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# Lane Detection for Departure using Hough Transform for Driving System

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## ABSTRACT

The Hough transform is technique of feature extraction used for analysis of images, computer vision, and digital image processing. The purpose of the technique is to find imperfect instances of objects within a certain class of shapes by a voting procedure. This voting procedure is carried out in a parameter space, from which object candidates are obtained as local maxima in a so-called accumulator space that is explicitly constructed by the algorithm for computing the Hough transform.

A Hough Transform Based Lane Detection for Driving System has been developed to aid a driver in the lane departure decision-making, to reduce a loss of concentration and to prevent an accident while driving. In this paper, we propose a method for detecting the lanes by using a webcam camera to record the road as a video file (.avi) and using Hough Transform method to detect the lanes in an image. The results show the lane detection in various line road conditions. According to the results, the drivers can use this information to increase their safety of driving, especially when making the decision of lane changing.
**Keywords:** Computer Vision, Voting Procedure, Hough Transform, Driver Assistance Systems, Standard Hough Transform

## I. INTRODUCTION

Vision based street lane detection and tracking is an important process for Driver Assistance Systems, which can reduce the risk of car accidents. Various lane detection and tracking methods have been proposed but situations like strongly differing illuminations, and unmarked or partly marked lanes are still challenging. Now a days, the growing volume of the traffic all around the world requires higher levels of the traffic safety on the road. There are so many unsafe driving cars that the driver required to be highly careful while driving. Important for driver is being careful when he/she is changing lane, especially in new driver who absolutely cannot keep too much information at once and has no confidence for driving. Driver may lose concentration and control over car. In fact, human behaviors are indeed hard to recognize, predict and handle by current available equipments. Therefore, a monitoring and warning system focusing on behaviors of the vehicle is needed while the car is moving on the road. A Hough Transform Based Lane Detection for Driving System was developed to find the way that can reduce the loss of views to the frontstreet.

The Hough Transform, one of the easy techniques for image processing, used for detecting road lanes within the image. This system is designed to work in conjunction with the general principles of the webcam image processing. The system helps the driver by keeping track of movements of a vehicle through the lanes. The System proposed in this paper is comprehensive system which uses road information collected using camera. Firstly, the acquired video file is extracted to image frames. Secondly, the image frames are specifically divided into road part from the information of webcam camera. Thirdly, RGB color image is converted by image enhancement to grayscale image. Threshold is applied to evaluate the grayscale image into a binary image. Fourthly, the Hough

transform method is applied to detect the lanes in the road image and finally, lane departure is predicted from obtain Hough Line Pattern. The concept in this paper proposes complete system to monitor the position of a vehicle with respect to road lanes for improved driving safety.

## II. METHODS AND MATERIAL

### Frame Differencing

Frame Differencing is an easiest simple method for finding objects which got subtracted from one frame to another, in which all the different objects of interest called foreground responsible for this process to be applied to detect moving objects. In this method, the algorithms cannot be used because the frame differencing were not able to detect the object when it is stationary, even it intrude along the defensive line at that time.

### Image Processing

Digital Image Processing converts image data into digital data. The system receives image data, calculates output digital image data and then store image data into the computer's memory that can be performed by reservation memory of the machine in the form of an array. The value in each array represents the quantity of pixel. The position of the image is determined by the position of the array.

### Principle for splitting video into image

Video file is a computer file that contains digitized video. The video which has high motion will be having the high numbers of frames per second (frame rate). Video files can be split into frame, used for process the image and stored in a three dimensional array.

### Cropping an image

Crop tool is used to extract road part within an image by using the ‘imcrop’ function that can specify the size and position as parameters by specifying the crop rectangle as a four-element position vector.

(A) Original Image

(B) Road Part Image

**Figure 1.** The result of cropping road part image.

### Image Enhancement

This process changes the color image (RGB) toa grayscale image. Its analysis detects objects in theimage frames into the process. If using the color imagein the work, the process will be slow because theprocess must access all of the chromaticity. Therefore,it would be easier to access the grayscale image.

### Morphological Operations

Morphological operations affect the form, structure or shape of an object in an image. These operations areperformed on binary images and used in pre or post processing. For this paper, Morphological operations assist segmentation. They are used to cleanup the image including clear border objects, remove small objects and also reduce noises in the image.

### Hough Transform

The Hough transform is a popular technique which can be used to isolate features of a particular shape within an image. In this work, it is used for detecting line road as lane detection. There are 2 methods for computing the Standard Hough transform(SHT) of the binary image BW, which is an algorithm of parameter matrix whose

rows and columns correspond to rho and theta values respectively. The first method is given below:

[H, theta, rho] = hough(BW) (1)

For detect lines in the image. The second methodis adding parameter name and value pairs in the same equation as follow:

[H, theta, rho] = hough(BW, ParameterName, ParameterValue). (2)

When Parameter Name is 'Rho Resolution', specify a real scalar value between 0 and norm (size (BW)), to determine the spacing of the Hough transform bins along the rho axis. The default value is 1. When Parameter Name is 'Theta', specify a vector of Hough transform theta values. The acceptable range of theta values is -90°≤θ< 90°.

