Department of Electronic & Telecommunication Engineering
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EN3160 Assignment 1
Intensity Transformations and Neighborhood Filtering

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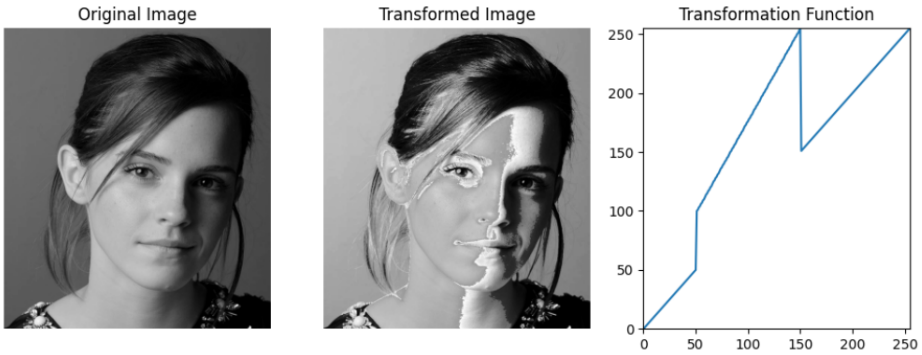
1 Implement the intensity transformation

1.1 Implementation of Transformation function

```
t[0:51] = t[0:51]
t[51:151] = np.clip(
    (155/99) * (np.arange(51, 151) - 51) + 100,
    0, 255
)
t[151:256] = t[151:256]
```

1.2 Output and Transformation Function as a plot



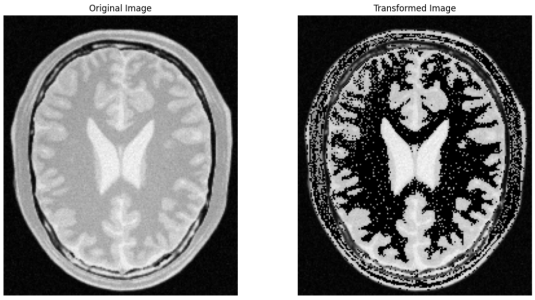
2 Apply a similar operation as above to the brain proton density image

2.1 White Matter

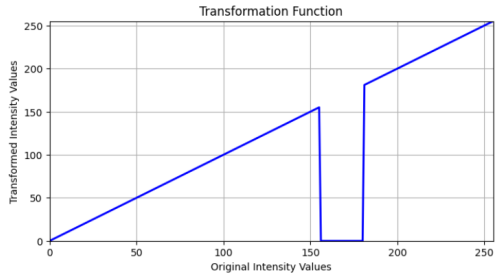
2.1.1 Select Arbitrary White Matter Points and Get Intensities

```
Intensity at point (100, 175): 217
Intensity at point (60, 100): 173
Intensity at point (50, 75): 163
```

2.1.2 White Matter



2.1.3 Transformation Function

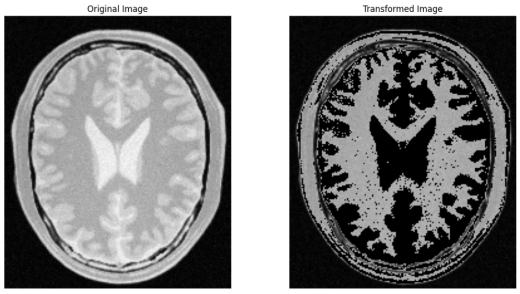


2.2 Gray Matter

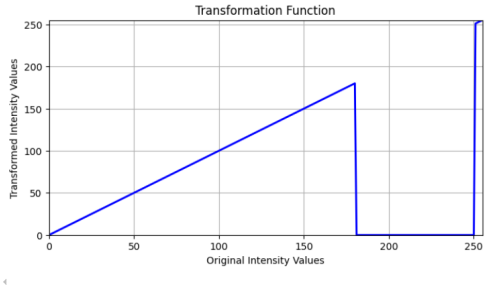
2.2.1 Select Arbitrary Gray Matter Points and Get Intensities

```
Intensity at point (150, 75): 205
Intensity at point (150, 150): 225
Intensity at point (125, 25): 198
```

