Volume 5, Issue 6, June 2015 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Lane Colorization Using Improved Hough Transformation

Er. Iqbal Singh
Electronics Department
Guru Nanak Dev University
RC Gurdaspur, Punjab, India

Dr. Shashi B. Rana
Assistant Professor
Guru Nanak Dev University
RC Gurdaspur, Punjab, India

Abstract: -Lane colorization allows drivers to operate a vehicle safely by telling them that where in actuality the lanes exists on the road or highway. Provided this information, drivers have better knowledge of the road. It can certainly help in driving reducing the probability of accidents. Probability of accidents decreases when vehicles do not cross lanes. Lane detection technique finds the lane edges without the prior understanding of the road geometry, and achieves this in situations, where there can be countless clutter in the road image. Thus need of the proposed algorithm is clear and straight i.e. to enhance the prevailing Lane colorization algorithm. Lane detection has become popular in Intelligent Transport Systems. This research work focuses on giving better results in Lane detection algorithm by integrating it with guided image filter. Classical Hough transform fails in situation when noise is present in images. This noise may be tire marks, dust, oil stains, shadows etc. This research work focuses on a modified Hough transform so as to provide better results in noisy environment.

Keywords: ITS, LANE DETECTION, HOUGH TRANSFORM, GUIDED FILTER,

I. INTRODUCTION

Lane detection is the procedure to discover lane markers on the highway and then presents the data to an advanced system. This advanced system further processes the data according to the applied algorithm. These systems can either be used to provide assistance to driver or may be authorized to take some particular decisions. Such systems are called intelligent transportation systems. In such systems, vehicles work side by side with smart infrastructure to provide a better environment and better traffic conditions. The applications of lane detection might beas simple as pointing out lane locations to the driver on an additional display, to more complicated tasks such as for instance predicting a lane change in the instant future to be able to avoid collisions with other vehicles.

For lane detection various sensing elements are required for understanding of the road and lane. It includes vision (camera), LIDAR, vehicle dynamics, information about vehicle from car odometer, GPS, and digital maps etc.

Figure1. Challenges faced by lane detection techniques

Various lane detection techniques have already been proposed. Challenges faced by these techniques are shadows, confusion of moving and parked vehicles, damaged roads etc. Though these techniques works efficiently but in situations where noise may be present, there performance degrades.

In this work we have proposed a technique which can overcome challenges mentioned above.

In next section, state of the art work in the field of lane detection and related image processing has been briefly outlined. Then section 3 goes on describe the methodology adopted in the course of work. It has been shown with the help of flow chart for better overview.

Section 4 contains the results obtained bytests conducted in different environments through classical Hough transform technique and the modified Hough transform proposed. Performance analysis of both techniques over different parameters has been done.

Final section concludes the better performance of modified Hough transform and provides outlook for the scope in future research.

II. RELATED WORK

J.M. Alvarez and A. Lopez [1] presented a composite index to quantitatively measure the performance of road detection algorithms. The measure is dependent on a heavy mixture of different evaluations which make use of a trade-off between precision and recall scores. Having single score helps in evaluating different algorithms. Trials on real environment verify the usefulness of the proposed index. M. Aly [2] proposed a method which was more and provided real-time results. Algorithm used was robust and efficient for detecting lanes. It was focused on going for a top view of the street image, filtering with Gaussian kernels, and then using line detection and a brand new RANSAC spline fitting technique to detect lanes in the street. This algorithm could detect all lanes in still images of urban streets under various conditions. This achieved better leads to other algorithms that only focus on detecting the present lane boundaries, and had great results for detecting all lane boundaries. Z. Kim [3] presented a strong lane-detection-and-tracking algorithm in this paper. It focused on random sample consensus and particle filtering. The algorithm was proposed to generate a sizable quantity of hypotheses in real-time when it was evaluated along with existing algorithms. O.O. Khalifa and A.H.A Hashim [4] put forward a real-timeline detection algorithm centered on video sequences obtained from an automobile driving on highway in this paper. The machine acquires the leading view utilizing a camera installed upon an automobile. Before the processing images are converted to grayscale, noise is removed and edge detection is done. With the use Hough transform lines are extracted and borderlines of street are simulated. Lighting changes and shadows were easily handled with this algorithm. The lanes were detected using Hough transformation with limited area. This algorithm performed better inreal-time requirements.

