

ASSIGNMENT-3 REPORT

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Purpose of the Project:

To perform image transformation of an image from an RGB scale to HSI scale and apply 2D compression on it using DCT. Further, remove unnecessary frequencies from the compressed matrix. Compare the results of 8-point compression of the images with different frequencies present. Compare the results of IDCT on images with different frequencies. To perform color-based segmentation and find ROI.

Method:

To convert an image from RGB to HSI image, the following calculations were used:

$$\text{RGB} \rightarrow \text{HIS}$$

$$\begin{aligned} I &= \frac{1}{3}(R + G + B) \\ S &= 1 - \frac{3}{(R + G + B)}[\min(R, G, B)] \\ \text{if } B \leq G \\ H &= \cos^{-1} \left[\frac{\frac{1}{2}[(R - G) + (R - B)]}{\sqrt{(R - G)^2 + (R - B)(G - B)}} \right] \\ \text{else, } H &= 360 - H \end{aligned}$$

To perform DCT on an image, the following calculations were used:

$$F(u, v) = a(u)a(v) \sum_{x=0}^{N-1} \sum_{y=0}^{N-1} f(x, y) \cos\left[\frac{(2x+1)u\pi}{2N}\right] \cos\left[\frac{(2y+1)v\pi}{2N}\right]$$

$$a(u) = \begin{cases} \sqrt{\frac{1}{N}} & \text{for } u=0 \\ \sqrt{\frac{2}{N}} & \text{for other} \end{cases} \quad a(v) = \begin{cases} \sqrt{\frac{1}{N}} & \text{for } v=0 \\ \sqrt{\frac{2}{N}} & \text{for other} \end{cases}$$

To perform IDCT on an image, the following calculations were used:

$$f(x, y) = \sum_{u=0}^{N-1} \sum_{v=0}^{N-1} a(u)a(v)F(u, v) \cos\left[\frac{(2x+1)u\pi}{2N}\right] \cos\left[\frac{(2y+1)v\pi}{2N}\right]$$

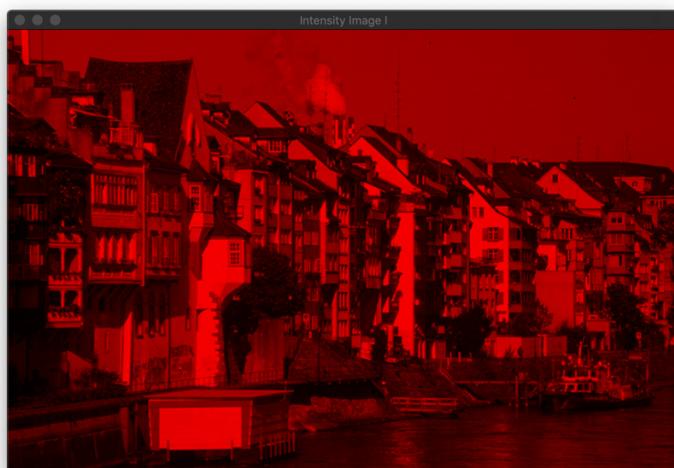
To perform color-based segmentation to find ROI, we first converted the image to the HSI model, and then we can apply the Sobel operation or the Canny edge detection to obtain edge information of the intensity image. By applying Hough Transform for line detection on the edge image we can get the ROI by color-based segmentation of the HSI image.

Results:

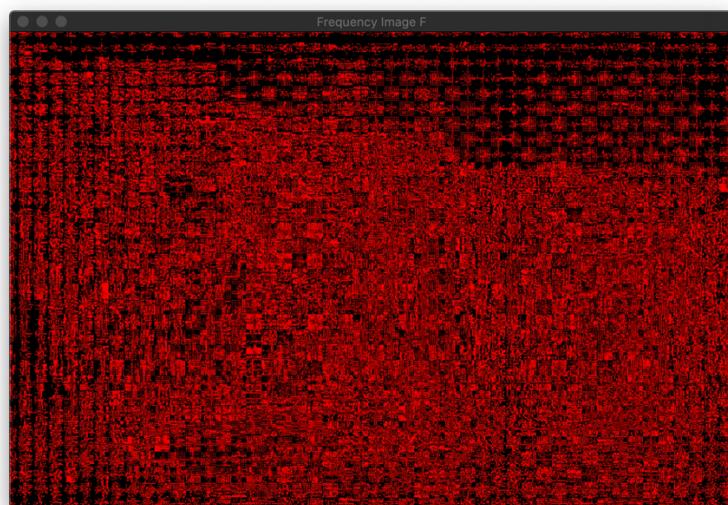
RGB to HIS image:



