ISSN: 2277-9655
Impact Factor: 1.852

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

Integrated Lane Colorization Using Hough Transformation and Bilateral Filter

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Abstract

Lane coloration is a significant technique in a number of intelligent automobile applications, containing the lane trip recognition and warning board, intelligent journey control and autonomous driving. This paper presents a literature review on the techniques for lane coloration and explores the benefits and limits of existing lane colorization problems. It has been found that most of existing researchers has neglected the filtering and restoration techniques. However it is also found that existing researchers has also neglected the overheads of existing techniques. So in order to reduce the limitations of the existing researchers we have proposed a new strategy which uses bilateral filter as pre-processing stage which has ability to reduce the noise from images before further processing. By doing so it has started working fine even for noisy images. The proposed algorithm has been designed and implemented in MATLAB. By passing different images we have shown the significant improvement of the proposed algorithm over the existing algorithms.

Keywords: Image filtering, Lane coloration, Overheads, Hough transformation, Bilateral filter.

Introduction

Lane coloration plays an significant role in a number of intelligent automobile applications. Various lane coloration methodologies have been proposed so far by different researchers [1] - [8]. They are classified into infrastructure-based and vision-based approaches. Although the infrastructure-based methods accomplish extremely robustness, building cost to lay leaky coaxial cables or to put magnetic indicators on the road surface is high. Vision based methods with camera on a vehicle have benefits to use well-known available lane detection in the road location and to sense a road curvature in front view.

Lane coloration and lane tracking are two different steps in vision based techniques. Lane coloration is the problem of discovesring lane boundaries without any prior information of the road. Lane tracking deal with the tracking of the lane edges from frame to frame given an existing model of road geometry. Lane tracking is quite simple problem than lane coloration, as knowledge of the road geometry is known in advance which permits lane tracking processes to put properly strong constraints on the likely location and orientation of the lane edges in a new image.

Lane coloration technique has to locate the lane edges without any prior knowledge of the road geometry, and do so in situations where there may be a countless clutter in the road image. This clutter can be because of the noise, dust, shadows, puddles, oil stains, tire skid marks, etc. Thus it becomes a major issue when noise is present in the input image. Thus we focus on providing an efficient algorithm which will provide better results when noise or any other unknown factor is present in the image.

Literature Survey

Christian et al. (2005) [1] has presented a multi-camera lane coloration algorithm that makes use of a conventional PC and a graphics card. The feature detection and lane fitting approach are able to cope with different lighting situations, weather conditions, road layouts and lane markings. Christian et al. (2005) [1] has conclude that the lane colorization is an important application in intelligent vehicular systems.

Tseng et al. (2005) [2] has discussed a lane marking detection algorithm by using geometry information and modified Hough transform. First, the acquired image is divided into road part and non-road part from the geometry information. Secondly, the histogram of intensities is applied to quantize the road image into a binary image. Thirdly, a modified Hough transform method is developed to detect the lane markings in road image by using the road geometry information. However, only straight lane marking is studied here in [2]. Thus, it is interesting to develop the detection algorithm for curved lane markings.

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Shanshan et al. (2012) [3] has used the Canny edge detection, improved Hough transform for the detection of straight lines, through set a proper threshold to get rid of the false road edge, fit out the actual road edge. The experimental results show that the proposed algorithm has strong ability to adapt to the environment, and the extraction of boundary has a high precision. How to deal with the road edge detection under the complex environment still needs to do further research.

Miao et al. (2012) [4] has proposed a novel intelligent vehicle oriented lane coloration approach. Conclusions are made as (1) .A five steps lane coloration scheme that can successfully locate the lane line or boundary. In addition, it is also effective in various bad road scenes. (2) No assumptions are made about road structure, marking, or lane type, etc, so it owns a better generalize capability than others. (3) Plenty of experiments have been conducted and results show that the proposed method is robust to noises, shadows, illumination variations in the captured road videos, and is also applicable to both the marked and the unmarked road.

Zaidi et al. (2012) [5] has also suggested that the bottleneck in traffic is sometimes due to bus stops that are present on highways. Since we at the movement have very little information that the bus stops might have on certain highways, Zaidi et al. (2012) usually were not able to plan their locations well enough with respect to lane congestions. If only we have precise information of traffic concentration on each lane we can plan bus stops, route traffic and ovoid congestions.

Hongying et al. (2013) [6] has described a lane coloration and tracking method based on annealed particle filter algorithm, which combines multiple cues with annealed particle filter. As a first step, preprocessing, with bar filter and color cues being used. In the annealed particle filter step, angle information of edge map is utilized to measure weights of particles.

Saha et al. (2012) [7] has suggested that automated road lane coloration is the crucial part of vision-based driver assistance system of intelligent vehicles. This driver assistance system reduces the road accidents, enhances safety and improves the traffic conditions. Saha et al. (2012) has presented an algorithm for detecting marks of road lane and road boundary with a view to the smart navigation of intelligent vehicles. Initially, it converts the RGB road scene image into grey image and employs the flood-fill algorithm to label the connected components of that grey image. Afterwards, the largest connected component which is the road region is extracted from the labelled image using maximum width and no. of pixels. Eventually, the outside region is subtracted and the marks or road lane and road boundary are extracted from connected components.

