Advanced Lane Finding Project P2 Tim Kaufmann

Rubrics link https://review.udacity.com/#!/rubrics/1966/view

1)Camera Calibrations

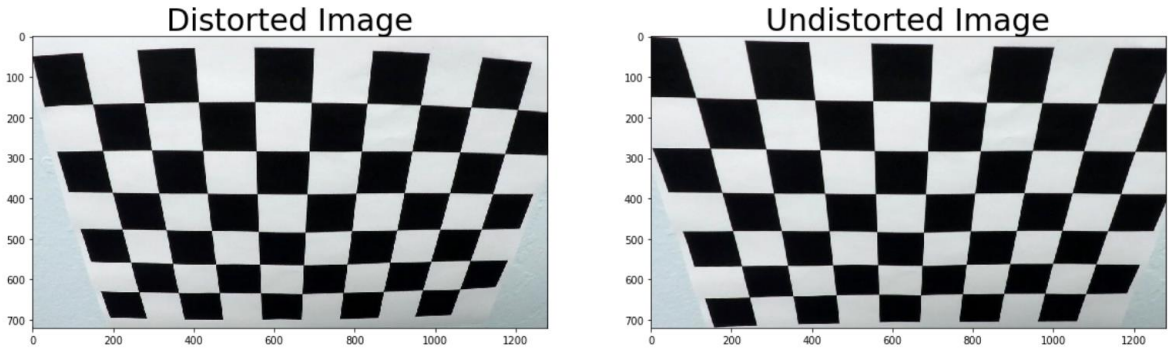
Computed camera matrix and camera coefficients 9x6

This program reads all of the images in the camera_cal directory and computes the camera correction values mtx and

ret, mtx, dist, rvecs, tvecs = cv2.calibrateCamera(objpoints, imgpoints, img_size,None,None)

undst = cv2.undistort(img, mtx, dist, None, mtx)

Example of distortion corrected image



2) Perspective transform

How:

This segment performs a perspective transform, on the region of interest, then plot the original image and the perspective image using the following commands.

The following snippet of code defines the region of Intrest

```
if file.find('straightline2') > 0 :
    src=np.float32([[710,450],[1150,720],[150,720],[575,450]])   # straightline2
```

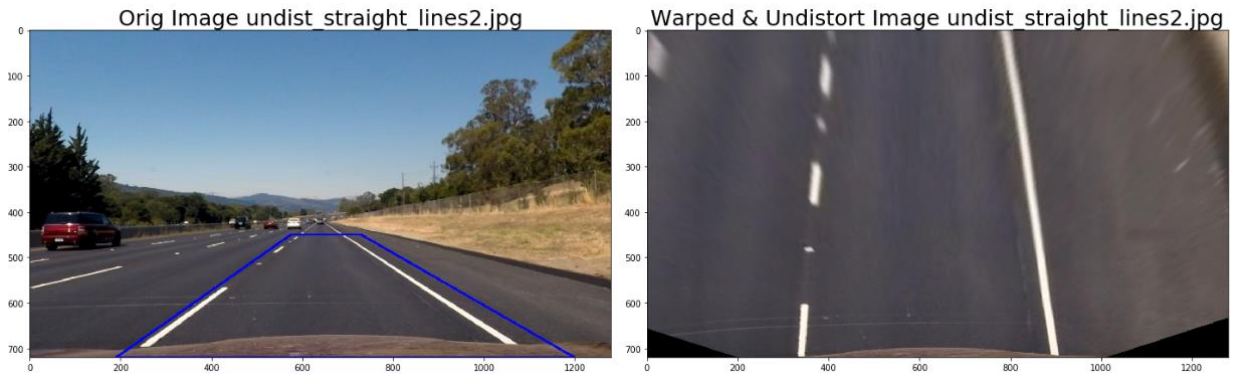
Draws the region of interest on the original image

```
cv2.line(img, corner_tuples[0], corner_tuples[1], color=[255,0,0], thickness=3)
cv2.line(img, corner_tuples[1], corner_tuples[2], color=[255,0,0], thickness=3)
cv2.line(img, corner_tuples[2], corner_tuples[3], color=[255,0,0], thickness=3)
cv2.line(img, corner_tuples[3], corner_tuples[0], color=[255,0,0], thickness=3)
```

Performs the perspective transform

```
warp_img,Minv=persp_transform(undistort_img, src)
```