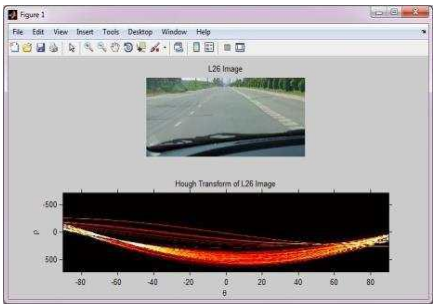



**Figure 2.** Detect line road by using the Hough transform

**Houghlines**

This method is used to extract line segments in the image based on Hough transform. There are 2 functions to describe the meaning of parameter and how to search the line segment. The first function is given below:

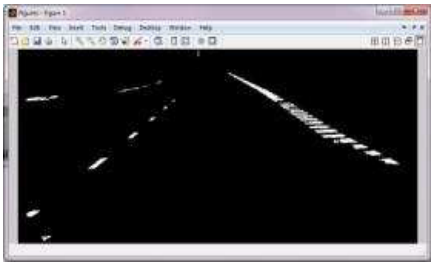
lines = houghlines(BW, theta, rho, peaks) (3)

Where BW associated with particular bins in a Hough transform.theta and rho are vectors returned by function hough. peaks is a matrix returned by the hough peaks function which contains row and column coordinates of the Hough transform. Secondly, using parameter/value pairs as follow:

lines = houghlines(..., param1, val1, param2, val2) (4)

It specifies the distance between two linesegments with the same Hough transform bin. If its distance less than the value specified, the hough lines function will merge the line into a single line, and Minlength parameter which specifies whether merged line should be kept or left.

(A) Road Part Image



(B) Image after Extract Line Segment

**Figure 3.** Example of Hough lines

**Proposed Method for Hough Transform**

In this paper, the main components of driving system detection based on the Hough transform are webcam camera and computer for storing imagedata. Firstly, the system saves image data from webcam camera and then transfers it into frame grabber processing the computer. Secondly, in recording data, real times applied to image data (.avi). Then the program which analyses the image data in a video signal will be taking the recorded data to further processing. The idea of this project is to provide a computer to monitor the image of line road that has intruded. The surveillance will be notified when car crosses the line. The processes are described below:

The main components of driving system detection based on the Hough transform are describedas below:

Step 1: Receiving image: the developed systemis able to acquire images from video files, which are already saved in a form of .avi video. The image willbe the same size as the resolution of the camera thatused to record without any additional configuration.

Step 2: Splitting image: The system analyzes the video file to apply to the video frames splitting process by applying the data of video files and then the system specifies the variable to divide sub frames in the variable of array image to the frame.

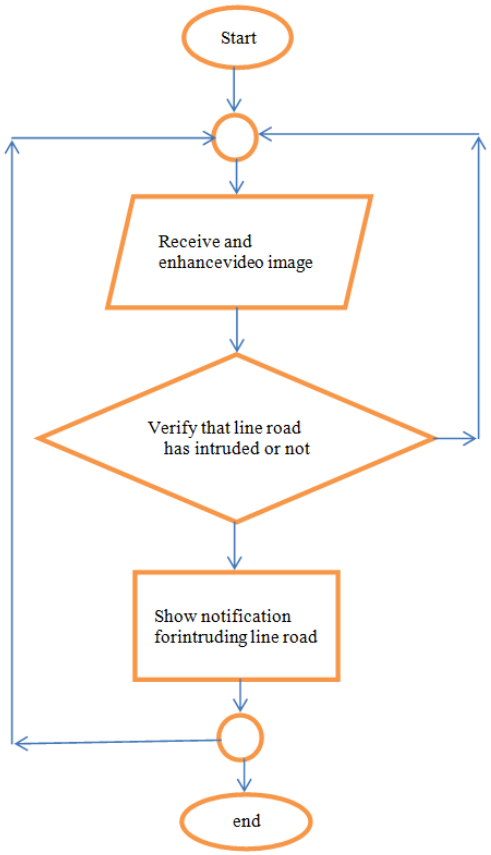



**Figure 4.** Frame work of driving system detection based on the Hough transform.

Step 3: Cropping image: Specifying the area of interest by using crop tool to extract the region of road part within the image. It can specify the size and position as parameters by specifying the crop rectangleas a four-element position vector.

Step 4: Image enhancement (from RGB colorto grayscale image): In this process, the system conducts the frame, which stored in the storage module, to convert RGB color image into grayscale image. After this process, we have the grayscale image. As shown in Fig 5.

