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ECE 332

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MP#5 - Canny Edge Detection

Description of Aglorithm

The purpose of this algorithm is to identify edges of interest in a given image. The process consists of several operations in order to identify these edges. In their relative order, these operations are Gaussian smoothing, calculating the image gradient, determining thresholds, suppressing nonmaxima values, and finally linking the edges.

Gaussian smoothing is an operation that blurs an image by convolving a Gaussian kernel to the given image. This kernel iteratively applies a Gaussian curve to each pixel and its neighbors across the entire image. The result is a blurrier version of the original image whose level of blurriness depends on the inputted standard deviation argument.

The image gradient describes how intensity values of the image change. It consists of both a magnitude and direction theta. The magnitude describes how much the intensity changes over a given area. A larger magnitude means a larger change in intensity. The direction theta of the gradient describes the angle that the gradient takes place. In general, there are four standard directions a gradient can take place in a given square kernel.

Determining the maximum and minimum thresholds is determined using histogram characteristics and allows us to essentially choose our intensity percentage criteria for what is considered an edge. All of the edges in the image are divided into both weak and strong edges based in their intensity.

Non-maximum suppression is used to clean up the image and reduce the number of double lines. The function simply iterates through the points in the gradient magnitude matrix and identifies the pixels with the maximum value in the edge directions.

Finally, the edges in the resulting image from non-maximum suppression can be linked using the previously determined thresholds. The strong edges are first linked using the higher threshold. The weaker edges are then used to fill the gaps in the strong edges.

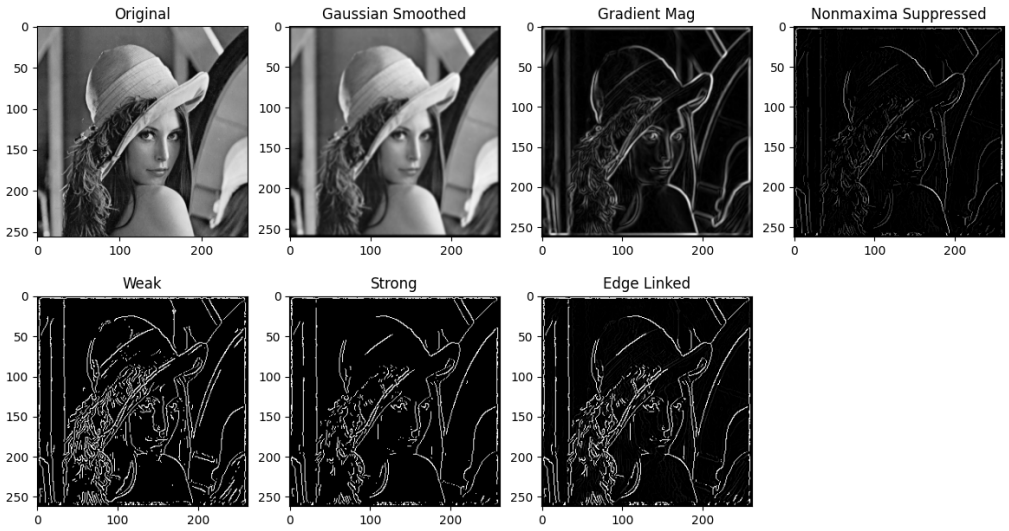
Results and Analysis

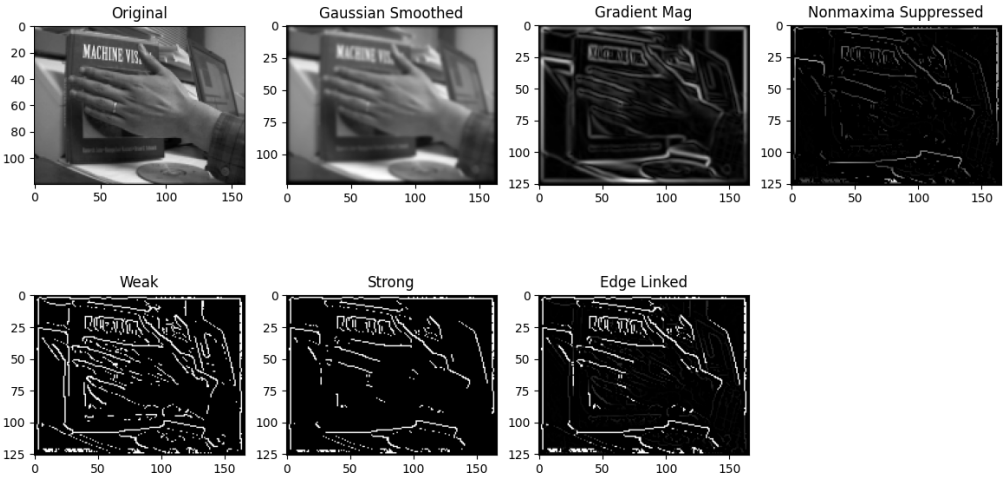
Upon altering the Gaussian smoothing parameters, it can be easily seen that changing the standard deviation parameter sigma results in both a blurrier image during processing and a less defined final result. Altering the size of the kernel also has a similar effect on the final result.

