A

Synopsis Report

on

Road Lane Detection

TY- COMP

Computer Engineering

by

Nayan Bhabad 112003017

Prathamesh Bhillare 112003019

Subodh Choudhari 112003028

Department of Computer Engineering,
COEP Technological University (COEP Tech)
(A Unitary Public University of Govt. of Maharashtra)
Shivajinagar, Pune-411005,Maharashtra, INDIA

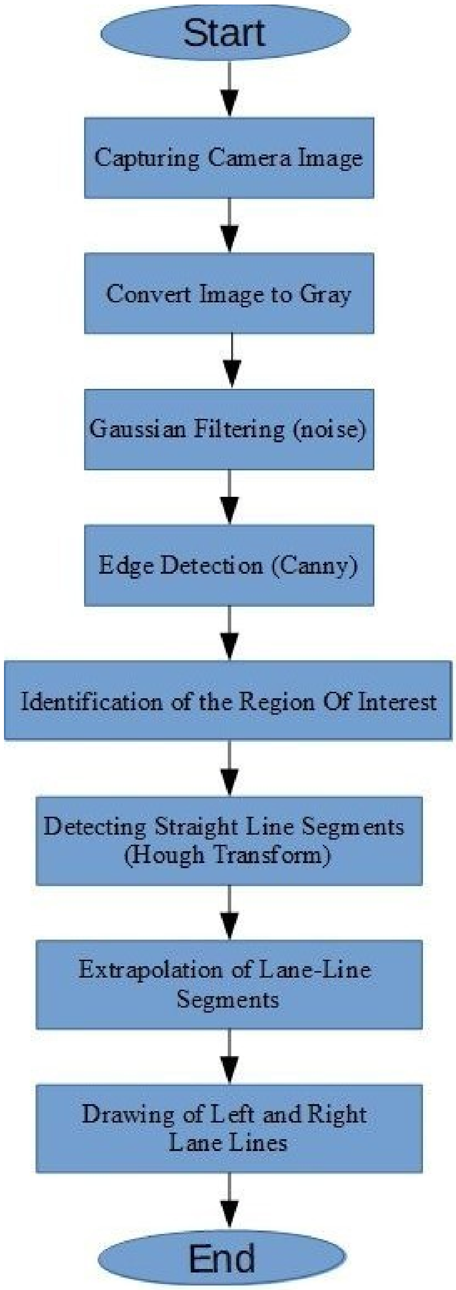
Abstract:

Lane detection plays an important role in intelligent vehicle systems. Therefore, this paper presents a robust road lane marker detection algorithm to detect the left and right lane markers. The algorithm consists of optimization of Canny edge detection and Hough Transform. The system captures images from a front viewing vision sensor placed facing the road behind the windscreen as input. Then a series of image processing is applied to generate the road model. Canny edge detection performs features recognition then followed by Hough Transform lane generation. The algorithm detects visible left and right lane markers on the road based on real-time video processing.

1 Introduction

Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image. Nowadays, image processing is among rapidly growing technologies. It forms core research area within engineering and computer science disciplines too. Image processing is a method to perform some operations on an image, in order to get an enhanced image and or to extract some useful information from it.If we talk about the basic definition of image processing then “Image processing is the analysis and manipulation of a digitized image, especially in order to improve its quality”.

Digital-Image: An image may be defined as a two-dimensional function f(x, y), where x and y are spatial(plane) coordinates, and the amplitude of fat any pair of coordinates (x, y) is called the intensity or grey level of the image at that point. In another word An image is nothing more than a two-dimensional matrix (3-D in case of coloured images) which is defined by the mathematical function f(x, y) at any point is giving the pixel value at that point of an image, the pixel value describes how bright that pixel is, and what colour it should be.Image processing is basically signal processing in which input is an image and output is image or characteristics according to requirement associated with that image.



