DOI:10.22413/ijatest/2021/v6/i3/8

LANE DETECTION FOR AUTO-PILOT VEHICLES USING PERSPECTIVE AND HISTOGRAM APPROACH

[1] Fahimuddin Shaik,[2] P.charan kumar,[3] K.lakshmi prasanna,[4] G.jyothi,[5] C.guru kishore
Annamacharya Institute of Technology & Sciences, Rajampet, A.P, India.

***Abstract*: The automobile industry has experienced a faster rate of growth in recent years. The vehicles design has moved from a simple mechanical model to a smart, fast, comfort, and automatic driving vehicles. However, providing safety and avoiding road accidents are main things to perceive, in which LANE DETECTION plays a crucial role and it is critical component of self-driving and autonomous cars. Once the lane positions are obtained, the vehicle will know where to go and avoid the risk of running into other lanes or getting off the road. This can prevent the car from drifting off the lane. The existing methods for automatic lane detection are Minimalistic approach, LIDAR and RADAR. But these methods provide detection for small lengths, suitable only for straight lanes detection and the cost level is high.**

The proposed method for lane detection is the-" Perspective and Histogram analysis for lane detection". This method will overcome the limitations of the previous existing methods like detecting the curved and the steep lane markings. The need and importance of this method is to provide the optimal safety to the passengers, to avoid the accidents and promoting safe lane shifting of the vehicles. This method consists of two important components- the camera and the computer vision, which helps the self-driving cars perceive the surroundings around them. The sensing camera is fixed at the front of the vehicle, which is the source of data will extract the relevant information from the surrounding environment. The computer vision will understand the digital images and videos send by the camera using the image processing techniques along with the perspective and histogram algorithms. Through this approaches the vehicles are guided to go in correct lanes and can shift the lanes automatically with safety. In this work, MATLAB computing tool is utilized to detect the lanes with easy analysis.

Keywords: Histogram, Lane detection, Matlab.

I. INTRODUCTION

An image is a two-dimensional representation of a genuine entity or a human having the same appearance as another thing. A two-dimensional, photographic, screen display and a three-dimensional, statue-like image are both examples of image. Visual instruments such as lenses, mirrors, cameras, detectors, microscopes, and anomalies and natural objects like as water particles or the human eye can capture them.Every two-dimensional image, such as a pie chart, graph, map, or abstract artwork, is referred to as an image in the broadest meaning. Images can also be created manually in this larger sense, for example, by painting, drawing, carving, or automatically by type-setting technology, or digital graphics are generated by a mixture of technologies,especially in pseudo-photography. It is determined by the mathematical equation f(x, y), where x is the horizontal coordinate and y is the vertical coordinate.

1.1 Literature Review

The perception of a road or lane is a critical issue. The perception of the road or lane is a key enabler for advanced driver assistance systems. As a result, for the past two decades, it has been a hotbed of research. With significant progress made in recent years The perception of a road or lane is a critical issue. A component that allows advanced driving assistance systems to work. As a result, it has been a hotbed of research over the past decade. . The subject was tackled in a variety of scenarios, each with a different task definition, resulting in the use of distinct sensing modalities and methodologies. In this study, we examine the methodologies and computational strategies used to solve the problem during the last 5 years, several methods. We give a general breakdown of the problem into its functional building pieces, as well as a comprehensive list of possible solutions. The plan For each functional block, we discuss and examine the many implementations that have been suggested hypotheses. While great progress was demonstrated in a few cases, a closer look at the requirements for next-generation systems exposes major gaps. We identify these chasms and propose research avenues that could fill them.

Vehicles are rapidly incorporating advanced driver aid systems, which either notify the driver in dangerous situations or actively participate in driving. Such systems are projected to get increasingly complicated as time goes on.During the following decade, we will have complete autonomy. The perception problem [1], which has two aspects, is the fundamental bottleneck in the development of such systems is the perception problem [1], which consists of two parts: road and lane perception and obstacle detection (i.e. automobiles and pedestrians). The first is taken into account in this survey.

The key perceptual clues for human driving are road colour and texture, road limits, and lane markings. Semi-autonomous and fully autonomous vehicles are intended to coexist with human drivers, therefore this trend is projected to continue to rely on perceptual cues similar to those used by humans. While different infrastructure cuing for human

DOI:10.22413/ijatest/2021/v6/i3/8

drivers and automobiles (e.g. lane markings for people) may theoretically exist,and a vehicle-to-infrastructure communication system.It is impractical to expect substantial expenditures in automobiles.Construction and maintenance of such a double infrastructure is required, with the danger of mismatched marking [2]. As a result, traditional cues for road and lane awareness remain the most likely approach for autonomous driving.

