A Study Of Lane Detection Techniques And Lane Departure System

Suvarna Shirke
PhD CSE Research Scholar
Bharath Institute of Research and Education
Chennai, (Asst. Prof. Atharva COE, Mumbai)
suvarnashirke@yahoo.com

Dr.C.Rajabhushanam
Department of Computer Engineering
Bharath Institute of Research and Education
Chennai

Abstract— As India is progressing so the infrastructure as well as the transportation such as roads, technologies are also developing. The transportation plays a vital role in Indian economy. As we know many people have lost their lives in the accident. So managing the lane system on the road for the vehicles is very important. We can provide safety by using the lane detection system and also guide people for lane departure on the express highway. This paper gives the vast review of lane detection methods and the lane departure system methods. Lane detection is very challenging for different road scenarios. This paper is trying to figure out the problems and limitations in the existing lane detection and lane departure system.

Keyword-Lane Detection,* Line of Sight, *Lane Departure.

I. INTRODUCTION

Now a day's vision based lane detection is an area where researchers are performing research. The motive behind it is that every year there are so many road accident cases in India as vehicles collide on each other. According to a survey in year 2016 there are 17 deaths on Indian roads per hour. In 2014 there was 1, 39,671 people were killed in the road accidents [3]. These road accidents were avoidable, if the vehicles had the lane departure warning system. On Mumbai Pune express highway maximum road accidents were happened due to the speed of the vehicle, careless driving and while departing the lane. It is important to have a lane departure system tracking the leading vehicle, finding the curves of the road [2]. But while developing this system the main problem is detecting the street and path recognition and identifying obstruction, for example, vehicles and person on footpath. Advanced driver assistance systems, which alarm the driver in risky circumstances or take a dynamic part in the driving, are bit by bit being consolidated into vehicles. Such frameworks are relied upon to develop increasingly complex towards full self-rule amid the following decade. The principle bottleneck in the improvement of such frameworks is the discernment issue [1], which has two components: street and path/lane recognition and obstruction (i.e. vehicles and passerby) detection.

The lane detection and departure system has following challenges [1] [4] [5] [6] [14]:

1. Identifying the parked and moving vehicles on the road.
2. There are faded lined on the road so t quality of lines is not good for processing.
3. Another challenge is shadows of trees, structures and different vehicles.
4. There are sharper curves on the road and even some lines on the road have irregular shapes. It is also observered that merging of lines also creates the problem.
5. Many times it is observed that writing on the road and other markings also create problem to detect the lane.
6. Strange street materials and different slopes create problems in lane detection.
7. If there is change in lane color then it also create problem in detecting the lane. As we can see in Fig.2 some lanes are having white color and some are of yellow color.
8. Some roads are having continuous lines and some have dotted lines as shown in fig 2.
9. Environmental condition issues which affects on the image clarity like roads covered with the snow, fog, heavy rains, and reflection on wet road low visibility. It is shown in fig 3.

Fig. 1. Road Image Example [5]

Fig. 2. Challenges in Lane Detection [6]

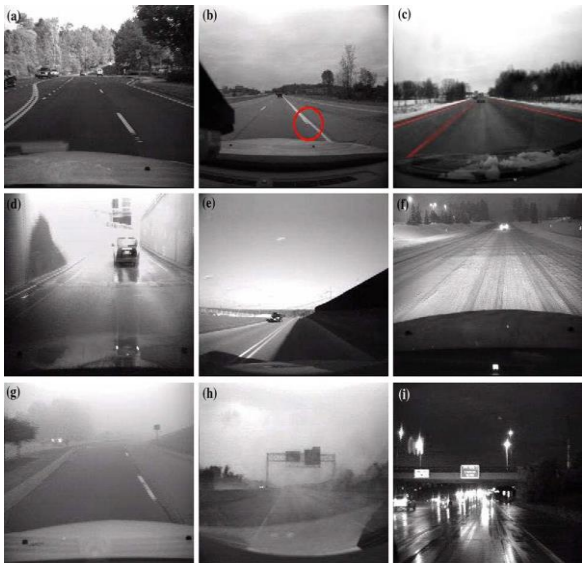

Fig. 3. Scenario Diversity and Image Clarity Issue [1]

