A Lane Detection, Tracking and Recognition System for Smart Vehicles (LTRSV)

A report submitted in partial fulfilment of the requirements for

the award of the degree of

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE AND ENGINEERING

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CHAPTER I

INTRODUCTION

1.1 SYSTEM OVERVIEW

In this LTRSV Reports, It proposed a real time Lane Assist System for Intelligent Vehicles, aiming at lane detection, recognition and tracking integrated with Lane departure warning. Different segmentation algorithms are implemented, which makes the proposed system consists of two different modules, a comprehensive module which takes advantage of edge segmentation and a simplified module with MSER segmentation.

For the comprehensive module, it is worth to be mentioned that, after the detection and tracking of lanes, LTRSV system takes advantage of the parallel computation to perform lane departure warning and lane marking recognition. To the best of our knowledge, this is the first whole architecture that considers lane detection and tracking, lane departure warning and lane marking recognition systems. The comprehensive module not only helps to detect and track lanes, but also warns inattentive drivers on the nature of pavement marking, and on the potential lane departure crashes.

As a lightweight LDT system, the simplified module focuses only on lane detection and tracking, which occupies the main function of lane assist systems. Different from the comprehensive module, the advantages of using MSER segmentation for LDT system can be outlined as following:

- A relatively simple way of extracting ROI by MSER algorithm, without projective model and Inverse Perspective Mapping (IPM).
- A relatively lightweight and efficient refinement scheme without ATSL and TRM which are essential parts of comprehensive module.

1.1.1 Lane Detection

Lane detection is one of the methods which use the principle of vision-based lane detection. As the name itself indicates is a process of detecting as well as recognizing the lanes where the ground traffic circulates. For driving advanced driving assistances, the lane detection is one of the essential functions. The lane detection has become very specific term that implies the utilization of certain perceptive sensors, certain processing units, and certain algorithms to perform this functionality. The lane detection is processes which have to be effective with the following.

There are many factors which affects the lane detection. The Good quality of lane should not be affected by shadows of which can be caused by appearances of trees, buildings and other aid boards, the existences of surrounding object, the change of light condition, the dirt left on the road surface etc. It humans has still some problems in detection of road lanes marks, detection should also have to assume the curved roads instead of assuming only that the roads are straight. Balancing the image which detects the lane should assume the parallelism Figure 1 General Block diagram of proposed Research Video Acquisition SNR Improvement Object Detection Simulation Lane + Object Lane Detection 4 of both sides of the lane marking to improve the detection in the existence of noises in images. Despite of existence of many researches works on lane detection. The difficulties of lane detection always exist. So far there is no such technique that can boast of detecting lanes successfully. This can say that lanes can be visible by us humans.

1.1.2 Object Detection

Detect various moving objects such as vehicles and pedestrians, the ego motion of host vehicle is firstly estimated by A robust NGPP (near ground point projection) method. Then a novel point based moving object detection method is proposed which can detect fast motion as well as slight motion in the bird-eye image. Finally, a region-based motion compensation method is used in order to filter out the false detection results caused by the error matching points. In driving assistance systems, obstacle detection especially for moving object detection is a key component of collision avoidance. Many sensors can be used for obstacle detection, such as laser, radar and vision sensors.

In the last few years vision sensors have been more and more popular as they giving more information about the scene. Vision sensors can be divided into normal cameras with a limited view and fisheye cameras. The latter have much wider application prospect in backup aid and parking assist systems as their much larger field of view. For driving assistance systems using visual sensors, feature based object detection algorithms are often used for detecting some specific kinds of objects such as pedestrians and vehicles as explained. This kind of approach is applicable for the appearances of objects are known beforehand and not change much. In backup aid applications, all kinds of obstacles can possess potential threatens to host vehicle. So, this kind of algorithm is not suitable. For detecting all kinds of obstacle on the road, IPM (inverse perspective mapping) method is often used. The simulated results of the lane detection and object detection are collaborated in the final stage of the system which gives the expected results of the system.

1.2 IMAGE PROCESSING

Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Usually Image Processing system includes treating images as two-dimensional signals while applying already set signal processing methods to them.

It is among rapidly growing technologies today, with its applications in various aspects of a business. Image Processing forms core research area within engineering and computer science disciplines too.

Some techniques which are used in digital image processing include:

- Anisotropic diffusion.
- Hidden Markov models.
- Image editing.
- Image restoration.
- Independent component analysis.
- Linear filtering.
- Neural networks.
- Partial differential equations.

In LTRSV Reports It use Image Restoration and Linear Filtering Techniques

1.2.1 Digital Image Analysis

Digital Image Analysis or Computer Image Analysis is when a computer or electrical device automatically studies an image to obtain useful information from it.

Note that the device is often a computer but may also be an electrical circuit, a digital camera or a mobile phone. It involves the fields of computer or machine vision, and medical imaging, and makes heavy use of pattern recognition, digital geometry, and signal processing. This field of computer science developed in the 1950s at academic institutions such as the MIT A.I. Lab, originally as a branch of artificial intelligence and robotics.

1.2.2 Image-Understanding Systems (IUS)

Image-understanding systems include three levels of abstraction as follows: low level includes image primitives such as edges, texture elements, or regions; intermediate level includes boundaries, surfaces and volumes; and high level includes objects, scenes, or events. Many of these requirements are entirely topics for further research. The representational requirements in the designing of IUS for these levels are: representation of prototypical concepts, concept organization, spatial knowledge, temporal knowledge, scaling, and description by comparison and differentiation. While inference refers to the process of deriving new, not explicitly represented facts from currently known facts, control refers to the process that selects which of the many inference, search, and matching techniques should be applied at a particular stage of processing. Inference and control requirements for IUS are: search and hypothesis activation, matching and hypothesis testing, generation and use of expectations, change and focus of attention, certainty and strength of belief, inference and goal satisfaction.