II. EXISTING METHOD:

There are already some existing methods for the lane detection.In this lane detectionfor autopilot vehicles using perspective and histogram approach the existing methods are

2.1Radar
2.2 Lidar
2.3 Minimalistic approach

2.1.Radar:

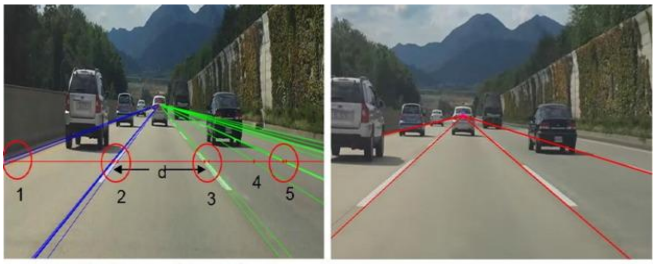
In this method,lanes are detected by placing a radar sensor.In this process,the radar reflector is integrated into the lane,so with the help of the reflected signals from these sensors.vehicles are guided to a proper laneRadar, lidar and ultrasonic sensors are very useful in covering from the short comings of cameras. Depth information, i.e.distance to objects can be measured effectivelyto retrieve3D information with these sensors, and they are not affected by illumination conditions. However, they are active sensors.Radars emit radio waves that bounce back from objects and measure the time of each bounce. Emissions from active sensors can interfere with other systems. Radar is a well-established technology that is both lightweight and costeffective.For example, radars can fit inside side-mirrors.Radars are cheaper and can detect objects at longer distancesthan lidars, but the latter are more accurate.

Fig.1.The ADS equipped Prius of Nagoya University.

2.2.LIDAR

In this method,lanes are detected based on the intensity of road surface points,if the lanes are provided with high intensity then they can be easily determined and the vehicles are guided to move in a proper lane.But here instead of radio waves from laser are used and the time for how long the light waves takes to hit and back to the scanner is calculated and from this the distance of lane is calculated. Lidar operates with a similar principle that of radar but it emits infrared light waves instead of radio waves. It has much higher accuracy than radar under 200 meters. Weather conditions such as fog or snow have a negative impact on the performance of lidar. Another aspect is the sensor size:smaller sensors are preferred on the vehicle because of limited space and aerodynam restraints and lidars are generally larger than radars.Inhuman sensing performance is compared to ADS.

One of the key findings of this study is that even though human drivers are still better at reasoning in general, the perception capability of ADSs with sensor-fusion can exceed humans, especially in degraded conditions such as insufficient illumination.



a. The lane marking estimation b. Lane markings indicated by red line segments

Fig.2. The lane marking estimation

Lidar light detection and ranging is aremote sensing method used to examine the surface of the earth.Topographic lidar typically uses a near infrared laser to map the land,while bathymetric lidar uses water-penetrating green light to also measure seafloor and riverbed elevations.Radar and Lidar are examples of active remote sensing where the time delay between emission and return is measured,establishing the location,speed and direction of an object.Passive sensors gather radiation that is emitted or reflected by the object or surrounding areas.Lane-detection is crucial information for driving autonomy.The lidar can detect the intensity of road surface points,so the lane mark will appear as high-intensity point segment in each scan layer.Detecting- lane markings and vehicles enables vehicles to evade collisions and support a warning system. Many researchers used the edge information and hough transformation to find straight line,which can be the lane markings.In addition,the modified Hough-transform approaches have been proposed for faster.

2.3.Minimalistic approach:

Generally the lanes are marked either in yellow or white colors.Soin this method,the color segmentation is used to detect the lanes that are of particular color and after doing some pre-processing and smo0thing the image,Hough transformation is used to extract the information related to lane.based on this information vehicles are guided to a proper lane.But for the above mentioned methods have some limitations as mentioned below:

2.4 Limitations:

1.Less accuracy
2.Suitable only for straight lane detections
3.More suspectable to external environmental conditions.

III. PROPOSED METHOD

The importance of autonomous road cars is growing, and all manufacturers are participating in research programmesto

DOI:10.22413/ijatest/2021/v6/i3/8

build semiautomated or completely automated systems. Although various research organisations have been working in this topic for over 20 years, the recent demonstrations of Google's automobiles seems to have piqued their attention. These self-driving cars all have the capacity to do two tasks: detecting objects to avoid collisions and positioning to plot a path. These two issues have been studied since their inception, and there is still no universal solution that fits the requirements of dependability, robustness, and efficiency for each.

