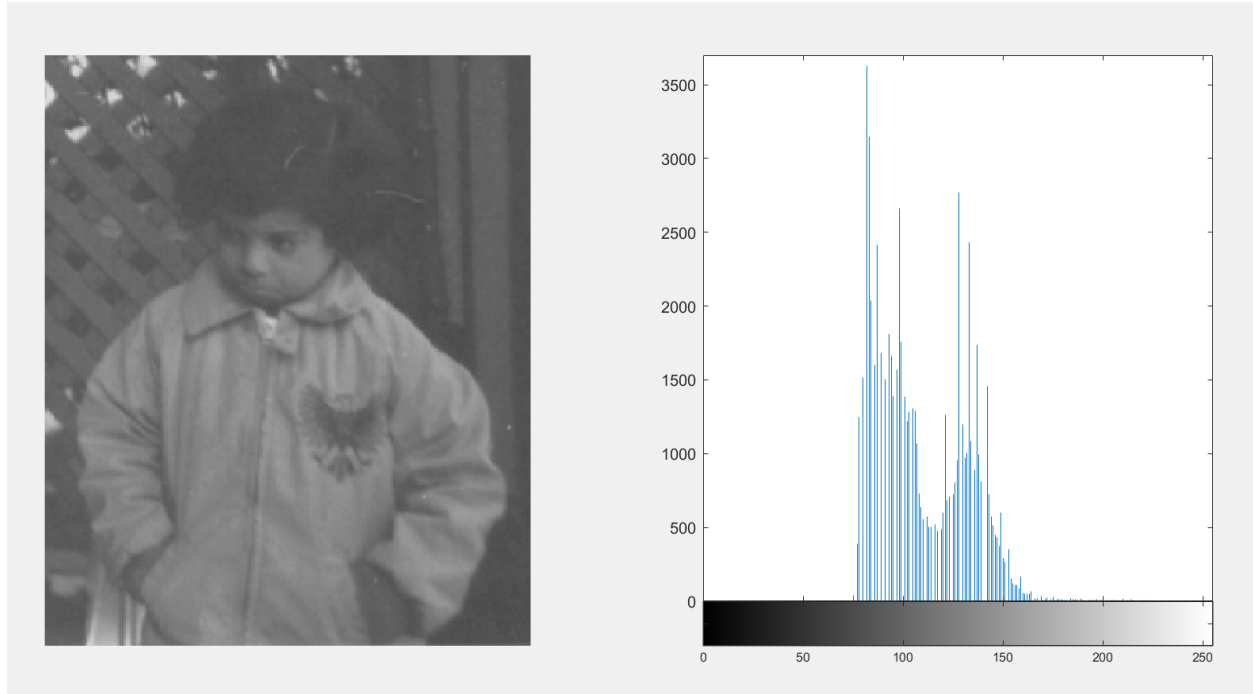# Zewail City
University of Science and Technology
CIE 227 – Signals and Systems
Image Processing assignment
Dr. **Mahmoud Abdelaziz**
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Name: **Omar Mosaad El-Sakka**

ID: 201900773

E-mail: s-omar.elsakka@zewailcity.edu.eg

Part a:

1) **Observe the histogram.**

   With observing the histogram, it is noticeable most of pixels in the image is concentrated in a certain region. Meanwhile, the other values of pixels are unused.

