LANE DEPARTURE WARNING SYSTEM FOR VEHICLE SAFETY

[1]K. Sravanthi, [2]Mrs. Ch. Padmashree

[1]P.G. Scholar, [2]Assistant Professor

AL Ameer College of Engineering

ABSTRACT

In Malaysia, the rate of fatality due to accidents cases increases year by year. This problem becomes more serious and need all concerns to immediately take the following urgent actions in order to save precious human life. Therefore, this work attempts to present a technique based on video and image processing for lane guidance warning system as an alternative way to reduce the accident rate due to lane departure. This system is capable to identify two lane markings from the video captured through a webcam. Warning system will automatically 'switch on' once lane departure occurs either to the right or to the left side of the road. The input video will first undergo threshold process and binary conversion. Then, lane marking detection is done using Hough transform, Hough line detection and local maxima finder. Finally, a decision-making algorithm is applied in the system to detect lane departure. It is found that, this system is able to identify straight lane markers, highlighting both markers with colour lines and able to give appropriate warning when lane crossing happen. For future enhancement, distance measuring function should be applied in the system so that the distance from one vehicle in front with another one at the back can be measured automatically.

Keywords: *lane departure, image and video processing*

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 . A National Crime Records Bureau (NCRB) report revealed that every year, more than 135,000 traffic collision-related deaths occur in India. In New Delhi, the capital of India, the frequency of traffic collisions is 40 times higher than the rate in London, the capital of the United Kingdom. Traffic collision-related deaths increased from 13 per hour in 2008 to 14 per hour in 2009. More than 40 per cent of these casualties are associated with motorcycles and trucks. The most accident-prone time on Indian roads is during the peak hour at afternoon and evening. In that, 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).

Lane Departure Warning (LDW) system is a typical application in the field of ITS, which is an active safety system to prevent inattentive lane departure. Compared with other technologies lane departure warning system based on proposed methodology is better solution to avoid lane departure fatalities with low cost and high reliability.

This paper is organised into 4 sections. In section 1, a brief description of lane departure warning system. In section 2 describe the algorithm implementation of lane departure warning system. In section 3 describe the experimental results and finally in section 4 describe conclusion and future scope.

2. ALGORITHM IMPLEMENTATION

Lane departure system consists of two different major components. The first is lane detection unit and the second is decision-making warning unit. The most important part in this system is to identify lane markers on the road.

A Typically, lane detection system process includes:

- Smoothing
- Edge detection
- Line detection and
- Lane detection

Smoothing is the process of removing noise from an image by using one of the various filters. 2D- FIR filter is selected among other edge operators to generate a binarized edge map. Hough transform is applied to the edge map to detect lines and Hough line to detect lane boundaries.

The steps of the Lane departure system operation are briefly explained as follows:

1. Place a webcam at the appropriate position behind the windshield.
2. Convert the video captured into frames of images. Then, digitalized the images for threshold process.
3. Detect lane markers in the current video frame using Hough Transform.
4. Match the current lane markers with those detected in the previous video frame.
5. Find the left and right lane markers.
6. Issue a warning message if the vehicle moves across either of the lane markers.

2.1. Lane Detection

In this project, few image and video processing techniques have been applied. The first algorithm involves in the system is lane detection which is the most important process to ensure the whole system success.

In many vision applications, threshold based segmentation is useful to be able to separate out the regions of the image corresponding to objects in which we are interested, from the regions of the

image that correspond to background. Thresholding often provides an easy and convenient way to perform this segmentation on the basis of the different intensities or colors in the foreground and background regions of an image. However, in this paper, the threshold value is a constant because the system is design to be implemented during sunny day. Figure 1 shows an image of highway road taken during a sunny day with no obstacle on the lane.

Figure 1: Highway road on sunny day

Figure 2 shows the image after threshold process. It is also known as a binary processing of the image. The desired lane marking with different contrast from other objects in the image is the only feature that remains in the image as the result of this process.

Figure 2: Binary image after threshold process

2.2 Edge Detection and Line 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. After finding out edges perform Hough transform on it.

