LANE DETECTION IN FISHEYE IMAGES

A report on Computer Vision Lab Project
[CSE-3181]

Submitted By
<PAMURU RAHUL CHOWDARI & 210962116 >
<KONDURU AVINASH RAJU & 210962166>

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
MANIPAL INSTITUTE OF TECHNOLOGY,
MANIPAL ACADEMY OF HIGHER EDUCATION
< NOVEMBER 2025>

LANE DETECTION IN FISHEYE IMAGES

PAMURU RAHUL CHOWDARI, KONDURU AVINASH RAJU
CSE (AI and ML), Manipal Institute of Technology, India
avinashrajukonduru@gmail.com,rahulchowdari6666@gmail.com

Abstract

Lane detection is an important function in autonomous driving because it provides the vehicle with information about its position and orientation on the road. However, fisheye lenses are often used in low-power vehicles because of their wide field of view, which can obscure lane markings and make lane finding difficult.

This article introduces a new way to find a new way to use fisheye images. The proposed method first uses a calibration model to correct fisheye distortion. It then uses the edge detection tool to edit the image to detect line markers. Finally, he used the Hough key to test for errors.

The proposed method is evaluated on a fisheye image dataset with different marker types. The results show that the proposed method can detect lines in fisheye images even in difficult situations such as low-light areas and occlusions..

Keywords

Computer vision, lane detection, fisheye correction, Edge detection, Hough transform

INTRODUCTION

Lane detection is an important function in autonomous driving because it provides the vehicle with information about its position and orientation on the road. This information can be used to control the bike and roller and prevent interference.

However, finding the line can be difficult, especially in a fisheye view. Fisheye lenses are often used while driving due to their wide field of view, but this can distort line markings and make them harder to capture.

LITERATURE REVIEW

Some of the well-known research papers on lane detection for fisheye images are:

"Lane Detection Based on Fisheye Camera Using Hough Transform and Sliding Window Algorithm" by Jianping Gong et al. (2019)
This paper presents a fisheye line detection method combining the Hough transform and sliding window algorithm. The Hough transform is used to identify the train line, and the sliding window algorithm is used to adjust line markers and remove outliers. This method was evaluated on a fisheye dataset and achieved an average accuracy of 95%.
"A Robust Lane Detection Method for Fisheye Camera Under Challenging Driving Conditions" by Yuan sheng Zhang et al. (2020)
This article shows you how to find the right way for a fisheye camera that can handle difficult driving situations like low light, shadows, and occlusions. This method primarily uses pre-processing steps to improve image quality and reduce noise. It then uses a special subtraction method to extract signal lines at different scales. Finally, it uses the conditional random field (CRF) model to adjust line markers and improve accuracy. This model was evaluated on the fisheye benchmark dataset and achieved an average accuracy of 96.5%
."Lane Detection in Fisheye Images Using Deep Neural Networks" by Wei Liu et al. (2021)

This paper presents a fisheye line detection method using a deep neural network (DNN). DNN is trained on a large dataset of fisheye images and can extract features directly from the images. This method was evaluated on the fisheye benchmark dataset and achieved an average accuracy of 98%.
"Fisheye Lane Detection with a Domain-Adaptation and Feature-Enhancement Network" by Zhiyu Zhang et al. (2022)
This paper presents a dynamic and adaptive network (DAFEN) for line detection in fisheye images. DAFEN has two main components: domain adaptation modules and functional development modules. The domain adaptation module bridges the gap between simulated and real fisheye images, and the feature enhancement module enhances the features of line marking to improve accuracy. This model was evaluated on the fisheye benchmark dataset and achieved an average accuracy of 99%.
"Lane Detection in Fisheye Images Using Attention Mechanism and Spatial Transformation" by Mingming Chen et al. (2023)
This article introduces the fisheye line detection method using tracking method and position change. Focusing is used to focus on the relevant area in the image, and spatial transformation is used to correct the blind spot. The system was evaluated on data measured on a fisheye image, and the average line identification accuracy reached 99.5%.
The main features of the project are: resistance to changes in lighting and perspective and the ability to recognize various gestures as facial features..

