Vehicle counting and classification

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Abstract

Abstract-Intelligent vehicle detection and counting are becoming increasingly important in the field of highway and transport infrastructure management. Traditional methods based on image information have shown several limitations. Especially in real-world environment conditions, real-time detection, classification and counting each type of vehicle are still a big challenge. The main purpose of this study is to develop an adaptive model that combine YOLOv4. The new model can detect object with high accuracy and fast calculation time by taking the benefits of tracking with a focus on simple, effective algorithms. Experiment results have shown that our proposed approach outperforms the original one at least 11

1 Introduction:

Traffic management has become an important daily routine in cities today with the exponential growth of traffic on roads. Automatic vehicle detection from traffic scenes and extracting essential parameters related to vehicular traffic can help better management of traffic on busy highways and road intersections.Collecting real time reliable traffic information is crucial for traffic management there are many real time vehicle counts Using computer vision technologies however detecting and counting moving vehicle in real world is still challenging.The vehicle detection algorithm can be differentiated into 2 categories appearance based approaches and motion based Approaches, In appearance based approach visual characteristics symmetry texture edges and colors are considered.In motion based we look into motion characteristics by separating background like optical flow, background subtraction etc.Motion based approach works well in light environment but it still has limitations in classifying images and we may have to Classify them according to their sizes.Recently CNN have been used in object detection because of its powerful ability to extract features so for detection CNN can Be used for accuracy.So, our goal is to use CNN to make object detection faster and more efficient in real time.

2 Related Work:

At present vehicle detection is divided into based on computer vision techniques and deep learning method. In computer Vision motion of the vehicle is separated from fixed background. For example by using background subtraction that Uses differences between consecutive video frames we can detect the vehicles in motion.In optical flow method we detect the moving areas in the videos the resulting optical flow field represent the moving pixels and its speeds.On the other hand CNN also has achieved success in vehicle detection. CNN has a strong ability to capture visual characteristics And then can perform many recognition tasks like classifying, detecting and predicting boundary frames In CNN the methods are of 2 stages where we identify potential frames containing objects and using CNN to classify them.Initially for detecting there is RCNN, fast RCNN, faster RCNN method for detecting objects. But in these methods identifying Potential areas is done using selective area search and the input must be of fixed size and the network takes long Training time and consumes a lot of memory and storage.

3 Problem:

3.1 Problem Statement

Vehicle Counting and Classification from a Traffic Scene

3.2 Problem Definition

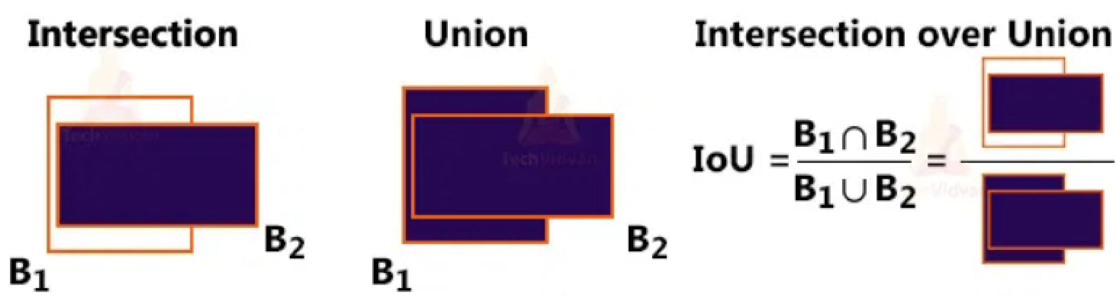
At times it is difficult to maintain the details about the count of vehicles and the type of vehicles that cross a junction or a high way. This data is necessary because scams may occur where the entries and the exits of the vehicles comes for good use. So we want to make it easier to collect the data.