New algorithm proposed by M. Meuter et al. [5] for camera based lane recognition for lane detection and tracking system. This detection algorithm was coupled with a following algorithm which combined two Extended Kalman filter utilizing the Interacting Multiple Models (IMM) algorithm. The tracking filter and the detection interact in a way that the tracking filter can be used to put an area of interest for a detection of lane segments in a variety of distances. The algorithm was linear over time and robust in the clear presence of noise and weak markers. The algorithm could be properly used to detect the position and the slope of the lane segments.

Z. Teng et al. [6] proposed a real-time lane detection algorithm which integrated multiple cues, including bar filter which includes been efficient to detect bar-shape objects like road lane, color cue, and Hough Transform. Particle filtering technique is used to make sure that it works efficiently in real time. This algorithm improved the accuracy of the lane detection. It's been effective on a wide selection of challenging road conditions.

S. Zhou et al. [7] proposed a road detection algorithm on the marked road. It had been centered on Geometrical model and Gabor filter. Lane Departure Warning System and other auxiliary driving systems can use this. This algorithm is dependent on two assumptions: the street before vehicle is approximately planar and marked which are generally correct on the highway and freeway where most lane departure accidents happen. The lane geometrical model contained four parameters that were initial spot, original orientation, width and curvature of the lane. The algorithm made up of three stages: the very first stage is known as off-line calibration which just runs once following the camera is mounted and fixed in the vehicle. The parameters of camera employed for lane detection is accurately estimated by the 2D calibration method .The next stage is named lane model parameters estimation and lane model candidate construction. Parameters i.e., starting point, lane orientation and width of the lane are likely to be estimated using dominant orientation estimation and local Hough transform. Then a construction of lane model candidates is implemented for the ultimate lane model matching; |the next stage is model matching. This algorithm can overcome the universal lane detection problems as a result of inaccuracies in edge detection such as for instance shadow of tree and passengers on the road. This algorithm wasmore accurate and was robust to the noise and other interferences such as for example shadow. Q. Lin et al. [8] a real-time vision-based lane detection method has been presented the position and form of lanes in every frame. In the proposed lane detection method, lane hypothesis was generated and verified centered on a highly effective mixture of lane-mark edge-link features. First, lane-mark candidates were searched inside region of interest (ROI). In this searching process, a long edge-linking algorithm with directional edge-gap closing was used. Within the edge link pars color was checked in the region of interest. It is done in the YUV color space. Continuouslane was estimated employing a Bayesian probability model centered on lane-mark color and edge-link length ratio. Finally, a straightforward lane departure model has been created to detect lane departures centered on lane locations in the image. Experiment results reveal that the proposed lane detection method can perhaps work robustly in real-time. In this algorithm, there have been no special requirements for camera parameters, background models, or some other road surface models. Therefore, the algorithm was more adaptive to various road environments. K. Ghazali et al. [9] presents a lane detection technique predicated on H-MAXIMAtransformation and improved Hough Transform algorithm which first defines the region of interest from input image for reducing searching space; divided the image into near field and far field of view. Hough transform has been placed on detect lane markers after image noise filtering over near field. The proposed method uses image processing programming language platform and trials were done on video data obtained.Positiveresult was obtained with high efficiency of detection.

Inad A. Aljarrah, Ahmed S. Ghorab, Ismail M. Khate [10] in 2012, proposed detection technique in which templates were used. Various shapes were included in templates which could be used for prediction. Lane detection techniques can use proposed work to make template of most probable objects on roads that needs to be detected.

F. Mariut et al. [12] proposed a straightforward algorithm that detects the lane marks; lane marks characteristics and has the capacity to determine the travelling direction. It used the popular Hough transform to detect the potential lines in the images. To guarantee the right detection of the lane mark, they developed a technique that extracts the inner margin of the lane. The margins are highlighted by generating the image of higher magnitude.

Charbel Fares [13] in 2013, proposed a method in which image recognition was done for detecting licencse plates. Alongwith Hough transform and watershed technique, he proposed a new Hybrid Segmentation algorithm. Technique used by him processed the image in 0.8 seconds. This made it practical for real time detection.

