PROJECT BASED LEARNING - I REPORT

ON

Road Lane-Lines Detection in Real-Time for Advanced Driving Assistance Systems

REPORT SUBMITTED TOWARDS PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF

BACHELOR OF TECHNOLOGY
IN
(IT)

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CERTIFICATE

The project titled "**Road Lane-Lines Detection in Real-Time for Advanced Driving Assistance Systems"** submitted to the Symbiosis Institute of Technology, Pune for the third-year project in **IT** is based on our original work carried out under the guidance of Dr Ambika Pawar. The report has not been submitted elsewhere for the award of any degree or for any other research related activity.

The material borrowed from other source and incorporated in the report has been duly acknowledged and/or referenced.

We understand that we could be held responsible and accountable for plagiarism, if any, detected later.

Date: 25-04-2022 **Signature of the candidate**

Research Guide **Head of the Department**

Dr Ambika Pawar (Dr. Deepali Vora)

ACKNOWLEDGEMENT

It gives us great pleasure in presenting the preliminary project report on "**Road Lane-Lines Detection in Real-Time for Advanced Driving Assistance Systems**".

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CHAPTER 1
INTRODUCTION

1.1 Overview

In this paper, a fast and reliable lane-lines detection and tracking technique is proposed. The proposed technique is well suited to be used in Advanced Driving Assistance Systems (ADAS) or self-driving cars. The main emphasis of the proposed technique in on simplicity and fast computation capability so that it can be embedded in affordable CPU's that are employed by ADAS systems. The proposed technique is mainly a pipeline of computer vision algorithms that augment each other and take in raw **RGB** (Red, Green, Blue) images to produce the required lane-line segments that represent the boundary of the road for the car. Each used algorithm is described in details, implemented and its performance is evaluated using actual road image captured by the front mounted camera of the car. The evaluation of the proposed technique shows that it reliably detects and tracks road boundaries under various conditions. The usefulness and the shortcomings of the proposed technique are also discussed in details.

1.2 Project Idea

Lane Line detection is a critical component for self-driving cars. This concept is used to describe the path for self-driving cars and to avoid the risk of getting in another lane. We will build a machine learning project to detect lane lines in real-time. We will do this using the concepts of computer vision using the OpenCV library. To detect the lane we have to detect the white markings on both sides on the lane. With the current rise in automated cars this project will help lead us closer to completely self driven cars.

1.3 Motivation

Increasing safety, reducing road accidents and enhancing comfort and driving experience are the major motivations behind equipping modern cars with Advanced Driving Assistance Systems (ADAS). In the past couple of decades, major car manufacturers introduce many sophisticated ADAS functions like Lane Departure Warning, Lane Keep Assist, Electronic Stability Control, Anti-lock Brake System … etc. Both LDW and LKA functions are examples of how important for the car to detect and track the road lane lines or the road boundaries accurately and on time. Future ADAS functions like Collision Avoidance, Automated Highway Driving (Autopilot), Automated Parking and Cooperative Maneuvering requires more and more fast and reliable road boundaries detection, which is among the most complex and challenging tasks.

CHAPTER 2

Demand analysis of lane detection and identification

2.1 GOALS REQUIRED -

Final goal to identity lane line accurately and efficiently .For achieving this goal some parameters are required

1. Accuracy - Reduce rate of urban traffic accident. Bring safety to vehicle, road and driver itsell

2. High efficiency - To work a vehicle properly accuracy and speed maintenance are major factor

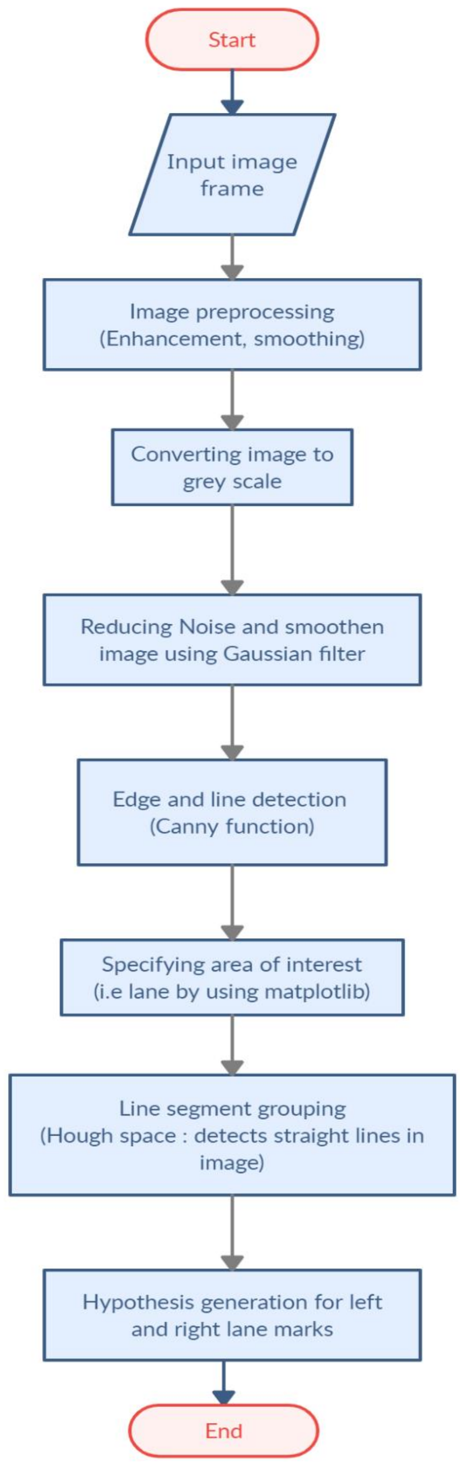
3Memory - A good memory function can effectively store data and manage records and can use this data at time of traffic accidents.

