Lane Detection Using Embedded System

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Received: 22/8/2019
Accepted: 30/9/2019

Abstract **- The embedded systems are particularly important in vehicle intelligence system, this article aims to develop the device and compare its performance of Algorithms developed for real-time Lane detection by using camera captures images and identify street lanes in a variety of environments for real-time recording. An algorithm developed using ROI, Canny Edge Detection, Hough Transform and Gaussians Smoothing which are able to eliminate any factors that enables the system to detect high accuracy and accurate road lane. The camera will be used in recording the images in the traffic lanes in the front of the cars immediately and the recorded images can be analysed using ARM Architecture 32-bits Cortex™-A7. The performance test found that the prototype device can detect traffic lane and identify and interpret the object within the image of traffic lines correctly by an algorithm developed.**

Keywords **- Lane Detection; Canny Edge Detection; Hough Transform**

I. INTRODUCTION

At present, the number of vehicles on the road increases and accidents increase respectively. By accident each time, the loss was a lot of injuries, loss of property and death. Despite the declining trend, the death rate remains at an average of 5-10% per year, according to a report by the Thai Road Safety Collaboration Centre 2016 - 2018 which indicates that the driver is the main factors of collision 75%. Besides, accident may occur on many factors as shown in Figure 1 indicate the road traffic statistics that happened from variety of reasons as follows: Fatigue and drowsiness, Traveling in the distance, driving in the middle of the night from 1:00 am to 6:00 am, Long holiday driving, Drunk driving and drug use and high speed driving [1].

There are a number of highway roads in Thailand [2], and road lanes are crowded with increasing numbers of vehicles or transportation. Road conditions and conditions will lead to high failure rates in the detection of road lanes, such as crowded roads, unclear traffic lines or some missing traffic lines. The system cannot detect the lane of the road, as well as many other environments such as weather, low intensity light conditions, curved roads, the unclear road sign or faded include the damage road or the road without the road edge line as shown in Figure 2; showing the road characteristics that will cause the system to operate incorrectly so the system may not detect traffic lanes.

Figure 1. Different Road Conditions.

In the car help system developed to assist in driving and reduce the risk of vehicle accidents, such as collision avoidance systems, automatic parking system and car navigation systems. These security systems are still unclear developed or did not produce device. There may be limitations or factors that make it unsuccessful. In the passage research on road traffic lane inspection, researchers have invented and applied the technology based on the principle of image processing also called Image processing; the video was recorded on the front of the car to analyse on the computer [2]. The program was designed to monitor traffic on the road as follows [3]. It has been developed on an Embedded System (FPGA). Histogram shape for street alignment and road marking and ROI techniques. Researchers [4] can find the edges of images within 75.8% accuracy, traceability and distant calculation. Which was developed on embedded system (Intel X Scale) and can also use canny technique to find the line on the road with are the best and the most accurate 87% [5-7].

This article aims to develop a new algorithm for road lane validation using real-time lane monitoring protocols in a variety of environments. With Image Processing Techniques uses the camera to detect the image and Identify road lanes by showing traffic line signs and save the data to the cloud system to store traffic information and compare the performance of the route recorded. Researchers have introduced a new algorithm for detecting road lanes and developing prototype devices for road lane detection in a variety of environments in real time.

II. PROPOSED METHOD

The topic presents principles of image processing and system overview, to design the device to find the correct road lanes precisely. So all different ways are presented and explained the details of each technique are as follows.

