

Lane and Surrounding Detection for Auto Driving

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Outline

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Introduction

- Sensing and Turning Without Human Input
- Control System, Computer Vision, Robot Operating System
- Lane Detection feed data back into control system for turning
- Surrounding detection visualize and highlight sensor detection of road sign and vehicle

Objectives

- Lane detection
Detect road lane and generate Turing angle to system
- Traditional Computer Vision
Using computer vision to detect target road sign
- Computational Neural Network
Train model to detect object in real world

Lane Detection

- Image Thresholding in Color Space:HSV
- Bird eye perspective
- Canny edge detection
- Hough method

Image Thresholding in Color Space

Why threshold in color space?

- The sun light right on the camera affect the color of the image
- The color of lanes are different

What do we do?

- Select the region of interest
- Equalization in brightness color(YUV) to avoid the effect of sun light
- Set Image threshold in color space

Image Thresholding in Color Space

The result

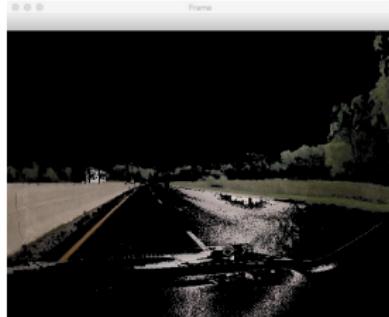
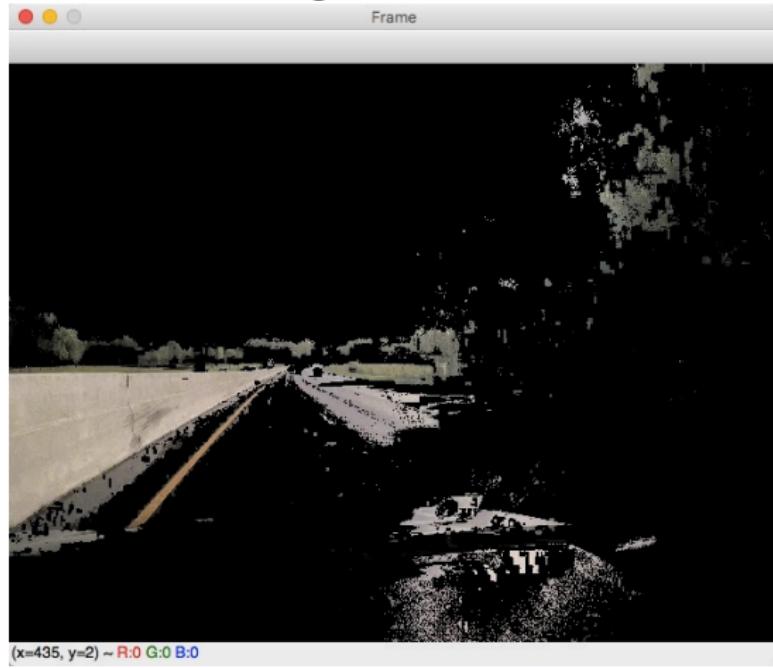


