Digital Image Processing Laboratory

Experiment Report

Experiment Title Histogram Equalization and Specification

Student's Name _____

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Class _____

Date handed in _____

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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.

(1) Perform histogram equalization on images.

(2) 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)

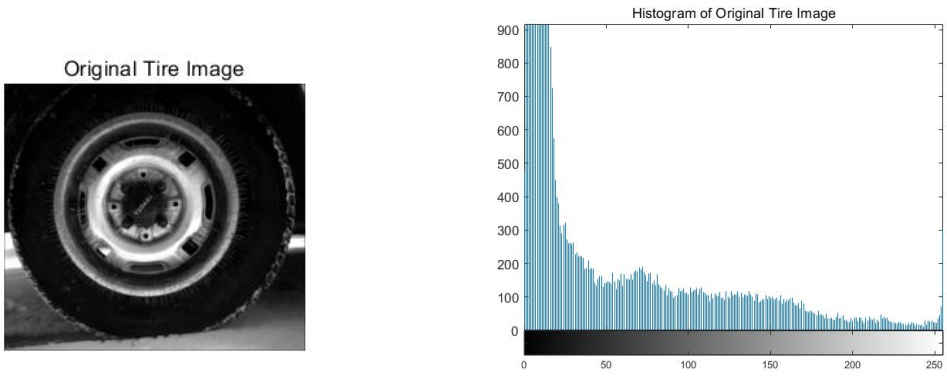


Figure 1: Original **tire.tif** and its histogram information

4. 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.

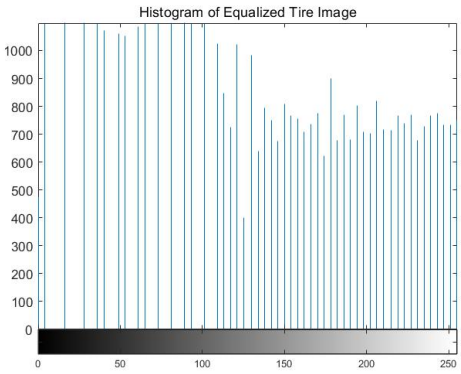
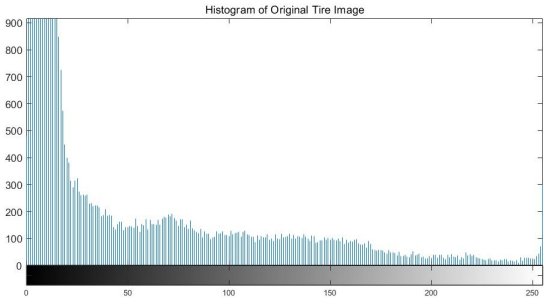


Figure 2: Perform histogram equalization on **tire.tif**

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



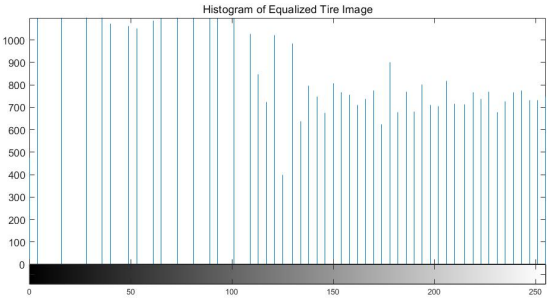


Figure 3: Visual comparison between the images and their histogram information

The code to complete this experiment is as follows:

```
% Read the image

tireImage = imread('tire.tif');
```

```
% Show the image
figure, imshow(tireImage), title('Original Tire Image');

% Show the histogram of the original image
figure, imhist(tireImage), title('Histogram of Original Tire Image');

% Perform histogram equalization
equalizedImage = histeq(tireImage);

% Show the histogram equalized image
figure, imshow(equalizedImage), title('Histogram Equalized Tire Image');

% Show the histogram of the histogram equalized image
figure, imhist(equalizedImage), title('Histogram of Equalized Tire Image');

% Visual comparison using subplot
figure;
% Original Image
subplot(2, 2, 1), imshow(tireImage), title('Original Tire Image');

% Histogram of Original Image
subplot(2, 2, 2), imhist(tireImage), title('Histogram of Original Tire Image');

% Equalized Image
subplot(2, 2, 3), imshow(equalizedImage), title('Histogram Equalized Tire Image');

% Histogram of Equalized Image
subplot(2, 2, 4), imhist(equalizedImage), title('Histogram of Equalized Tire Image');
```

