, this project can run in real-time with better accuracy. In the stream that is captured in the webcam, the object detection model will identify the set of objects present in that frame and will provide information about their positions and the accuracy (confidence) within the captured frame. We can move around the webcam for detecting various real time objects accordingly .

Introduction

Real Time Object Detection is the task of doing object detection in real time with fast inference while maintaining a base level of accuracy.

The project is developed using opencv.
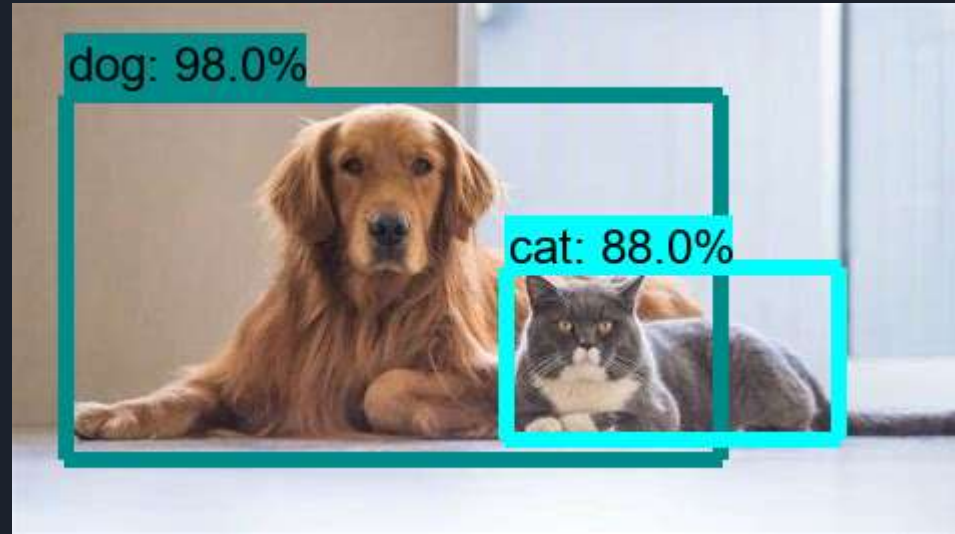
Literature Survey

Research Paper 1 :
Title : OpenCV for Computer Vision Applications
Author(s) : M. Naveenkumar , A. Vadivel
Learning(s) : OpenCV is a library of programming functions mainly used for image processing. The aim of image processing is to help the computer to understand the content of an image. Various concepts like image filtering , image transformation, object tracking ,Feature Detection,NMS are explained in the paper by taking image processing examples.(Face Recognition and Edge Detection System.)

Research Paper 2 :
Title : Deep Neural Networks for Object Detection
Author(s) : Christian Szegedy , Alexander Toshev , Dumitru Erhan
Learning(s) : Deep Neural Networks (DNNs) have recently shown outstanding performance on image classification tasks.This addresses the problem of object detection using DNNs, that is not only classifying but also precisely localizing objects of various classes.OpenCV dnn_ module is used for classifying and localizing objects of various classes and the objects detected are masked inside a bounding box .

Research Paper 3 :
Title : Multiple Real-Time Object Identification using Single-Shot Multi-Box Detection
**Author(s) :** G Gayathri, T Mala, S Kanimozhi
Learning(s) : Real time object detection is one of the challenging task as it need faster computation power in identifying the object at that time.A faster detection model based on DNN is called as SSD is employed for object detection. The use of MobileNet along with SSD improves the accuracy level in identifying real time objects.(Why SSD over (R-CNN,YOLO)?) is explained in this paper.

Why SSD over other models?

R-CNN detection method is not effective in detecting real time objects cause because of their complex network and its prediction speed is low i.e. it takes around 47 secs to detect an object and is not feasible for real time object detection .

YOLO overcomes the inference speed problem but faces issues in recognizing small objects present in the frame.