2) **Do pixels have high or low intensity values?**

   The pixels have neither low intensity values nor high intensity values. Most of pixels are in the middle region.
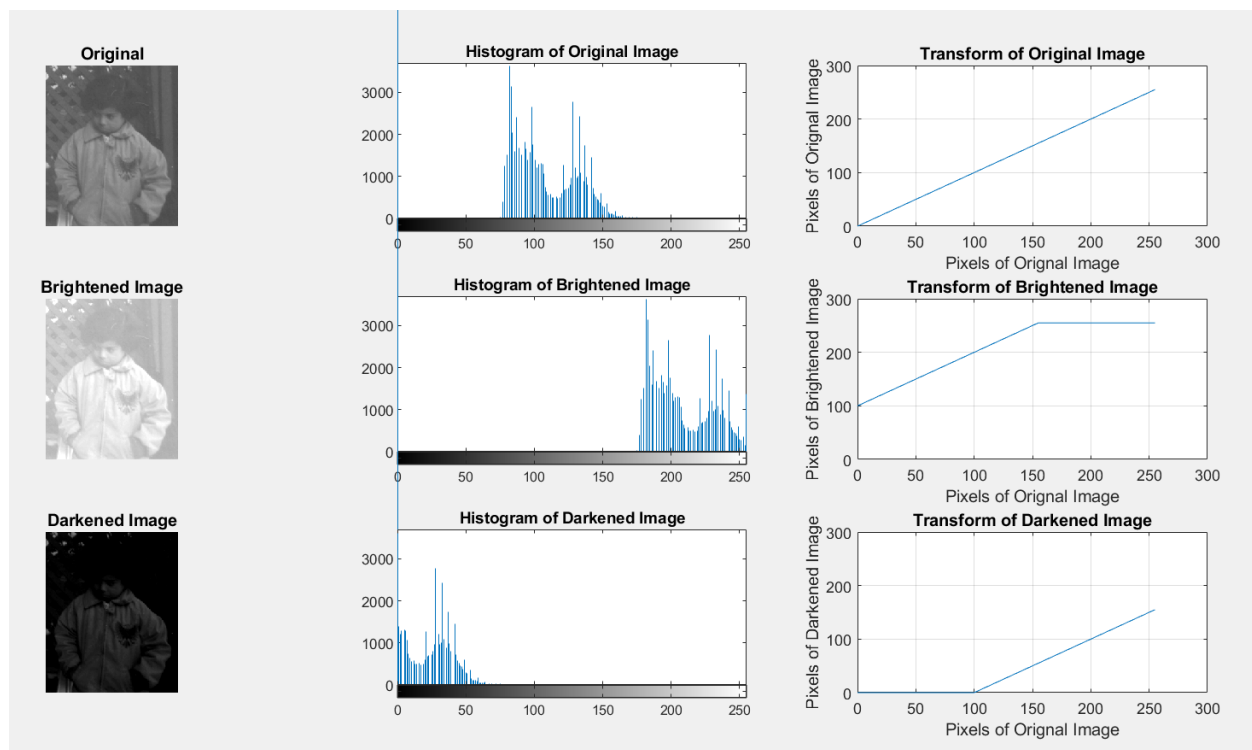
3) **What is the dynamic range of pixels?**

   Although there are values 74:224, the concentrated values are between 75:180. So, the dynamic range is 75:180.

4) **Do pixels have small or large dynamic range?**

   Pixels have a small dynamic range because it is concentrated in about 105 values (75:180) among 256 values.

Part b:

1) **Observe and compare the histogram of the brightened image and darkened image to that of original image.**

   With comparing the histogram of the original, Brightened, and the darkened image. It is noticeable that the histogram of the brightened image is the right shifted version of the histogram of the original image (That is because we added 100 to each value of pixels in the image, so pixels would start from 174 to 255 & dynamic range is 175:255). On the other hand, the histogram of the darkened image is the left shifted version of the histogram of the original image (That is because we subtracted 100 from each pixel in the image, so pixels would start from 0 to 124 & dynamic range is 0:80).

2) **Does increasing brightness shift pixel values to the right? Does decreasing brightness shift pixel values to the left?**

   Yes, increasing brightness shifts pixel values to the right as increasing pixels makes a shift with +100. Also, decreasing brightness shift pixel values to the left as decreasing pixels makes a shift with -100.

3) Does increasing/decreasing brightness affect the dynamic range of pixels?

The dynamic range of the original image is 75:180 "range of 180-75=105". After increasing brightness with 100, the dynamic range would be 175:255 "range of 255-175 = 80". So, **increasing brightness makes the dynamic range narrower.** After decreasing brightness with -100, the dynamic range would be 0:80 "range of 80-0=80". So, **decreasing brightness makes the dynamic range narrower.**
→**So, Finally, increasing, or decreasing brightness of the image would make the range narrower.**

4) Does increasing brightness shift the output transform to the left? Does decreasing brightness shift the output transform to the right?

