A Survey for Building Real-time Vision based Road Detection Model

Devyani Kalghatgi, Digambar Kulkarni

Abstract*: With every passing day around the year nearly thousands of lives across the world are lost due to mishaps on the roads. Furthermore, many other people are injured. The finest way to handle such a problem is to build a road detection mechanism. It plays an ultra-critical part of various vision navigation systems for putting together an intelligent transport or vehicle guidance systems. In recent times number of computer vision based independent navigation systems have been presented by various researches in various social and industrial applications. Thus, this paper conducts a voluminous survey on different state-of-art model for designing road edge detection model. From the survey it can be observed that these methods are broadly classified into model driven, feature driven and activity driven. Further, the existing model for detecting the outcome is substantially affected by the presence of noise in an image (due to fog and other environmental condition). To address such a research hurdle, this paper gives a research direction for modeling efficient mechanisms for detecting the edges of the road identifying exact location, speed and size of obstacles and direction of road extension.

***Index Terms*: Autonomous robots, Computer vision, Edge detection, Intelligent transport system.**

I. INTRODUCTION

Provisioning safe and a reliable autonomous driving assisting model aid in reducing strain or distress of vehicular user (driver) and provide good potential in future autonomous driving assistance system. Recently, extensive work has been carried out to improve road safety and improve traffic management. A unique problem is self-accident where vehicles collide with trees, divider, median, poles etc. these kind of accidents occur due to collision with obstacle such as tree, rollover crash, running off road when travelling on roads (specifically highways) accidentally. Upgrading infrastructure of roads such as guardrails aid in reducing the accidents (i.e. prevent death or injury) by employing passive safety mechanism. As described by European Union (EU), there is a reduction of 36% of self-accidents in the last decade; self-accidents are still a major problem which is accountable for one third of accidents in European countries [1],[2]. Thus, non-urban roads and country roads are also accountable for accidents (i.e., poor road infrastructure).

Another area that benefits from dependable highway road limit recognition is independent driving. Capacity to explore and navigate imperative element for a complete autonomous system and portable robotic automated framework. To guarantee this it turns out to be basic to perceive urban roads region and remain out and about locale while exploring from source to end point. With proximity sensing device one can distinguish the ground plane yet it winds up close to difficult to perceive shape and different properties of the ground. Thinking about these actualities, the present research concentrates more on smart vision based route approaches. With advancement in vehicle innovation and urban road transportation framework mishaps are additionally expanding. It has turned out to be basic to create frameworks that can help driver while exploring or travelling on a highway. Highways road edge identification framework system can tremendously support the reason. The road edge identification methods are generally classified into following classes such as feature based, activity based, and model based [3]

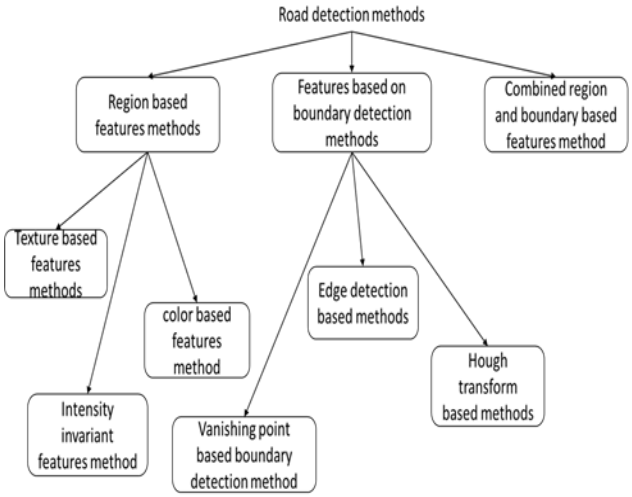

Fig. 1. Classification of road detection methods.

This, paper conducts an extensive survey of various existing methods for road edge detection. Road sign board identification and road edges discovery assumes an imperative part in the security of every vehicle users. Along these lines, this exploration field has been analyzed by numerous analysts. A large portion of the trials dependent on utilizing shapes and color features to distinguish traffic signal and signs.

