Lab 2 - Filters and histogram equalization

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Task 1

Grayscale conversion was implemented using the OpenCV function **cvtColor**. Figure 1b shows the result of the conversion. One can observe that the image appears quite dark, which corresponds well with the darkness in the original image viewed in figure 1a.

(a) Original image.

(b) Image converted to grayscale.

Figure 1: Comparison of the original image versus the grayscale version.

Task 2

Kernels of size 3×3, 5×5 and 7×7 were applied to the implemented min and max filters. The results are shown in figure 2.

The smallest kernel size applied, shown in figure 2a, did not result in removing the wires in the background. This may be explained by the fact that a smaller kernel will keep more detail in the image as it spans across less pixels at a time. The largest kernel size applied, shown in 2c, distorted the image a little too much. This is explained by the fact that the filter will span over a bigger area of the image at once, removing more details. Thus, the mid size was the best to remove the wires, while still keeping some detail. The result can be seen in figure 2b. This kernel size will be kept throughout this report.

In figure 3a, one can see the result of only the max filter. The max filter will choose the highest pixel value within the kernel for the source pixel. The expected result is that the image will lighten a bit, and that dark noise will be reduced. This seems to correspond well with the result as the wires in the background disappear after the filter is applied. The min filter is then expected to bring some darkness into the image, and remove light noise. The result is seen in figure 3b. One can observe that some light detail, especially when considering the tree in the image, is lost. This corresponds well with what is expected.

Task 3

Figure 4a shows the min- and max filtered image after applying a median filter. Figure 4b shows the min- and max filtered image after a Gaussian filter was applied. Both filtered images display some degree of

(a) 3x3 kernel

(b) 5x5 kernel

(c) 7x7 kernel

Figure 2: Result from min and max filtering using different kernel sizes.

(a) Grayscale image after max filter.

(b) Grayscale image after min and max filters.

Figure 3: Comparison of max filter only, and max and min filters combined.

smoothing of the image. The filters are both typically applied as a noise reduction step, as noise reduction typically involves reducing the amount of rapidly varying components in the image. By doing this, the result should appear smoother as neighboring pixels will have less variation. One can observe that the Gaussian preserves slightly more detail than the median filter does, which makes it more preferred in applications where one would wish to remove noise while keeping details of the image, like in edge detection.

Task 4

The suggested histogram with 256 bins in the range $[0, 255]$ is shown in figure 5. One can observe that the histogram is quite left centered, which matches well with the observed darkness of the image seen in Task 1.

(a) Image after Median filter.

(b) Image after Gaussian filter.

Figure 4: Median and Gaussian filters applied to the mix and max filtered image.

Task 5

After equalizing the histogram, one can first observe that the image appears more bright, as shown in figure 6a. The histogram in figure 6b shows a more spread-out histogram than what was seen in figure 5. The left-most values of the past histogram appear to be stretched out across more values in the equalized version, and the top-most values have been slightly stretched out and shifted to the right. This has resulted in more details being visible to the human eye, as there is a bigger range of pixel values in the image.

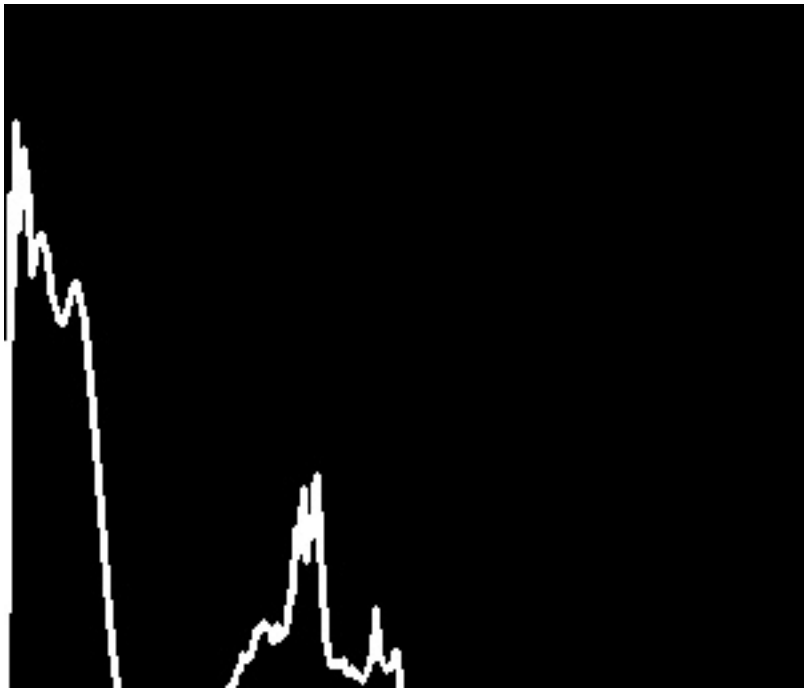
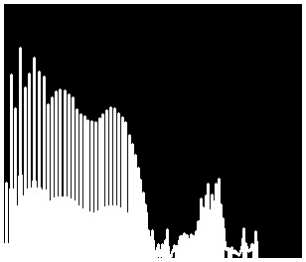


Figure 5: Histogram of grayscale image using 256 bins.

(a) Grayscale image after histogram equalization.



(b) Image histogram.

Figure 6: Result of applying histogram equalization.