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Survey on lane detection techniques

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ABSTRACT

Every year, a large number of persons are killed in highway departure crashes due by driver inattention. Because safety is the primary goal of these systems, lane detecting systems can help prevent accidents. Such systems are designed to detect lane markings and alert the driver if the vehicle is drifting out of its lane. Several lane identification systems have been proposed and effectively proven in recent years. The hybrid median filter was used in this study to provide a noble strategy for lane detecting. Lane detection is used in a variety of intelligent vehicle applications, including lane trip recognition and warning boards, intelligent journey control, and autonomous driving. The majority of previous research has ignored the use of image filtering algorithms.

Keywords— *Lane detection, Modified Hough transformation, edge detection, Hybrid median filter (HMF)*

1. INTRODUCTION

With the growing growth of urban traffic, road safety is becoming increasingly important. Leaving the lane is responsible for over 30% of all highway accidents, with the majority of these being caused by the driver's distraction and exhaustion. As a result, a system that can warn drivers of impending danger has the potential to save a substantial count of crowd. Advanced driver assistance systems are devices that are designed to assist the driver while driving (ADAS). ADAS includes a variety of systems like as adaptive cruise control, collision avoidance, night vision, blind spot recognition, and traffic sign detection. This category also includes lane departure systems. This system's purpose is to identify lane markings and alert the driver if the vehicle is drifting out of its lane.

The technique of locating lane markings on the street and giving this information to the system is known as lane detection. Intelligent and smart vehicles work together in intelligent transportation system to create a secure domain and better traffic circumstances. A lane discovery framework application cab be as straightforward as alerting the driver to as complicated as anticipating the change in lane and avoid accidents.

Image processing, on the other hand, is a complicated process that involves a big amount of data, scans at a high rate, and involves a big number of pixels every frame. As a result, real-time image processing necessitates a high-performance based CPU.

As a result, we use a video processing system. The primary benefit of using a video-based system is that a single camera can record far more data than numerous other sensors can. Another benefit is that the system's capability can be increased with a small bit of code change. FPGA's parallel architecture has the capability to detect road lanes that are obstructed by fast-moving automobiles.

Lane identification has been approached in a variety of ways, that are classified like a feature based or model based. Low-level characteristics such as lane-mark edges are used in feature-based algorithms to recognise lanes. The feature-based approaches rely heavily on clear lane markings and are susceptible to poor lane markings, noise, and occlusions. Which is identified using some basic geometrical aspects. When opposed to feature-based methods, model-based methods are less susceptible

to weak lane appearance cues and noise. However, the model built for one scene may not function in another, making the process less adaptable. Additionally, for the optimum evaluation of the model parameters, an algorithm is applied which will consume less time and has constant error minimization.

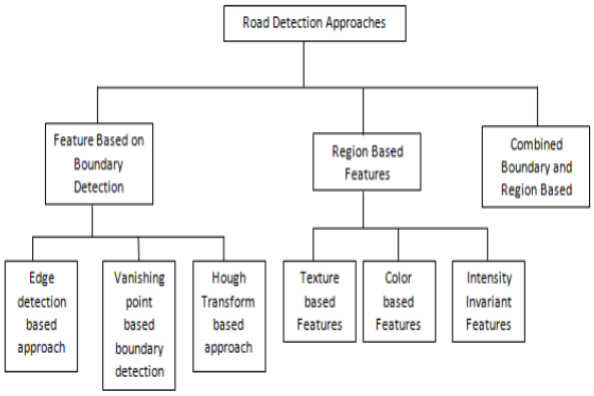

Fig 1: Classification of road detection approaches

1.1 Lane

A lane is a section of a road reserved to be used by a single line of cars. It is used to guide and control drivers, as well as to reduce traffic congestion. Most roads have at least two lanes for traffic in each direction, which are separated by lane markers. On multilane highways and busier two-lane roads, road surface markings define the lanes.

2. Literature review

The objective of this study is to discover and investigate the advantages of path recognition system, as well as the various flaws in previous studies. Primary purpose of this study is to identify the lope holes which were there in the previous algorithms, as well as potential solutions for filling these loopholes.

