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ECE 332

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MP 5 Report

INTRODUCTION

In this MP, I implemented the Canny edge detector which consists of many smart ideas in image processing. I used four images as my test image and did different functions on them. And analyze the result image by changing the parameter values.

CONTENTS

Gaussian Smoothing:

In this function, I first need to generate a gaussian kernel, read my image as a grayscale image and then create a kernel which filled with formula:

exp(-(x**2+y**2)/(2*(SIGMA**2)))/(2*np.pi*(SIGMA**2)).

My image goes over the [N*N] conv and become more smooth. And generally they look more vague than before.

In my sample, I mainly used N*N = 3*3 and sigma = 1. Below is what they look like.

GaussSmoothing_3x3_1_lena

smooth_joy

smooth_pointer

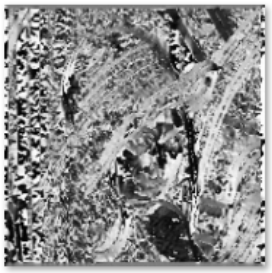
smooth_test

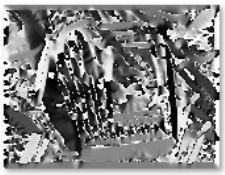
Calculating Image Gradient:

After getting the smooth image, we can choose either ‘sobel’ or ‘robert’ or some other methods to do the gradient. Each different method has different parameters for the x and y kernel.

Then we create magnitude and direction images separately and calculate the gradient. Use the angle of gradient as direction while absolute value of gradient as magnitude.

Here’s the direction and magnitude of the image.


direction_3x3_sobel_lena


direction_joy

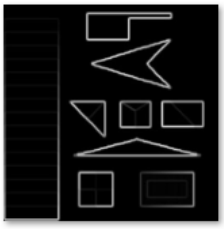

direction_pointer


direction_test


magnitude_3x3_sobel_lena


magnitude_joy


magnitude_pointer


magnitude_test

Selecting High and Low Thresholds:

We need to use magnitude and Percentage Of Nonedge to get the high and low threshold. Firstly, we find out the max magnitude, and then build a histogram and normalize it. And we go over each pixel to check if this pixel has a value which is larger

than most (the number is Percentage Of Non Edge) pixel, if yes, then the pixel appears, if not, then it gets ignored on the screen.

We can get T_high and semply set T_low = ½*T_high. And T_high means our threshold is higher, less lines show up. And T_low means our threshold is half, more lines show up.

I set the Percentage Of Nonedge to 0.9 and here's the result.

T_high_184_0.9_lena

T_low_92_0.9_lena

high_joy

low_joy

high_pointer

low__pointer

high_test

low_test

Supressing Nonmaxima:

We need to use Suppressing Non Maxima to do the T_high and T_low image as stated before. For each angle(direction), we need to determine its angle range and turn it in either up, left, down or right. For magnitude, we need to choose the local max magnitude.

Below is their image under the sobel method.

Sup_Nonmax_sobel_lena

Supressed _joy

Supressed _pointer

Supressed _test

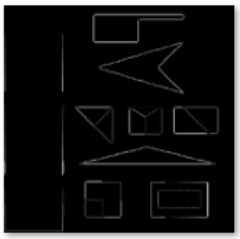
Edge Linking:

In this function we linked all the lines and made the image look more complete. We compared each line of T_low and T_high images. If the lines appear in T_low and connect to any lines in T_high, Then it would be added to our edge linking image. So the final image should consist of the linked part and the lines in T_high.

Link_184_92_0.9_lena

Linked image_joy

Linked image_pointer



Linked image_test

ANALYSIS

In Gaussian Smoothing, If we replace 3*3 → 6*6:

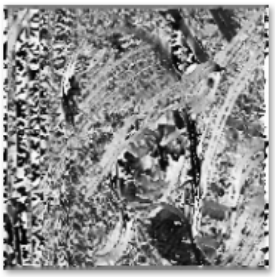
There's not much difference between direction and magnitude, but the 6*6 kernel image is more vague than 3*3 kernel image. The reason is in a larger kernel, each pixel will be more affected by the surrounding pixels.

GaussSmoothing_3x3_1_lena

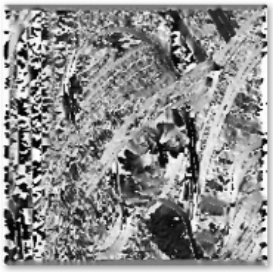
GaussSmoothing_6x6_1_lena

magnitude_3x3_sobel_lena

magnitude_6x6_sobel_lena



direction 3x3 sobel lena



direction_6x6_sobel_lena

In Gaussian Smoothing, If we replace sigma = 1 → 5:

The change of sigma is exponential to our pixel of the kernel, which means we are focusing more on our local pixel. So as sigma increases, the image becomes more vague.

GaussSmoothing_3x3_1_lena

GaussSmoothing_3x3_5_len

In Calculating Image Gradient, if we change the method from Sobel → Roberts:

As the way of line detection changes, the image looks totally different. Since Sobel detects thicker lines than Roberts, and the image looks more clear.


direction_3x3_sobel_lena


Link_184_92_0.9_lena


magnitude_3x3_sobel_lena


Sup_Nonmax_sobel_lena


T_high_184_0.9_lena


T_low_92_0.9_lena


direction_3x3_Robert_lena


Link_50_25_0.95_lena


magnitude_3x3_Robert_lena


Sup_Nonmax_Robert_lena


T_high_50_0.95_lena


T_low_25_0.95_lena

In High and Low Thresholds, if we change the percentageOfNonEdge from 0.9 → 0.8:

As we can see, if we set the percentageOfNonEdge lower, then our threshold is lower, which means more detailed lines are included in our image. If we want to keep our image clear and concise, we should choose higher percentageOfNonEdge , but if we want it to include more detail, we hope percentageOfNonEdge to be smaller.


Link_184_92_0.9_lena


Link_96_48_0.8_lena