Intensity Image:



DCT Frequency Image:



Preserving DC components and removing Higher Frequencies:

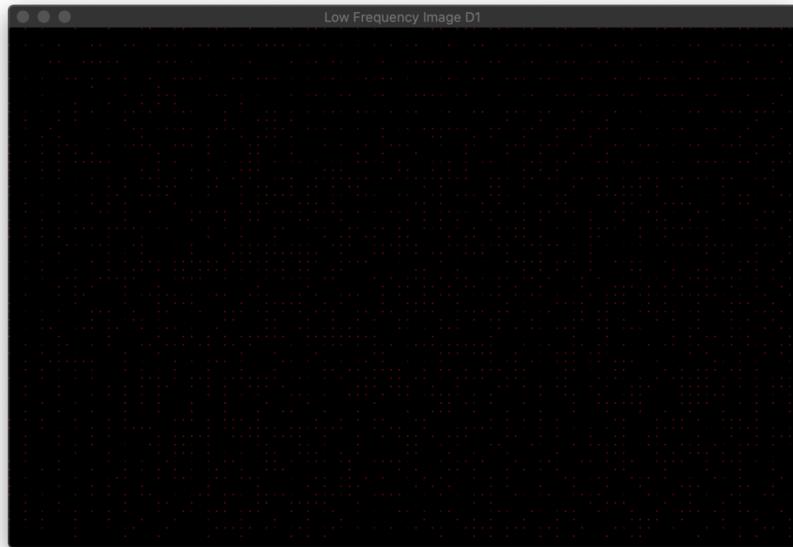
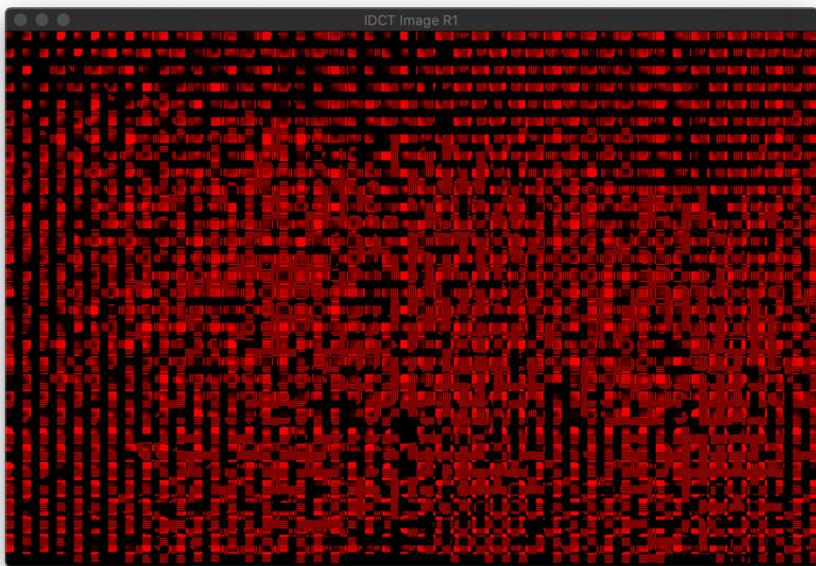


