

The Report of the Second Assignment

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1.The project clarification

The project has two steps, step 1 is the enhancements of the image, step 2 is image extraction. For the step1, we have a bunch approaches to enhance the image quality. The step2 is detect the edge of the image and generate the magnitude of the gradient. I will introduce the details such like the approaches and reason why it needs these approaches later in the report.

2.Methods

2.1 Power-Law Transformations:

The power-law transformations follows this formula:

$$s = T(r) = c r^\gamma$$

Basically, it is used to change the grey level and luminance of the image by changing the parameter γ . The figure1 and 2 shows the change of histogram when the parameter γ changed. And when γ large than 1 the image is over exposed.

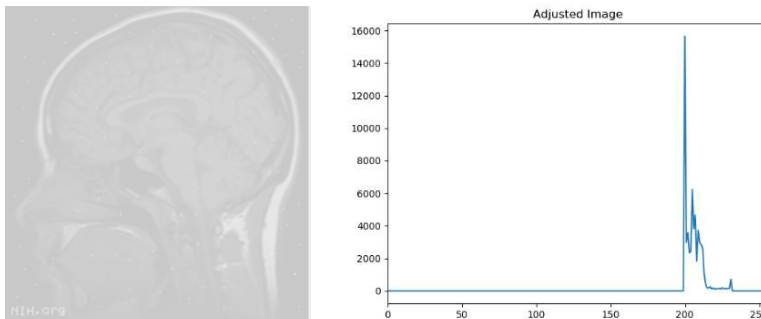


Figure 2.1.1 ($\gamma=0.10$)

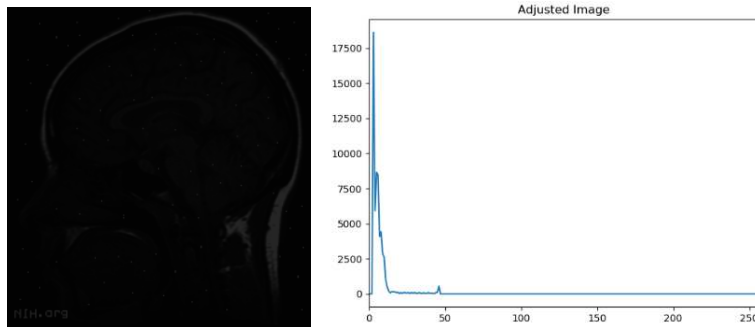


Figure 2.1.2($\gamma=1.97$)

When the value of γ is too low or too high, it will lead a bad performance of the result because we cannot generate a comfort grey level.

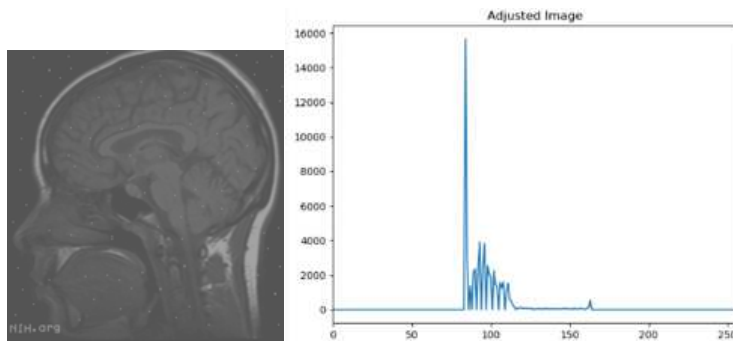


Figure 2.1.3 ($\gamma=0.46$)

We have adjust the value of γ and the result is acceptable.

Because the main aim of the project is to enhance the image, which means the histogram of the image should be as smooth as possible, so just use the gramma correction is not enough.

