

A REVIEW PAPER ON INTELLIGENT LANE DEPARTURE WARNING SYSTEM FOR DRIVER ASSISTANCE

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ABSTRACT

Most traffic accidents were primarily occurred around the world, because of the lane Departure and cause many casualties and injuries. Lane Departure Warning system(LDWS) is that the part of Advanced driver assistance systems that monitor driver intent warn drivers of lane departures. The lanes have different appearances in different weather, light and road conditions and because of that reason when driving the vehicle it's not properly discover the lane and vehicle cross the Lane and accidents occurs. therefore the Lane detection and Lane tracking may be a difficult task because of the varying road conditions that one will come across while driving. Lane Departure Warning systems(LDWS) is one of the main approaches for Lane Detection and Lane tracking and accident prevention.

In this paper, Lane detection and Lane tracking systems are helpful in avoiding these accidents as safety is that the main purpose of these systems. Such systems have the goal to detect and track the lane marks and to warn the driver in case the vehicle includes a tendency to depart from the lane. A lane detection and Lane tracking system is a vital component of the many intelligent transport systems. however detection of Lane isn't only used to solve the problem of avoiding accidents .To avoid the accidents Lane tracking is vital technique . within the past few years, various approaches for lane detection were proposed and successfully demonstrated.

In this paper, a comprehensive review of the literature in lane detection techniques and Lane tracking techniques is given. the most objective of this paper is to find the constraints of the existing lane detection methods and Lane tracking methods and to overcome all the issues that are enclosed in existing lane detection methods and Lane tracking methods and to develop a proposed computer vision based (Real Time Video based) Intelligent Lane Departure warning system for various weather, light-weight and road conditions.

Index Terms---Lane Departure Warning system, Lane detection, Lane tracking,

I - INTRODUCTION

Most traffic accidents were caused by the negligence of the drivers. so as to reduce the number of traffic accidents and to improve the safety and efficiency of the traffic, research on Intelligent transportation system (ITS) are conducted worldwide. Intelligent vehicle (IV) is a part of the ITS system that aims to help drivers in perceiving any dangerous situations earlier to avoid the accidents through sensing and understanding of the environment around itself. The goal of the Intelligent Vehicles[1] is especially of rising driving safety and enhancing the drivers capability and capability. Advance driver assistance system is employed for increasing the safety of driving cars and support the driver. The inattentive, incompetence or sleepiness driving especially in long-distance journeys would possibly end in traffic accidents and cause dramatic results like loss of life and property.[1] in several countries, completely different statistics was reportable regarding accidents that happened attributable to LD WS. Generally, the reason of regarding two hundredth of the crashes and half-hour of fatal crashes is due the driver drowsiness and lack of concentration means that drift the Lane. In single-vehicle crashes (accidents that only 1 car is damaged) or crashes involving heavy vehicles, the proportion of accidents was reportable up to four-hundredth that ar principally attributable to out of Lane .

This system includes a goal to find the lane marks and to advise the driver in case the vehicle includes a tendency to go away the lane. Lane detection is that the method to find lane markers on the road and so present these locations use Kalman & particle filter for Lane tracking to an intelligent system. A lane detection and Lane tracking system is a crucial part of the many intelligent transport systems. Lane detection and Lane tracking may be a difficult task because of the varied road conditions that one will come across while

driving. but detection of Lane is not only used to solve the problem of avoiding accidents .To avoid the accidents Lane tracking is vital technique .The lanes have completely different appearances in several weather, light-weight and road conditions as shown in - fig.1.[2]



Figure 1: Lane scenario under completely different weather/ light/road conditions & Challenges of Lane Detection [2,9]

In several proposed systems, the lane detection consists of the localization of specific primitives such as road markings of the surface of the painted roads. various challenges like parked and moving vehicles, dangerous quality lines, shadows of trees, buildings and different vehicles, sharper curves, irregular lane shapes, merging lanes, writings and different markings on the road, unusual pavement materials and dissimilar slopes causes issues in lane detection. There are active analysis on lane detection and a large type of algorithms of varied representations, detection and tracking techniques, and modalities have been proposed.

