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Lane Detection using Neural Networks

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Abstract - *Numerous groups have conducted many studies on lane detection. However, most methods detect lane regions by color feature or shape models designed by human. In this paper, a traffic lane detection method using fully convolutional neural network is proposed. To extract the suitable lane feature, a small neural network is built to implement feature extraction from large amount of images. The parameters of lane classification network model are utilized to initialize layers' parameters in lane detection network. We use Canny and Hough algorithm for detecting the lanes accurately In particular, a detection loss function is proposed to train the fully convolutional lane detection network whose output is pixel-wise detection of lane categories and location.The designed detection loss function consists of lane classification loss and regression loss. With detected lane pixels, lane marking can be easily realized by random sample consensus rather than complex post-processing. Experimental results show that the classification accuracy of the classification network model for each category is larger than 97.5%. And detection accuracy of the model trained by proposed detection loss function can reach 82.24% in 29 different road scenes.*

***Key Words*: Convolution Neural Network, Canny algorithm, Hough algorithm, Pixel-wise detection**

1. INTRODUCTION

Traffic accidents have become one of the most serious problems in today's world. Roads are the mostly chosen modes of transportation and provide the finest connections among all modes. Most frequently occurring traffic problem is the negligence of the drivers and it has become more and more serious with the increase of vehicles. Increasing the safety and saving lives of human beings is one of the basic function of Intelligent Transportation System (ITS).

Intelligent transportation systems are advanced applications which aim to provide innovative services relating to different modes of transport and traffic management. This system enables various users to be better informed and make safer, more coordinated, and smarter use of transport networks. These road accidents can be reduced with the help of road lanes or white markers that assist the driver to identify the road area and non-road area. A lane is a part of the road marked which can be used by a single line of vehicles as to control and guide drivers so that the traffic conflicts can be reduced.

This study proposed a lane detection algorithm for vehicles in complex road conditions and dynamic environments Firstly, converting the distorted image and using the superposition threshold algorithm based on the Sobel operator and color space for edge detection, an aerial view of the lane was obtained by using ROI extraction and inverse perspective transformation. Compared with traditional methods and deep learning based methodologies, this lane detection algorithm had excellent accuracy and real-time performance, high detection efficiency and strong anti-interference ability.

2. LITERATURE SURVEY

2.1. Lane Detection of curving roads for structural high-way with Straight Curve Model on Vision published in 2019 by IEEE transaction on Vehicular Technology

Curve is the traffic accident-prone area in the traffic system of the structural road. How to effectively detect the lane-line and timely give the traffic information ahead for drivers is a difficult point for the assisted safe driving. The traditional lane detection technology is not very applicable in the curved road conditions. Thus, a curve detection algorithm which is based on straight-curve model is proposed in this paper and this method has good applicability for most curve road conditions. First, the method divides the road image into the region of interest and the road background region by analyzing the basic characteristics of the road image. The region of interest is further divided into the straight region and the curve region. At the same time, the straight-curve mathematical model is established. The mathematical equation of the straight model is obtained by using the improved Hough transform. The polynomial curve model is established according to the continuity of the road lane-line and the tangent relationship between the straight model and the curve model. Then, the parameters of the curve model equation are solved by the curve fitting method. Finally, the detection and identification of the straight and the curve are realized respectively and the road lane-line is reconstructed. Experiments show that this method can accurately identify the curve lane-line, provide effective traffic information, make early warning and it also has a certain universality.

2.2. Passenger Compartment Violation Detection in HOV/HOT Lanes published in 2015 in IEEE transactions on intelligent Transport Systems

Due to the high volume of traffic on modern roadways, transportation agencies have proposed high occupancy vehicle (HOV) and high occupancy tolling (HOT) lanes to promote carpooling. Enforcement of the rules of these lanes is currently performed by roadside enforcement officers using visual observation. Officer-based enforcement is, however, known to be inefficient, costly, potentially dangerous, and ultimately ineffective. Violationratesupto50%–80% have been reported, whereas manual enforcement rates of less than 10% are typical. Near-infrared (NIR) camera systems have been recently proposed to monitor HOV/HOT lanes and enforce the regulations. These camera systems bring an opportunity to automatically determine vehicle occupancy from captured HOV/HOT NIR images. Due to their ability to see through windshields of vehicles, these cameras also enable enforcement of other passenger compartment violations such as seatbelt violation and driver cell phone usage, in addition to determining vehicle occupancy.

2.3. Automatic Detection and Classification of Road Lane Markings Using Onboard Vehicular Cameras published in 2015 by IEEE transaction on Intelligent Transport Systems

This paper presents a new approach for road lane classification using an onboard camera. Initially, lane boundaries are detected using a linear–parabolic lane model, and an automatic on-the-fly camera calibration procedure is applied. Then, an adaptive smoothing scheme is applied to reduce noise while keeping close edges separated, and pairs of local maxima–minima of the gradient are used as cues to identify lane markings. Finally, a Bayesian classifier based on mixtures of Gaussians is applied to classify the lane markings present at each frame of a video sequence as dashed, solid, dashed solid, solid dashed, or double solid. Experimental results indicate an overall accuracy of over 96% using a variety of video sequences acquired with different devices and resolutions.