Example image



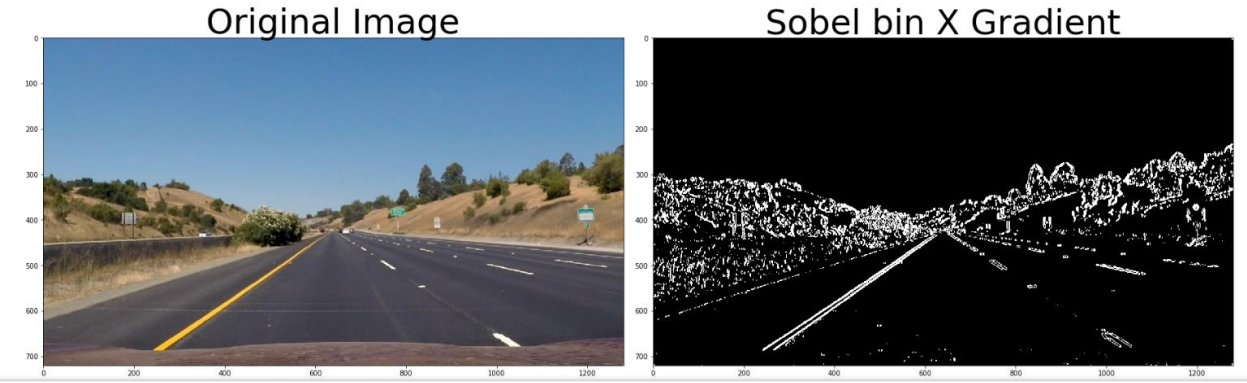
The other images are in the project file P2.ipnyb

3) Pipeline(test images)

How I used color transforms, gradients,…. Create a threshold binary image

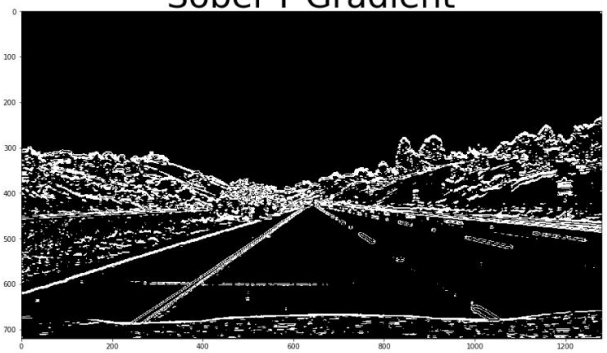
Exploring other options in image processing, Sobel Gradient (X and Y), Threshold Binary(Magnitude and Direction), Combined Binary, Color Threshold Binary (H,L,S.(H,S,V usin LUV),(B,A,L using LAB)), Combined S V and gradient thresholds

