

# Lab 02, Low level image processing

João Santos, *MRSI*, 76912

*Index Terms*—OpenCV, Computer Vision, MRSI, UA, DETI,  $\LaTeX$ .

## I. INTRODUCTION

**T**HIS report is intended to be used alongside the Python3 code developed for this Lab.

The Lab #02 is a introduction class to an IDE (in the case of the author, Visual Studio Code), OpenCV and Python 3.

This report was written using  $\LaTeX$ .

## II. EXERCISES

Lets analyse the resolution of the proposed exercises.

### A. Ex. 2.1: Drawing primitives

In this exercise, the keyboard input is used as a parameters for the mouse callbacks of each window. These callbacks then call the OpenCV drawing methods (`cv2.rectangle()`, `cv2.circle()`, `cv2.line()`) based on the received parameter to draw the primitive on the image.

In Figs. 1 and 2 two example uses are shown.

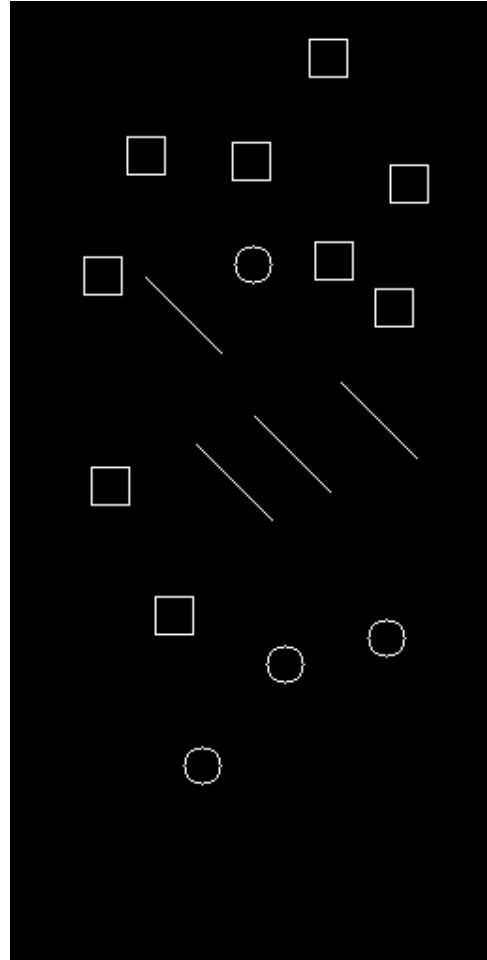


Fig. 1. Primitives drawn in gray.

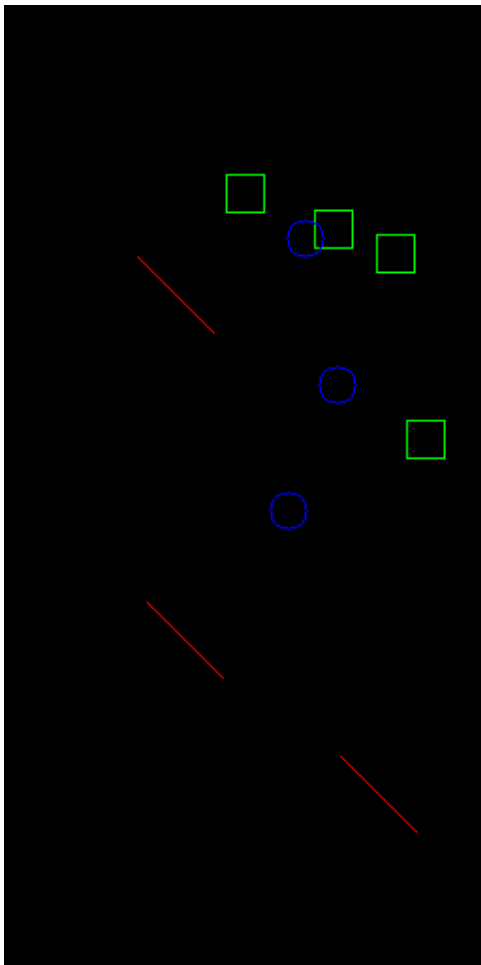


Fig. 2. Primitives drawn in RGB.

