© IJCIRAS | ISSN (O) - 2581-5334
August 2019 | Vol. 2 Issue. 3

VISION BASED DEPARTURE WARNING FOR LANE KEEPING ASSISTANCE SYSTEM

Thanda Aung

Department of Computer Engineering and Information Technology, Mandalay Technological University, Myanmar

Abstract

The increasing amount of vehicle usage leads in traffic accidents and most lane departure crashes occur especially on high-way roads due to driver's inattention or incompetence or drowsiness. Therefore lane keeping assistance system is needed to save the considerable number of lives by warning the driver from imminent danger. Reducing the possibility of traffic accident occurrence is important for both developed and developing country. Moreover, lane departure warning is one of the most interesting parts in traffic safety system which still needs to develop. Most systems are based on computer vision and image processing with the use of visible-light cameras. Therefore, vision based image processing techniques are used in implementation of the system. This system is aimed to alerts the driver when the vehicle begins to drift out of its lane markings and road edges. In this system lanes are detected using improved Hough Transfrom. By testing with different datasets under various road conditions, results show that the proposed system has accuracy more than 99% on straight lanes.

Keyword: lane departure warning, lane keeping assistance, Hough Transfrom

1.INTRODUCTION

One of the top ten causes of death is due to road traffic accidents and such accidents lead to serious socio-economic problem [1]. Many departure crashes on single vehicle roadway take place in light traffic situations and good weather conditions often due to driver's inattention or drowsiness. Studies have also shown that many accidents are caused by driver falling asleep [2] especially during long journeys on high speed roads. In such cases, mortality rates tend to be higher as the driver is not sufficiently alert to break or steer to avoid obstacles [3]. Therefore, to save a considerable number of lives, a system is needed to provide a mean of warning the driver to danger if the vehicle drifts out of lane. Detecting the road image is one of the important roles for a warning system that alerts the driver.

In many intelligent-transportation system applications, detecting and localizing lanes from a road image are becoming important components. Lane detection, an important functionality of any Driver Assistance System that primarily works for vehicle's lateral control systems, namely, Lane Keeping Assist System (LKA). It is used to find lane and road boundaries in given images and also used to detect lane-change events that may occur unwittingly for the driver.

This paper is organized into six sections. The remainder of the paper is arranged as follows: some recent proposed lane departure warning systems are described in Section 2. Section 3 discusses methods that are used in departure warning. Section 4 states overview of the proposed system and Section 5 provides results for various experimental conditions. This paper concludes in Section 6.

2. RELATED WORK

Nowadays, many Driver Assistance systems are emerging to assist human drivers by working harmony with them in accordance to help preventing driver's mistakes and reduce traffic accident effectively. Many digital devices for driver assistant system were developed and implemented in the past decade [4] and many different vision-based road detection algorithms are currently developed to avoid assist drivers on the road. An edge-based lane boundary detection algorithm can be seen in GOLD system stated in [5]. In that system, where the lane markings are nearly vertical bright lines on a darker background, the acquired image is remapped in a new image representing a bird's eye view of the road. To extract quasi vertical bright lines that concatenated into specific larger segments, specific adaptive filtering is used. Other alternative to a vision-based approach is using a global-position system (GPS) with a geographic information system (GIS). It is practical to locate a vehicle with certain accuracy with GPS systems. However, the GPS data do not provide the exact positions of vehicles at the time of lane departure because of the limitation on the spatial and temporal resolution of GPS. Furthermore, in GIS, detailed information is often missing or not updated frequently. Therefore, to determine the exact lane position that a vehicle is departing becomes challenging task [6], [7]. Another system is based on color information that is developed by [8] which is proposed to handle moving vehicles in the traffic scenes. A series of images taken from a digital camera with different distances in an urban street is used as the input to the system. An adaptive region of interest ROI is set firstly. Then the lane marks are then extracted to eliminate many articles that might interfere with lane-detection process based on the color information. Segmentation and morphological operations are used to detect lanes in restricted search area.

3. METHDOLOGY

The proposed system is developed by using the following steps:

- Input dataset creation.
- Preprocessing
- Edge detection
- Lane detection and
- Lane tracking.

3.1. Input Dataset Creation

Video is captured under various lighting conditions to contain different road segments. Therefore video camera is installed on the central top of the vheicle dashboard. The duration of captured video sequence is a short sequence but with many features from different road conditions. The system is able to perform different types of video format which are suited with window media. Nevertheless, due to its superb video quality, flexibility and the most popular among other formats, the developed system is processed with the video file which is saved in a form of .avi file format.

3.2. Preprocessing

The video file containing road segment under different environmental conditions are captured and each frame in the video may contain unwanted region and noise. Therefore, to speed up the processing performance, only specific regions to identify and extract the features of interest instead of processing entire frame of images. The input video frame is divided horizontally into two sub-frames and takes only the lower half of the frame as road lines and marks are located only at the lower part. After diving the input frame, it is converted to intensity and YCbCr image to continue detection processes. The preprocessing setp is necessary because removing noise is important because the presence of noise in the system can affect the detection of edge.

