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Lane Departure Warning System Based on Canny Edge Detection and Hough Transform

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Abstract - *The objective of this research is to develop a Lane Departure Warning System (LDWS) and is providing a safer car driving environment. The rumble strips on the road provide drivers lane departure warning (LDW). However, rumble strips require an infrastructure and it may not exist on majority of roadways. Hence it is very desirable to have in vehicle LDW system to detect when driver is in danger of departing the road and then give the warning when danger exists. It represents the development of an Image based LDW system using canny edge detection and Hough transform algorithm.'*

Key Words **Lane Departure Warning, Canny Edge Detection, Hough Transform**

SECTION -I

INTRODUCTION

Automotive electronics is a rapidly expanding area with an increasing number of safety, infotainment devices, and driver
assistance becoming standard in new vehicles. As such, many systems have been developed to assist in driving and to reduce
the risk of vehicle accident, such as Lane Departure Warning System (LDWS), Adaptive Cruise Control System and For-
ward Crash Avoidance System – a subset of Automatic Driver Assistance System (ADAS)[1] Lane departure warning alerts you that your car is about to veer out of lane and warns you to get back into lane. That's the basic idea, but there are several versions of the technology available now, including ones that react and steer away from the lane edge and even proactively keep the car centered. All forms of lane departure warning employ a low-cost camera mounted in the windshield near the rear view mirror that continuously watches the striped and solid lane markings of the road ahead. It is part of the circle of safety, the three most common and useful driver assists: protecting you to the front (adaptive cruise control and forward collision warning), side (lane departure warning), and rear side (blind spot detection). [5]

A. Lane: A lane is a part of a roadway that is designated for use by a single line of vehicles. It is used to give direction to the driver and also help in reducing traffic conflicts. For traffic in each direction, there are at least two lanes on the roads and lane markings are used to separate them. Lanes are specified by road surface markings on multilane roadways and busier two lane roads.

B. Lane detection In the lane detection the detection algorithm detects the lane boundaries and estimates the straight line in geometry of lane. The Lane Detection Algorithm supports various applications: (1) Lane departure warning – give a warning when the vehicle is crossing the lane without any warning signal. (2) Lane keeping assist – when the vehicle is crossing the lane unintentionally, automatically steering torque is applied to prevent the vehicle from exiting the lane. (3) Lane centering – In this the steering wheel is always in control to keep the vehicle in the lane center. This application is a crucial component in autonomous driving systems. There are different approaches for the lane detection algorithm, such as B-snake, Histogram based segmentation, Edge linking and Hough transform.

C. Lane Departure Warning :The lane departure warning system (LDWS) uses the information from the lane detection, to estimate if the vehicle is unintentionally cross the lane boundary within the next few second. If the driver did not show any signal to switch lanes, a warning is issued. The warning mechanism depends upon sensitivity – for example, this system is used to warn only when the vehicle is actually crossing the lane, or give an early warning, before lane are crossed. The warning can be any mode like LED light, vibrating steering or beep. This can be designed based the type of road – for example, it will provide the driver with more slack for narrow roads or allow the driver to "cut" curves.[8]

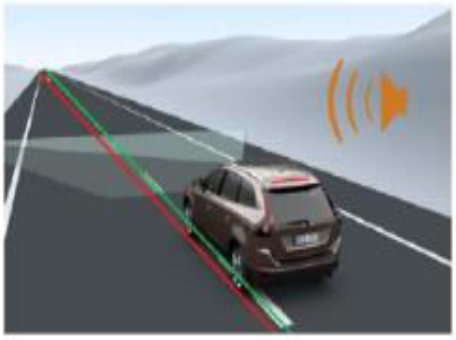


Fig 1. A simple illustration how LDWS work

The rest of the paper is organized as follows: Section II de- scribes and discusses our proposed approach and algorithms. Section III shows the implementation and results. Section IV concludes with future work.

SECTION –II
PROPOSED APPROACH

Different edge detection techniques

The following table gives the advantages and disadvantages between edge detection techniques. We can conclude from the table that the Canny Edge detection Technique is the most Efficient technique for the carrying out the edge detection.

Operator	Advantages	Disadvantages
Classical (Sobel, prewitt, Kirsch,…)	Simplicity, Detection of edges and their orientations	Sensitivity to noise, Inaccurate
Zero Crossing(Laplacian, Second directional derivative)	Detection of edges and their orientations. Having fixed characteristics in all directions	Responding to some of the existing edges, Sensitivity to noise
Laplacian of Gaussian(LoG) (Marr-Hildreth)	Finding the correct places of edges, Testing wider area around the pixel	Malfunctioning at the corners, curves and where the gray level intensity function varies. Not finding the orientation of edge because of using the Laplacian filter
Gaussian(Canny, Shen-Castan)	Using probability for finding error rate, Localization and response. Improving signal to noise ratio, Better detection specially in noise conditions	Complex Computations, False zero crossing, Time consuming

