International Engineering Journal For Research & Development

Vol.5
Issue 5

E-ISSN NO:-2349-0721

Impact factor : 6.549

REAL TIME LANE DETECTION USING ROSS KIPPENBROCK METHOD AND OBJECT DETECTION USING YOLO

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ABSTRACT

The aim is to detect lane and object with higher accuracy rate, even in different climatic conditions. Using Ross kippenbrock principle for finding lane (Advance lane detection) and YOLO for object detection which has a higher speed and accuracy rate. Self-driving cars might not be in our everyday lives yet, but they are coming. Analyzing images and figuring out where the lane lines are on a given roadway is one of the core competencies of any respectable self-driving car. After getting the output for the lane detection, these frames are sent to the CNN model using YOLO (you only look once) which will detect the object which are present in the frame. These two methods gives a higher accurate and spped result, which is must for self-driving car.

Keywords— Self driving car,Advance lane detection, YOLO

INTRODUCTION

In intelligent transportation systems, the main goal is to achieve a safer environment and better traffic conditions. To improve the traffic control ability, to move the car according to the traffic light. In this work the robotic chassis are made to make its movement by predicting the paths that are already trained to it. By the trained prediction it made its movements by mappings its path to the convolution neural network. The traffic signs of the car be predicted by the color mapping to differentiate the colors to the camera or by using the concept of the pre-trained classifiers like haar classifier. The distance of the signal and the stop sign to the car camera is measured by the monocular vision. The live feed from the camera is broad casted to the driver through the socket networking. The collision avoidance of the one car form other or to any other obstacles is prevented by the ultrasonic sensors through the distance measurement. The process are initially the car is pre-trained by the path and travel in its track if the obstacles is in front of it stops and check the obstacles behind it and convey the message to the driver and in the signals if it detects the red color it stops and make the move until the color is turned to green.. In case if the car met with the accident it alerts the hospitals nearby and to the associated persons of the car owner

Objectives

1. Path Finding and changing direction.
2. Object Detection.

The ultimate goal of the thesis is to build a low-cost prototype of an car through end-to-end machine learning, primarily using deep neural networks. This car should be able to drive itself on a flat road model. The main input of the car will be real time video from a camera, which will be mounted front to the car. The system should then control the car when detected by obstacles and change it path accordingly. Avoiding obstacles is a different problem which is also possible to solve, but combining it with steering and creating a single controller to handle both situations is beyond the scope of this thesis. However, we will use ultrasonic sensors to detect obstacles on the road and stop the car accordingly. The network will be trained with the traffic signals and other objects to be identified and the specified path that will control the car. The vehicle will then be fully independent of other machines. Another goal of the thesis is to make this system is easy to build. The software will be written with standard deep learning libraries and easy to extend and reproduce.

LITERATURE REVIEW

Deep learning has progressed quite fast over the past few years and implemented in almost every field today. Convolutional neural networks are one of the most extensively used and researched neural networks which have found applications in almost every domain from image processing to natural language processing .Convolutional neural networks (CNNs) are one of the most widely used type of deep artificial neural networks that are used in various fields such as image and video recognition, speech processing as well as natural language processing. These networks have been inspired by biological processes, such as working of the visual cortex in cats and spider monkeys. Hubel and Wiesel, in the year 1969, studied to classify the cells in the cortex of these as-simple, complex and hypercomplex. The complex cells were found to have a receptive field, i.e., the area of response to stimulus, approximately twice as large as that of a simple cell. Hence the idea of using translational invariance in order to recognize visual imagery was realized. This property stated that the exact location of an object in an image was of less importance rather than detecting the object. Using convolutional neural networks is better than fully connected networks in many applications since instead of every node in a layer being connected to every other node in the previous layer, the former has every node in the mth layer being connected to n nodes in the (m-1)th layer, where n is the size of the receptive field of the CNN.

ADVANCED LANE DETECTION

Advanced Lane Detetion

The main reason to build intelligent vehicles is to improve the safety conditions by the entire or partial automation of driving tasks. Apparently, among the challenging tasks of future road vehicles is road lane detection or road boundaries detection. One of the principal approaches to detect road boundaries and lanes is using computer vision system on the vehicle. However, lane detection is a difficult problem because of the varying road conditions and different curved lanes that one can encounter while driving. In this paper, a computer vision-based lane detection approach capable of reaching real time operation is presented. The system acquires the front view using a camera mounted in front of the vehicle then applying few processes in order to detect the lanes. One of the main technology involves in these takes computer vision which become a powerful tool for sensing the environment and has been widely used in many application by the intelligent transportation systems (ITS). In many proposed systems, the lane detection consists of the localization of specific primitives such as the road markings and cross roads of the surface of painted roads. This restriction simplifies the process of detection of road lanes, nevertheless, two situations can disturb the process: the presence of other vehicles or other objects on the same lane occluded partially the road markings ahead of the vehicle are the presence of shadows caused by trees, buildings etc. This paper presents computer vision based approach capable of reaching a real time performance in detection and tracking of structured road boundaries

Advanced Lane Detetion Implementation.