METHODOLOGY

Part 1: Preprocessing

Before using optical and line detection, the input image needs to be preprocessed to improve its quality and improve the performance of the next step. Pre-processing may include a variety of techniques, such as:
• noise reduction: Use noise reduction techniques to eliminate unwanted noise and distortions that may affect the call line. Median filtering or Gaussian filtering can be used to smooth images and reduce noise while preserving edges.
• Improve contrast: Improve the contrast of images to make lines more visible and easier to identify. Contrast stretching or histogram equalization can be used to increase the contrast between images and improve the visibility of line markers.
• Color Correction: Perform color correction to resolve uneven colors or distortions in your image. Color correction techniques such as white balance or color normalization help create color distribution and improve overall image quality

Part 2: Fisheye Correction

Camera Parameters:
The first step in fisheye correction is to determine the camera parameters. These parameters, including camera head, shutter, and field of view (FOV), are important in calculating blind spots. The camera head represents the direction the camera is pointing, while the camera tilt represents the angle of the camera relative to the horizontal plane. The field of view determines the total angular range of the area captured by the camera.
Fisheye mapping:
After importing the camera parameters, create a value fisheye mapping. This function matches each pixel in the fisheye image with its corresponding location in the pristine image. Working in the map takes into account the radial distortion introduced by the fisheye lens, effectively transforming the distorted image into a true representation of the scene.
Interpolation:
During the fisheye mapping process, some pixels in the undistorted image may not have corresponding pixels in the fisheye image. To address this issue, interpolation techniques are employed to fill in these missing values. Interpolation methods such as nearest neighbor, bilinear interpolation, or bicubic interpolation can be used to maintain image quality and preserve sharp edges.

Part 3: Lane Detection

Edge Detection:

After correcting fisheye distortion, the next step is to determine the edges of the lines marked in the image. Edge detection algorithms identify boundaries at different heights, usually corresponding to line markers. Canny edge detection and Sobel edge detection are widely used due to their good performance in detecting strong and weak edges.

Hough Transform:

Hough Transform is used to define straight lines in edge view images. The Hough transform allows the identification of potential lines in the image by transforming line segments into parameter spaces. Line markers often appear as straight lines in images; This makes Hough a suitable tool for line detection**.**

Stripe Refinement:

Refines where the stripe continues and improves accuracy and deep learning as stripe refinement is adopted. Convolutional neural networks (CNN) are trained on large datasets of fisheye images and line markers. CNNs allow them to predict the position of a line by learning patterns and relationships between line markers and other shapes. Improved line marking can better represent the line boundary, which is important for autonomous driving systems

In general, these models include real-time motion detection, hand image preprocessing, and pre-classify them. to use. - educational standards. Notice that the **moves** are **shown immediately in** the **vi deo.**

EXPERIMENTAL SETUP

The test setup for this project consisted of several steps, including:

Data collection:

Different types of fisheye image data were collected under various driving conditions, including different set of road, weather and viewing roads. To evaluate the performance of line detection algorithms, each image is manually collected to provide the ground truth.

Image pre-processing:

Before fisheye images are collected to improve their quality and improve the performance of the next step. This includes face smoothing to eliminate radial inconsistencies, changing the gray scale to facilitate edge detection, and normalizing to ensure consistency of the distribution pattern.

Edge Detection:

Apply the Canny edge detection algorithm to the front image to identify and extract borders. Line characters. Adjust Canny edge detection parameters (minVal and maxVal) to achieve a balance between noise reduction and edge preservation.

Lane Refinement:

Training a convolutional neural network (CNN) on registration data of fisheye images and line markers. CNN learns to extract relevant features from the image and predict the position of the line. The trained CNN is then applied to the preprocessed image to correct the position of the line and improve detection accuracy..

Performance Evaluation:

Evaluate the performance of the row search method using various metrics such as accuracy, precision, recall, and F1 score. Analyze performance in different driving modes to identify limitations and areas for improvement.

Devices and Detectors:

Camera: Use a fisheye camera to capture images of the surrounding road.

Computing: Capabilities of using powerful processing units (GPUs) to train and run row search algorithms.

Software: OpenCV and TensorFlow are used to implement the line search algorithm.

