HW4

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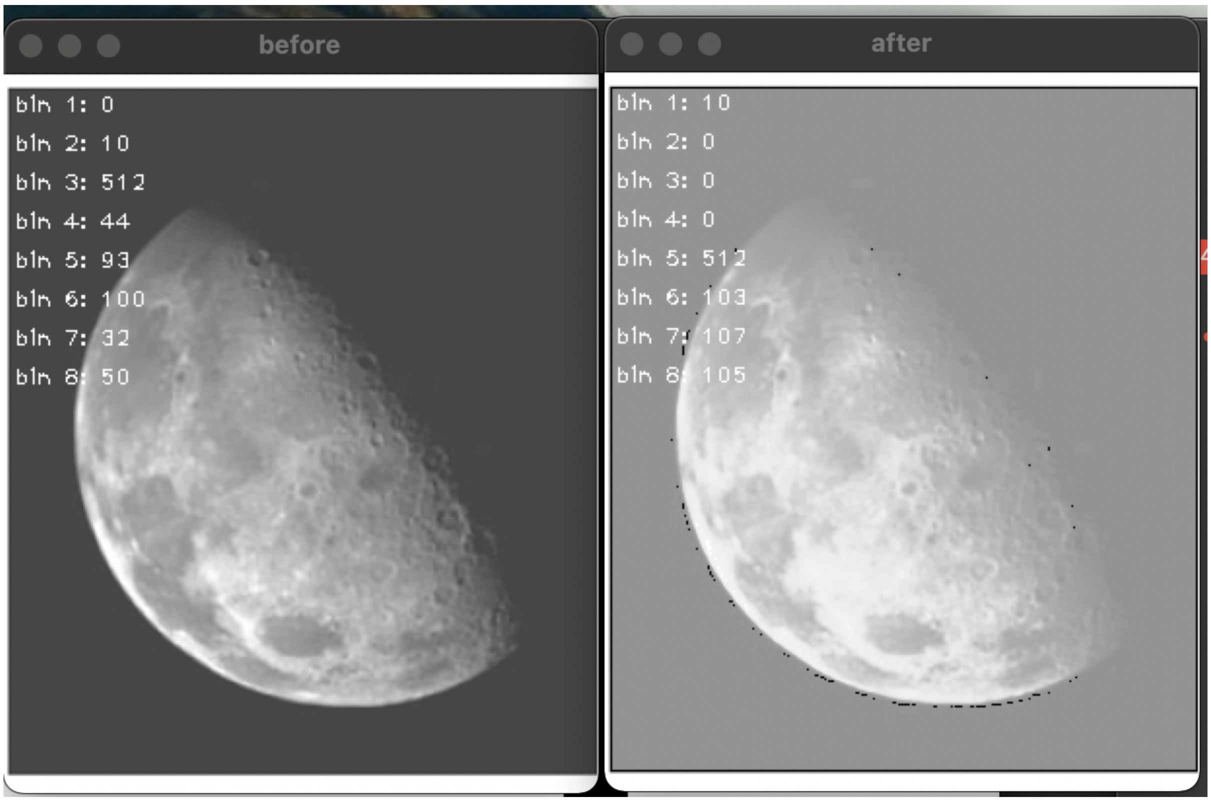
1. Homework 4

1) Please follow the instructions below.

- ✓ Read an image “moon.png” as gray scal image
- ✓ Perform histogram equalization on the input image
  - Display each image with the window name as “before”, “after”
- ✓ Display each histogram of the input and the result image
  - Set the number of bins to 16
  - Ste the matrix size for displaying histogram ass width: 512, height:512
  - Display each image with the window name as “h1”, “h2”
- ✓ Compute. The value of each component of a normalized histogram of the input image; write all values on the input image; and display the result
  - Set the number of bins to 8
  - You can arbitrarily set the. Font, color, and position of the text (but consecutively)



```
bin 1: 0
bin 2: 10
bin 3: 512
bin 4: 44
bin 5: 93
bin 6: 100
bin 7: 32
bin 8: 50
```

```
bin 1: 10
bin 2: 0
bin 3: 0
bin 4: 0
bin 5: 512
bin 6: 103
bin 7: 107
bin 8: 105
```

Figure 1. results of “before” and “after”