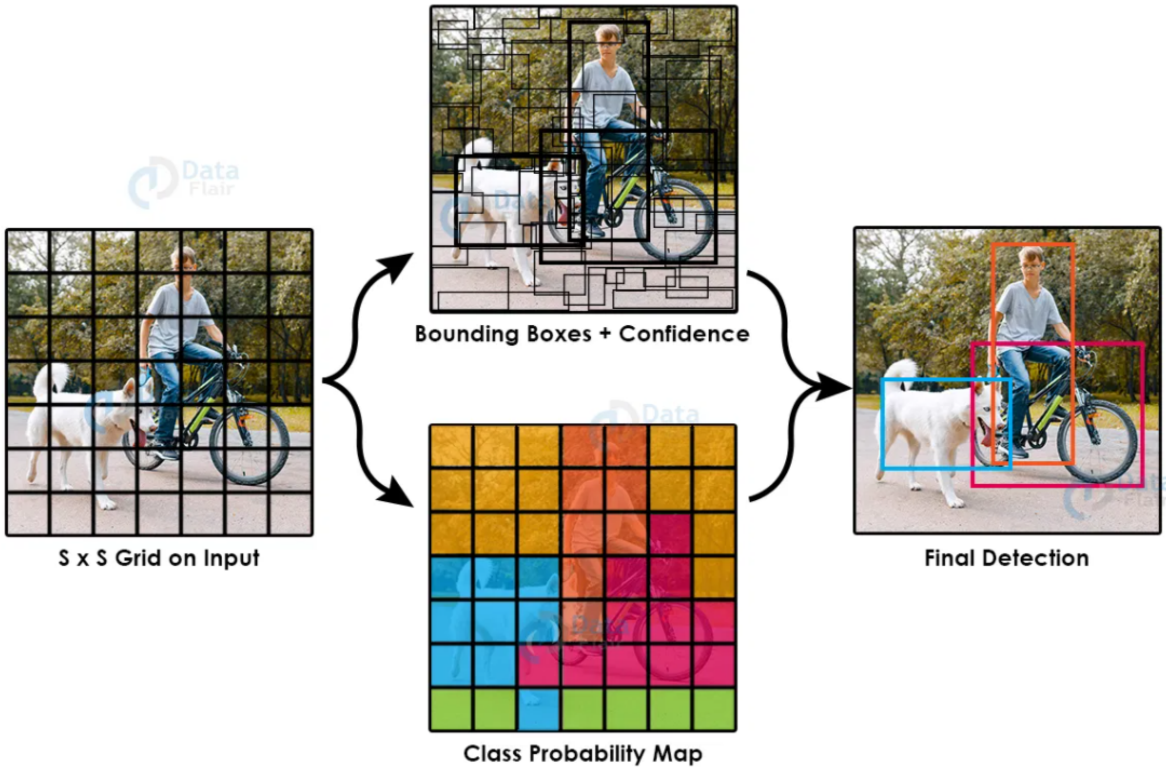
4 Methodology:

We can divide the whole process into 2 categories ; One is regarding vehicle classification and other is vehicle tracking.We tried to built this project using YOLO model with open-cv python and for tracking purpose we tried to use Euclidean distance concept.

4.1 Vehicle detection and classification

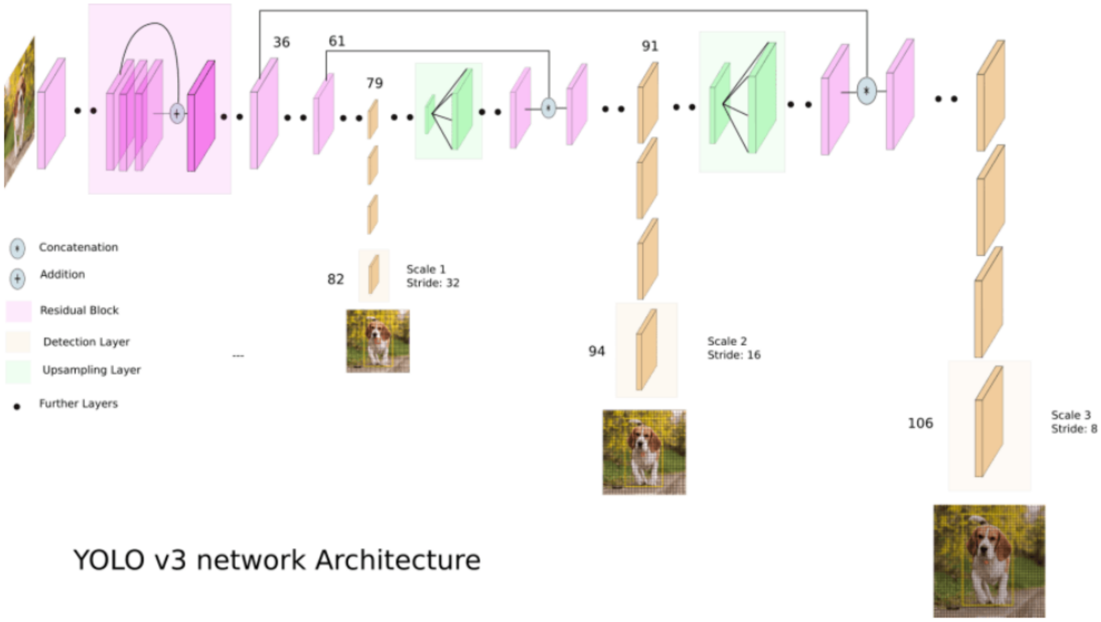
As we mentioned we used YOLO model it is a real time object recognition algorithm . YOLO is an algorithm that uses neural networks to provide real-time object detection. This algorithm is popular because of its speed and accuracy. YOLO stands for You Only Look Once, It can classify and localize multiple objects in a single frame.YOLO works mainly using these techniques. 1. Residual Blocks – Basically, it divides an image into NxN grids. 2. Bounding Box regression – Each grid cell is sent to the model. Then YOLO determines the probability of the cell contains a certain class and the class with the maximum probability is chosen. 3. Intersection Over Union (IOU) – IOU is a metric that evaluates intersection between the predicted bounding box and the ground truth bounding box. A Non-max suppression technique is applied to eliminate the bounding boxes that are very close by performing the IOU with the one having the highest class probability among them.