Many approaches are applied to lane detection, which may be classified as either feature-based or model-based. Feature -based ways find lanes by low-level

options like lane-mark edges. The feature based mostly ways are extremely dependent on clear lane-marks, and suffer from weak lane-marks, noise and occlusions. Model-based ways represent lanes as a form of curve model which may be determined by a few critical geometric parameters. The model based methods are less sensitive to weak lane appearance features and noise as compared to feature-based ways. However, the model created for one scene might not add another scene, which makes the strategy less adaptive. To boot, for best estimation of model parameters, an iterative error minimization algorithmic rule ought to be applied, that is relatively time consuming. In this study, a driver help system (DAS) is proposed to minimize the on road accidents. One part of the system referred to as Lane Departure Warning (LDWS) is accountable for detecting involuntary lane departures by monitoring the lane lines. Lane Departure warning System (LDW) uses a camera to monitor the distance between the vehicle and lane markings and, if the vehicle drifts towards the lane markers, the system sounds an audible warning to alert driver for keeping vehicle back into its lane. Detecting road lane markings exploitation image analysis has been an area of active analysis over the last 20 years. The recent survey paper by McCall and Trivedi [3] provides a comprehensive outline of existing approaches. Most of the ways propose a three-step method, (i) extracting features to initialize lane markings like edges [4], texture (ii) post-processing the extracted features to remove outliers using techniques like Hough transform [5] and so (iii) tracking the detected lane markings using a Kalman filter [6] or particle filters [7,8]. The Lane tracking scenario under day and night conditions as shown in fig.2

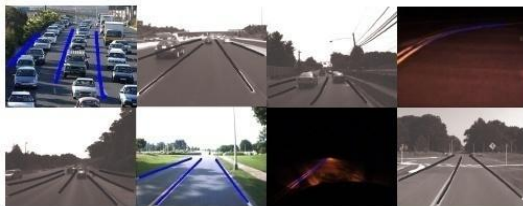


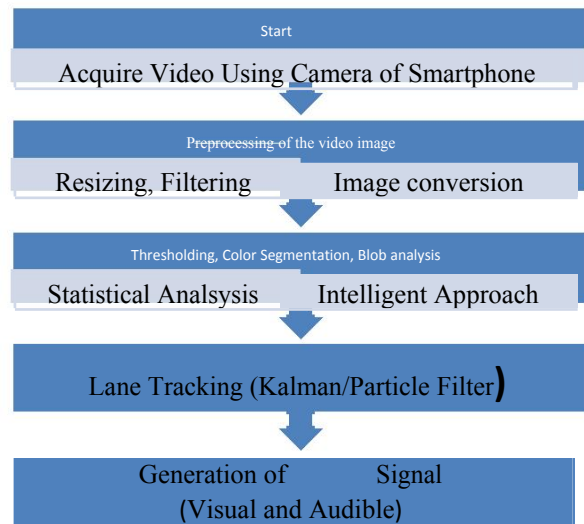
Fig.2.Lane tracking at day and night condition

More recently, there has been an increased focus on building realtime systems [9] on difficult urban scenarios [10,11], including night time driving conditions [12], and on providing functionalities like lane departure warning [13]. Machine learning methods a single classification boundary like neural networks and support vector machines [8] have also been used for detection. The diagram shown in figure two reflects the conventional structure of LDWS.