1.2.3 Recognition

The classical problem in computer vision, image processing, and machine vision is that of determining whether or not the image data contains some specific object, feature, or activity. Different varieties of the recognition problem are described in the literature

- **Object recognition** (**object classification**)

It is one or several pre-specified or learned objects or object classes can be recognized, usually together with their 2D positions in the image or 3D poses in the scene. Blippar, Google Goggles and LikeThat provide stand-alone programs that illustrate this functionality.

- **Identification**

In this, an individual instance of an object is recognized. Examples include identification of a specific person's face or fingerprint, identification of handwritten digits, or identification of a specific vehicle.

- **Detection**

The image data are scanned for a specific condition. Examples include detection of possible abnormal cells or tissues in medical images or detection of a vehicle in an automatic road toll system. Detection based on relatively simple and fast computations is sometimes used for finding smaller regions of interesting image data which can be further analysed by more computationally demanding techniques to produce a correct interpretation.

Currently, the best algorithms for such tasks are based on convolutional neural networks. An illustration of their capabilities is given by the ImageNet Large Scale Visual Recognition Challenge; this is a benchmark in object classification and detection, with millions of images and hundreds of object classes. Performance of convolutional neural networks, on the ImageNet tests, is now close to that of humans The best algorithms still struggle with objects that are small or thin, such as a small ant on a stem of a flower or a person holding a quill in their hand. They also have trouble with images that have been distorted with filters (an increasingly common phenomenon with modern digital cameras). By contrast, those kinds of images rarely trouble humans. Humans, however, tend to have trouble with other issues. For example, they are not good at classifying objects into fine-grained classes, such as the particular breed of dog or species of bird, whereas convolutional neural networks handle this with ease.

1.3 RELEVANT WORK

1.3.1 Pre-Processing

Pre-processing is always mandatory as the initial stage of image processing. The purpose of pre-processing stage is to enhance the input image in order to increase the likelihood of the successful delivery of areas with useful information to subsequent stages. Conventionally, pre-processing consists of image smoothing and segmentation, which will be introduced as follows. Additionally, for the purpose of lane Detection, extraction of Region of Interest (ROI) and Inverse Perspective Mapping (IPM) are usually added into pre-processing steps.

1.3.2 Image Smoothing

Smoothing is often used to reduce noise within an image or to produce a less pixelated image. Most smoothing methods are based on low pass filters. The most

Classification		Remarks
Image Smoothing	**Median Filter**	Median filter replaces every pixel value with the median of its neighbouring entries
	Gaussian Filter	uses 1D Gaussian filter exceptionally of all
	Other Filters	Including dilation and erosion filter, 2D high-pass filter and a temporal blurring
ROI	**Vanishing Point**	Vanishing points need to be detected and updated in real time, in order to provide accurate ROI for every frame
	Perspective Analysis and Projective Model	Sometimes this method serves to detect
	Sub-sampling	Different sub-sampling strategies need to be applied respectively for rural and urban areas
IPM		IPM refers to inverse perspective mapping, which transforms image view into birds' eye view Canny, Sobel and Preweitt
Segmentation	**Edge based Segmentation**	Included in the literature Relevant experiment on the selection of edge detectors
	Colour-based Segmentation	Detection colour-based segmentation has to be done in different colour spaces other than RGB.
	MSER-based	improvement of MSER Segmentation

Table 1: Classification for Methods of Pre-processing Stage

basic of filtering operations is called "low-pass". A low-pass filter, also called a "blurring" or "smoothing" filter, averages out rapid changes in intensity. The simplest low-pass filter just calculates the average of a pixel and all of its eight immediate neighbours. The result replaces the original value of the pixel. The process is repeated for every pixel in the image. This low-pass filtered image looks a lot blurrier. But why would you want a blurrier image? Often images can be noisy – no matter how good the camera is, it always adds an amount of” snow” into the image. The statistical nature of light itself also contributes noise into the image.

Noise always changes rapidly from pixel to pixel because each pixel generates its own independent noise. The image from the telescope isn't "uncorrelated" in this fashion because real images are spread over many pixels. So the low-pass filter affects the noise more than it does the image. By suppressing the noise, gradual changes can be seen that were invisible before. Therefore, a low-pass filter can sometimes be used to bring out faint details that were smothered by noise.

1.3.3 Region of Interest (ROI)

The extraction of region of interest (ROI) is an important task of pre-processing stage, aiming at reducing the computational cost due to the processing time. It is unnecessary to process the entire pixels of images. Computation should be focused on regions which contain important information (as the rectangular in Figure2.1, which contains lane marking pixels). To get the ROI, three main approaches can be found in literature, which are vanishing point detection, perspective analysis and projective model, and sub-sampling.

1.3.4 Inverse Perspective Map (IPM)

After the generation of ROI, inverse perspective mapping (IPM) is usually deployed on the extracted area. This may be realized by remapping each pixel towards a different position, usually birds’ eye view. Experimentally, it has already been proved that Lane detection within the image given by IPM performs much better than methods without IPM. Many researchers have used IPM to transform an image from a real-world plane to a bird’s eye view. By eliminating the perspective effect, the desired lane marking candidates present in the form of straight and parallel lines in the re-mapped image. Moreover, noisy information can be removed since the remapped images put main focus on the road surface and ROI.