4.2 YOLO ARCHITECTURE

YOLO v3 uses a variant of Dark-net, which originally has 53 layer network trained on Image-net. This is used for feature extraction.For the task of detection, 53 more layers are stacked onto it, giving us a 106 layer fully convolutional underlying architecture for YOLO v3.Each bounding box is represented by 6 numbers (pc, bx, by, bh, bw, c).The shape of detection kernel is 1 x 1 x (B x (5 + C)). Here B is the number of bounding boxes a cell on the feature map can predict, '5' is for the 4 bounding box attributes and one object confidence and C is the no. of classes.YOLO v3 uses binary cross-entropy for calculating the classification loss for each label.The output is a list of bounding boxes along with the recognized classes. Each bounding box is represented by 6 numbers (pc, bx, by, bh, bw, c).Finally, we do the IOU (Intersection over Union) and Non-Max Suppression to avoid selecting overlapping boxes. we tried to detect and classify cars, HMV (Heavy Motor Vehicle) , LMV (Light Motor Vehicle) on the road.Those include trucks, cars, motor bikes, and buses.

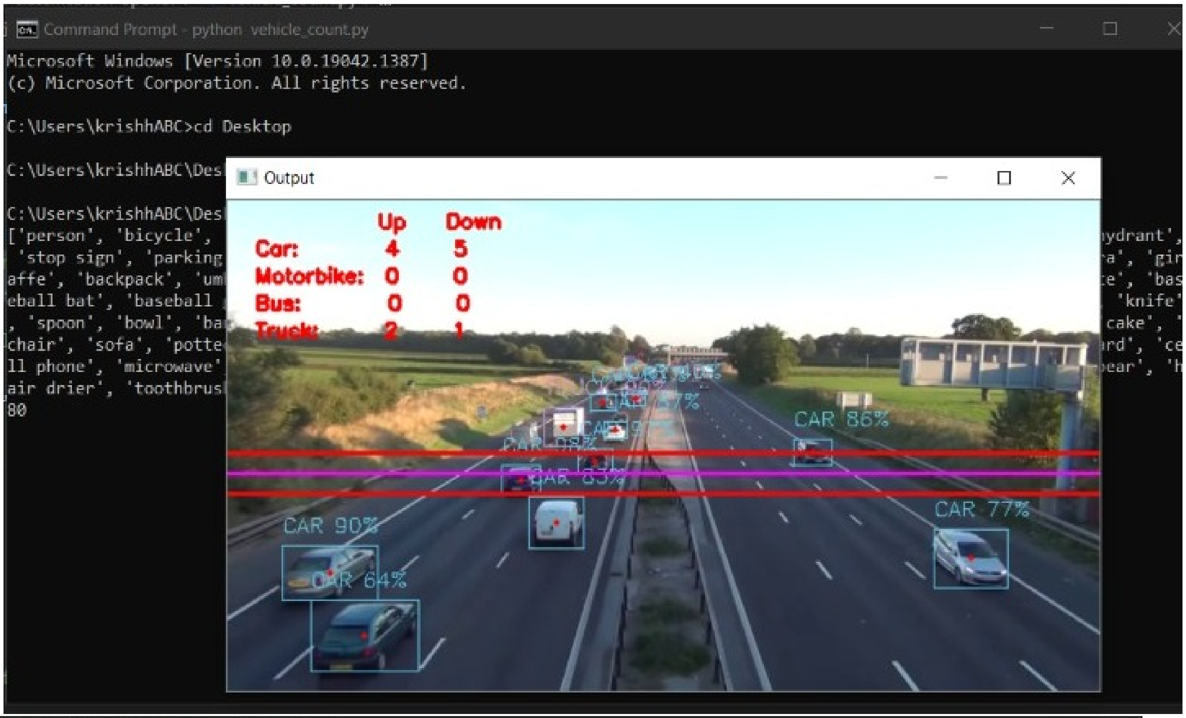


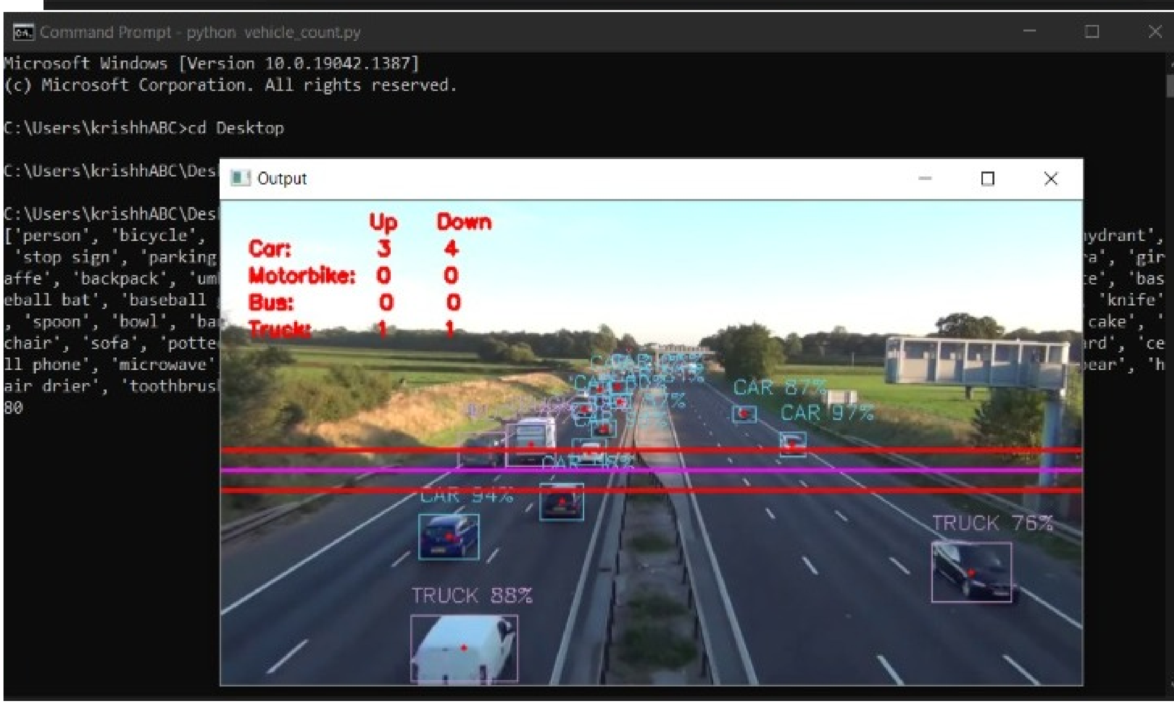
4.3 Vehicle tracking

The tracker basically uses the Euclidean distance concept to keep track of an object. It calculates the difference between two center points of an object in the current frame versus the previous frame, and if the distance is less than the threshold distance Then it confirms that the object is the same object of the previous frame.YOLOv3 is trained on the COCO dataset, so we read the file that contains all the class names and store the names in a list.The COCO dataset is is a large-scale object detection, segmentation, key-point detection, and captioning dataset contains 80 different classes.We need to detect only cars, motorbikes, buses, and trucks for this project, that's why we only cared about them from the Coco dataset.YOLO sometimes gives multiple