The Lane Departure Warning System (LDWS) work is to assists the human driver, and responds passively according the circumstance of the vehicle. In the LDWS, it is important to identify whether the lane-departure occurs. So the position data, offset of the curve and tracking methods are not required in LDWS. The first step of lane detection system is extraction of lane related information. There are many lane detection approaches feature based and model based lane detection. The model based approach required the high hypothetical computational cost. These methods also required the calibration of camera. The feature based approach mainly focuses on the quality of the images. The model based approach required the inverse perspective mapping which is not easy to migrate to the embedded platform [12].

This paper presents the literature survey of recent 2 to 3 years progress of lane detection and departure system. It also gives some brief idea about the lane datasets which are used for lane detection system by the researcher.

II. LITERATURE SURVEY

Borkar et al. [8] built up a strategy in view of the parallel way of path markers. To start with Inverse Perspective Mapping is performed. At that point the IPM picture is changed over to gray scale picture. Normalized Cross Correlation is used to filter the image. After that Polar Randomized Hough Transform (RHT) is utilized to discover the gathering of the straight lines. Best fitting lines are dictated by utilizing the high scoring coordinates. To distinguish the parallel lines organizes with the indistinguishable θ value are paired. Typically the path markers are parallel however because of some blame in focal point, variety in path or lane marker, position in caught picture, it may not be parallel dependably. So the requirement of indistinguishable θ value should be extricated. The tolerance window is utilized to conquer this issue. The path video is tried progressively and got great outcomes. Normal challenges confront in path recognition, for example, nearness of shadows neighboring vehicles and surface inconsistencies are extraordinarily decreased in this approach. There is trouble in identifying exhausted path markers.

Tan et al. [9] built up a strategy for path detection and classification. To recognize the path or lane markers a linear parabolic model is utilized. The path marker pixels are accepted to have higher intensity than the pixels on the pavement. Measurable properties are extricated between the path marker pixels and pavement related pixels by utilizing the little rectangular fix. In each edge the consistency of every pixel in the fix comparing to path marker with the conveyance of pavement pixels are checked to separate asphalt and path marker pixels. After discovery cascade classifier is utilized to order the path marker. Four binary classifiers are used to characterize the distinguished path stamping into five classes: dashed, dashed-solid, solid dashed, single solid, double-solid.

Gopalan et al. [10] used the learning based approach for lane detection.

The related data imparted between lane markers to the environment is demonstrated utilizing a pixel hierarchy feature descriptor. The circumstance can be displayed as a two class identification issue comparing to path marker and non - path marker. Rather than utilizing the nearby components of protest in seclusion here the data imparted by the question its surroundings view is utilized. To break down the different visual components like intensity pattern examples, edges and textures in light of the region encompassing every pixel relating to the to the object the pixel - hierarchy based descriptor is utilized. At that point from the contextual features the pertinent elements are chosen utilizing a powerful boosting calculation algorithm. Particle filter is utilized for tracking the subsequent lane marker and static motion model is used for tracking which represents the particles state.

Jieh-Shian Young [11] has developed new approach which estimates the position of objects by using an only CCD camera. In this the pixel information generates two equations and additional variable. It performs the camera calibration, after that it estimates the basic parameters of a camera from more pixel information. The important factor of this approach is the configuration of CCD chip cell. The pixels of a subsequent image straightforwardly mirror the geometry of the CCD cell, or the CCD exhibit, in the camera. This approach built a coordinate transformation for resolving the geometrical relation

between fixed coordinates and film coordinates or CCD array. The author has also used some related techniques like image geometry analysis, CCD array distribution analysis least mean square error (LMS) algorithm. The disadvantage if this approaches the accuracy of the image is depending on the image position. The images get affected because of vehicle vibrations. To overcome the problem of vehicle vibration use camera stabilizer and apply the image filters to reduce the effect of noise.

