

COL783: Assignment 1

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1 Color quantization

Two methods of quantization are implemented in matlab and Floyd Steinberg dithering is done to compensate the quantization error-

1. Popularity/ Populosity algorithm
2. Median cut algorithm

In any quantization method, basic method is as follows -

1. Determine the color distribution in original image
2. Determine the color palette/ color-map for given K
3. Get the new image using the color palette/map, thus quantizing the image.

Last third step remains same for most of the quantization methods. Color is chosen from the map/palette based on the minimum euclidean distance, thus minimizing the MSE. For the mentioned algorithms, distribution of is determined using histogram of the color image. Difference arising in the determination of colormap/palette.

1.1 Popularity algorithm

In this method, colormap is calculated by choosing the K most frequently appearing colors in the original image. In matlab, image 3D matrix is reshaped into 2D matrix (number of pixels X 3), then each pixel is assigned unique label. Using this unique labels, histogram is determined as this will give the frequency of each label. Finally, K most labels are chosen for the color palette/map.

This method works for the images in which range of colors is small, otherwise it will remove the less frequently appearing color.

1.2 Median cut algorithm

In this algorithm, color space is cut/split into K regions. Flowchart in figure 1 shows the process to split the region into K disjoint boxes. Here box stores colormap for this region, level of split, min and max of red, green and blue channel. Box to split is determined by checking the number of colors in the box which should be greater than 2 and minimum level of split. When the region splitting is completed, color palette/ map is the representative color of each region/box which is average of colormap in a box/region.

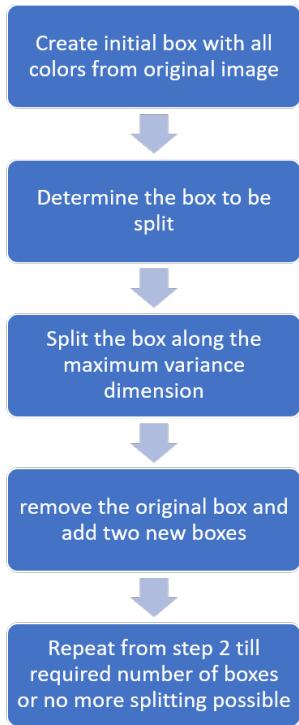


Figure 1: Median cut flowchart

1.3 Results

Table 1 and Table 2 show the images with various quantization values for popularity and median cut algorithm.



(a) Original image



(b) $K = 4$

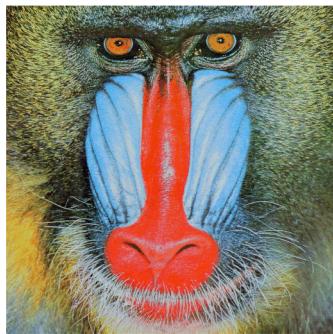


(c) $K=16$



(d) $K=32$

Figure 2: Median cut demonstration of disjoint sets



(a) Mandril



(b) Surface



(c) Pamela

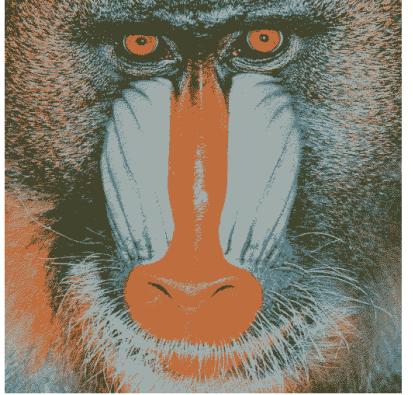
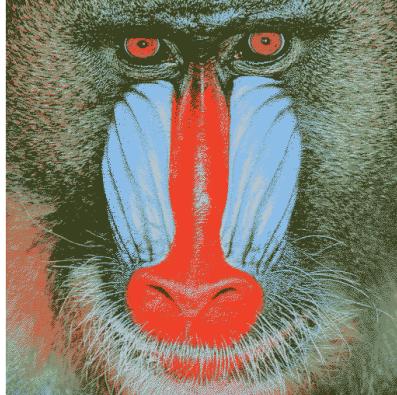
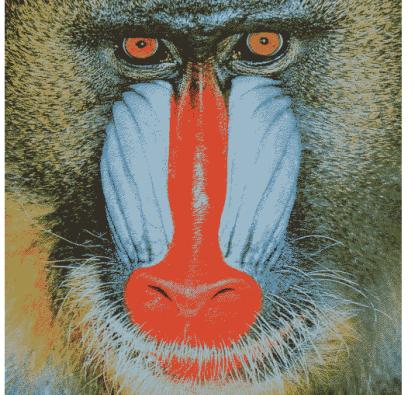
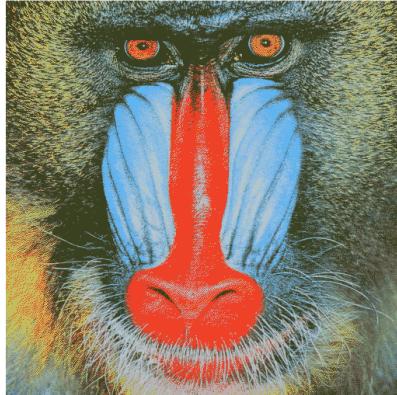
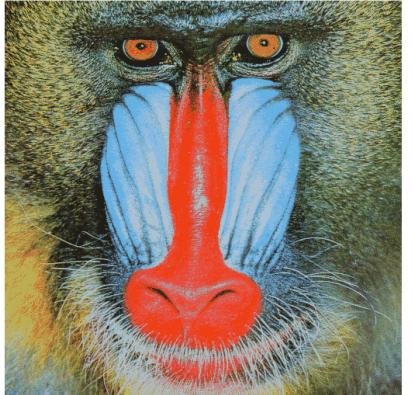
Figure 3: Original images

