

CS 4476/6476 Spring 2020

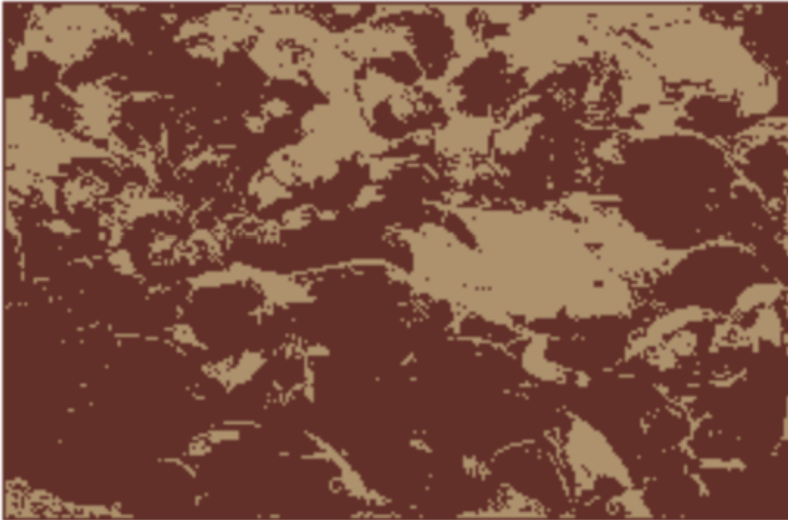
PS4

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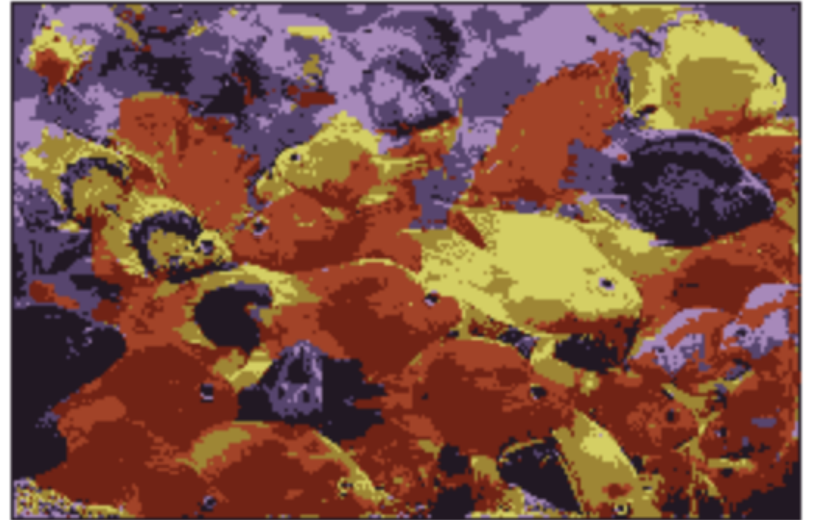
Color Quantization with K-Means

2.1 Color Quantization of RGB images

$K = 2$, $\text{err} = e^{(20.74190896807324)}$



$K = 7$, $\text{err} = e^{(19.66245678819473)}$



2.2 Color Quantization of HSV images

$K = 2$, $\text{err} = e^{(19.809599535739427)}$



$K = 7$, $\text{err} = e^{(17.53334724992102)}$



2.3 Quantization error (remember to use the random state initialized in the script).

Enter values as $\log_e(\text{error})$

k	RGB	HSV
3	15.12216290311367	14.600732690618507
5	14.704915196955724	13.526757245272831
10	14.113046320228813	12.235082753577267

1.4 Answers (1-2 sentences each)

a) Number of quantization bins decide number of colors in RGB image and number of Hue values in HSV image. Thus, as number of quantization bins increases, the quantized image would have more color and would be more similar to the original image. In addition, the quantization error would be less.