Radar, laser scanners, and computer vision are the three most prevalent technologies for identifying long-range impediments. Each has its own set of benefits and drawbacks, and sensor fusion is frequently utilized to overcome these limits. Computer vision and laser scanner are two technologies that may be used to identify the surroundings of a vehicle and can also be utilized for autonomous steering.

Navigation methods such as waypoints utilising Global Navigation Satellite Systems (GNSS), tracking lines or other infrastructure features, and following the previous vehicle have all been used to improve autonomous vehicle control. In any scenario, vehicle positioning precision at the lane level is crucial for safe and accurate route guidance. The GNSS receiver is the principal sensor in this situation, and it can generate locations with a precision of up to 1 cm when differential correction is applied.

Laser scanners are becoming increasingly significant in the field of autonomous driving, especially as they have progressed from 2D to 3D scanning. The issues associated with 2D laser scanners are eliminated when 3D data is used, such as measurement inaccuracies caused by partially obscured observation of a barrier or higher detail in the information received. Furthermore, with 3D data, the information acquired is far more comprehensive and may be utilised for a variety of applications.

Fig.3a.sample Lanes on road used by vehicles

In situations where the GNSS receiver fails or provides accuracy below the required level, this paper presents an alternative system for maintaining the position of autonomous vehicles without adding other elements to the standard sensor architecture by using “histogram and perspective algorithms with computer vision” for both obstacle detection and lane detection.

3.1 Proposed method:

The suggested algorithm's failure spots were determined using the minimalistic technique outlined earlier. Figure 4.2 depicts the framework of the enhanced lane detecting methodology. A more robust lane-finding algorithm has been developed to address these failure points. The algorithm is optimized to recognize the lanes and the autonomous vehicle's safe zone. It also determines the ego vehicle's relative location with relation to the road lane markers.The algorithm's enhanced robustness can be attributable to the following enhancements**.**

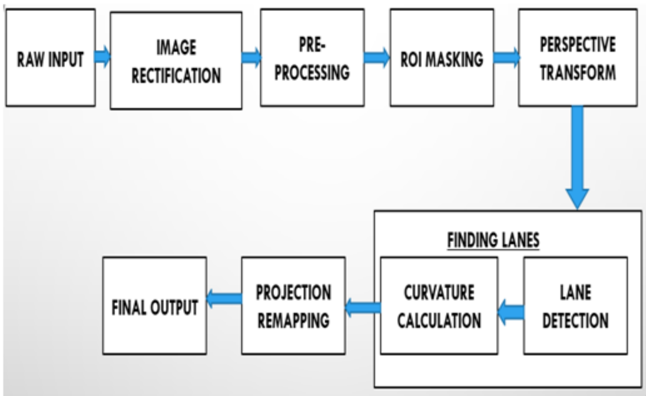


Fig.3.1a Framework of the advanced approach for lane detection.

3.2.Correction of camera distortion:

Lens distortion and occlusions are natural camera characteristics that must be handled when designing a reliable computer vision programme. Before moving on to the next stage of the algorithm, we employed the camera calibration approach outlined in to calibrate our cameras. This guarantees that the algorithm is consistent.The contrast between the original image and the undistorted image is seen in Figure.

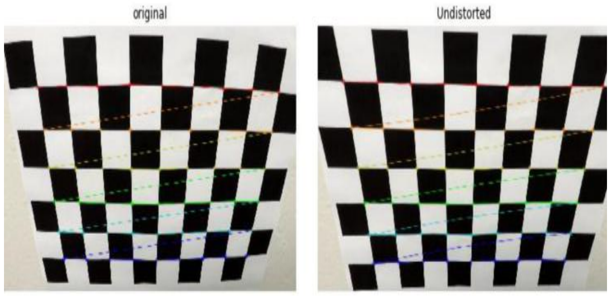


Fig.3.2b.Demonstration of camera calibration**.**

3.3.Color segmentation that is more extensive:

In contrast to the previously mentioned strategy of employing a single-color space, the current work employs a hybrid of two-color spaces: HLS and LAB (with L for lightness and A and B for the color dimensions). Yellow and white lines are detected differently in the two-color spaces. The current effort, like the prior work, is focused on keeping the binary thresholding and masking approach after each of the color spaces. The RGB-to-LAB color-space conversion is mathematically modelled as follows.