### B. Ex. 2.2: Drawing a grid upon an image

In this exercise it was asked for us to create a script that would draw a grid upon a given image. To accomplish this, we needed to iterate over all lines and columns of the image and, at every 20 pixels, use the OpenCV method `cv2.line()` to draw either a vertical or horizontal line.

In Figs. 3 and 4 we can see the result for two distinct images. Notice how the color of the grid changes accordingly to the color space (RGB or gray) of the source image.

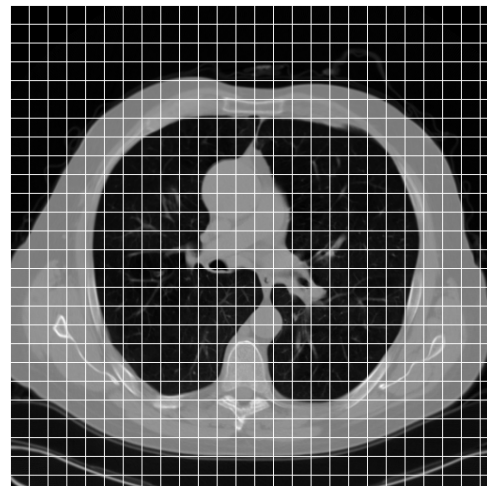


Fig. 3. Grid on gray image.

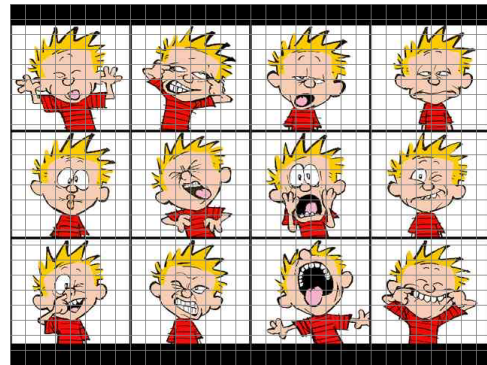


Fig. 4. Grid on RGB image.

### C. Ex. 2.4: Analyzing the histograms of different images

Bellow are the histograms of, sequentially, the ireland-06-\* images. Some notes:

Fig. 5 shows an overexposed image.

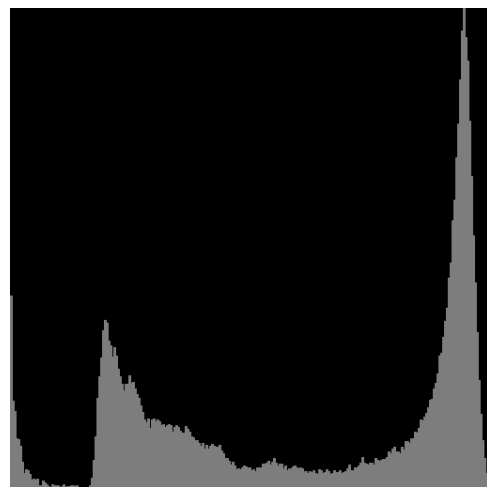


Fig. 5. Histogram of ireland-06-01.tif.

Fig. 6 shows a low contrast image.

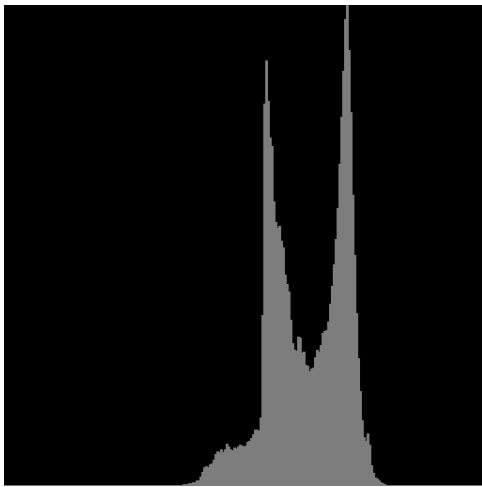


Fig. 6. Histogram of ireland-06-02.tif.

