Project Report (CSC481: Introduction to image processing)
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Lane Detection using Image Processing

Abstract:

Autonomous vehicles are the next big step in the transportation sector due to their efficiency and safety benefits. A self-driven car needs to understand its surroundings so it can navigate its way in streets with minimal human assistance. Driver and passenger safety systems are one of the rising topics in automotive development. Lane keeps and Steering assist are some of the systems that allow vehicles to detect lanes and help in keeping the car in an ideal position with respect to the road and assist in turning. There are several works presented on the well-structured roads having proper lane markings, but fewer on unmarked roads. In this study one such approach for detecting lanes on an unmarked road is reviewed followed by an improved approach. The approaches are based on digital image processing techniques and purely work on vision or camera data. The main aim is to obtain a real time curve value to assist the driver/autonomous vehicle for taking required turns and not go off the road. We simplify the process of edge detection by using a horizontal differencing filter. The detected edge points are grouped into lines with a modified Hough transform.

Introduction:

Lane detection is a developing technology that is implemented in vehicles to enable autonomous navigation. Most lane detection systems are designed for roads with proper structure relying on the existence of markings. The main shortcoming of these approaches is that they might give inaccurate results or not work at all in situations involving unclear markings or the absence of them.

There are several works presented on the well-structured roads having proper lane markings, but fewer on unmarked roads. This project is based on Digital Image processing techniques. It involves using various computer algorithms for manipulating images. This is performed to obtain an image that is according to desired requirements which can be with improved clarity, sharpness, details, reduced noise for efficient extraction and analysis.

The common step in this project is Thresholding, Warping and Region of Interest (ROI). Then further processing includes Pixel Summation (Histogram), Gaussian Blur, Image dilation, Canny Edge Detection, and Sliding Window algorithm which are subject to specific methods.

Background:

After researching with the topic on lane detection I have come to know that we can detect the lane detection through two categories The first one applies the bird's-eye view transform in an input image from a rear-view camera to recognize lane markings. The second category uses a front mounted camera.

As Lane Departure Warning System (LDWS) can warn a lethargic, disturbed, or distracted driver that they are about to leave the lane in which they are driving. Using image processing algorithms, this system

should be able to locate lane markings in an input video frame, track these lines, calculate Time to Line Crossing (TLC) and issue a warning if TLC is under a threshold. We had to experiment on lot of data Extracting and tracking lane boundary lines are critical steps of the algorithm. As it requires more processing time and present computational complexity. we used methods with minimal computation's time to perform a real-time software or hardware implementation.

The computation of TLC is beyond the range of this paper. Different methods to calculate it are described. In this paper, we have described the most used video-based lane detection algorithms. And we have we presented a technique to extract and track lane markings in video frames of a camera mounted behind the windshield of a vehicle. I have added Houghlines algorithm to the lane detection image as it will give us a proper lane detection in the video.

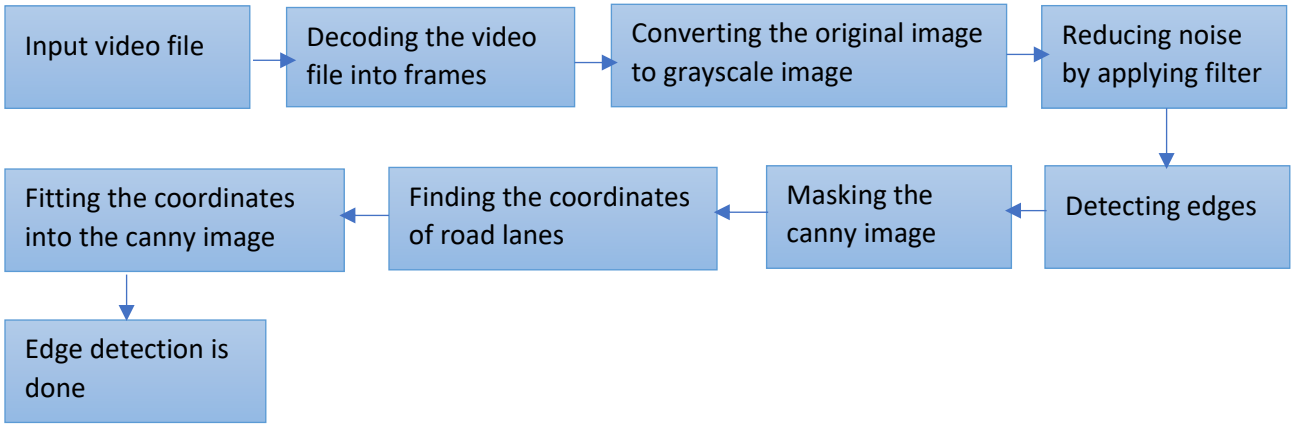
Methods:

In this paper, we firstly extract the colour features based on the white colour and then extract the edge features based on the straight lane. Because the high-speed section is the traffic accident-prone section, the high-speed road section mostly is the straight-line lane. Therefore, to obtain a very high recognition rate, we convert the original image to grayscale and then perform edge detection to the lane. This paper combines colour features extraction and edge features extraction, and the experiment proves that the recognition rate and accuracy of lane detection are greatly improved.