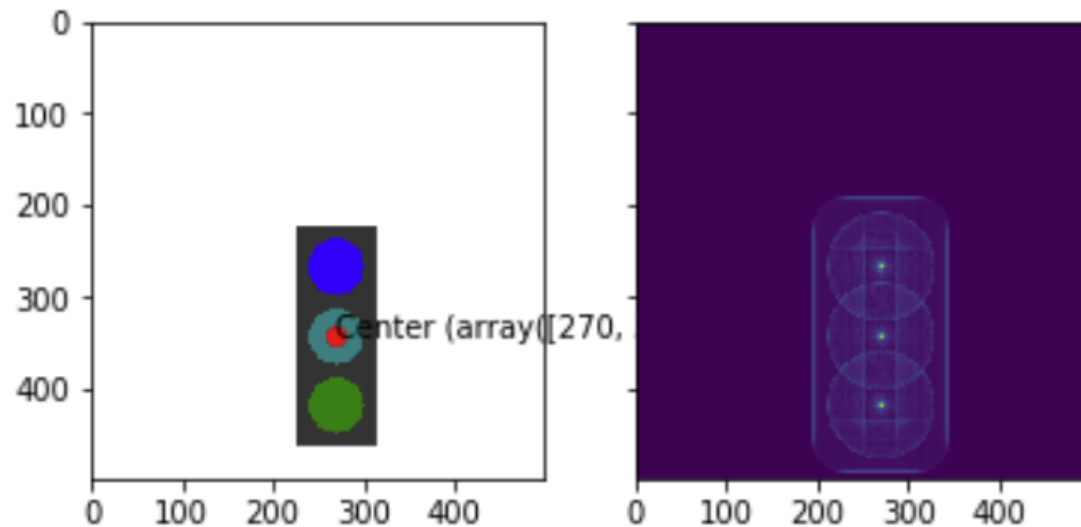
b) In RGB space, after doing quantization we will have k colors. In HSV space, we will have more than k colors since we only quantize Hue value but not Saturation and Value.

- c) 1. compare with histogram between original image and quantized image
2. Randomly choose pixels or areas, and check their error

