

COMPUTER VISION

Report - Lab 3

IMAGE EQUALIZATION, HISTOGRAMS, FILTERS, MORPHOLOGICAL OPERATORS

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1 Part 1: Histogram Equalization

In the first part of the homework the goal was to equalize the histogram of a given image. First I worked on the RGB color space. I divided the image in the three channels using the function "split()" and computed the three histograms with "calcHist()", as shown in Figure 1.

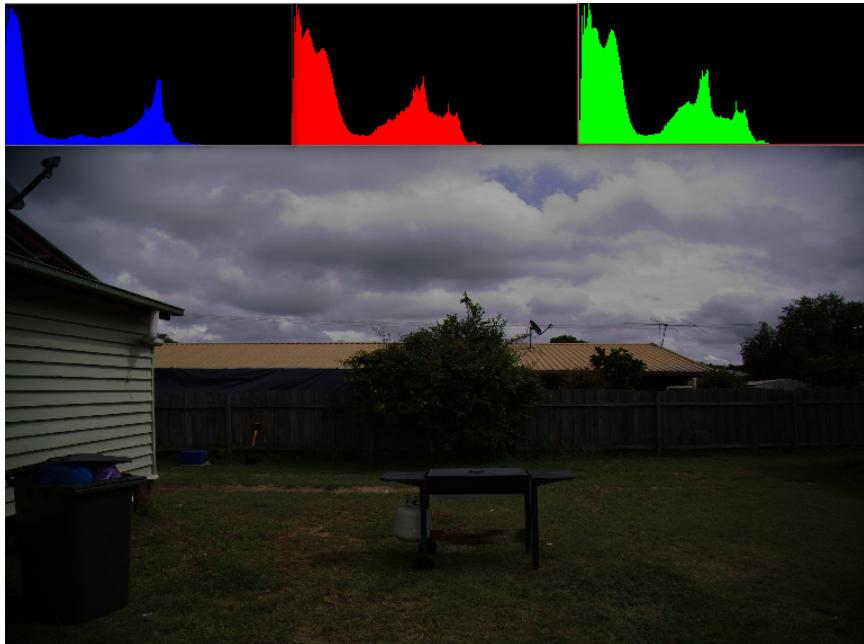


Figure 1: *Original image with histograms (B-R-G)*

Next I used the function "equalizeHist()" to equalize the histogram of each channel of the image and with the provided function "showHistogram()" I printed them, along with the equalized image. The result can be seen in Figure 2. We see how the new equalized image seems to have a stronger blue component than the original one, and this is mostly noticeable in the wooden fence, in the rubbish bin and in the antenna.

The general result is not completely satisfactory and a solution is to try to change the color space and equalize the new channels. I used the function "cvtColor()" to move to Lab color space and I splitted the image in the three channel as I did with the RGB image. I selected the L channel and equalized its histogram, as it gave the best result, and I left the other two channels, a and b, untouched. Then I reconverted the image in RGB and splitted again to be able to compute and show the three histograms. The final result is shown in Figure 3 and we can see how the performance is much improved with respect to the previous attempt.

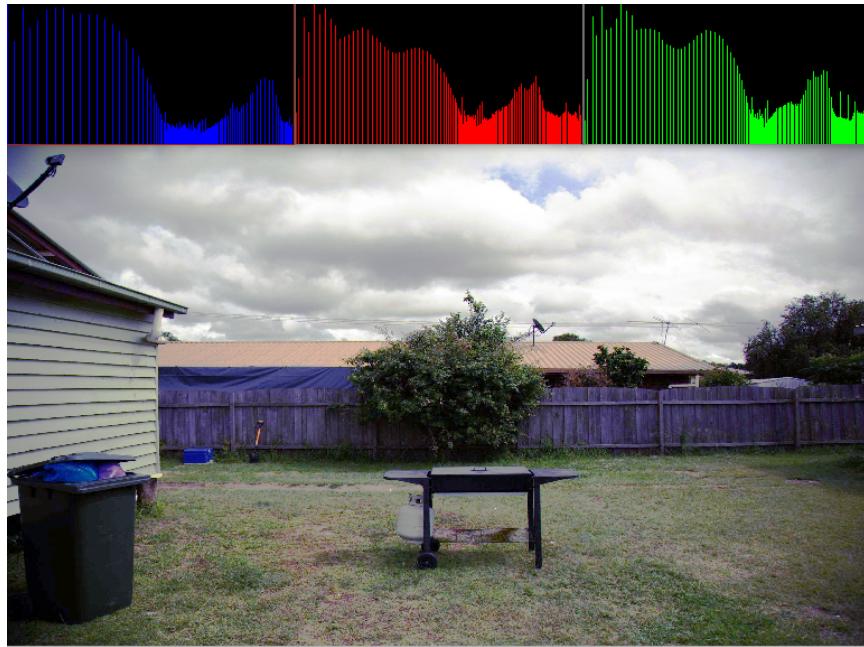


Figure 2: Equalized image in RGB color space with histograms (B-R-G)

