Introduction to Visual Computing - Lab4
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1. Canny has two thresholds that control the edge thresholding process. What is their purpose?
Low threshold: T_L.
High threshold: T_H.
This is used to control the sensitivity of the algorithm, which helps the algorithm selectively identify edges it considers strong, while rejecting weak and noisy edges.
Magnitudes below T_L are not edges; between T_L and T_H are weak edges; above T_H are strong edges.
Higher Threshold -> fewer edges being detected.

2. What is the purpose of the aperture parameter? What is the result of changing it from 3 to 5, 7, 9 or greater?
The aperture parameter is the aperture size for the Sobel operator, i.e., the size of Sobel kernel used for finding image gradients. The default value for the aperture parameter is 3, which corresponds to a 3x3 Sobel kernel. Larger values will result in a larger Sobel kernel being used to compute the image gradients. As the Kernel size increases, more pixels are now a part of the convolution process, and the gradient map (edges) will tend to get blurry. Therefore, will generally result in a more accurate estimation of the gradient magnitudes and directions.

3. The Hough transform has two parameters that specify the resolution of the accumulator. Their default values are 1 and π/180. What is the effect of increasing the first and reducing the second?
The first one is <u>Rho</u>, which determines the distance resolution of the accumulator (in pixels). It specifies the distance between the origin (top-left corner of the image) and the line.
The second is <u>Theta</u>, which is the angle resolution of the accumulator (in radians). It specifies the angular distance between the detected lines in the image space and the horizontal axis.

Increasing the Rho: more accurate detection of lines at longer distances from the origin.
reducing the Theta: more accurate detection of lines with small angular differences.
Increasing the Rho and reducing the Theta: more accurate detection of lines in an image, especially for long and straight lines.

4. The Hough transform has a pair of parameters that determine the minimum length of a line that can be accepted, and the maximum gap between two segments if they are to be considered part of the same line. What is the effect of changing these values?
minLen: minimum line length to be detected.
　Increasing minLen: shorter line segments will be discarded.
　Reducing minLen: more shorter line segments will be considered.

maxGap: the maximum allowed gap between line segments to be considered as a single line.

> Increasing maxGap: consider larger gaps between line segments as part of same line, obtain a more complete representation of the line. Gives more longer lines.

> Reducing maxGap: consider smaller gaps between line segments as part of the same line. Gives more shorter lines.

5. **How close are the computed horizons to where you think the horizon should be? What might cause any discrepancy?**
   Very close. This is because I use several trackbars to set thresholds for different functions. Each time I needed to set a threshold, I used a track bar to display the corresponding result image (with lines) in the window and used the threshold that made the current result image the best.

   However, subjective judgement of threshold value will allow some noise to appear in my results images. This is because I found that when filtering the vertical lines, the image after filtering the short line segments still had some very close to parallel short line segments in it, but not the ones I needed, affecting my final lines. This means that my threshold in the previous step (short line filter) was not set high enough. It might be better to put some track bars in the same window, such as short line filters and angles, and adjust the threshold at the same time.