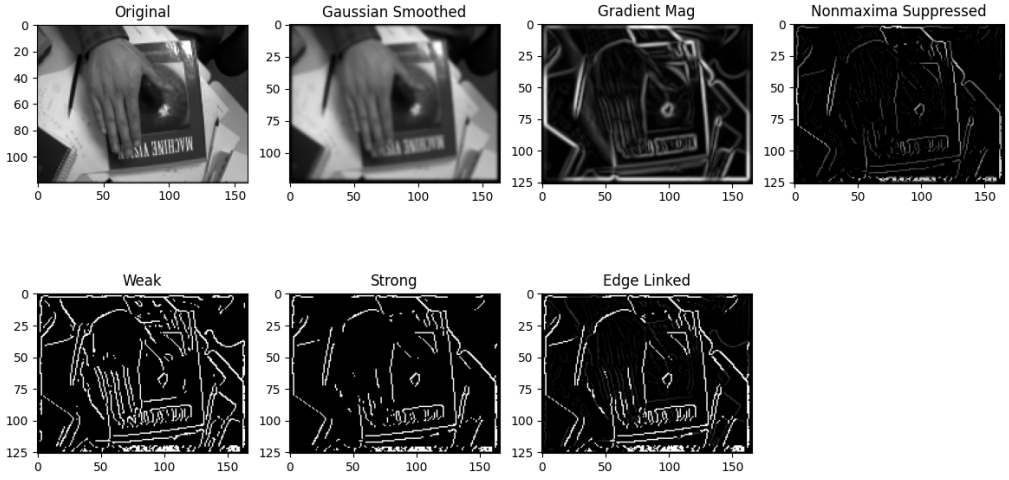
Increasing the `percentageOfNonEdge` parameter results in far less lines being found and a less defined result. Reducing the parameter leads to opposite results with more lines being found and a very muddled result.

Switching between the various edge detectors offers varying results in the image. Sobel's method seems to emphasize values that lie closer to the center of the operator during processing. Roberts' method seems to succeed better at defining the edges in general. Finally, Pruitt's method seems favorable for defining both horiztonal and vertical lines compared to the others.

Overall, the results look promising and certainly showcase the vast majority of the perceptable edges found in the original images.


Original
Gaussian Smoothed
Gradient Mag
Nonmaxima Suppressed
Weak
Strong
Edge Linked


Original
Gaussian Smoothed
Gradient Mag
Nonmaxima Suppressed
Weak
Strong
Edge Linked


Original
Gaussian Smoothed
Gradient Mag
Nonmaxima Suppressed
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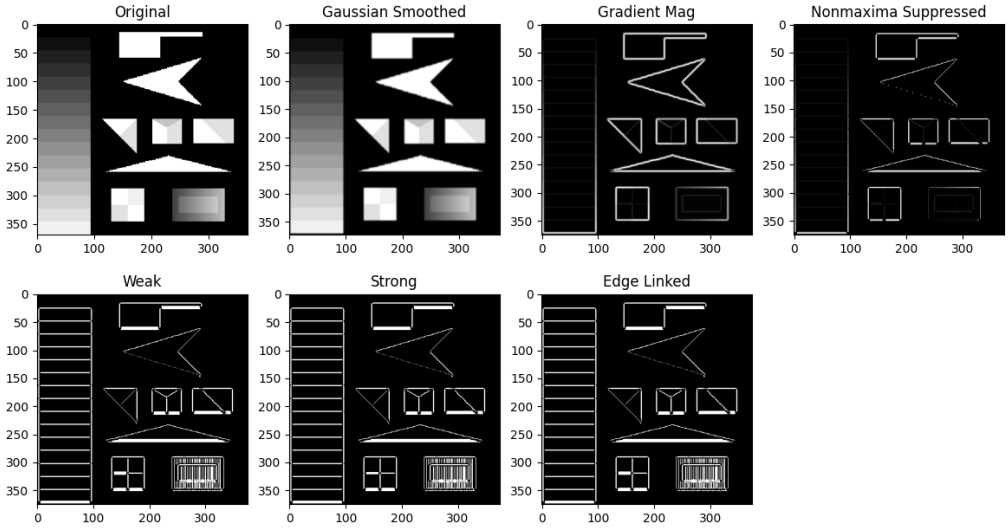
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