Lane Detection System

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Abstract

Lane line is an important reference for safe driving. In order to improve the accuracy and real-time performance of lane line detection, a lane line detection algorithm based on improved Hough transform is proposed in this paper. Firstly, the lifting algorithm of wavelet is used to extract the low-frequency wavelet coefficients of the image, so as to reduce the complexity of the image and improve the efficiency of image processing; Then Canny operator is used to detecting the edge of the image region of interest, and the threshold is automatically selected according to edge information for threshold processing;

Finally, three constraints are proposed from two aspects of angle and lane width to improve the Hough transform to detect lane lines, and the correct lane lines are fitted by linear regression method. Experiments show that the proposed algorithm has good correctness and real-time performance for lane line detection.

Introduction

With the rapid development of society, automobiles have become one of the transportation tools for people to travel. On the narrow road, there are more and more vehicles of all kinds. As more and more vehicles are driving on the road, the number of victims of car accidents is increasing every year. How to drive safely under the condition of numerous vehicles and narrow roads has become the focus of attention. Lane Keeping Assist and Adaptive Cruise Control can help people analyse the current driving environment and provide appropriate feedback for safe driving or alert the driver in dangerous circumstances. This kind of auxiliary driving system is expected to become more and more perfect. However, the bottleneck of the development of this system is that the road traffic environment is difficult to predict. After investigation, in the complex traffic environment where vehicles are numerous and speed is too fast, the probability of accidents is much greater than usual. In such a complex traffic situation, road colour extraction and texture detection as well as road boundary and lane marking are the main perceptual clues of human driving.

Lane detection is a hot topic in the field of machine learning and computer vision and has been applied in intelligent vehicle systems. The lane detection system comes from lane markers in a complex environment and is used to estimate the vehicle's position and trajectory relative to the lane reliably. At the same time, lane detection plays an important role in the lane departure warning system. The lane detection task is mainly divided into two steps: edge detection and line detection.

Literature Survey

Y. Wang et al. (2004) used a B-Snake spline as a geometric model that can represent the road. Then he processed images with Canny/Hough Estimation of Vanishing Points (CHEVP) to extract the parameters needed by the geometric model. The obtained results were very robust and accurate. As in his paper, the algorithm can overcome the interference of shadows.

However, when the system detected the shadow of a tree trunk or a shadow of a telegraph pole that has a uniform orientation, an unpredictable result occurred. M. Chen et al. (2004) developed another system called AURORA which tracks the lane markers present on the structured roads using a colour camera mounted on the side of a car pointed downwards toward the road. A single scan line is applied in each image to detect the lane markers. C. R. Jung et al. (2005) used edge detection, squares angular estimation, Hough transform to estimate lanes on a road. The results were

The algorithm mostly runs well except when it comes to shadow or other interference on the road.

Proposed Work – Algorithm

In this project, we used **Hough transformation and canny edge** detection in order to find the lanes in different lane conditions (i.e. Day time (with and without traffic) night time, foggy conditions)

Hough Transformation:

The Hough transform is a feature extraction technique used in image analysis and in computer vision. The purpose of the technique is to find imperfect instances of objects within a certain class of shapes by a voting procedure. This voting procedure is carried out in parameter space, from which object candidates are obtained as local

maxima in a so-called accumulator space that is explicitly constructed by the algorithm for computing the Hough transform

Canny edge Detection:

Canny Edge Detection is a popular edge detection algorithm. It was developed by John F. Canny in

1. It is a multi-stage algorithm and we will go through each stage.
2. **Noise Reduction**

   Since edge detection is susceptible to noise in the image, the first step is to remove the noise in the image with a 5x5 Gaussian filter. We have already seen this in previous chapters.

3. **Finding Intensity Gradient of the Image**

Smoothened image is then filtered with a Sobel kernel in both horizontal and vertical direction to get the first derivative in the horizontal direction (Gx) and vertical direction (Gy). From these two images, we can find edge gradient and direction for each pixel as follows:

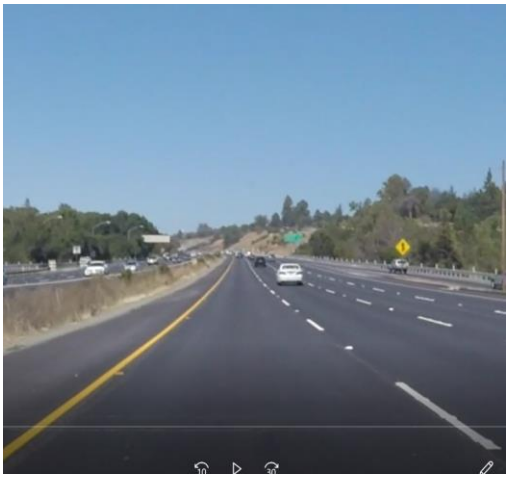
$$Edge\_Gradient\ (G) = \sqrt{G_x^2 + G_y^2}$$

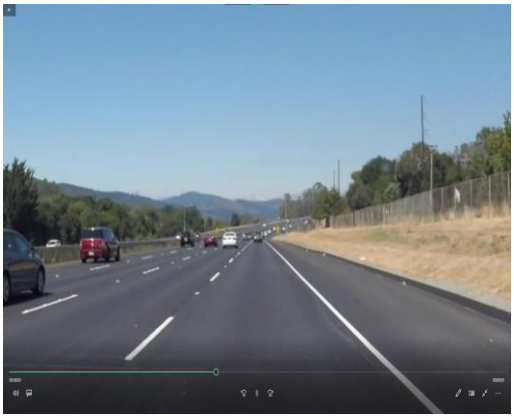
$$Angle\ (\theta) = \tan^{-1}\left(\frac{G_y}{G_x}\right)$$

Gradient direction is always perpendicular to edges. It is rounded to one of four angles representing vertical, horizontal, and two diagonal directions.

Experimental Setup - Dataset

We used 2 different data sets, which are 2 videos where it shows the video of the road with traffic and a road without traffic. We have downloaded the video from google and pasted it in the code





Software - Hardware Needed

Software requirements – The code requires a python version >= 3.8 to run smoothly with all the pre requisite libraries mentioned in the requirements.txt file installed beforehand

Hardware Requirements –Minimum of 8 GB ram, along with 20GB storage space. Should have a good processor (at least greater than or equivalent to Intel i5) along with a GPU for support

Results obtained

Output 1:
In this output we can see the road is empty and the red line are the lines detected by our project.

Output 2:
In this output, we can see the road is empty and the red line are the lines detected by our project

Conclusion

Lane detection techniques play a significant role in intelligent transport systems. The only reason to use the Hough transformation and canny edge detection is that it can detect the curved roads and lanes easily and other processes can't do it. The proposed system was tested or different outputs and it seems that the lanes are detected efficiently and lane lines are highlighted with red colour to recognize them. Overall we could say that this was efficient in detecting the lanes. Any future work includes alerting the driver when he crosses the lane.

References

[1]https://www.researchgate.net/publication/352550561_Road_lane_detection_through_image_and_video_processing_using_edge_detection_and_Hough_transform_for_autonomous_driving_purposes/link/60cee53192851ca3acb2e74d/download

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[3] https://towardsdatascience.com/a-deep-dive-into-lane-detection-with-hough-transform-8f90fdd1322f