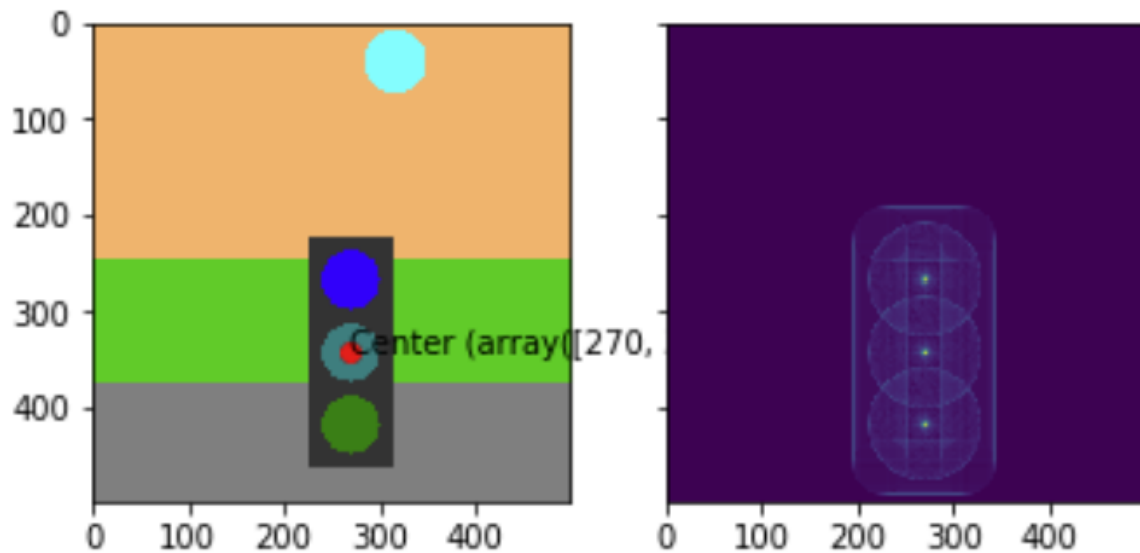
Hough Transform

Hough Transform on Generated Images

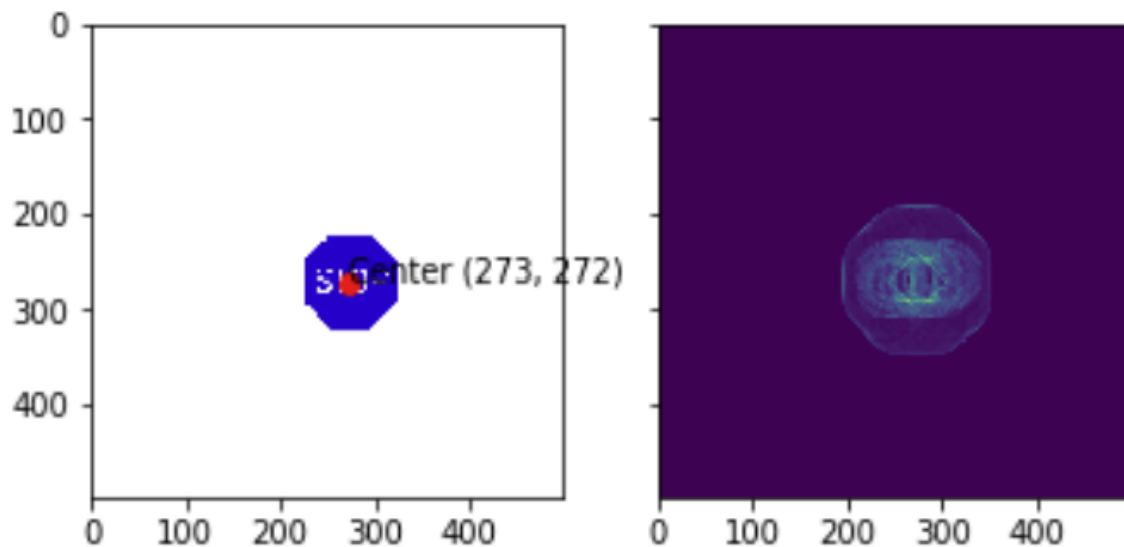
3.1.1 Traffic lights - Blank



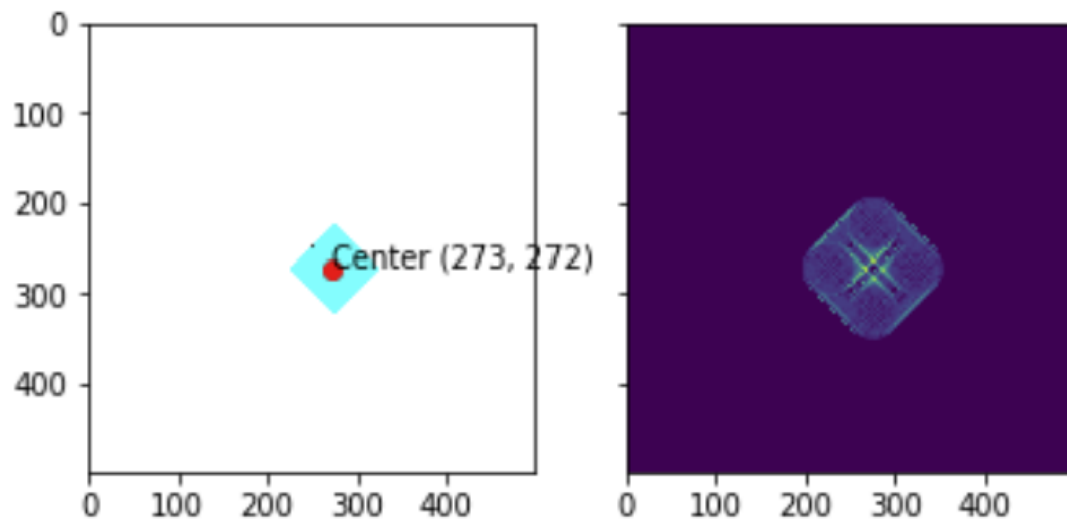