Hough Transform

The Hough transform (HT), transforms between the Cartesian space and a parameter space in which a straight line (or other boundary formulation) can be defined. Let's consider (x, y) points in a road lane image, where all straight lines passing through that point satisfy the following equation for varying values of line slope and intercept (m ,c) as shown in figure 3.

$$y = mx + c \qquad (1)$$

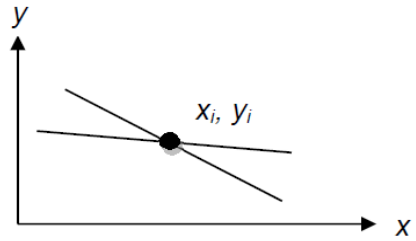

Figure 3: Lines through a point in the Cartesian domain

To reverse variables the above equation becomes

$$c = y - mx \quad (2)$$

Which describe a straight line on a graph of c against m as shown in figure 4.

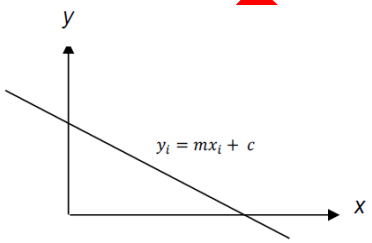

Figure 4: The (m, c) domain

The Hough transform is a feature extraction technique used in image analysis, computer vision, and digital image processing. The purpose of the technique is to find imperfect instances of objects within a certain class of shapes. The classical Hough transform was concerned with the identification of lines in the image, but later the Hough transform has been extended to identifying positions of arbitrary shapes, most commonly circles or ellipses. Compared with a template matching, Hough transform can give the same result with a faster speed.

In this case its sole is to identify lane markings in the image captured. Practically, due to the disturbance of noise, the resulting pixels seldom characterize an edge completely. One approach that can be used to find and link line segments in the image is by using Hough transform. After identifying the entire Hough peak, the lines in the image are being highlighted.

The above algorithm for detecting Line in Images as summarized as follows.

1. Find all the edge points in the image using canny edge detection scheme.
2. Quantize the (m, c) space into a two-dimensional matrix H with appropriate quantization levels.
3. Initialize the matrix H to zero.
4. Each element of H matrix, H (mi, ci), which is found to correspond to an edge point is incremented by 1. The result is a histogram showing the frequency of edge points corresponding to certain (m, c) values
5. The histogram H is threshold where only the large valued elements are taken. These elements correspond to lines in the original image.

2.3. Warning system

The parameters obtained from Hough transform will be used in decision making algorithm. The system will measure the distance of both the lanes from the center of the image. The distance obtained will be compared with the pre-define distance. If the distance measured is greater than the value in the database, the system will automatically detect the lane departure occurred either to the right or to the left depends on which side of the image distance exceeds the default distance. Once lane departure is determined, the system will then warn the driver by displaying a warning text to indicate whether it is a right or left departure.

3. EXPERIMENTAL RESULTS AND DISCUSSIONS

The system with proposed algorithm is tested using MATLAB. Besides, it has been tested on a straight highway road with white lane markings during a sunny day. The collected data is then being analyzed in terms of the efficiency, accuracy and functionality of the system based on the percentage of correct detection and recognition.

The below figure 5 shows the lane marking process for both sides (right and left) of the image by highlighting it using different colours. As the vehicle is moving within the boundary of the lane, warning pop-up box is not appearing on the screen.

Figure 5: Moving within the lane markings

Figure 6: Right departure

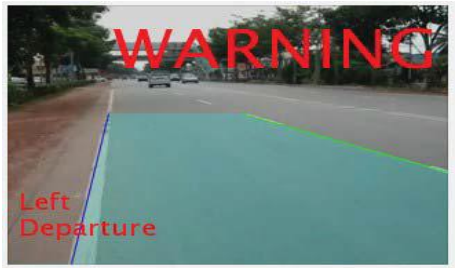

Figure 7: Left departure

However, departure text will be appeared on the screen as shown in Figure 6 whereby lane crossing happen on the road. The 'Right Departure' warning text is displayed on the screen when the distance from the center of the image to the right side line is greater than the other side while Figure 7 shows the opposite situation happen on the road.

CONCLUSION AND FUTURE SCOPE

In this paper, a video and image processing based lane departure warning system is proposed. In this system, lower parts of the input frames out of the video sequence are first filtered using 2D FIR filter and the filtered image is performed auto thresholding operation. The detection of lane marks and lane boundaries are proposed using Hough Transform and Hough Lines. The developed system performance in terms of normal day light, night under the vehicles beam light, under the tunnel dim light and under general system is useful for safety application

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