2.2.2 Gray Matter



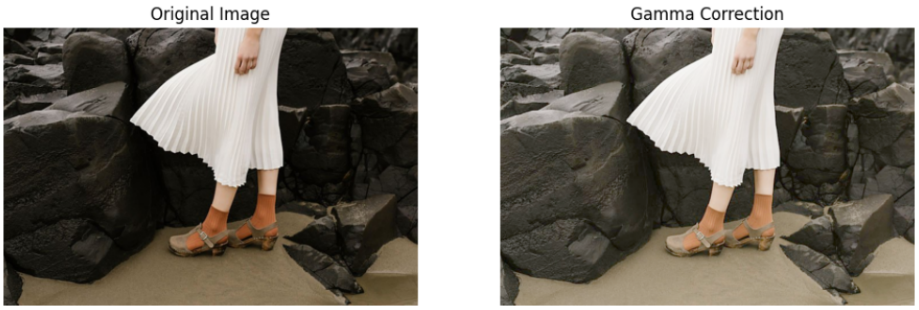
2.2.3 Transformation Function



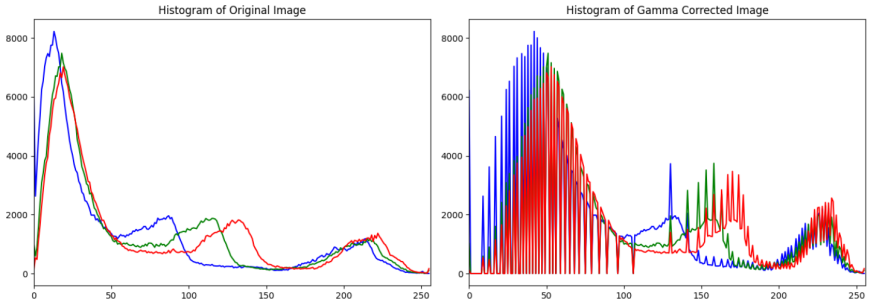
3 Gamma Correction

To address the issue of low brightness in the darker areas of the image, I adjusted the gamma value to enhance visibility in those regions. After testing different values, I found that a gamma of 0.6 yielded the most balanced result, effectively brightening the dark parts without overexposing the highlights.

3.1 Gamma = 0.6 Corrected Image



3.2 Histograms of the original and corrected images



3.3 Conclusion

When comparing the histograms of the original and gamma-corrected images, where the x-axis represents pixel intensity and the y-axis represents the number of pixels at each intensity level, the histogram of the gamma-corrected image is shifted to the right. This rightward shift indicates an overall increase in pixel intensities. By applying a gamma value of 0.6, the darker parts of the image have been brightened, resulting in more pixels falling into higher intensity values compared to the original image, which causes the histogram to move towards the right.

4 Increasing the vibrance of a photograph

4.1 Split the image into hue, saturation, and value planes

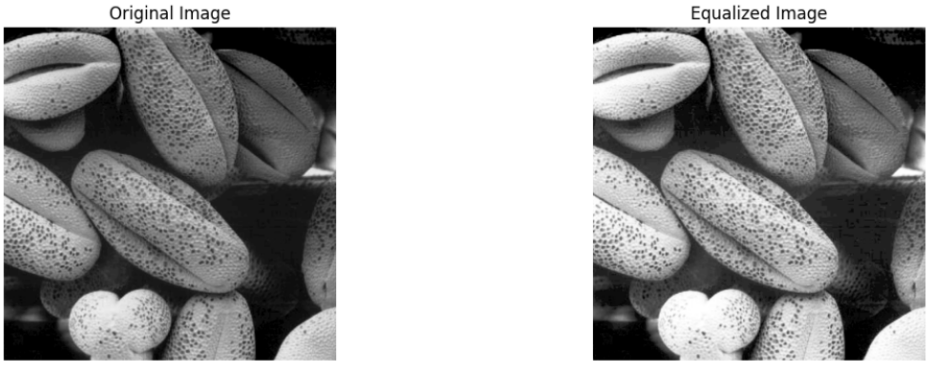
4.2 Apply intensity transformation to the saturation plane

