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RESEARCH ARTICLE

TWO-PARTITION BASED LANE DETECTION USING HOUGH TRANSFORMATION

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Abstract

One of the most important component of the Autonomous Driver Assistance System is the lane detection and tracking. There are some factors like occlusion, object shadows, improper illumination, etc. cause complex problem of appearance variations in lane marking. There are several methods developed and are working fine when the noise is not present in image.. But the results are not efficient when model encounter any kind of noise like dust, shadows, puddles, oil stains, tire skid marks, etc. In this paper, we present tracking technique and lane detection which can handle several variations in environment like lane ending, lane splitting, lane curvature, improper lane, etc. The proposed method takes camera captured image and detects lane using partition. The lanes are split and detected, so they are merged to find the lane boundaries.

Keywords: Lane detection, Hough transform, Computer vision, Driver Assistance System.

Introduction

With Rapid increase in number of cars buyers, it has been noticed that there has been increase in number on road accidents every year. The main reason for the accidents is lack of attention and carelessness of a driver. There are lot of distraction for drivers like accessing infotainment system while driving, activities while driving, and major cause is drowsiness due to heavy workload, illness, fatigue, etc.so as to reduce the quantity of traffic accidents and for improvement of the security and efficiency of the traffic, the researches and firms on Intelligent transportation System (ITS) are conducted worldwide study for several years. Intelligent vehicle (IV) system could be a component of the ITS system, which aims to guide and help drivers in perceiving any dangerous situations earlier to avoid the accidents by detecting awaring drivers through sensing and understanding of the environment around itself. The goal of the Intelligent Vehicle Systems is principally that of improving driving safety as well as others safety and reducing the driver's capacity and capability.

An advanced driver assistance system is used to improve the safety of driving cars by interpreting traffic situations independently and assisting the driver. There has been significant amount of work done in field of computer vision. The process of lane marking can be achieved by vision-based lane detection and marking. The image captured through camera mounted on a moving vehicle in a sequential shot which monitor the distance between the vehicle and its surroundings like lanes, objects, etc. Edge based detection is major technique used. Usually, the boundaries on road are straight lines while there are some complex model loke B-spline, hyperbola, parabola, Hough Transform (HT) (Deans Stanley 1981) to detect curves and lanes. Hough Transformation is generally applied after getting results from edge detection over a grayscale image. Apart from Hough Transformation, several techniques like, deformable template matching (Jain 1996) neural networks (James A Anderson 1995; Dong-Joong Kang and Mun-Ho Jung 2003) and dynamic programming (Richard Bellman. 1954) are also used for lane detection.

Trace tracking problem, on the other hand, involves tracking the edges of a road line in each image sequence product by camera mounted during motion of object. In order to follow the route, various approaches have been suggested so far. For model scale problems, Kalman filtering (Greg Welch and Gary Bishop 1995; McCall 2006; Freeman and Adelson 1991) and particle filtering are popular options.

Lane detection based on hough transform

A. An Overview of Hough Transform

The Hough Transform (HT) (Deans Stanley 1981; Qing Li 2005) is a method used to detect an unknown shape in an image, given a parameterized description of the problematic shape. Also, HT is able to produce results when image is noisy and shape gaps can be tolerated. Shape gasps can be understood as non-uniformity in image shape which can be predicted and neglected using HT. HT is able to predicts various shapes like line, circles, etc. Line transformation is the simplest HT. Since, general equation is unable to deal with lines of infinite slope, polar form is used. A point (x,y) on x-y plane can be treated as point at a distance(**ρ**) from origin and making (θ) with horizon.

For any point in (X, Y) plane, there exist infinite lines passing through a point with corresponding values of (θ) and (**ρ**) and all the lines can be represented by single sinusoidal curve plotted on (**ρ,** θ) plane. Figure 2 shows sinusoidal curve plotted on Hough Space for each point present in Image Space shown in Figure 1. For every point in Hough space there exist a line whose parameters are (**ρ,** θ). The basic idea is to find a common parametric line with respect to every point present in image space and the point of intersection of all lines in Hough space is the line of best fit in Image space.