II. Proposed Lane Departure warning system Proposed Lane departure Warning system the lanes to be detected may be straight or curvy, at any time i.e. day, night, dawn or Dark and with any weather conditions sunny/rainy/foggy or snowy. The lane markings will be broken, faded, occluded, solid or dash lines. For detection of Lane Marker we proposed a Hough transform followed by intelligent system like Neural Network/SVM etc [23]. apart from detecting the lane markers, Lane tracking is additionally a serious problem under various conditions. Kalman Filter and

Particle Filter [6,7,8] would be used to solve the problem of lane tracking and also to identify the position of the vehicle with respect to lane markings, that is helpful for warning signal activation. Moreover, the proposed system will incorporate features like different Light/ Weather/ Lane condition that are used to reduce the amount of traffic accidents and to enhance the protection. In the proposed system to overcome all the issues that are enclosed in existing system and to develop a proposed real time video based (computer vision based) intelligent Lane departure warning system for driver assistance. The flowchart shown below summarizes the logical steps of proposed rule

for LDWS under Various conditions.



III. LANE DETECTION & TRACKING

TECHNIQUES

The general method of lane detection is to first take an image of road with the help of a camera fixed in the vehicle. Then the image is converted to a grayscale image in order to minimize the processing time. Secondly, as presence of noise within the image can hinder the right edge detection. Therefore, filters should be applied to remove noises like bilateral filter, gabor filter, trilateral filter, 2-D FIR Filter, Median Filter. Then the edge detector is used to produce an edge image by using canny filter, Sobel filter with automatic thresholding to obtain the edges. Then edged image is sent to the line detector once detecting the edges which will produce a right and left lane boundary segment. The lane boundary scan uses the information within the edge image detected by the Hough transform to perform the scan. The scan returns a series of points on the right and left side. Finally pair of hyperbolas is fitted to these information points to represent the lane boundaries. For visualization functions the hyperbolas are displayed on the original color image. Kalman Filter and Particle Filter would be used to solve the problem of lane tracking and also to identify the position of the vehicle with respect to lane markings, that is helpful for alarm activation. The above algorithm undergoes various changes and detection of patterns in the images of roads for detecting the lanes. Some of the images are shown in Figure 4-7.

Figure 4a, shows the input image. Figure 4b represents the filtered image of fig 4a. In Figure 5a, the filtered image is converted to grayscale image for reducing the processing time. Then this image is segmented to binary image 5b. It is done to locate the lanes in captured image. Figure 4a) Input Image b) Filtered Image [9]

Figure 5: a) Grayscale Image b) Binary Image [9]
 Figure 5a) represents the smoothed image and Figure 6b) shows the detected edges in the image with the help of canny edge detector. Figure 6: a) Smoothed Image b) Edge Detected Image [9]. Figure 7a) shows the smooth ed image and finally the output image is represented in Figure 7b. Figure 6: a) Smoothed Image b) Output Image[9]



Figure 4: a) Input Image b) Filtered Image [9]



Figure 5: a) Grayscale Image b) Binary Image [9]

Figure 6a) represents the smoothed image and Figure 6b) shows the detected edges in the image with the help of canny edge detector.

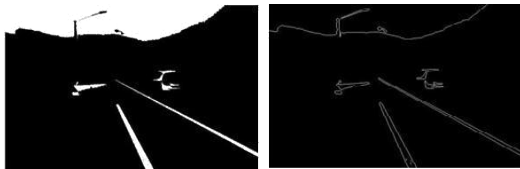


Figure 6: a) Smoothed Image b) Edge Detected Image [9] Figure 6a) shows the smoothed image and finally the output image is represented in Figure 7b.



Figure 7: a) Smoothed Image b) Output Image [9]

IV. LITERATURE REVIEW

The objective of the literature review is to find and explore the advantages of lane detection and Lane tracking algorithms and additionally what are the various issues in existing algorithms and techniques. the most goal of this literature review is to find the gaps in existing research and methods and also what will be the possible solutions to overcome these holes.

Pomerleau et al., (1996) [16] proposed the RALPH system, used to control the lateral position of an autonomous vehicle. It uses a matching technique that adaptively adjusts and aligns a template to the averaged scan line intensity profile so as to see the lane's curvature and lateral offsets.