2.4. Real Time Lane Detection for Autonomous Vehicles published in 2016 at International Conference on computer and communication Engineering

An increasing safety and reducing road accidents, thereby saving lives are one of great interest in the context of Advanced Driver Assistance Systems. Apparently, among the complex and challenging tasks of future road vehicles is road lane detection or road boundaries detection. It is based on lane detection (which includes the localization of the road, the determination of the relative position between vehicle and road, and the analysis of the vehicle's heading direction). One of the principal approaches to detect road boundaries and lanes using vision system on the vehicle. However, lane detection is a difficult problem because of the varying road conditions that one can encounter while driving. In this paper, a vision-based lane detection approach capable of reaching real time operation with robustness to lighting change and shadows is presented. The system acquires the front view using a camera mounted on the vehicle then applying few processes in order to detect the lanes. Using a pair of hyperbolas which are fitting to the edges of the lane, those lanes are extracted using Hough transform. The proposed lane detection system can be applied on both painted and unpainted road as well as curved and straight road in different weather conditions. This approach was tested and the experimental results show that the proposed scheme was robust and fast enough for real time requirements. Eventually, a critical overview of the methods were discussed, their potential for future deployment were assist.

3. EXISTING SYSTEM

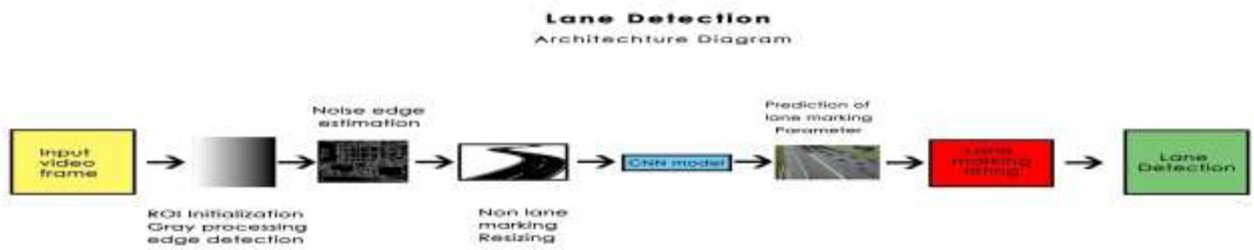
The outcomes have been acquired based on the samples from real-world scenarios of the road environment as of the road testing. The images and vehicle signals have been acquired from a monocular camera installed in a commercial vehicle windshield and instrumentation of the data bus. The use of IPM algorithm allows the range determination, of the tracking for several ROI sizes. The smaller ROI (100 lines) analyzed covers a range of 10.4 m ahead of the vehicle; the largest (150 lines) reaches a coverage of 34.5m

4. PROPOSED SYSTEM

This study proposed a lane detection algorithm for vehicles in complex road conditions and dynamic environments Firstly, converting the distorted image and using the superposition threshold algorithm based on the Sobel operator and color space for edge detection, an aerial view of the lane was obtained by using ROI extraction and inverse perspective transformation. Compared with traditional methods and deep learning based methodologies, this lane detection algorithm had excellent accuracy and real-time performance, high detection efficiency and strong anti-interference ability.

5. SYSTEM ARCHITECTURE AND MODULES

A system architecture is the conceptual model that defines the structure, behavior, and more views of a system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system.

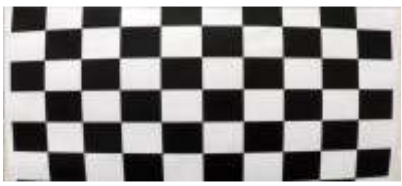


MODULES

- Calibrate the camera
- Threshold the image using gradients and colors
- Perspective transform
- Identify the lane lines

5.1 Calibrate the camera

Calibrating the camera really means accounting for the distortion in an image introduced by the camera's lens. This is done using multiple images of checkerboard patters, which *should* have straight lines. Examining how the checkerboard patterns are distorted (not straight) allows us to precisely identify **how** the camera lens is distorting images.



5.2 Threshold the image using gradients and colors

Thresholding is a method of isolating the pixels we are interested in. This can be done using a combination of gradient and color filters. Here's what a thresholded image looks like next to the original. The original road image and a thresholded image. I applied pixel-gradient and color threshold filters to narrow down the pixels of interest (lane lines).

5.3 Perspective transform

While undistorting and thresholding help isolate the important information, we can further isolate that information by looking only at the portion of the image we care about—the road. To focus in on the road-portion of the image we shift our perspective to a top-down view of the road in front of the car. While we don't gain any extra information from this step, it's much easier to isolate lane lines and measure things like curvature from this perspective.

5.4 Identify the lane lines

Finally, we take all this information we gathered and draw the results back onto the original image. The blue and red lines we identified above are present, and the space between them is colored green to show the lane. The calculated right/left lane curvature and center-lane offset are shown in the top-left of the image as well. (These values would be useful when telling a self-driving car how to steer.)

6. CONCLUSION

The experimental results show that the algorithm can accurately identify the road lane-line and give the deviated information of vehicle and the direction of the curve. It has great significance to improve the active safety driving and assisted driving of the vehicle which is in the curved road conditions. Eventhough, lot of progress has been attained in the lane detection and tracking area, further improvements can be made as per the requirements.

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