3.1.2 Traffic lights - Scene



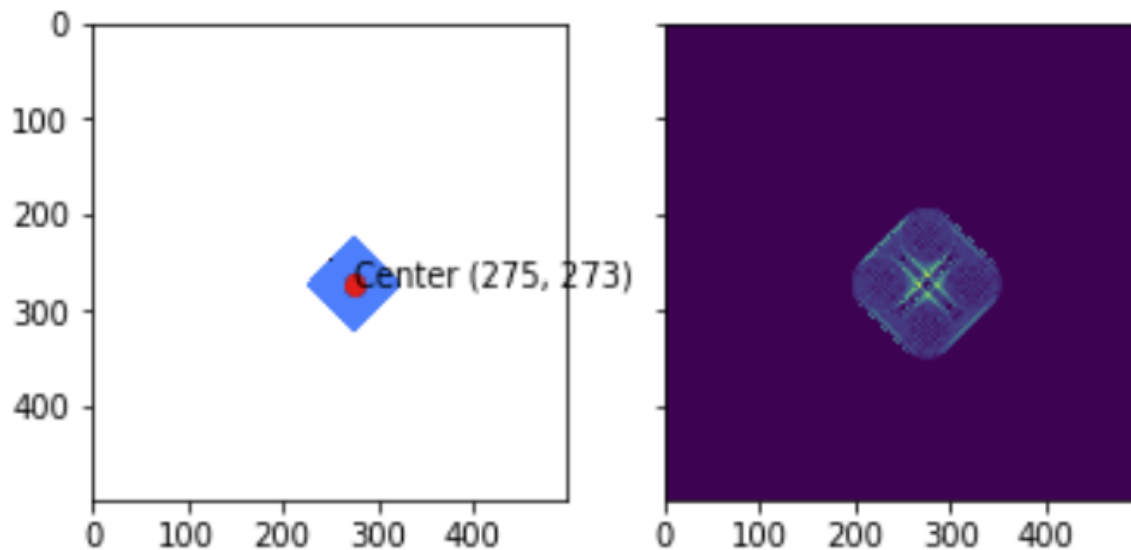
3.2.1 Stop sign detection



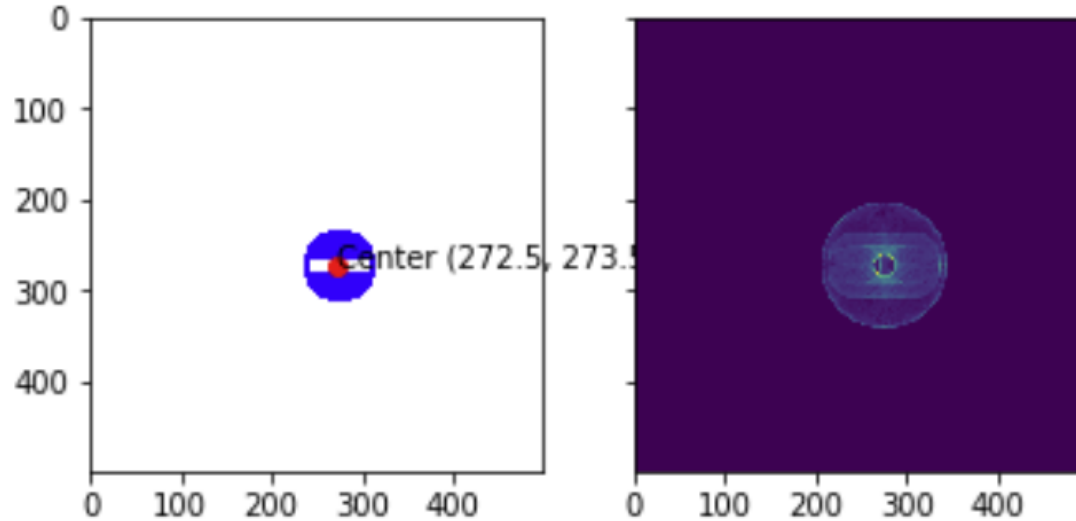
3.2.2 Warning sign detection



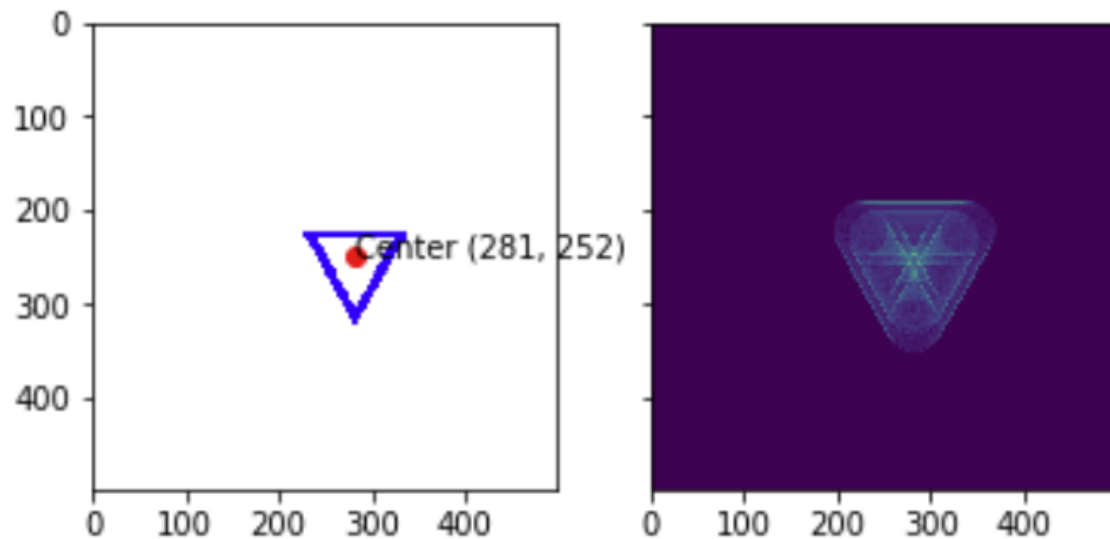