1.3.5 Segmentation

It is noticeable that, for the sake of refinement, proper projective model can be used to transform between normal view and birds' eye view. Thus, in the comprehensive module of the proposed system, inverse perspective map is transformed into normal image plane after Hough transform, by using proper projective model.

To prepare images for detection stage, segmentation can be accomplished by extracting certain features from the input image. Colour and edge are two main features considered for lane detection segmentation, the major problem with edge segmentation is that a number of thresholds need to be adjusted, and the adjustments depend only on the testing, while colour segmentation techniques are sensitive to lighting conditions, especially those occurring on sunny days.

1.4 DETECTION STAGE

The second stage, i.e., detection, extracts lane markings from the ROI using feature extraction methods and refinement approaches. Three main feature extraction approaches can be categorized in the literature: edge-based methods, colour-based methods and hybrid (edge and colour) methods.

1.4.1 Facial Expression Detection

Before It can start the lane detection process first It need to detect the driver facial expression because if the driver may be feel sleepy at that time this facial expression will detect and alert the driver with voice assistant otherwise there is a chance to occur accidents and these always keep analyse the facial expressions of the driver until he reaches the destination for facial expression detection It can use Facial Expression Recognition Using Support Vector Machines

1.4.2 Feature Extraction Based on Edges

Hough transform is the most commonly used edge extractor for this application. However, Hough transform has some drawbacks such as its computational complexity and the inevitably high false positive rate. To cope with this problem, variants of Hough Transform are used. Probabilistic Hough transform (PHT) and adaptive random Hough transform (ARHT) are both effective approaches in terms of reducing false positive rate. PHT has been used while ARHT performs well. Especially, Hota et al. shows some improved detection results by using the

Probabilistic Hough Transform (PHT) followed by refinement based on clustering regression algorithm. Because of the importance of PHT, which is the core detection method of this LTRSV Reports.

Another important edge-based method is introduced where the authors compute the image with the Inverse Fourier Transform, and choose diagonally dominant edges in the frequency domain to be lane markings.

Classification		**Remarks**
Edge-based Detection Method	**Hough Transform**	Including SHT, PHT and ARHT
	Steerable &Filter Frequency Domain	Effective for smooth road surface, e.g. highway IFT is used to choose diagonally dominant edges The desired feature is usually enhanced based on colour segmentation
Hybrid Detection Method		Taking both colour and edge information into account
Other Detection Method		Including using wave radar,"slice" modelling and particle filter for both tracking & detection
Refinement Method	**RANSAC**	RANSAC refers to random sample consensus, which usually cooperate with spline
	Spline Fitting	Different from others using B-Spline, uses cubic spline
	Quadratic Model	Including hyperbolic and parabolic model
	Least Square	The least square estimation (LSE) fits the data points to a line on the inlier

Table 1.1: Classification for Methods of Detection Stage

1.4.3 Tracking Stage

To enable the following of lane marking over time, a tracking stage is usually incorporated. This stage has the ability to decrease false detections and to predict future lane markings positioning in the image. A prior knowledge of the road geometric properties allows lane tracking to put confidently constraints on the possible location and orientation of lane markings for a new frame. Results of the detection on previous frames should be fed into the current frame as the main cue, to increase the accuracy of following steps. Some simple tracking methods (not involving a specific tracking algorithm) can be quite straightforward. By directly taking the position of vanishing point into account, Fardi et al. track the road border after detecting straight lines with Hough transform.

Classification	***Remarks***
Kalman Filter	Use Extended Kalman Filter
Particle Filter	Methods differ from each other in terms of different measurement
Other methods	Only considers the vanishing point position

Table 1.2: Classification for Lane Tracking Methods

1.4.4 Departure Warning

When a car is departing from the left side of a lane to the right side, visually for the driver, both of the lane markings move to left; on the other hand, both lane markings can appear to move to right if the car is moving towards the left side of a lane. Based on this observation, the detection scheme for lane changing can be formulated with respect to three information: vanishing point position, lateral offset, optical centre of CCD.

Classification	***Remarks***
Vanishing Point	The vanishing point position needs to be compared with previous frames
Lateral Offset	Lateral offset of lane markings need to be tracked in real time
Position of Origin Point	Optical centre of CCD and vehicle origin in world plane are considered for and respectively.

Table 1.3: Classification for Departure Warning Methods

1.4.5 Lane Marking Recognition

Recognition of lane markings is another very challenging task. It is notable that, the differentiation between lane marking colours and types are barely suggested in the literature, nor in the commercial systems. To recognize yellow and white lines on the road, there existed some patents on lane colour recognition. Besides, when it comes to lane type recognition (distinguish between solid and dashed lane markings), Satzoda et al. determines the lane type by monitoring the lane marking occurrence within a given number of frames. If the ratio of the number of frames containing lane markings over the entire number of frames is equal or greater than a threshold, the lane markings can be regarded as solid lines, otherwise dashed lines.

Although marking recognition is not as important as other components of DAS (Driving Assistant System), it is of great significance for Autonomous Driving Systems. In this LTRSV Reports, an algorithm that recognizes and distinguishes between both lane marking types (dashed or solid) and colours (yellow or white) is proposed in order to provide possible recognition options for autonomous driving.

1.5 MOTIVATION OF THE RESEARCH WORK

The road accidents are the main causes for the sudden death in this world. Even though It have many good and advanced techniques in this world, It are left over with something to make it better than before. There are chances from different angles. The road lane detection and object detection is also the other important way that It can improve the safety in roads.