Thus, the line formed by points present in image space must have same parameter (**ρ,** θ) for each point as they lie on same line. This result can be shown by intersection of sinusoidal curves intersecting at same point (**ρ,** θ) which shows that there exist a line which is satisfied by all points.

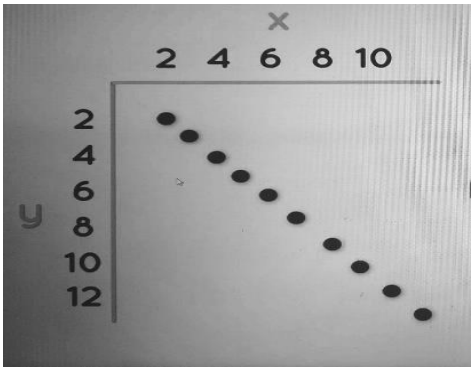


Fig.1. Image Space

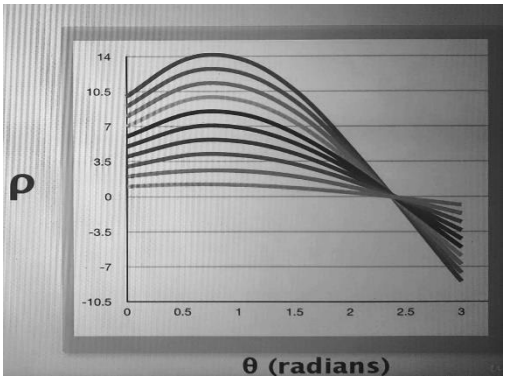
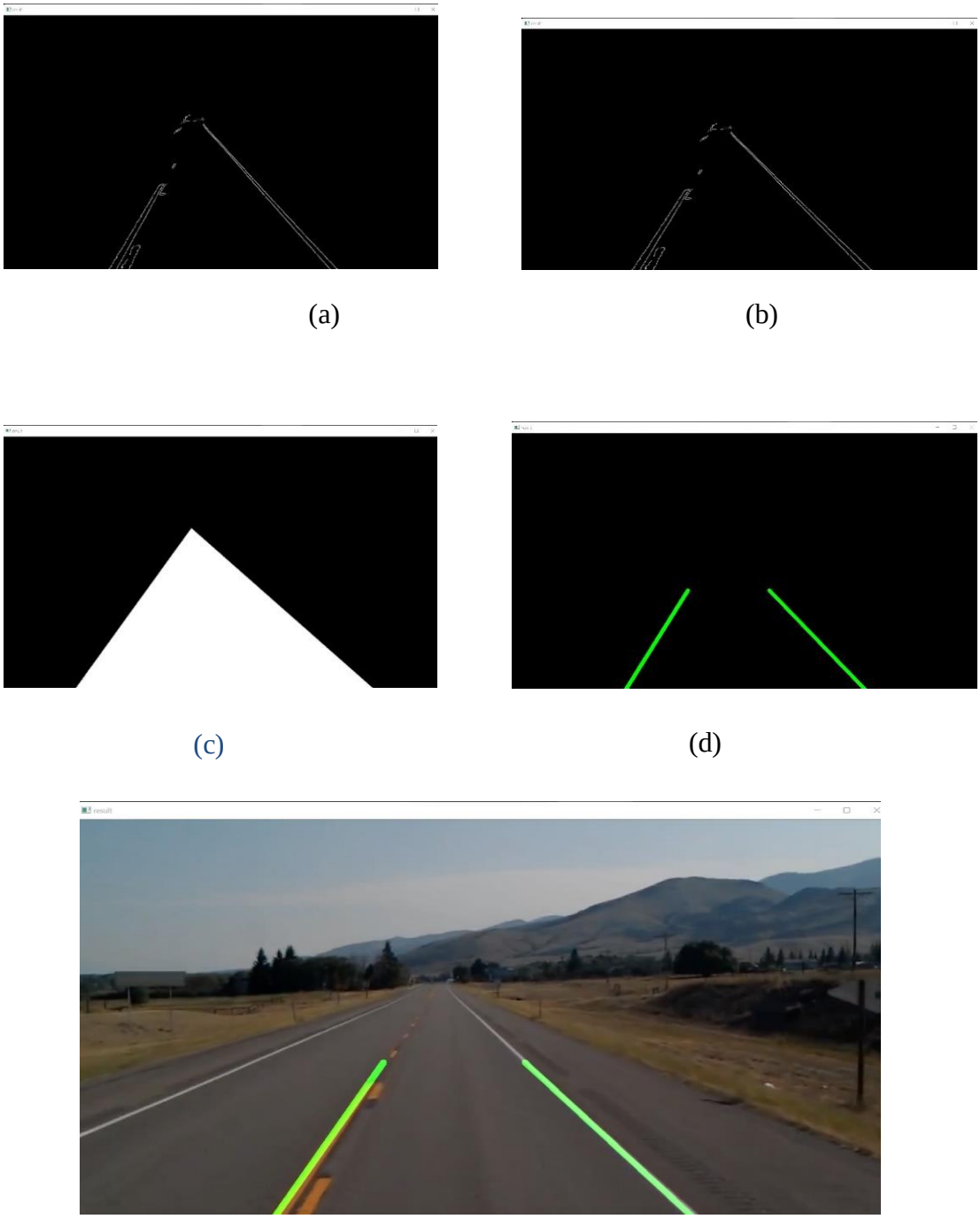


