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Accident Avoiding System Using Lane Detection (Based on Simulink)

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***Abstract* - :This Model based on machine vision is a human decision-make like solution to avoid lane departure fatalities with high reliability. The goal of this model titled "Accident avoider using edge detection" is to implement an image processing algorithm to detect lanes on the road and give a textual warning on departure from the lane. In this paper, the model of vision-based lane departure warning system and the realization is described at first. Then the method of lane detection is illustrated, which is composed of five steps: image preprocessing, binary processing and dynamical threshold choosing, lane detection and departure detection. After that, the solution of how to perform the departure decision-making is proposed and demonstrated. Simulink was used and tested for implementation of this model under graphical user interface unit.**

1. INTRODUCTION

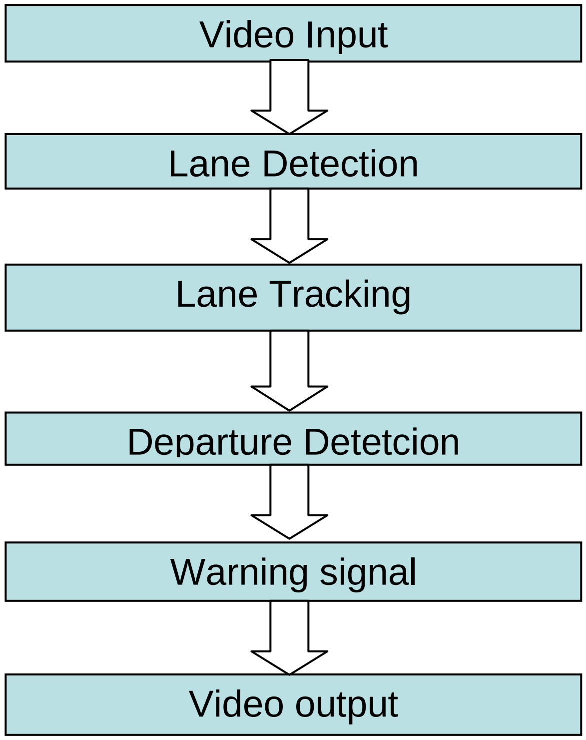
Leaving the lane causes about 30% of all accidents in the high way, and most of these are resulted from the inattentiveness and fatigue of the driver. The U.S. Department of Transportation has reported 42,643 fatalities in the year of 2003, 59% among which were caused by lane departure. Therefore, it's necessary to investigate a driver assistant system which can remind the driver when needed. Actually, the technologies of intelligent vehicle have been researched widely, such as the intelligent transportation system (ITS). This model is a typical application in the field of ITS, which is an active safetysystem to prevent inattentive lane departure. Compared with other technologies, this model based on machine vision is a human decision-make like solution to avoid lane departure fatalities with low cost and high reliability.

There are some machine vision based LDW systems have been reported. The Mobil eye's Lane Departure Warning System uses monocular image processing to detect the lanes and measure the position of the vehicle relative to the lanes. Carnegie Mellon University's AURORA [4] employs a wide-angle lens camera and a portable Sun Sparc workstation. The system use TLC method to make the departure decision. The Michigan University's CAPC [5] uses a camera scene of roadway and a suite of transducers provide vehicle motion and driver steering commands information. These are used to anticipate unintended road departures and warn the driver.

This model deals with a video of a lane in front of a vehicle recorded while it is being driven. We give this as the input to our model. After applying various techniques like enhancement, segmentation, detection etc., the lane is marked and then departure detection is done using encoding techniques. Then a textual warning is inserted whenever required i.e. when the vehicle departs from the specified lane. This paper is organized into 5 sections.

2. OVERVIEW

This model is mainly composed of two key modules: lane detection module and lane departure decision making module. Lane detection module detects the left and right lane markers on the road and the decision making module calculates the current position of the vehicle with respect to these left and right lane markers and issues a warning message whenever the vehicle is out of lane. The decision is made about the departure by calculating the distance between the center of the image and the left and right lane markers for left and right departure respectively. Whenever the calculated distance is less than a certain threshold, a warning is sent indicating the left or right departure.

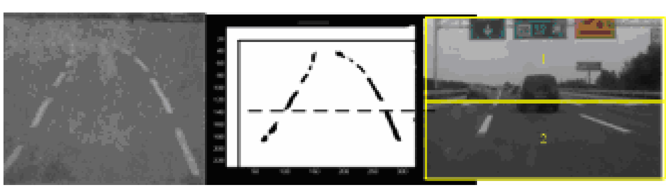


In section 3, a brief description of lane detection is explained, in section 4 ,the decision making in departure detection is explained and in section 5 Lane tracking is explained.

3. LANE DETECTION

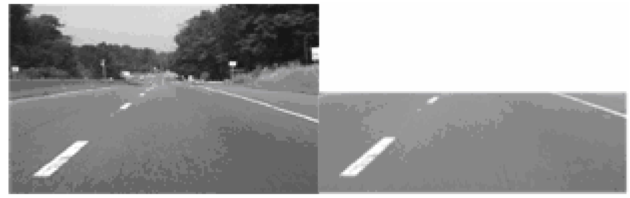
A. Image Preprocessing

The lane detection is the first step of a lane departure warning system. We firstly divide the picture and take the low half regard as Figure 1(c). Secondly we filter the image to remove some black and white noises. Then we make use of the Histogram of the image to gain a proper threshold to perform a binary processing of image.