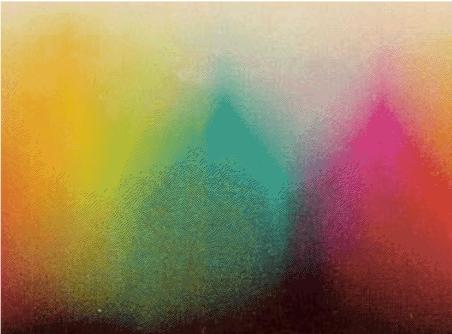
Table 1: Comparision between different method for various values of K and with no dithering

Quantization value	Popularity	Median cut
4	A quantized version of the mandrill image where the colors are very limited, resulting in a blocky appearance. The red and blue areas are more distinct but lack fine detail.	A quantized version of the mandrill image where the colors are more muted and less distinct than the popularity method, appearing more like a grayscale with colored highlights.
8	A quantized version of the mandrill image where the colors are more refined than at K=4, showing some texture in the fur and the red/blue areas.	A quantized version of the mandrill image where the colors are more vibrant and closer to the original than the K=4 median cut, though still less detailed.

Quantization value	Popularity	Median cut
32		
256		
8		
256		

Table 2: Comparision between different method for various values of K and with dithering

Quantization value	Popularity	Median cut
4		
8		
32		

