Histograms Equalization

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Using OpenCV

Goal

What an image histogram is and why it is useful To equalize histograms of images by using the OpenCV function <u>cv::equalizeHist</u>

What is an Image Histogram?

- It is a graphical representation of the intensity distribution of an image.
- It quantifies the number of pixels for each intensity value considered.



What is Histogram Equalization?

- It is a method that improves the contrast in an image, in order to stretch out the intensity range.
- To make it clearer, from the image above, you can see that the pixels seem clustered around the middle of the available range of intensities. What Histogram Equalization does is to *stretch out* this range.

The green circles indicate the *underpopulated* intensities. After applying the equalization, we get an histogram like the figure in the center. The resulting image is shown in the picture at right.



Histogram equalization is a method in image processing of contrast adjustment using the image's histogram.

- This method usually increases the global contrast of many images, especially when the usable data of the image is represented by close contrast values.
- Through this adjustment, the intensities can be better distributed on the histogram.
- This allows for areas of lower local contrast to gain a higher contrast.

- Histogram equalization accomplishes this by effectively spreading out the most frequent intensity values.
- The method is useful in images with backgrounds and foregrounds that are both bright or both dark.
- OpenCV has a function to do this, cv2.equalizeHist(). Its input is just grayscale image and output is our histogram equalized image.

How does it work?



Equalization implies *mapping* one distribution (the given histogram) to another distribution (a wider and more uniform distribution of intensity values) so the intensity values are spread over the whole range.



To accomplish the equalization effect, the remapping should be the *cumulative distribution function (cdf)*

$$H^{'}(i) = \sum_{0 \leq j < i} H(j)$$

$$equalized(x,y) = H^{'}(src(x,y))$$