Digital Image Processing Project - Part 1

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1. Load Grayscale Image

The original input image was taken using a personal device. A watermark containing the name and student ID . The image was then converted to grayscale for further processing.

Orginal Image (Watermarked):

Code{

```python
def add_watermark(image, text, position=(50, 50)):
    watermarked = image.copy()
    font = cv2.FONT_HERSHEY_SIMPLEX
    font_scale = 1
    color = (255, 255, 255)
    thickness = 2
    cv2.putText(watermarked, text, position, font, font_scale, color, thickness, cv2.LINE_AA)
    return watermarked

original_img = cv2.imread('images/input.jpg')
watermarked_img = add_watermark(original_img, 'Mohammad Khalaf - 12112969', position=(50, 50))
watermarked_img = add_watermark(watermarked_img, 'Ayham Fuqha - 12217066', position=(50, 100))
```

}

Grayscale Image:

2. Image Statistics

Displayed image dimensions, number of color channels, and basic pixel statistics (mean, min, max).

Dimensions: (640, 640)

Min pixel: 0

Max pixel: 255

Mean pixel: 61.721279296875

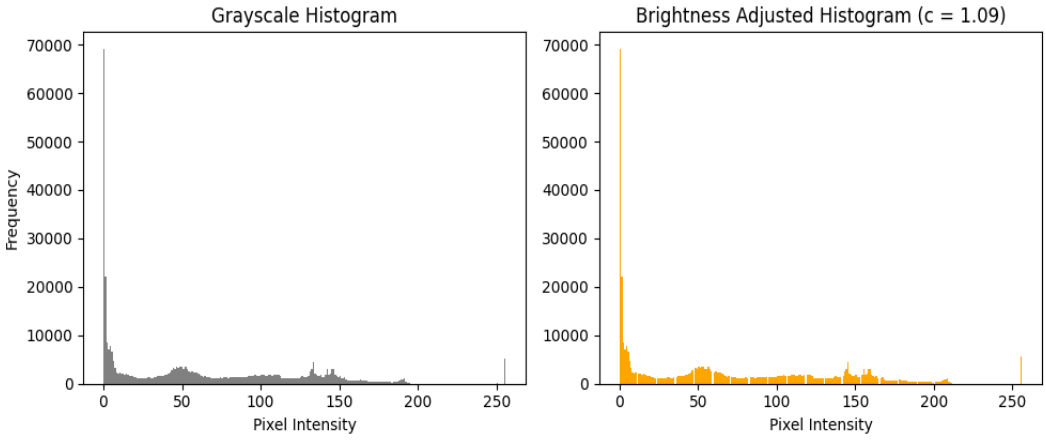
3. Brightness Modification

Brightness was modified using the formula: s = c * r, where c is a randomly chosen constant in the range 0.4 < c < 2.0.

Brightness Modified Image:

4. Brightness Histogram Analysis

The histogram of the brightness-modified image was plotted and analyzed.

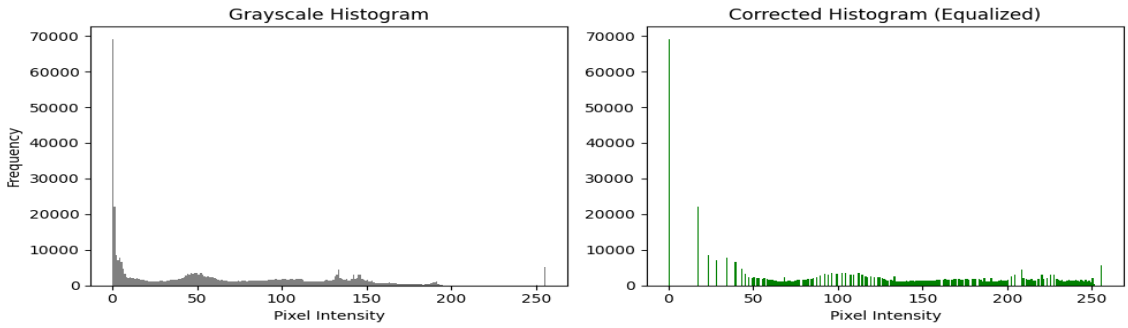


5. Brightness Correction

To correct brightness, histogram equalization was applied. This method enhances contrast by distributing intensities more uniformly.

Corrected Image:

Histogram Comparison (Before and After Correction):



6. Salt-and-Pepper Noise Addition

Salt-and-pepper noise was added by randomly turning some pixel values to either black (0) or white (255).

Noisy Image:

7. Noise Reduction

Both mean and median filters were applied to reduce noise. Additional sharpening was done if needed to correct smoothing artifacts.

Mean Filter Result:

Median Filter Result:

Sharpened :

8. Comparison of Filtering Methods

Median filtering provided better noise reduction in the presence of salt-and-pepper noise without blurring edges as much as the mean filter. Visual inspection and histogram comparison confirmed this result.

9. Summary and Reflections

This project covered a complete pipeline of image preprocessing, enhancement, and filtering techniques. Challenges included handling brightness extremes, balancing detail preservation while filtering, and choosing proper filters for noise types. All steps were tested and visually verified using histograms and comparisons.