NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS

School of Science

Information Technologies in Medicine and Biology

Direction: *Bioinformatics*

Image Processing and Analysis

Postgraduate Student: *Begetis Nikolaos* Professor: *Sangriotis Manolis*

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Assignment 1

Task 1

In the first task of our assignment we were given two pictures where the first one (Figure 1 - "picture_with_wrong_illumination_1.bmp") shows two shapes, a square and a circle, but with wrong illumination and noise. The second picture (Figure 2 - "source_illumination_ profile_of_picture_1.bmp") shows the same picture but without the shapes, so that we can use it to correct the illumination. To do that, we find the mean value of the illumination values of the profile picture. And after that, we adjust the corrected illumination in the first figure with the shapes, and also quantize it in a 0-255 greyscale.

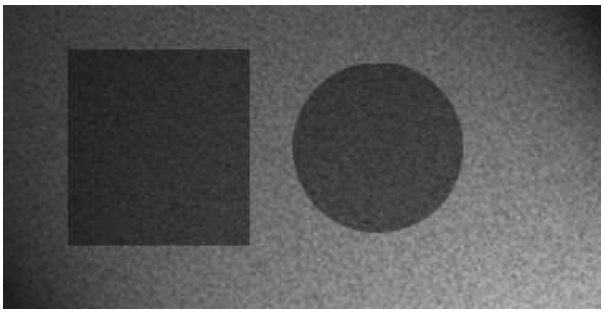

Figure 1: Picture showing a square and a circle. It has wrong illumination and noise.

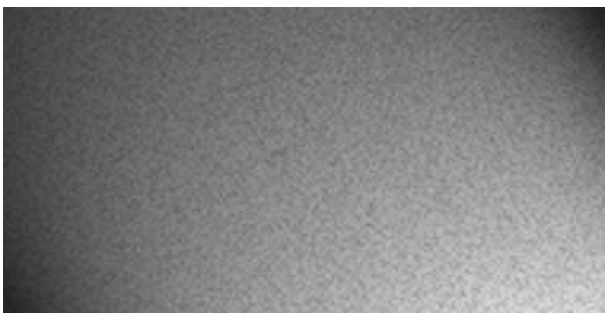

Figure 2: Picture showing the profile illumination of the above Figure 1. It is used to correct the illumination

Having done so, the first picture turns to become as shown in Figure 3 (picture_with_right_ illumination_1.bmp) where now the image is correctly illuminated and quantized in 256 scales of greyscale.

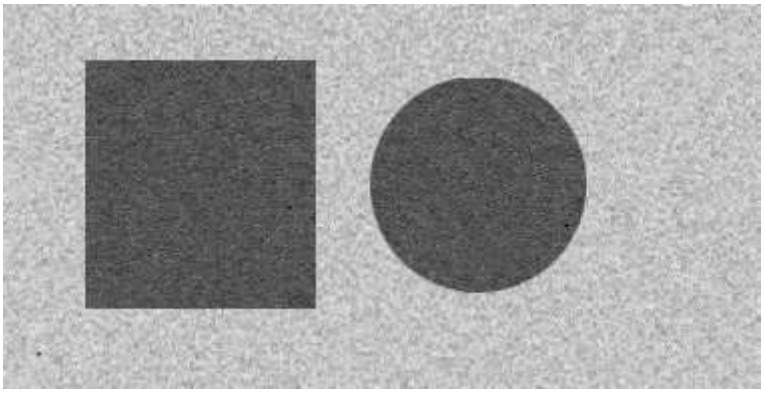

Figure 3: Picture showing a square and a circle. It is correctly illuminated, but noise still exists.

The next thing to do, is to create a histogram with purpose to use it in removing the noise. So, given the Figure 3 we can infer the histogram shown in Figure 4 (picture_1_histogram_ illumination.bmp).

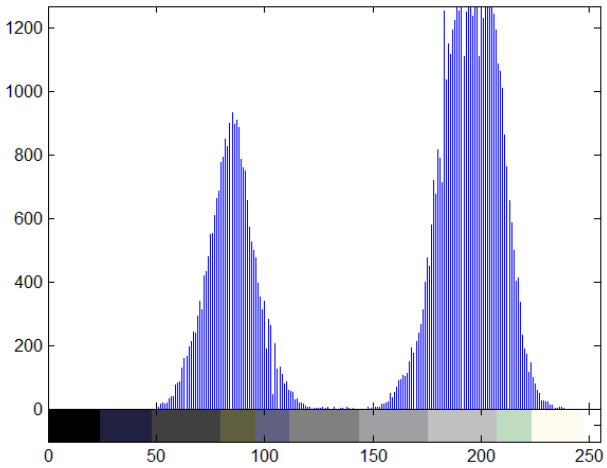

Figure 4: Histogram created from Figure 3. It is applied on a 0-255 scale.

We then, in order to remove the noise, we apply a threshold with a global threshold of value 142 of the greyscale as shown in Figure 5 (threshold_placed_pic1.bmp), because the first dispersion of values 50-142 corresponds to the shapes of the initial picture and the second discrete dispersion of values 142-240 corresponds to the noise of the picture.

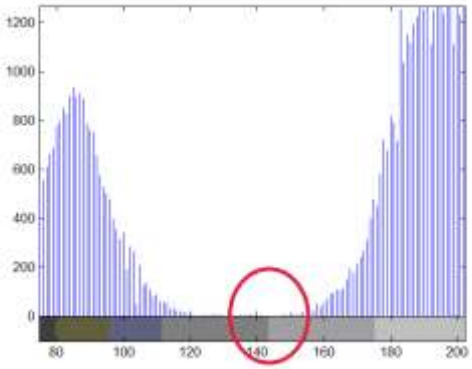

Figure 5: Histogram showing the threshold picking in order to clear the picture's noise.

Finally, we keep the first dispersion and we highlight it as black color (value 0 of greyscale) and the rest we threshold it and mark all the noise spots in white (value 255 of greyscale). The final result of this first task, with the initial picture corrected in illumination and cleared by its noise is shown in Figure 6 (picture_1_cleared.bmp).

Figure 6: Picture showing a square and a circle. It is correctly illuminated, and noise is cleared.

Task 2

As a second task of our assignment we were given one picture (Figure 7 - "picture_with_ wrong_illumination_2.bmp") which depicts a theatrical program, but with wrong illumination including variable luminosity desperation. In order to correct the illumination we now should apply an adaptive thresholding.

Figure 7: Picture showing a theatrical program. It has variable luminosity desperation.

We chose the technique of adaptive thresholding, because it is commonly used in such cases where the background is not illuminated in a uniform way and we cannot access the pattern that the source illuminates. With this technique the value which we put as a threshold is selected differently for each pixel of the picture.

As indicated in class notes for every pixel (l,c) the mean value T(l,c) of the surround pixels, in a region LxL is selected as the best value for thresholding. In our case we set the mean value to be selected in a surround region of 7x7. So the formula we used was:

$$T(k,m) = \left(\frac{1}{49}\right) \sum_{i=-3}^{3} \sum_{j=-3}^{3} w(\mathrm{k}-\mathrm{i}, m-j) - C$$

where C is a constant variable, with its value depending on the number of quantization scales and the background noise. In class notes it was indicated to use the value C=5 to result in the best solution. The resulted corrected and cleared picture is shown in Figure 8 (picture_2_cleared.bmp).

Figure 8: Picture showing a theatrical program. It is corrected and cleared.