A Project Report on

Road Lane Line Detection

Submitted in partial fulfillment of the requirements for the award of the degree of

Bachelor of Engineering

in

Information Technology

by

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Approval Sheet

This Project Report entitled ***"Road Lane Line detection"*** Submitted by ***"Prerana Kanawade" (18104053), "Dhrru Ahuja" (18104048), "Shubham Sakpal" (18104067)*** is approved for the partial fulfillment of the requirement for the award of the degree of ***Bachelor of Engineering*** in ***Information Technology*** from ***University of Mumbai*** .

Prof. Yaminee Patil

Guide

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Place:A.P.Shah Institute of Technology, Thane

Date: 31 March 2022

CERTIFICATE

This is to certify that the project entitled ***"Road Lane Line Detection"*** submitted by ***"Prerana Kanawade" (18104053), "Dhrru Ahuja" (18104048), "Shubham Sakpal" (18104067)*** for the partial fulfillment of the requirement for award of a degree ***Bachelor of Engineering*** in ***Information Technology*** ,to the University of Mumbai,is a bonafide work carried out during academic year 2021-2022.

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Acknowledgement

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Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, We have adequately cited and referenced the original sources. We also declare that We have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Abstract

As India is a progressing country, so is the infrastructure as well as the transportation like roads, technologies are also developing. Transportation is a crucial aspect that helps within the Indian economy. With the increase in transportation, there is also an increase in accidents. The main cause of this is driver's error in lane detection. So, lane management is very essential in order to avoid mishaps. The objective of Road-lane line detection is to provide safety by using the lane detection and also guide people on the correct ways and time for shifting from a lane to another lane and avoid accidents. Driverless technology has been developing rapidly in recent years. Unmanned vehicles need to learn to observe the road from the visual point of view if they have to understand automatic driving, which specifically is the detection of lane lines. This includes identifying the positional relationship between the lane line and therefore the car, whether it's a solid line or a line. The detection of lanes is an important part of the system we are trying to create here for the safety of the drivers and other vehicles. Given this feature, this paper proposes the use of improved Hough-transform to understand straight-track detection of lane detection.

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List of Abbreviations

ADAS: Advanced Driver Assistance Systems

LDW: Lane Departure Warning

ITS: Intelligent Vehicle Systems

ROI: Region Of Interest

2D: Two Dimension

RGB: Red Green Blue color channel

Introduction

Advanced driver assistance systems (ADAS) are being developed to assist the driver in their driving processes to reduce road accidents. Car safety and road safety are thereby nowadays a most important issue. Human errors are prone to occur in the majority of road accidents on highways. Not being Patient or attentive is one of the main factors for road accidents. ADAS provides the automated system to automate, enhance and adapt to the environment to reduce road fatalities and avoid collisions. The system either alerts the driver or takes necessary actions of driving tasks providing necessary information like lane departure warning (LDW), the position of vehicles, road boundaries. One of the scientific fields involved in these tasks includes computer vision that performs tasks automatically compared with human visual system tasks. Computer vision senses the environment and can be applied in many applications supported by intelligent vehicle systems (ITS). Autonomous vehicles are a newer arena of computer vision ranging its level from fully autonomous vehicles to vehicles where a driver is supported by computer vision-based systems. Road boundaries and lane markings are the most perceptual cues for human driving. The Lane Line detection may be a critical component for self-driving and cars generally and also for computer vision. Through this project, 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 and also use the programming language Python. To detect the lane, we have to detect the white markings that are present on both sides of the lane. Using computer vision techniques in Python, we'll identify road lane lines during which autonomous cars must run. This will be a critical part of autonomous cars, as self-driving cars should not cross their lane and should not go in the opposite or adjacent lanes to avoid accidents.

Literature Review

"Real-Time Lane Detection for Autonomous Vehicles"

Authors: Abdulhakam.AM.Assidiq, Othman O. Khalifa, Md. Rafiqul Islam, Sheroz Khan.

Methodology:

Image Capturing:. A colored image is taken from the camera mounted inside the vehicle at the front-view mirror along the central line. It takes images of the surroundings in front of the vehicle, including the road, other vehicles, objects, etc.

Conversion to GrayScale: In order to provide less information for the pixel. The road surface consists of many different colors caused due to shadows, different pavement styles, or age, which leads to color change of the road surface and lane markings to change. Therefore, color images are converted into grayscale.