Edge is one of the essential attributes of the picture, which conveys a large portion of the data of a picture [4]. Edge attributes are in this way essential in performing analysis of multimedia data

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processing, specifically, in the field of extracting and detecting important features of an image [5]. To decide the area of the picture edge, the modification feature point of the picture signal must be resolved and established, which give the position of picture profile.

Computerized multimedia picture edge discovery is the advanced technique. Picture, has a unique features such as grey scale optimization in orientation, position, estimation and so on The motivation behind edge recognition is to recognize the unusual and unstable circumstances and unpredictable structure of the change point in the picture, and afterwards to give the futuristic element status prerequisite to the processing and computing of multimedia images. Edge feature construction process is the major part in the multimedia image investigation and identification, on which object recognition, identification and picture segmenting processes depend [6].

Generally, when the smart vehicle is safely travelling in the highway environment, the accurate connections among automobiles and urban or highway roads must possess knowledge/information of environmental condition it's operating on. Practically, information which is received via vision is 90%, for example, traffic symbols, traffic signal indication, path, automobiles, highway deviation shapes, street marking on highway roads and presence of obstacles [7]. In smart vehicle frameworks, the implementation of machine vision, for urban road's condition data ought to be considered. So on highways or in-city roads the road edge location is vital and feature extraction aids in analysing it. The direction and navigation of the street expansion in few particular areas speed and size of the obstacle in line of sight on roads also aids in analysis [8]. In this manner, vehicle user may decide if the driver is required to maintain a strategic distance from the obstacle or whether the user is driving out of viable region of the highway road [9].

The research contributions of this work are as follows:

• Firstly, this work conducts extensive survey of various road edge detection algorithms for building efficient autonomous vehicle driving assistance system.

• Presents de-hazing methodology for natural scene picture based on hue analysis and rebuilding with street edge detection using canny edge and prewitt edge detection methods and experiments are conducted.

• Further, presents a future possible solution to design efficient autonomous vehicles driving assistance system.

The manuscript is organized as follows. In section II, literature survey is presented. In section III research and industry gaps are identified and research solution is given. Lastly, the research is concluded with future research direction of work.

II. LITERATURE SURVEY

This section gives extensive survey of various methods presented for detecting the road's edge for building efficient autonomous transport system. In [10], indicated each year 1.3 million individuals worldwide are slaughtered on highway roads, and somewhere in the range of 20 and 50 million are harmed and are in trauma. A responsive answer for this issue is creating machines, which take into record nature. That is the reason today, safe auto driving is turning into a well-known subject in numerous fields, from little ventures to substantial vehicle industrial facilities. Anyway this subject additionally brings up numerous issues there is a need to characterize the width of the edges of the urban roads, perceive street signs, traffic lights, and people on foot, and different articles which contribute the driving securely. There are numerous techniques for resolving these tasks and functionality. Here are a portion of the techniques which will be considered in their work: limit, canny edge recognition and SURF – calculation, Hough strategy.

In [11], it presents an examination of an ideal algorithm for edge identification so as to use in the urban road path discovery process. The principle issues, including the speed parameter, the precision, and the restricted assets, were taken into consideration for the acknowledgment on the FPGA innovation. The edge discovery algorithm of Prewitt, Canny, Roberts and Sobel were observed. In [2] it present a flexible and practical recognition approach for identifying urban roads limits by intertwining video and radar. The urban roads limit is characterized as the change from highway roads surface to non-road territory. We demonstrate the coordination of a multi-path recognition framework into the identification algorithm, which makes the methodology free of the quantity of paths and the perceivable path design.

In [4] it presented extensive survey of state-of-art edge detection method such as Prewitt administrator (PA): Prewitt administrator [14] is the main request differential Function (DF). PA utilizes gray-scale distinction left to right, start to end, and adjacent pixels for obtaining the finest edge. The standard of RO is like SO, Roberts's operator (RO): RO [12] utilizes partial differential function (PDF) to discover the edge using least complex function (LCF). As indicated by the rule that any pair difference of overlapping direction can be utilized to compute the inclination, the distinction among adjoining corner to corner bearing pixels is determined. Sobel operator (SO): The standard of Sobel edge identification function [13] is to utilize partial differential function to discover the picture edge. It can successfully diminish the noise that affects the yield picture, Canny operator (CO): CO [16] is a moderately novel Edge finding function, that has in recent times been utilized generally. The fundamental thought of CO is to make the picture gradient function, and post that for producing the edge by checking pixels local maximal gradient weights. In [17], showed presence of noise such as fog severely affects the state-of-art edge detection methods. Further, the existing methods are computationally very heavy. Thus, a novel edge detection method is required which overcomes issues of noise and obstacles for