2 Motivation

In the past five years, autonomous driving has gone from “maybe possible” to “definitely possible” to “inevitable” to “how did anyone ever think this wasn’t inevitable?” to "now commercially available." In December 2018, Waymo, the company that emerged from Google’s self-driving-car project, officially started its commercial self-driving-car service in the suburbs of Phoenix. The details of the program—it's available only to a few hundred vetted riders, and human safety operators will remain behind the wheel—may be underwhelming but don't erase its significance. People are now paying for robot rides. And it's just a start. Waymo will expand the service's capability and availability over time. Meanwhile, its onetime monopoly has evaporated. Smaller start-ups like May Mobility and Drive.ai are running small-scale but revenue-generating shuttle services. Every significant automaker is pursuing the tech, eager to rebrand and rebuild itself as a “mobility provider” before the idea of car ownership goes kaput. Ride-hailing companies like Lyft and Uber are hustling to dismiss the profit-gobbling human drivers who now shuttle their users about. Tech giants like Apple, IBM, and Intel are looking to carve off their slice of the pie. Countless hungry start-ups have materialized to fill niches in a burgeoning ecosystem, focusing on laser sensors, compressing mapping data, setting up service centres, and more. This 21st-century gold rush is motivated by the intertwined forces of opportunity and survival instinct. By one account, driverless tech will add $7 trillion to the global economy and save hundreds of thousands of lives in the next few decades. Simultaneously, it could devastate the auto industry and its associated gas stations, drive-thrust,taxi drivers, and truckers. Some people will prosper. Most will benefit. Many will be left behind.