Fig.2. Hough Space

The image fetched by camera is converted to grayscale binary image and then edges are detected using canny edge detection. The obtained edges are fed into HT for straight line detection. There can be several instances which can produce multiple lines as a result , to overcome this Hough Space is divided into bins and the bins having maximum votes is considered as line of best match for detection.



(a) (b)

(c) (d)

(e)

Fig. 3. (a) Cranny Image, (b) Cropped Cranny Image, (c) Mask , (d) Lines Image, (e) Final Image

III.Two Partition Hough Transfromation

The original Hough transform processes the whole image to find lines which also comes with problem of noise in case of vehicles passing through the line.

We can do more partitions in this method but that may increase complexity as well as computing resulting in slow working of transformation.

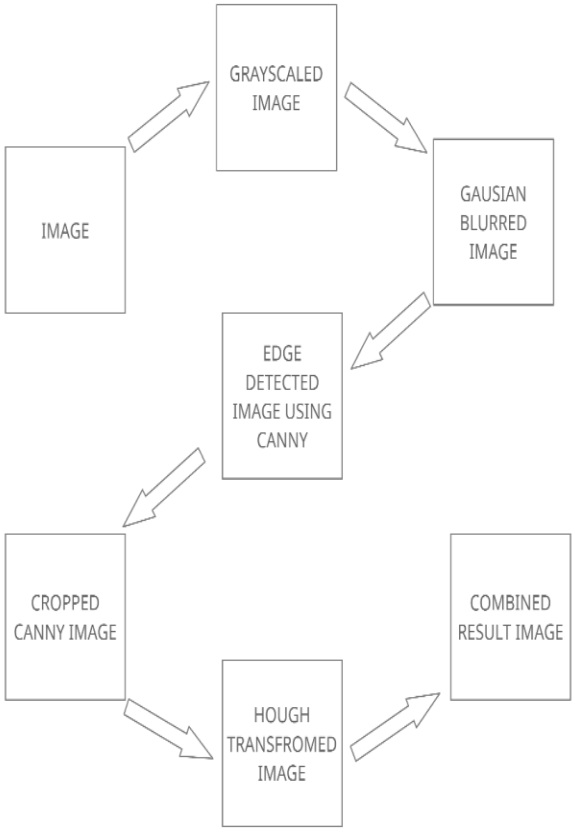


Fig. 4. Block Diagram of HT

So proposed solution is dividing the image in to two parts in keeping with camera height. After all the processing steps including grayscale conversion, canny detection is applied the processed frame is divided into partitions and so each partition goes through Hough transformation. After that we find cumulative height which will help us in combining all the lines in an exceedingly single Hough space.

