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A Survey on Lane Marking Techniques

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***Abstract*— A lane is part of a carriage way (roadway) that is designated for use by a single line of vehicles, to control and guide drivers and reduce traffic conflicts. Most public roads (highways) have at least two lanes, one for traffic in each direction, separated by lane markings. A new method is proposed for lane marking. Zebra cross detection is also done to stop the vehicle and allow the pedestrian to cross the road. Detection and markings of lane is an important method for autonomous vehicles. This paper gives the comparison of different papers and analyses the advantage and disadvantage of lane markings**

***Keywords*— image processing, lane marking, road detection, autonomous vehicle, tracking algorithms**

I. INTRODUCTION

Road scene analysis is a challenging problem that has applications in autonomous navigation of vehicles. An integral component of this system is the robust detection and tracking of lane markings. This work focuses on the methodologies and issues of lane markings. It provides a state of art review which includes detail of some representative methods and comparison of different existing lane marking methods. Detecting lane markings and Lane departure Warning is an important task in autonomous vehicles. It is a hard problem primarily due to large appearance variations in lane markings caused by factors such as occlusion (traffic on the road), shadows (from objects like trees), and changing lighting conditions of the scene (transition from day to night).

Detecting road lane markings using image analysis has been an area of active research over the last two decades. The recent survey paper by McCall and Trivedi provides a comprehensive summary of existing approaches. Most of the methods propose a three step process: 1) extracting features to initialize lane markings such as edges , texture , colour, and frequency domain features 2) post processing the extracted features to remove outliers using techniques like dynamic programming, along with computational models explaining the structure of the road using deformable contours and regions with piecewise constant curvatures and 3) tracking the detected lane markings using a Kalman filter or particle filters by assuming motion models such as constant velocity or acceleration for the vehicle. There are also methods that use stereo cameras to enforce similarity of points observed from both cameras.

II. LANE DETECTION AND TRACKING USING B-SNAKE

B-Snake based lane detection and tracking algorithm without any cameras' parameters is proposed. Compared with other lane models, the B-Snake based lane model is able to describe a wider range of lane structures since B-Spline can form any arbitrary shape by a set of control points. The problems of detecting both sides of lane markings (or boundaries) have been merged here as the problem of detecting the mid-line of the lane, by using the knowledge of the perspective parallel lines. Path findings and navigational control under these situations are usually accomplished from the images captured by camera mounted on the vehicles. These images are also interpreted to extract meaningful information such as positions, road markings, road boundaries, and direction of vehicle's heading. Among many extraction methods, the lane marking (or road boundary) detection from the road images had received great interest. As the captured images are usually corrupted by noises, lots of boundary-detection algorithms have been developed to achieve robustness against these noises. The main properties that the lane marking (or boundary) detection techniques should possess are

- The quality of lane detection should not be affected by shadows, which can be cast by trees, buildings, etc.
- It should be capable of processing the painted and the unpainted roads.

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- It should handle the curved roads rather than assuming that the roads are straight.
- It should use the parallel constraint as a guidance to improve the detection of both sides of lane markings (or boundaries) in the face of noises in the images.
- It should produce an explicit measurement of the reliability of the results obtained.

Furthermore, a robust algorithm, called CHEVP, is proposed for providing a good initial position for the B-Snake. Also, a minimum error method by Minimum Mean Square Error (MMSE) is proposed to determine the control points of the B-Snake model by the overall image forces on two sides of lane. Experimental results show that the proposed method is robust against noise, shadows, and illumination variations in the captured road images. It is also applicable to the marked and the unmarked roads, as well as the dash and the solid paint line roads. Various vision-based lane detection algorithms have been developed. They usually utilized different lane patterns (solid or dash white painted line, etc.) or different road models (2D or 3D, straight or curve), and different techniques (Hough, template matching, neural networks, etc.). Basically, there are two classes of approaches used in lane detection: the feature-based technique and the model based technique. The feature based technique localizes the lanes in the road images by combining the low-level features.