Marcos Nieto [12] et al proposed the method based on Bayesian inference theory. They have confined the straight and nonlinear part of the street model to apply the possibility of Rao-Blackwellized particle filters (RBPF). This strategy diminishes the quantity of tests the particle filters uses as contrast with customary sapling strategies. They have utilized the genuine tome cameras to catch the picture at 30 Hz in the installed PC. The Rao-Blacwellization separates the handling into two stages: 1) Linear part decides the transversal position of the vehicle and its esteem. 2) The non-linear segment creates the theories of the ebb and flow, gauges and consolidates them utilizing a particle filters. The creators have considered the situations like sudden lighting changes, night, absence of estimations, presence of different vehicles, and so forth. They have great exactness. The hindrance of the framework is it requires an excessive amount of Hypothesis calculation.

Abdelhamid Mammeri [13] et al has displayed an in vehicle figuring framework. This framework is equipped for confining path markings and conveying them to drivers. It consolidates the Maximally Stable Extremal Region (MSER) technique with the Hough change for identifying and perceiving path markings like lines and pictograms. They have planned framework for restricting the area of enthusiasm utilizing the MSER strategy. A three-arrange upgrade processing calculation is utilized to expand the consequences of MSER and to sift through undesirable data, for example, trees and vehicles. To finish the necessities of real time frameworks, the Progressive Probabilistic Hough Transform (PPHT) is utilized as a part of the discovery stage to recognize line markings. Therefore, color or shading acknowledgment and the sort of line checking is done in light of the consequences of the utilization of the MSER to left and right line markings. The acknowledgment of High-Occupancy Vehicle pictograms is performed utilizing another calculation, in view of the aftereffects of MSER districts. In the following stage, Kalman channel is utilized to track both finishes of each recognized line checking.

Jongin Son [14] et al proposed strategy for functions admirably in different lighting conditions like awful climate conditions and at evening time. They have considered the three noteworthy segments: 1)they distinguished a flight point in view of a voting map and recognize a versatile region of intrest (ROI) to diminish computational complexity.2) They have utilized the distinctive property of path hues to finish lighting invariant path marker applicant location. 3) Lastly they locate the principle path utilizing a clustering technique from the path marker competitors. At the season of lane departure, their framework closes driver caution flag. The creators got a normal discovery rate of 93% under different lighting conditions and the general procedure takes just 33 ms for every frame.

III. LANE DATASETS

1. The KITTI-Road Dataset

There are 600 frames in KITTI dataset of size 375*1242 pixels. The spatial distance of the frame is 20m. This database is recorded at 5 different days and with the less traffic. This data contains the color images, GPS information and Velodyne laser scans. The dataset is divided into three categories. Each category represents typical road scenario. For every category there are 100 annotated images training set as well as testing set. There are three urban subsets unmarked urban unmarked (UU), urban marked two way roads (UMM) and urban marked multilane road (URBAN) [15]

2. Caltech Lanes dataset

In Caltech lane dataset there are four clips captured around the street in Pasadena, CA at different day time. There are 1225 individual frames. There are 4 individual clips. The first clip is cordova 1 and it has 250 frames. Second clip is cordova2 and ir has 406 frames. Third clip is washingameton1 and it has 337 frames. The fourth one is washingameton2 and it has 232 frames [17].

3. MSRC-21

There are 591 color images and they have 20*213 size with the matching ground truth labeling of 21 object class [16] [19].

4. The Cambridge-driving Labelled Video Database (CamVid)

The Camvid dataset is having four image sequences with ground truth labels at 1fps that connect each pixel with one of 32 semantic classes. Videos are captured with the fixed position CCTV type camera. Keeping in mind the driving perspective the data is captured. More than ten minutes of astounding 30Hz footage is being given, with comparing semantically labelled pictures at 1Hz and to some extent, 15Hz. The CamVid Database offers four commitments that are pertinent to protest examination specialists. To begin with, the per-pixel semantic division of more than 700 pictures was determined physically, and was then examined and affirmed by a moment individual for precision. Second, the high caliber and huge determination shading video pictures in the database speak to profitable stretched out term digitized footage to those keen on driving situations or ego-movement. Third, alignment successions are shot for the camera shading reaction and intrinsic, and registered a 3D camera posture for every edge in the groupings. At long last, in support of extending this or different databases, specially designed labelling programming for helping clients who wish to paint exact class-labels for different pictures and recordings [18]

IV. CONCLUSION

In this paper we have studied the different approach of lane detection and lane departure system. We have also studied the various challenges faced by the lane detection system. We have also seen the datasets available for lane detection. As compare to feature based approach the model based approach requires too many computations, but as compare to feature based approach the model based approach gives good accuracy. For

straight roads the algorithms work properly but for curved road the accuracy is less.