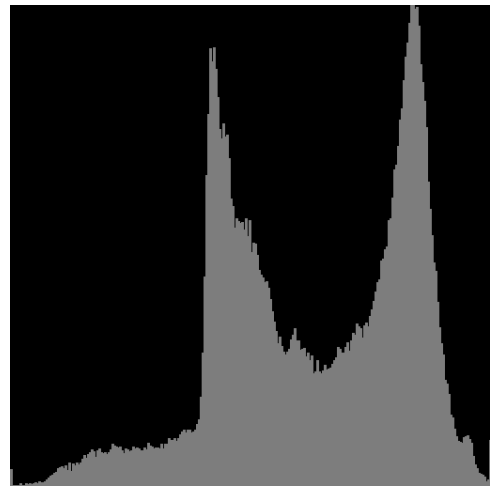


Fig. 8. Histogram of ireland-06-04.tif.

Figs. 7 and 8 show very similar images, in what regards intensity levels.

Fig. 9 shows an image with only 6 intensity levels.

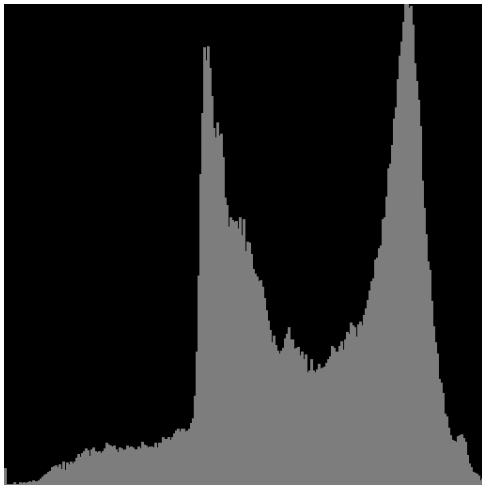


Fig. 7. Histogram of ireland-06-03.tif.

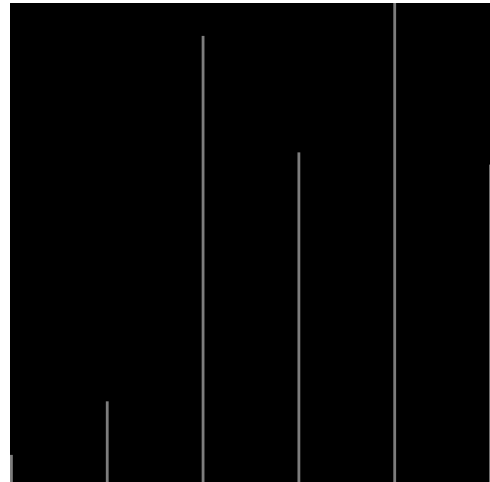


Fig. 9. Histogram of ireland-06-05.tif.

Fig. 10 shows an image with 64 intensity levels.

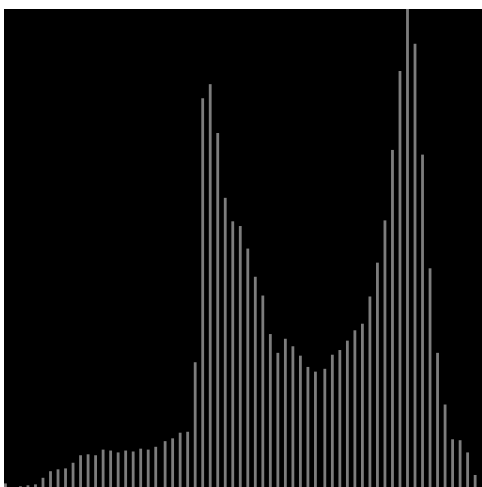


Fig. 10. Histogram of ireland-06-06.tif.