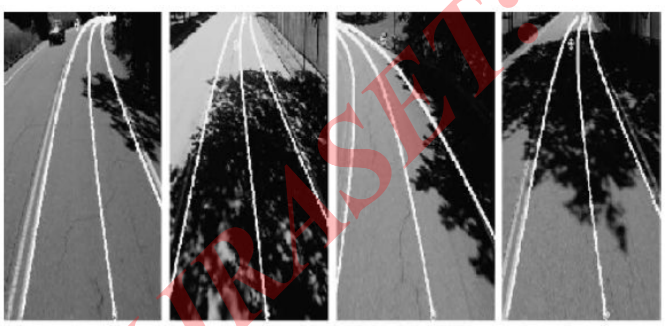

Fig. 1 Some results of lane marking

A. Disadvantage

1. Processing time depend on the number of edge pixels
2. Prespecifed road model

III. ROBUST VISION BASED LANE TRACKING USING MULTIPLE CUES AND PARTICLE FILTERING

One of the more startling effects of road related accidents is the economic and social burden they cause. Between 750,000 and 880,000 people died globally in road related accidents in 1999 alone, with an estimated cost of US518 billion. One way of combating this problem is to develop Intelligent Vehicle which is self- aware to increase the safety of transportation system. The General Obstacle and Lane Detection system (GOLD) used in the ARGO vehicle at the University of Parma transforms stereo image pairs into a common bird's eye view and uses a pattern matching technique to detect lane markings on the road. This system is limited to roads with lane markings as they form the very basis of the search method. This presents the development and application of a novel multiple-cue visual lane tracking system for research into Intelligent Vehicles (IV). Particle filtering and cue fusion technologies form the basis of the lane tracking system which robustly handles several of the problems faced by previous lane tracking systems such as shadows on the road, unreliable lane markings, dramatic lighting changes and discontinuous changes in road characteristics and types. Experimental results of the lane tracking system running at 15Hz will be discussed, focusing on the particle filter and cue fusion technology used. The Distillation algorithm is used for lane tracking are The Distillation Algorithm is a novel method for target detection and tracking that combines a particle filter1 with a cue fusion engine and is suitable for both low and moderately high dimensional problems. The algorithm is based in Bayesian statistics and is self-optimized using the Kullback-Leibler distance to produce the best statistical result given the computational resources available. The basis of the Distillation Algorithm is that a suite of cues are calculated from image and state information and combined to provide evidence strengthening. The utility2 of each cue over time is evaluated and the set of cues that are performing optimally are distilled to a select set that can run in the foreground at a desired processing speed. The remainder of the cues are processed in the background at speeds less than the desired frequency and their results are monitored for a contribution to the overall tracking. The cues can be reinstated to run in the foreground at any time if their contribution will result in improved tracking performance.

A. Disadvantage

1. Not effectively track on curve roads

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IV. ROBUST LANE DETECTION AND TRACKING IN CHALLENGING SCENARIOS

A lane-detection system is an important component of many intelligent transportation systems. A robust lane-detection-and-tracking algorithm is presented to deal with challenging scenarios such as a lane curvature, worn lane markings, lane changes, and emerging, ending, merging, and splitting lanes. First a comparative study is done to find a good real-time lane marking classifiers and after that detection is done, the lane markings are grouped into lane-boundary hypotheses. The grouping of left and right lane boundaries is done to handle merging and splitting of lanes.

A fast and robust algorithm, based on random-sample consensus and particle filtering, is proposed to generate a large number of hypotheses in real time. The generated hypotheses are evaluated and grouped based on a probabilistic framework. The suggested framework effectively combines a likelihood-based object-recognition algorithm with a Markov-style process (tracking) and can also be applied to general-part-based object tracking problems. An experimental result on local streets and highways shows that the suggested algorithm is very reliable. a real-time lane-detection-and-tracking system has

1) It uses more sophisticated lane-marking-detection algorithm (than gradient- or intensity bump-based detection) to deal with challenging situations, such as worn lane markings and distracting objects/markings, for example, at an intersection and on a road surface.