4. Architecture - It should have simple design structure and should be as small as possible.

5. Fully autonomous - There should be a alert system design whenever the driving goes wrong in a particular situation

6. A good quality camera is required for capturing a better image of lane and other background at a minimum speed of vehicle.

2.2 Proposed method of lane line detection



CHAPTER 3
PROBLEM DEFINITION AND OBJECTIVES

3.1 Problem Definition

Machine learning methods are used for lane detection but are mainly used for classification rather than feature design, these methods have not been fully implemented in the efficiency and accuracy of lane detection. But modern machine learning methods can be used to identify the features that are rich in recognition and have achieved success in feature detection tests.

3.2 Scope

Lane Line detection is a critical component for self-driving cars. This concept is used to describe the path for self-driving cars and to avoid the risk of getting in another lane.

We will build a machine learning project to detect lane lines in real-time. We will do this using the concepts of computer vision using the OpenCV library. To detect the lane we have to detect the white markings on both sides on the lane.

With the current rise in automated cars this project will help lead us closer to completely self driven cars.

3.3 Hardware and Software Requirements

3.3.1 Software Requirement

1) Platform: ANACONDA NAVIGATOR
2) Technology : PYTHON
3) IDE: JUPYTER NOTEBOOK

CHAPTER 4

IMPLEMENTATION

4.1 THE LANERTD ALGORITHM

One of the advantages of the LaneRTD algorithm is that it is only using a single CCD camera. This camera should be mounted on the car's front-windshield mirror to capture the front view of the road. By assuming that the baseline is adequately horizontal, then the horizon is assured to be in the image parallel to the X-axis. However, the calibration data of the camera can be used to fix the orientation if the horizon is not adequately parallel to the X-axis. For the matter of clarification, the lane boundaries are arranged in pairs of markings, which usually have rectangular forms (or approximate).
The Hough transformation is then used to detect potential straight line segments, in the edged image, that can be later part of the lane boundary. The search for these line segments is only done within the ROI. The detected line segments are then grouped together in a way to construct both the left and right lanes. Two straight lines will be fitted to the grouped line-segments and point to represent the lane boundaries. For visualization purposes, the LaneRTD algorithm is illustrated by the flowchart in Fig. 1, and the resultant straight lane lines are displayed on the original color image as shown by the example in Fig. 2.

4.2 CANNY EDGE DETECTOR

The Canny edge detection algorithm is mainly implementing the following 5 steps in order :

Applying a Gaussian filter for noise removal and image smoothening . Computing the intensity gradients for all the pixels in the image and inte (i.e o intensity means no intensity or complete black while 255 intensity means max intensity or complete white) . Applying a process called "non-maximum suppression" to avoid unauthentic response to edge detection. Applying a double-threshold categorization to evaluate edges, and determine the potential ones. Evaluating edges by categorization: completing the detection of edges by removing all the other edges that are in the low category or are weak but not associated (close to or connected) to edges in the high category.

4.3 Hough transform

Unclear detection and multi-peak detection problems are the biggest problems faced by traditional Hough transforms and are severely affected by noise. After the Hough transform is improved, the robustness and adaptability of the detection result are enhanced.
In the actual calculation, the Hough transform builds a two-dimensional accumulative array based on the parameter space by accumulating the curve values in the ρ-θ parameter space [16]. Here, the quantization accuracy of 1 or 0.5 is selected to quantize the variables ρ and θ as the two-dimensional array. The value of each cell represents the number of collinear points in the image. Therefore, the conversion of the straight line parameter is converted to the peak point in the search.