Broggi et al., (1998)[15] prepared a GOLD system that uses an edge-based lane boundary detection algorithmic rule. The acquired image is remapped in a new image representing a bird's eye view of the road wherever the lane markings are nearly vertical bright lines on a darker background. Specific adaptive filtering is employed to extract quasi vertical bright

lines that concatenated into specific larger segments. Kreucher et al., (1998) [24] proposed within the LOIS algorithm as a deformable template approach. A parametric family of shapes describes the set of all attainable ways in which the lane edges might seem within the image. A function is defined whose value is proportional to how well a specific set of lane shape parameters matches the pixel data in a specified image. Lane detection is performed by finding the lane shape that maximizes the function for the present image.

Wang et al., (2004) [25] used B-Snake spline as a geometrical model that may represent the road. Then the processed images with Canny/Hough Estimation of Vanishing Points (CHEVP) to extract the parameters required by the geometric model. The obtained results were very robust and correct. As in his paper, the algorithm will overcome the interference of shadows. However, once the system detected the shadow of a tree trunk or a shadow of telegraph pole which has a uniform orientation, an unpredictable result occurred.

Chen et al., (2004) [26] developed another system referred to as AURORA that tracks the lane markers present on structured road employing a color camera mounted on the side of a car pointed down toward the road. a single scan line is applied in every image to find the lane markers.

Jung and Kelber (2005) [27] used the edge detection, squares angular estimation, Hough transform to estimate lanes on a road. The results were obtained in his paper using his algorithm. The algorithm mostly runs good except when it involves shadow or other interference on the road.

Aly (2008) [9] proposed an efficient, real time, and robust algorithm for detecting lanes in urban streets. The algorithm was based on taking a top view of the road image, filtering with gaussian kernel s, so using line detection and a new RANSAC spline fitting technique to detect lanes within the street. This algorithm was able to find all lanes in still images of urban streets under numerous conditions. This method has issues due to stop lines at cross streets, at cross walks, passing cars and confused writings.

Kim (2008) [8] given a robust lane detection and tracking algorithm to deal with challenging scenarios like a lane curvature, worn out lane markings, lane changes, and emerging, ending, merging, and splitting lanes. The algorithm was based on random sample consensus and particle filtering. The algorithm was planned to supply a large number of hypotheses in real time as compared to different algorithms.

Khalifa et al., (2009) [28] proposed a real time lane detection algorithm based on video sequences taken from a vehicle driving on main road. This algorithm showed a robust behaviour to lighting change and shadows. The lanes were detected using Hough transformation with restricted search area. It might be applied in both painted and unpainted road, similarly as slightly curved and straight road in numerous weather conditions. This algorithm proved to be robust and fast enough for real time requirements as compared to different algorithms. Vehicles are assumed to move on flat and straight roads or with slow curvature. This algorithm does not work well on sharp curves and in presence of shadows.

Meuter et al., (2009) [17] proposed a new robust approach for camera based lane recognition for lane detection and tracking system. This detection algorithm was combined with a tracking algorithm which combined two Extended Kalman filter using the Interacting Multiple Models (IMM) algorithm. The algorithm was linear in time and robust in the presence of noise and weak markers. The algorithm could be used to detect the position and the slope of the lane segments.

Zhou et al., (2010) [18] proposed a road detection algorithm on the marked roads based on Geometrical model and Gabor filter. This algorithm can be used for Lane Departure Warning System or other auxiliary driving system. The lane geometrical model contained four parameters which were starting position, lane original orientation, and lane width and lane curvature. Gabor filter is adopted to estimate orientation in each pixel and to filter the image along the line of lane model. This algorithm can overcome the universal lane detection problems due to inaccuracies in edge detection such as shadow of tree and passengers on the road. As compared to other methods, the algorithm achieved high accuracy and was robust to the noise and other interferences such as shadow.

Teng et al., (2010) [19] proposed an algorithm which integrated multiple cues, including bar filter which has been efficient to detect bar-shape objects like road lane, color cue, and Hough Transform. To guarantee the robust and real-time lane detection, particle filtering technique has been utilized.

