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Important Points about the code:

- Run Demo_Canny.m to run the simulation of canny edge detector for different values the results are explained further
- I have used matrices and logical ‘and’ and ‘or’ operations to simulate a similar working as can be achieved by using for loops
- I have used red channel to work on the image as the image I was working on was a red car and the edges were better highlighted by using a red channel giving better results
- I have arrived on the final thresholds and Gaussian sigma by various trial and errors. However, I have demonstrated only a few i.e. 3 values of each parameter. I could give you a detailed analysis if required
- You can also call: canny_edges(input_image, threshold1,threshold2,Gaussian_sigma) to call any variation with different parameters.
- Output and input images(.jpeg) in directory for checking the outputs

Values tried (ones highlighted are the final and fixed while rest varied)

Threshold1	Threshold2	Threshold2
0.04	**0.02**	**1**
0.02	0.01	5
0.06	0.06	0.5

Input Image in Gray Scale using imagesc() and colormap as gray:

Final Output (threshold1: 0.04, threshold2: 0.02, Gaussian Filter: 1):

Variations in Threshold 1:

A change in threshold1 not only affects the phase after non-maximal suppression but also the final output as increase in threshold1 can allow less and less pixels to be a part of edge detection and a very high threshold can sometimes result in getting absolutely no point eventually giving a blank output. However, decrease in threshold1 value can result in the process taking each point as a seed point and giving various pixels which may not contain an edge generating noise and if very low can result in the full image. Threshold1 choosing can affect the output of the whole algorithm so it should be chosen wisely

Output (lesser Threshold1) (threshold1: 0.02, threshold2: 0.02, Gaussian Filter: 1):

As we can see as discussed above various extra points i.e. noise introduced at a lower threshold1 value

Output (Higher Threshold1) (threshold1: 0.06, threshold2: 0.02, Gaussian Filter: 1):

As explained as we are increasing the threshold value we are detecting lesser points eventually ignoring the edges which are relevant to the image

Variations in Threshold 2:

A change in threshold2 can result in a fully changed final output. A decrease in threshold2 for a given threshold1 can result in lighter edges being highlighted which is sometimes useful if we have very thing edges which do not have much magnitude but in some cases, it can give out noise. If we increase the threshold1 for a given threshold1 it will result only in edges with very high magnitude around the given threshold1 and non-maximal suppression passed pixels resulting in less amount of edges but only very relevant edges. It is solely on the usage that the value of threshold2 to be decided.

Output (lesser Threshold2) (threshold1: 0.04, threshold2: 0.01, Gaussian Filter: 1):

As explained it increases the edges giving a little noise which would further increase with decrease in threshold2

Output (Higher Threshold2) (threshold1: 0.04, threshold2: 0.06, Gaussian Filter: 1):