Example of binary image result



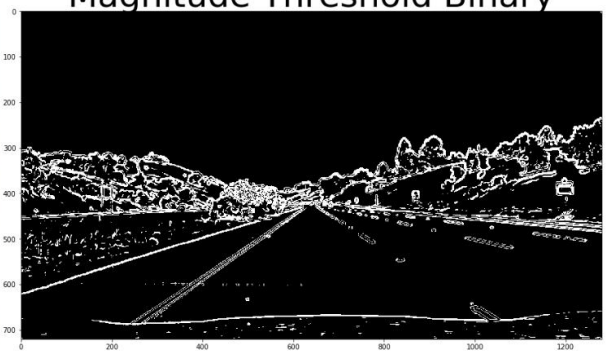
Original Image

Sobel Y Gradient



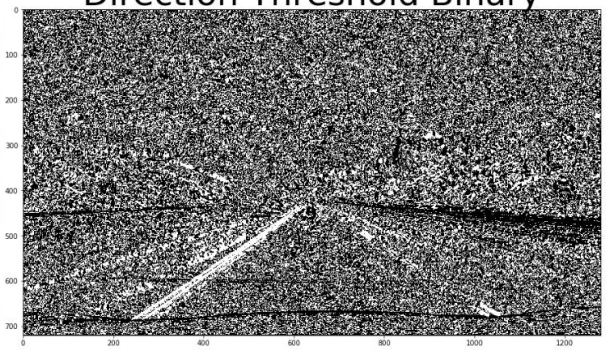
Original Image

Magnitude Threshold Binary



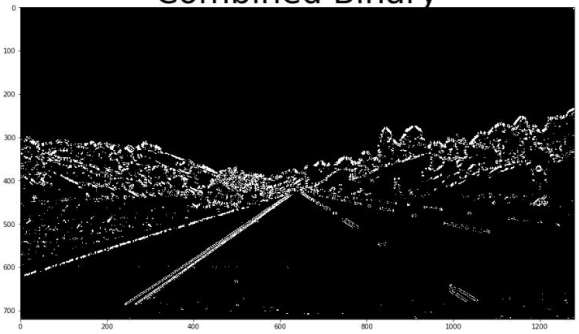
Original Image

Direction Threshold Binary



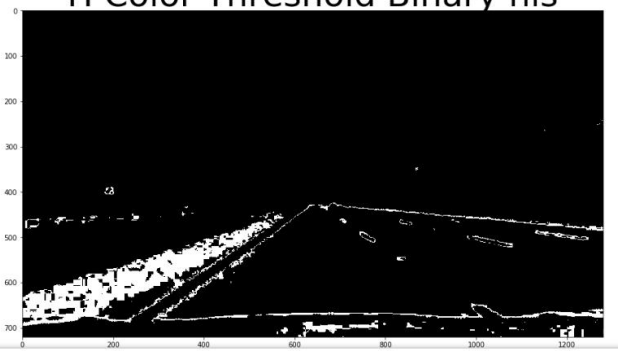
Original Image

Combined Binary



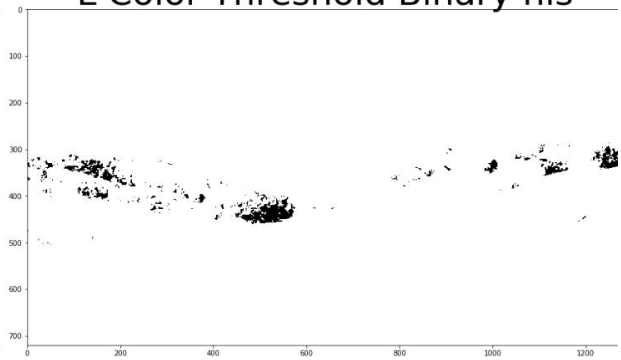
Original Image

H Color Threshold Binary hls



Original Image

L Color Threshold Binary hls



Original Image

