COMPUTER VISION - LAB 3

Topics: Image Equalization, Histograms, Filters, Morphological Operators

Part 1: Histogram Equalization

Write a program that:

1. Loads an image (e.g., one of the provided images like “image.jpg” or “countryside.jpg”)

2. Prints the histograms of the image. You have to compute 3 histograms, one for each channel (i.e., R, G and B) with 256 bins and [0, 255] as range. Notice that you need to use the calcHist() function separately on the 3 channels. You can use the provided function to visualize the data.

3. Equalizes the R,G and B channels by using cv::equalizeHist()

4. Shows the equalized image and the histogram of its channels.

5. Is it possible to obtain a better equalization than the one obtained in point 4? Try to perform some experiments using a different color space, e.g. the HSV color space (use the functions cv::cvtColor() with the flags cv::COLOR_BGR2HSV or cv::COLOR_HSV2BGR in your color space conversion code), and equalize only one channel. Which one would be better to choose?
   Note: The HSV color space is very similar to the HSI color space presented in class. As for the HSI color space, H and S stand for Hue and Saturation, respectively, while V stand for Value, that actually is a value of the lightness of the pixel. Roughly speaking, you can think of V as the grey level of the pixel.

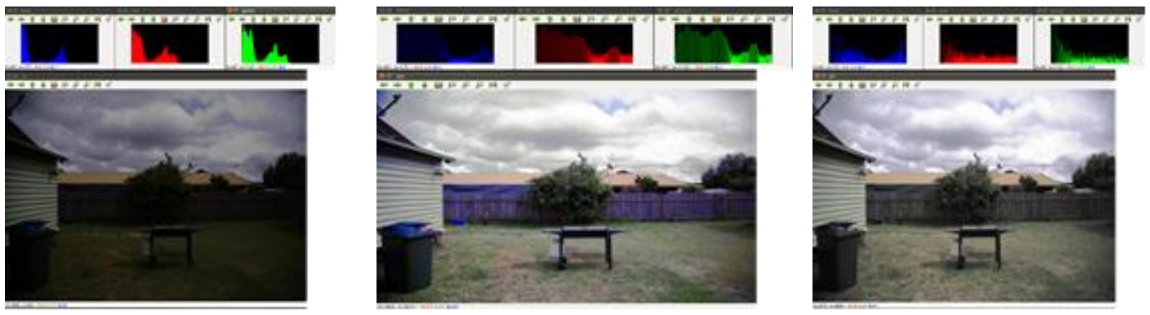


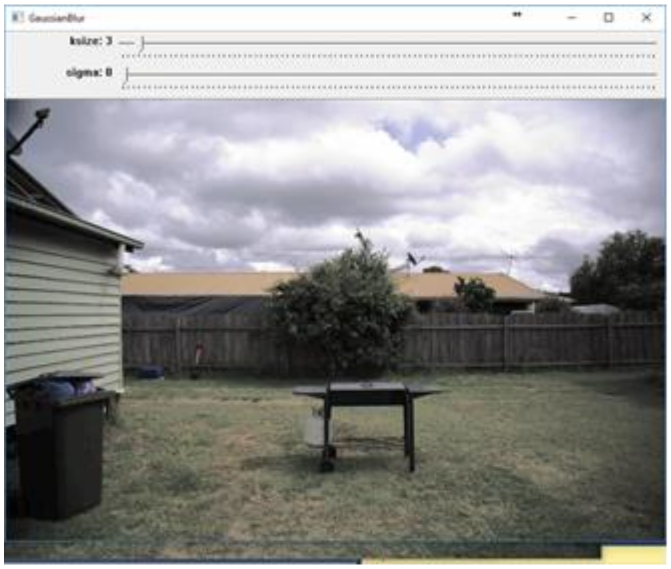
Figure 1: Example of the results of the first part

Part 2: Image Filtering

Generate a denoised version of the image computed in point 5. You should try different filters and parameter values.

Write a program that shows the result with some trackbars to vary the parameters of each filter (see the example in the figure). Table 1 specifies the requested filters to test and the parameters to be controlled with the trackbars.

- In order to generate the trackbars you can use the cv::createTrackbar() function.
- In order to pass the image and the parameters to the callback of the trackbar create a class containing the image and the filter parameters.
- For the filter parameters create a base class using the provided source code and extend it creating subclasses for the various filters.



ksize: 3

sigma: 0

Figure 2: Example of the window with trackbars (2nd part)

cv::medianFilter()	● kernel_size
cv::GaussianBlur()	● kernel_size (keep it square) ● sigma_X (=sigma_Y)
cv::bilateralFilter()	● kernel_size (trackbar not required, use a fixed value or use the 6σ_s rule) ● sigma_range ● sigma_space

Table 1: Filters to be implemented and their parameters

Part 3: Morphological Operators (optional, not required for the homework)

By using one or more morphological operators (in particular the erode and dilate ones, that correspond to min/max filters), remove the electric cables and the handle of the barbecue from the image without damaging too much the rest of the image. Recall that the max/min filters correspond to the morphological operators on greyscale images with a square window as structuring element. In OpenCV you can use the dilate/erode morphological filters.

The functions to be used are cv::erode(), cv::dilate() and cv::morphologyEx() with cv::MOP_OPEN and cv::MOP_CLOSE as operators (in this case, you may try different structuring elements with the function cv::getStructuringElement()).

Which is the filter that provides the best result?

Reference:

http://homepages.inf.ed.ac.uk/rbf/HIPR2/morops.htm

https://www.cs.auckland.ac.nz/courses/compsci773s1c/lectures/ImageProcessing-html/topic4.htm

https://www.sciencedirect.com/topics/engineering/morphological-operator