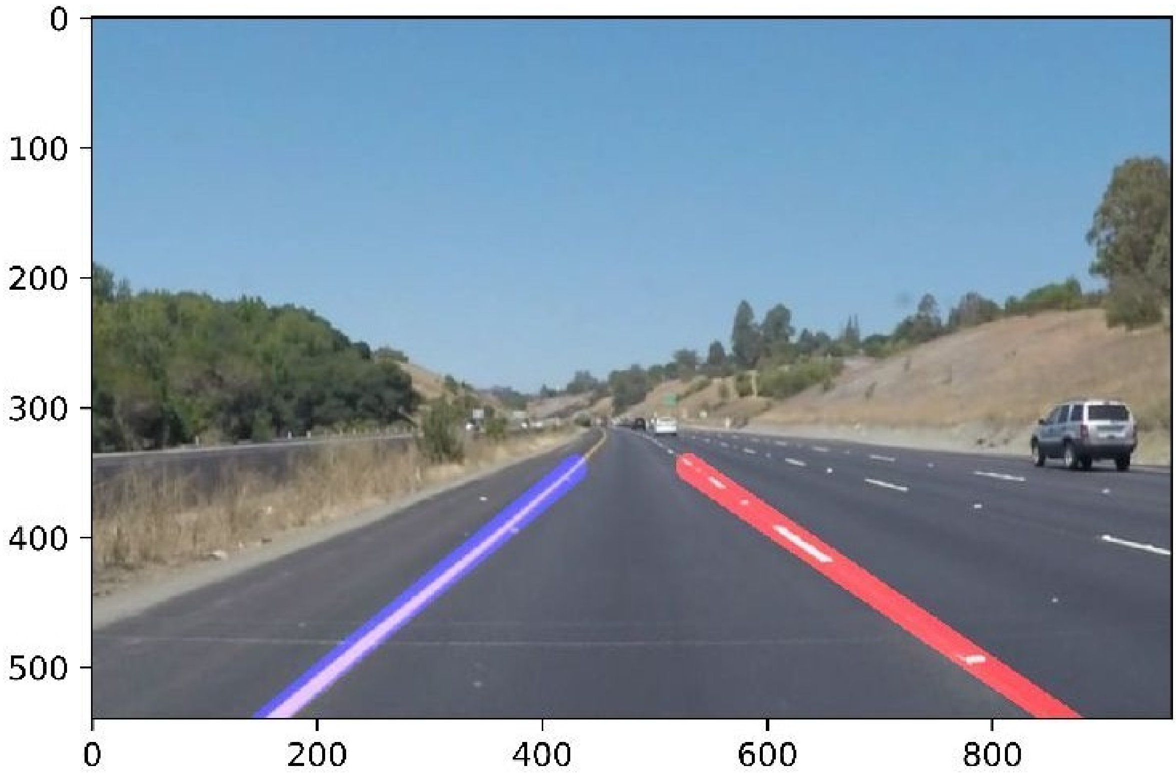
It’s worth remembering that when automobiles first started rumbling down manure-clogged streets, people called them horseless carriages. The moniker made sense: Here were vehicles that did what carriages did, minus the hooves. By the time “car” caught on as a term, the invention had become something entirely new. Over a century, it reshaped how humanity moves and thus how (and where and with whom) humanity lives. This cycle has restarted, and the term “driverless car” will soon seem as anachronistic as “horseless carriage.” We don’t know how cars that don’t need human chauffeurs will mold society, but we can be sure a similar gear shift is on the way. Just over a decade ago, the idea of being chauffeured around by a string of zeros and ones was ludicrous to pretty much everybody who wasn’t at an abandoned Air Force base Pageoutside Los Angeles, watching a dozen driverless cars glide through real traffic. That event was the Urban Challenge, the third and final competition for autonomous vehicles put on by Darpa, the Pentagon’s skunkworks arm. At the time, America’s military-industrial complex had already thrown vast sums and years of research trying to make unmanned trucks. It had laid a foundation for this technology, but stalled when it came to making a vehicle that could drive at practical speeds, through all the hazards of the real world. So, Darpa figured, maybe someone else—someone outside the DOD’s standard roster of contractors, someone not tied to a list of detailed requirements but striving for a slightly crazy goal—could put it all together. It invited the whole world to build a vehicle that could drive across California’s Mojave Desert, and whoever’s robot did it the fastest would get a million-dollar prize. The most successful vehicle went just seven miles. Most crashed, flipped, or rolled over within sight of the starting gate. But the race created a community of people—geeks, dreamers, and lots of students not yet jaded by commercial enterprise—who believed the robot drivers people had been craving for nearly forever were possible, and who were suddenly driven make them real. They came back for a follow-up race in 2005 and proved that making a car drive itself was indeed possible: Five vehicles finished the course. By the 2007 Urban Challenge, the vehicles were not just avoiding obstacles and sticking to trails but following traffic laws, merging, parking, even making safe, legal U-turns. When Google launched its self-driving car project in 2009, it started by hiring a team of Darpa Challenge veterans. Within 18 months, they had built a system that could handle some of California's toughest roads (including the famously winding block of San Francisco's Lombard Street) with minimal human involvement. A few years later, Elon Musk announced Tesla would build a self-driving system into its cars. And the proliferation of ride-hailing services like Uber and Lyft weakened the link between being in a car and owning that car, helping set the stage for a day when actually driving that car falls away too. In 2015, Uber poached dozens of scientists from Carnegie Mellon University—a robotics and artificial intelligence powerhouse—to get its effort going.

3 Literature Review

3.1 EDGE DETECTION

Edges characterize boundaries and are therefore a problem of fundamental importance in image processing. Edges in images are areas with strong intensity contrasts – a jump in intensity from one pixel to the next. Edge detecting an image significantly reduces the amount of data and filters out useless information, while preserving the important structural properties in an image. Canny edge detection algorithm is also known as the optimal edge detector. Cranny's intentions were to enhance the many edge detectors in the image. The first criterion should have low error rate and filter out unwanted information while the useful information preserve.

The second criterion is to keep the lower variation as possible between the original image and the processed image.Third criterion removes multiple responses to an edge. Based on these criteria, the canny edge detector first smoothens the image to eliminate noise. It then finds the image gradient to highlight regions with high spatial derivatives. The algorithm then tracks along these regions and suppresses any pixel that is not at the maximum using non-maximum suppression. The gradient array is now further reduced by hysteresis to remove streaking and thinning the edges.



