A Simple Stable Method in Real-time Lane Tracking of Broken Lanes

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Abstract: Lane detection is one of the major components of traffic intelligence. It is impossible to recognize lanes as human do in all kinds of special situations; however, we can try to solve special problems with special methods. In this paper we propose a simple method using color segmentation, the Probabilistic Hough Transform (PHT), and the Least-Square in real-time lane tracking. Vehicles in neighborhood can be eliminated with one simple threshold in segmentation. Meanwhile, broken shape lanes in different road conditions can be successfully detected using the combination of PHT and Least-Square method. Eventually, this method is tested with groups of static images downloaded from internet and video sequences shot randomly on some highways. Satisfactory results are received.

1. Overview of Our Method

A compact overview of the algorithm is depicted in Fig.1: HIS color segmentation method is initially carried out to separate the road area and the lane mark area apart according to the reference [8]. In the meantime, the first several frames of video are segmented in order to get the average segmentation threshold for road area and the lane marking areas. With this threshold, the following frames can be segmented in high efficiency, while effects caused by some vehicles (except vehicles with the same color as the lane markings) in the near distance are successfully avoided.

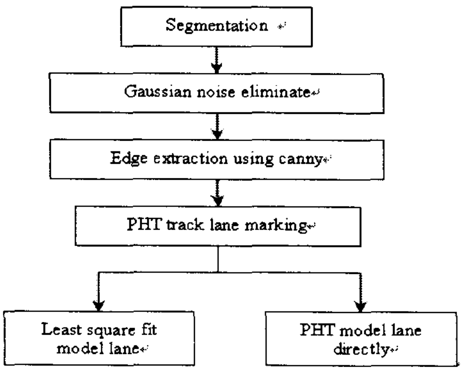


Fig.1. Overview of our method

Based on the segmentation consequence, Gaussian filters follow the image and the edges are extracted using canny in OpenCV. The Probabilistic Hough Transform is then carried out to track the lane markings in every frame of the video sequences.

Two regions of interest are set in both right and left lane markings according to the tracking result produced by the Probabilistic Hough Transform. A least square method is applied in the both regions of interest to fit the lane markings. The broken area of the lane can still be modeled out with stability.

2. Experiment results

In the experiments, our method is tested on 3 sample video sequences (each lasts 30 seconds with 1800 frames or so) randomly shot on some highways and 3 groups (20 images divided by road condition, weather condition and the complication of backgrounds) of pictures downloaded randomly from the Google engine.

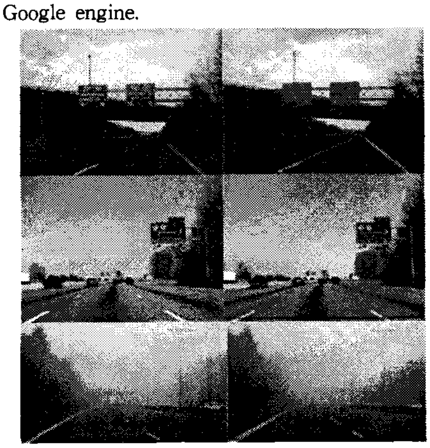
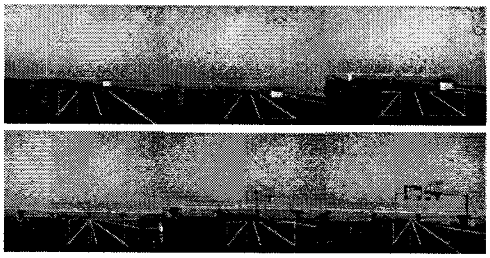


Fig. 2. Static lane detection not affected by the vehicles and the shape of the lane markings, three groups has different weather condition, different road condition and different complicated backgrounds.

As shown in Fig. 2, the images are downloaded from internet. The lane markings with broken shapes and in different conditions can be detected, and it is not affected by the vehicles in the way because the vehicles are removed in the segmentation procedure. As showed in Fig. 3, the video sequences are randomly shot on highways, and good results were received in both curved lane markings and straight lanes. The computing speed can reach up to 20 frames /second.

(a)



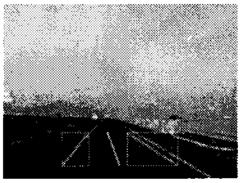
(b)

Fig. 3. Lane detections in video sequences, (a) straight lane marking; (b) curved lane marking

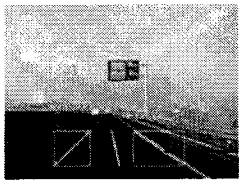
In both static and video situations, only the inner parts of lanes are expressed by straight green lines. At the same time, we can also see failed model of lanes like in Fig. 4. This may caused by the simple threshold segmentation or the noise that is not easily eliminated. The experiment results also show that at the very beginning or the end frames of the video sequences, the lane tracking tends to be unstable because the horizontal scan line may be set on nothing in beginning and the segmentation is not well executed. The tracking accuracy is the ratio of the correct tracking (as a human thinks to be near the lane in several pixels) and the whole frames or images. The computing speed is obtained by the computer calculating. The statement is shown in Table. 1.

Table. 1. Fitting accuracy on highways and static pictures

	Fitting accuracy	Speed (frames/second)
Video on highway	93.4	20
Static pictures	85	/



(a)



(b)

Fig. 4. (a) Lost fitting; (b) good fitting

As showed in Table.1, the accuracy of videos is higher than that of static pictures. The main reason for this is that the segmentation thresholds of videos are averages of several frame pictures. The main cause of the detecting mistakes is noise that is not totally eliminated and the pixel accuracy.

3. Conclusion

In this paper, we present a method in lane detection composed of HIS color segmentation, PHT, and Least-Square to solve the special problems below in vision-based lane detection: Vehicles in the way can not affect the result (except the vehicles with the same color as the lane marking), which is usually ignored in other algorithms. Our paper offers a real-time method that can detect broken shape lanes with different colors in many different road conditions, even badly painted lanes can be detected successfully. Curved lane markings are detected and expressed by the tangent line of the lane.

In order to get stable lane detection system, using a real-time classification method to extract the road area seems meaningful. Researchers have to build a geometric context construction in one single image which can be used in road extraction. In the future, we will conduct further research in this area.

4. References

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