S Color Threshold Binary hls

Original Image

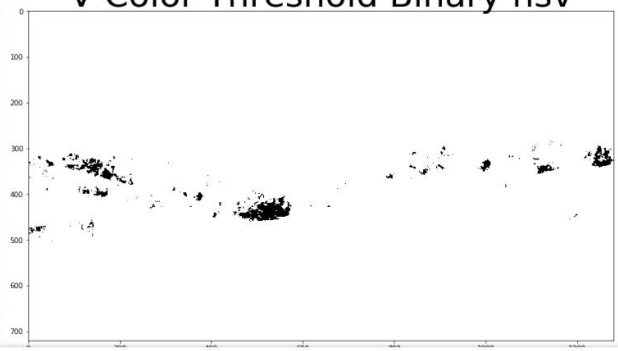
H Color Threshold Binary hsv

Original Image

S Color Threshold Binary hsv

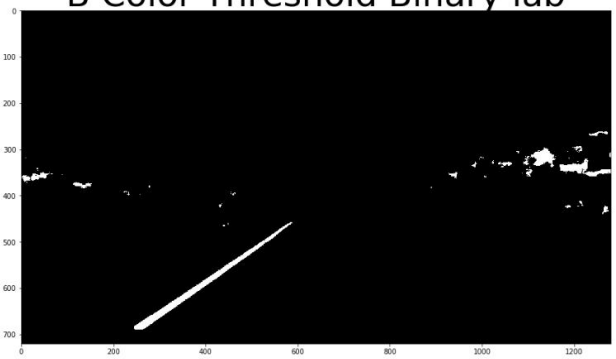
Orig Image

V Color Threshold Binary hsv



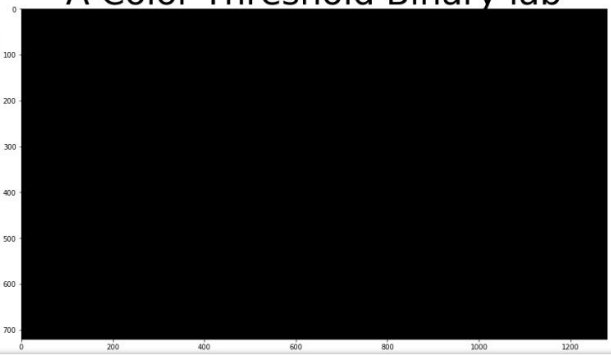
Original Image

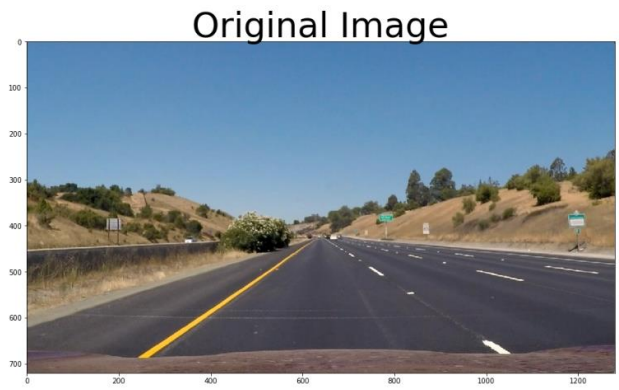
B Color Threshold Binary lab

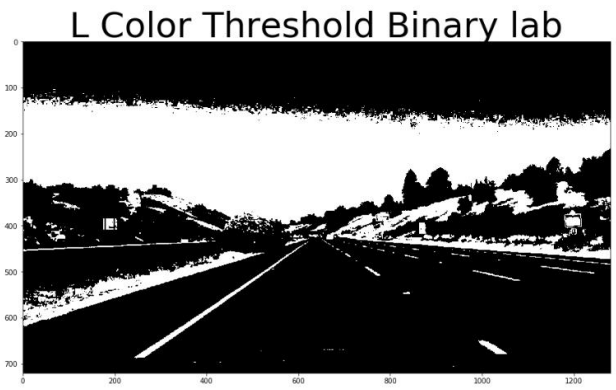


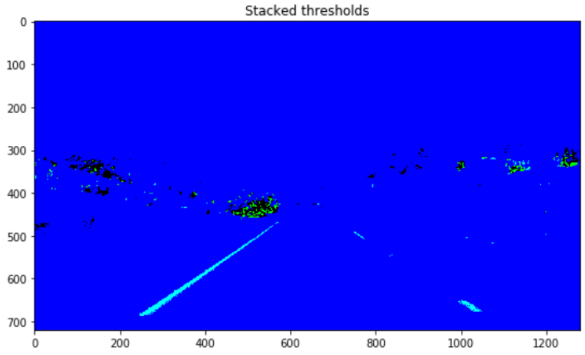
Original Image

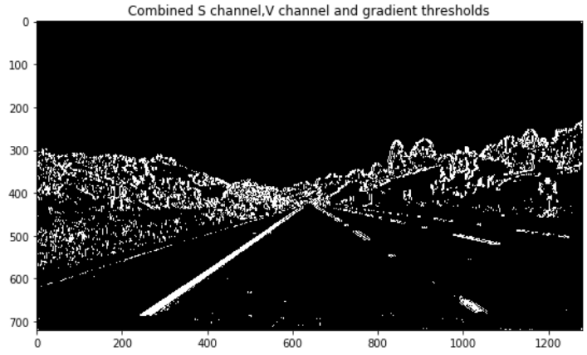