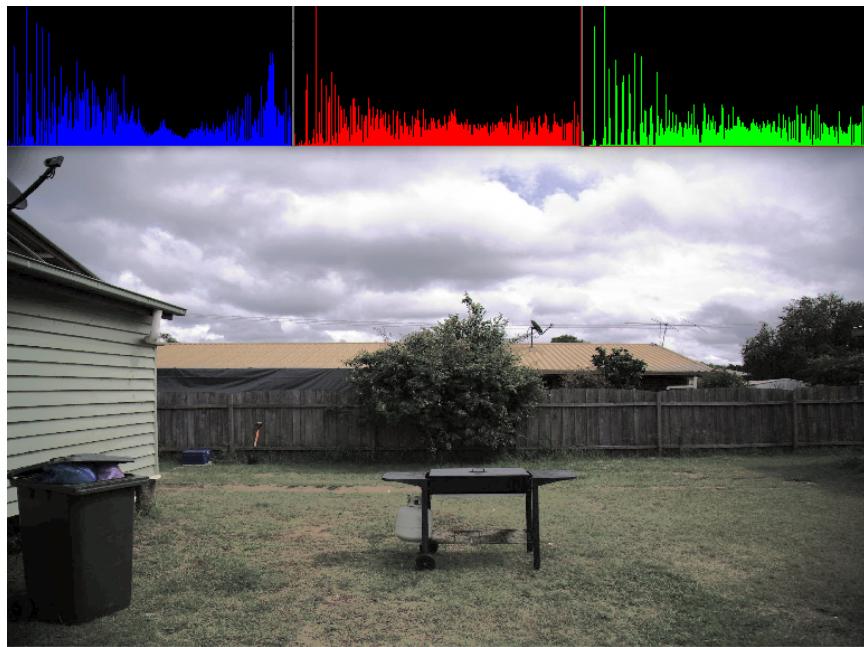


Figure 3: Equalized image in Lab color space with histograms (B-R-G)

2 Part 2: Image Filtering

In the second part of the homework the request was to generate a denoised version of the image using different filters and parameters.

I extended the given class "Filter" with the three required filters and I then used the function "createTrackbar()" to generate a trackbar controller to vary the parameters of the filters. In order to be able to change the parameters I had to declare some global variables and a callback function that was called every time the slider of the trackbar changed position. I also implemented a new method that changed the value of sigma for the filters that required it (gaussian and bilateral).

In Figure 4, 5 and 6 we can see the three different results.



Figure 4: Interface for the setting of median filter parameters and result image with $ksize=3$

3 Part 3: Morphological Operators

In the third part of the homework the request was to use different morphological operators in order to remove the electric cables and the handle of the barbecue without damaging too much the rest of the image.

I performed morphological operations such as erosion, dilation, opening and closing, the last two also with different structuring elements. The worst result is obtained with erosion and opening, as the removal was not successful and the original image was a lot damaged, while instead I got better performances with dilation and closing.

In my opinion the best result is obtained with the closing operation, which is a dilation followed by an erosion, setted with cross as structuring element and a kernel size of 2. In this way the electric cables and the handle of the barbecue are removed and the rest of the image has an acceptable quality. In Figure 7 the result of this morphological operation is shown.



Figure 5: Interface for the setting of gaussian filter parameters and result image with $ksize=3$ and $\sigma=1$

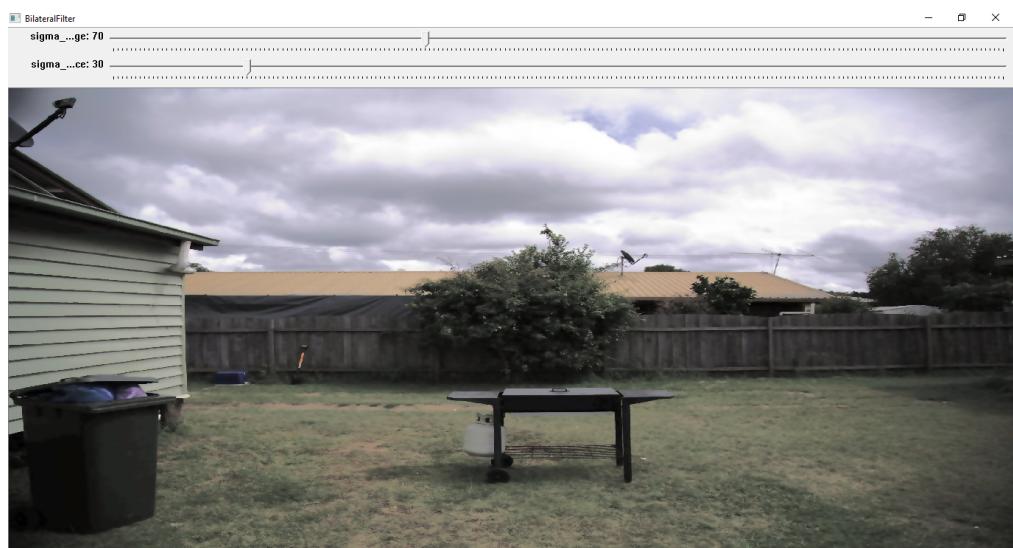


Figure 6: Interface for the setting of bilateral filter parameters and result image with $\sigma_{range}=70$ and $\sigma_{space}=30$



Figure 7: *Result of closing morphological operation*