So we are using **SSD** with **Mobile net** method. This method overcomes the problems faced in other detection methods and also detects the object in about 3 secs with good amount accuracy and is really feasible for detecting real time objects..
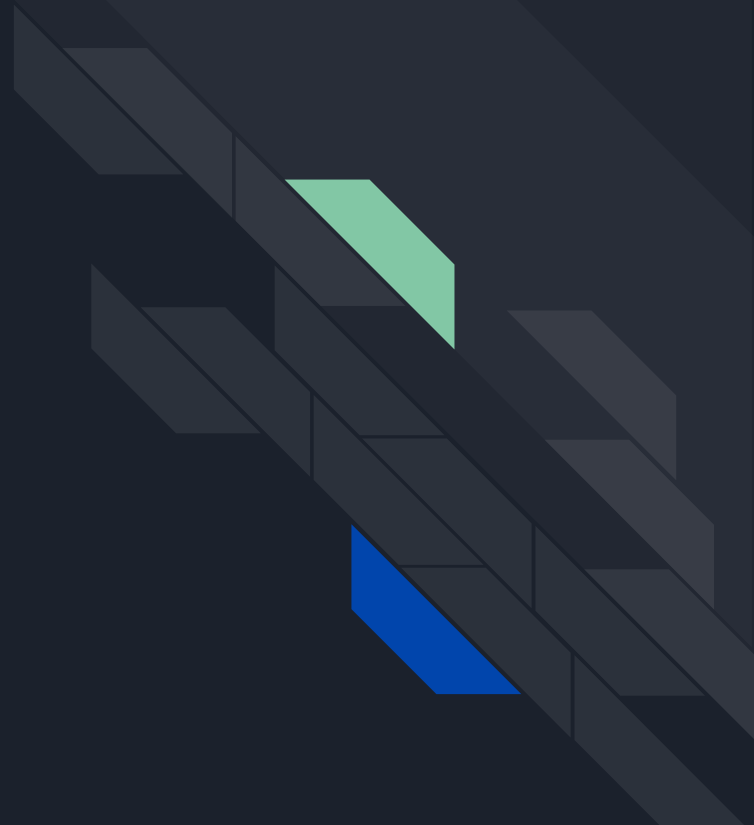
Methodology

- Data Set Collection.
- Internal working of the project (OpenCV modules used for Real - Time Object Detection).
- Integration with a webcam for Real - Time Object Detection.

Resources Used for Project

Software:

Browser: Google Chrome

OS:Windows

Programming Language :Python
(Library OpenCV)

Editors: Pycharm

Hardware:

Laptop with RAM 8 GB

Processor: Intel® Core™ i5

Hard Disk: 500 GB

Monitor: 15.6" HDD

Keyboard: 122 Keys
Inbuilt webcam or extended webcam

What is COCO Dataset?

COCO stands for Common Objects in Context, as the image dataset was created with the goal of advancing image recognition. The COCO dataset contains challenging, high-quality visual datasets for computer vision. ***It is dataset which contains predefined class labels.***

```
'person', 'bicycle', 'car', 'motorcycle', 'airplane', 'bus', 'train', 'truck',
'boat', 'traffic light', 'fire hydrant', 'stop sign', 'parking meter', 'bench',
'bird', 'cat', 'dog', 'horse', 'sheep', 'cow', 'elephant', 'bear', 'zebra',
'giraffe', 'backpack', 'umbrella', 'handbag', 'tie', 'suitcase', 'frisbee',
'skis','snowboard', 'sports ball', 'kite', 'baseball bat', 'baseball glove',
'skateboard', 'surfboard', 'tennis racket', 'bottle', 'wine glass', 'cup', 'fork',
'knife', 'spoon', 'bowl', 'banana', 'apple', 'sandwich', 'orange', 'broccoli',
'carrot', 'hot dog', 'pizza', 'donut', 'cake', 'chair', 'couch', 'potted plant',
'bed', 'dining table', 'toilet', 'tv', 'laptop', 'mouse', 'remote', 'keyboard',
'cell phone', 'microwave', 'oven', 'toaster', 'sink', 'refrigerator', 'book',
'clock', 'vase', 'scissors', 'teddy bear', 'hair drier', 'toothbrush'
```

Coco dataset images

How the object detection actually takes place in the project?
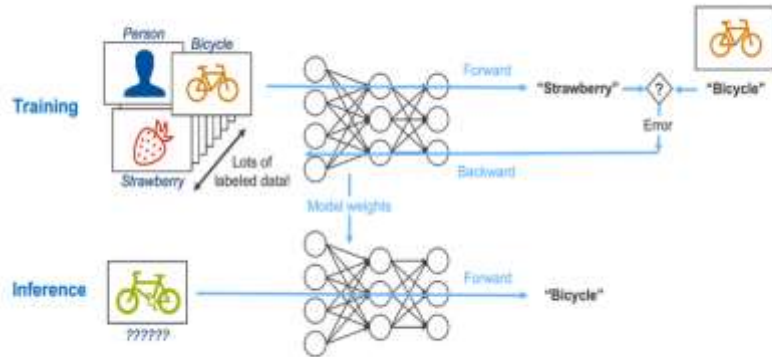
- By means of **OpenCV DNN module**
- Difference between training and inference

  Training:Developing the DNN model

  Inference:Using the DNN model

- The OpenCV DNN module only supports deep learning inference on images and videos. It does not support fine-tuning and training(so **SSD** txt file **(prediction model)**, **pretrained weights** are given as input).

