Department of Computer Engineering

Bu-Ali Sina University

Digital image processing Course

Digital image processing technique for image enhancement , assignment 4

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Fall 2024

1 INTRODUCTION

Digital image processing plays an essential role in analyzing and enhancing images for various practical applications. This assignment explores advanced techniques such as morphological operations, histogram equalization, and object analysis to solve specific problems like repairing corrupted images, enhancing exposure, removing noise, separating blobs, and analyzing rice grains. The main objective is to demonstrate how these techniques improve image quality and provide valuable insights through computational analysis.

1.1 Question 1: Repairing Corrupted Image

Objective: To remove lines and artifacts from the image `fruits.png`.

Methodology:

- The corrupted image was converted to grayscale to simplify processing.
- Binary thresholding was used to create a mask highlighting the artifacts.
- Morphological operations, specifically closing, were applied to clean the mask.
- Finally, inpainting techniques were utilized to restore the image.

1.2 Question 2: Histogram Equalization

Objective: To enhance the low-exposure image `badexposure.jpg`.

Methodology:

- The original histogram of the image was analyzed to understand its intensity distribution.
- Histogram equalization was applied to redistribute pixel intensities, improving contrast.

1.3 Question 3: Noise Removal and Blob Separation

Part A (Noise Removal):

- **Objective:** To remove noise from `splash.png`.
- **Methodology:** A median filter was applied to smooth the image while preserving edges.

Part B (Blob Separation):

- **Objective:** To separate blobs in the image `blobs.png`.
- **Methodology:** Binary thresholding was performed to segment the image into foreground and background, followed by connected component analysis to label and separate the blobs.

1.4 Question 4: Rice Grain Detection and Analysis

Objective: To detect and analyze rice grains in `rices.png`.

Methodology:

- The image was thresholded to extract the rice grains from the dark background.
- Morphological operations, such as opening and closing, were used to clean the mask.

- Connected component analysis was performed to count the grains and calculate their average size.

2 EXPERIMENTAL RESULTS

2.1 Question 1: Repairing Corrupted Image

Results:

Figure 1: Original corrupted image (`fruits.png`).

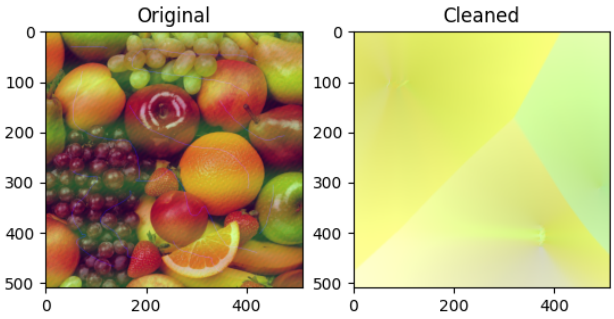

Figure 2: Cleaned and repaired image after morphological operations and inpainting.

Analysis: The morphological operations successfully removed the artifacts, and the inpainting method restored the damaged areas, improving the visual quality of the image.

2.2 Question 2: Histogram Equalization

Results:

Figure 3: Original image (`badexposure.jpg`) and its histogram.

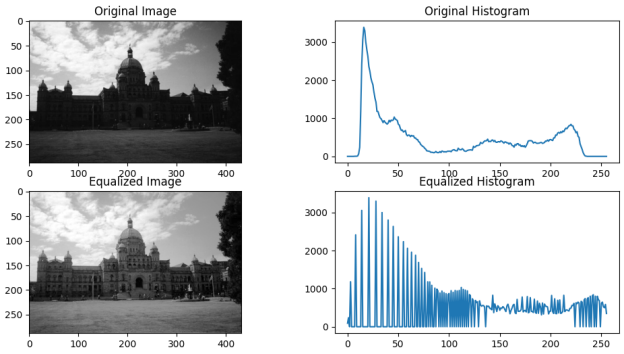

Figure 4: Enhanced image after histogram equalization and its histogram.

Analysis: Histogram equalization redistributed the pixel intensities, improving the image contrast significantly, as reflected in the equalized histogram.