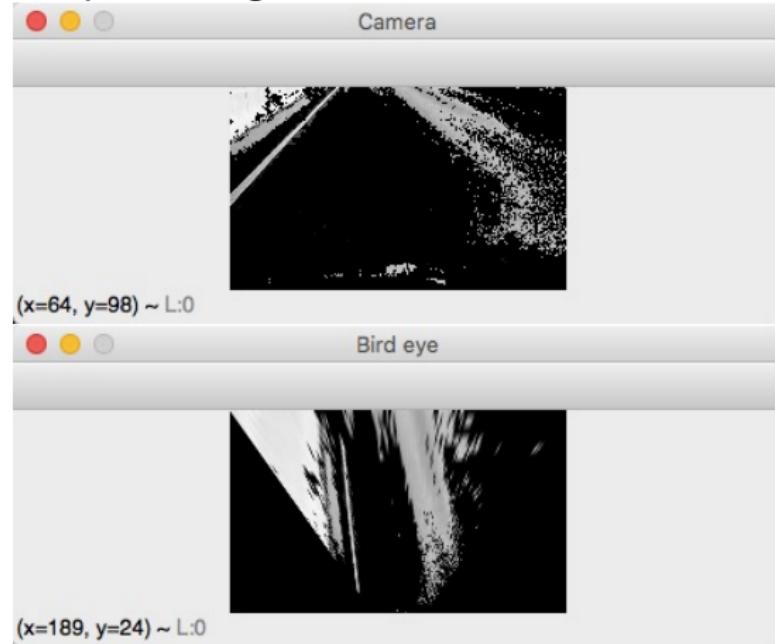
Image Thresholding in Color Space

Still some challenge



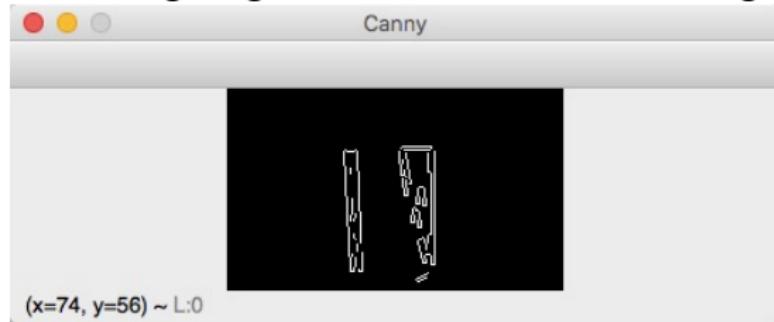
Bird Eye Perspective

Warp the image of lane from the view from the camera to the bird eye view

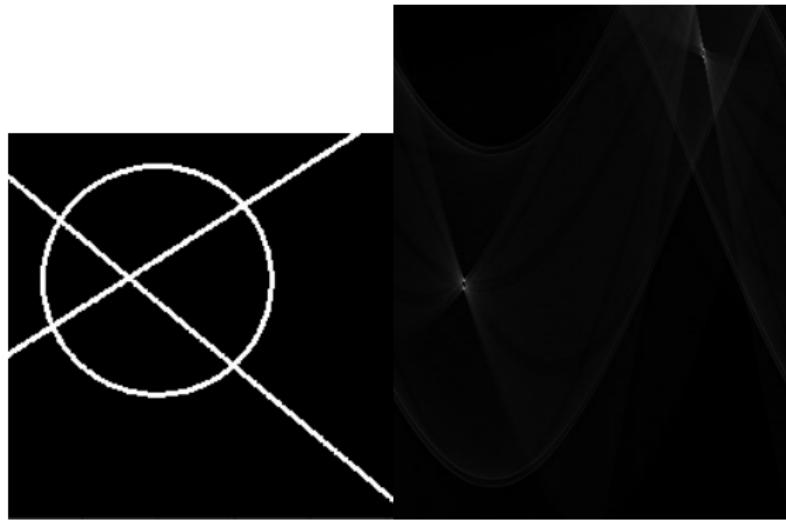


Canny edge detection

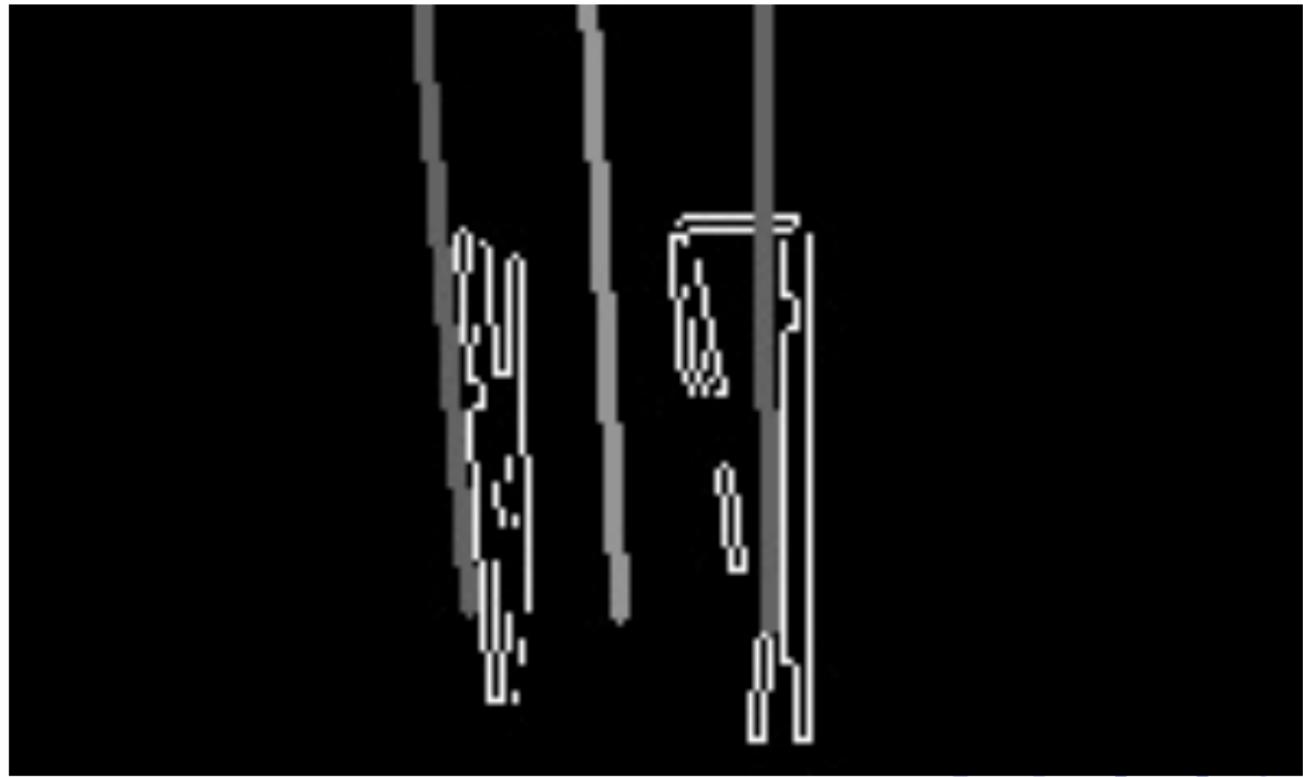
The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images.



