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Road Lane Line Detection System by Using Cnn and Rnn Algorithms in Deep Learning

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ABSTRACT
One of the most fundamental tasks in computer vision for autonomous driving is lane lines detection on road. Lane lines are painted for humans to see and follow while driving. In a very similar way, an autonomous vehicle that uses human designed infrastructure, needs to *see* the lane markings to steer accordingly and follow the road trajectory. In this project I implemented a computer vision algorithm that processes real data recorded with the front facing camera of a vehicle driving on a California highway. The result is a processed video that highlights the lane lines on the paved road. With the positions of the lane lines identified, the vehicle's offset from the lane's center can be calculated and feed a PD controller to compute the necessary steering angle. While only the lane lines detection is the scope. Then we create a function called draw line (the dram line method's purpose is to draw lines or lines). The Hough line transform method is used to detect lanes or lanes from the replacement image in polygon images. The detected line or lanes are then drawn. Finally, when the lines are drawn, we blend the previous image.

Keyword: Computer vision, autonomous, lane lines, infrastructure and polygon image.

I. Introduction

The World Health Organization states that approximately 1.24 million people die every year due to traffic accidents. This number is expected to increase to 2.2 million by the year 2030. These statistics are alarming and indicate that measures need to be taken to address the issue of road safety.[2] Autonomous vehicles are a potential solution to this problem. These vehicles rely on sensors such as cameras and radars to collect data and use a computer-based system for intelligent driving, which allows them to operate without a human driver. One of the key components of autonomous vehicles is lane line identification, which directly impacts the safety performance of the vehicle.

Lane line detection methods have been extensively researched both in foreign and domestic research studies, and they can be broadly classified into two categories: feature-based and model-based methods. Some of these methods utilize techniques to enhance the contrast between the lane line and the road by adjusting the brightness, gain, and exposure time of the

CCD. Seed points of the image are then selected and classified, and Hough transform is performed on these points. Others use circular curve lane line models and density-based Hough transformation for lane line recognition.[6] Some researchers use boundary tracking detection algorithms based on fuzzy clustering to recognize the interested area of the lane.

Despite these advancements, detecting lane lines accurately remains a significant challenge due to various factors such as light, wear, vehicle shade, and tree shadow. Therefore, a new algorithm has been proposed to detect lane line pixels quickly.[9] This algorithm utilizes a combined gradient and color filter of the region of interest to identify the lane lines. First, the algorithm uses the Sobel edge detection operator to detect the edge information of the structured road based on the high contrast between the lane line and the road surface. Secondly, the color characteristics of the lane line are taken into account.[14] Lane lines usually come in two colors: white and yellow. Therefore, the algorithm filters these two colors in the color space to extract the pixel of the lane line. By combining edge gradient and color filter, a relatively stable lane line extraction method is obtained in the region of interest model.[7]

The development of an accurate and reliable lane line detection algorithm is essential for the widespread adoption of autonomous vehicles. This algorithm has the potential to significantly reduce traffic accidents and save millions of lives in the future.[13] The proposed algorithm is fast, efficient, and can be easily implemented in various autonomous vehicle systems. However, further research is required to improve the accuracy and robustness of the algorithm, especially under challenging road conditions. With continued efforts and research, autonomous vehicles may soon become a common sight on roads, providing a safer and more efficient means of transportation.[3]

II. Literature Survey

The detection of lanes on roads is an essential task for intelligent transportation systems, and various techniques have been developed for this purpose.[7] In this review, we consider a recent paper that explores the use of neural networks for lane detection, particularly a multitask deep CNN. The paper reports that both CNN and RNN detectors are effective in detecting lanes.

The lane detection process begins with the acquisition of a road image using a camera attached to the vehicle. To reduce processing time, the image is then translated into a grayscale image. However, the presence of disturbances captured in the image can interfere with the accurate detection of edges. Therefore, filters such as bilateral, Gaussian, and trilateral filters are activated to remove noise.[20] An edge detector can then be used to produce an edged image, using machine-generated thresholding and a Canny filter to obtain the edges.[5] A line detector is then used to detect the left and right segments of the lane boundary, and yellow and white lanes are obtained using RGB color codes.

The techniques used for lane detection play a significant role in intelligent transportation systems, and the paper highlights the need for further research to improve the efficiency of the setup. The authors suggest that future work could involve changing the current Hough

Transformation to account for curved and straight roads separately, as this approach may not produce accurate results in poor environmental conditions such as haze, clouds, rain, or storms.

Overall, the paper provides valuable insights into the use of neural networks for lane detection and suggests avenues for future research to improve the efficiency and accuracy of the technique.[16]

III. System Architecture

Image acquisition: A camera attached to the vehicle captures images of the road, which are then processed for lane detection.

Pre-processing: The acquired image is translated into a grayscale image to reduce processing time. Filters such as bilateral, Gaussian, and trilateral filters are activated to remove noise.

Edge detection: An edge detector is used to produce an edged image, which is obtained using machine-generated thresholding and a Canny filter to detect edges.