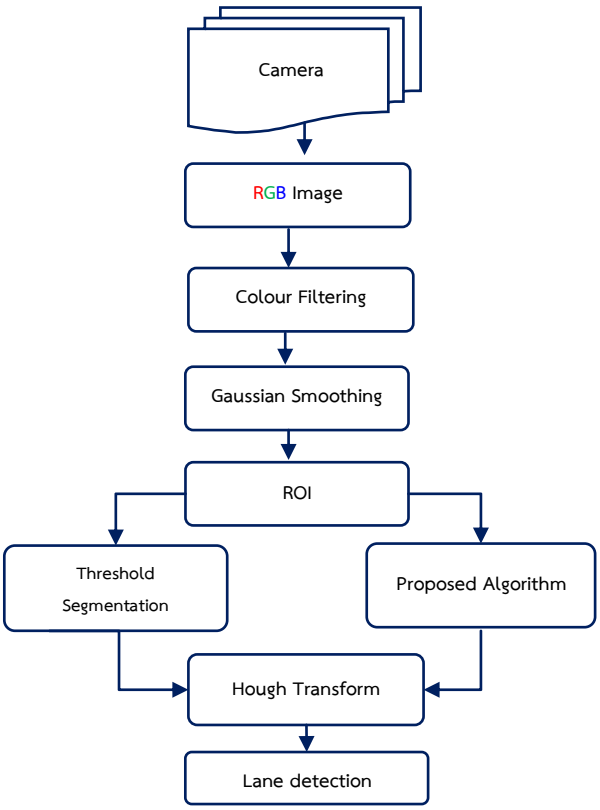


Figure 2. Flow Diagram of the Lane Detection

III. EXPERIMENTAL RESULTS AND DISCUSSION

In this paper, we introduced new prototype devices and algorithms for real-time lanes detection. This research uses the area of interest (ROI) as the input of the system, extracting image data from one webcam mounted on the front of the car. This image processing is a search for the lane lines. Therefore, the lanes detection device offers for highways only. The procedure of this system starts with taking a picture and then sends for image processing. In this section, we begin with the automatic colouring and lighting method to reduce the effect of colour and light translations in real conditions. Each sequence of images is reduced to a different time interval of system testing. Then the method used to find the started changing point of the image. Thresholding to separate the lane line from the background image. The next step is to find the edge of a picture with the Canny Edge method and the Hough Transform method in finding a straight line and use Curve Fitting method to find the curve in the image, respectively. The research shows that the techniques used to find lanes in different ways in the highways, such as straight and curves lanes, day or night time and even line mark detection for both solid lines and dashes lines. The researcher divided the work process and explanation into 5 steps as follows.

Step 1: Install the Device's Camera.

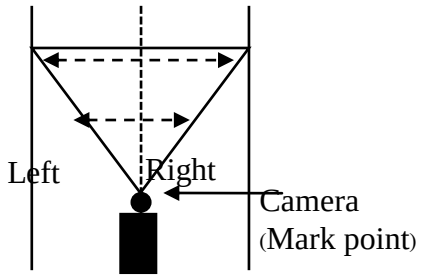


Figure 3. The Camera Setting in Car

Step 2: Pictures Recording (RGB Image)

The webcam is installed in the centre of the car's front glass and real-time video records the road lanes with the captures of 720 x 680 pixel images, then sends the files to the processor to get the image of a RGB colour space.

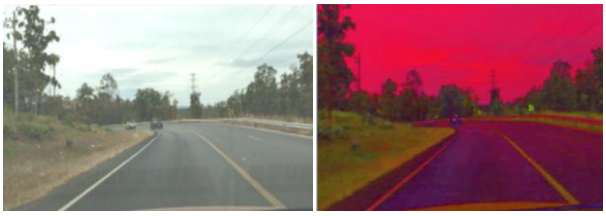
Figure 4. RGB Referenced Master Image

Step 3: Adjust the Colour and the Light of Image.

To adjust the light and colour of image is an important step due to getting the picture from the camera which is mounted on a moving vehicle, at various times where the environment conditions are uncontrollable; night, day, sunny, no sun, partly cloudy, less or bright light etc., and environment. As a result, the reflect color of images those are affected from objects such as trees, buildings, and the road pave we are interested in has different colors resolutions and brightness in different time and different environment, the system cannot find the road line images throughout the test period. To solve such problems, researchers have to adjust the degree of color and brightness of the images for each condition to be similar to make the image processing become more accurately by adjust the color and brightness automatically before the images are processed. It will use the image with color and brightness that is suitable as a reference image. The average value of each color space in the HSV (Hue Saturation Value) is considered by Hue Saturation and Value. Hue is the color value of the color. In practice, it is between 0 and 255. If Hue is 0, it will be red, and when Hue is increased, the color will change to a colour spectrum of up to 256 colors and return to Red again. It can be represented in degrees as follows: red = 0 degrees green = 120 degrees, blue = 240 degrees. Use the principle of the brightness of the color of the image. The HSV color space is represented by the vector three-dimensional, so in order to convert the RGB color space into a HSV color space, as following equations.

$$H=\begin{cases}\delta, & \&B\leq G\\ 2\pi-\delta, & \&otherwise\end{cases} \quad (1)$$

$$\delta = \cos^{-1}\left(\frac{(R-G)+(R-B)}{2\sqrt{(R-G)^2+(R-B)\cdot(G-B)}}\right) \quad (2)$$