4.3 Display the original image, vibrance-enhanced image, and the intensity transformation

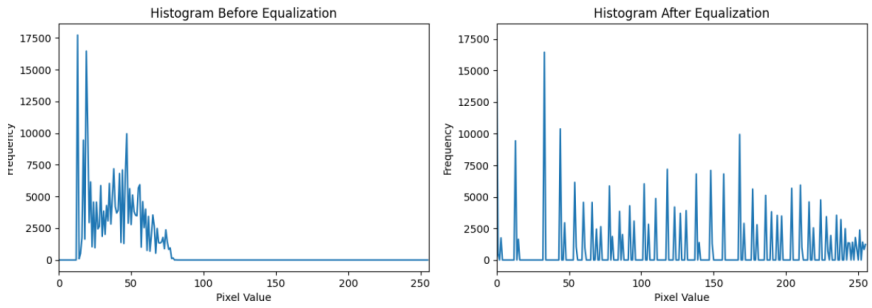
Best value for a = 0.4

5 Histogram equalization

5.1 Original and Equalized Images



5.2 Histograms Before and After Equalization

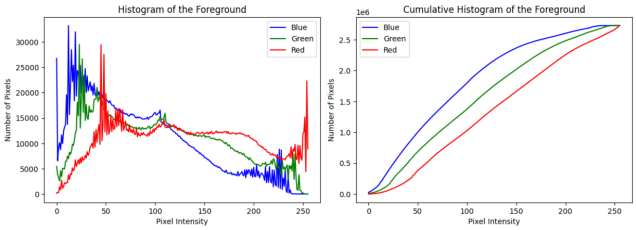


6 Histogram equalization only to the foreground of an image

6.1 Hue, saturation, and values planes

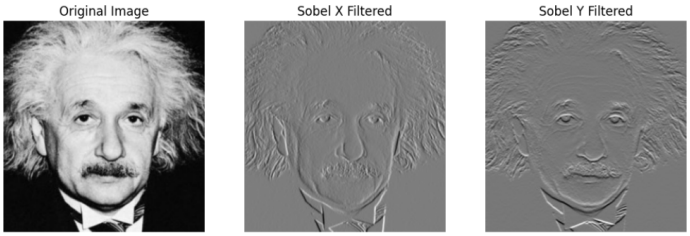
6.2 Images

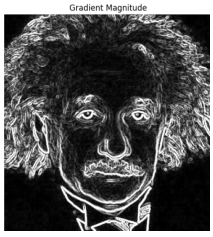
6.3 Histograms



7 Filtering with the Sobel Operator

7.1 Images Related to Finding the Gradient





- **Blocky Artifacts with Box Filter**: Box filter causes blocky artifacts due to uniform averaging, resulting in an unnatural appearance.
- **Solution - Fuzzy Filter**: A fuzzy filter spreads smoothly in the X and Y directions, reducing these artifacts.
- **Gaussian Filter**: Gaussian distribution is commonly used as a fuzzy filter to create smoother, more natural transitions by giving more weight to nearby pixels.

8 Zoom Images

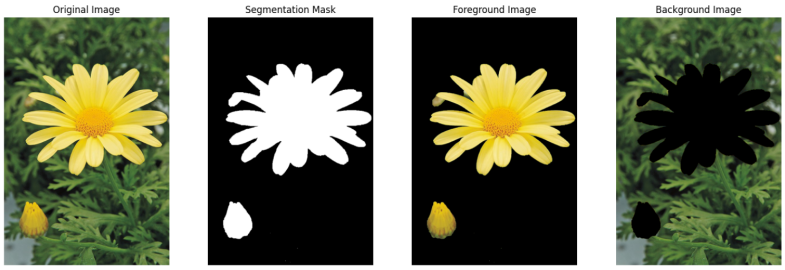
8.1 Zoomed Images with Nearest-neighbor ,Bilinear Interpolation and Original Image

8.2 Sum of Squared Difference (SSD)

```
SSD (Nearest Neighbour Interpolation):  190.36575892857144
SSD (Bilinear Interpolation):  192.51366071428572
```

9 Image Segmentation

9.1 Final Segmentation mask, Foreground image, and Background image



9.2 Original nad Enhanced Images

9.3 Why is the background just beyond the edge of the flower quite dark in the enhanced image?

The background just beyond the edge of the flower appears quite dark in the enhanced image due to the nature of the Gaussian blur kernel, which takes into account neighboring pixel values to generate the new pixel value. Since the filtering process includes contributions from dark pixels surrounding the flower, the resulting background remains darker.

Additionally, a glowing effect is observed because the bright pixels of the daisy flower also contribute to the new pixel value during Gaussian filtering, blending both the flower and background areas.

GIT Link - [ ]