Yes, we can say that the output transform of increasing brightness shifts the output transform to the left, and decreasing brightness shifts the output to the right. (with a maximum of 255).

Part c:
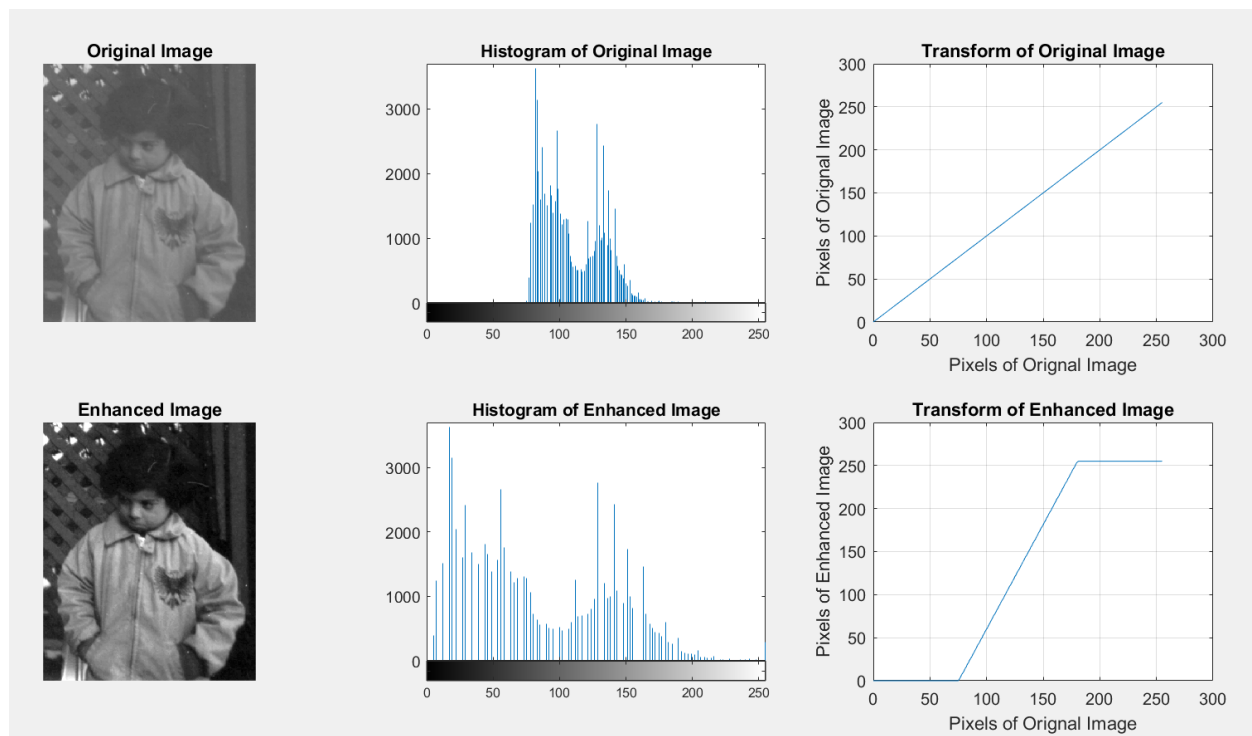
1) **Observe and compare the histogram of the original image and enhanced image.**

the histogram of the enhanced image is like rescaling process for pixels from 75 to 180 on the scale 0:255. (or multiplying process each pixel in 75:180 by a gain). Consequently, it would increase the contrast.

2) **Is the dynamic range of pixels stretched over the entire spectrum of pixel values in enhanced image?**

Yes, the dynamic range of pixels is stretched over the entire spectrum of pixel values in enhanced image and it would definitely improve the image quality.

3) **Does that improve image quality?**

Yes, the image quality improves as the contrast of the image become better. Now, we can see more details in the image.