A video file in which dashcam footage of a car moving along the highway is provided for the script laneDetection.py

Image Processing Functions

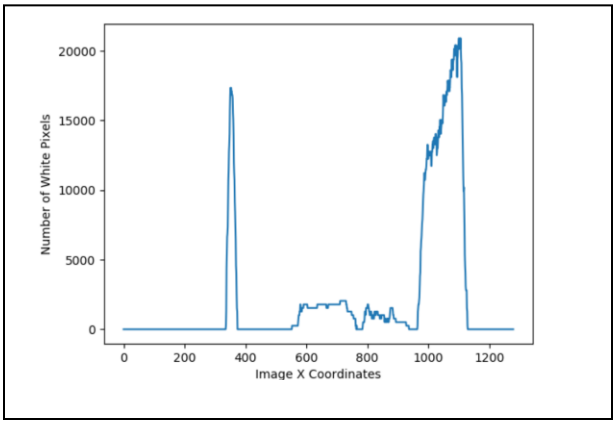
readVideo()-Access the video file using readVideo() function.

processImage()-This function performs processing techniques to separate the white lane lines and it prepares for further analysis upcoming functions. This function applies HLS color filtering to filter out whites in the frame, then converts it to grayscale which then is applied thresholding to get rid of unnecessary detections other than lanes to reduce the redundancy, gets blurred and finally edges are extracted with cv2.Canny() function.

perspectiveWarp()-Now we have the image we want; a perspective warp is applied to the image. 4 points are placed on the frame such that they surround only the area which lanes are present, then maps it onto another matrix to create a birdseye look at the lanes. This will enable us to work with a refined image and help detecting road lane curvatures. It should be noted that this operation is subject to change if another video is used. The predefined 4 points placed on the frame are calculated with this particular footage. It should be returned if another video that has a slightly different angled camera.

Lane Detection, Curve Fitting & Calculations

plotHistogram()- Plotting a histogram for the bottom half of the image is an important part to obtain the information of where exactly the left and right white lanes start. Upon analyzing the histogram, one can see there are two distinct peaks where all the white pixels of the lanes are detected which is a very good indicator of where the left and right lanes begin. Since the histogram x co-ordinate represent the x co-ordinate of our analyzed frame, it means we have x coordinates to start searching for the lanes.



generalsearch()-After running the slide_window_search() function, general_search() function will be now able to fill up an area around those detected white lanes, again applies the second degree polynomial fit to then draw a yellow line which overlaps the lanes almost accurately. This line will be used to measure radius of curvature which is essential for the prediction of steering angles.**measure_lane_curvature()-**With information provided by the previous two functions, np.polyfit() function is used again but with the values multiplied by xm_per_pix and ym_per_pix variables to convert them from pixel space to meter space. xm_per_pix is set as 3.7 / 720 with lane width as 3.7 meters and left & right lane base x-co-ordinates obtained from histogram corresponds to lane width in pixels which turns out to be approx720 pixels. Similarly, ym_per_pix is set to 30 / 720 as the frame height is set to 720.

VIisualization and main functions

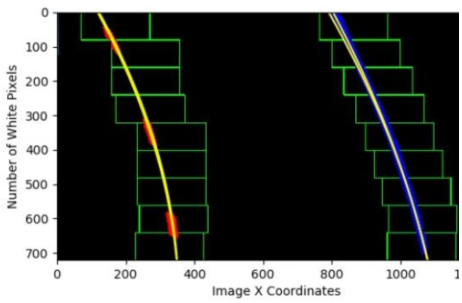


Fig: *slide_window_search function visualized*

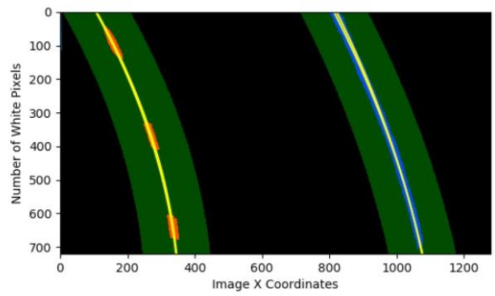


Fig: *general_search function visualized*

draw_lane_lines()

From here on, the methods are applied to visualize the detected road lanes and other information to be displayed in the final image. This draw_lane_lines function takes detected lanes and fills the area inside them with a green colour to show the path. It also visualizes the centre of the lane by taking the mean of left_fit x and right_fit x lists and storing them in pts_mean variable, which then is represented by a yellowish colour. This variable is also used to calculate the offset of the vehicle to either side or of it is cantered in the lane.

offCenter()

offCenter() function uses pts_mean variable to calculate the offset value and show it in meter space.

addText()

Fig:Final Image for lane detection.

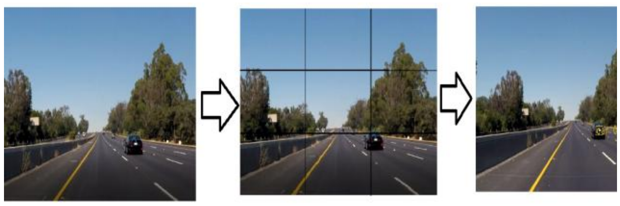


Fig: Anchor box is used

Finally by adding text on the final image would complete the process and the information displayed.

main()

Main function is where all these functions are called in the correct order and contains the loop to play video.

