EXPERIMENT 2

Histogram Equalization and Matching

- *Perform histogram equalization on the 512 × 512 grayscale lena_gray_dark.jpg image. Perform the same on other low-contrast, dark, normal (gray/colored) images.*
- *Perform histogram matching of the same images with respect to a standard image (e.g. lena.jpg, cameraman.jpg, walkbridge.jpg image, etc).*

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INTRODUCTION

Histogram equalization

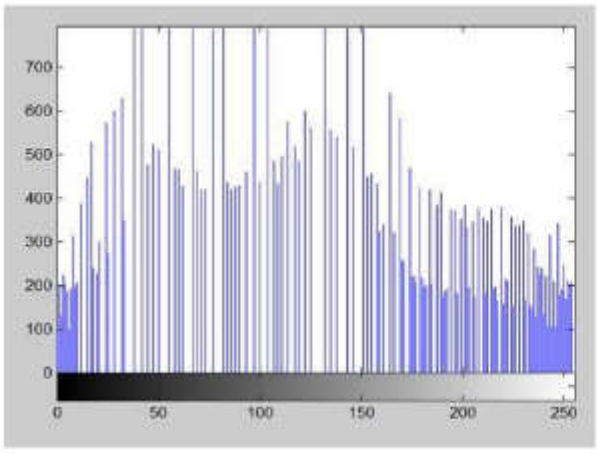
This method usually increases the global contrast of many images, especially when the usable data of the image is represented by close contrast values. Through this adjustment, the intensities can be better distributed on the histogram. This allows for areas of lower local contrast to gain a higher contrast. 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. In particular, the method can lead to better views of bone structure in x-ray images, and to better detail in photographs that are over or under-exposed. A key advantage of the method is that it is a fairly straightforward technique and an invertible operator. So in theory, if the histogram equalization function is known, then the original histogram can be recovered. The calculation is not computationally intensive. A disadvantage of the method is that it is indiscriminate. It may increase the contrast of background noise, while decreasing the usable signal.

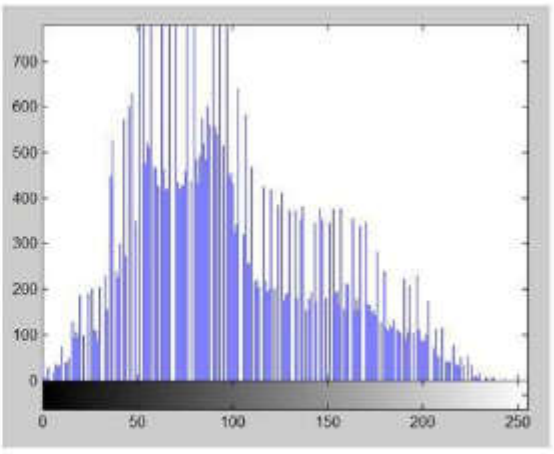
New Image

Old image

New Histogram



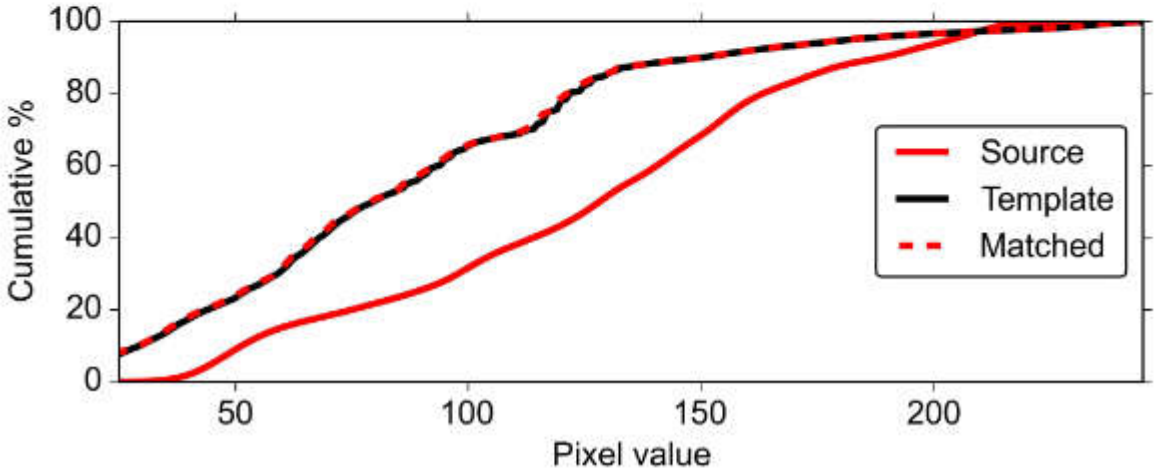
Old Histogram



Histogram Matching

In image processing, histogram matching or histogram specification is the transformation of an image so that its histogram matches a specified histogram. The well-known histogram equalization method is a special case in which the specified histogram is uniformly distributed.

