**Experiment No.: 8**

**Title:** To apply the global processing technique: Histogram equalization on a digital image

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| **Objective:**  To learn and understand the concept of histogram stretching and equalization in image enhancement operations. |

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| **COs to be achieved:** |
| **CO3:** Understand basics of image fundamentals. |

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| **Materials Required:** MATLAB software  **Books/ Journals/ Websites referred:**   1. <http://www.mathworks.com/support/> 2. www.math.mtu.edu/~msgocken/intro/intro.html. 3. R. C.Gonsales R.E.Woods, “Digital Image Processing”, Second edition, Pearson Education 4. S.Jayaraman, S Esakkirajan, T Veerakumar “Digital Image Processing “Mc Graw Hill. 5. S.Sridhar,”Digital Image processing”, oxford university press, 1st edition." |

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| **Theory:**  **Image histogram:**  In an image processing context, the histogram of an image normally refers to a histogram of the pixel intensity values. This histogram is a graph showing the number of pixels in an image at each different intensity value found in that image. For an 8-bit greyscale image there are 256 different possible intensities, and so the histogram will graphically display 256 numbers showing the distribution of pixels amongst those greyscale values. Histograms can also be taken of color images either individual histogram of red, green and blue channels can be taken, or a 3-D histogram can be produced, with the three axes representing the red, blue and green channels, and brightness at each point representing the pixel count. The exact output from the operation depends upon the implementation it may simply be a picture of the required histogram in a suitable image format, or it may be a data file of some sort representing the histogram statistics.      **Fig. 1 An image and its histogram**  **Histogram Equalization:**  A perfect image is one which has equal number of pixels in all its grey levels. hence our objective is not only to spread the dynamic range, but also to have equal pixels in all the grey levels. This technique is known as histogram equalization.  Basically, the histogram equalization spreads out intensity values along the total range of values in order to achieve higher contrast. This method is especially useful when an image is represented by close contrast values, such as images in which both the background and foreground are bright at the same time, or else both are dark at the same time. For example, the result of applying histogram equalization to the image in figure 1 is presented in figure 2.    **Fig. 2 New image and its equalized histogram**  **Description of cumulative histogram equalization:**  Here are the steps for implementing this algorithm:   1. Create the histogram for the image. 2. Calculate the cumulative distribution function histogram. 3. Calculate the new values through the general histogram equalization formula. 4. Assign new values for each gray value in the image.   Thus, processed image is obtained by mapping each pixel with level rk into a corresponding pixel with level sk in o/p image. This transformation is called Histogram equalization  **Resources Used:** Matlab  **Implementation Details:**  clc;  clear;  close all;  img = imread('tree.jpg');  if size(img, 3) == 3  img = rgb2gray(img);  end  eq\_img = histeq(img);  figure;  subplot(2,2,1);  imshow(img);  title('Original Image');  subplot(2,2,2);  imhist(img);  title('Histogram of Original Image');  subplot(2,2,3);  imshow(eq\_img);  title('Equalized Image');  subplot(2,2,4);  imhist(eq\_img);  title('Histogram of Equalized Image'); |

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| **Conclusion:**  To conclude, the histogram provides a visual representation of an image's intensity distribution, helping to assess contrast and brightness. Comparing it with the original image aids in understanding and improving image quality. |
| **Post Lab Questions:**   1. **Compare between contrast stretching and histogram equalization.**  |  |  |  | | --- | --- | --- | | **Feature** | **Contrast Stretching** | **Histogram Equalization** | | **Purpose** | Expands the range of intensity levels to enhance contrast | Redistributes intensity values to achieve a uniform histogram | | **Method** | Uses a linear transformation to stretch pixel values | Uses cumulative distribution function (CDF) to adjust intensity levels | | **Effect on Image** | Improves contrast by spreading pixel values over a wider range | Enhances contrast, especially in images with poor intensity distribution | | **Best Used For** | Images with low contrast but not highly skewed intensity distribution | Images with uneven brightness or high concentration of pixels in a narrow range | | **Preserves Original Image** | Yes, but may not enhance very dark or very bright regions effectively | No, as it modifies pixel intensity based on distribution rather than a fixed mapping | | **Use Cases** | Medical imaging, remote sensing, and general image enhancement | Face recognition, satellite imagery, and images with poor global contrast | |

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| **Signature of faculty in-charge with Date:** |