Vehicle crashes remain the leading cause of accident death and injuries in Malaysia and Asian countries claiming tens of thousands of lives and injuring millions of people each year. Most of these transportation deaths and injuries occur on the nation’s highways. The United Nations has ranked Malaysia 30th among countries with the highest number of fatal road accidents, registering an average of 4.5 deaths per 10,000 registered vehicles. It is not only limited to one country most of the traffic congested countries like U.S, India, other Asian countries have many calculations of deaths and injuries. In intelligent transportation systems with improved technologies, the vehicles are made more sophisticated with better infrastructure. But the way to move on the roads by means of lane and object detection aspect is neglected by many automobile companies and the ways to improve these aspects does not change from many years. Lane detection and object detection plays vital role for accidents.

For human vision and human intelligence, the task of lane detection and object detection changes due to variations in the road conditions. Sometimes it is very easy to detect with the human eyes but in some conditions due to externals effects the human intelligent have detection problems. Due too many external conditions that appears for the lane detection and obstacle detection which may lead for the accidents. They are conditions such as appearances such as change of Light conditions at Night vision, shadows caused by building and trees, existence of surrounding objects, Mismatching of lanes, and lane changes in curved roads. So in LTRSV research It provide the way to improve the lane detection and object detection in vehicles is import ants then rest of the other categories that may avoid the many road accidents. Lane should have to be detected clearly even with the external factors in consideration.

The object detection will provide driving person confidences even in the different lighting and different environments situations by improved techniques to detect the objects. Thought you can provide the safety in roads to achieve a safer environment and in traffic congested conditions. In LTRSV Reports It have motivated to improve the intelligent vehicle assistances with improving the SNR quality for lane and object detections as an important aspect to avoid the road accidents and improving the safety on roads .

1.6 PROBLEM STATEMENT

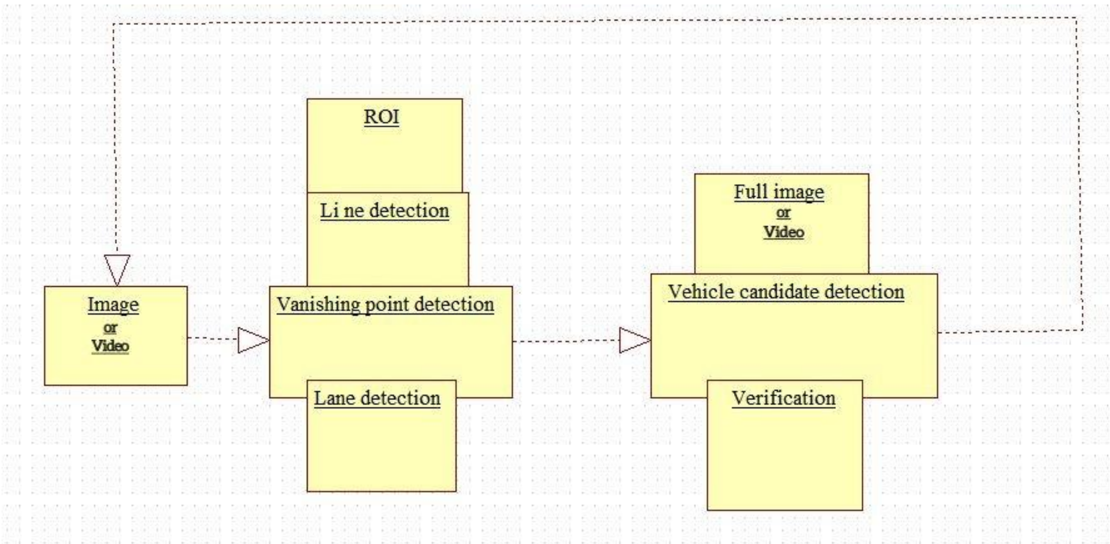
Many people die each year in roadway departure crashes caused by driver inattention. Lane detection systems are useful in avoiding these accidents as safety is the main purpose of these systems. Such systems have the goal to detect the lane marks and to warn the driver in case the vehicle has a tendency to depart from the lane . A lane detection system is an important element of many intelligent transport systems. Lane detection is a challenging task because of the varying road conditions that one can come across while driving. In the past few years, numerous approaches for lane detection were proposed and successfully demonstrated.

Traffic problems are becoming more and more serious in most countries. To reduce traffic accidents and improve the vehicle ride comfort side impact collision is one of the common types of car accident. This mostly happens when vehicles change their lanes, or merge into the highway. These accidents take place when the approaching vehicle drives into the blind spot of the rear view mirrors or the driver gets distracted. Lateral vehicle detection and distance measurement will help the driver to increase the driving safety.

1.7 OBJECTIVE

The objective of this LTRSV Report is to avoid accidental deaths and provide a better safety on roads, by use of advanced technologies in driving assistances system. The clear idea of the important aims and objectives of this LTRSV Report is

Explained with the flow diagram



1.8 SOFTWARE AND HARDWARE REQUIREMENTS

1.8.1 Python 3

Python was developed by Guido van Rossum in early 1990's and its latest version is 3.7.1, It can simply call it as Python3. Python 3.0 was released in 2008. and is interpreted language i.e. it's not compiled and the interpreter will check the code line by line.

Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. Python is a MUST for students and working professionals to become a great Software Engineer specially when they are working in Web Development Domain. In the below some of the key advantages of learning Python:

- **Python is Interpreted** − Python is processed at runtime by the interpreter.

You do not need to compile your program before executing it. This is similar to PERL and PHP.

- **Python is Interactive** − You can actually sit at a Python prompt and interact with the interpreter directly to write your programs.
- **Python is Object-Oriented** − Python supports Object-Oriented style or technique of programming that encapsulates code within objects.
- **Python is a Beginner's Language** − Python is a great language for the beginner-level programmers and supports the development of a wide range of applications from simple text processing to WWW browsers to games.