In work proposed by R. K. Satzoda and M. M. Trivedi [14]in 2011, a lane feature extraction method was used. This method involves various different configure rations which addresses both accuracy and embedded systems constraints. This method was used effectively in different lanes types various environments. It absolutely was shown that both design parameters, i.e. amount of scan bands and their width, can be used to have vision (embedded) system that provides robustness along with computation cost efficiency.

N. Phaneendra et al. [15] proposed a vision-based lane departure warning system. It's been predicated on an individual decision like solution in order to avoid lane departure with high reliability. The key goal with this model was to implement a graphic processing algorithm for detecting lanes on the way and offer a textual warning on departure from the lane. The lane detection performance has been improved by utilizing Kalman filter, set alongside the usual way of using Hough transform. The model became efficient and feasible when compared with other systems. Fernando et al. [16] present a story method using cues from the symmetric Gabor filter and an entropy image. The cues were along with a revised rule based classifier to estimate the lane boundaries of unstructured suburban roads. Interestingly, it absolutely was observed that, at the mercy of on-road obstacles and shadows, the proposed method provided better results than parametric approaches. It could effectively extract lane boundaries from the image within just 90 milli second demonstrating acceptability for real-time operation. The outcome demonstrates that the proposed lane boundary detection algorithm performs well weighed against other lane detection algorithms for various circumstances. With the advancement in automobile industry, the intelligent vehicle technology will be developed. Electronic systems are likely to be used up to 50%. Particularly, LDWS (Lane Departure Warning System) technique is actively developing to generate a notice signal if the lane is left. In proposed work, we use optimized Hough transform within accumulator cells in the four ROI in parallel and detects lanes with highly efficiency. The consequence of verification of an algorithm resulted in detecting lanes up to 94.3%. While Hough transform recognized only linear lanes this modified work could also detect curved lanes. Transform has been placed on to detect lane markers after removing the noise from the image. Proposed method uses image processing programming language platform. Positive result was obtained with high efficiency of detection. It presented an effective road lane marker detection algorithm to detect the left and right lane markers. The algorithm contains optimization of canny edge detection and Hough Transform. Canny edge detection is done accompanied by Hough Transform lane generation. The algorithm detects visible left and right lane markers on the way predicated on real-time video processing.

III. PROPOSED METHODOLOGY

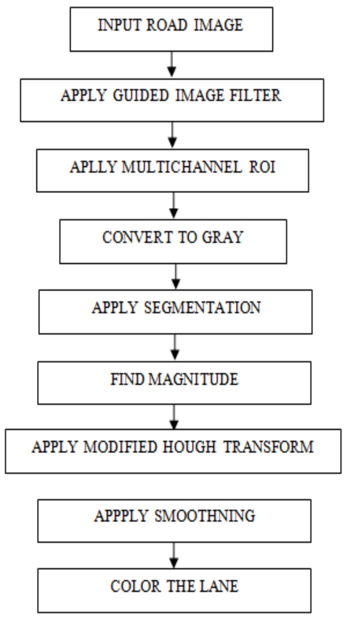

Figure 2: Proposed Methodology

Various steps involved to implement the proposed technique are shown as flow chart.

IV. RESULTS AND DISCUSSIONS

We have implemented the final two objectives in normal environmental conditions. The outcomes obtained shows great results when compared with previous work.

Results of Hough Transformation (Classical)

In the experiments, the proposed approach has been implemented to check a wide selection of road images. The algorithm has been implemented in MATLAB. We tested our algorithm for a variety of marked roads. It successfully detected road lanes for both straight and curved roads. Here to startwith, output of classical Hough transformation and modified Hough transformation are compared through images. Then both techniques are compared on the cornerstone of values evaluated by various parameters. Figure 3shows theoutcomes of the straight lane image. It is actually shown that the lanes have now been detected efficiently on straight roads. It suggests that classic Hough Transform gives very efficient results for the lanes which are straight. The important thing Hough Transform is always to} represent a direct line not by its points, but by the parameters of the line, like slope parameter and intercept of line [1].

