IMAGE PROCESSING
1.ASSIGNMENT REPORT
IMAGE FILTERING

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Problem Definition:

Image filtering is some of the most important and fundamental techniques in image processing. It works as simply removing high frequency component which does smoothing for human eyes.High frequency components mean where some sudden changes occur in values of image intensities like edges. Because high frequency components are seen at edges it can also be worked as getting edges from images.

In this assignment our goal was to create a cartoon like images from normal images. For this purpose we need to do some steps. First we need to apply a Gaussian or Median Filter to make the images smooth or blurry as we say. Then With this smoothed images we do 2 separate steps. One is to use 2 gaussian kernel to extract the edges. And the other one is quantization which modifies the image values to distribute in some intervals. Finally we multiply edge extracted values with quantized images and find our final result. I chose 8 different images to test my algorithms.

1) Smoothing:

Smoothing can be done in many different ways. One is using a Gaussian filter which eliminates the high frequency components. The other one is to use a median filter which also does the same but in a different way. In some cases the median filter does a better job. I tested Gaussian smoothing both in terms of kernel size and sigma values. I also tested the median filter in terms of kernel size.Because of this I used both of them in this section.Results are shown below.

k = 3x3 s = 0.5

k = 3x3 s = 1.5

k = 3x3 s = 2.5

These are for the comparison of changing sigma value. As you can see when we increase the sigma value from 0.5 to 2.5 there is no seen effect. Although we expect increasing sigma values would increase the smoothing.

k = 5x5 s = 2.5

k = 7x7 s= 2.5

k = 9x9 s = 2.5

These are for the comparison of changing kernel size. When we focus on number behind the car we can see that as kernel size increases from the blurring increases. This was what we are expecting.

k = 3x3

k = 9x9

These are the images from median filtering. As we can see again there is blurring in text behind the car.

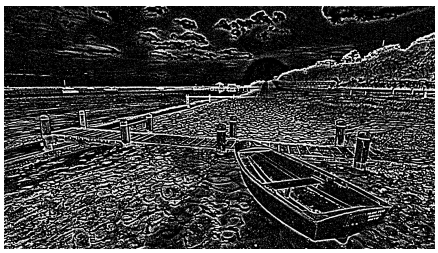
Note that we lose some details when we apply filtering. However we also remove some noise while doing that.

Note 2: Because the images shown here are too small to be fixed you can refer to the “report/result” folder for further analysis.

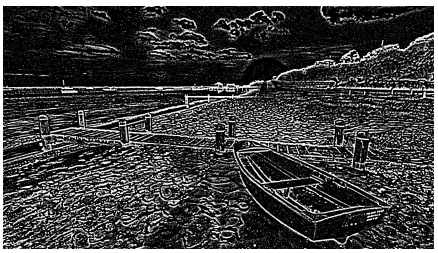
2)Edge Extraction:

Edges are important parts of images. They can be useful in many ways. One is we can take only edges and make them more visible to be able to draw a cartoon-like image. For this we first take the gray scale of the main image. Then we do gaussian blur that we did in 1. part with 2 different sigma values. We subtract the more

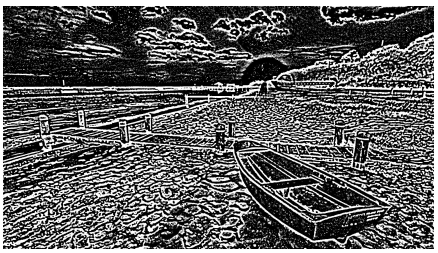
smoothed image from the less smoothed one. Because when I did convolution I had some peculiar results. I just skipped that part. After that we do normalization on images. Then we do thresholding to extract the edges. Finally we turn it back to 8 bit representation. I tested on many different sigma and epsilon values. Results are shown below.



k = 1.2 eps = 0.5



k = 1.2 eps = 0.7



k = 1.6 eps = 0.1

Because I was not able to do a good convolution I did not get good results. However because we know that when we increase k then sigma increases and the image gets blurrier. After extracting from the lesser sigma valued image we get sharper images. Also when we increase epsilon the image should be blacker as thresholding will turn more values into 0's.

3)Image Quantization:

Image quantization is the process of distributing the image values into some intervals so that it resembles more like a cartoon image. We used the images from the gaussian images results.I tested this for different values of intervals. Results are shown below.

level = 3

level = 6

level = 14

Inspecting the results we can see that increasing the level value image resembles the original gaussian blurred images. This is what we expected because increasing the number of intervals will at last converge to level for all values and the image will be the same.

4)Combining Edge and Quantized Images:

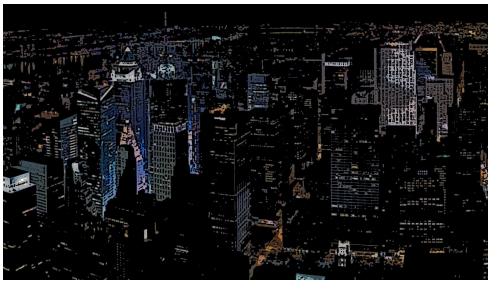
In this part our goal is to combine the images we found in 2. and 3. parts namely the edges and quantized images. First we need to invert the edges because we had edges as white then we multiply edge values with quantized image values to get the final result.
I took 5 images per image from the edge part and 5 images per image from the quantization part.
Edge part values:
(k, epsilon) = (1.2,0.1) (1.2,0.7) (1.6,0.1)) (1.6,0.7) (2.8,0.7)
Quantization part values:
levels = (3, 4, 6, 9, 14)

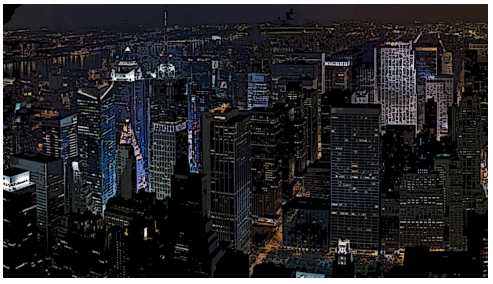
(k, epsilon)=(1.2,0.1),
level = 3

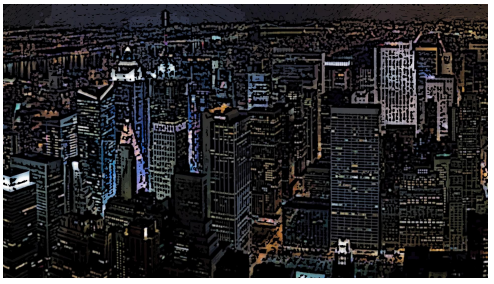
(k, epsilon)=(1.6,0.1),
level = 6

(k, epsilon)=(1.6,0.1),
level = 14

As we can see when the luminance increases the noise increases too.







However there is more detail too.