3.3. Edge Detection

For edge detection, the proposed system used 2-D FIR filter as it has the ability to differentiate the edges and to smooth the noise in a noisy image simultaneously. The 2-D FIR edge detector is especially designed for the regions where light intensity changes slowly. Therefore it is better than the conventional edge detectors which can detect edges with abrupt change of light intensity such as step edges. It has advantages of ability to differentiate the edge and to smooth the noises in a nosy image simultaneously, and computationally more efficient than the popular Laplacian of Gaussian methods. [9]

3.4. Lane Detection

Lane detection phase uses the edge image, the Hough Lines [10] and the horizontal lines as input. Eventhough the Hough transform is a popular robust method for detecting lines in an image, the computational complexity and storage requirements are the main bottlenecks on real-time detection. Therefore, improved Hough Transform is used for line detection which employs many-to-one mapping and sliding window neighborhood technique to alleviate the computational and storage load [11].

3.5. Lane Tracking

Lane tracking is processed by matching and by Kalman filter. First, the distance between the lines found in the current frame and those in the repository. Then, the best matches between the current lines and those in the repository. If a line in the repository matches with an input line, replace it with the input one and increase the count number by one, otherwise, reduce the count number by one. The count number is then saturated. Kalman filtering algorithm [12] works in a two-step process. In the prediction step, the filter produces estimates of the current state variables, along with their uncertainties. Once the outcome of the next measurement (necessarily corrupted with some amount of error, including random noise) is observed, these estimates are updated using a weighted average, with more weight being given to estimates with higher certainty.

4. PRPOSED SYSTEM

In this paper, lane departure warning for lane keeping assistance system based on image processing and computer vision techniques are described. The overall system process is shown in Figure 1. Input to the system is video streams recorded by the video camera mounted on the vehicle. The input video is recorded from Taungnyo Road, Nay Pyi Taw, Myanmar. The steps used to carry out lane detection for departure warning process are:

- Receiving video file
- Horizontally dividing the input frame to reduce system processing time
- Converting RGB to intensity image to apply 2-D FIR filtering
- Converting RGB to YCbCr image to classify type and color of lane marks
- 2D- FIR filtering for edge detection
- Thresholding using Otsu's method to remove false edge segments
- Computing improved Hough transform
- Finding peaks for lane tracking
- Fnding the longest line in the image
- Tracking and matching lane marker lines
- Detecting lane departure and
- Producing departure warning depending on the vehicle's position of the lane.

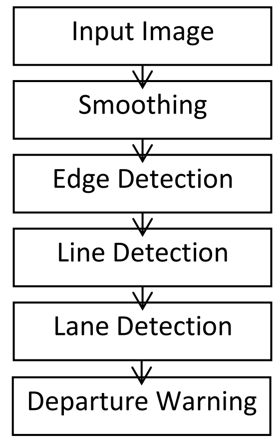

Figure 1Overall process of the proposed system

5. EXPERIMENTAL RESULTS

In this paper, lane departure warning for lane keeping assistance system is demonstrated using MATLAB. The input to the system is (.avi) format and frame size is 360x240 pixels per frame. In order to analyze the performance of the proposed method, five types of lane conditions: straight lane, curved lane, lane with unwanted lane markings, lane with shadow cast by trees and objects and cloudy weather condition. are used as an input for testing. These input are taken by digital video camera.

	12 frames/s	15 frames/s	18 frames/s	20 frames/s	24 frames/s	25 frames/s	30 frames/s
straight lane	99.32	99.51	99.6	99.64	99.73	99.76	99.81
curved lane	92.73	93.14	95.8	95.85	95.87	96.12	96.23
unwanted lane markings	89.54	90.91	91.4	91.57	91.63	91.71	91.77
shadow casted lane	87.63	92.6	93.3	93.64	93.67	93.68	93.69
poor visual condition	75.14	78.36	80.5	80.51	80.51	80.53	80.55