provisioning real-time edge detection mechanism. Laplace - Gaussian operator (LGO): LGO [15] (for the most part alluded to as the LOG function) uses second- order differential function. The LGO model produces a steep zero-crossing over an edge of a picture. So as to lessen the noise due to interference, the initial process required to utilize Gaussian operation to filter the picture, and afterwards to get derivative of the picture (i.e., second order derivative (SOD).

III. RESEARCH/INDUSTRIAL GAP WITH FUTURE POSSIBLE SOLUTION

Independent and autonomous driving vehicles (IADV) with different dimensions of mechanization from semi-autonomous driving advancements (SADA), for example, lane-keeping assistance systems (LKAS), Dynamic cruise control (DCC) to fully-IADV are currently economically accessible. While ordinary advanced digital routing systems has made it easier for vehicle user to have street-level firmness, suppliers are currently concentrating on creating computerized gps plots with a very good resolution. The existence of path-level advanced maps or plots lessens the weight limit and at the end the expense of particular independent driving.

Utilizing traditional advanced maps at street-level, in specific automated driving vehicles causes worries about unreasonable concern to completely comprehend its environment to settle on a choice. For instance, if the car needs to make an exit at a comfortable junction, it needs to make sense of the absolute number of paths out and about and the path that the vehicle is on as of now, so as to move to the furthest right path securely before achieving the intersection. Be that as it may, if a path level guide were given to the vehicle, the way arranging procedure would turn out to be extensively more straightforward and more secure so the discrete vehicles would be less committed to be furnished with various processors and transducers.

Nothing like the street-level computerized map generating, a large part of which is robotized, the way of producing path-level advanced guide normally needs physical work at numerous steps. Path or lane identification on a highway is progressively troublesome in view of multiple paths and lanes, specifically diversion roads and road-signs on the ground and complex path variations at the intersections.

On account of road-level atlas generating, it is imperative to mirror the direction and the deviation of the urban street precisely (because of quality haze and other natural condition), just as the presence of inclines and bridges. Path-level map generation requires more subtleties; along these lines, the individual paths must be effectively procured by means of precise urban road line identification pursued by suitable parameterization. If the urban road chance is basic and has just two or three urban road with no urban highway symbol on the ground level other than the road lines the generation of a urban road-level map and a path-level atlas won't be altogether variant. Notwithstanding, an intricate road in a urban region has various Paths or lanes and different urban roads signs blended with urban road lines. For this situation, quick and precise urban road line identification turns into an essential issue in road-level map producing.

A significant number of the traditional urban road line identification strategies utilizing LiDAR information about 10 years back concentrated on identifying only both lines on either side of the automobile, In order to decrease the unintended path deviations in independent driving vehicle [18] [19]. However, these models are profoundly influenced because presence of noise and ambiguity are computationally overwhelming. The proposed imagined technique is computationally less intricate and can be connected progressively without acquaintance of any bogus shading which improves the difference of the scene objects. We will likewise consider road limit identification utilizing two unique systems a) Boundary finding b) Hough transforms [HT]. Lane limit recognition is a part of division. The reason for the present strategies exclusively relies on HT pursued with definite edge[ED] recognition process. The proposed structure by [20] is vision-based road limit identification. The formula for the excellent way depends on Dynamic Programming (DP) trailed by the utilization of randomized (HT)Hough Transform. Attributable to the utilization of Dynamic Programming the assessed measurement time is observed to be substantially less. In [21] Hough Transform with 2D filter is utilized for fast track recognition framework. Here, picture binarization is performed independently which is only an additional progression, as far as unpredictability is concerned. In [22] road ED identification for road limit is proposed. The downsides of first technique are defeated in the subsequent strategy utilized for urban road ED identification. The calculation time taken continuously is a strategy which is additionally less and progressively reasonable for constant applications which we will consider for execution.

Fig. 2. Input image used for performing de-hazing.