3.2.3 Construction sign detection



3.2.4 Do not enter sign detection



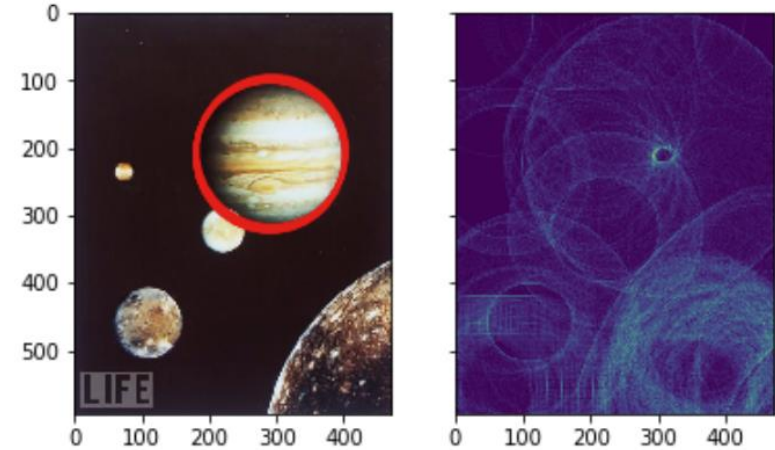
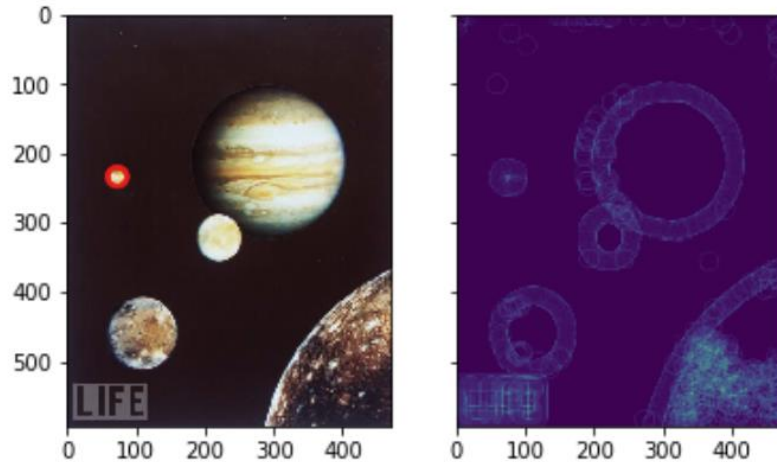
3.2.5 Yield sign detection