(2) **Histogram Matching**

1 Read the images **moon.tif** given in the folder, and show it. (referenced function:

imread, imshow, figure, subplot)

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

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

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

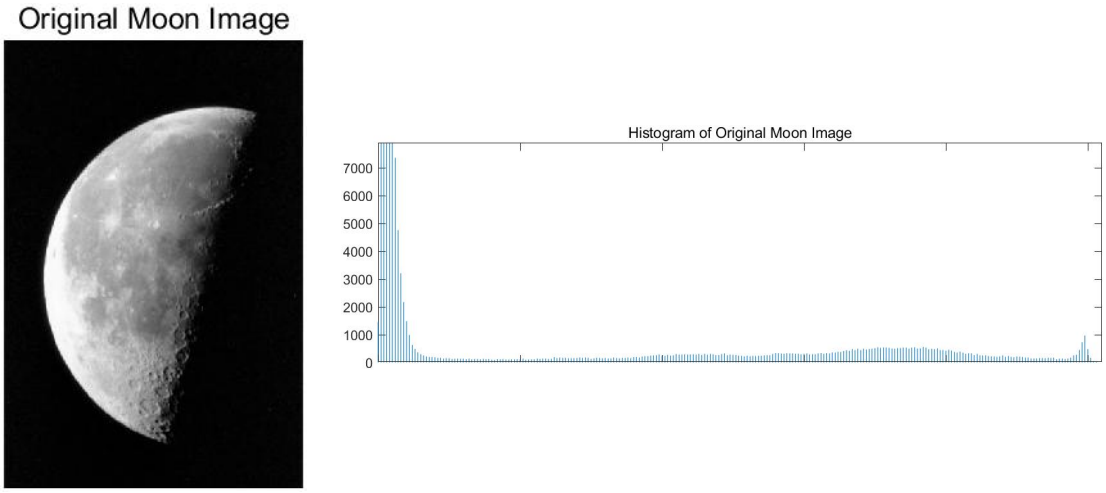


Figure 4: Original **moon.tif** and its histogram information

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

6 Show the histogram of the new image.

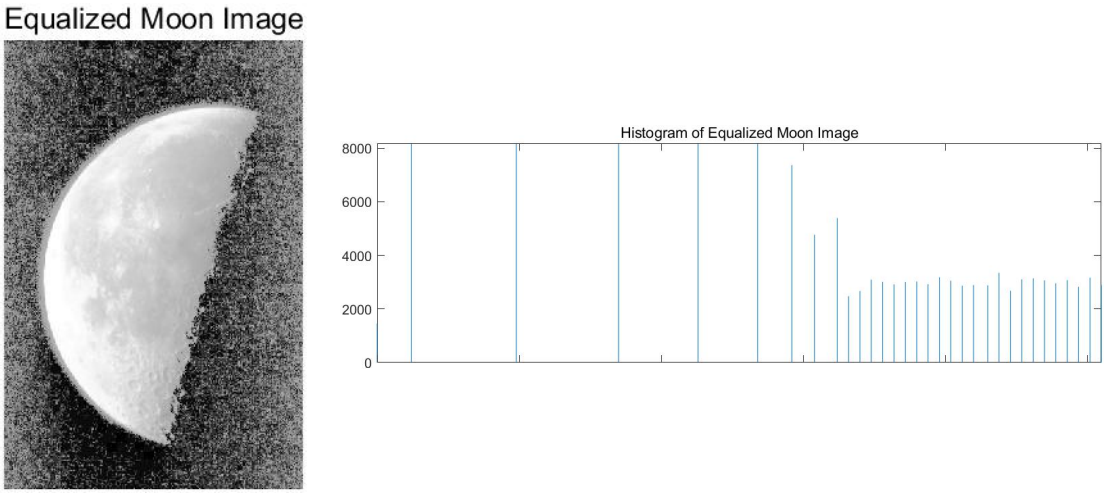


Figure 5: Perform histogram equalization on **moon.tif**

7 Specify the histogram as H = [256, 1, 1, ……, 1] that is a vector with size of 1 × 256. (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)