2.3 Question 3: Noise Removal and Blob Separation

Part A (Noise Removal):

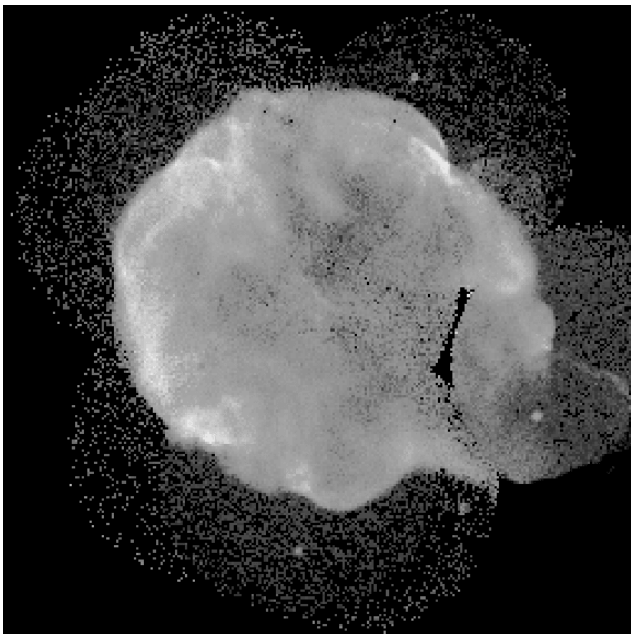

Figure 5: Original noisy image (`splash.png`).

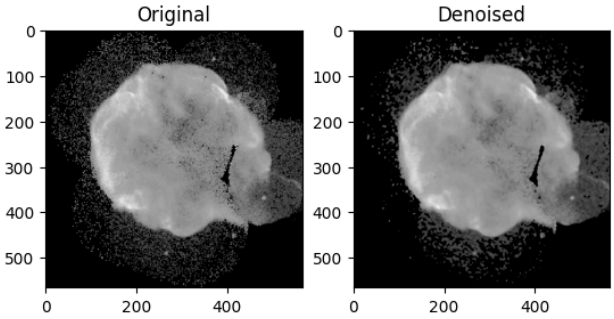

Figure 6: Denoised image after applying a median filter.

Analysis: The median filter effectively removed noise while preserving the edges of the image.

Part B (Blob Separation):

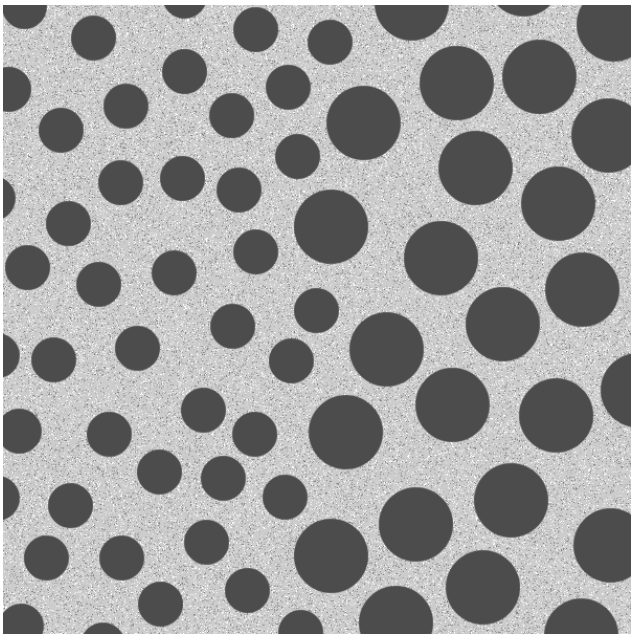

Figure 7: Binary thresholded image of `blobs.png`.

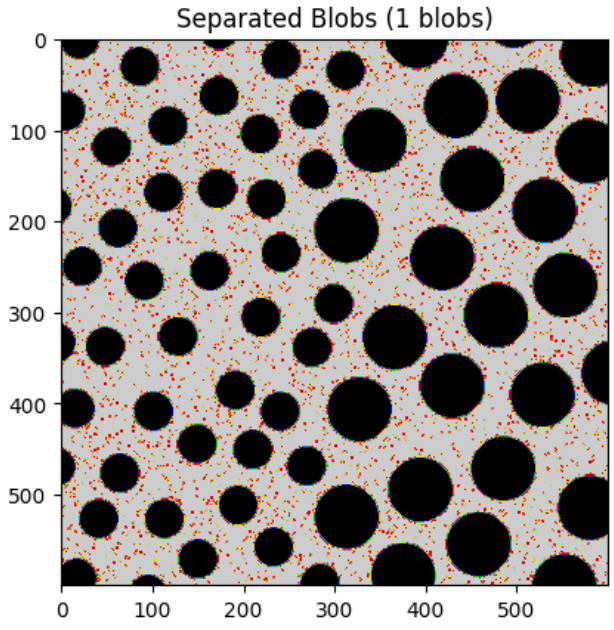

Figure 8: Labeled blobs, each assigned a unique identifier.

