Experiment 2

Image Enhancement

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. 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. 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. Histogram matching is a process where an image, or higher dimension scalar data is modified such that its histogram matches that of another (reference) dataset. A common application of this is to match the images from two sensors with slightly different responses, or from a sensor whose response changes over time.

There are two transformation in power law transformations, that include n^{th} power and n^{th} root transformation. This symbol γ is called gamma, due to which this transformation is also known as gamma transformation. Variation in the value of γ varies the enhancement of the images. Different display devices / monitors have their own gamma correction, that's why they display their image at different intensity. This type of transformation is used for enhancing images for different type of display devices.

Problem Objective

Write C/C++ code to

a) Perform histogram equalization on the *given set of* (gray/colored) images.
b) Perform histogram matching of the input image with respect to Target image.
c) Apply power law transformation on given gray level images with gamma values
   - >1
   - <1

Display the

a) Histograms of the original image and Histogram equalized image
b) Histograms of the original image, Target image and Histogram matched image.
c) Original image and output image after power law transformation.

Note

1. **Do not** hardcode the filenames (image names) and/or image size into the code.
2. Use proper code commenting and documentation.
3. Use self-explanatory identifiers for variables/functions etc.
4. Make separate programs for equalization and matching.

References

1. R. C. Gonzalez and R. Woods, *Digital Image Processing*, Reading, MA: Addison-Wesley, 1992.
2. http://en.wikipedia.org/wiki/Histogram_equalization
3. P.K.Biswas Digital Image Processing videos (18-19)