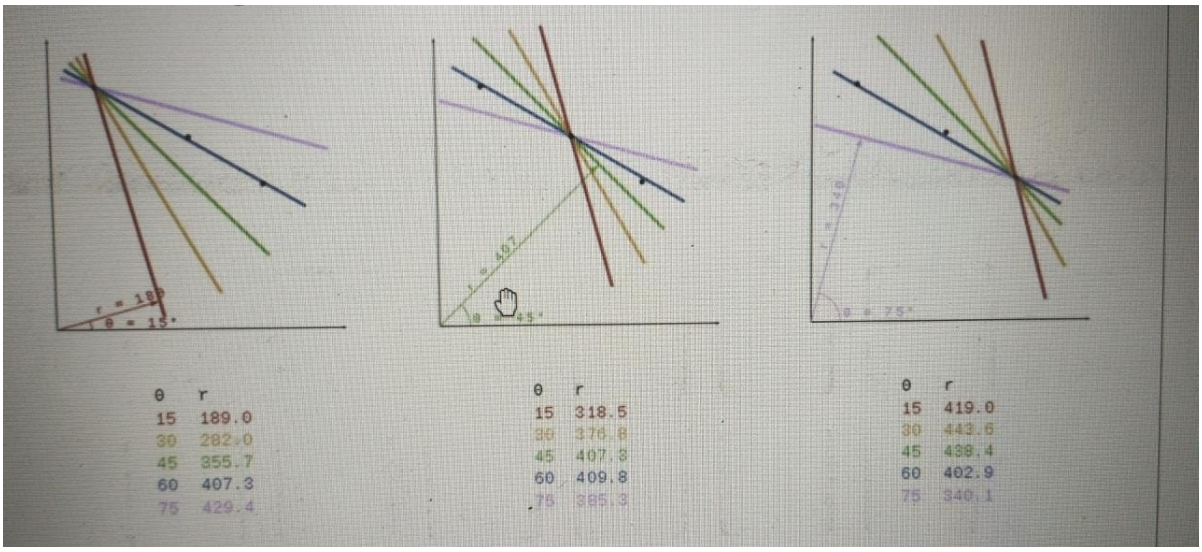
3.2 FILTER OUT NOISE

First step to Canny edge detection require some method of filter out any noise and still preserve the useful image. Convolution is a simple mathematic method to many common image-processing operators.

Convolution is performed by sliding the kernel or mask over a grey- level image. The kernel starts from the top left corner and moves through entire image within image boundaries. Each kernel position corresponds to a single output pixel.

Each pixel is multiplied with the kernel cell value and added together. The output image will have M-m+1 rows and N-n+1 column, M image rows and

N image columns, m kernel rows and n kernel columns. The output image will be smaller when compared to the original image.



4 Research Gaps

The following list summaries the suggested improvements:

I. I. Using line-segment length as a differentiator between strong line segments and weak line segments while applying the line–fitting technique.

II. More investigation needs to be done in the design of the FIR filter: trying higher orders, trying different low pass polynomials like Butterworth, Chebychev, Elliptical … etc.

III. Identification for the type of the lane (dashed or solid) is important in driving regulations, so it needs to be added.

5 Problem Statement and Objectives

I. Given an image captured from a camera attached to a vehicle moving on a road in which captured road may or may not be well levelled, or have clearly delineated edges, or some prior known patterns on it, then road detection from a single image can be applied to find the road in an image so that it could be used as a part in automation of driving system in the vehicles for moving the vehicle in correct road.

II. In this process of finding the road in the image captured by the vehicle, we can use some algorithms for vanishing point detection using Hough transform space, finding the region of interest, edge detection using canny edge detection algorithm and then road detection. We use thousands of images of different roads to train our model so that the model could detect the road which is present in the new image processed through the vehicle.