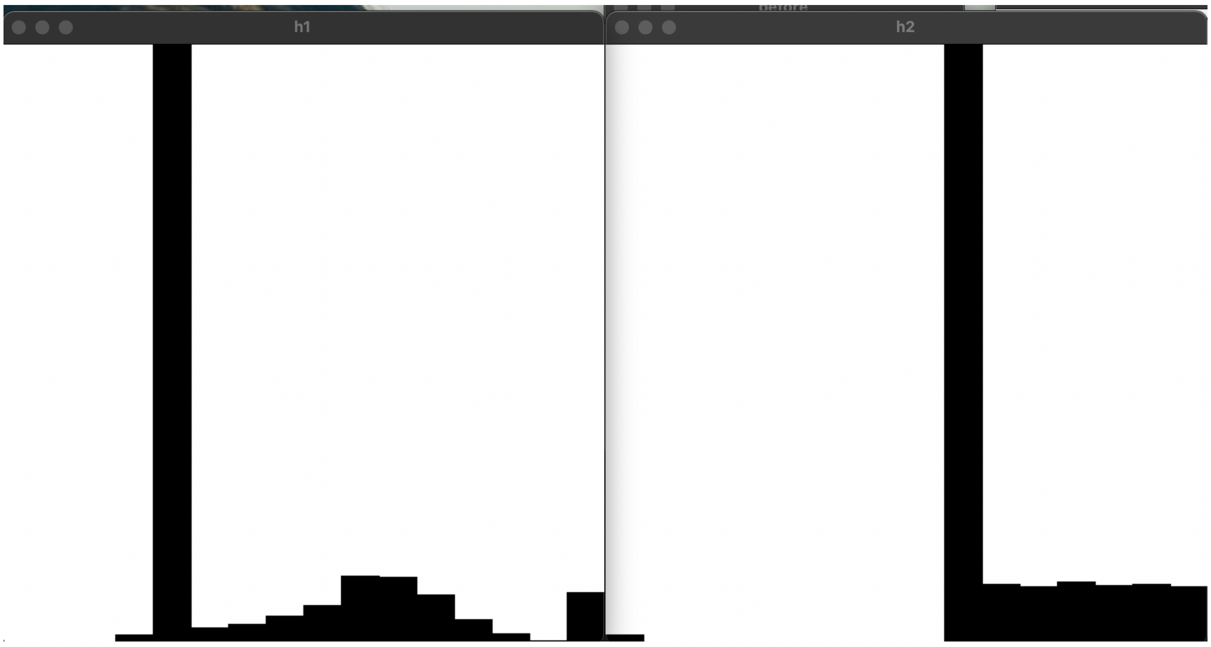


Figure 2. results of “h1” and “h2”

2) explanation

First, read 'moon.png' and then equalize the average of the entire image through the equalizeHist() function. If the colors are evenly distributed, the contrast is ensured through equalization. However, as shown in figure 2, since the input image is dominated by data in a specific range, the average rises when equalization is performed, and the overall brightness rises. Also, it can be confirmed that data in a specific range still appears dominant.

3) Source code

```
#include <opencv2/opencv.hpp>
#include <iostream>
#include <string>

using namespace cv ;
using namespace std ;

Mat
drawHistogram (Mat src, int histSize) {
    int width = 512 ;
    int height = 512 ;
    float range[] = { 0, 256 } ;
    const float* hist_Range = { range } ;

    // bin interval
    int bin_w = cvRound((double)width / histSize) ;

    Mat histImage = Mat(width, height, CV_8UC3, Scalar(255, 255, 255)) ;

    Mat hist ;

    calcHist(&src, 1, 0, Mat(), hist, 1, &histSize, &hist_Range) ;

    normalize(hist, hist, 0, histImage.rows, NORM_MINMAX, -1, Mat()) ;

    for ( int i = 0 ; i < histSize ; i++ ) {
        rectangle(histImage, Point(bin_w * i, height), Point(bin_w * i + width /
histSize, height - cvRound(hist.at<float>(i))), Scalar(0, 0, 0), -1) ;
        // putText(histImage, to_string(cvRound(hist.at<float>(i))), Point(bin_w *
i + bin_w / 6, height), 1, 0.8, Scalar(100, 150, 200), 1, 8) ;
    }

    return histImage ;
}
```

```
Mat
drawText (Mat src, int histSize) {
    float range[] = { 0, 256 } ;
    const float* hist_Range = { range } ;

    Mat hist ;
    calcHist(&src, 1, 0, Mat(), hist, 1, &histSize, &hist_Range) ;
    normalize(hist, hist, 0, 512, NORM_MINMAX, -1, Mat()) ;


    for ( int i = 0 ; i < histSize ; i++ ) {
        putText(src, format("bin %d: %d", i + 1, cvRound(hist.at<float>(i))),
Point(5, i * 20 + 20), 1, 0.8, Scalar(255, 255, 255), 1, 8) ;
    }
    return src ;
}

int
main() {
    // 1. read an image
    Mat moon = imread("./resources/moon.png", 0) ;

    if ( moon.empty() ) {
        cout << "no such file" << endl ;
        return 0 ;
    }

    // 2. Perform histogram equalization on the input image
    Mat before = moon.clone() ;
    Mat after ;

    equalizeHist(before, after) ;

    // // display each image with the window name as 'before', 'after'
    // imshow("before", before) ;
    // imshow("after", after) ;

    // 3. display each histogram of the input and result image
    Mat before_hist_16 = drawHistogram(before, 16) ;
    Mat after_hist_16 = drawHistogram(after, 16) ;

    // display each image with the window name as 'h1', 'h2'
    imshow("h1", before_hist_16) ;
    imshow("h2", after_hist_16) ;

    // 4. compute the value of each component of a normalized histogram of the
input image;
    //    write all values on the input image;
    //    and display the result
    // Mat before_hist_8 = drawHistogram(before, 8) ;
    // Mat after_hist_8 = drawHistogram(after, 8) ;
    before = drawText(before, 8) ;
    after = drawText(after, 8) ;
    imshow("before", before) ;
    imshow("after", after) ;
    // imshow("before histogram(bin 8)", before_hist_8) ;
    // imshow("after histogram(bin 8)", after_hist_8) ;




    waitKey(0) ;
    return 0 ;
}
```