Extra Credit

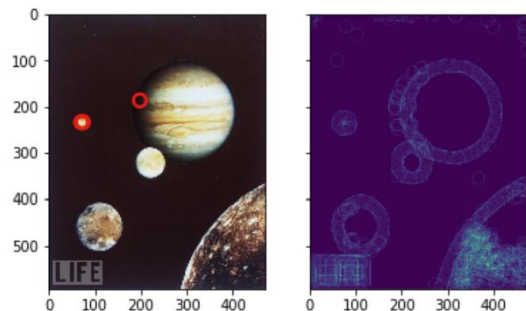
Hough Transform on Real Images

4.1 Known Radius



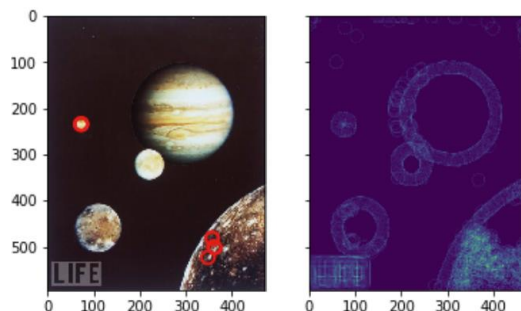
UnitTest testHoughstransform passed successfully!
Time elapsed: 23.603423595428467

4.1 Known Radius



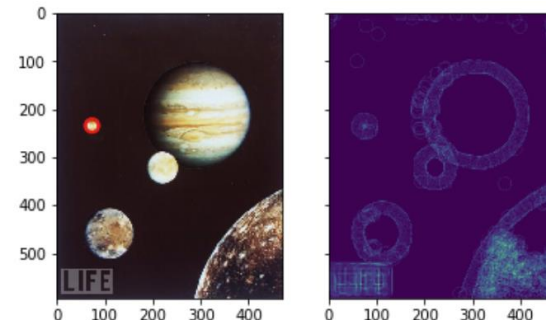
UnitTest testHoughstransform passed successfully!
Time elapsed: 3.30843448638916

Threshold = 0.4



UnitTest testHoughstransform passed successfully!
Time elapsed: 3.3103015422821045

Threshold = 0.7

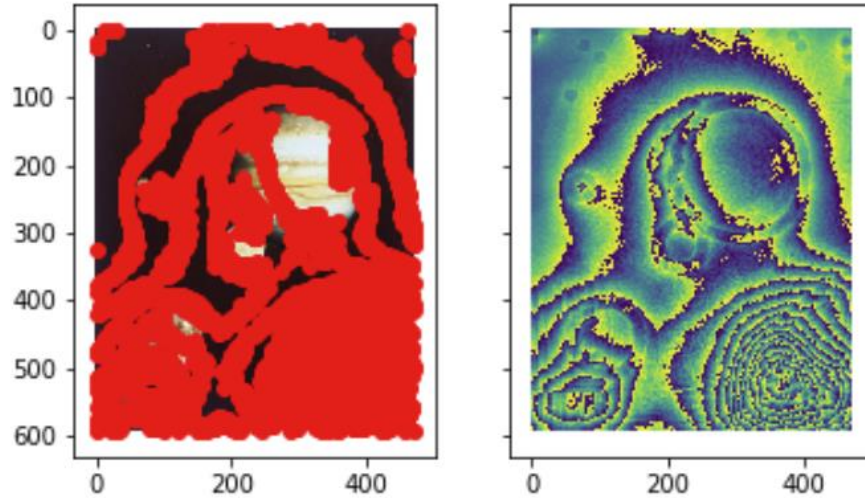


UnitTest testHoughstransform passed successfully!
Time elapsed: 3.330826759338379

Threshold = 0.95

When threshold is low, the circle detection is not accurate, the error is significant as it detects some incorrect object. Then after I increase the threshold, it only detects the correct object.

4.2 Unknown Radii



21 out of total 5 circles found

UnitTest testHoughstransformMultiple passed successfully!