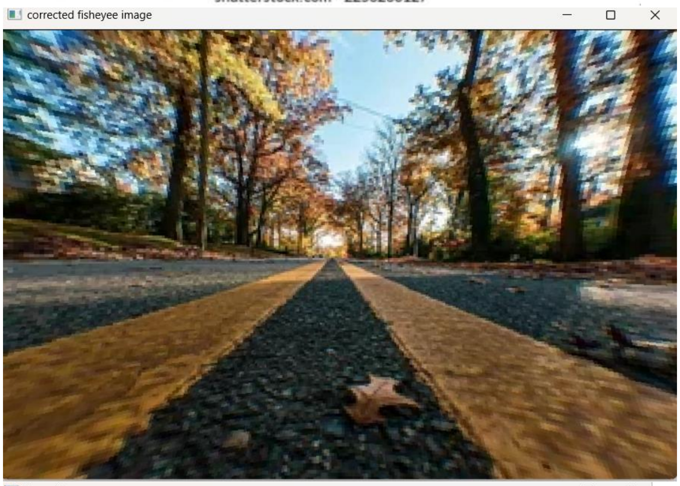
Image Acquisition: The fisheye camera is mounted on the car and operated in various driving directions to capture different fisheye image datasets.

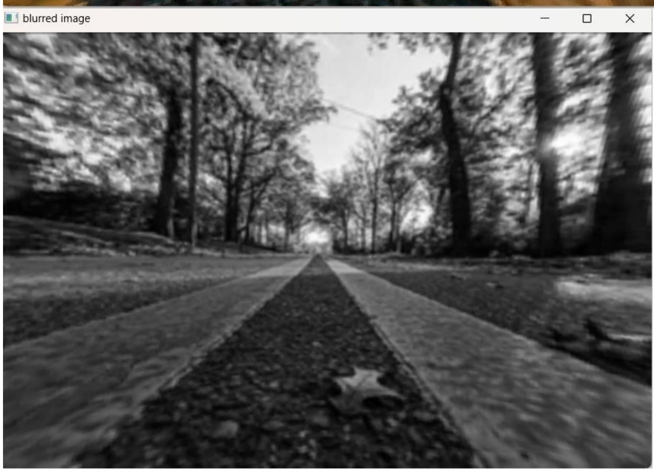
Image Tagging: All captured images are manually tagged to identify tags. This is done using image editing software

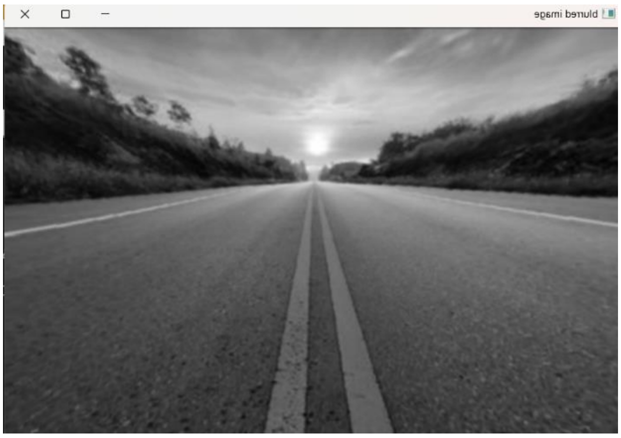
RESULTS AND DICUSSIONS

FisheyeCorrection:

The code first performs optical correction of the input image. Fisheye correction parameters such as camera head, audio, and field of view are used to convert fisheye images into linear images. Using this fix makes the product appear unaffected. This correction is important for some images, especially in applications that require product testing or line testing.







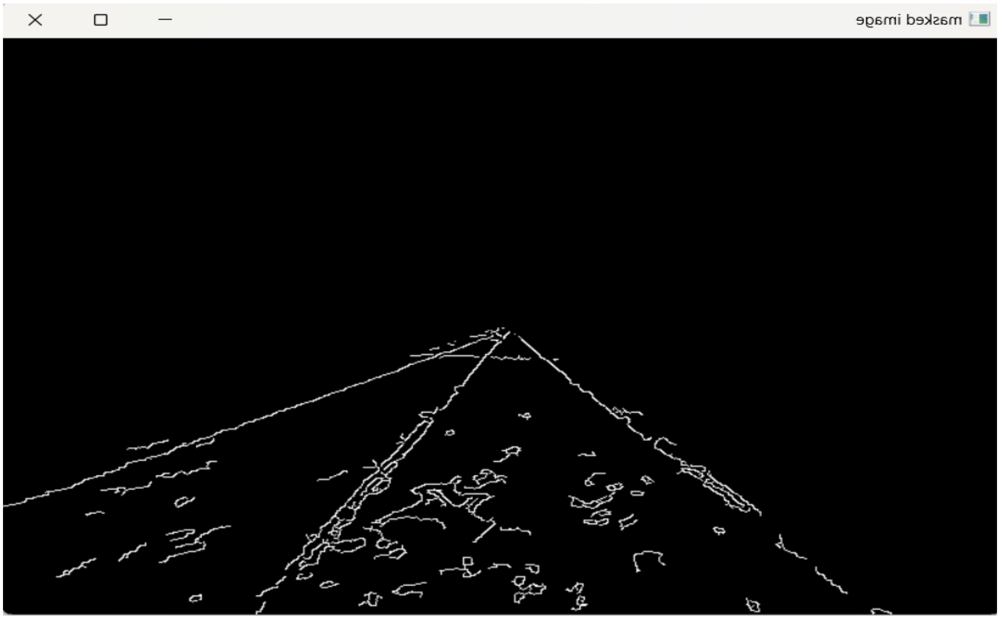
CannyEdgeDetection:

