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Assignment 2 Report

Purpose:

To use Unsharp masking, Sobel operator, Laplacian of Gaussian operator, and Scale Space filter for edge detection and enhancement. Apply these operators to a gray scale image to generate the edge image.

Method:

Unsharp Masking:

- Initialized a 3x3 mask
- Used mask to perform convolution for every pixel of cloned image.

Sobel Operator:

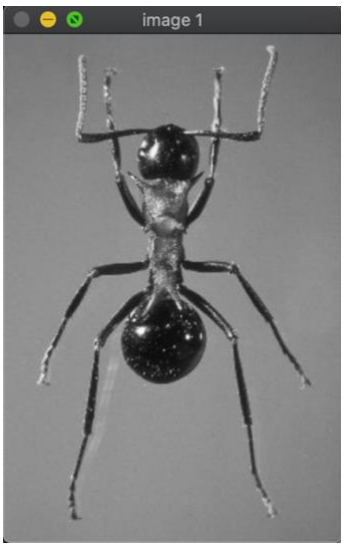
- Calculated x-gradient and y-gradient.
- If the sum of the gradients is greater than 255 then corresponding pixel is 255 else 0.

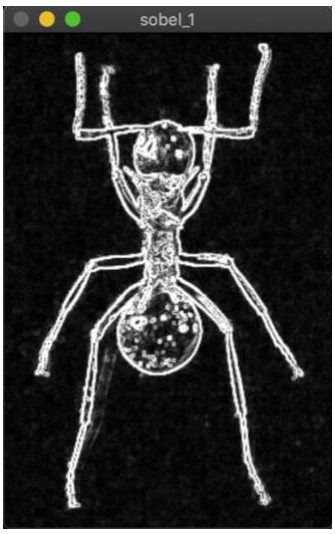
Laplacian of Gaussian:

$$LoG(x,y) = -\frac{1}{\pi\sigma^4}\left[1 - \frac{x^2+y^2}{2\sigma^2}\right]e^{-\frac{x^2+y^2}{2\sigma^2}}$$

- Used above formula to calculate LoG value and generated a mask.
- Used mask on the image to get final image.

Results:






LoG11_1

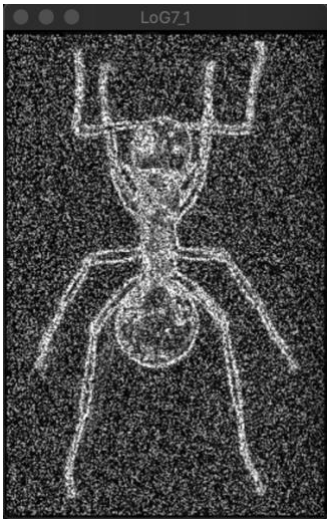
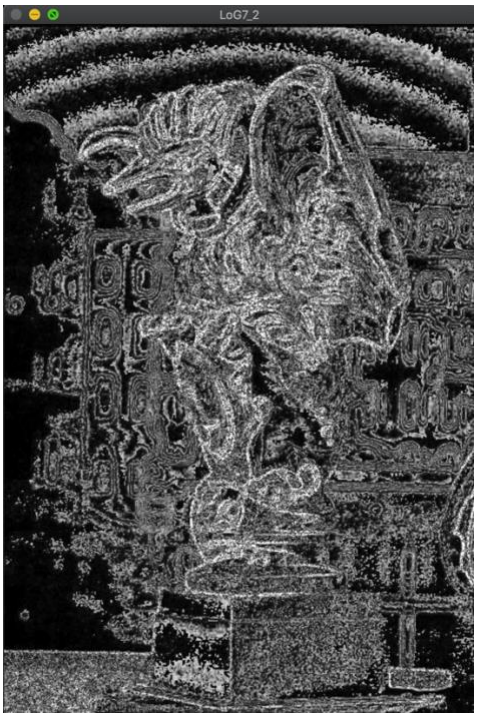

LoG7_1


image 2


blur_2


enhance_2


sobel_2


LoG7_2


LoG11_2

We can see that 7x7 mask has more detailed edges. It will have lesser smoothness than 11 x 11 mask. Thus, the amount of noise removed is more in 11 x 11 leading to lesser detailed edge detection.

```
7 x 7
1       3       4       5       4       3       1
3       5       3       0       3       5       3
4       3       -11     -23     -11     3       4
5       0       -23     -40     -23     0       5
4       3       -11     -23     -11     3       4
3       5       3       0       3       5       3
1       3       4       5       4       3       1

11 x 11
0       -1      -3      -4      -5      -6      -5      -4      -3      -1      0
-1      -3      -6      -8      -9      -10     -9      -8      -6      -3      -1
-3      -6      -9      -11     -13     -13     -13     -11     -9      -6      -3
-4      -8      -11     -14     -16     -17     -16     -14     -11     -8      -4
-5      -9      -13     -16     -18     -19     -18     -16     -13     -9      -5
-6      -10     -13     -17     -19     -20     -19     -17     -13     -10     -6
-5      -9      -13     -16     -18     -19     -18     -16     -13     -9      -5
-4      -8      -11     -14     -16     -17     -16     -14     -11     -8      -4
-3      -6      -9      -11     -13     -13     -13     -11     -9      -6      -3
-1      -3      -6      -8      -9      -10     -9      -8      -6      -3      -1
0       -1      -3      -4      -5      -6      -5      -4      -3      -1      0

7 x 7
1       3       4       5       4       3       1
3       5       3       0       3       5       3
4       3       -11     -23     -11     3       4
5       0       -23     -40     -23     0       5
4       3       -11     -23     -11     3       4
3       5       3       0       3       5       3
1       3       4       5       4       3       1

11 x 11
0       -1      -3      -4      -5      -6      -5      -4      -3      -1      0
-1      -3      -6      -8      -9      -10     -9      -8      -6      -3      -1
-3      -6      -9      -11     -13     -13     -13     -11     -9      -6      -3
-4      -8      -11     -14     -16     -17     -16     -14     -11     -8      -4
-5      -9      -13     -16     -18     -19     -18     -16     -13     -9      -5
-6      -10     -13     -17     -19     -20     -19     -17     -13     -10     -6
-5      -9      -13     -16     -18     -19     -18     -16     -13     -9      -5
-4      -8      -11     -14     -16     -17     -16     -14     -11     -8      -4
-3      -6      -9      -11     -13     -13     -13     -11     -9      -6      -3
-1      -3      -6      -8      -9      -10     -9      -8      -6      -3      -1
0       -1      -3      -4      -5      -6      -5      -4      -3      -1      0
```

Bug Report:

No bugs. Extra parts not implemented.

Steps to run:

1) Open Terminal
2) cd to project directory
3) Compile using command: g++ $(pkg-config --cflags --libs opencv4) -std=c++11 program_2.cpp
4) Type ./a.out

Reference:

https://stackoverflow.com/questions/2556958/laplacian-of-gaussian

https://theailearner.com/2019/05/25/laplacian-of-gaussian-log