6 Methodology

Digital image processing consists of the manipulation of images using digital computers. Its use has been increasing exponentially in the last decades. Its applications range from medicine to entertainment, passing by geological processing and remote sensing. Multimedia systems, one of the pillars of the modern information society, rely heavily on digital image processing.The discipline of digital image processing is a vast one, encompassing digital signal processing techniques as well as techniques that are specific to images. An image can be regarded as a function f (x, y) of two continuous variables x and y. To be processed digitally, it has to be sampled and transformed into a matrix of numbers. Since a computer represents the numbers using finite precision, these numbers have to be quantized to be represented digitally. Digital image processing consists of the manipulation of those finite precision numbers. The processing of digital images can be divided into several classes: image enhancement, image restoration, image analysis, and image compression. In image enhancement, an image is manipulated, mostly by heuristic techniques, so that a human viewer can extract useful information from it. Image restoration techniques aim at processing corrupted images from which there is a statistical or mathematical description of the degradation so that it can be reverted. Image analysis techniques permit that an image be processed so that information can be automatically extracted from it. Examples of image analysis are image segmentation, edge extraction, and texture and motion analysis. An important characteristic of images is the huge amount of information required to represent them. Even a grey-scale image of moderate resolution, say 512 × 512, needs 512 × 512 × 8 ≈ 2 × 106 bits for its representation.

Therefore, to be practical to store and transmit digital images, one needs to perform some sort of image compression, whereby the redundancy of the images is exploited for reducing the number of bits needed in their representation. Digital image processing is to process images by computer. Digital image processing can be defined as subjecting a numerical representation of an object to a series of operations in order to obtain a desired result. Digital image processing consists of the conversion of a physical image into a corresponding digital image and the extraction of significant information from the digital image by applying various algorithms. Digital image processing mainly includes image collection, image processing, and image analysis. At its most basic level, a digital image processing system is comprised of three components, i.e., a computer system on which to process images, an image digitizer, and an image display device. Physical images are divided into small areas called pixels. The division plan used often is the rectangular sampling grid method shown in Fig. 13.6, in which an image is segmented into many horizontal lines

composed of adjacent pixels, and the value of each pixel position reflects the brightness of corresponding point on the physical Physical images cannot be directly analysed by a computer because the computer can only process digits rather than images, so an image must be converted into a digital form before processed by a computer. The conversion process is called digitization image. At each pixel position, the brightness is sampled and quantized to obtain an integer value indicating the brightness of the corresponding position in the image. After the conversion of all pixels of an image is completed, the image can be represented by a matrix of integers. Each pixel has two attributions: position and grey level. The position is determined by the two coordinates of sampling point in the scanning line namely row and column. The integer indicating the brightness of the pixel position is called grey level. Images displayed by digital matrix are called digital images, and all digital image processing is based on the digital matrix. The digital matrix is the object process f(i, j) = the grey level of pixel (i, j).On the basis of image processing, it is necessary to separate objects from images by pattern recognition technology, then to identify and classify these objects through technologies provided by statistical decision theory. Under the conditions that an image includes several objects, the pattern recognition consists of three phasesssed by a computer. The first phase includes the image segmentation and object separation. In this phase, different objects are detected and separate from other background. The second phase is the feature extraction. In this phase, objects are measured. The measuring feature is to quantitatively estimate some important features of objects, and a group of the features are combined to make up a feature vector during feature extraction. The third phase is classification. In this phase, the output is just a decision to determine which category every object belongs to. Therefore, for pattern recognition, what input are images and what output are object types and structural analysis of images. The structural analysis is a description of images in order to correctly understand and judge for the important information of images. Image processing is the application of a set of techniques and algorithms to a digital image to analyse, enhance, or optimize image characteristics such as sharpness and contrast.Most image processing techniques involve treating the image as either a signal or a matrix and applying standard signal-processing or matrix manipulation techniques, respectively, to it. A pixel or “picture element” is the smallest sample of a two-dimensional image that can be programmatically controlled. The number of pixels in an image controls the resolution of the image. The pixel value typically represents its intensity in terms of shades of grey (value 0– 255) in a grayscale image or RGB (red, green, blue, each 0–255) values in a colour image. A voxel or “volumetric pixel” is the three-dimensional counterpart of the 2D pixel. It represents a single sample on a three-dimensional image grid. Similar to pixels, the number of voxels in

