Curved Lane Detection Using Canny edge detection and Hough Transformation

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RESEARCH PAPER SUMMARY

Bibliographical info:

Title: Curved Lane Detection using Improved Hough
Transform and CLAHE in a Multi-Channel ROI

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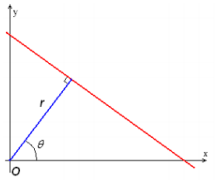
Background

In the discussed paper the authors aim to solve road accidents caused due to human error by implementing the Advanced Driver Assistance System(ADAS). Moreover, the authors also mention about there being not enough work on curved lane detection, though a significant amount of work has been done on straight lane detection. Hence, they developed a Curved Lane detection system which will take real images from a moving car and will display relevant information to the driver.

Summary of contributions:

The research conducted by the paper provides better image contrast by application of CLAHE along with precise curved lane detection by using the Hough Transformation. The Hough Transformation is a technique which can be used to isolate features of a particular shape within an image, analyzing image using CV and digital image processing.



The relationship between the origin and angle of a straight line and the position of a straight line.

Each line of the image can be correlated with a pair of parameters (r, θ). This parameter (r, θ) plane is sometimes called Hough space and is used for the set of two-dimensional straight lines.

The overall algorithm implemented by the paper also provides better results and performance which was measured using the following parameters: Accuracy, BER, Sensitivity and F-measure.

Limitations and discussion:

The discussed system detects lanes based on the road marks, so if there are no road marks, the system will fail to distinguish lanes. Moreover on a rainy day due to refraction of light the system might miscalculate the lanes and fail to work with accuracy. Furthermore if the tracks are covered in snow, dust or damaged then the system might fail.

Why this paper:

Going through some papers we finally came to a decision to choose this particular one. Firstly, this paper is relevant to our course contents and that made us think that we could learn the topics better and implement them at the same time. Also, we could grasp the contents of the paper conveniently. Secondly, this project gives us a scope to roam different outputs and judge better results. Finally, our goal is to learn some new algorithms related to image processing and implement them in our project.

Wider research context:

Yes, the problem this paper focuses on solving has much broader aspects. To begin with, this whole idea is one of the key features of what we know as "Intelligent Vehicle". In the near future, is coming the trend of self-driving cars, and determining the track which the car will follow, needs to be precise, which is the cause of intensive research now being done in this field. Autonomous lane detection in hilly terrain, snowy/rainy days, unstructured roads, etc are the more critical extensions of this paper. Moreover, some of the methods introduced in this paper can also lead to a solution to some other tasks, such as, a clear image on a foggy day, following the speed or detecting a car in a particular lane, driving accordingly analyzing the weather and so on.

PROJECT DESCRIPTION

The main goal of the project:

Our first goal is to implement the algorithms introduced in this paper and build an initial model. Then, we will apply some other algorithms instead of the ones in the paper and after comparing, will select the most suitable one. We chose this goal because we'd like to experiment with different algorithms under different road conditions to observe and find out an optimal one which can be used in a self-driving car. After that, if we have additional time in our hand, we would like to extend our project to simultaneously detecting objects, like detecting a road sign or an obstacle . Moreover, we also plan to implement weather based lane detection given that we have time. For instance, different algorithms will be used for sunny/rainy/snowy/foggy days and so on.

The deep image processing/computer vision task(s) addressed in the project :

We will be addressing the lane detection computer vision task. We will feed a video of a lane to the program and it will output the lane coordinates, region of interest, and the visual representation of the lane. An example of possible input and output is given below:

Figure: Possible input

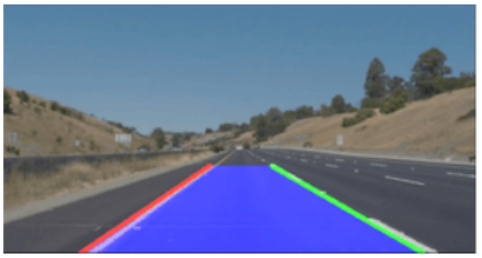


Figure: Possible output

The data that will be used :

We plan to collect our own data for the system from the front dash camera of a car. However for testing purposes such videos can also be extracted from the internet. Our input videos would look something like this :

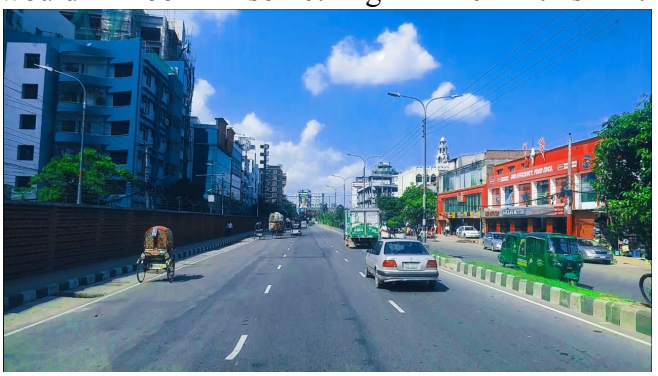


Figure: A car's front dash camera image

Gathering the raw input data(the videos) will not take much time; however, we will need to

correct camera distortion internally before implementing the system.

Method of image processing that will be used :

We will be using a classical based approach. There are a number of models and techniques we intend to use and test our program with. For example, CLAHE is used in the paper to improve local contrast. We might compare it with normal histogram equalization as CLAHE has a tendency to amplify noise, or we might use a guided filter to remove the noise. Furthermore, we'll compare Canny edge detection against Sobel operator edge detection to discern which one works better under various road conditions. Then, we will use Hough transformation and advanced Hough transformation tweaking some parameters and equations.

Baseline(s) to be used :

As we are re-implementing the discussed paper, we are setting the process of the paper itself as our baseline. Additionally, we will use several other papers (with the same goal), as our baseline to compare our scores with.

Process of evaluation of our results:

The evaluation metrics we will use for quantitative evaluation are Accuracy, F-measure, sensitivity and Bit Error Rate. The original method achieved pretty good scores but we expect our method to perform better as we will be combining and implementing the models from several papers. Apart from computer simulation, we also wish to do qualitative evaluation using a raspberry pi and our own vehicles to test the on-field performance of our model.

TEAM MEMBERS' CONTRIBUTIONS

Our team consists of three (03) members: Shadab Iqbal, Srijan Banik & Taher Abdullah. All of us are totally new in the field of image processing. However, the key strength of our team is collaboration that enables us to learn and implement a project effectively. Shadab is highly skilled in computational analysis and analytical thinking. Taher is great with research works and extracting useful information and Srijan is skilled in introducing creative ideas, thinking outside the box and bringing new concepts on the table. All the members will contribute equally in terms of the implementation of the project and coding.