2) It detects the left- and right-lane boundaries separately, whereas most of the previous work uses a indexed-width lane model. As a result, it can handle challenging scenarios such as merging or splitting lanes and on- and o← ramps effectively.

3) It combines lane detection and tracking into a single probabilistic framework that can effectively deal with lane changes, emerging, ending, merging, or splitting lanes. Much previous work has focused on lane tracking and usually uses a time-consuming detection algorithm to initialize the tracking.

A. *Disadvantages*

1. Misdetection in curvy roads

2. Misdetection due to shadows

V. PROBABILISTIC LANE TRACKING IN DIFFICULT ROAD SCENARIOS USING STEREOVISION

Here accurate and robust lane results are of great significance in any driving assistance system. To achieve robustness and accuracy in di-cult scenarios, probabilistic estimation techniques are needed to compensate for the errors in the detection of lane- delimiting features. While there is no universal definition of tracking, we can regard it as the process of reasoning about the state of a time evolving entity, given a sequence of observations. In particular, lane tracking can be defined as the process of reasoning about the position and geometry of the lane, given a sequence of image derived feature sets. 1) Dynamic model 2) Prediction: Computation of the conditional probability density of the current state, given the past sequence of measurements 3) Data association: At each frame i, there may be several measurements that are available, and not all of them are equally useful.4) State update.

A solution for lane estimation in di-cult scenarios is presented based on the particle-filtering framework. A practical approach to tracking general probability density functions, i.e., particle filtering. Instead of trying to analytically approximate an unknown function, their system uses N discrete values called 'samples' or 'particles'. The solution employs a novel technique for pitch detection based on the fusion of two stereovision- based cues, a novel method for particle measurement and weighing using multiple lane delimiting cues extracted by grayscale and stereo data processing, and a novel method for deciding upon the validity of the lane-estimation results. Initialization samples are used for uniform handling of the road discontinuities, eliminating the need for explicit track initialization. The resulting solution has proven to be a reliable and fast lane detector for difficult scenarios.

A. *Disadvantage*

1. inaccuracy of estimated parameters

VI. REAL TIME DETECTION OF LANE MARKERS IN URBAN STREETS

A robust and real time approach to lane marker detection in urban streets is presented. It is based on generating a top view

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of the road, and then filtering using selective oriented Gaussian filters, using fitting to give initial guesses to a new and fast algorithm for fitting Bezier Splines, which is then followed by a post-processing step.

The algorithm can detect all lanes in still images of the street in various conditions, while operating at a rate of 50 Hz and achieving comparable results to previous techniques.

An efficient, real time, and robust algorithm for detecting lanes in urban street is proposed. The algorithm is based on taking a top view of the road image, filtering with Gaussian kernels, and then using line detection and a new spline fitting technique to detect lanes in the street, which is followed by a post-processing step.

- Inverse Perspective Mapping (IPM): The first step in our system is to take generate a top view of the road image. This has two benefits: 1) We can get rid of the perspective effect in the image, and so lanes that appear to converge at the horizon line are now vertical and parallel. This uses our main assumption that the lanes are parallel (or close to parallel) to the camera. 2) We can focus our attention on only a subregion of the input image, which helps in reducing the run time considerably.

- Filtering and Thresholding: The transformed IPM image is then filtered by a two dimensional Gaussian kernel.

- Line Detection: This stage is concerned with detecting lines in the threshold image. The simplified Hough transform gets a sum of values in each column of the threshold filtered image. This sum is then smoothed by a Gaussian filter, local maxima are detected to get positions of lines, and then this is further refined to get sub-pixel accuracy by fitting a parabola to the local maxima and its two neighbours. At last, nearby lines are grouped together to eliminate multiple responses to the same line.

- RANSAC Spline Fitting: The previous step gives us candidate lines in the image, which are then refined by this step. For each such line, we take a window around it in the image, on which we will be running the spline fitting algorithm. The algorithm can detect all lanes in still images of urban streets and works at high rates of 50 Hz. Comparable results to other algorithms that only worked on detecting the current lane boundaries, and good results for detecting all lane boundaries is achieved.