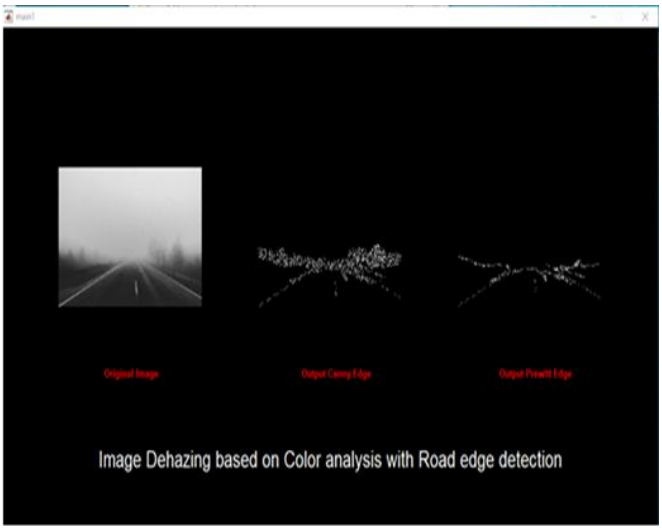

Fig. 3. Image de-hazing based on hues analysis for highway ED detection using canny and prewitt detection method.

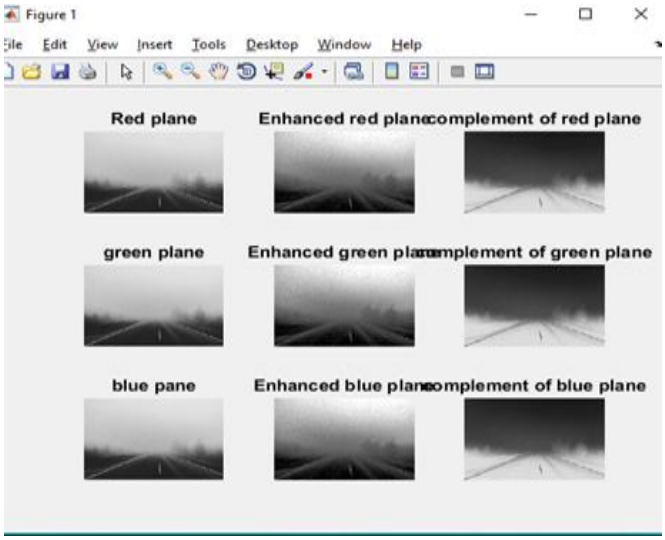

Fig. 4. After elimination of RGB.