IV. PERSPECTIVE TRANSFORMATION

The algorithm mentioned before failed to recognise curved lanes, which is a major drawback in its performance. A lane detection approach is given here that employs a viewpoint modification to enhance lane detection. When seen from a different angle, certain traits can be identified with greater precision. One such element is the curve of the road lane markers. The suggested method employs a perspective

DOI:10.22413/ijatest/2021/v6/i3/8

transform to convert the undistorted image into a "birds eye view" of the road that focuses primarily on the lane lines and presents them in such a way that they appear to be substantially parallel to one another.

The mapping coordinates for the perspective transformation are listed in Table 4.1. The bird's-eye view of the original image following the perspective change is shown in Fig.4.9. The matrix of a perspective transform is calculated in such a way that

$$\begin{bmatrix} TiXi1 \\ TiYi1 \\ Ti \end{bmatrix} = \text{M.} \begin{bmatrix} Xi \\ Yi \\ 1 \end{bmatrix}$$

where

(Xi1 , Yi1)→ coordinates of the corresponding quadrangle vertices in the destination image (Xi,Yi)→ the coordinates of quadrangle vertices in the source image.

We then use the calculated [3 × 3] matrix M to transform the image as follows:

$$\textbf{dst(x,y)=SR}C\left(\frac{\mathbf{M11x + M12y + M13}}{\mathbf{M31x + M32y + M33}}, \frac{\mathbf{M21x + M22y + M23}}{\mathbf{M31x + M32y + M33}}\right)$$

where

dst(x, y)→coordinates of pixels in the transformed image and

src(x,y) →coordinates of pixels in the source image.

5.Result:

Performance comparison of proposed and conventional algorithms:

The following shows the outcome of comparing the suggested lane-finding method to the standard technique [15].The suggested approach can effectively locate lanes even when the road surface changes, but the minimalistic lane-finding approach, as demonstrated fails in circumstances when the road surface changes.

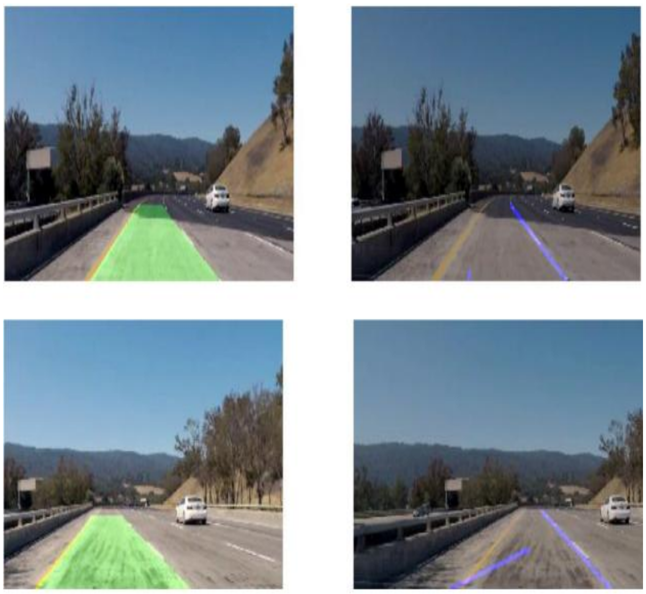


Fig.4a.Result of the proposed lane-finding algorithm compared with that of the conventional algorithm

The accompanying example exhibits the suggested algorithm's resistance to changes in illumination and road surface. When compared to the previous basic method, the suggested sanity tests and filtering algorithms appear to be more resilient. The revised perspective-transform-based technique increases the algorithm's robustness, allowing it to recognize curving roadways with more accuracy than the minimalistic technique previously described.

5.1Process time analysis of the proposed algorithm

The following table 5.1 shows the processing time of our suggested system. On a system with an Intel Core i5 (6th generation) CPU, 8 GB of RAM, and no GPU acceleration, the system was evaluated on a sample movie with a resolution of 1280 720 pixels (HD quality). The results of the algorithm time study show that the suggested method is efficient, taking just 63.65 milliseconds on average. In real-world settings, this equates to 15.7 frames per second. The suggested algorithm's stepwise time analysis data throughout the number of frames and time distribution are shown in above Fig.

Table.1. Processing time analysis of the proposed system (in Milliseconds).