Edge Detection Line Detection Hyperbola Fitting Hough Transform OpenCV

Findings:

The aim was to take the video frames and process them through a lane line detection algorithm. The system uses a series of images. Some of the different frames used are shown in the lane detection algorithm which conducts image segmentation and removes the shadow of the road. The lanes were detected using Hough transformation with a restricted search area. This algorithm can be used on the painted as well as slightly curved roads.

"An Efficient method of Lane Detection and tracking for Highway Safety"

Authors: Bubly Barua, Shuva Biswas, Kaushik Deb

Methodology:

Capturing Image: The first step involves capturing an image. The system takes a color image as

input through the ccd camera. The system has a camera mounted along the central line of the road on the front view mirror. Due to the distortion of the image, the camera calibration is used. Geometric camera calibration, also referred to as camera resectioning, measures the parameters of the camera lens and image sensor of the captured image.
RGB to Grayscale conversion, Edge Detection, Line Finding Using Standard Hough Transform finding, lane line curve fitting.

Findings:
The camera height from the ground should not be more than two meters. The results reveal that the surroundings or the environment of the road doesn't affect the proposed system; have the ROI selected suitable for any set frames recorded by the camera.

"Lane Detection and Tracking for Intelligent Vehicles: A Survey"

Authors: Mehdi FENICHE, Tomader MAZRI

Methodology:

Image Cleaning Features Detection Model Application Tracking Integration Coordinates Translation Adaptive bilateral filter

Findings: Several advancements were made in these detection fields. Most of the strategies are based on the Vision or Lidar (Light Detection and Ranging) approach and are very simple for detecting. There is a wide range of variabilities in the vehicle and its surrounding, thus providing a huge area for future development, such as the dynamic motion of obstacles, parked, moving vehicles, bad road conditions, absences of the lane markings or irregular lane markings, etc.

"A Study of Lane Detection Techniques and Lane Departure System"

Authors: Suvarna Shirke, Dr. P. Rajabhushanam

Methodology:
None

Findings:

In this paper, they studied the different approaches to lane detection and lane departure systems. The various challenges and difficulties faced by the other road detection systems were studied, along with the various lane detection datasets. As compared to the feature-based approach the model-based approach requires too many computations, but as compared to the feature-based approach the model-based approach gives good accuracy.

"Research on Lane Detection and Tracking Algorithm Based on Improved Hough Transform"

Authors: Xianwen Wei1, Zongjun Chai 2, Wei Feng3, Zhaojin Zhang1

Methodology:

Image Pre-processing Extraction Lane Line Lane Line Detection Based on Hough Transform Improved by ROI Region

Findings:

The Hough line detection method is accurate and simple, and the curve detection can be performed after adding the tracking algorithm. The fitting method is unstable but has the advantage of being able to detect curves. The advantage of the affine transformation method is that multi-lane detection can be performed. In a complex situation, the vehicle or other object in front can be easily obstructed and suffer severe interference. Therefore, the detection of lane lines needs to adapt to various conditions. Compared with the above two algorithms, the algorithms designed in this paper have good robustness and hold many advantages. This algorithm is not only applicable to structured roads with lanes such as roads, but also can be applied to non-structured roads such as country roads. While changing the lanes or the direction of the vehicle, the driver is reminded to take corresponding measures to realize the lane departure warning, which can effectively suppress the occurrence of the accident.

Project Design

The Terminologies:

1) Image Capturing:

Through the camera mounted on the front of vehicle along the central line, we take a set of images in coloured format. It takes the images of the surrounding in front of the vehicle, including the road, other vehicles, roadside, and sometimes incident objects on the road. The on- board computer with image capturing card captures the images in real time (up to 30 frames/ second), and saves them in the computer memory. The lane discovery system read the image sequences from the memory and starts reprocessing.

2) Grayscale conversion

Conversion to Gray Scale is necessary to retain the color information as well as to part the road from the lane boundaries using the color information. Due to colored image detecting the edge becomes problematic and thus effecting the processing time. The road surface are/can be made and surrounded by multiple components like shadows, pavement style or age, which adds multiple different colors to the image due to which cause the color of the road surface and lane markings changes from one image region to another. In order to avoid this, the color image is converted into grayscale. It coverts a 24-bit, three-channel, color image to an 8-bit, single channel grayscale image. The function formed a weighted sum of the red component of the pixel value *0.3 Green component of the pixel value *0.59 blue component for the pixel value *0.11 and then it will give gray scale value for the corresponding pixel as output.