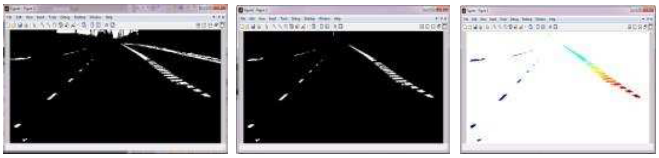
(a) Road part image

(b) Grayscale image

**Figure 5.** The results of image enhancement from converting RGB color image (road part) to grayscale image.

Step 5: Converting grayscale image to binary image: Threshold is an appropriate method that uses to convert the grayscale image to binary.

Step 6: Segmenting and removing objects: Using the opening operation, Morphological Operations which can assist segmentation and remove objects which are not structuring element. As shown in Fig 6.



(a) (b) (c)

**Figure 6.** The image received by Morphological Operations, (a)is cleaned image, (b) is image with clear border bjects and(c) is all remaining connected regions. It was showed bycolor.

Step 7: Defining the analytic area within theimage: The system conducts the binary image to define detection or surveillance area within the image by using the Hough transform which can identify straight line. We set green color to detect line and red color to detect the longest line segment as shown in Fig 7.

(a) red color (b) green color

**Figure 7.** The results of final detected lines

Step 8: Computing Hough transform: From step7, the system operates the defined segment to analyze the Hough transform. The original image is determined by Hough function. After computing, we get the Hough transform in red color to show the line parameters of its algorithm in the image.

## III. RESULT AND DISCUSSION

A Hough Transform Based Lane Detection for Driving System has been operated by setting the webcam camera to monitor the movement of vehicle through the lanes, segmenting the video file to the image, converting RGB color image to grayscale, setting threshold to make a binary image, using Morphological Operations and defining the analytic areas by using Hough transform. In this section we will explore the experimental results of the performance of the lane detection algorithm in various environments and describe its algorithm based on its process. We test the lane detection while driving along the lanes which have 2 types of lanes; dashed line and solid line. It also has 2 colors; white and yellow lane color. We proposed test conditions as follows:

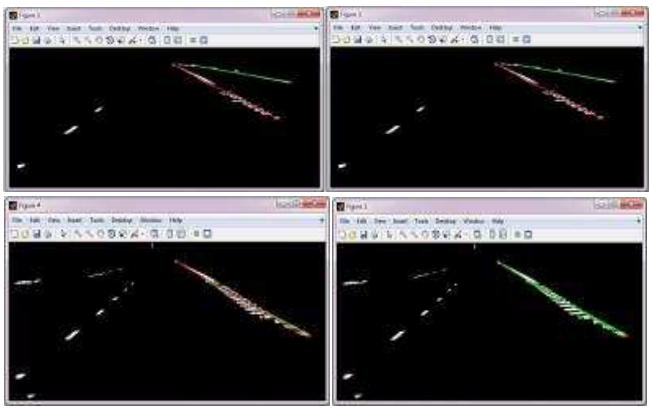
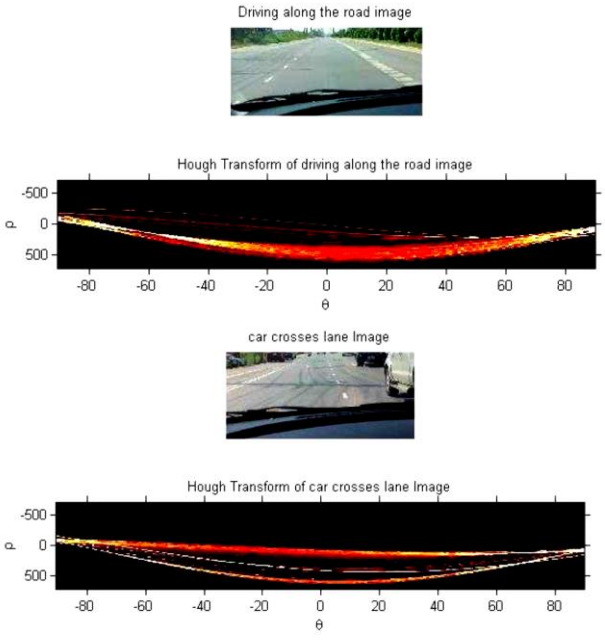


**Figure 8.** Lane detection results by Hough transform

This test condition shows the detected lane boundaries which are highlighted by green color. The longest detected lane boundaries are highlighted in redcolor. From the experimental results, this algorithmcan detect any kind of lanes with various test conditions.




This test condition shows the red line parameters in Hough transforms. We show the original image in 2 Situations; intruded lane and not intruded lane.

## IV. CONCLUSION

In this paper, we proposed a method for helping the drivers in the lane departure decision-making based on the Hough transform by detecting lanes. The adopted lane detection method was consisted of image processing, morphological operations, dynamic threshold, Hough lines and Hough transform. Its advantages of Hough transform are easy to use, lowcost and also effective in detect lines form the image. Experimental results reveal the efficiency of the performance of the lane detection algorithm in various environments. In further research, we will focus on how to detect the lane correctly in various situations, and how to arouse driver's attention by setting the sensor in a car.

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