A Color Threshold Binary lab



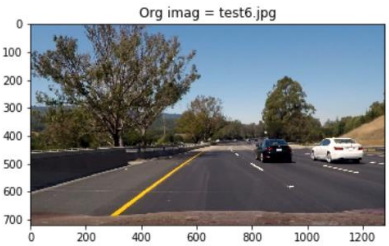


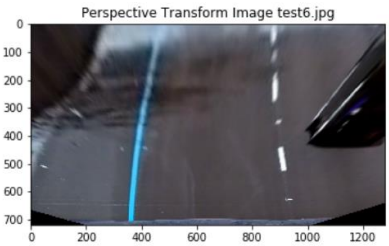


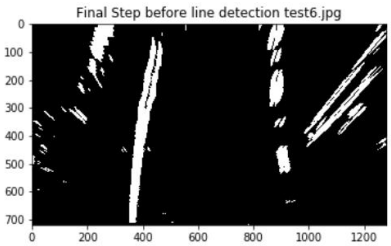




Perspective transforms







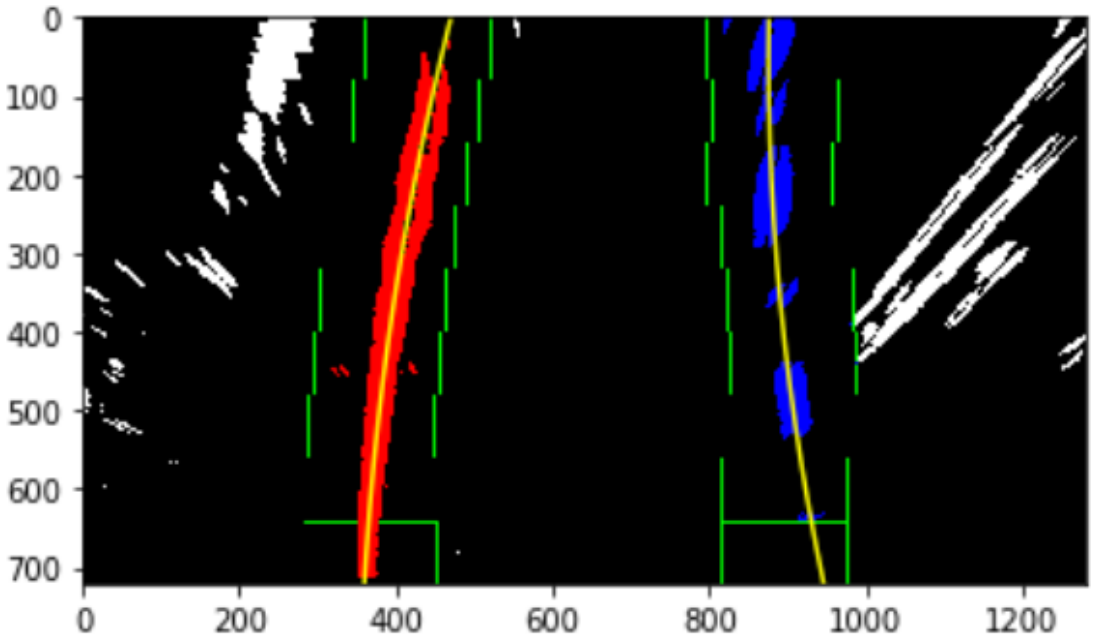
4) identify where lane-line pixels and fit their position to a polynomial

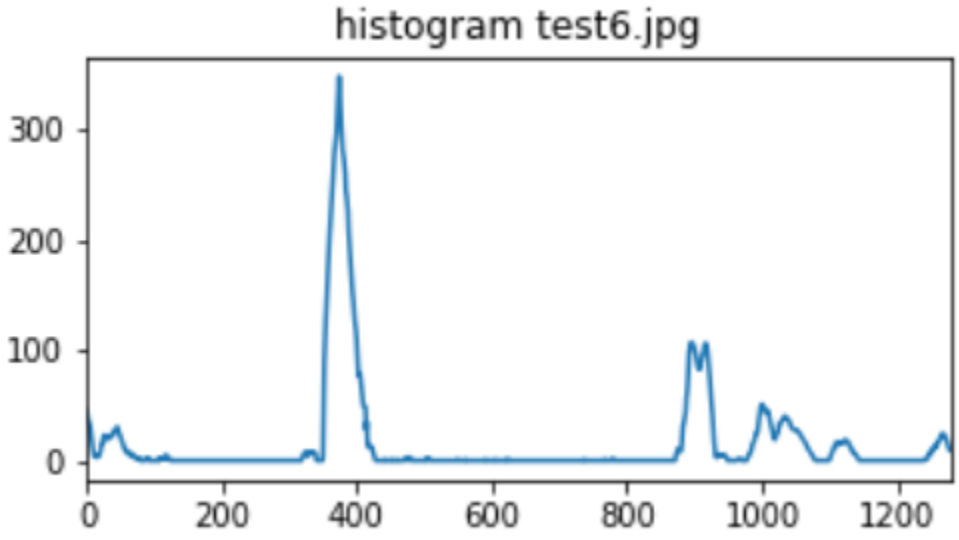
How

Used the following code

```
plot= True
left_fit, right_fit, left_lane_inds, right_lane_inds, histogram = sliding_window_polyfit(pers_bin_img,plot)
```