DhanaLakshmi et al. (2012) [8] has exposed that lane coloration is an essential component of Advanced Driver Assistance System. The cognition on the roads is increasing day by day due to increase in the four wheelers on the road. The cognition coupled with ignorance towards road rules is contributing to road accidents. The lane marking violence is one of the major causes for accidents on highways in India. In this work DhanaLakshmi et al. (2012) [8] have designed and implemented an automatic lane marking violence detection algorithm in real time.

Cuong et al. (2012) [9] has proposed a method for robust detection of pedestrian marked lanes at traffic crossings. The proposed method employed colour and intensity information in extracting the candidate markers and verified the extracted markers in a probabilistic framework. Multiple geometric cues were used for the verification. The proposed method was evaluated and compared with existing approaches.

Gaps in Literature

Following are different gaps found in literature survey:

1) However, only straight lane marking is studied here in [2]. Thus, it is interesting to develop the detection algorithm for curved lane markings.
2) How to deal with the road edge detection under the complex environment still needs to do further research [3].

Lane coloration technique has to locate the lane edges without any prior knowledge of the road geometry, and do so in situations where there may be a countless clutter in the road image. This clutter can be because to the noise, dust, shadows, puddles, oil stains, tire skid marks, etc. Thus it becomes a major issue when noise is present in the input image. So it is required to propose a technique which will provide better results when noise is present in the images.

Need of the Lane Colorization

Lane colorization allow vehicular drivers to drive safely by telling them that where the actually lanes exists on the road and prevent accidents. As there exist much less chance of accidents when vehicles not cross the lanes. As lane coloration technique has to locate the lane edges without any prior knowledge of the road geometry, and do so in situations where there may be a countless clutter in the road image. This clutter can be because to

ISSN: 2277-9655
Impact Factor: 1.852

the noise, dust, shadows, puddles, oil stains, tire skid marks, etc. Thus it becomes a major issue when noise is present in the input image. Thus need of the proposed algorithm is clear and straight to improve the existing lane detection algorithm.

Scope of the Problem

Saha et al. (2012) [7] has suggested that automated road lane coloration is the crucial part of vision-based driver assistance system of intelligent vehicles. This driver assistance system reduces the road accidents, enhances safety and improves the traffic conditions.

DhanaLakshmi et al. (2012) [8] has exposed that lane coloration is an essential component of Advanced Driver Assistance System.

The scope of this work is to improve the accuracy of the lane detection algorithm and reduce the road accidents which were due to poor lane detection mostly in hill sides. Thus proposed algorithm has a significant scope in the hill side area where lane plays a crucial role. However proposed algorithm has also a great scope in Vehicular Adhoc Network (Vanet).

How Improved Lane Colorization Works

Following are the different steps of the lane colorization using bilateral filter are given. Each steps convert and image into a new form. Like bilateral filter will produce noise free image, global histogram will reduce the unwanted objects etc.

Step 1: Read the Road image
Step 2: Apply bilateral filter to remove the noise from the input image so that image is more suitable to the rest of the application.
Step 3: Convert image into the gray scale if it is in colour plane.
Step 4: Now global histogram based threshoding will be applied to detect the background.
Step 5: Now detected background will be removed or subtracted from the main road image.
Step 6: Now canny edge detection will be applied to detect lane edges.
Step 7: Now apply Hough transform and thresholding to segment the image and detect the lanes.
Step 8: Now just color the lanes

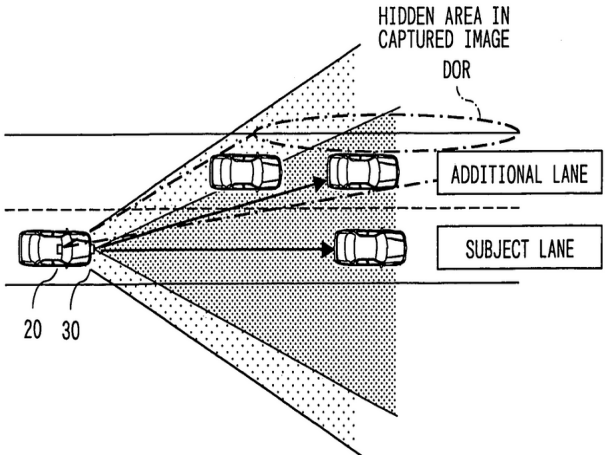

Figure 1 How to capture lanes

Figure 1 is demonstrating the vehicles as nodes, the main vehicle's sensor or camera will capture the road at a time and based upon the captured image lane detection will detect the lanes generally called as subject lane (lane of interest) and additional lanes.

Experiment Results

By taking different road images for experimental purpose we have seen the results of the integrated and existing approach. It is shown in the following figures why proposed algorithm is more beneficial over existing in case of noisy images. Figure 2 is showing the noisy input image. It is clearly shown that the visibility of the image is quite poor.