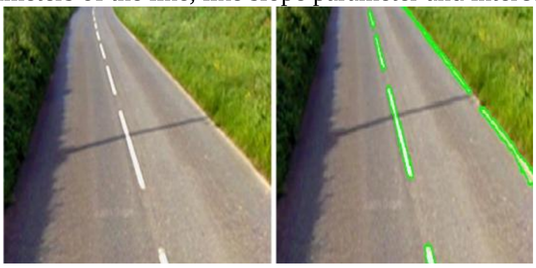
Figure3. a) The input image b) All lanes detected

Figure4 shows the results of the curved lane image. In thisimage all the lanes have not been detected efficiently. Some lanes which are left to be detected show the poor performance of the Classical Hough Transform. So there should be such a modification of Hough Transform which can efficiently detect all the lanes on the road. The Hough Transform is able to find the dominant lines of an image by counting each unique equation for every possible line through each point of the image.

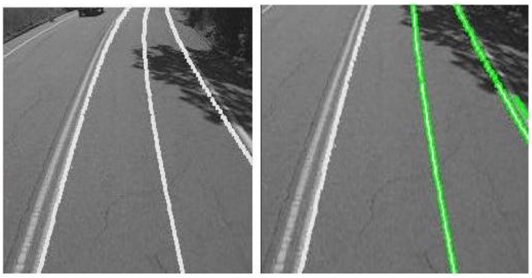
Figure4. a) The input image b) Some lanes detected

Figure5show the results of the curved lane image. It is clearly shown that no lane is detected. So we can say that the given technique is not so efficient to detect lanes on curved roads.


Figure5. a) The input image b) No lane detected

Results of Modified Hough Transformation (Guided Filter)

In this section, the outcomes of the implementation of the Modified Hough Transformation with the guided filter are shown visually and mathematically. The proposed technique has been implemented in experiments to check a wide selection of road images. The algorithm has been implemented in MATLAB. We tested our algorithm for a variety of marked roads. It successfully detected lanes for both straight and curved roads removing the noise.

Figure6 and Figure 7 indicates the outcomes of the straight lane image. It is actually shown that the all of the lanes has been detected efficiently and noise can also be removed with the aid of the guided filter. This filter can be used todisplace images corrupted by various noises like Gaussian noise. Guided filter is an advantage preserving smoothing filter and doesn't sufferwith gradient reversal artifacts. The filtering output is locally a linear transform of the guidance image.

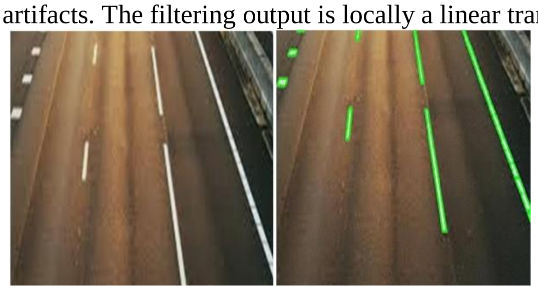
Figure 6. a) Input b) All lanes are marked

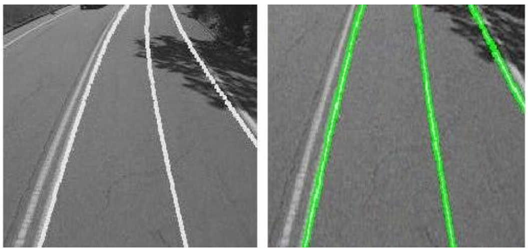

Figure7. a) Input b) Lanes recognized

Figure 8 has shown the results of the curved lane image. It is clearly shown all lanes detected efficiently and also clearer due to removal of noise. So we can say the proposed technique is very efficient for curved lane images.

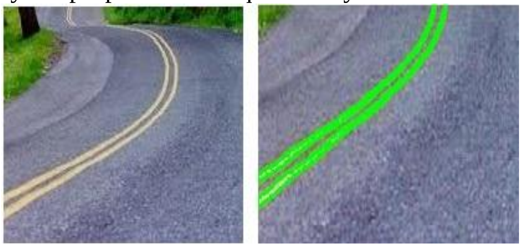

Figure8. a) The input image b) All lanes detected

V. PERFORMANCE EVALUATION

In this section there is comparison on the list of proposed and the present lane detection algorithm based on certain lane recognition metrics.

F-Measure

The F-Measure computes average of the data retrieval precision and recall metrics.