This algorithm improved the accuracy of the lane detection in both straight and curved roads. It has been effective on a wide variety of challenging road environments. This method fails for the lane tracking when it is to be applied to particle filter in the dashed lane situation.

Mariut et al., (2012)[14] 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.

Phancendra et al., (2013) [20] proposed 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 Kalman filter, compared to the usual method of using Hough transform. The model proved to be efficient and feasible as compared to other systems. This system failed to detect the lanes correctly when the situations on the road are more complex.

Raghuraman Gopalan (2012)[2] This paper describes that Without any assumptions on the road structure, or the motion pattern of the vehicle, we demonstrated

some results on challenging daylight and nighttime road scenes.

- (i) a robust boosting algorithm to select relevant contextual features for detecting lane markings, and
- (ii) particle filters to track the lane markings, without the knowledge of vehicle speed

Thanda Aung and Myo Hein Zaw [2014][21] This paper describes implementation of a lane detection system using Hough Transform and Lane tracking using Kalman Filter at daylight road scenes. The limitation of the system is its inefficient detection at poor visible conditions especially at night.

HamdiYalin Yalic, AliSeydi Keceli[2013][1] This paper describes a single-board computer system used an implementation of well-known methods for lane departure warning and vehicle detection in a combination with driver assistance system.

Sayanan Sivaraman [2013] [22] This paper describes an improved the performance of the lane tracking system to low density traffic scenario. But to high-density traffic scenario the performance of lane tracking will be poor. Second, the Processing time is slow for vehicle tracking on detected objects, derived from the estimated ground plane.

Borkar, M. Hayes [2012][12] This paper describes implementation of a lane detection system using RAN SAC and Lane tracking using Kalman Filter at Night light at straight and curvy road condition. Matlab implementation operates at approximately 0.8 s/frame on current Intel-based personal computer hard ware. Limitation of this system is low processing speed.

V. GAPS IN EXISTING LITERATURE

By conducting the literature survey it has been found that the most of the existing literature has neglected one of the following:

- 1) Lane detection is a complicated problem in LDWS under different light/weather/road/lane conditions.
- 2) The survey has shown that the existing methods provides good accuracy for high quality images but sometimes provide poor results for poor environmental conditions like fog, haze, noise, dust etc.
- 3) Most of the existing techniques are best for straight lanes, but they provide poor results for curved roads.
- 4) Most of the lane detection techniques are based on standard Hough transform, so it can be modified for improving the accuracy further.
- 5) Incorporation of very few conditions mostly sunny day with clear solid lane markings and occasionally rainy.
- 6) Inaccurate tracking algorithms either using Kalman or Particle filter.
- 7) Identification of the vehicle position with respect to lane markings.

VI. CONCLUSION AND FUTURE WORK

The lane detection and Lane Tracking techniques play a significant role in intelligent transport systems. In this paper, lane detection and Lane tracking methods have been studied. Most of them resulted in inaccurate results. Therefore, further improvements can be done to enhance the results. one can modify the existing Hough Transformation and Hybrid Kalman and Particle filter so that it can measure both the curved and straight roads. Various steps should be taken to improve the

results in different environmental conditions like sunny day, foggy day, rainy day etc. Lane departure Warning system the lanes to be detected can be straight or curvy, at any time i.e. day, night, dawn or Dark and with any weather conditions sunny/rainy/foggy or snowy. The lane markings can be broken ,faded ,occluded ,solid or dash lines. For detection of Lane Marker we proposed a Hough transform followed by intelligent system such as Neural Network/SVM etc. Other than detecting the lane markers, Lane Tracking is also a major problem under various conditions. Kalman Filter and Particle Filter would be used to solve the problem of lane tracking and also to identify the position of the vehicle with respect to lane markings, which is useful for warning signal activation. Moreover, the proposed system of a computer Vision (Real Time) based Intelligent Lane Departure Warning system will incorporate features such as different Light/Weather/ Lane condition which are used to reduce the number of traffic accidents and to improve the safety.

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