2.2 Linear transformation Frame:

The linear transformation frame follows this formula:

$$S=T(r)= ar + b$$

The figure 2.2.1 and 2.2.2 shows the results when applying the linear transformation

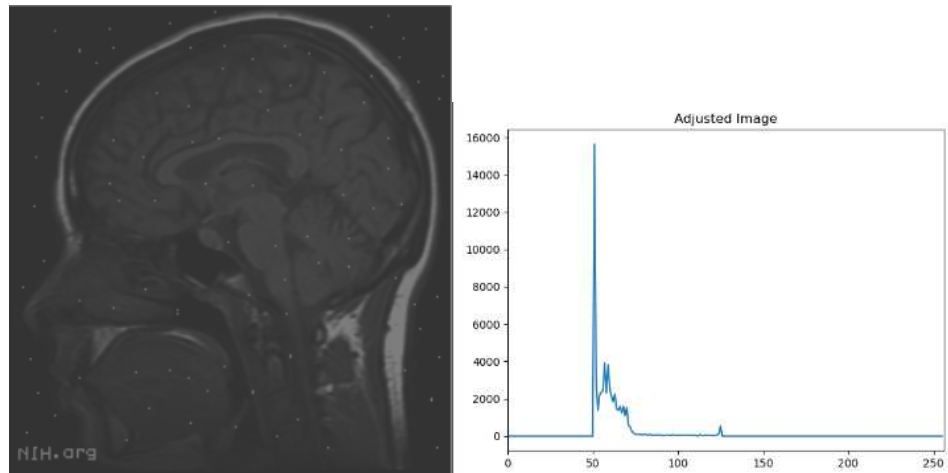


Figure2.2.1 linear transformation $a=1.0, b=28$

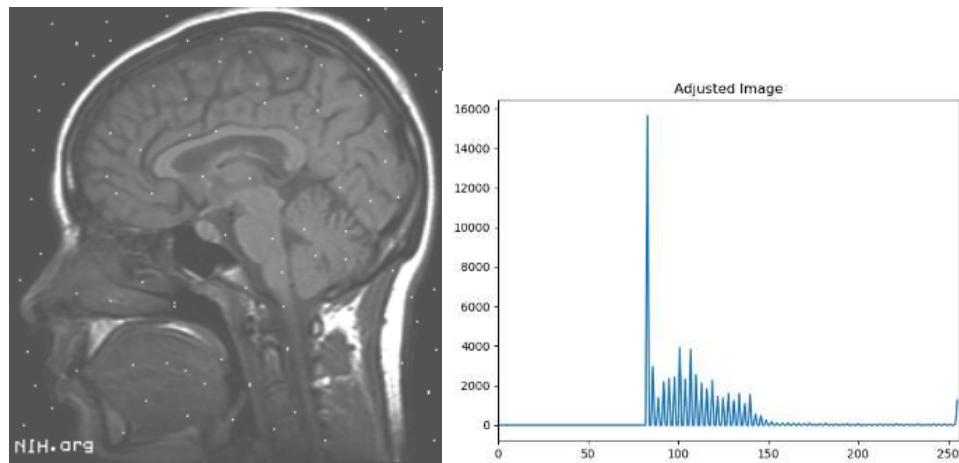


Figure2.2.2 linear transformation $a=3.0, b=14$

We chose the second result to take the next enhancement step.

2.3 Non-Linear Filtering Frame:

The filter frame contains linear filter (such as Average filter and Gaussian filter) and non-linear filter (such as Median filter). The follows will discuss the results when these filters are applying on the image.