Table1: F-measure Analysis

Image	Old method	Proposed Technique
1	51.7557	51.8065
2	98.3758	98.3982
3	62.9877	62.9904
4	96.8174	96.8174
5	99.6912	99.6959
6	52.5398	52.5747
7	67.8895	67.8895
8	64.0087	64.2043
9	98.9598	98.9598
10	90.9218	91.0952

The computed values are between 0 and 1 and a more substantial F-Measure value indicates higher classification/clustering quality.

Table 1 indicates the comparison among proposed and the present strategy predicated on F-measure. Whilst the F-measure is more in nearly every taken road image; which means proposed strategy indicates significant results within the available technique.

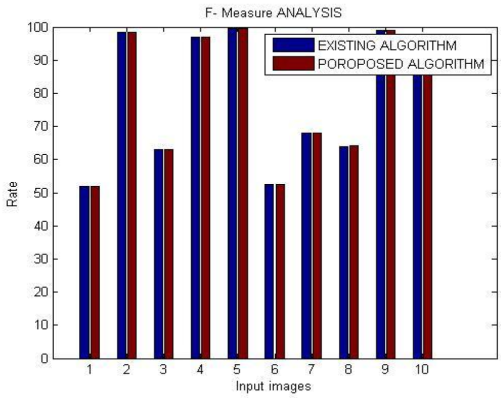

Figure 9. F-measure Analysis

The graph obtained for F-measure of these images is shown in figure9

Geometric Accuracy

Table 2: Geometric accuracy Analysis

Image	Old method	Proposed Technique
1	0.5909	0.5913
2	0.9839	0.9841
3	0..6780	0.6781
4	0.9687	0.9687
5	0.9969	0.9970
6	0.5969	0.5972
7	0.7169	0.7169
8	0.6861	0.6876
9	0.9897	0.9897
10	0.9130	0.9146

Table2 has shown the comparison among proposed and the existing strategy based on Geometric accuracy. As the value is more in almost every taken road image; therefore the proposed strategy has shown significant results over the available technique.

The graph obtained for Geometric Accuracy of these images is shown in figure10 below:

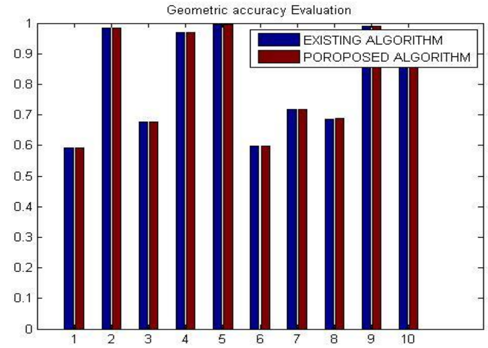

Figure10: Geometric Accuracy Analysis

Sensitivity

Table 3 has shown the comparison among proposed and the existing strategy based on Sensitivity.

Table 3: Sensitivity Analysis

Image	Old method	Proposed Technique
1	0.3491	0.3496
2	0.9680	0.98841
3	0.4597	0.6781
4	0.9383	0.9687
5	0.9938	0.9970
6	0.3563	0.5972
7	0.5139	0.7169
8	0.4707	0.6876
9	0.9794	0.9897
10	0.8335	0.9146

The graph obtained for Sensitivity Analysis of these images is shown in figure11.

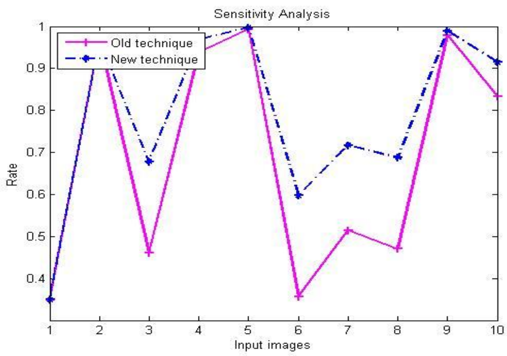

Figure11. Sensitivity Analysis

VI. CONCLUSION AND FUTURE SCOPE

In this paper, it's been surveyed that the techniques developed up to now work efficiently and giving great results just in case when noise isn't containedin the images. But problem is they fail or not give efficient results when there isany type of noise in the road images. The noise could be anything like dust, shadows, puddles, oil stains, tire skid marks, etc. This work has proposed a novel modified Hough based lane detection technique to improve the accuracy rate further specifically for curved lanes. To change the Hough transform segmentation round metrics has been used. The guided image filter based filtering has already been integrated in the proposed technique to be able to eliminate the aftereffectof the noise in road images. From the experimental results, it's been figure red the proposed algorithm gives efficient results.