1.8.2 Opencv4

OpenCV was started at Intel in 1999 by **Gary Bradsky**, and the first release came out in 2000. **Vadim Pisarevsky** joined Gary Bradsky to manage Intel's Russian software OpenCV team. In 2005, OpenCV was used on Stanley, the vehicle that won the 2005 DARPA Grand Challenge. Later, its active development continued under the support of Willow Garage with Gary Bradsky and Vadim Pisarevsky leading the LTRSV Reports. OpenCV now supports a multitude of algorithms related to Computer Vision and Machine Learning and is expanding day by day.

OpenCV supports a wide variety of programming languages such as C++, Python, Java, etc., and is available on different platforms including Windows, Linux, OS X, Android, and iOS. Interfaces for high-speed GPU operations based on CUDA and OpenCL are also under active development. OpenCV-Python is the Python API for OpenCV, combining the best qualities of the OpenCV C++ API and the Python language.

1.8.3 Numpy

NumPy is a general-purpose array-processing package. It provides a high-performance multidimensional array object, and tools for working with these arrays. Numpy is the fundamental package for scientific computing with Python. It contains among other things:

- a powerful N-dimensional array object
- sophisticated (broadcasting) functions

- tools for integrating C/C++ and Fortran code
- useful linear algebra, Fourier transform, and random number capabilities

Besides its obvious scientific uses, NumPy can also be used as an efficient multi-dimensional container of generic data. Arbitrary data-types can be defined using Numpy which allows NumPy to seamlessly and speedily integrate with a wide variety of databases.

1.8.4 PlaySound

The playsound module contains only one thing - the function playsound.It requires one argument - the path to the file with the sound you'd like to play. This may be a local file, or a URL.There's an optional second argument, block, which is set to True by default. Setting it to False makes the function run asynchronously. On Windows, uses windll.winmm. WAVE and MP3 have been tested and are known to work. Other file formats may work as well.On OS X, uses AppKit.NSSound. WAVE and MP3 have been tested and are known to work. In general, anything QuickTime can play, playsound should be able to play, for OS X.On Linux, uses GStreamer. Known to work on Ubuntu 14.04 and ElementaryOS Loki. Support for the block argument is currently not implemented.

1.8.5 Matplotlib

Matplotlib is a popular Python library that can be used to create data visualizations quite easily. It is probably the single most used Python package for 2D-graphics along with limited support for 3D-graphics. It provides both, a very quick way to visualize data from Python and publication-quality figures in many formats. Also, It was designed from the beginning to serve two purposes:

- Allow for interactive, cross-platform control of figures and plots
- Make it easy to produce static vector graphics files without the need for any GUIs.

1.8.6 Camera

A camera is a device that takes pictures (photographs). It uses film or electronics to make a picture of something. It is a tool of photography. A lens makes the image that the film or electronics "sees". A camera that takes one picture at a time is sometimes called a still camera. A camera that can take pictures that seem to move is called a movie camera. If it can take videos it is called a video camera or a camcorder. The majority of camera’s are on a phone. This is called a "Camera phone".

1.9 OUTCOME OF THE PROJECT

To provide safety and avoid accidents by detecting road lanes. This approach to detect lanes and track multiple vehicles for lane change support around the test vehicle Experimental results show its robustness in the cases of complex environment conditions.

In the methodology, It made use of the OpenCV library and its functions such as the Canny Function through which It achieved edge detection. Then It prepared a mask of zero intensity and mapped LTRSV region of interest by performing the bitwise operation. Then It used the Hough Transform technique that detected the straight lines in the image and identified the lane lines. It made use of the polar coordinates since the Cartesian coordinates don’t give us an appropriate slope of vertical and horizontal lines. Finally, It combined the lane image with zero-intensity image to show lane lines.

1.10 CONCLUSION

In these LTRSV report it proposed the approach to detect lanes, detect and track multiple vehicles for lane change support around the test vehicle. For lane detection, to detect lane in real-time, It use EDLines algorithm which can detect line segments between 10ms and 20ms and EDLines was applied to ROI. With frontal view, LTRSVdetects three lane areas, frontal lane, left-side lane. Moreover, both rear-side lanes were detected with two rear-side cameras by using LTRSV method.

Based on the detected lane areas combined with horizontal edge feature of vehicles, vehicle candidates are detected in each lane, and then the vertical edge are used to verify the vehicle candidates. With wrong detection cases, It use Kalman filter to predict and track vehicle target. Time of vehicle detection is about 30ms, total time for lane detection and vehicle detection are about 43ms. From the outcome of experiments LTRSV method obtains the goal in support lane change and warning.

CHAPTER II

LITERATURE SURVEY

2.1 INTRODUCTION

The literature survey discussed about few reference articles which is related to LTRSV Reports. These articles are used to identify what it is, how it is implemented, how it is related to LTRSV work and also identifying which algorithm has been used. Finally identify the merits and demerits of those articles. The identified demerits must be overcome. Literature survey is helpful to get the knowledge about domain of your application.

2.2 LANE IMAGE PRE-PROCESSING PROCEDURE

According to Aaron klug, to improve lane detection accuracy, different image pre-processing techniques are used by many researchers. These techniques are transformation of an image into hue, saturation, value (HSV) and applying morphological filters to reduce noise,use of a Chapter 2 Literature Survey An Improved Pedestrian Detection and Lane Departure warning System for Advanced Driver Assistance 18 Canny edge detector that produces single pixel wide edges histogram equalization, filtering, clustering and poly line extraction grayscale conversion and applying Gaussian low pass filter to remove noise smoothing and spitting of an image. In this article, the 5-PLSF is introduced to increase the contrast level of lane image. This function provides better performance than the above mentioned methods because it absolutely improves the contrast level of only lane markings and road surface which is a typical region of interest in lane images. This approach also reduces the computational time in comparison with other image pre-processing methods. Secondly, this function shows the robust performance to different lane colors and hence helps to increase the lane detection accuracy under various illuminating conditions[1].

