

HOMEWORK SET 4

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PART 1 | EDGE DETECTION BY ZERO CROSSING

The following results from the code was used to find edge detection by zero-crossing of difference of gaussian and laplace of gaussian methods. The initial picture is labeled as Fig 1. It was first converted to a grayscale image using Python's PIL library(Fig 2.)



Fig 1. Original Color Image



Fig 2. Grayscale image of original

We applied a difference of gaussian on the grayscale mask on the image to obtain a Difference of Gaussian image. Fig 3 shows the mask that was applied using convolve2d from the scipy library, to form Fig 4.

$$\begin{bmatrix} 0 & 0 & -1 & -1 & -1 & 0 & 0 \\ 0 & -2 & -3 & -3 & -3 & -2 & 0 \\ -1 & -3 & 5 & 5 & 5 & -3 & -1 \\ -1 & -3 & 5 & 16 & 5 & -3 & -1 \\ -1 & -3 & 5 & 5 & 5 & -3 & -1 \\ 0 & -2 & -3 & -3 & -3 & -2 & 0 \\ 0 & 0 & -1 & -1 & -1 & 0 & 0 \end{bmatrix}$$

Fig 3. Difference of Gaussian Mask



Fig 4. After applying mask on image

After this a zero-crossing method was used to find the edges, first an image was taken with no threshold values, this image showed to have a lot of noise as shown in Fig 5.

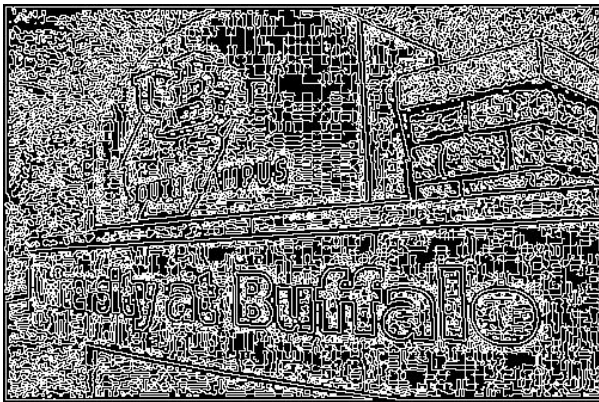


Fig 5. No Threshold Values

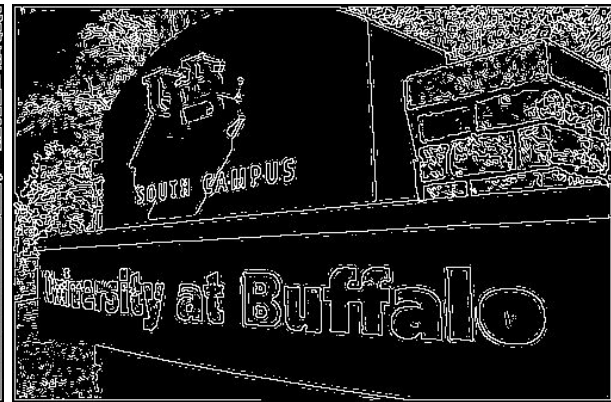


Fig 6. Threshold Value = 700

Applying a threshold value of 700 gives us a very good image of the edges by removing the weak edges from the image. After applying the difference of gaussian mask, we were asked to apply a Laplacian of Gaussian mask on the image, and follow the same steps. The Laplacian mask used to get the Laplacian Gaussian Image was as follows

$$\begin{bmatrix} 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 2 & 1 & 0 \\ 1 & 2 & -16 & 2 & 1 \\ 0 & 1 & 2 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 \end{bmatrix}$$

Fig 7. Laplacian of Gaussian Mask



Fig 8. After applying mask on image

Following the same steps as applied in Difference of Gaussian, we applied a no threshold zero-crossing to the image, and one with the same threshold value, which resulted in the following images.

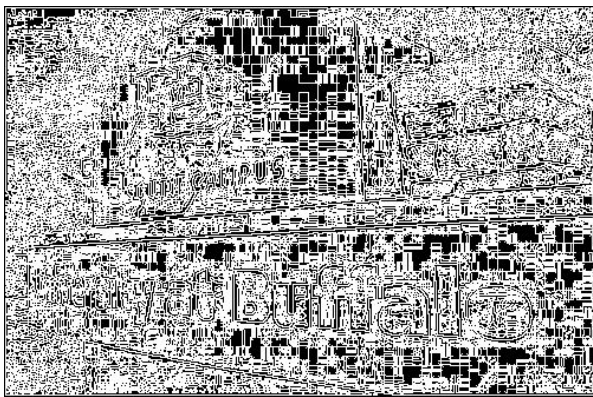


Fig 9. No Threshold

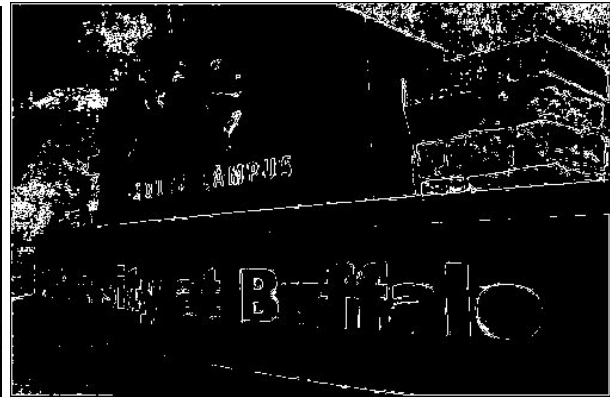


Fig 10. Threshold Value = 700

We can clearly see from the results of the images that with a no threshold value, more noise was created, and when the same threshold value was applied, a lot of the edges were lost. To acquire an approximate result similar to the Difference of Gaussian image, we had to apply a threshold value of 350.

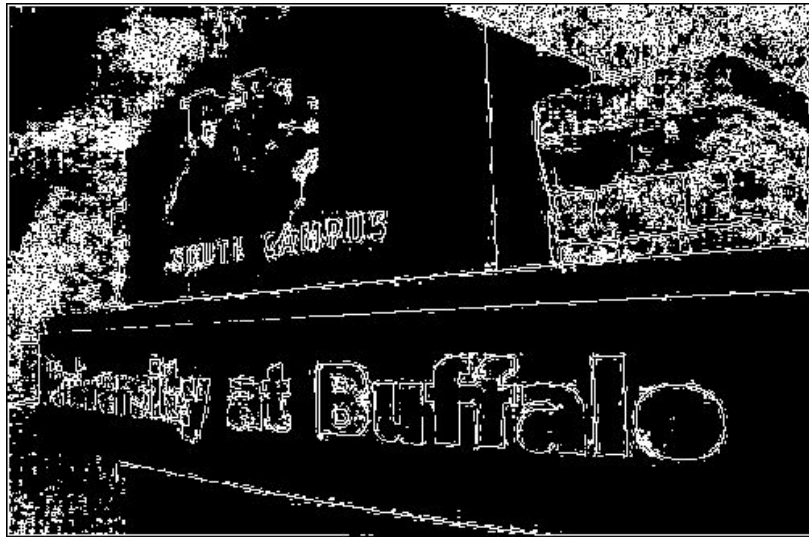


Fig 11. Threshold Value = 350 (Laplacian of Gaussian)

Comparing the two we can say that when Difference of Gaussian mask was applied a lot of the noise was removed when zero-crossing was applied and thus making the image more sharper with higher threshold values, whereas when the Laplacian mask was applied less noise was removed with zero-detection was applied and thus resulting in lower threshold values and a less sharper image. The ratio of the two with standard deviation of 1 will give us similar results, when trying to find the threshold value.