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ROAD BOUNDARY DETECTION BASED ON THE RASTER SCANNING AND THE RANDOMIZED HOUGH TRANSFORM

B.Yagavi[*1] J.Sowmiya[2] K.Ramachandiran[3] M.Ananthakumar[4]
[1*] Department of ECE, IFET College of Engineering, Villupuram.
[2]Department of ECE, IFET College of Engineering, Villupuram.
[3]Department of ECE, IFET College of Engineering, Villupuram.
[4]Department of ECE, IFET College of Engineering, Villupuram.
*Correspondence Author: **B.Yagavi**

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Abstract
Detecting the road boundary is an important aspect for the applications of Intelligent Vehicle (IV). Automatic road lane detection is one of the crucial parts of the vision based driver assistance system. The driver assisting system can reduce the accidents, and thereby control the flow of traffic. The existing system uses the Laser Interferometry Detection and Ranging (LIDAR) by generating the Region of Interest (ROI) as prior information to detect the object or the path. The problem associated with the existing technique is that the deficiencies in the software realm and in need to select the proper ground filtering algorithm. The proposed system is used to improve the road lane detection system by using Hybrid Median filter. The system also produces a warning or an alert message to the user for proper driving in the road. It also uses the Dynamic Programming (DP), a powerful algorithm for optimal path finding on a cost field. Randomized Hough transform is applied on the filtered edge image to detect practically useful road boundaries with straight line segments. Finally, we aim to evaluate our system with the use of various filters for estimating the processing speed, time consumption for each filter method thereby to achieve high efficiency over the existing methods.

Introduction
The ability to navigate is very important feature for both autonomous vehicle system and driver assisting system. To ensure this it becomes very critical to recognize road region and stay on the road region while navigating from source to destination. Lane and pavement boundary detection problems have been broadly studied in the field of intelligent transportation. Due to which the complicated nature of the road scenario, e.g., entry/exit ramps, occlusion from other vehicles, shadows, and varying outdoor Illumination, gradient based algorithms have shown their limitations in this boundary detection application.

The vision based techniques can be broadly divided into the feature based and model based lane detection. The feature based techniques extract the low level image features like color or edges to estimate the road lines. The model based techniques employ a linear or quadratic lane model for lane representation and are more robust against noise and missing data.

The proposed system is used for Lane marking in which one of the most important road signs are, which makes lane detection a necessary part for driver assistant system and unmanned vehicle. It uses the input as a road video file followed by Image Enhancement. Image Enhancement is to enhance the quality of the input video to get the clear vision of the road. Edge detection is used to detect the edges of the road and also for lane marking of through the white lines in the boundary. It also uses the Dynamic Programming (DP) algorithm to detect lane with the optimal path finding with the least cost factor. The Dynamic programming algorithm is used to subdivide the complex problem into smaller one and then solves it, so that the algorithm can work efficiently with the least time.

The Randomized Hough transform is the complex invariant of the Hough transform. The basic Hough Transform suffers from many difficulties stemming from binning the curves. Raster scanning is a technique for generating or recording a video image by means of a line-by-line sweep, tantamount to a data mapping Scheme between one and two dimensional space. Artificial Neural Network (ANN) is to design objective of the system is to recognize the lane which a test vehicle is currently driving through by determining its left and right lane boundaries. This system also uses various types of filters such as mean, median, hybrid median, BM3D and to compare its various performances such as processing speed and the PSNR values for the extracted two frames from the input video file.

Problem formulation
Lane detection is becoming popular in real time vehicular ad-hoc network. This research work focus on providing better performance in lane detection algorithm by integrating it with improved Hough transform. Main emphasis is to improve the result of lane detection algorithm when noise is present in the images. Hybrid Median Filter (HMF) is used in this research work which has not been used earlier and comparison shown among old technique (image without filter), and proposed technique i.e. HMF. To do performance

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analysis different metrics will be considered in this work. The performance of lane detection algorithms is usually evaluated in terms of accuracy, specificity, BER, and PSNR. To do performance comparison the result of proposed algorithm will be compared with some well-known lane detection algorithms.

Proposed system

Automated road lane detection is the crucial part of vision-based driver assistance system of intelligent vehicles. This driver assistance system reduces the road accidents, enhances safety and improves the traffic conditions. In this project, we present an algorithm for detecting marks of road lane and road boundary with a view to the smart navigation of intelligent vehicles. Initially, it converts the RGB road scene image into gray image and employs the dynamic programming to label the connected components of that gray image. Afterwards, the largest connected component which is the road region is extracted from the labeled image using maximum width and no. of pixels. Eventually the marks or road lane and road boundary are extracted from connected components. The experimental analysis show the effectiveness of the proposed algorithm on both straight and slightly curved road scene images under different conditions and in the presence of shadows on the roads.

Input Video

The input to the project is the road video file in "mp4"or "avi" format which is downloaded from the Internet or the input can be taken from the 3D camera which is placed on the roof the vehicle to capture the road. 3D camera is used usually to achieve the high efficiency. Image captured will be in the form of analog which is need to be converted to digital by sampling and quantization

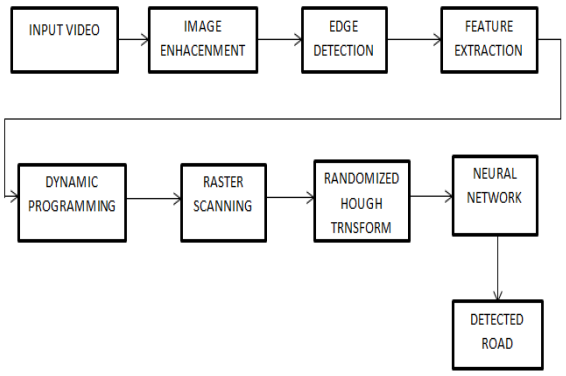

Figure: Block diagram of proposed model

Image Enhancement

Image Enhancement is the Process of processing an image to bring out specific features of an image or to enhance the image. Highlight certain characteristics of an image. By processing image so that the result is more suitable than the original image for a specific application (very much problem-oriented).Using filters image enhancement can be performed to achieve better image than the original image.