3) Noise Reduction

Noise is a real-world problem for all systems including computer vision processing. The presence of noise in proposed system can interfere the correct edge discovery. Hence noise elimination is

necessary for productive edge detection. With the help of (F.H.D.) algorithm the intense shadows are removed from the image. Shadows have distinguished boundary, hence removing the shadow boundary from the image derivatives and reconstruction of the image is applied. Thus, a shadow edge image has been created by applying edge-detection on the steady image and the original image. By opting the edges that exist in the original image but not in the steady image and to reconstruct the shadow free image by removing the edges from the original image by using a pseudo-inverse refiner has been applied.

4) Edge Detection

Edge detection is a technique of image processing to identify points during a digital image with discontinuities, simply to mention , sharp changes within the image brightness. These points where the image brightness varies sharply are called the sides (or boundaries) of the image. Lane boundaries are defined by sharp diverseness between the road surface and painted lines or some types of non-pavement surfaces. The edge detectors are very important in determining the position of lane boundaries. It reduces the amount of learning data required by simplifying the image greatly. It is important to have an

edge detection algorithm that could be suitable to select thresholds automatically.

5) Line Detection by using Hough Transform

We are using Hough transformation for line detection. The Hough Space is a 2D plane that has a horizontal axis representing the slope and the vertical axis representing the intercept of a line on the edge image. A line on an edge image is represented in the form of $y = mx + b$. As the line is characterized by its slope a and intercept b, one line on the edge image produces a point on the Hough Space. On the other hand, an edge point (x_i, y_i) on the edge image can have an infinite number of lines pass through it. Therefore, an edge point produces a line in the Hough Space in the form of $b = mx_i + y_i$ (Leavers, 1992). In the Hough Transform algorithm, the Hough Space is used to determine whether a line exists in the edge image.

In a vertical line, the slope is infinity. We can't represent infinity in Hough Space. This would result in the program crashing. So instead of using y = mx + b for the equation of a line, we'll use

P (rho) and θ (theta) to define a line. This is also referred to as the coordinate system. If we were to map all the sting points from a foothold image onto the Hough Space, it'll generate tons of cosine curves. If two edge points lay on an equivalent line, their corresponding cosine curves will intersect one another on a selected (ρ, θ) pair. Thus, the Hough Transform algorithm detects lines by finding the (ρ, θ) pairs that features a number of intersections larger than a particular threshold.

6) Hyperbola Pair Fitting

In hyperbola pair fitting for the input, we use the two vector data points from the scanned lane. To fit the hyperbola to the data, a method of least square technique is used. One hyperbola is fit to each of the vectors of data points.As they are, the pair model they are solved simultaneously. The parameters of the two hyperbolas are related because they must converge at the same point. The formula for the lane boundary as a hyperbola is given below:

$$U = \frac{k}{u-h} + b(v - h) + c$$

,where u, v are the road boundary point

u and v are the x- and y-coordinate in the image reference frame, h is the Y-coordinate of the horizon in the image reference frame, and k, b and c are the parameters of the curve, which can be calculated from the shape of the lane

Methodology

It uses a vision-based approach capable of reaching a real-time performance in detecting and tracking lane markings with a slight curvature, which is robust enough in presence of shadow conditions. The detection of road boundaries is first done by applying the edge detection and Hough transform algorithm and then by fitting parallel hyperbola pairs to the edges of the lane. The vehicle moves on a flat and straight road or with slow curvature.

The road surface is(sometimes) made of light or dark pavements or combinations. Depending upon the surrounding a variety of road conditions can be seen, some roads have relatively simple conditions with both solid and dashed line lane markings. Lane position in such cases can be considered relatively easy because of the clearly defined markings and uniform road texture.But in other complex cases in which the road surface varies and markings contain circular reflectors also as solid lines the lane detection will be quite a difficult task to do. Furthermore, shadowing obscuring road markings make the edge detection phase more complex. The visibility of the road is affected by various factors like the time of day, seasonal effects(fog, heavy rains, strong rains, etc).

A CCD camera is mounted on the front of the vehicle to capture the road scene. Each lane boundary marking, forms a pair of edge lines as it is mostly considered rectangular. In this system we are taking the input to the algorithm of a 620x480 RGB color image. Therefore, the first step of the algorithm is to convert the color RGB image to a 8-bit grayscale image to minimize the processing time . Secondly, the presence of noise in the image will be fixed using the correct edge detection. Therefore, they apply the (F.H.D.) algorithm to make the edge detection more accurate. Then the image is processed through the edge detector by using the canny filter with automatic thresholding to obtain the edges, it will change the pixel value of the image in order to make the analyzing of the image easier. Then edged image is sent to the line detector after detecting the edges which will produce a right and left lane boundary segment.And then the horizon is predicted by using the segment intersection. The image is further processed through the Hough transform which helps in detecting the other objects present on the road or the road environment. This will also provide a set of points on both sides of the road. Then pairs of hyperbolas are fitted to these sets of points to give the lane boundaries.