2.3 REAL TIME WARNING SYSTEM FOR INTELLIGENT VEHICLES

According to C.Y. Lin et al he proposed these methodologies for aiming attempts to propose an advanced design of driver assistance system which can provide the driver advisable information about the adjacent lanes and approaching lateral vehicles. The detection of lane lines is implemented with methods based on image processing techniques. The candidates for lateral vehicle are explored with lane-based transformation, and each one is verified with the characteristics of its length, width, time duration, and height. Finally, the distances of lateral vehicles are estimated with the well-trained recurrent functional neuro-fuzzy network. It advanced than the old lane detection model Improves reliability and accuracy. Drawbacks are Scope for more improvement in Completion time and Response time for assistance[2].

2.4 ROAD LANE SEGMENTATION USING DYNAMIC PROGRAMMING FOR ACTIVE SAFETY VEHICLES

According to D. J. Kang and M. H. Jung Officially they were first persons to introduce these systems for Nissan Vision-based systems for finding road lanes have to operate robustly under a wide variety of environmental conditions including large amount of scene clutters. This article presents a method to find the lane boundaries by combining a local line extraction method and dynamic programming. The line extractor obtains an initial position of road lane boundaries from the noisy edge fragments. Then, dynamic programming improves the initial approximation to an accurate configuration of lane boundaries. The main advantage is “It avoids the major accidents on roads”. Drawback is “It only effectively works on straight roads”[3].

2.5 GRADIENT ENHANCING FOR ILLUMINATION-ROBUST LANE DETECTION

According to Hunjae Yoo; Ukil Yang; Kwanghoon Sohn they proposed Lane detection is important in many advanced driver-assistance systems (ADAS). Vision-based lane detection algorithms are widely used and generally use gradient information as a lane feature. However, gradient values between lanes and roads vary with illumination change, which degrades the performance of lane detection systems. In this article, It propose a gradient-enhancing conversion method for illumination-robust lane detection. LTRSV proposed gradient-enhancing conversion method produces a new grey-level image from an RGB colour image based on linear discriminant analysis. The converted images have large gradients at lane boundaries. To deal with illumination changes, the grey-level conversion vector is dynamically updated. In addition, It propose a novel lane detection algorithm, which uses the proposed conversion method, adaptive canny edge detector, Hough transform, and curve model fitting method. It performed several experiments in various illumination environments and confirmed that the gradient is maximized at lane boundaries on the road. The detection rate of the proposed lane detection algorithm averages 96% and is greater than 93% in very poor environments. Improves completion time, response time by 8.49% and 5% when compared to above method Scope for more improvement in Response time[4].

2.6 AN IMPROVED LANE DETECTION BASED ON HOUGH TRANSFORM

According to Hyunhee Park, he implemented This study proposes a lane detection method based on expressway driving videos through a computer vision-based image processing system without using sensors. Both straight and curved sections can occur on a road, and thus, lanes must be detected by quickly determining such sections. The proposed method detects straight and curved sections that are estimated to be lanes using the Hough transform. When lanes are detected from actual images, the scope of left and right lanes is limited to reduce computational load. In this article, It propose a lane-detection algorithm using the colour space and a stepwise algorithm for accurate lane detection. To verify the proposed algorithms, It developed a small self-driving vehicle model using a TX-2 board. The experiment results when applying the proposed Hough transform algorithm and lane-detection algorithm using the colour space show that the lane detection rate of vehicles driving on curves at high speed is approximately 96%. Through the extensive simulation results, the proposed algorithm to vehicle black boxes or autonomous driving will help prevent lane departure and reduce accident rates[5].

2.7 CO-OPERATIVE COLLISION AVOIDANCE AT INTERSECTIONS

According to Michael R.Hafner In this article, It employ the techniques, which lead to linear complexity algorithms that are implementable in real-time applications. Furthermore, the results, as opposed to the others, guarantee safety in the presence of imperfect state information, due, for example, to sensor noise or communication delays, and only need a coarse model of the vehicle dynamics. It focus on a two-vehicle collision avoidance scenario at intersections and develop a decentralized control algorithm that uses V2V communication to determine whether automatic control is needed to prevent a collision. It prevent a collision through automatic control by only actuating the brake and throttle, but not steering, and assuming that drivers follow nominal paths as established by the driving lanes.

In LTRSV intersection collision avoidance (ICA) application, the drivers retain full control of the vehicle until the system configuration hits the capture set. At this point, a control action is necessary to prevent a collision, and automatic throttle or brake is applied to both vehicles in a coordinated fashion so that one vehicle enters the intersection only after the other has exited. After the crash has been prevented, the driver regains control of the brake and throttle. It report on the implementation of LTRSV algorithms on two instrumented Lexus IS 250 test vehicles engaged in a collision avoidance scenario at a test intersection at the Toyota Technical Center, Ann Arbor, MI, US[6].

2.8 AUTOMATED ROAD LANE DETECTION FOR INTELLIGENT VEHICLES

According to Saha, Anik, Dipanjan Das Roy, Tauhidul Alam, and Kaushik Deb they proposed Automated road lane detection is the crucial part of vision-based driver assistance system of intelligent vehicles. This driver assistance system reduces the road accidents, enhances safety and improves the traffic conditions. In this article, we present an algorithm for detecting marks of road lane and road boundary with a view to the smart navigation of intelligent vehicles. Initially, it converts the RGB road scene image into grey image and employs the flood-fill algorithm to label the connected components of that grey image. Afterwards, the largest connected component which is the road region is extracted from the labeled image using maximum width and no. of pixels. Eventually, the outside region is subtracted and the marks or road lane and road boundary are extracted from connected components.