Example





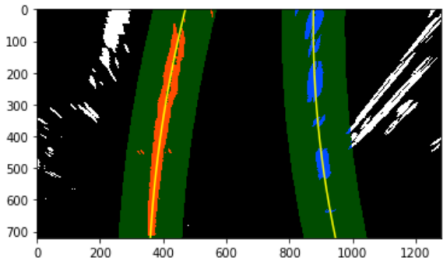
5) Radius of curvature, Position of vehicle to center

```
# radius of curvature
left_curv, right_curv, cent_dist = rad_curvature(pers_bin_img, left_fit, right_fit, left_lane_inds, right_lane_inds)
```

How sanity check (frame to frame?)

Look at previous frame

```
plot=True
left_fit_new, right_fit_new, left_lane_inds, right_lane_inds=polyfit_prevfit(pers_bin_img, left_fit, right_fit,plot)
```

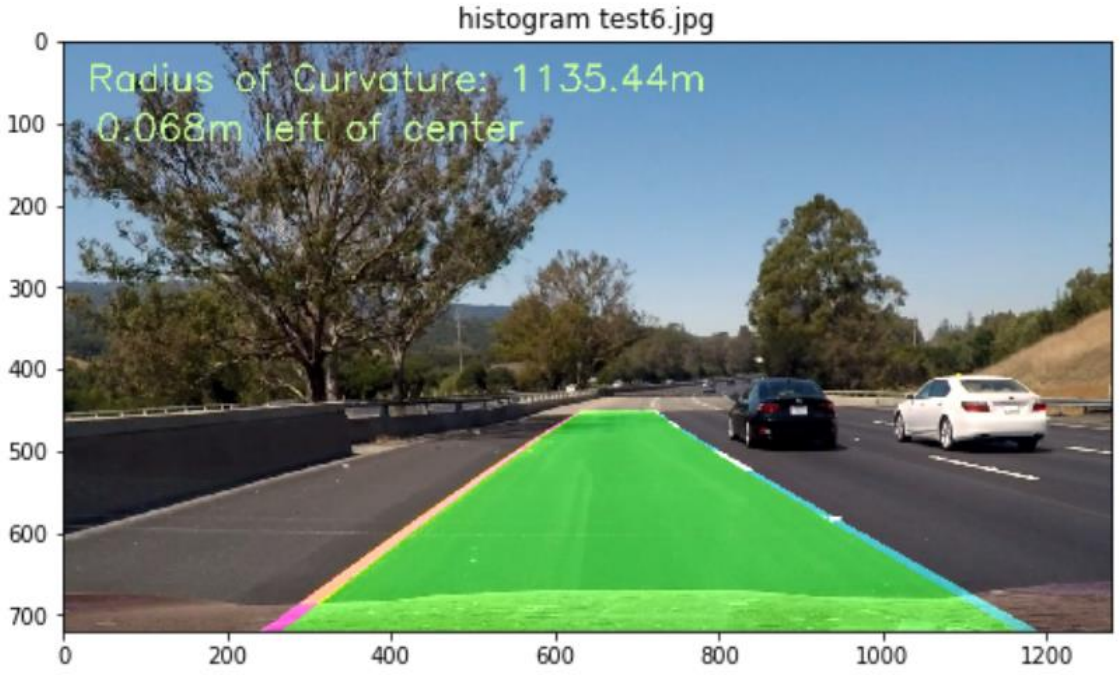


Output

```
Radius of curvature for example: 1237.3797806702942 m, 1033.5032284709991 m
Distance from lane center for example: -0.06848398670925986 m
```

6) provide an example onto the road such that the lane area is identified clearly

See below, other s are in dir output_images with detected_ appended to the jpg file name



7) Pipeline Video

Provide a link to my final video output

Output_project_video.mp4

Wobbly lines ok, keep car on road

Should find the lines entire image

use that infor for approx. position search that area

8) Discussion

Problems or issues,

where will the pipeline likely fail

poor lane markings, shadows on road, vehicle in region of interest

what to make it more robust

1)region of inters only where lines are, do not use the middle part of the lane

2)normalize the brightness of the image for night time vs day time and shadows