It is possible to use histogram matching to balance detector responses as a relative detector calibration technique. It can be used to normalize two images, when the images were acquired at the same local illumination (such as shadows) over the same location, but by different sensors, atmospheric conditions or global illumination.



ALGORITHM

The following functions have been used in the program:

- **calTranFunc:** This function calculates the transfer function between the two histograms. In this case the transfer function used is basically the CDF of the input histogram.

- **imageToHistogram:** this function creates the histogram for the input image. For each intensity value the number of pixels having that intensity gives the histogram of the image.

- **intensityMapping :** This function maps the histogram to the intensity values that result into a equalized image. The function used is the generic equalization function which maps the given CDF to form a uniform histogram.

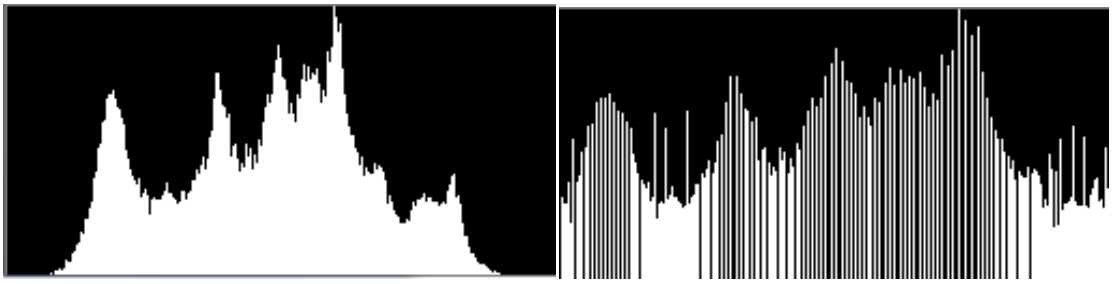
- **histogramMatching :** This function matches the histogram of the input image to the target image. the transfer function used is $G(j) > S_i$, looping until we get minimum k for which this is true, where S_i is the CDF value of i^{th} pixel.

OUTPUT RESULTS

The results obtained from the experiment are given below-

Histogram Equalization

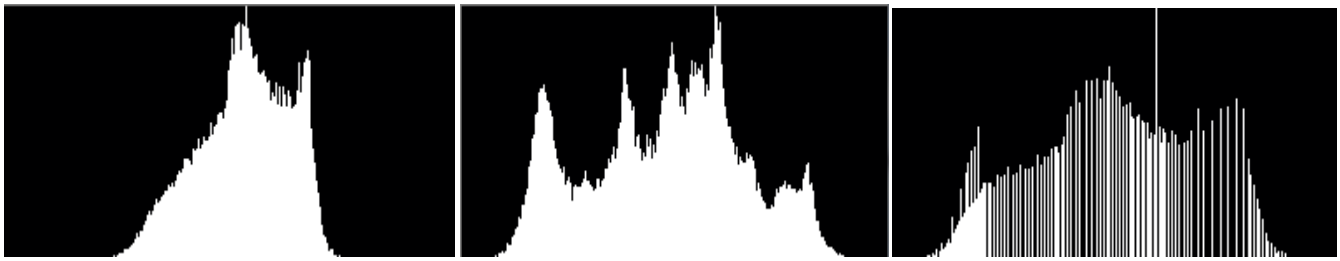
(a) Normal Image (b) Equalized Image



(a) Initial histogram (b) Final histogram

Histogram Matching

(a) Input Image (b) Target Image (c) Output Image



(a) Input histogram (b) Target histogram (b) Output histogram

DISCUSSIONS

- If histogram equalization is performed on a equalized image then there is hardly any change.
- For performing equalization on a color image we first need to convert the RGB image to HSI model and then perform equalization on the histogram obtained from luminance values of the HSI model.
- For histogram matching a high contrast image has to be chosen to obtained best results.

SOURCES

[1] https://en.wikipedia.org/wiki/Histogram_equalization

[2] https://en.wikipedia.org/wiki/Histogram_matching

[3] http://www.programming-techniques.com/2013/01/histogram-equalization-using-c-image.html

[4]https://www.planetsourcecode.com/vb/scripts/ShowCode.asp?txtCodeId=3351&lngWId=3