The experimental results show the effectiveness of the proposed algorithm on both straight and slightly curved road scene images under different day light conditions and the presence of shadows on the roads. An automated road lane detection algorithm on images taken from an intelligent vehicle is proposed in this article. The algorithm starts with the conversion of colour (RGB) road scene image to grayscale image. The flood-fill algorithm is used to label the connected components of grayscale image.

The largest connected component is extracted from labeled image subsequently. Finally, the unwanted region of road scene image is subtracted and the extracted connected component is filtered to detect white marks of road lane and road boundary. The algorithm is tested on a good number of road scene images. These images are taken from straight and slightly curved road under different day light and occlusion (of vehicles and people) conditions. Experimental results show that the algorithm achieves good accuracy despite the shadow conditions of road. However, the road lane detection algorithm still has some problems such as critical shadow condition of the image and colour of road lanes other than white. Therefore, future work will be the improvement of the algorithm to overcome these problems[7].

2.9 AN OBJECT TRACKING ALGORITHM FOR 3D RANGE DATA USING MOTION AND SURFACE ESTIMATION

According to Shuqing Zeng he Given a series of point sets sampled from a rigid surface by a 3-D rangefinder, It study the problem of estimating the motion and surface structure of a dynamic object. This target tracking problem with 3-D data can be formulated as maximizing the likelihood of the data (the scan map) and the Gaussian mixture model (GMM; object model up to the previous time step). It choose the prior for the object model from the conjugate distribution family of the GMM to yield a trackable posterior distribution for the object model. This GMM-based nonparametric model can be indexed by a hash lookup table, and It show that the method's complexity linearly scales with the number of scan points. Quantitative performance evaluation demonstrates that the proposed method substantially outperforms others. Results of road tests in divided freeway and urban scenes show the accuracy and robustness of the system, which can enable many vehicle active-safety and driver-assistance applications. The main advantage is using 3D merit but it takes more time to rendering so it was a main drawback[8].

2.10 ADVANCED VOICE ASSISTED ROAD LANE DETECTION BASED ON HOUGH TRANSFORM

According to Jay Hoon Jung, Yousun Shin, YoungMin Kwon they implemented an advanced Lane detecting algorithm. For vehicles to be able to drive by hearing voice alerts to the driver, they need to understand their surrounding world like human, so driver can navigate their way in streets, pause at stop signs and traffic lights, and avoid hitting obstacles such as other cars and pedestrians. Based on the problems encountered in detecting objects by vehicles an effort has been made to demonstrate lane detection using OpenCV library. The reason and procedure for choosing grey scale instead of colour, detecting edges in an image, selecting region of interest, applying Hough Transform and choosing polar coordinates over Cartesian coordinates since the Cartesian coordinates don't give us an appropriate slope of vertical and horizontal lines. Finally, It combined the lane image with our zero-intensity image to show lane lines. The proposed algorithm works in an average of 43 ms for each frame with resolution on a 3.30 GHz Intel CPU.

Safety and decline of road traffic accidents remain important issues of autonomous driving. Statistics show that unintended lane departure is a leading cause of worldwide motor vehicle collisions, making lane detection the most promising and challenge task for self-driving. Today, numerous groups are combining deep learning techniques with computer vision problems to solve self-driving problems. In this article, a Global Convolution Networks (GCN) model is used to address both classification and localization issues for semantic segmentation of lane. It are using colour-based segmentation is presented and the usability of the model is evaluated. A residual-based boundary refinement and Adam optimization is also used to achieve state-of-art performance. As normal cars could not afford GPUs on the car, and training session for a particular road could be shared by several cars. It propose a framework to get it work in real world. It build a real time video transfer system to get video from the car, get the model trained in edge server (which is equipped with GPUs), and send the trained model back to the car[9].

2.11 OVERVIEW OF LANE DETECTION TECHNIQUES

For lane detection Wang, Teoh and Shen [1] proposed B-Snake method and achieved efficient tracking. Chi-Feng Wu [2] used fan-scanning detection method, but has the limitation of less accuracy. Chunyang Mu [9] used piecewise fitting for lane detection, but suffers from more false alarms. shen obtained good lane detection results using local gradient features, but this approach shows poor performance in shadows and gives more false alarms. Hough transform (HT) is used to detect any arbitrary shape and shows robust performance in different conditions [2]. In this article Hough transform is used to detect lane lines extracted from the binary image. Computational complexity of the Hough transform is optimum [9]. So this method is selected for identifying lane boundaries in the proposed algorithm used the Illuminant Invariance technique for road detection. The proposed algorithm works with still images and does not depend on either road shape or temporal restrictions. This study shows that the method is robust to shadows and lighting changes. Also, the proposed algorithm provides the highest performance when compared with hue–saturation–intensity (HSI)-based algorithms. But the needful condition for this algorithm is camera calibration, i.e. an intrinsic parameter of the camera, i.e., the invariant direction, must be provided.