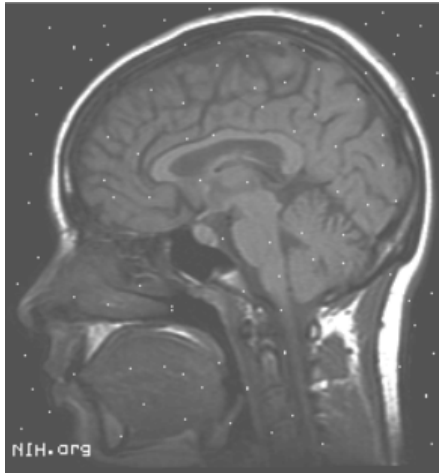


Figure 2.3.1 the original image

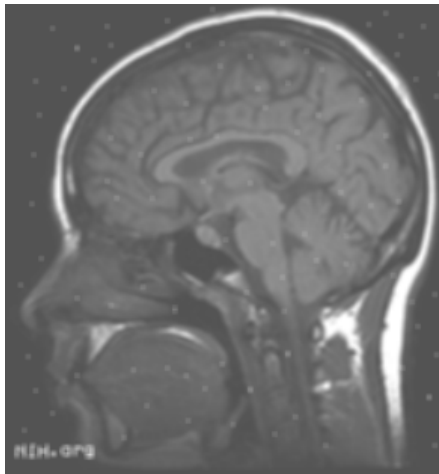


Figure2.3.2 the image applying the average filter

This image shows the average filters is focusing on smooth the image, it can't reduce the noise but blurred them and the texture of the image.

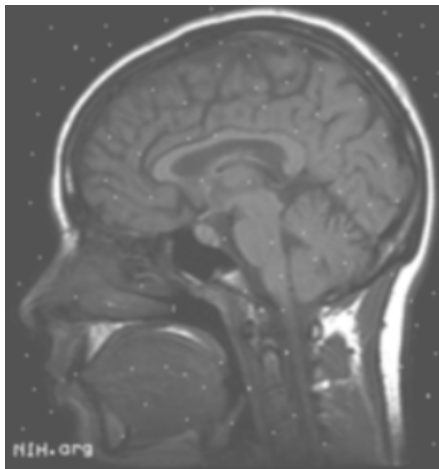


Figure 2.3.3 using Gaussian filter

Gaussian filter has a better performance than average filter, it could reduce the gaussian noises.

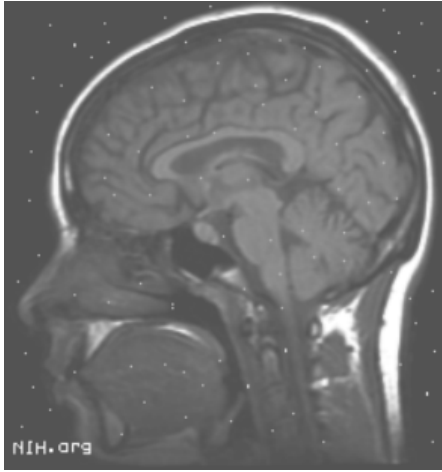


Figure 2.3.4 Bilateral filter

As a compromise solution, the Bilateral filter depends Euclidean distance of pixels and the radiometric differences both, so it can preserve the boundary when smooth the image.

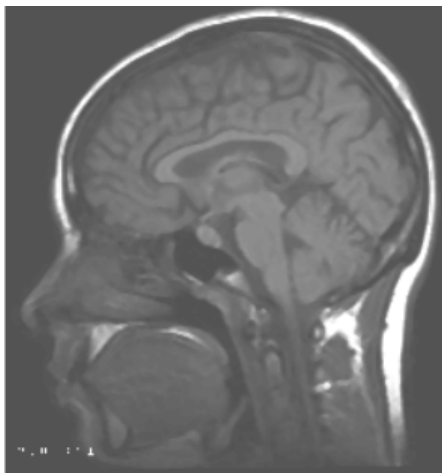


Figure 2.3.5 Median filter

The figure 2.3.5 shows that the Median filter had almost eliminate all the noises, however, it can't keep the boundary of the image, it is hard to recognize the words in lower left corner. Because in this image, the quantity of noise points are low so the median filter is the best choice to enhance the picture.

2.4 Another method (Hist equal & CLAHE)

Hist equal can equalize the intensity of the image to improve the contrast ratio. We use the function “equalizeHist()” of OpenCV to get the image after equalization. As the figure 6.1 shows.