Part d:
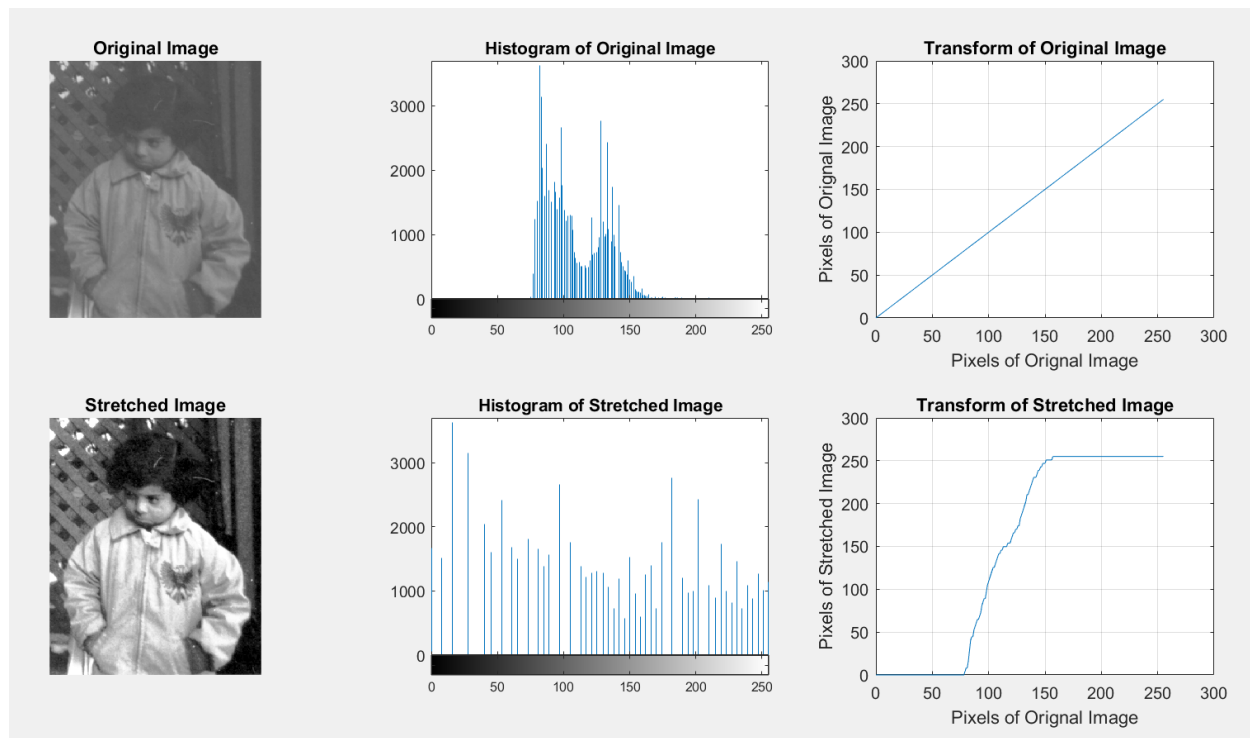
1) Observe and compare the histogram of the original image and enhanced image.

In the histogram of the stretched one, we stretched important values of pixels from 0 :255, or in other words we distributed the most repeated values of pixels into 0:255.(75:180→0:255) by a certain factor to make the image has more contrast.

2) Is the histogram flat/equalized in enhanced image?

Yes, the histogram is equalized in enhanced image. as we used histeq() function to describe what happens in stretched image in details.

3) Does that improve the quality of image?

Definitely, it improved the quality of image, as it makes the image has more contrast by stretching the most repeated values of pixels into 0:255, so we would observe more details.

4) Are the pixel values between 75 and 180 stretched between 0 and 255 in the output transform of enhanced image?

Yes, the pixel values between 75 and 180 stretched between 0 and 255 in the output transform of enhanced image. histeq() function stretched the image pixels somehow to make the best stretching can be done ever. So, more details can be seen in the image.