Hough Line Detection



Hough Line Detection



Final steps

- Calculate the angle of offset
- Inverse the perspective process
- Calculate the lane position from camera view and draw lines on the image

Road Sign Detection

Traditional Computer Vision detection



Figure: Stop sign



Figure: Color Standard of traffic signs

Steps

- RGB threshold
- Morphological Transformations
- Binary threshold
- Detect edge
- Find Contours

RGB threshold and canny edge

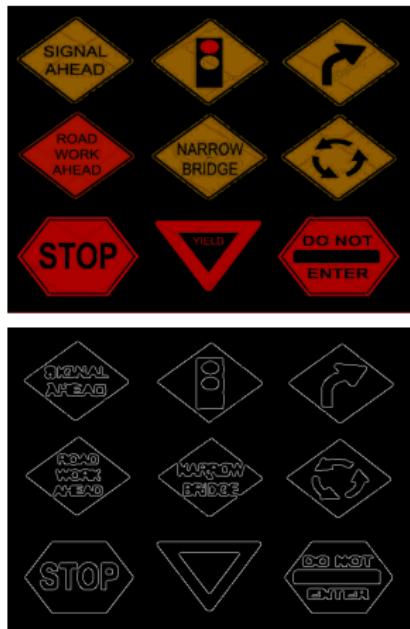


Figure: Image after color threshold and canny filter

Road sign Detection



Figure: Detection Result

Region-CNN

The goal of R-CNN is to take in an image, and correctly identify where the main objects (via a bounding box) in the image.

- Inputs: Image
- Outputs: Bounding boxes + labels for each object in the image

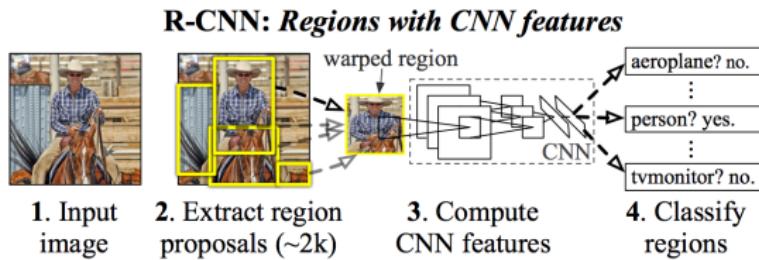


Figure: Region-CNN Walk through.

Mask-R-CNN

Mask RCNN improves the image segmentation into pixel level specificity

- Inputs: CNN Feature Map
- Outputs: Matrix with 1s on all locations where the pixel belongs to the object and 0s elsewhere

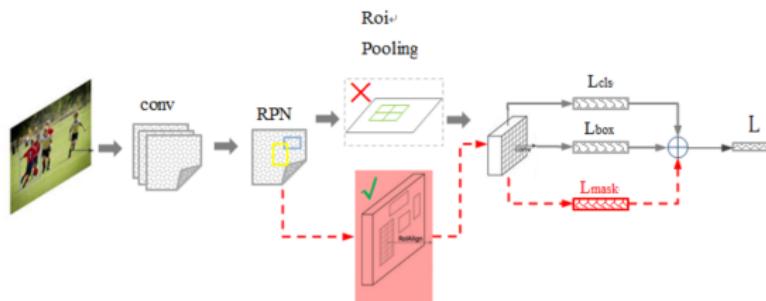


Figure: Improve of Mask-RCNN from Faster-RCNN

Road sign Detection



Figure: Valid inputs, adversarial inputs and their prediction labels.

Lane detection

For Lane Detection Results: uploading...

Car detection

For Car Detection Results: Uploading...

Conclusion

- We Generated lane detection through computer vision, successfully generated road sign detection and vehicle detection.
- Under some conditions, the detection would miss detected. Still need to improve the compatibility.
- Mask-R-CNN is a useful and powerful algorithm. However, it has its limitation. We need to feed more data to train it to get more accurate output.

Future Work

- Combine the detection together.
- Apply to random scenarios.
- Train a better model.