The RALPH system, proposed by D. Pomerleau et al. (1996), is utilized to control the horizontal situation of a self-driving car. To figure the path's curve, it utilizes a coordinating philosophy that adaptively adjusts a layout to the middle value of output line power profile.

The B-Snake spline was used by Y. Wang et al. (2004) for demonstrating the path like a geometric figure. Later he applied the CHEVP (Canny/Hough Estimation of Vanishing Points) in order to obtain the essential parameters of the images which were received from the geometric model. The conclusions that were acquired were very sturdy and definite.
However, an unexpected outcome happened as the methodology identified a shade of a building or that of an electric pole which had an undeviating exposure.

M. Chen et al. (2004) created AURORA, a system that made the use of a color camera pointed below at the road and fitted near the side of the vehicle in order to imprint the lane markers present on organized roads. To recognize the lane markers, each image uses a single scan line. In order to evaluate the road lanes, , C. R. Jung et al.(2005)used the squares angular evaluation ,detection of edge and Hough transform The results were achieved using his algorithm, which he described in his paper. Except when there is shade or other road disturbance, the algorithm performs perfectly.

M. Aly (2008) proposed an algorithm for recognizing lanes on urban roadways that is effective and strong. The program worked by capturing the birds eye view of the street, screening using the Gaussian kernels, and thus detecting lanes in the street applying the RANSAC spline fitting methodology and lane detection . the program was able to detect all the lanes as observed in the constant urban pictures.

F. Mariut et al in (2012) introduced a technique that implies the Hough transform to automatically emphasize lane markers and distinguish them from digital photos. This approach can also recognize the characteristics of lane marks and determine the travel direction. To ensure that the lane mark is correctly detected, a methodology that extracts the inside edge of the lane is used. The algorithm is quite efficient on straight roads, however it fails on curved roads in some circumstances.

A vision-based lane departure warning system was proposed by N. Phaneendra et al in (2013) . The major purpose of this model was to create an image processing system for detecting lanes on the road and providing a textual warning when a lane was left unoccupied. The distance from the bottom to the center of the lanes in collected picture coordinates is used to make lane departure decisions, which takes less time parameters.
Pallavi.V.Ingale proposed Comparative Study of Lane Detection Techniques.

Chandaporn keatmanee(2019) proposed vision based lane keeping in 2019. It used the lane boundary tracking method. To study the features that were extreme problem specific, and which avoided the necessity for full onboard perception, Ad-hoc method was implemented. The preliminary issue in this research area was the noise understanding and the widening scope for road geometry. In (2020) Stevan stevic proposed Vision-Based Extrapolation of Road Lane Lines in Controlled Conditions. He used Numerical vision-based algorithm Hough transform in his research. The noise was cleared with thresholding.

Ziqiang Sun proposed Vision Based Lane Detection for Self-Driving Car in 2020. He used Sliding window polynomial fitting method Canny detector. Still it was difficult to detect curved roads.

Himesh Kumar Singh, Nishant Yadav, Kumar Ashish (2020) proposed lane detection in real time environment using embedded systems in 2020. They used Sobel edge detection technique Hough transform. Compared to other detection technique Sobel edge detection technique gives more accurate and relatively fast result

3. LANE DETECTION

The most common way to detect the lane of the road is by clicking a picture using the camera fitted in the car. In order to save the processing time, the picture is than transformed into grayscale picture.. proper edge detection will be difficult due to the presence of noise in the image. The bilateral filter, trilateral filter, Gabor filter and hybrid median filter can be used to remove noise. With the use of canny filter the edge detector is used to create an edge image. To execute the lane boundary scan, data on the image is detected by Hough transform. Finally, these data points are fitted with a pair of hyperbolas to represent the lane boundaries.