A. *Disadvantage*

1. Limited to detecting lanes in urban streets

VII. A Novel Lane Detection System With Efficient Ground Truth Generation

A new night-time lane detection system and its accompanying framework is presented here. The accompanying framework consists of an automated ground truth process and systematic storage of captured videos that will be used for training and testing. The proposed Advanced Lane Detector 2.0 (ALD 2.0) is an improvement over the ALD 1.0 or Layered Approach with integration of pixel remapping, outlier removal, and prediction with tracking. Additionally, a novel procedure to generate the ground truth data for lane marker locations is also proposed. The procedure consists of an original process called time slicing, which provides the user with unique visualization of the captured video and enables quick generation of ground truth information. Finally, the setup and implementation of a database hosting lane detection videos and standardized data sets for testing are also described. The ALD 2.0 is evaluated by means of the user-created annotations accompanying the videos. Finally, the planned improvements and remaining work are addressed.

Lane detection is still a fertile area of machine vision research; consequently, many approaches have been proposed to accomplish this task. However, variations of the Hough transform are still among the most popular and commonly used methods. In these approaches, the input images are first pre-processed to find edges using a Canny edge detector or steerable filters, followed by a threshold. The classical Hough transform is then used to find straight lines in the binary image, which often correspond to lane boundaries. The randomized Hough transform, which is a quicker and a more memory efficient counterpart of the classical Hough transform, has also been also been used for lane detection.

The classical transform methods for line finding works well when the roads are mostly straight; however, for curved roads, splines and hyperbola fitting are often used to provide support. A piecewise line shows some improvement by performing the

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Hough transform on sections of the road image to produce a curve and handles many problems regarding shadows and road patterns. The final step of the algorithm is the measurement/update process. In general formulation of the tracking problem as probabilistic inference, updating means applying Bayes' rule to get the posterior probability density, given the prior probability density and the measurement. The prior state probability density is, at this point, completely encoded in the distribution of the values of the weightless particles through the domain of possible state values.

B. *Disadvantage*

1. Not well accurate in lane detection

VIII. A Learning Approach Towards Detection And Tracking Of Lane Markings

Autonomous navigation of road vehicles is a challenging problem that has widespread applications in intelligent systems and robotics. Detection of lane markings assumes importance in this framework since it assists the driver with details about the road, such as how many lanes are present, is they straight or curved, and so on. It is a hard problem due to variations present in the following:

- the appearance of lane markings (solid lines, dotted lines, circular rectors, and their colour, yellow or white)
- the type of road in which the vehicle is traveling, such as highways and city streets, and objects that occlude the lane markings like vehicles and pedestrians
- the time of day in which the scene needs to be analysed (for instance, at night, the most visible regions are those that are just ahead of the vehicle, whereas during the day, more regions in the field of view of the camera need to be analyzed by the detector)
- the presence of shadows due to objects such as trees that affect the appearance of lane markings.