(a) Normal lane picture (b) Lane model (c) Image dividing
Fig. 1 The lane model and interest region of image

In many cases, the road might be dirtied by cars, rains, etc. In order to remove the spots in the image, we employ a digital FIR filter.



(a) Original image (b) Image after smoothing
Fig. 2: Original image and image after smoothing

Now, an Auto threshold Block is used to convert the gray level image into a binary image and the threshold value is calculated on its own.

B. Hough Transform

The binary image is now served as an input to Hough transform block. This block calculates the two longest lines in the image and gives out the polar representation of these two lines(rho, theta).

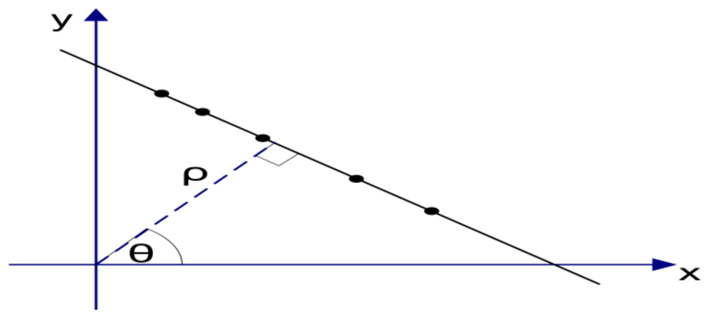


Fig. 3: *Rho* and *theta* representation of a straight line. Each line has a unique parameter set (rho, theta).

A find local maxima block is used which evaluates the two strongest lines from the image. The polar coordinates of the two lanes are now sent to the departure detection block.

4. LANE DEPARTURE DECISION MAKING

In order to make the system easier to realize and be adopted by various vehicles, a method which uses as least parameters as possible should be proposed. In our design, the proposed solution for lane departure decision-making is based on the distance between the center of the image and the left and right lanes for left and right departure respectively. This subsystem uses the hough lines block, selectors, relational operators etc.

The Hough Lines block inputs are the theta and rho values of lines and a reference image. The block outputs the zero-based row and column positions of the intersections between the lines and two of the reference image boundary lines. The boundary lines are the left and right vertical boundaries and the top and bottom horizontal boundaries of the reference image.

Suppose that Line1 and Line2 intersect the boundaries of the reference image as shown in the following figure.

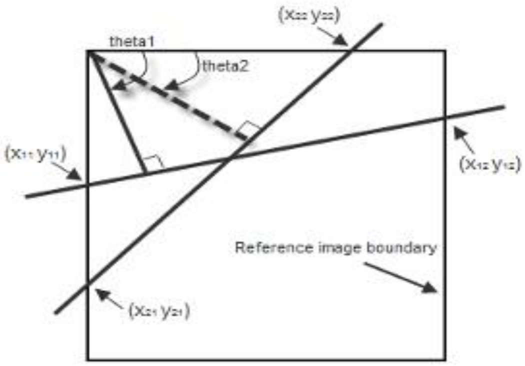


Fig.4: Hough lines

When the reference image and the theta and rho values of these lines are passed into the Hough Lines block, it outputs the coordinates of the intersections.Left and right lanes are identified by their intersection positions with the bottom image boundary. The intersection point of the left lane is to the left of the image bottom boundary center, and is the one closest to the center. By the same way, but to the right, the right lane is defined.

Now that the Cartesian coordinates are available, the center of the image is found out by halving the total number of columns available in the image. The distance between the left lane and the center (left dis) is found out by subtracting the column number of left lane from the column number of center. The distance between the right lane and the center (right dis) is also found out in the same way by subtraction of the column numbers.

A threshold value for departure detection is suitable for decision by taking one-third of the total columns in the image.

The left dis and right dis are now compared with the threshold and whenever these values fall below the threshold, a warning message indicating the left and right departure respectively are displayed on a screen.

5. LANE TRACKING

This subsystem saves the previously-detected lanes in a repository and counts the number of times each lane is detected. This subsystem matches the lanes found in the current video frame with those in the repository. If a current lane is similar enough to another lane in the repository, the example updates the repository with the lanes' current location. The Kalman Filter block predicts the location of each lane in the repository, which improves the accuracy of the lane tracking. A frame count of 5 is suitable for our model which approves the lane only if it is found five times continuously. This continuous tracking makes it more accurate than the other proposed systems.

6. OUTPUT RESULTS

The Results window shows the left and right lane markers and a warning message. The warning message indicates that the vehicle is moving across the right lane marker. The type and color of the lane markers are also shown in this window, in addition to the text message
A video display, textual warning and draw shapes blocks in Simulink are used to display the output of the model.

As we could see, the distance between the center of the bottom and the right lane is less than the threshold and hence a warning message named right departure is displayed.

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8. CONCLUSIONS

This model acts as a reminder when the vehicle is in danger of departing the road. In this paper, the process of lane departure detection approach was presented. The adopted lane detection method was consisted of image preprocessing, binary processing and dynamical threshold choosing, and Hough transform model fitting. The lane detection performance was improved by making use of Kalman filter, compared to the usual method of using Hough transform. The lane departure decision-making based on distance between lanes and the center of bottom in captured image coordinate was proposed, which needed less parameters than the usual TLC or CCP way. The experimental results indicated the efficiency and feasibility of the solution. Future research of this project will focus on how to detect the lanes correctly when the situations on the road are more complex.

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