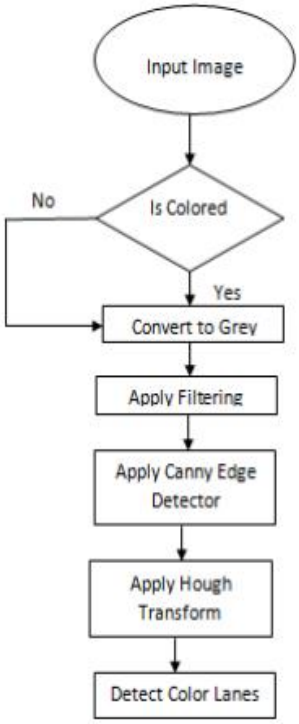

Fig 2: Traditional Lane Detection Algorithm

3.1 Edge Detection

Edge detection is simply attempting to locate regions in a picture or image where there is a sharp shift in intensity, with the highest value indicating a steep shift and the lowest value indicating a shallow change. The first stage is to use filter techniques to detect these edges in the image, and then amplify those portions of the image where the edges are present, increasing the image's clarity and brightness and making it easier to view. Various edge detector technique are.

- Roberts edge detector
- Canny edge detector
- Prewitt edge detector
- Sobel edge detector

3.2 Roberts edge detector:

To measure the 2-d spatial gradient of photograph in a simple way is by using the Roberts cross detector, resulting in highlighted rich spatial frequency regions that coincide with the edges. The pixel value at each output point is represented by a spatial gradient of t which is calculated by absolute magnitude. By using only addition and subtraction to calculate the output pixel, only 4 input pixels are tested. Furthermore, there are not any criterion to configure. The only demerit is -extreme noise receptive as it uses a small kernel.

3.3 Prewitt edge detector:

The Prewitt operator is used to detect the two main types of edges in a photograph- horizontal, vertical.in order to measure the edges the difference between the interrelated pixel intensities of a photograph is used.

Derivative masks refer to all of the masks that are used for edge detection. Since, as we've shown in previous tutorials, a picture is also a signal, changes in a signal can only be measured using differentiation. As a result, these operators are also known as derivative operators.

3.4 Canny edge detector:

Edge detection with a low error rate is critical since different edges that exist inside an image should not be overlooked, and there should be no responses to non-edge. The edge point will be localized, which means that the distance between the detector's edge pixels and the real edge will be kept to a minimum. Only one approach to a single edge was enforced because the first two are insufficient to fully rule out the possibility of multiple responses to an edge.

3.5 Sobel edge detector:

By using Sobel Edge Detection, the photograph is filtered separately in the A and B directions, which is a combination of a new image that is the sum of A and B edges. These files, however, can be processed separately. Before using a Sobel edge detector it is mandatory to transform the picture into a grayscale photograph from an RGB scale. Then we'll use a technique known as kernel convolution the filter that we will use detect edges is a kernel with a matrix of 3X3 symmetrically made. When scanning over an image's X direction, for example, we'll want to use the A Direction Kernel to look for significant changes in the gradient. Similarly, if we want to search over an image's B direction for wide gradients, we can use the B Direction Kernel.

Processing time of different edge detection function
Priwitt_avg_time=0.306
Canny_avg_time=0.996
Sobel_avg_time=0.0294
Roberts_avg_time=0.444

As the average time of “Sobel edge detector” is the lowest amongst all the four detectors, it is the most efficient detector.

4. CONCLUSIONS

Lane detection algorithms are crucial in intelligent transportation systems. One of the most essential elements of modern automobiles is the driver support system, which ensures driver safety and reduces vehicle accidents on the road. The technology was tested in a variety of lighting conditions as well as shadow effects on various road types. The technology has shown that it is

capable of detecting road lanes in a variety of circumstances. Lane detecting strategies are investigated in this research. They were real-time and envisioned technology used for lane detection. The image is segmented, road's shade is removed. The lanes were discovered using the Hough algorithm, according to a set of experiments. We can see that the algorithm performs well in these situations based on the preceding result. The most essential methods ae finding the background grey range, hybrid median filtering, edge detection, background subtraction and Hough transform. The results in these experiments demonstrated, the program can meet a standard criterion of providing relevant information to the driver in order to ensure safety. When compared to other detection techniques, the Sobel edge detection methodology produces more accurate and reasonably rapid results. We use the region of interest instead of the entire frame in this method, which lowers the processing cost. e. More work is needed to be done in the lane detection area as it can pave the way for fully automatic cars and can greatly reduce the number of road accidents that are happening everywhere around the world especially India.

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