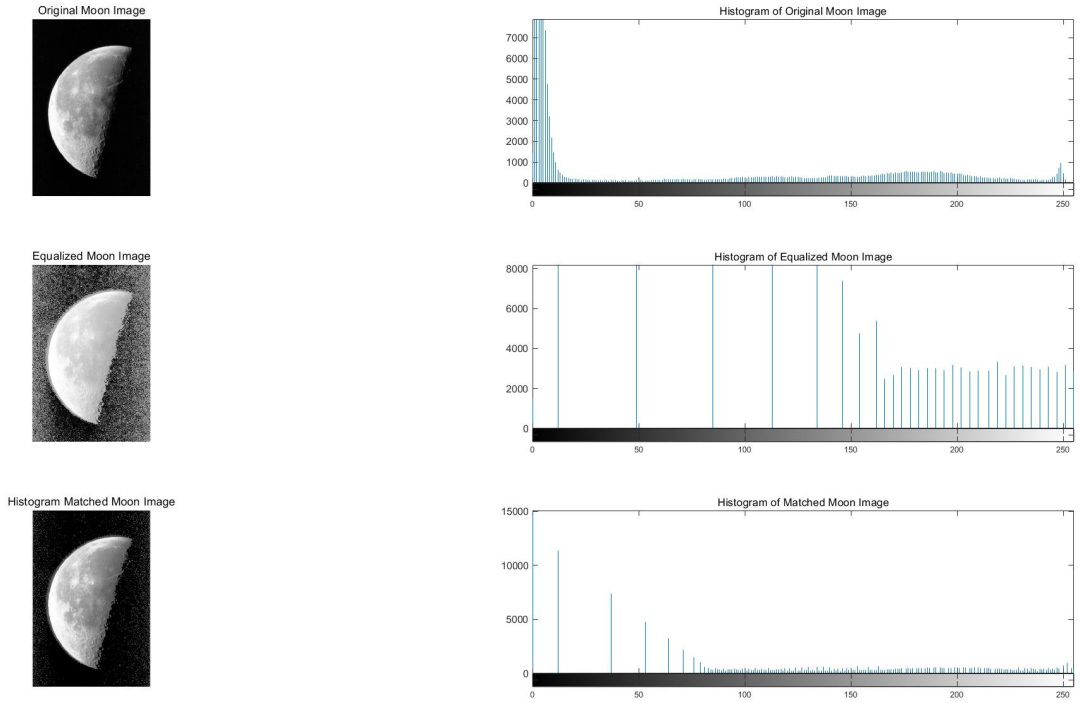


Figure 6: Final results comparison

The MATLAB code to implement the experimental content is as follows:

```
% Read the image

moonImage = imread('moon.tif');


% Show the image

figure, subplot(3, 2, 1), imshow(moonImage), title('Original Moon Image');


% Show the histogram of the original image
```

```
subplot(3, 2, 2), imhist(moonImage), title('Histogram of Original Moon Image');


% Perform histogram equalization

equalizedImage = histeq(moonImage);


% Show the histogram equalized image

subplot(3, 2, 3), imshow(equalizedImage), title('Equalized Moon Image');


% Show the histogram of the histogram equalized image

subplot(3, 2, 4), imhist(equalizedImage), title('Histogram of Equalized Moon Image');


% Specify the histogram H

H = ones(1, 256);H(1) = 256; % Set the first value to 256


% Use histogram matching

matchedImage = histeq(moonImage, H);


% Show the histogram matched image

subplot(3, 2, 5), imshow(matchedImage), title('Histogram Matched Moon Image');


% Show the histogram of the histogram matched image

subplot(3, 2, 6), imhist(matchedImage), title('Histogram of Matched Moon Image');
```

D. Conclusions

In this laboratory experiment on Digital Image Processing, I gained a comprehensive understanding of histogram equalization and histogram matching, two crucial techniques for image enhancement. By working with MATLAB, I learned how to manipulate image histograms to improve image contrast and match a specified histogram.

The experiment provided a hands-on opportunity to apply theoretical knowledge to real-world applications, enhancing my practical skills in image processing. I appreciated the step-by-step guidance and the MATLAB code snippets, which made the learning process more accessible and engaging.

Through this experiment, I realized the significance of histogram manipulation in image processing and gained confidence in using MATLAB for image analysis. The visual comparisons of the original and processed images were particularly helpful in understanding the impact of histogram equalization and matching on image quality.