Comparative Study of Various Methods Adapted in Lane Detection

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Abstract:

The automobile companies make investments of millions in developing technologies to keep drivers safe and avoid accidents while driving their vehicles. These technologies are known as Advanced Driver Assistance Systems (ADAS). It incorporates frameworks dependent on sensors, such as Lane departure warning system, Electronic stability control, Active cruise control, Pre-crash systems. Lane Departure Warning System (LDWS) is technology in ADAS that alerts the driver if the vehicle tends to depart the lane unintentionally. To do so, this framework keeps track of the lane markings on the road. It takes input as a traffic video to measure the vehicle speed at various stages .For this process, the various image processing technique is proposed and an alert message is generated when the vehicle changes the lane. In this paper, the lane detection techniques and algorithms are discussed using lane related parameters and the performance of the different lane detection technique is also compared and contemplated.

Key terms:ADAS, s Lane detection · Road detection ,canny edge detection, Hough Transform, Adaptive Hough Transform

Introduction

In automated vehicle system, a lane departure warning system mechanism designed to warn once the vehicle is driver when the car is about to cross its lane on roads without a turn signal. These frameworks are designed to reduce accidents by addressing the main reasons behind the collision like driver inattention, distractions and drowsiness. In the future, vehicles become more automated and will assist the driver for safe journey. The Advanced Driver Assistance Systems (ADAS) [4] offers many facilities like night vision assistance, lane departure warning system (LDWS), pedestrian detection, cruise control, etc.Lane-mark detection is one amongst the foremost necessary elements of ADAS and autonomous driving cars, and it's also a precondition for lane departure warning (LDW) [3]–[5]. ADAS are typically carried out to the extraction of lane markings1-3. Since most lanes on the road have clear lines and most of them are straight lines so that it is easy to detect the lanes and the lane detection technology for structured roads has reached a high level during recent years. However, due to in homogeneous surface and curved shape of the roads, and the unstructured roads are vulnerable to light, shadow, water and other factors, actors that result in poor detection performance. Therefore, the unstructured road detection technology is still in the research period. In the past two decades, researchers have made considerable progress in the vision-based approaches [2], [3], while facing several major challenges, especially in attaining robustness under complex lighting conditions and dense traffic.

There are considerable challenges in developing an effective Lane Departure Warning System (LDWS). No machine vision system is perfect. LDW works with less functionality **when** there is heavy rain and when visibility is poor. It may also fail to perform if the roads are covered with snow or there are no visible lane markings present on the road. The performance may also be affected when there is road construction and temporary markers are setup. The gravel road where the lane markings are absent, or worn off, would also lead to poor performance. Unusual lane markings would also confuse the system. Some of the different road conditions are shown below.

Road conditions that can impact lane detection.

Temporary lane markings

Unusual Lane marking

The proposed lane departure warning system should

• Obtain accuracy of lane detection more than 98%

• Able to detect lanes and provide departure warnings under diverse atmospheric / lighting conditions

• Provide less number of false warnings / nuisance alarms

Literature Survey;

In paper [1] the author had proposed algorithm consists of initialization, lane detection, and lane tracking. The initialization finds a rectangular ROI using the VP, and the lane detection finds the -ROI, which is a distorted trapezoidal region surrounding the lane markings The lane detection methods detects and tracks the lane markings within the ROI. Many sophisticated methods are proposed in this study, such as

the introduction of color cues, line clustering, scan-line testing, lane verification, and iron-ROI variable, and the proposed algorithm shows better performance for road conditions with noisy components than others. The proposed algorithm is verified using 48 video clips, which represent 12 road and weather conditions

In **paper[4]** the author the author had proposed Gabor filter was used for edge which can extract the edge information in multi-direction and multi-scale. and Hough transform algorithm **was used** for lane detection. As tested the algorithm was suitable for fast lane detection under the multi-lane and multi- scene on the structured road.

In paper[3]the author has proposed

an algorithm based on canny edge detector and Hough transform. The algorithms have been implemented on raspberry pi so that it can be used in real time lane detection. The algorithm was tested on the running vehicle and was able to detect the lane successfully

In this paper[2], the author had proposed a lane departure warning system based on the transformation of Hough and Euclidean distance. Equalization of histogram is used in the proposed methodology to improve the contrast of the input frame. The ROI subdivision facilitates the independent removal of the right and left lane markings using Hough transform. This will reduce the computational time required to detect the lane.