Classification and Localization

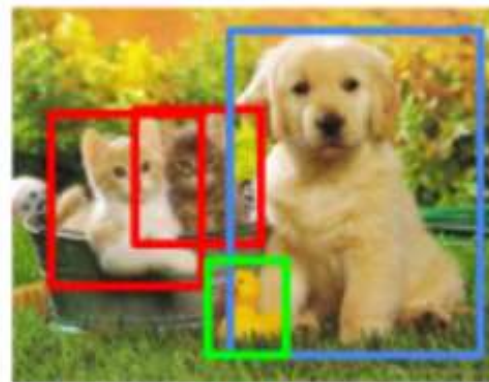# How DNN module is used and the resultant outcome

The dnn_DetectionModel actually maps the objects detected on the frame captured by webcam to the pre defined labels on the dataset(classification), the objects recognised are bounded by a bounding box (localization) with its respective class label along with accuracy and the outcome is as shown

Output on the terminal
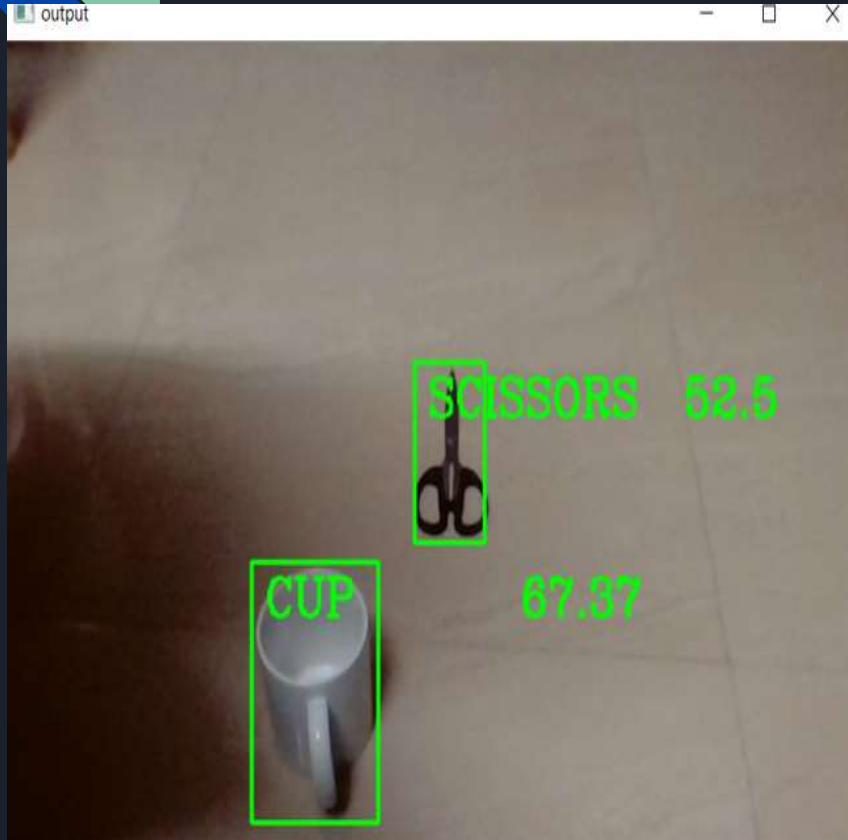
[47 87] [[184 292 94 150]

 [307 180 49 103]]

Integration with a webcam for Real-time Object Detection

In order to create real-time object detection application, we need to make a minor changes to the previous model. Using OpenCV, a VideoCapture object is created. This VideoCapture uses read function to get the current frame in the video stream.

