**Digital Image Processing Laboratory**

Experiment Report

Experiment Title Histogram Equalization and Specification

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**A. Objectives**

1. to master the concept of histogram and the principle of histogram equalization and matching.
2. to know how to manipulate histogram in MATLAB
3. to be able to use histogram and histogram matching to enhance an image in MATLAB.

**B. Technique**

In this project, the image **tire.tif**, and **moon.tif** will be used. The functions that might be used in the experiment include **imread, imshow, imhist, histeq, title, ones, figure, subplot** and so on.

* Perform histogram equalization on images.
* Perform histogram matching on images

**C. Experiment Content**

1. **Histogram Equalization**

1. Read the images **tire.tif** given in the folder and show it. (referenced function: imread, imshow, figure)

2. Show the histogram information of the image. (referenced function: imhist )

3. Add title to the images. (referenced function: title)

图表, 直方图

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Figure 1: The Original tire.tif and its histogram information

1. Perform histogram equalization on the image to get a new image (referenced function: histeq)

5. To show the new image and add title to it. (referenced functions: imshow, title )

6. Show the histogram of the new image.

图表, 直方图

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Figure 2: Do histogram equalization on tire.tif

7. Put all the four images into one figure for visual comparison (referenced function: subplot)

图表, 直方图

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Figure 3: Visual comparison of the four images

The above functions are implemented by the following code:

|  |
| --- |
| % 1. Read the image  img = imread('tire.tif');  % Create a new figure window  figure;  % Display the original image  subplot(2, 2, 1);  imshow(img);  title('Original Image');  % 2. Display the histogram of the original image  subplot(2, 2, 2);  imhist(img);  title('Original Histogram');  % 3. Perform histogram equalization  equalized\_img = histeq(img);  % 4. Display the equalized image  subplot(2, 2, 3);  imshow(equalized\_img);  title('Equalized Image');  % 5. Display the histogram of the equalized image  subplot(2, 2, 4);  imhist(equalized\_img);  title('Equalized Histogram'); |

1. **Histogram Matching**
2. Read the images moon.tif given in the folder, and show it. (referenced function: imread, imshow, figure, subplot)
3. Show the histogram information of the image. (referenced function: imhist )
4. Add title to the images. (referenced function: title)

图表

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Figure 1: The Original moon.tif and its histogram information

4. Perform histogram equalization on the image to get a new image (referenced function: histeq)

5.. Show the new image and add title to it. (referenced functions: imshow, title )

6 Show the histogram of the new image.

图片包含 图表

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Figure 5: Do histogram equalization on moon.tif

7. Specify the histogram as H=[256,1,1,……,1] that is a vector with size of 1X256. (referenced function: ones)

8. Use histogram matching to produce an image that has a histogram like H. (referenced function: histeq)

9. Put all the six images into one figure for visual comparison (referenced function: subplot)

图表, 条形图

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Figure 6: Results comparison

The above functions are implemented by the following code:

|  |
| --- |
| % 1. Read the image  img = imread('moon.tif');  % Create a new figure window  figure;  % Display the original image  subplot(3, 2, 1);  imshow(img);  title('Original Image');  % 2. Display the histogram of the original image  subplot(3, 2, 2);  imhist(img);  title('Original Histogram');  % 3. Perform histogram equalization  equalized\_img = histeq(img);  % 4. Display the equalized image  subplot(3, 2, 3);  imshow(equalized\_img);  title('Equalized Image');  % 5. Display the histogram of the equalized image  subplot(3, 2, 4);  imhist(equalized\_img);  title('Equalized Histogram');  % 6. Specify the histogram H = [256, 1, 1, ..., 1]  H = [256, ones(1, 255)];  % 7. Perform histogram matching  matched\_img = histeq(img, H);  % 8. Display the matched image  subplot(3, 2, 5);  imshow(matched\_img);  title('Matched Image');  % 9. Display the histogram of the matched image  subplot(3, 2, 6);  imhist(matched\_img);  title('Matched Histogram'); |

**D. Conclusions**

In this experiment, we successfully navigated through the various stages of image enhancement using **histogram equalization** and **histogram matching techniques**. Here is a summary of our key findings and outcomes:

* **Image Loading and Display:** We began by loading and displaying the image moon.tif. This initial step provided a baseline for subsequent image enhancement processes.
* **Histogram Analysis:** We examined the histogram of the original image. This step highlighted the distribution of pixel intensity values and identified the potential areas for enhancement.
* **Histogram Equalization:** By applying histogram equalization, we enhanced the contrast of the image. This technique redistributed the pixel intensity values, resulting in a more balanced and visually appealing image. The equalized image and its histogram demonstrated significant improvement in contrast.
* **Histogram Matching:** We specified a target histogram and applied histogram matching to the original image. This advanced technique allowed us to transform the image such that its histogram closely resembled the specified target histogram. The matched image and its histogram provided further insights into the effectiveness of histogram-based enhancement techniques.
* **Visual Comparison:** By displaying all images (original, equalized, and matched) alongside their histograms in a single figure, we were able to perform a comprehensive visual comparison. This step enabled us to observe the differences and improvements resulting from the various enhancement techniques.

Overall, this experiment illustrated the power and versatility of **histogram-based image enhancement methods**. Through systematic application of histogram equalization and matching, we were able to significantly **improve the visual quality of the image**. These techniques are invaluable tools in the field of digital image processing, offering robust solutions for enhancing image contrast and detail.