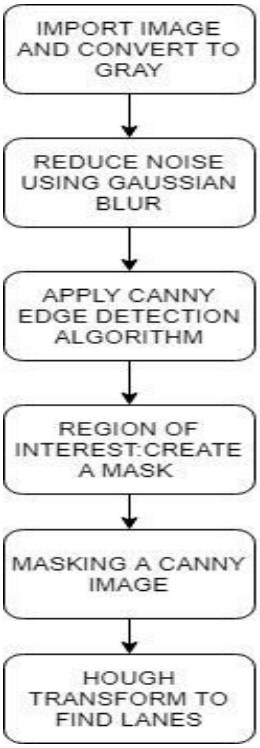
Table 1: Some Advantages and Disadvantages of Edge Detectors

CANNY EDGE DETECTION ALGORITHM

The Canny edge detection algorithm is known to many as the optimal edge detector. Canny's intentions were to enhance the many edge detectors already out at the time he started his work. He was very successful in achieving his goal and his ideas and methods can be found in his paper, "A Computational Approach to Edge Detection". In his paper, he followed a list of criteria to improve current methods of edge detection. The first and most obvious is low error rate. It is important that edges occurring in images should not be missed and that there be no responses to non-edges. The second criterion is that the edge points be well localized. In other words, the distance between the edge pixels as found by the detector and the actual edge is to be at a minimum. A third criterion is to have only one response to a single edge. This was implemented because the first two were not substantial enough to completely eliminate the possibility of multiple responses to an edge. Based on these criteria, the canny edge detector first smoothes the image to eliminate and noise. It then finds the image gradient to highlight regions with high spatial derivatives. The algorithm then tracks along these regions and

suppresses any pixel that is not at the maximum (nonmaximum suppression).

ALGORITHM



SECTION-III

STEP 1) The first step in the algorithm is to import the image and to convert into Gray .As For many applications of image processing, color information doesn't help us identify important edges or other features. So we convert the image into Gray for more efficiency

STEP 2) The next most important step is to reduce the noise in the image using Gaussian Blur.

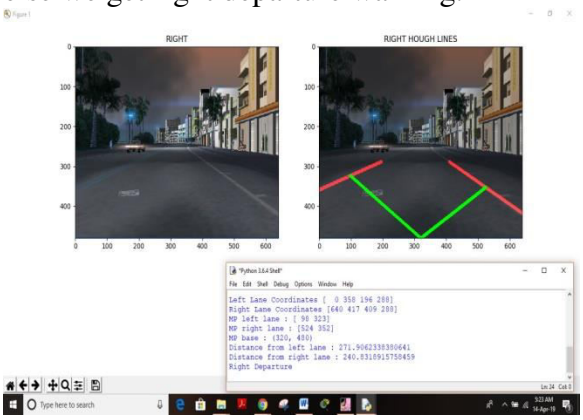
STEP3)Next the Canny edge detection algorithm is applied to the image to detect the edges.

STEP 4) Next we need to find the region of interest .Which is done by firstly defining the points in the code and then later we get manys lines, in order to get a 2 single lines we use averaging. Thus we get only two lines.

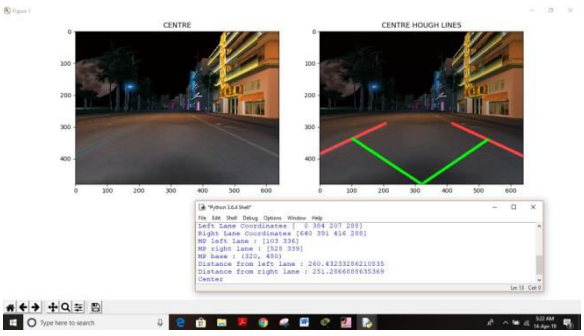
STEP 5) Then the last step is to find the Hough Lines and plot them on the input image. Thus the figure below shows the plotting of hough lines, centre , left and right .

RESULTS

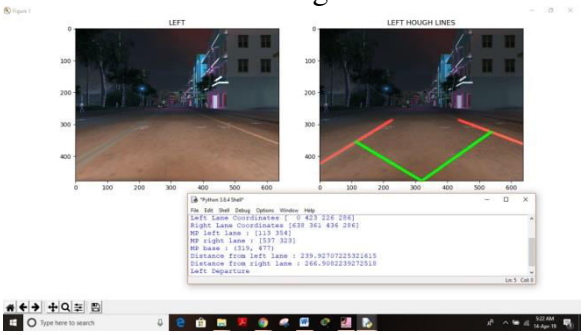
We get the following results. We then set the threshold for getting the Lane departure Warning . We calculate the distances from left and right lane respectively. Then the difference between is compared each time to give the warning.For eg if the difference is less than or equal to 12 then we get the warning as centre.And when the difference is greater than 18 and d1<d2 the we get left departure warning else we get right departure warning.



Right hough lines



Centre hough lines



Left Hough lines

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