However, still, some problems are not solved yet such as sharp curves in the image and the accurate detection of the lanes under strong weathered conditions like heavy rains, fog, etc also

the captured frames are not that stable due to the variable velocity and momentum of the vehicle and therefore, we need there is need for improvement in the algorithm to overcome these problems. In the lane detection due to shadowing, the Hough line and horizon overlap thus failing to provide accurate markings.

Add Case Diagrams

Project Implementation

In Chapter 4 which is Project Implementation Project Groups should add at Max 6 snippets of your code or Screenshots which you feel are major & Technically critical along with brief description.

Testing

As per outline in Chapter 5 Project Groups should jot down Which testing method out of Standard SW Testing methods is best suits for their Implementation. Write Theory in Breif about that Testing method as one paragraph. In second Para justify why it’s best suits your project

Result

This shall form the penultimate chapter of the report and shall include a thorough evaluation of the investigation carried out and bring out the contributions from the study. The discus- sion shall logically lead to inferences and conclusions as well as scope for possible further future work.

Parameters	Wormhole Attack	AODV
Total No.of Sent Packets	85068	85068
Total No.of Received Packets	16252	68068
Total No.of Drop Packets	61948	16864
Throughput	98.01	410.24
Delay	0.0244	0.1528
Jitter	23.93	100.16

Table 6.1: Wormhole Attack Comparison with AODV Protocol

Conclusions and Future Scope

In this paper, we studied a real time lane detection algorithm based on real time video sequences taken through the camera mounted on the front of the car. As mentioned above the system uses a series of image frames. We used various algorithms to conduct image segmentation, edge detection, color conversion and removal of the shadow on the road. We studied the different approach of lane detection and lane departure system and the various challenges faced by the lane detection system. We have also studied the datasets available for lane detection. As compared to feature based approach the model-based approach requires too many computations, but as compared to feature based approach the model-based approach gives good accuracy.

In this project, we have presented a framework which is robust for lane detection and tracking on highway roads. This presents a detailed analysis of the use of lane position in various environments with different illuminations. This led to our presentation of the lane-tracking system operated in a wide range of environments.

We studied various papers, their advantages and disadvantages, for our work. We have studied the different approaches of lane detection and lane departure systems. We have also studied the various challenges faced by the lane detection system. We have also studied various datasets available for lane detection. Thus, trying to eliminate all the possible problems appeared in the previous systems

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Appendices

Detailed information, lengthy derivations, raw experimental observations etc. are to be presented in the separate appendices, which shall be numbered in Roman Capitals (e.g. “Appendix I”). Since reference can be drawn to published/unpublished literature in the appendices these should precede the “Literature Cited” section.

Appendix-A: NS2 Download and Installation

1. Download ns-allinone-2.35.tar.gz from http://sourceforge.net/projects/nsnam/

2. Place ns-allinone-2.35.tar in your desired directory; like /home/vishal.

3. Go to terminal and do as following commands

sudo apt-get update

sudo apt-get install automake autoconf libxmu-dev build-essential

4. Extract ns-allinone-2.35 and after extracting go to folder ns-allinone-2.35 from Termi- nal as

$cd ns-allinone-2.35

$./install

5. Path Setting

$ gedit .bashrc

This command will open an existing file in editor. Just put the following path which is given bellow. [Remember that our ns-allinone path is /home/vishal. we will change this path according to our ns-allinone folder’s path]

export PATH=$PATH:/home/vishal/ns-allinone-2.35/bin:/home/vishal/ns-allinone-2.35/tcl8.5.10/unix/home/vishal/ns-allinone-2.35/tk8.5.10/unix

export LD LIBRARY PATH=$LD LIBRARY PATH:/home/vishal/ns-allinone- 2.35/otcl-1.14:/home/vishal/ns-allinone-2.35/lib

export TCL LIRARY PATH=$TCL LIBRARY PATH:/home/vishal/ns-allinone-2.35/tcl8.5.10/library

After this save and exit.

6. Now type in terminal to check that, is all command we entered in .bashrc is correct or not? And To take the effect immediately

$source .bashrc

7. Then perform the validation test using this command.

$ ./validate

8. Run ns2 using this command

$ns

We will get % prompt in our terminal. Now ns2 has been installed.

Publication

Paper entitled **“Paper Title”** is presented at **“International Conference/Journal Name”** by **“Author Name”.**