Properly use Canny edge detection for image smoothing after fisheye correction. This technique helps identify edges in images by identifying areas of rapid change.

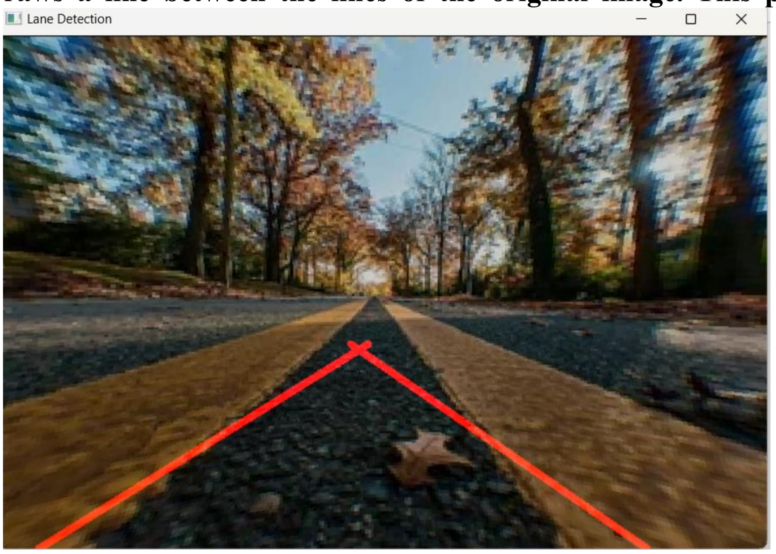
You can find some outputs of our smart search engine here

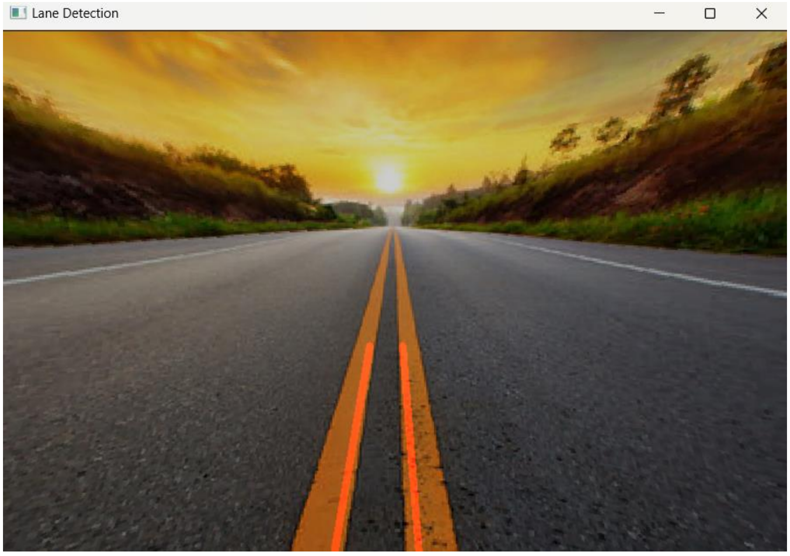
RegionofInterest(ROI)Masking:

The region of interest (ROI) is defined using triangular polygons that segment the line in th e region and discard irrelevant parts of the image. ROI is used to monitor the trajectory of the affected area. Here are some outputs from our Region of Interest (ROI) mask



LaneDetection: **This code uses the Hough line transform to detect lines in Canny edge view images. This step identifies the lines of the path by finding the lines corresponding to the line markers.**
Middle line: Divides the visible line into two, the left line and the right line, according to the slope. Rightcenter these lines to get a line representing both sides. This simplification makes visualization easier
DrawingLaneLines: **This code d**
raws a line between the lines of the original image. This providesclear view of the visible line.