Motivated by these challenges, this paper propose a learning-based approach to detect lane markings without requiring a predefined road model and track them without knowledge of vehicle speed. For the two-class object detection problem, corresponding to lane markings and nonlane markings, collect a set of representative training data with which, 1) instead of using local features to describe the object in isolation, learn the relationship shared by the object with its surrounding scene. To model this source of information, often referred to as spatial context, this method propose a pixel-hierarchy descriptor in which different visual features such as intensity patterns, texture, and edges are analysed in a hierarchy of regions surrounding each pixel corresponding to the object; 2) given a bag of contextual features for exemplar pixels corresponding to the two classes, this method learn their relevance for decision making using a machine learning algorithm based on boosting that determines a final strong classifier by combining several weak learners. In this process, address the outlier sensitivity problem of boosting algorithms through methods that jointly optimize the detection error rate and the balance in weight distribution of training exemplars; 3) then represent the detected lane markings using polynomials and track them in a particle filtering framework. However, since do not know the vehicle motion to predict the new position of lane markings, look at a slightly different problem by assuming the lane markings to be static over the video sequence and then characterize deviations in the tracked model parameters to infer their causes. Assuming the road to be at, illustrate this by learning three sources of variations in road scene, namely, the change in road geometry (straight or curved), changes in the lateral motion of the vehicle, and the presence of occluding objects in the road ahead. the most visible regions are those that are just ahead of the vehicle, whereas during the day, more regions in the field of view of the camera need to be analysed by the detector); and 4) the presence of shadows due to objects such as trees that affect the appearance of lane markings. Motivated by these challenges, this paper propose a learning-based approach to detect lane markings without requiring a predefined road model and track them without knowledge of vehicle speed. For the two-class object detection problem, corresponding to lane markings and non-lane markings, collect a set of representative training data with which, 1) instead of using local features to describe the object in isolation, learn the relationship shared by the object with its surrounding scene. To model this source of information, often referred to as spatial context, this paper propose a pixel hierarchy descriptor in which different visual features such as intensity patterns, texture, and edges are analysed in a hierarchy of regions surrounding each pixel corresponding to the object; 2) given a bag of contextual features for exemplar pixels corresponding to the two classes, this paper learn their relevance for decision making using a machine learning algorithm based on boosting that determines a final strong classifier by combining several weak learners. In this process, address the outlier sensitivity problem of

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IX. CONCLUSION

Lane detection is important because it is an integral part of autonomous vehicle control system. A survey of existing methods for detection and marking of lanes is provided in this work. The previous methods proposed for detection and marking have several shortcomings. A lane departure warning system and lane marking detection using Hough Transform has been proposed. By incorporating a departure warning system, the functionalities of the lane marking system can be enhanced.

REFERENCES

[1] Y. Wang, E. Teoh, and D. Shen, _Lane detection and tracking using B-snake,Image Vis. Comput., vol. 22, no. 4, pp. 269_280, Apr. 2004.

[2] N. Apostolo_ and A. Zelinsky, _Robust vision based lane tracking using multiple cue and particle _ltering,_ in Proc. IEEE Intell. Veh. Symp., Jun. 2003, pp. 558_563.

[3] Z. Kim, ┼Robust lane detection and tracking in challenging scenarios,◄ IEEE Trans. Intell. Transp. Syst., vol. 9, no. 1, pp. 16┴ 26, Mar. 2008

[4] R. Danescu and S. Nedevschi, ┼Probabilistic lane tracking in di-cult road scenarios using stereovision,◄ IEEE Trans. Intell. Transp. Syst., vol. 10, no. 2, pp. 272┴ 282,Jun. 2009.

[5] M. Aly, ┼Real time detection of lane markers in urban streets,◄ in Proc. IEEE Intell. Veh. Symp., Jun. 2008, pp. 7┴ 12.

[6] A. Borkar, M. Hayes, and M. Smith, ┼A novel lane detection system With efficient ground truth generation,◄ IEEE Trans.Intell.Transp.Syst., DOI:10.1109/TITS.2011.2173196, to be published.

[7] Y. Xiao, D. Tien and X. P. Jia "Region Based Perceptual Grouping for Road Extraction from High Resolution Images"The 6th International Conference on Information Technology and Applications (ICITA 2009)

[8] Shinko Yuanhsien Cheng andMohanManubhai Trivedi"Lane Tracking with Omnidirectional Cameras: Algorithms and Evaluation"Hindawi Publishing Corporation EURASIP Journal on Embedded Systems Volume 2007, Article ID 46972, 8 pages doi:10.1155/2007/46972

[9] Juan M. Collado, Cristina Hilario, Arturo de la Escalera, and Jose M. Armingol"Adaptative Road Lanes Detection and Classi cation"IEEE trans.intell.Transp.Syst.,vol. 11 ,mar.2009

[10] Andrés F. Cela,Luis M. Bergasa"Lanes Detection Based on Unsupervised and Adaptive Classifer"2013 Fifth International Conference on Computational Intelligence,Communication Systems and Networks