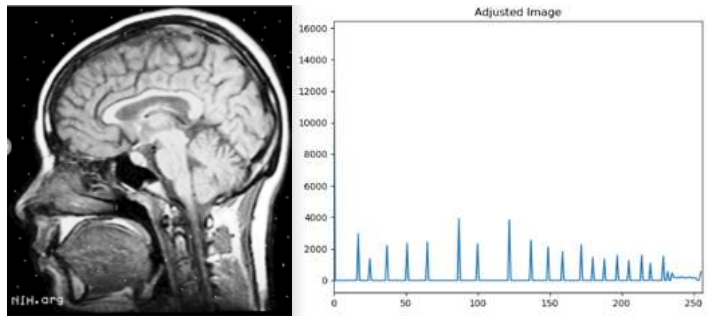


Figure 2.4.1 Hist equal and its Histogram

The main difference between CLAHE and Hist equal is that it makes some limitation to the contrast ratio and generate the image with normal contrast ratio.

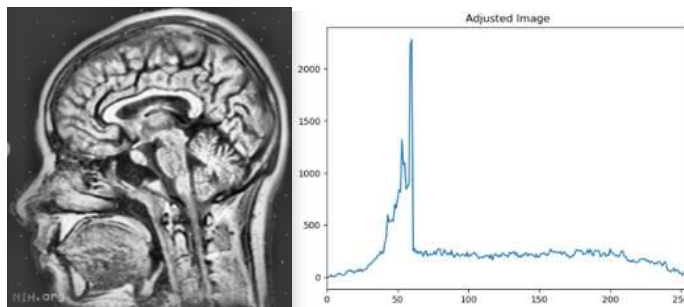


Figure 2.4.2 CLAHE and its Histogram

3.Edge detection

After image enhancement, we have used a few methods to detect the edge of the image. Here are the results.

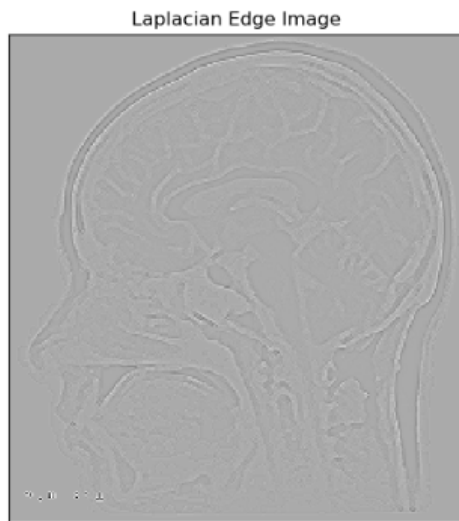


Figure 3.1 Laplacian Edge image



Figure 3.2 Scharr image



Figure 3.3 Sobel image

By compare Scharr image and Sobel image, it can conclude that the Sobel image have clarify boundary.

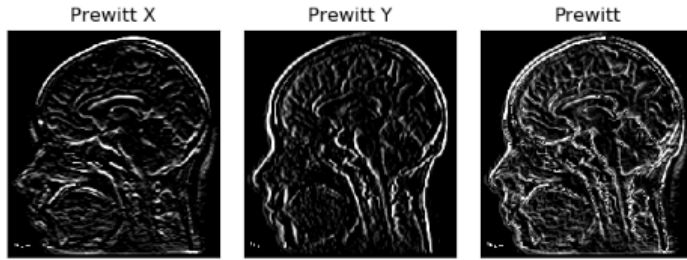


Figure 3.4 Prewitt



Figure 3.5 Canny

The result Prewitt clearly shows the boundary of the image

4. Conclusion

Through this assignment, we've learned how to enhance the image and how to take the best filter according to the features of the image. According to the instruction, we use the power-law transformation to change the grey level of the testing image, we found that the parameter γ strongly influence the grey level. Then we use the linear transformation frame to enhance the image, the histogram shows that the image is better. The nonlinear transformation, basically, the filters, we found that in this image, the median filter is the best filter to reduce the noise. Also, we discussed the other method such like Hist equal, CLAHE algorithm. After we enhanced the image, we generate the edge detection image to see the difference between Laplacian, Scharr, Sobel, Prewitt and Canny methods.