As Explained It shows only edges with high magnitude ignoring various edges

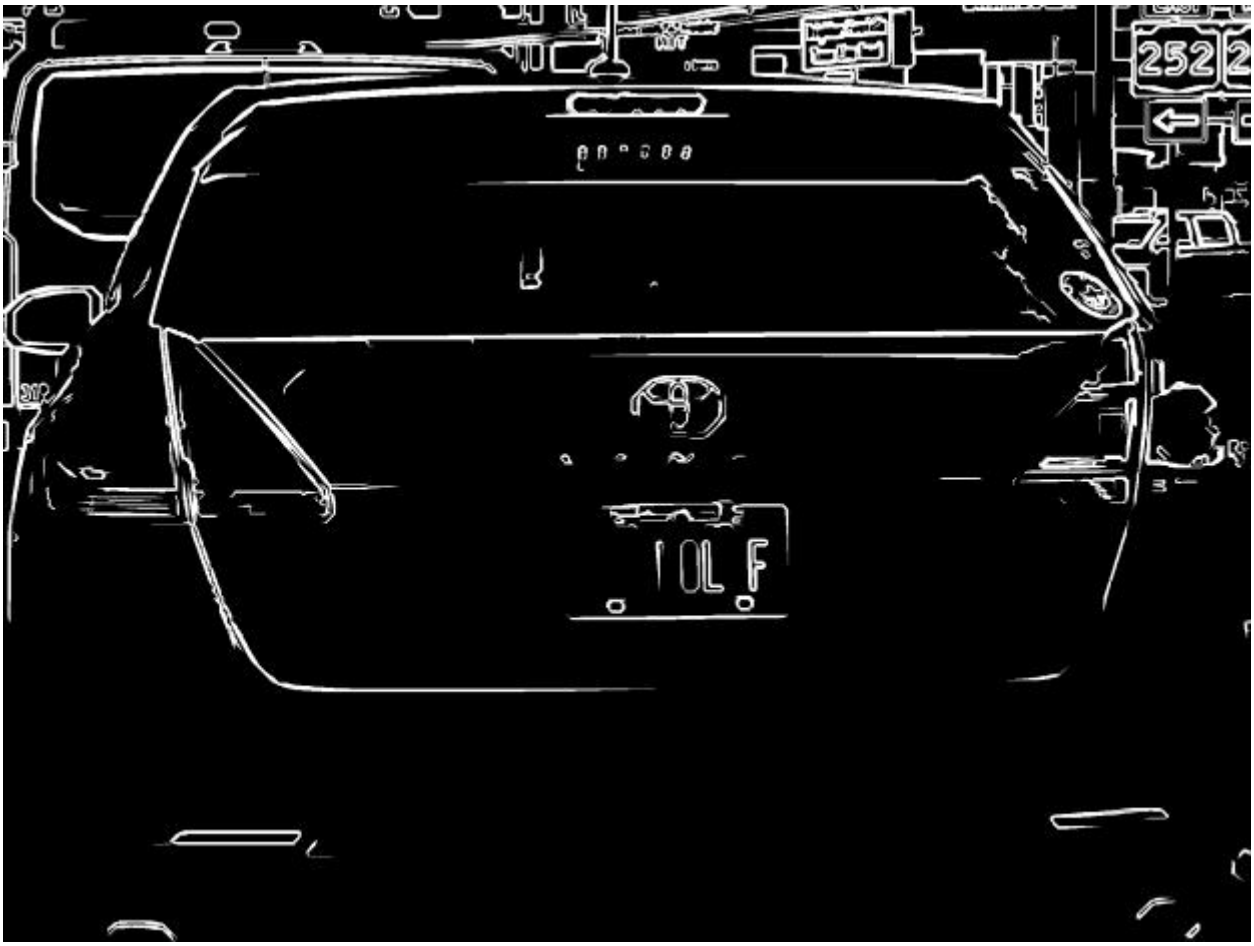
Variations in Gaussian Standard deviation(Blurring):

A change in Gaussian Standard deviation(Sigma) can result in the change in the final output image as would be shown in next 2 images. As we know sigma is the spread of the point when we increase the sigma we spread the points to outer pixels that is reducing the intensity at the given pixel and distributing it if we increase the sigma the edge pixels are affected as there magnitude decreases and when we have a lesser sigma it allows noise to be passed as well so it is very important to select a sigma such that it doesn't vanish the actual edges i.e. smooth them to not recognize them but also not let noise pass through it. It is very important to find a balanced sigma.

Output (Lesser Sigma) (threshold1: 0.04, threshold2: 0.02, Gaussian Filter: 0.5):

As Explained we can see a lesser sigma giving noise which is not needed i.e points here and there

Output (Higher Sigma) (threshold1: 0.04, threshold2: 0.02, Gaussian Filter: 5):



As written above, we can see various edges vanished due to increase in sigma which would decrease more with a higher Sigma.

Learnings:

- Choosing the channel to perform the operation
- Choosing a good sigma for Gaussian filter
- Choosing threshold 1 and threshold 2
- Applying Matrix operations to substitute for loops
- Different types of image plotting
- Understanding and implementing Canny Edge Detector