Now we filter the lines which are almost vertical i.e. having slope in range (-0.4, 0.4) i.e. threshold range. Now we draw the lines which are edges of the lane with added cumulative height. After separately detecting lines for both the partition we combine them to get resultant image with marked lines.

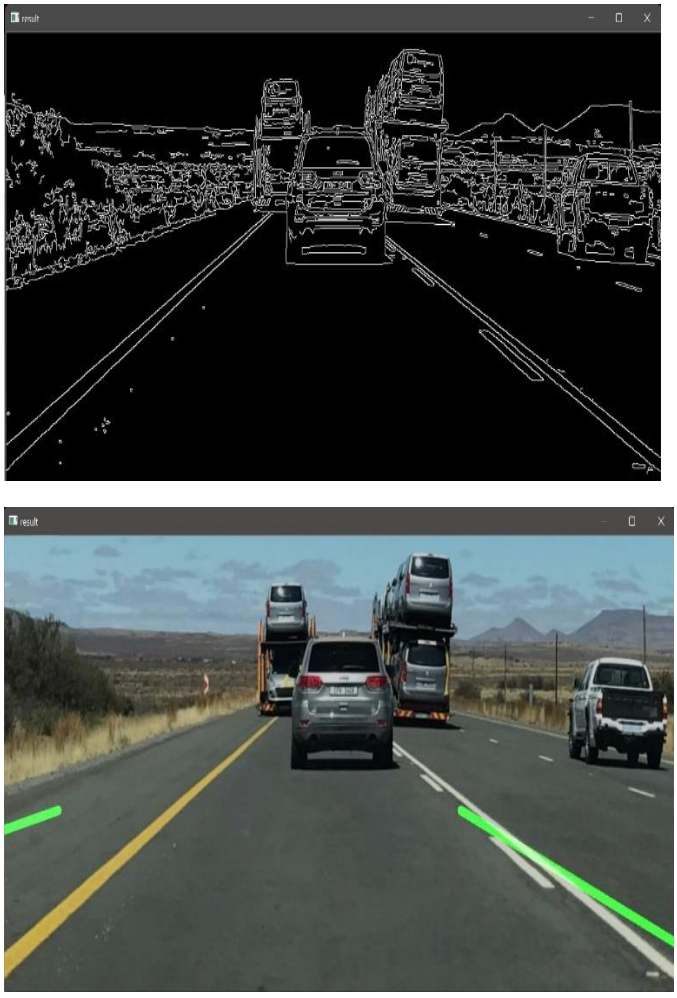


Fig.5 (a) Cranny image of lane with vehicle, (b) Lines detected after processing noise lines by vehicle

IV.Result

The proposed two partition technique which we talked about earlier is applied on a highway video having vehicles. The partition we did is in 60:40 ratios from above which are according to height at which camera is placed. The idea is to find lines in case of noise due to vehicle. After the partition is done we apply Hough transform in both the partitions. And after the lines are detected we combine them and resultant is most promising lines. Then they are marked in final image.

At the same time we also applied the classic Hough transform technique on a different video of empty highway drive. Where we detect the lane and mark it on final image.

Both the results can be seen in Figure 6. The image on the left hand side are the lines detected using proposed two partition approach and image on the right hand side are the lines detected using classical Hough transformation. We can see that new technique remove the noise due to vehicle and give best possible lane for our self-driving car.

(a)

(b)

Figure 6. (a) Lane detection using Two Partition Technique, (b) Lane detection using classical HT

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