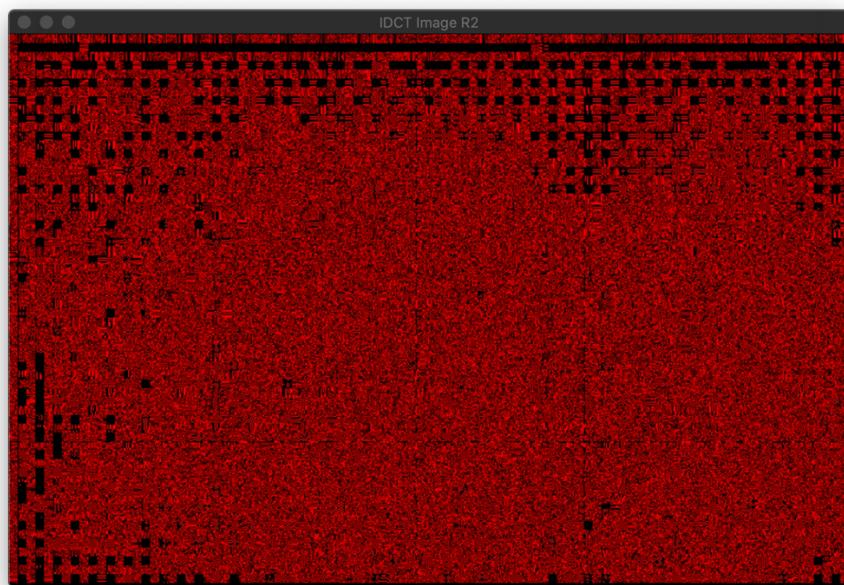
Image with just first 9 frequencies:



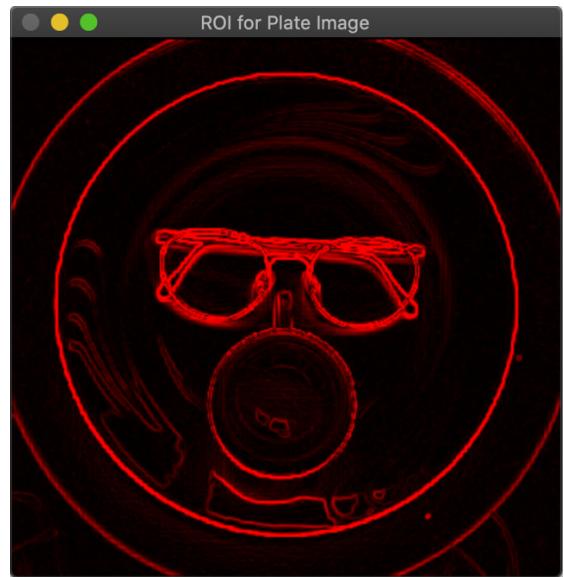
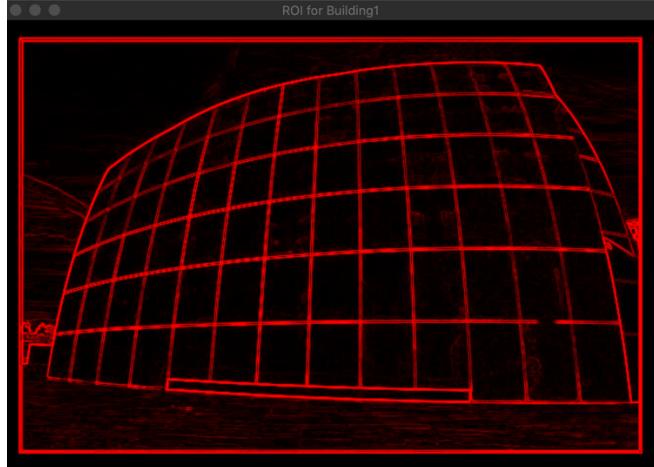
IDCT for first DCT Image with just DC components:



IDCT for the DCT image with just first 9 frequencies



Images after performing ROI color based Segmentation:



Bug Report:

Couldn't perform color-based segmentation to find ROI completely. Could just perform the edge detection on the HSI image and couldn't perform Hough Transform.

Steps to compile and run:

1. Go to the *Assignment-3* directory and then go to the *programs* subdirectory:
2. Type *make* in the terminal
3. To clean the executables type *make clean*.

References:

For RGB TO HIS :

- 1) <https://www.imageprocessing.com/2013/05/converting-rgb-image-to-hsi.html>

For DCT:

- 2) <https://www.math.cuhk.edu.hk/~lmlui/dct.pdf>