We can move around the webcam and see different objects being detected.
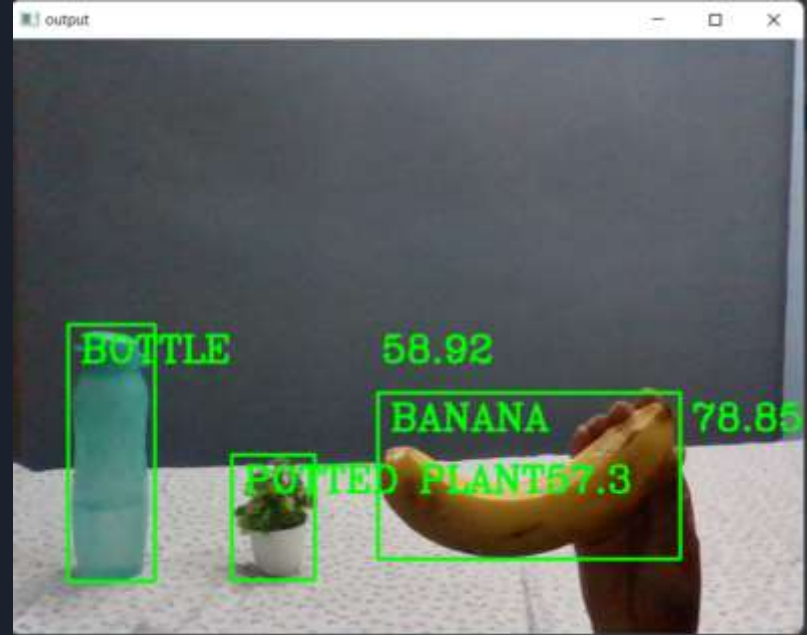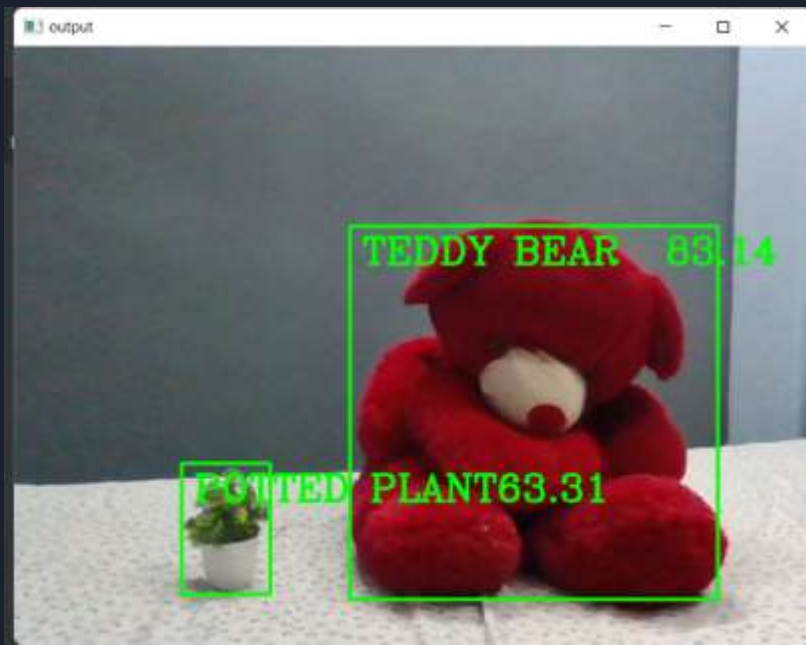
MobileNetSSD

What is SSD?

- SSD stands for Single Shot Detector, is a faster detection method based on CNN model. It is originally developed by Google.

What is MobileNet?

- MobileNets, are efficient neural networks used for image classification, which is based on CNN. Because of their small size, these are considered great deep learning models to be used on mobile devices.
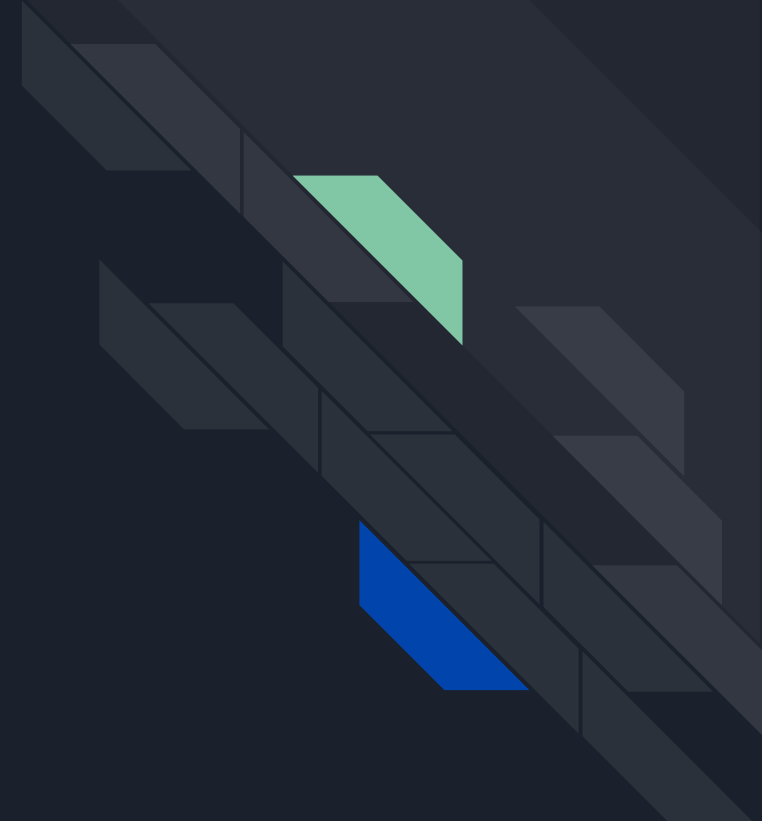
Combining MobileNets and SSDs

If we combine both the MobileNet architecture and the SSD framework, we arrive at a fast, efficient deep learning based method to object detection.
The MobileNet SSD is trained on COCO dataset.

Conclusion

The project detects the real world objects with good amount of accuracy and speed. A high accuracy object detection procedure has been achieved by using the deep neural network for an object detection and the speed in detecting the objects is enhanced by SSD and Mobilenet.

Thank you!