REFERENCES

[1] J.M. Alvarez and A. Lopez, "Novel Index for Objective Evaluation of Road Detection Algorithms", Proceedings of the 11th International IEEE Conference on Intelligent Transportation Systems, Beijing, China, pp. 12-15, 2008.

[2] M. Aly, "Real time Detection of Lane Markers in Urban Streets", In IEEE Intelligent Vehicles Symposium, Eindhoven, pp. 7 - 12, June 2008.

[3] Z. Kim, "Robust Lane Detection and Tracking in Challenging Scenarios", In IEEE Transactions on Intelligent Transportation Systems, vol. 9, no. 1, pp. 16 - 26, March 2008.

[4] O.O. Khalifa and A.H.A Hashim, "Vision-Based Lane Detection for Autonomous Artificial

[5] Intelligent Vehicles", In IEEE International Conference on Semantic Computing, Berkeley, CA, pp. 636 - 641, Sept. 2009.

[6] M. Meuter, S. Muller, A. Mika, S. Hold, C. Nunn and A. Kummert, "A Novel Approach to Lane Detection and Tracking", In IEEE 12th International Conference on Intelligent Transportation Systems, St. Louis, MO, pp. 1-6, Oct. 2009.

[7] Z. Teng, J.H. Kin and D.J. Kang, "Real-time Lane detection by using multiple cues", In IEEE International Conference on Control Automation and Systems, pp. 2334 - 2337, 2010.

[8] S. Zhou, Y. Ziang, J. Xi, J. Gong, G. Xiong and H. Chen, "Novel lane detection based on geometrical model and gabor filter", in IEEE Intelligent Vehicles Symposium, pp. 59-64, 2010.

[9] Q. Lin, Y. Han and H. Hahn, "Real-time lane departure detection based on extended edge-linking algorithm", In IEEE 2nd International Conference on Computer Research and Development, Kuala Lumpur, pp. 725-730, May 2010.

[10] Inad A. Aljarrah, Ahmed S. Ghorab, Ismail M. Khate, "OBJECT RECOGNITION SYSTEM USING TEMPLATE MATCHING BASED ON SIGNATURE AND PRINCIPAL COMPONENT ANALYSIS", In International Journal of Digital Information and Wireless Communications (IJDIWC), Vol. 2, No. 2, pp 156-163, April 2012

[11] K. Ghazali, R. Xiao and J. Ma, " Road Lane Detection Using H-Maxima And Improved Hough Transform", Fourth International Conference on Computational Intelligence, Modelling and Simulation, pp: 2166-8531, 2012.

[12] F. Mariut, C. Fosalau and D. Petrisor, "Lane Mark Detection Using Hough Transform", In IEEE International Conference and Exposition on Electrical and Power Engineering, Iasi, Romania, pp. 871 - 875, Oct. 2012.

[13] Charbel Fares, "Intelligent License Plate Recognition", in International Journal of New Computer Architectures and their Applications(IJNCAA) Vol.3, No.3, pp 54-69,2013.

[14] R. K. Satzoda and M. M. Trivedi, "Vision-based Lane Analysis: Exploration of Issues and Approaches for Embedded Realization", IEEE Conference on Computer Vision and Pattern Recognition Workshops, 2013.

[15] N. Phaneendra, G. Goud and V.Padmaja, "Accident Avoiding System Using Lane Detection", International Journal of Research in Electronics and Communication Engineering, vol. 1, no. 1, pp. 1 - 4, April 2013.

[16] Fernando, Shehan, Lanka Udawatta, Ben Horan, and Pubudu Pathirana. "Real-time Lane Detection on Suburban Streets using Visual Cue Integration." Int J Adv Robot Syst 11 (2014): 61.

[17] Cho, Jae-Hyun, Young-Min Jang, and Sang-Bock Cho. "Lane recognition algorithm using the Hough transform with applied accumulator cells in multi-channel ROI." In Consumer Electronics (ISCE 2014), the 18th IEEE International Symposium on, pp. 1-3. IEEE, 2014.