Table 1. Accuracy comparison different frame rates

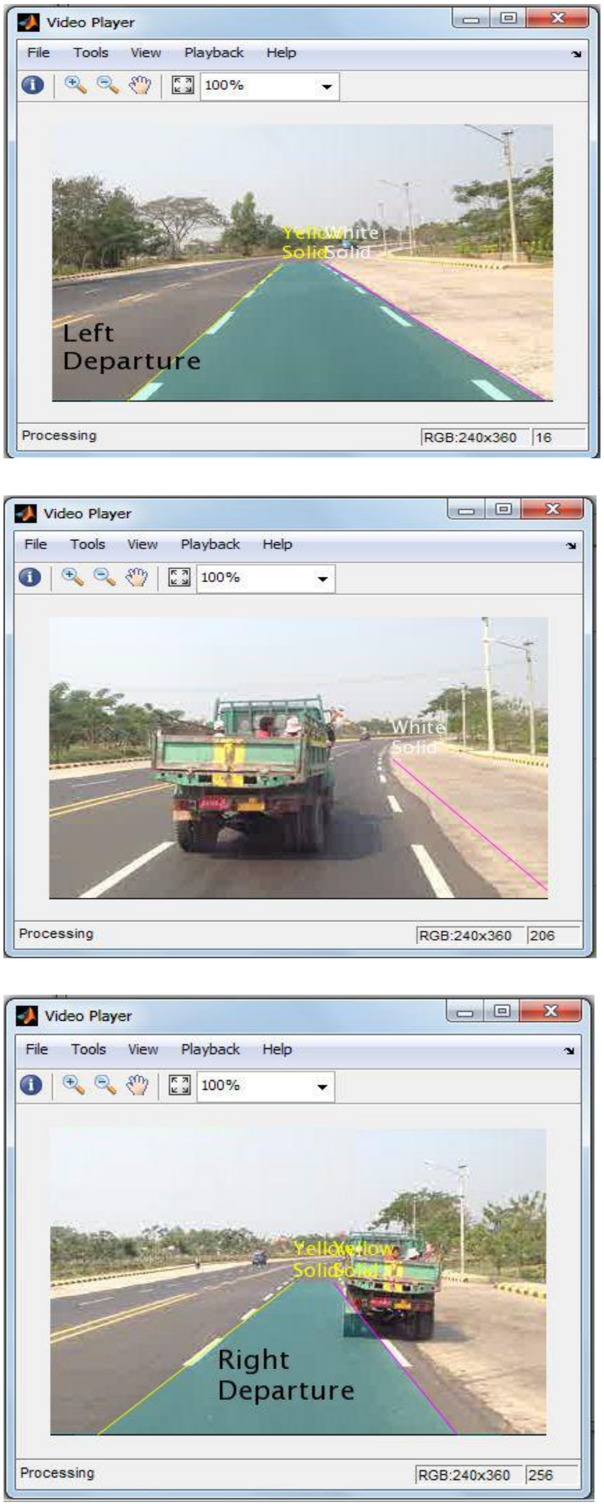

Figure 2Example of detection results

6. CONCLUSION

Detecting and localizing lanes from a road image is an important component of many intelligent transportation systems. In fact, lane detection is one of the most studied topics for intelligent transportation systems within the present decade. Many research teams around the world have been trying to improve lane detection and warning systems. In this system lanes are detected by using improved Hough Transform and various types of lane marks such as solid line or broken line are classified after the lane is detected. To produce departure warning, lane departure is determined upon the detected lane marks and vehicle position.
This system can detect 99% on straight lanes and about 96% on curved lanes. Moreover, the use of visible-light camera is cost effective for its low installation cost and maintenance. The limitation of the system is the accuracy of detection is declined for poor visible conditions especially at night. As the system is implemented to detect the departure only when after the road marks have been detected therefore detection of lane departure for unpainted road is left for further extension.

7.ACKNOWLEDGEMENT

The author thanks all, who have given suggestions and advices for the submission of paper.

REFERENCES

[1] Anonymous. (2012). Fuzzy C-Means Clustering, The MathWorks [Online].
Available: www.mathworks.com

[2] J. A. Horne, L. A. Reyner, "Sleep Related Vehicle Accidents", BMJ, 310(6979), 1995, p. 565–567.

[3] P. Nahi NCSDR/NHTS, "A Expert Panel on Driver Fatigue and Sleepiness", Drowsy driving and automobile crashes, Report No. DOT HS 808 707, 1998.

[4] S. Stephan, K. Sarath, A. Alen, D. Gamini, "Robust lane detection in urban environments", Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems, 2007, pp.123-128.

[5] B. M, Broggi, "GOLD: A parallel real-time stereo Vision system for generic obstacle and lane detection", IEEE Transactions on Image Processing, 1998, pp. 4-6.

[6] K. Y. Chiu, S. F. Lin, "Lane detection using color-based segmentation", in Proc. IEEE conference in Intell. Veh. Symp., 2005, pp.706–711.
[7] J. Gangyi, C. Yanhua, Y. Mei, Z. Yi, "Approach to lane departure detection", In Proc. IEEE 5th ICSP, 2000, pp.971- 974.
[8] N. Arshad, K. S. Moon, S.S. Park, J. N. Kim. "Lane detection with moving vehicle using color information". WCES Vol I, Ocotober 2011.
[9] M. Shah, "Fundamentals of Computer Vision, Orlando", 1997.
[10] Anonymous. (2011-14)). Hough Line Transform [Online].
Available: https://docs.opencv.org
[11] D. Duan, M. Zie, Q. Mo, Z. Han, Y. Wan, "An improved Hough Transform for line detection", 2010 Internal Conference on Computer Application and System Modeling, 22-24 Oct 2010.
[12] P. Zarchan, "Fundamentals of Kalman filtering: A Practical Approach", American Institute of Aeronautics and Astronautics, Incorporated., 2010, ISBN 978-1-56347-455-2.