REFERENCES

[1] Hillel, Aharon Bar, et al. "Recent progress in road and lane detection: a survey." Machine vision and applications 25.3 (2014): 727-745.

[2] Kreucher, Chris, Sridhar Lakshmanan, and Karl Kluge. "A driver warning system based on the LOIS lane detection algorithm." Proceedings of IEEE International Conference on Intelligent Vehicles. Vol. 1. Stuttgart, Germany, 1998.

[3] https://data.gov.in/catalog/total-number-persons-killed-road-accidents-india

[4] Yue Wang, Eam Khwang Teoh, Dinggang Shen, "Lane detection and tracking using B-Snake", Image and Vision Computing 22 (2004) 269–280

[5] ZuWhan Kim, "Robust Lane Detection and Tracking in Challenging Scenarios", IEEE Transactions On Intelligent Transportation Systems, VOL. 9, NO. 1, MARCH 2008.

[6] Aly, Mohamed. "Real time detection of lane markers in urban streets." Intelligent Vehicles Symposium, 2008 IEEE. IEEE, 2008.

[7] Joon Woong Lee, "A Machine Vision System for Lane- Departure Detection", Computer Vision and Image Understanding 86, 52–78 (2002) doi:10.1006/cviu.2002.0958

[8] A.Borkar, M.Hayes, and M.T.Smith, "Polar randomized hough transform for lane detection using loose constraints of parallel lines." Acoustics, Speech and Signal Processing (ICASSP), 2011 IEEE International Conference on. IEEE, 2011.

[9] M.Tan, B. Paula, and C.R.Jung, "Real-time detection and classification of road lane markings," In Graphics, Patterns and Images (SIBGRAPI), 2013 IEEE 26th SIBGRAPI-Conference on, pp. 83-90. IEEE, 2013.

[10] R.Gopalan, T.Hong, M.Shneier, and R. Chellappa, "A Learning Approach Towards Detection and Tracking of Lane Markings," Intelligent Transportation Systems, IEEE Transactions on, vol. 13, no. 3, pp. 1088- 1098, 2012.

[11] Jieh-Shian Young, "Lane Detection via Object Positioning Systems Based on CCD Array Geometry" Inventions 2016, 1(3), 16; doi:10.3390/inventions1030016

[12] Marcos Nieto, Andoni Cortés, Oihana Otaegui, Jon Arróspide,Luis Salgado, "Real-time lane tracking using Rao-Blackwellized particle filter", Journal of Real-Time Image Processing, January 2016, Volume 11, Issue 1, pp 179–191

[13] Abdelhamid Mammeri ,Azzedine Boukerche ,Zongzhi Tang, "A real-time lane marking localization, tracking and communication system", Computer Communications Volume 73, Part A, 1 January 2016, Pages 132–143

[14] Jongin Son , Hunjae Yoo, Sanghoon Kim, Kwanghoon Sohn, "Real-time illumination invariant lane detection for lane departure warning system", Expert Systems with Applications 42 (2015) 1816–1824

[15] Fritsch, Jannik, Tobias Kuehnl, and Andreas Geiger. "A new performance measure and evaluation benchmark for road detection algorithms." 16th International IEEE Conference on Intelligent Transportation Systems (ITSC 2013). IEEE, 2013.

[16] Alvarez, Jose M., Mathieu Salzmann, and Nick Barnes. "Large-scale semantic co-labeling of image sets." IEEE Winter Conference on Applications of Computer Vision. IEEE, 2014.

[17] http://www.vision.caltech.edu/malaa/datasets/caltech-lanes/

[18] http://mi.eng.cam.ac.uk/research/projects/VideoRec/CamVid/

[19] http://rodrigob.github.io/are_we_there_yet/build/semantic_labeling_datasets_results.html