#### D. Ex. 2.5: Contrast-Stretching

For the contrast stretching technic we used an image that already had a poor contrast. With this, we converted Fig. 11 to 12. Regarding the histograms, we improved from 13 to 14. We can see that the stretched image used a wider range of values and, therefor, has a better contrast, even the the "spikes" observed.

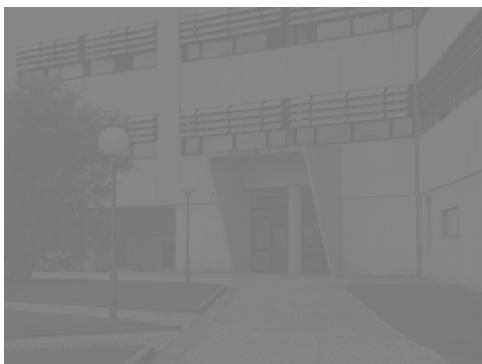


Fig. 11. Original image.



Fig. 12. Stretched image.

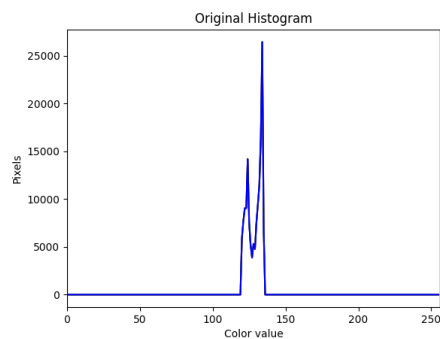


Fig. 13. Original image histogram.

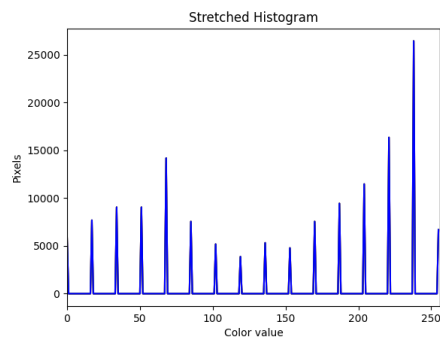


Fig. 14. Stretched image histogram.

#### E. Ex. 2.6: Histogram-Equalization

Applying and histogram equalization to Fig. 15 we obtain Fig. 16.



Fig. 15. Original image.

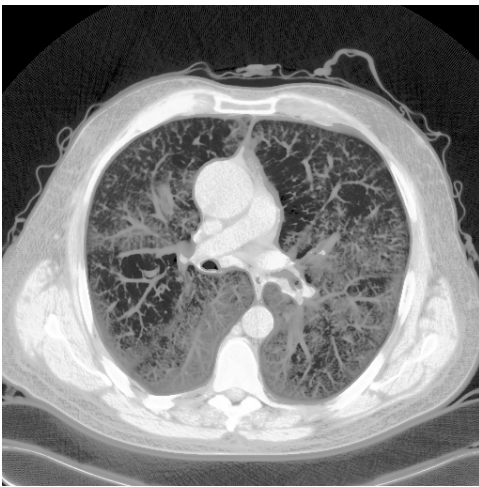


Fig. 16. Equalized image.

This method allows us to, although using the same values range, to make a better use of the said range by making a better distribution of the pixels values within it. Histogram of Fig. 17 is then transformed to Fig. 18 by this process.

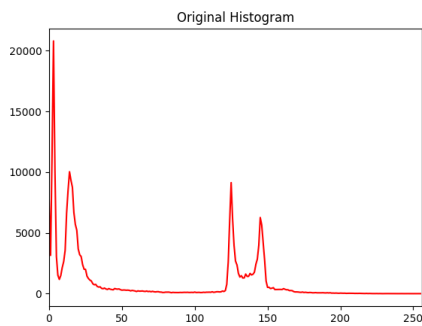


Fig. 17. Original image histogram.