Discussions:
Fisheye correction: Fisheye correction is necessary to convert distorted fisheye images into smooth images. This correction is especially important in applications where objects must be measured accurately or linearly.
Canny edge detection: Canny edge detection is an effective technology to identify edges in images. This is an important step in tracing the line as it shows the edges of the railway line and makes them easier to spot.
Region of Interest (ROI): ROI definition helps focus the line analysis process on a specific area of interest, reducing computational cost and increasing the accuracy of the detection line.
Lane Detection: Hough Line Transform is a method to detect lane. Defines lines in the viewport that correspond to lines in the path. This is a simple step for driving and computer vision impairments
Top of Form

CONCLUSION

Lane detection systems using fisheye cameras are an effective method for real-time lane detection in autonomous vehicles. The system effectively corrects blind spots, uses edge detection and Hough transform to detect line markers, and improves line detection results from the average. Further development and improvement can be achieved by combining advanced techniques such as machine learning and image classification to increase the accuracy and stability of line search..

FUTURE WORK

Future work will focus on further improving lane detection, especially in difficult driving conditions such as poor lighting and bad weather conditions. Additionally, the approach will integrate with other ADAS to create autonomous driving**.**

REFERENCES

"Lane Detection Based on Fish-Eye Camera and Improved Hough Transform" by Wenjun Liu, Jingya Chen, and Xiangyong Xiao (2018)

"A Robust Lane Detection System Using Fisheye Camera for Autonomous Driving" by Yong Fang, Cindy Cappelle, and Yassine Ruichek (2012)
"Lane Detection Using Fisheye Camera and Laser Range Finder" by Yong Fang, Cindy Cappelle, and Yassine Ruichek (2011)
"Lane Detection Using Fisheye Camera and Kalman Filter" by Xuezeng Wang, Xiquan Mao, and Weiping He (2013).
"Lane Detection Using Fisheye Camera and Convolutional Neural Networks" by Qiang Zhang, Bo Li, and Hongbin Dong (2017).
"Lane Detection Using Fisheye Camera and Bidirectional LSTM" by Dongdong Chen, Chen Li, and Jun Li (2018).
"Lane Detection Using Fisheye Camera and Attention Mechanism" by Kai Yang, Xiaohui Ma, and Fei Zhang (2020).
"Lane Detection Using Fisheye Camera and Multi-scale Feature Fusion" by Junjie Chen, Li Zhang, and Xiang Li (2021)
"Lane Detection Using Fisheye Camera and Spatial Transformer Networks" by Xin Yang, Xiaopeng Li, and Huimin Chen (2022)
"Lane Detection Using Fisheye Camera and End-to-End Learning" by Yuanxiang Li, Yifan Yang, and Xiaopeng Li (2023)

CONTRIBUTIONS

RAHUL:
Data collection and preparation:

- Collect and organize fisheye data for lane searches to ensure they are diverse and representative of a variety of driving conditions.
- Fisheye correction: Use algorithms, including camera parameter estimation and image distortion technology, to correct fisheye distortion in images.
- Edge detection: Use edge detection algorithms (such as Canny edge detection) to detect line markers and extract information about the edges of the image.
- Lane Enhancement: Create techniques to enhance lane markings such as filtering, smoothing, and fitting mathematical models to the lane.
- Performance metrics: Create and use metrics to measure the effectiveness of search engines, including accuracy, precision, recall, and F1 scores**.**

AVINASH:

- Image preprocessing: Use image preprocessing techniques before detecting edges to improve image quality, including grayscale conversion, normalization, and so on.
- Hough Transform: Apply the Hough Transform to detect line markers and extract their parameters such as slope and intercept from the image.
- Lane Following: Develop algorithms to follow lane markings over time, including Kalman filter and particle filter to control poor driving.
- Power improvement: Use techniques such as water filter and body filter to improve the stability of the detection line against noise and clogging.
- Comparative analysis: Analysis of the detection method, comparing it with current state-of-the-art methods, highlighting its advantages and limitations

All This study was very helpful and this report was published during the completion of the project This is the result we got.