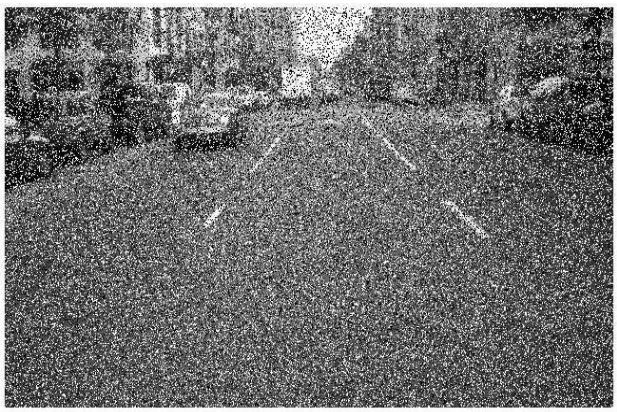

Figure 2 Input noisy image

ISSN: 2277-9655
Impact Factor: 1.852

Figure 3 Filtered image using bilateral filter

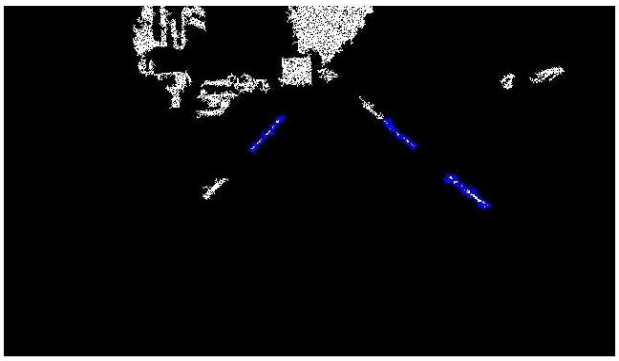

Figure 4 Hough transformed output without using bilateral filter

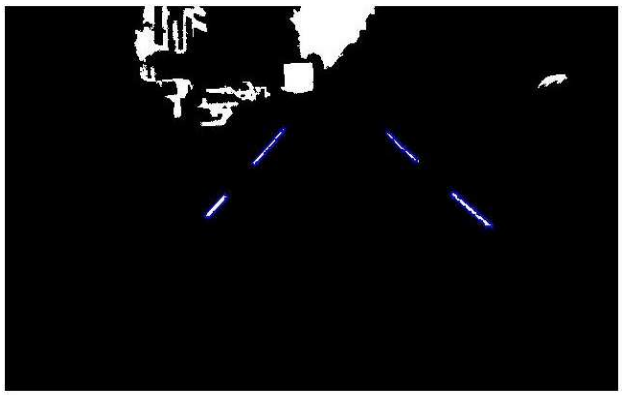

Figure 5 Hough transformed output using bilateral filter

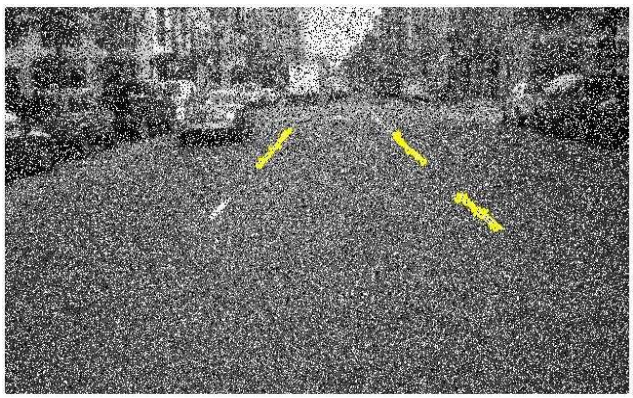

Figure 6 Final output image without using bilateral filter

Figure 3 is showing the filtered image using bilateral filter. It is clearly shown that the visibility of the Figure 3 is quite improved than the image shown in figure 2.

Figure 4 has demonstrated the output of the Hough transformed without using the bilateral filter. It has been noticeably shown that the Hough lines are not as accurate as expected.

Figure 5 has shown the Hough transformed output image using bilateral filter. The results are quite better than the image shown in figure 4.

The lane colorized image is shown in Figure 6 and 7. The image shown in figure 6 is without bilateral filter so have some artifacts i.e. not visibility too accurate and even lanes are not properly detected. But image shown in Figure 7 is showing the smoothed image even the colorized lanes are properly shown. Thus proposed algorithm is quite better than the existing algorithm.

Figure 5 Final output image t using bilateral filter

Conclusion

Lane coloration is becoming popular in real time vehicular ad-hoc network. The methods

developed so far are working efficiently and giving good results in case when noise is not present in the images. But problem is that they fail or not give efficient results when there is any kind of noise in the road images. The noise can be anything like dust, shadows, puddles, oil stains, tire skid marks, etc. So in order to reduce these problems a new strategy is proposed which has integrated Hough transform based lane colorization with the bilateral filter. The integrated approach has shown significant improvements over the existing methods especially when noise is present in the images. However no objective measurement is done in near future we will compare integrated strategy with existing methods.

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