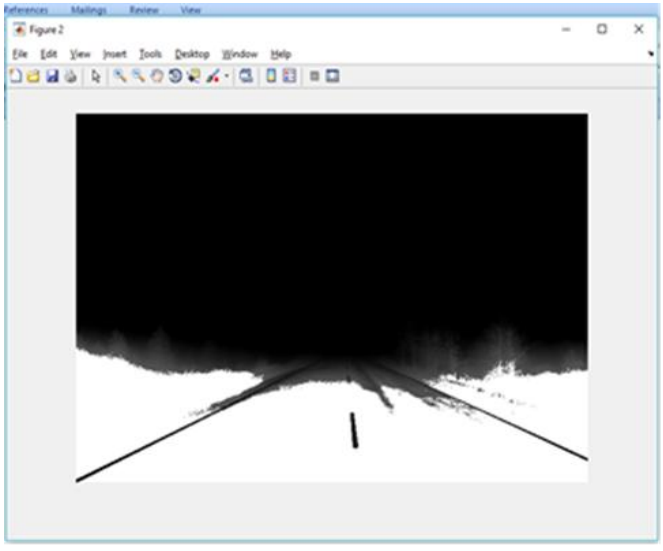

Fig .5. Resultant de-hazed image Using canny ED Detection

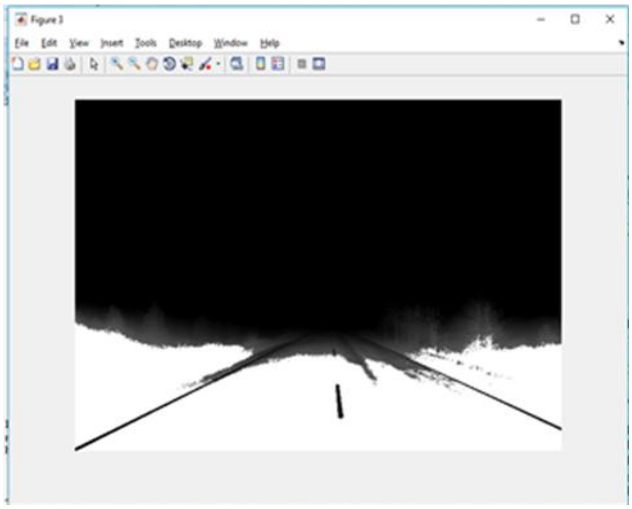

Fig. 6. Resultant de-hazed image Using Prewitt ED Detection

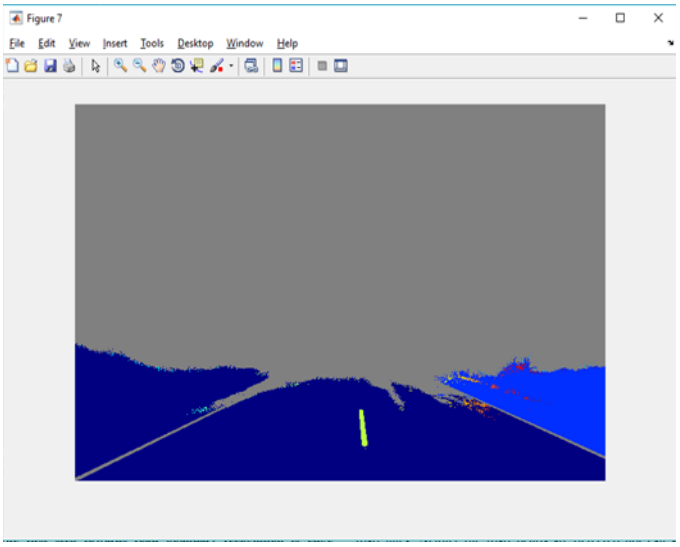

Fig. 7. Utilizing Prewitt After road boundary tracing.

IV. PERFORMANCE ANALYSIS

This segment indicates or shows de-hazing system for common scene picture, dependent on shading investigation and reclamation with lane's ED and identification using canny ED and prewitt ED detection methods. Images used for analysis is shown in Fig. 2. The proposed technique was designed and implemented on Intel Pentium I-5 processor, equipped with 8GB RAM and 64 bit windows 10 operating system and MATLAB R2015a on a personal computer. The fig 3 shows, image de-hazing based on hue analysis for road ED detection using canny and prewitt detection method. The Fig. 4, shows, after removal or elimination of RGB.

The Fig. 5 shows resultant de-hazed image using canny ED detection (CED). The Fig. 6 shows Resultant de-hazed image using prewitt ED detection (PED). The fig. 7, shows using Prewitt after road boundary tracing. The outcome picture that the research work obtained seems darker towards areas of less contrast and lighter or whiter in areas of high contrast in the picture that is complimented. Heavier the fog condition in the first picture taken by the automobile or the original picture, darker will be the areas in the complimented picture. Hence on adding some steady esteem k to the darker areas of the supplemented picture we can upgrade the shading transmission of that part of the image. So also the bits of high difference shows up totally white in the supplemented picture so on lessening a base consistent esteem c from the supplemented picture we can make the relating locales or areas in the first picture look less white. The estimation of k and c both have been kept consistent at the value of 45 for both the constant values.

V. CONCLUSION

This work conducted a deep rooted survey of various ED detection methods for designing efficient autonomous vehicle management system. From this survey it can be seen that the ED detection is greatly affected due to the presence of noise such as fog in the image. Furthermore, this model's computation is not time consuming in fact the ends of the road are detected within 5 to 7 seconds which was a limitation in various other models and is thus effective in finding the ends. Thus, future ED detection method must overcomes the issue of regaining the actual image colors for provisioning even more efficient autonomous transport system. Thus, for future work we would consider road ED detection using Hough transformation using 2D filter rather than using dynamic programming method also it can be extended for video based systems. Thus the proposed envisioned model can be used for real-time without inducing any noise (i.e., color) to improve the contrast of the sight objects.

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