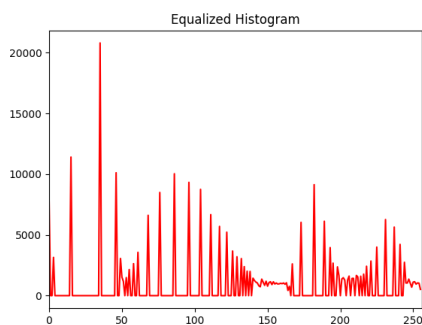


Fig. 18. Equalized image histogram.

#### F. Ex. 2.7: Histograms of RGB images

To obtain the histogram of an RGB image, we have to split each of the color channels and make the histogram of each one of them. Figs. 19 and 20 show the two example images.



Fig. 19. Original image 01.

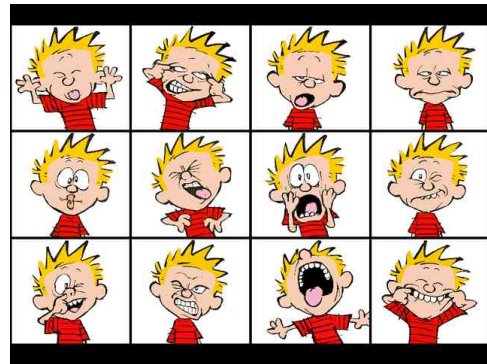


Fig. 20. Original image 02.

The corresponding color histograms are shown on Figs. 21 and 22. These histograms make sense since for Fig. 19 that a larger amount of colors the histogram of all three channels are better distributed than the respective color histogram of Fig. 20. Fig. 20 has a big white portion that explains the spike closer to the 255 value for all color components.

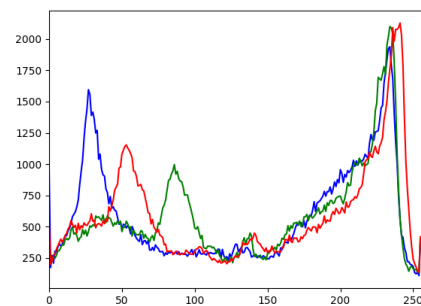


Fig. 21. Color histogram of image 01.

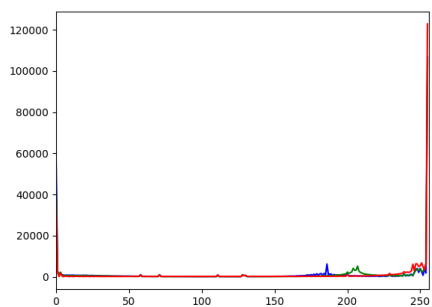


Fig. 22. Color histogram of image 02.

This trend is maintained on the histograms obtained from the corresponding gray images, that can be seen, respectively, on Figs. 23 and 24.

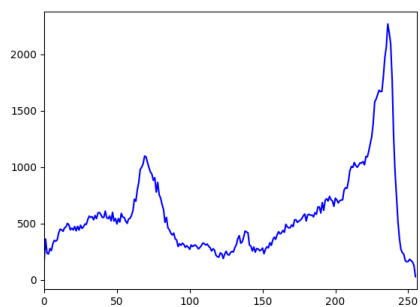


Fig. 23. Gray histogram of image 01.

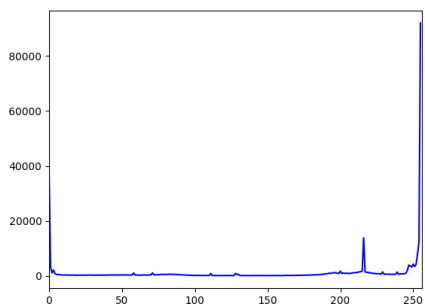


Fig. 24. Gray histogram of image 02.