PROCESING FACTOR	TIME (in milli sec)
Image Rectification	11.4
Pre-processing	29.91
ROI Masking	1.33
Perspective Transformation	4.41
Finding Lanes	12.12
Projection Remapping	4.48
Total	**63.65**

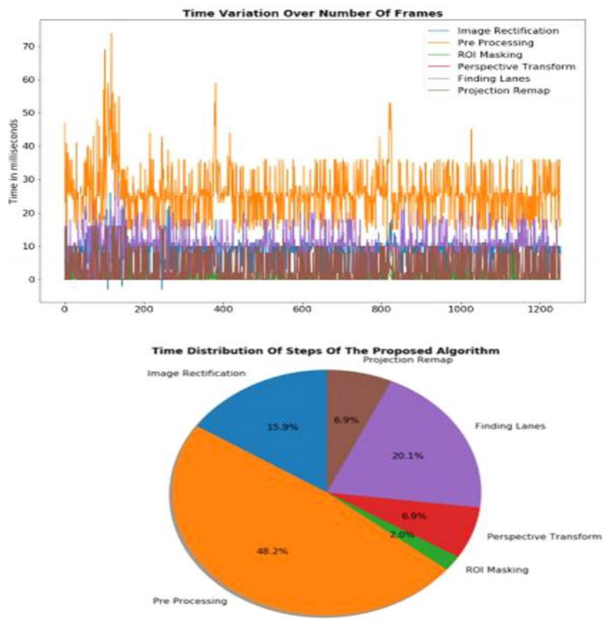


Fig. 4b.Stepwise time analysis data from the proposed algorithm

DOI:10.22413/ijatest/2021/v6/i3/8

V.CONCLUSION

Although the minimalistic lane-finding algorithm was successful in detecting straight lane markings, it cannot be used for curved and steep lane markings. Consequently, we have proposed the use of perspective transformation and a histogrambased search to detect curved or steep lane markings. The shortcomings of the minimalistic approach were overcome with the advanced lane-finding approach, which is more robust and less susceptible to different environmental conditions. By observing the simulation results, we can conclude that the proposed advanced lane detection approach is better than the conventional techniques. This work can be extended for big data and cloud environments, which requires intelligent techniques using neural networks and deep learning

REFERENCES

[1] Lu M, Wevers K, Heijden RVD. Technical feasibility of Advanced Driver Assistance Systems (ADAS) for road traffic safety. Transp Plan Technol June. 2005;28(3):167–87.

[2] Bengler K, Dietmayer K, Farber B, Maurer M, Stiller C, Winner H. Three Decades of Driver Assistance Systems: Review and Future Perspectives. IEEE IntellTransp Syst Mag 2014;6(4):6–22.

[3] Abraham H, Reimer B, Mehler B. Advanced Driver Assistance Systems (ADAS): a consideration of driver perceptions on training, usage &implementation. In: Proceedings of the human factors and ergonomics society annual meeting, 61; 2017. p. 1954–8.

[4] Domínguez R, Onieva E, Alonso J, Villagra J, González C. LIDAR based perception solution for autonomous vehicles. In: Proceedings of the eleventh international conference on intelligent systems design and applications; 2011. p. 790–5.

[5] Rasshofer H, Gresser K. Automotive radar and lidar systems for next generation driver assistance functions. Adv Radio Sci May 2005;3:205–9.

[6] an X, Li Y. A method of lane edge detection based on Canny algorithm. In: Proceedings of the Chinese automation congress (CAC); 2017. p. 2120–4.

[7] Talib ML, Rui X, Ghazali KH, MohdZainudin N, Ramli S. Comparison of Edge Detection Technique for Lane Analysis by Improved Hough Transform. In: Lecture notes in computer science, 8237. Cham: Springer; 2013. p. 176–83.

[8] Yan X, Li Y. A method of lane edge detection based on Canny algorithm.. In: Proceedings of the Chinese automation congress (CAC); 2017. p. 2120–4.

[9] Amaradi P, Sriramoju N, Dang Li, Tewolde GS, Kwon J. Lane following and obstacle detection techniques in autonomous driving vehicles. In: Proceedings of the IEEE international conference on electro information technology (EIT); 2016. p. 0674–9.

[10] Assidiq AA, Khalifa OO, Islam MR, Khan S. Real time lane detection for autonomous vehicles. In: Proceedings of the international conference on computer and communication engineering; 2008. p. 82–8.16 R. Muthalagu, A. Bolimera and V. Kalaichelvi / Computers and Electrical Engineering 85 (2020) 106653.