Our main contribution in this paper is to do a lot of work in the preprocessing stage. We started by decoding the video file into different images and then converting the image to grayscale image, then reducing the noise by applying filter to the image and then we have detected the edges of the image adn. We proposed to convert the color image to grayscale image, then extract white, and then perform conventional preprocessing operations in sequence. Moreover, we selected an improved method proposed in the area of interest (ROI). After basic preprocessing, one-half part of the processed image is selected as the area of interest (ROI). In addition, we performed twice edge detection. The first is in the preprocessing stage, and the second is in the lane detection stage after the ROI is selected. The purpose of performing twice edge detection is to enhance the lane recognition rate.

The importance of edge detection involves recognizing and locating sharp discontinuities in the image. It is the region of significant change in the image intensity or contrast, and it can find areas with strong intensity contrasts Edge detection is utilized in light of the fact that it helps in highlighting and bringing out information about an image. Example of such information's are, highlighting and finding objects presents in the image, their shape, size, image sharpening and enhancement. It is also a tool for image segmentation as a result in changes in intensity. In a continuous image, an intensity change between neighboring pixels is known as an edge.
There are three steps involved in edge detection which are:
1. Image smoothing: For noise reduction, this step involves filtering the image to improve the performance of edge detector.
2. Detection: This step involves extracting all edge points that are possible Candidates to become edge point.
3. Edge localization: This step involves selecting from the candidate edge points only the points that are true members of set of points comprising an edge.
In this paper, Hough transform is used for the straight-line detection.

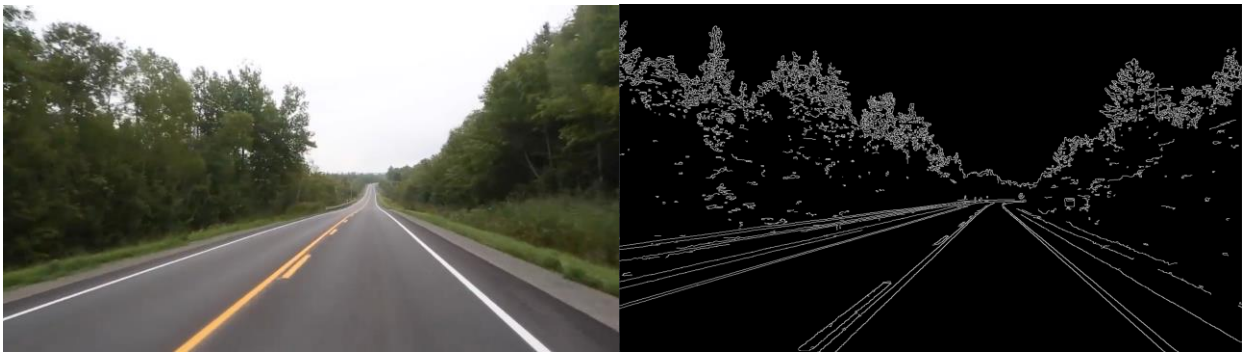
Basic steps of the process:



Thresholding without Blurring

Thresholding with blurring

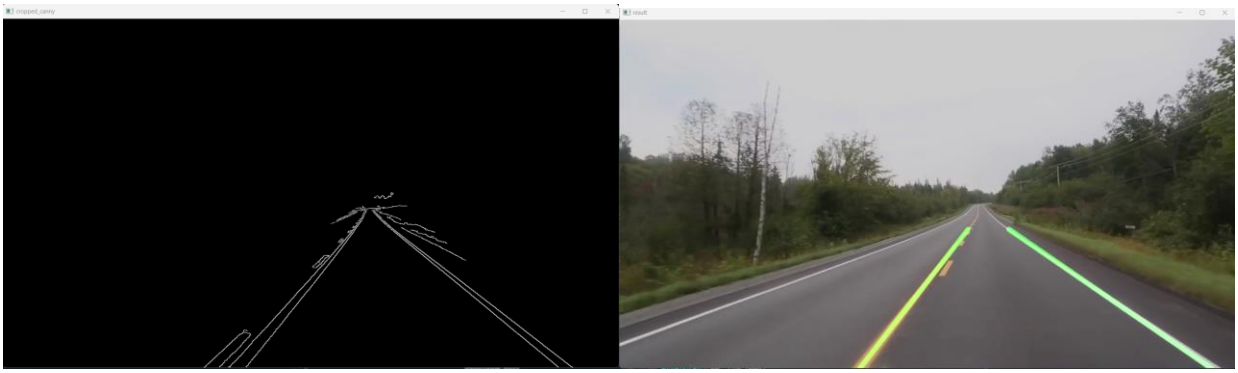
Canny edge detection is used here which involves extracting all edge points that are possible Candidates to become edge point.



The above images show original image and the edge detection of the original image.

Results

After running the program and using ROI, I was able to detect the lane detection using the Houghlines algorithms. To evaluate the performances of the proposed methodology, we applied it in different road scenes. In figure, we present only results in the ROI of each tested image. Results show that we can detect both yellow and white road lines. Therefore, the tracking mode allows us to select lane boundary lines among others candidate lines which can be present in a real road image. However, the tracking mode needs to be improved, because in some cases there is a false detection of road lines specially when there is a road lane change.



Conclusion

The overall purpose of this project is to enable lane detection in poor road conditions wherein the lane markings are not clearly visible or worn out. This project approaches for the implementation of lane detection with the help of image warping, thresholding, and approaches such as pixel for an intelligent autonomous vehicle. Finally, the advantages and shortcomings of the above methods along with their ideal use case scenarios have been discussed.