In **paper[5]** A lane detection method based on combined fuzzy control with RANSAC algorithms has been proposed. The author suggested the traditional lane detection methods based on the RANSAC algorithm used to cause many false detections and unable to accurately detect the lanes in a complex road environment, because of the existence of existence of the interferential noise points To solve these problems, the author has extracted boundary points in ROI after image preprocessing to form the initial set of lane boundary points and then exclude the interference noise points from the data set to construct the effective data set of lane boundary points using fuzzy control. RANSAC algorithm is used to fit points of lanes, ignoring the interferential boundary points, the accurate detection of lanes in

complicated situations can be achieved

Methodology:

Comparison Work

Hough Transformation for Lane Detection

A camera initially captures an image and then extracts the region of interest from the image input. Then

the image is converted to the gray - scale image. In order to minimize the processing time

The Hough Transform is then used to detect the lanes of straight roads and curved roads

Modified Hough Transformation for Lane Detection

A camera initially captures an image and then extracts the region of interest from the image input. Then

The image is converted to the gray - scale image. In order to minimize the processing time

The modified Hough Transform is then used to detect the lanes of straight and curved roads efficiently. The algorithm consists of clustering based image segmentation technique that is used to segment the road lane image.

Additive Hough Transform Algorithm

A camera initially captures an image and then extracts the region of interest from the image input. Then clustering based image segmentation technique was used to segment the road lane from the image. edge points are extracted by using Canny edge detector. And additive Hough transform are used to detect the straight lane as well as curved lane road images efficiently .

Lane Detection Based On Fuzzy Logic

A camera initially captures an image and then extracts the region of interest from the image input. Then Segmentation was applied to segment the road lane from the image then modify Hough transform i.e. Fuzzy Logic is used to detect straight lane as well as curved lane road images efficiently.

Experimental results

Testing a wide variety of road images was implemented in the experiments. The algorithm was implemented in MATLAB. Comparisons of algorithm on many different marked roads has been made . It successfully detected road lanes for straight and curved roads. First of

all, in this section we compare the classical Hough transformation with the modified Hough transform, Additive Hough Transform Algorithm, Lane Detection Images Based On Fuzzy Logic

Performance Evaluation

This section contains the comparison of the 4 existing lane detection

F-Measure

The F-Measure computes average of the information retrieval precision and recall metrics. The computed values are between 0 and 1 and a larger F-Measure value indicates higher classification/clustering quality**.**

F-Measure= $2*\frac{P*R}{P+R}$

Images	Method1	Method2	Method3	Method4
Image1	98.37	98.39	99.12	95
Image2	96.8174	96.8174	96.81	97
Image3	99.6912	99.6959	99.7	92
Image4	98.9598	98.9598	98.9	98.12
Image4	90.9218	91.0952	92.12	90.4

Where P represent precision and R represents recall

Table 1.1 has shown the comparison among proposed and the existing strategy based on F-measure.

. Recall: Recall(also known as sensitivity) is the fraction of relevant instances that are retrieved. It is defined as collection of positive cases. Recall can be expressed as:

Recall=$\frac{TP}{TP+FN}$

Images	Method1	Method2	Method3	Method4
Image1	0.02	0.3496	0.98	0.2
Image2	0.35	0.5972	0.99	0.45
Image3	0.9	0.9897	0.87	0.92
Image4	0.55	0.6876	0.78	0.68
Image4	0.78	0.7169	0.91	0.8

TP=True Positive

FN-False Negative

Bit Error Rate The bit error rate (BER) is the percentage of bits that have errors relative to the total number of bits received in a transmission.

BER=$\frac{1}{MN}\sum_{I=1}^{m} \quad \sum_{j=1}^{n}$ [f(i-j) f′$(i-j)$]

Images	Method1	Method2	Method3	Method4
Image1	32.5438	32.5206	38.5	37.8
Image2	1.5982	1.5765	32.65	28.5
Image3	27.0138	27.0124	4.23	4.43
Image4	3.0845	3.0845	8.45	18.54
Image5	0.3079	0.3032	0.34	8.45

Conclusion:

Accidents on road are the major problem for the government of any country. A survey of existing methods for detection and marking of lanes is provided in this work. Various performance evaluation metrics are moreover discussed in this paper The previous methods proposed for detection and marking have several shortcomings. Even though lot of progress has been attained in the lane detection and tracking area, there is still telescopic for enhancement due to the wide range of variability in the lane environments

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