(a) RGB (b) RGB to HSV

Figure 5. Color Conversion Data from RGB Color Space to HSV Color Space

Step 4: Canny Edge Detection Processes

In this research, we found the edges of the image by using the 4 steps canny method, starting with smoothing with a Gaussian filter to get rid of noise. Then, the first derivative is calculated for the size and direction of the gradient. Calculate the values of Non-maxima suppression and gradient values to make a thin edge. The last step, use the two reference points (Double Thresholding) to specify the value of the edge pixel and to help connect the edge. In each step, there are the following details.

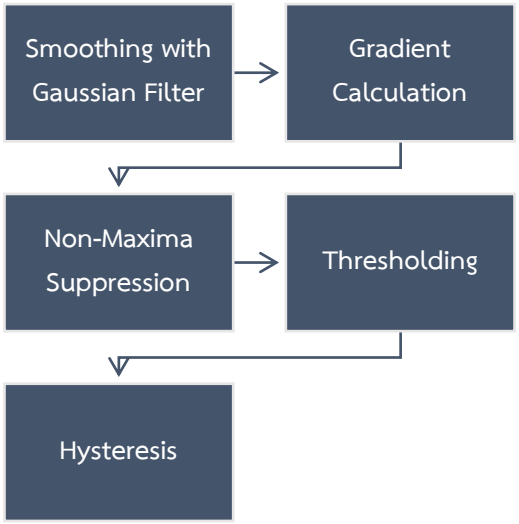


Figure 6. Canny Edge Algorithm

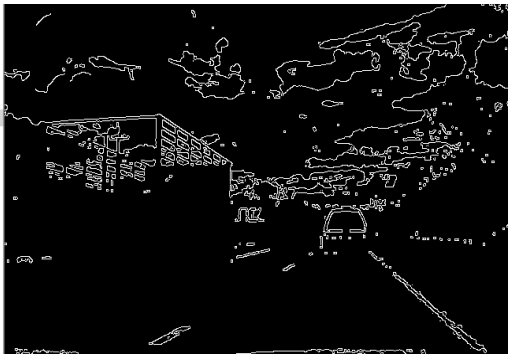


Figure 7. Finding Edge by Canny Algorithm

Step 5: The Process of Finding the Bus Lane Line Using the Hough Transform Method.

This section describes how to separate the road lines out of the floor area. From the layout of the road in Figure, the road lane line will have a distinctive color scheme. The left lane will look like a white line. The right side of the line will look like a yellow line. For this research, we will use a common process between RGB and HSV color spaces to separate the left and right lane. Because of the ability to separate the line of the road lane on the condition of changing colors and lighting well. This research will use the horizon point or the intersection of the margins of the two-lane as the moving point of the system, as shown in Figure 8 indicate the right and left lane line and the leading moving point.

The Hough transform is a popular technique which can be used to isolate features of a particular shape within an image. In [2] 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(ρ) and theta(θ) values respectively. The Hough transform equation as below:

$$[H, \theta, \rho] = \text{hough}(BW) \quad (3)$$

$$[H, \theta, \rho] = \text{hough}(BW, \text{ParameterName}, \text{ParameterValue}) \quad (4)$$

The standard Hough Transform (SHT) uses the line parametric as follow:

$$\rho = x*\cos(\theta) + y*\sin(\theta) \quad (5)$$

Figure 8. Find Lane Used by Hough Transform

IV. CONCLUSIONS AND FUTURE WORK

This research was presented the Finding a road lane for cars by the method of automatic light and color adjustment. Applied in conjunction with the color response of lane lines and roads in RGB and HSV color space for separation of the road lanes, which can work well in different lighting conditions and are effective in finding the lanes lines, even though the color and lines of the road lanes are less clear. There are 6 conditions of road to find the lane: 1) The lane of the road with straight lines and curves, 2) The lane of the road without the lane line, 3) Traffic lane with solid or dotted lines, 4) the lane of the road with straight and curved, 5) The lane of the road has no marked lines, and 6) The colour intensity of the line is not marked obviously. This research is able to solve the problems and factors mentioned above in finding the precise and accurate road lanes.

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(Arranged in the order of citation in the same fashion as the case of Footnotes.)

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