Edge Detection

Edge detection is the name for a set of mathematical methods which aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges.

Raster Scanning

Raster scanning is a technique for generating or recording a video image by means of a line-by-line sweep, tantamount to a data mapping scheme between one and two dimensional spaces. While this geometric structure has been widely used on many data transmission and storage systems as well as most video displaying and capturing devices, its application to audio related research or art is rare.

Randomized Hough Transform

The Hough Transform is a technique which can be used to isolate features of a particular shape within an image. Because it requires that the desired features be specified in some parametric form, the classical Hough transform is most commonly used for the detection of regular curves such as lines, circles, ellipses, etc.,

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However the HT has several drawbacks:

- All pixels are mapped, and every bin in the grid needs an accumulator. If there are d parameters, each represented by M bins or grid points, one needs Md accumulators.
- To reduce the computational cost, quantization resolution cannot be high, which blurs the peaks and leads to low detection accuracy.
- Each pixel activates every accumulator located on a line, but there is only one that represents the correct one while all the other are disturbances.
- If the grid window is set inappropriately, some objects may locate outside the window and thus cannot be detected.

Disturbing and noisy pixels cause many interfering accumulations.

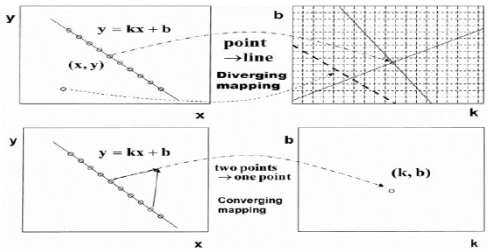


Figure: RHT Model

Let the set of candidate curves s_Θ be initially empty and set a pre specified number k_Θ for the number of candidate curves.
Step 1: Randomly sample a number of pixels and implement a converging mapping into a point $\Theta \in \Theta$.
Step 2 : check whether there is already an accumulator $a(\vec{\Theta})$ with $\Theta=\vec{\Theta}$.

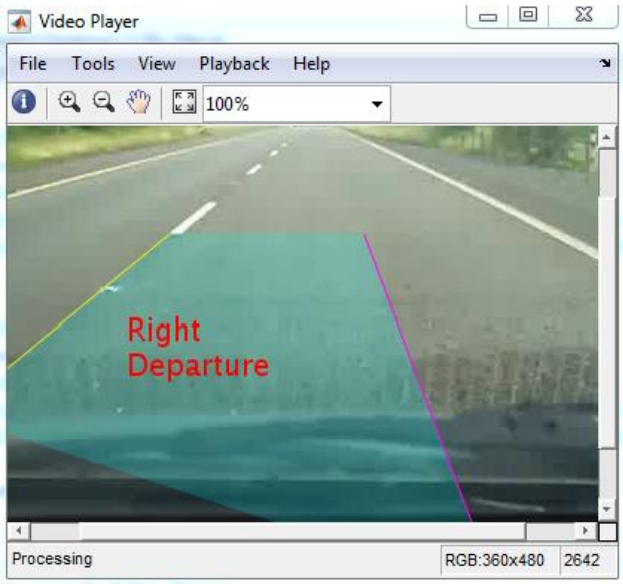
- If yes, set $a(\Theta^{new})= a(\vec{\Theta})+1$, $\Theta^{new} = \alpha\Theta+(1-\alpha)\vec{\Theta}, \alpha>0$ and delete the odd $a(\vec{\Theta})$.
- Otherwise, set $a(\Theta^{new})=1$;

Step 3: check all the accumulators if there is one $a(\Theta)>k_0$ then put the corresponding Θ into s_Θ as a candidate solution.
Step 4: If there are number of candidate solution in s_Θ is larger than k_Θ, examine every candidate $\Theta \in s_\Theta$ to see whether there are enough image pixels that can be reasonably expressed as Θ.

- If yes, refine Θ by these pixels as a confirmed solution and then remove the pixels from the image;
- Otherwise, simply discard this Θ.

Step 5: t $\leftarrow$ t+1 if $t>M_c$, then stop; otherwise go to step 1;

Results



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S.NO	FILTER	FRAME PER SECOND	EXECUTION TIME	CLOCK
1	hfilter2d	24358300	1.00377	1.014
2	hfilter3d	48716600	1.01173	1.014
3	BM3d	24358300	1.01319	1.014
4	Hmean3d	24358300	1.01055	1.014
5	Particle Filter	48716600	1.00346	1.014
6	Hybrid median3d filter	48716600	1.00098	1.014

Table: 4.1 comparisons of various filters

FILTER	SALT & PEPPER	GAUSSIAN	POISSON	SPECKLE
Mean	18.72	18.71	18.739	18.748
Median	22.57	22.6064	22.5618	22.5908

Table: 4.2 Psnr in dB

Conclusions

A robust method for road boundary detection is proposed. The system was investigated by using various filters such as mean, median, particle, BM3D. The approach was based on the Hybrid Median filter (HMF) to increase the number of frames per second and to reduce the processing time. The approach was also based on Randomized Hough transform to find the lane boundary of the road. And the approach is applicable under various lighting conditions, shadows etc., It can be concluded that this method performs well in both straight and curved road lines. It is found that the proposed algorithm become even more powerful when noise is present in the input road images. The Hybrid median filter performs well in removing noises present in the input and producing the output with the least time.

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