Analysis: Thresholding and connected component analysis successfully separated individual blobs, demonstrating the efficiency of these methods in blob segmentation.

2.4 Question 4: Rice Grain Detection and Analysis

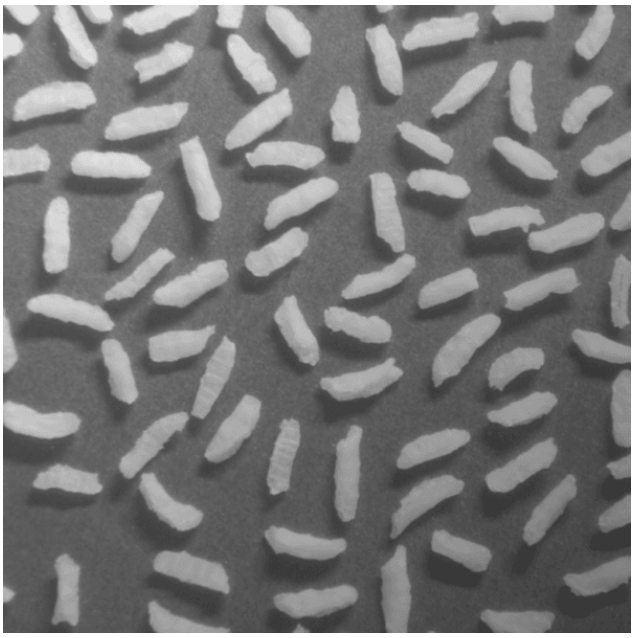

Figure 9: Binary image showing detected rice grains.

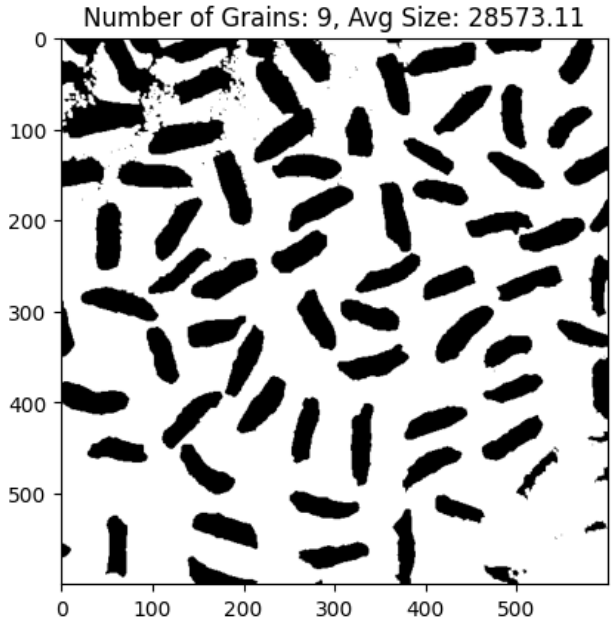

Figure 10: Labeled image of rice grains with individual components highlighted.

Analysis:

- Number of grains detected: <9>.

- Average size of grains: <28573.11> pixels.

Morphological operations effectively cleaned the mask, and connected component analysis provided accurate measurements of grain count and size.

3 CONCLUSION

This assignment demonstrated the application of advanced image processing techniques to solve real-world problems:

- Morphological operations and inpainting were effective in repairing corrupted images.
- Histogram equalization enhanced the visual quality of low-exposure images.
- Median filtering efficiently reduced noise while preserving image details.
- Blob separation and object analysis provided valuable insights, such as the ability to count and measure objects in images.

These methods illustrate the versatility of image processing techniques, laying the groundwork for more complex applications in medical imaging, object recognition, and image enhancement.