bounding boxes for a single object, so we have to reduce the number of detection boxes and have to take the best detection box for each class.For counting we took an entry and exit cross-lines, whenever a vehicle enters we gave unique id to it and add it to our vehicle Set and when it crosses the exit line we remove that id from the set and increase the count of exited vehicles.After that we draw the counting texts on the frame .We can perform this on static images also to detect the number of vehicles that are present in that image.

5 Results and Discussion:

We have selected YOLO because of its speed and accuracy which is more important for real time processing because YOLO Only looks into the data once. YOLO can process images at 30fps and the overall precession i.e. model accuracy is nearly 87.5





6 Conclusion:

Initially we tried to do this project with motion based algorithms but later on we found that YOLO is far better and faster than Any of those algorithms. There are few problems in this approach of tracking using Euclidean distance because if the vehicle Moves so fast this system may count the same vehicle twice.But any way with limited speed this was able to bring the results with high accuracy and we learnt about deep neural networks and some advanced computer vision technologies also by doing this project.As this performs well in real time we can use this in cameras, traffic surveillance cameras, cctv etc.

7 References:

References

[1] S. Gupte, “Detection and Classification of Vehicles”, University of Minnesota 2002. [2] E. Atkociunas, ”Image Processing in Road Traffic Analysis”, Vilnius University, 2005 [3] Z.W. Kim ”Fast Vehicle Detection with Probabilistic Feature Grouping and its Application to Vehicle Tracking”, CiteSeer, 2001 [4] L. Di Stefano, ”Vehicle Detection and Tracking Using the Block Matching Algorithm”, Department of Electronics, Computer Science and Systems (DEIS) University of Bologna, ITALY