Lane detection: A line detector is used to detect the left and right segments of the lane boundary. Yellow and white lanes are obtained using RGB color codes.

Neural network implementation: A multitask deep CNN or RNN detector can be implemented to improve the accuracy of the lane detection process.

Integration with intelligent transportation systems: The lane detection system can be integrated with other intelligent transportation systems, such as autonomous vehicles, to improve road safety.

Further research: The system architecture can be improved through further research, such as incorporating deep reinforcement learning for more effective lane detection in various weather and lighting conditions.

Fig. 1 original image

IV. Implementation

The methodology used for the lane detection system involves several steps. Firstly, a video of the road surface is captured using a camera attached to the vehicle. The video is then converted into a sequence of images for processing.

Next, edges are detected from the image sequence using edge detection techniques. The Hough line transform method is then applied to select the lane lines from the image. The detected lines are tracked, and the lines are drawn on the lane boundaries.

The lane detection process starts with the selection of vertices on the X and Y axis of the image to define a polygon. The image is then converted into grayscale to simplify the image processing. Edge detection is performed on the grayscale image to detect the edges of the lane boundaries.

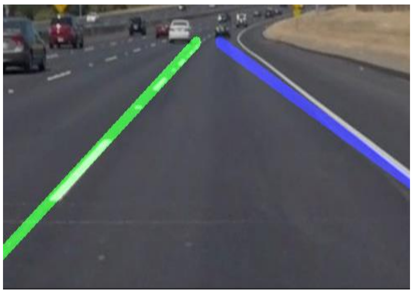

Fig. 2 lane lines detected

The middle point of the original image is identified to determine the polygon from which the lane boundaries will be detected. Edge detection is again performed on the polygon selected area to detect the lane boundaries using the Hough line transformation method. The detected lines are then drawn on the lane boundaries.

The methodology includes several image processing techniques and algorithms, such as edge detection and the Hough line transformation, to accurately detect the lane boundaries. The system can be further improved by incorporating deep learning techniques, such as convolutional neural networks, to enhance the accuracy of lane detection in various weather and lighting conditions. Overall, the methodology provides a robust and effective approach to lane detection for intelligent transportation systems.

System Flow Diagram:

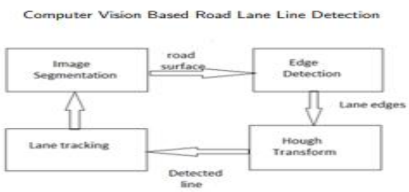

Figure 1: The whole process for Road Lane Line detection in one image.

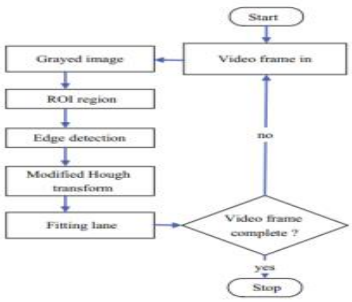

Figure 2: Flow chart of Road Lane Line detection system.

The user accesses the website and selects the desired time slot and parking spot. The website sends a request to the database to check for availability. If available, the user is directed to make the payment. Once payment is confirmed, a confirmation message is sent to the user, and the spot is reserved for the specified time.

Screenshots:

Fig. 3 Algorithms prediction

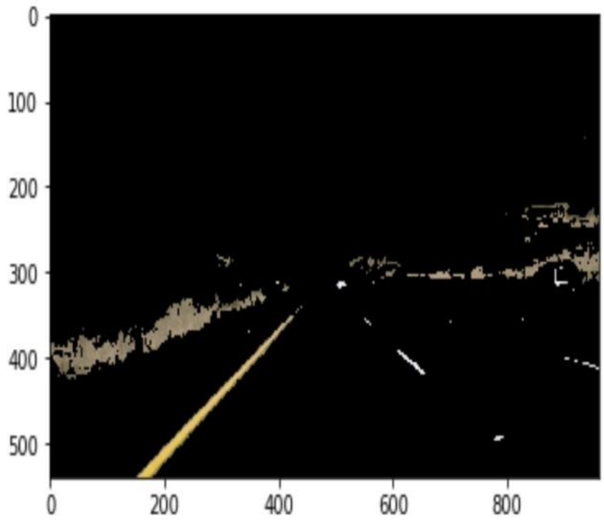

Fig. 4 Algorithm detecting lines

V. Conclusion

Lane detection is an essential component of intelligent transportation systems, providing critical information for safe and efficient driving. The use of cameras and image processing techniques to detect lane boundaries has become increasingly popular in recent years. The system architecture and

described in this example demonstrate an effective approach to lane detection using a combination of edge detection and the Hough line transformation. By selecting vertices on the X and Y axis of the image to define a polygon, edge detection can be performed on a smaller area of the image, improving the accuracy of lane detection. However, the system may not work well in poor weather or lighting conditions, and the accuracy of lane detection may be affected by occlusions or objects in the lane. To address these limitations, further research is needed to improve the accuracy and robustness of the lane detection system. Deep learning techniques, such as convolutional neural networks, may be useful in improving lane detection accuracy in various environmental conditions.

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