Quantization value	Popularity	Median cut
64		
128		
256		
8		

Quantization value	Popularity	Median cut
256		

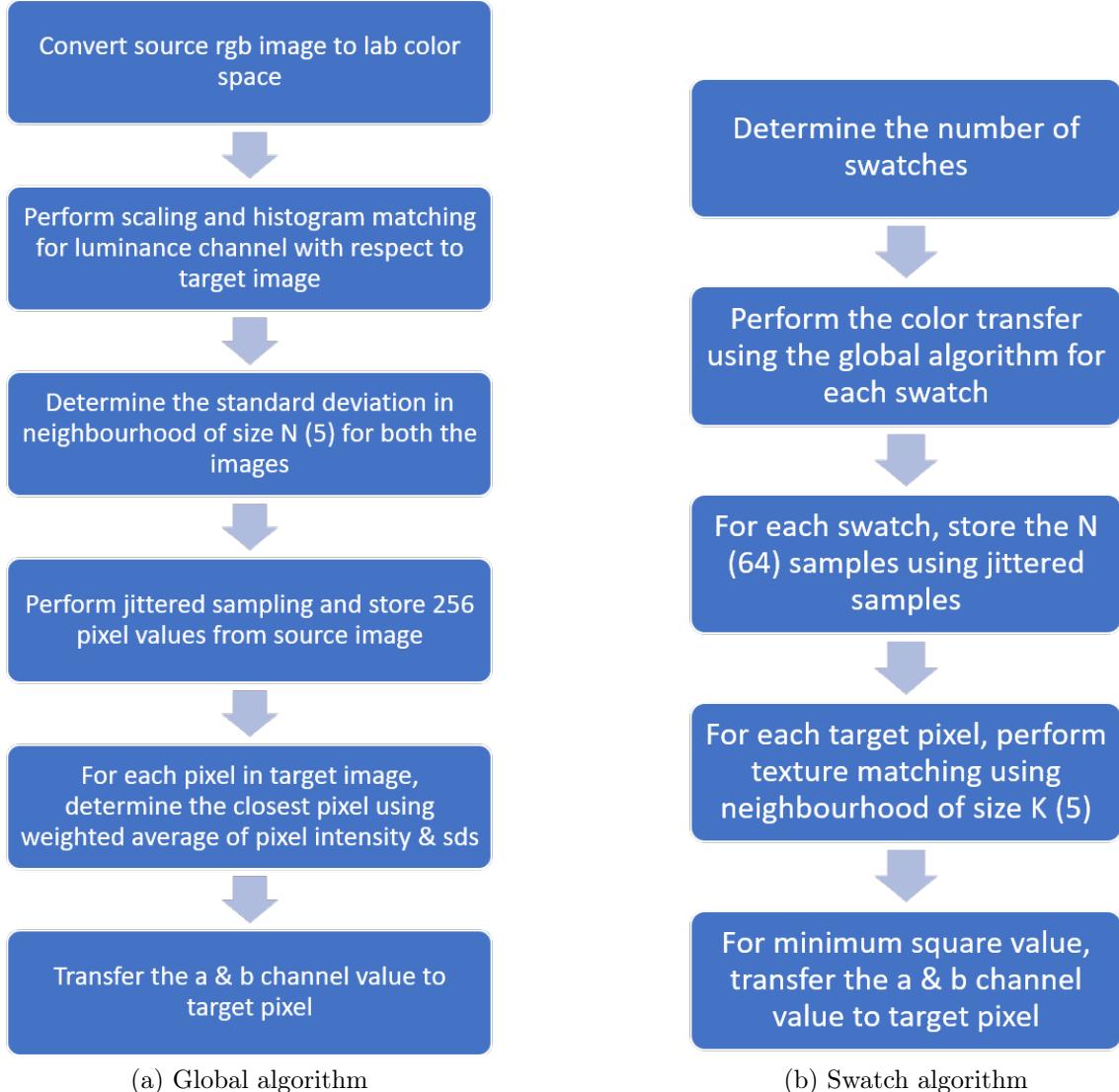


Figure 4: Flowchart

2 Image colorization

There are two ways to colorize the greyscale image -

1. Global colorization algorithm. Flowchart in Figure 3(a)
2. Using swatches to color the image. Flowchart in Figure 3 (b)

In both methods, there will be source image (colored image) and target image which need to be colorized.



(a) Global algo



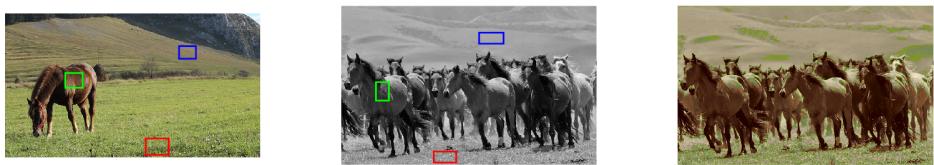
(b) Swatches based algo

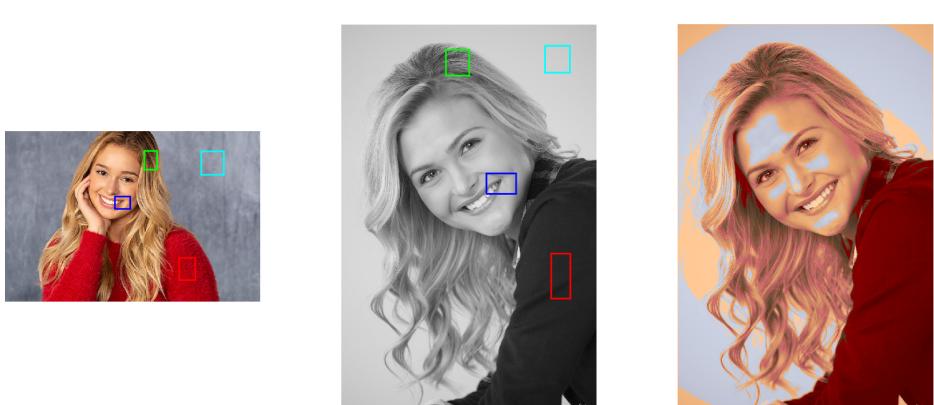
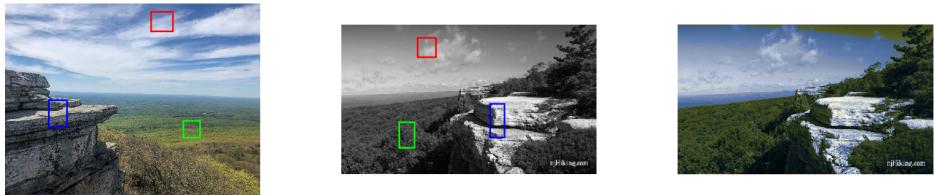


(a) Global algo



(b) Swatches based algo





References

- [1] Heckbert P. Color image quantization for frame buffer display. ACM Siggraph Computer Graphics. 1982 Jul 1;16(3):297-307.
- [2] Welsh T, Ashikhmin M, Mueller K. Transferring color to greyscale images. InProceedings of the 29th annual conference on Computer graphics and interactive techniques 2002 Jul 1 (pp. 277-280).