The Hough transform detects lane lines with good self-adaptability. When the lane lines are not continuous, it can still detect the effect very well and has good robustness.

4.4 Implementation of laneRTD Algorithm

1) The algorithm is applied using python and open CV computer vision library and the following is procedure of the following code.
2) Image capturing: the input data will be seen as colour image sequences taken from a moving vehicle. (the data used in the project will not be live but will be used from online datasets)
3) Conversion to grayscale: to segment the road from the lane boundaries using the colour information, edge detection becomes difficult and consequently effects the processing time. Therefore the data gathered will be converted into grayscale.
4) Noise reduction: Noise is a real world problem for all systems including computer vision processing. presence of noise in proposed system will hinder the correct edge detection. So the grayscale images will be filtered for noise.
5) Edge detection: Lane boundaries are defined by sharp contrast between the road surface and painted lines or some types of non-pavement surfaces. Therefore edge detectors are very important in determining the location of lane boundaries. So finally the data will be detected for edges.
6) Canny function - derivate X and Y in both direction and determine change of intensity with respect to adjacent pixel. Image is represented as 2d coordinate space X and Y where x is width(i.e no of columns) of image and Y is height(i.e no of rows) of image.

   X * Y = gives you total no of pixel.

7) Finding lane lines (Region of interest)-create an image that is completely black , a mask with same dimension as our road image and fill the part of its area with a triangular polygon.

8) Mask image - converted to array of binary no where region is interest in denoted with max intensity(i.e 255) so then binary representation will be 11111111 and other with low intensity as 0 so binary representation will be 00000000. Now we will aplly mask on our canny image so that we can only get region of interest which is traced by that polygon. All this is obtained when

we apply bitwise and operator (i.e&) between mask and canny image .

9) Detecting straight lines – this is identified using hough transform() function.

Fig. 1. The Original Image.

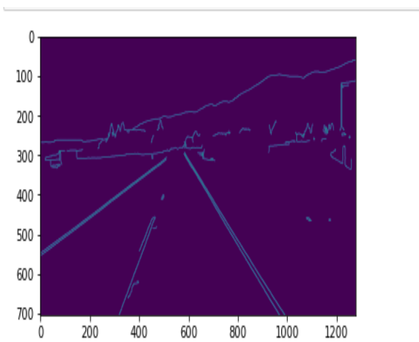


Fig. 2. Converting image in grey scale and smoothing using Gaussian filter

Fig. 3. Image in gray scale.

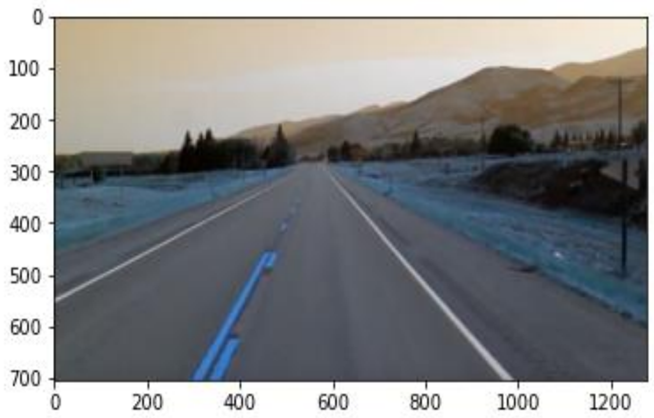


Fig. 4. Image after applying And operator

Fig. 5. Final Output for Lane Line Detection.

CHAPTER 5

DISCUSSION

ADVANTAGES:

1) One of the main challenges for advanced driver assistance systems (ADAS) is the environment perception problem. One factor that makes ADAS hard to implement is the large amount of different conditions that have to betaken care of. The main sources for condition diversity are lane and road appearance, image clarity issues and poor visibility conditions. As we are converting a video in number of images so that this issue is getting resolved.

2) With the increasing need for road lane detection used in lane departure warning systems and autonomous vehicles, many studies have been conducted to turn road lane detection into a virtual assistant to improve driving safety and reduce car accidents. Most of the previous research approaches detect the central line of a road lane and not the accurate left and right boundaries of the lane. In addition, they do not discriminate between dashed and solid lanes when detecting the road lanes. However, this discrimination is necessary for the safety of autonomous vehicles and the safety of vehicles driven by human drivers. To overcome these problems, we propose a method for road lane detection that distinguishes between dashed and solid lanes. Experimental results with the Caltech open database showed that our method outperforms conventional methods.

DISADVANTAGES:

1) Robustness(condition) of lane is very poor mainly due to surrounding of our road, or traffic in streets or trees/ building shadow around lane.

2) Real time nature of lane line is very poor -pollution increase than image coolected is very poor and incomplete which will create difficulty in further process.

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