YOLO OBJECT DETECTION

Yolo is better than region-based algorithm, because it was much more slower and error was more as compared to YOLO algorithm. Yolo prioritize the speed; this is particular are used in application like self-driving car. The self-driving car is an excepted to detect the objects on its path with much more speed and accuracy, then the current system allows. A self-driving car can look at an object and recognize the object whether, the image or a video are able to identify whether the object is present in that and detect what kind of object is present.

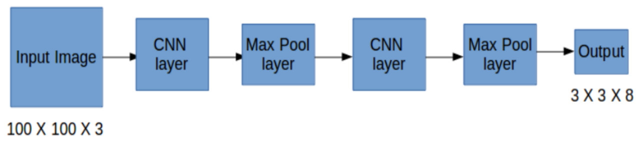


Fig: Flow chart for yolo.

Yolo object detection implementation for self driving car

In yolo input image is provided to a convolutional neural network, which outputs a particular vector which consist of class probability of that object, the class to which the particular object belongs to and coordinates of the bounding box.

Silding window approach

In a sliding window approach, particular dimension of a window and slide it over a image stride by stride. Stride allows us to decide, what is the overlap of each sliding window. In yolo instead of using stride of finite number, stride of 0 is been used, which basically gives no overlap between each sliding window and it result into image been divide into grids, so imagine that there are no overlap between sliding window and the whole image is divided into grids of particular dimensions .

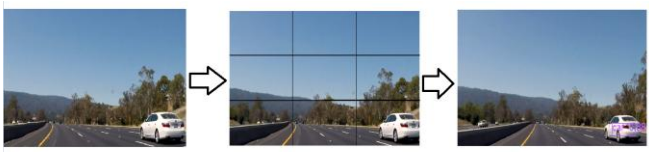


Fig: Sliding window approach

b)Anchor box

If two or more object are present in same grid or if a single object is present in two or more grids, then angular box is used. Two anchor boxes are used, one vertically and one horizontally, ideally, we can choose as many as anchor box which are required, hence it is particular aspect ratio. When anchor boxes are used then, the output vector are also changed according to the output of two anchor boxes for a particular grid cell.

Equations

- **pc** be the probability of class present.
- **c1, c2…. cn** be the probability of each class present.
- **(bh, bw)** -> height and width of the bounding box
- **(bx, by)** -> co-ordinates of the bounding box.

pc, bh, bw, bx, by are the five fixed parameters.

Let **n** number of class be present, **m** number of anchor box we are using and for above example there are **3 x 3 grid**. So,

y = (5+n) x m x 3 x 3

Network

The network structure of CNN model in yolo, with convolutional and maxpooling layers, for 2 fully convoluted layers are,

Name	Filters	Output Dimension
Conv 1	7 x 7 x 64, stride=2	224 x 224 x 64
Max Pool 1	2 x 2, stride=2	112 x 112 x 64
Conv 2	3 x 3 x 192	112 x 112 x 192
Max Pool 2	2 x 2, stride=2	56 x 56 x 192
Conv 3	1 x 1 x 128	56 x 56 x 128
Conv 4	3 x 3 x 256	56 x 56 x 256
Conv 5	1 x 1 x 256	56 x 56 x 256
Conv 6	1 x 1 x 512	56 x 56 x 512
Max Pool 3	2 x 2, stride=2	28 x 28 x 512
Conv 7	1 x 1 x 256	28 x 28 x 256
Conv 8	3 x 3 x 512	28 x 28 x 512
Conv 9	1 x 1 x 256	28 x 28 x 256
Conv 10	3 x 3 x 512	28 x 28 x 512
Conv 11	1 x 1 x 256	28 x 28 x 256
Conv 12	3 x 3 x 512	28 x 28 x 512
Conv 13	1 x 1 x 256	28 x 28 x 256
Conv 14	3 x 3 x 512	28 x 28 x 512
Conv 15	1 x 1 x 512	28 x 28 x 512
Conv 16	3 x 3 x 1024	28 x 28 x 1024
Max Pool 4	2 x 2, stride=2	14 x 14 x 1024
Conv 17	1 x 1 x 512	14 x 14 x 512
Conv 18	3 x 3 x 1024	14 x 14 x 1024
Conv 19	1 x 1 x 512	14 x 14 x 512
Conv 20	3 x 3 x 1024	14 x 14 x 1024
Conv 21	3 x 3 x 1024	14 x 14 x 1024
Conv 22	3 x 3 x 1024, stride=2	7 x 7 x 1024
Conv 23	3 x 3 x 1024	7 x 7 x 1024
Conv 24	3 x 3 x 1024	7 x 7 x 1024
FC 1	-	4096
FC 2	-	7 x 7 x 30 (1470)

Fig: CNN ouput

CONCLUSION

Lane detection and tracking system in self- driving car are in the research of many companies. The vision is to do a real time application for lane detection and object detection using yolo, these to methods which are used for the objective had increased the accuracy rate and enhancement due to wide range of variability in the environment

Fig: Final output

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