a 3D representation of an image controls its resolution. The spacing between voxels depends on the type of data and its intended use. In a 3D rendering of medical images such as CT scans and MRI scans, the size of a voxel is defined by the pixel size in each image slice and the slice thickness. The value stored in a voxel may represent multiple values. In CT scans, it is often the Hounsfield unit which can then be used to identify the type of tissue represented. In MRI volumes, this may be the weighting factor (T1, T2, T2*, etc.). Image arithmetic is usually performed at pixel level and includes arithmetic as well as logical operations applied to corresponding points on two or more images of equal size. Geometric transformations can be applied to digital images for translation, rotation, scaling, and shearing, as required. Matrix transformation algorithms are typically employed in this case. For binary and grayscale images, various morphological operations such as image opening and closing, skeletonization, dilation, erosion, and so on, may also be employed for pattern matching or feature extraction.An image histogram represents the distribution of image intensity values for an input digital image. Histogram manipulation is often used to modify image contrast or for image segmentation when the range of values for the desired feature is clearly definable. Some common image processing applications are introduced as follows. Feature extraction is an area of image processing where specific characteristics within an input image are isolated using a set of algorithms. Some commonly used methods for this include contour tracing, thresholding, and template matching. Image segmentation is a common application of feature extraction which is often used with medical imaging to identify anatomical structures. Pattern and template matching is useful in applications ranging from feature extraction to image substitution. It is also used with face and character recognition and is one of the most commonly used image processing applications. There are several image processing software packages available, from freely distributed ones such as ImageJ to expensive suites such as MATLAB and Avizo which range in functionality and targeted applications. We'll discuss only a few of the commonly used ones within medical physics/clinical engineering here. The image format most commonly used in medical applications is DICOM, providing a standardized structure for medical image management and exchange between different medical applications .The 3D files are represented in the STL format.45 The most common input format is DICOM, but other image formats such as TIFF, JPEG, BMP, and raw are also supported. Output file formats differ, depending on the subsequent application, but common 3D output formats include STL, VRML, PLY, and DXF. Mimics provides a platform to bridge stacked image data to a variety of different medical engineering applications such as finite element analysis (FEA; see the next section), computer- aided design (CAD), rapid prototyping, and so on ..

7 Hardware and Software Requirements

The proposed system must be able to detect road lanes given a proper real-time driving environment. The performance will depend upon the quality of the camera as well. The proposed system due to its well-designed and easy-to-use interface can be used by both day-time and night-time drivers. Users can follow up the interface step by step for their purpose. The proposed system must be available for use to the user as and when needed provided that the user's system meets the specified requirements. The proposed system must be able to recover from failure in case of the application crashing abruptly and become ready-to-use after recovery Along with the necessary peripheral hardware, and Python 3 will be used to implement the software functionality of drowsiness detection.

7.1 Hardware Requirements:

I. Webcam

7.2 Software Requirements:

I. Python3

II. OpenCV Library

III. Dlib

IV. Huge Data-set for training and analysis

8 Conclusions

In this paper, a fast and reliable lane-lines detection and tracking technique is developed, presented thoroughly and given the name “LaneRTD”. LaneRTD uses a pipeline of well- known algorithms like Canny edge detection and Hough transform. Moreover, the pipeline uses a comprehensive lane line detection and drawing technique to produce the final output. The proposed technique needs only raw RGB images from a single CCD camera mounted behind the front windshield of the vehicle. The performance of the LaneRTD is tested and evaluated using tons of stationary images and many real-time videos. The validation results show fairly accurate and robust detection except in one scenario where complex shadow patterns exist. The measured throughput (execution time) using an affordable CPU proved that the LaneRTD is very suitable for real-time lane detection without much overhead. Therefore, the proposed technique is well suited to be used in Advanced Driving Assistance Systems (ADAS) or self-driving cars. A comprehensive discussion and analysis regarding the usefulness and the shortcomings of the proposed technique as well as suggestions for improvements and future work are presented.

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