2.12 LANE DETECTION PERFORMANCE IMPROVEMENT FOR STRAIGHT ROADS

F. Mariut et.al (2012) [10] proposed an algorithm that automatically emphasizes the lane marks and recognizes them from digital images, by the use of Hough transform. This method also detects lane mark's characteristics and has the ability to determine the travelling direction. A technique that extracts the inner margin of the lane is used to ensure the right detection of the lane mark. The algorithm works very efficiently for straight roads but fails in some cases of curved roads.A vision-based lane departure warning system. The main goal of this model was to implement an image processing algorithm for detecting lanes on the road and give a textual warning on departure from the lane. The lane departure decision making is based on distance between lanes and the center of the bottom in captured image coordinate, which needed less parameters. The lane detection performance has been improved by making use of Hybrid median filter with modified Hough transform, compared to the usual method of using Hough transform. The model proved to be efficient and feasible as compared to other systems

S.No	Author and year	QoS metrics	Proposed Approach	Comments /merits	Demerits
1	Aaron Klug[1]	Cost	Lane image pre-processing Procedure	Reduces the computational time	Sometimes background is not clear
2	C. Y. Lin et al.2010[2]	Cost	Real-time mark-on-windshield warning system for intelligent vehicles	The detection of lane lines is implemented with methods based on image processing techniques The candidates for lateral vehicle are explored with lane-based transformation, It improves latency	This proposed method can be applied for specific purpose only
3	D. J. Kang and M. H. Jung,2003 [3]	Cost	Road lane segmentation using dynamic programming for active safety vehicles	Developed for avoiding accidents	It effectively worked only on straight lines
4	F. Mariut et.al (2012) [4]	Cost	Lane detection performance improvement for straight roads	has the ability to determine the travelling direction	fails in some cases of curved roads
5	Hunjae Yoo; Ukil Kwanghoon Sohn 2013 [5]	Cost	Gradient-Enhancing Conversion for Illumination-Robust Lane Detection," in Intelligent Transportation Systems	Improves completion time, response time by 8.49% and 5%	Scope for more improvement in Response time
6	Hyunhee Park2015 [6]	Expensive	Lane Detection for Autonomous vehicles	Fully Automated	Some time it can’t possible to detect
7	Jay Hoon Jung, YoungMin Kwon 2019[7]	Cost & Response Time	Advanced voice Assisted road lane detection based on Hough Transform	Semi Automated & voice assistance	Response time
8	Michael R. Hafner	Cost	Cooperative Collision	It focus on a two-vehicle collision	sometimes peer to peer

	2009[8]		Avoidance at Intersections	avoidance scenario at intersections and develop a decentralized control algorithm that usesV2V communication to determine whether automatic control is needed to prevent a collision.	connections are violated
9	Shuqing Zeng 2011[9]	Cost	An Object-Tracking Algorithm for 3-D Range Data Using Motion and Surface Estimation	Using 3D range estimation	It takes more time for rendering
10	Saha, Anik, Dipanjan Das Roy, Tauhidul Alam, and Kaushik De 2012[10]	Cost	Automated Road Lane Detection for Intelligent Vehicles	Lane coloration has become popular in real time vehicular ad-hoc networks (VANETs).	sometimes peer to peer connections are violated
11	Wang, Teoh and Shen [11]	Cost	Overview of lane detection techniques	Detect any arbitrary shape and shows robust performance	shows poor performance in shadows

Table 2.12: Comparison of Lane detection techniques

2.13 CONCLUSION

So far It discussed up to Basics of Image processing, challenges and issues in lane detection, motivation, problem statement are discussed in Chapter 1. Rest of the LTRSV Reports is organized as follows: Literature review on road lane detection and Comparison of different lane detection technique methods are presented in Chapter 2 and other chapters are discussed in future sessions.

REFERENCES

[1] C. Y. Lin et al., “Real-time mark-on-windshield warning system for intelligent vehicles,” Transactions of the Canadian Society for Mechanical Engineering, vol.36, no. 1, 2012, pp. 97-112.

[2] A. M.A. Soliman et al., “Fuzzy-skyhook control for active suspension systems applied to a full vehicle model,” International Journal of Engineering and Technology Innovation, vol. 2, no. 2, 2012, pp. 85-96.

[3] Y. He et al., “Color-based road detection in urban traffic scenes,” IEEE Transaction on Intelligent
Transportation System, vol. 5, no. 4, 2004, pp. 309-318.

[4] D. J. Kang and M. H. Jung, “Road lane segmentation using dynamic programming for active safety vehicles,” Pattern Recognition Letters, vol. ,no. 16, 2003, pp.3177-3185.

[5] N. Benmansour et al., “Stereovision-based 3D lane detection system: a model driven approach,” 11th International IEEE Conference on Intelligent Transportation System, Beijing, China, 2008, pp. 182-188.

[6] A. Assidiq et al., “Real time lane detection for autonomous vehicles,” International Conference on Computer and Communication Engineering, Kuala Lumpur, Malaysia, 2008, pp. 82-88.

[7] M. Bahgat, “A simple implementation for unmarked road tracking,” The 14th IEEE Mediterranean Electrotechnical Conference, Ajaccio, France, 2008, pp.929-934.

[8] A. Borkar et al., “A layered approach to robust lane detection at night,” IEEE Workshop on Computational Intelligence in Vehicles and Vehicular Systems, Nashville ,TN, U.S., 2009, pp. 51-57.

[9] B. F. Wu et al., “A new vehicle detection with distance estimation for lane change warning systems,” Intelligent Vehicles Symposium, Istanbul, Turkey, 2007,pp. 698-703.

[10] H. Sungji, H. Youngjoon, H. Hernsooi, Vehicle detection method using haar-like feature on real time system, World Acad. Sci., Eng. Technol. 59 (2009) 455–459.

[11] A. Mohamed, O. Ahmad, M. Swamy, Vehicle detection using td2dhog features, in: 12th International New Circuits and Systems Conference.