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# Applying Popularity Quantization Algorithms on Color Satellite Images

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**Abstract**: The real key to the color image processing is to get the right colors of the images. In the RGB (Red, Green, Blue) coordinate, the system of (24) bit used to represent the 16 million true colors. The popularity and the modified popularity quantization methods are applied on the SPOT color satellite images, two appropriate set of representation of 16 and 256 colors are used in the quantization. The developed method of the popularity quantization gives better appearances to the processed images compared with the known methods. The modified method work well on both images with wide range of colors and small number of colors. The modified popularity quantization method gives less reduction in satellite image information compared with popularity quantization method.

**Keywords:** Satellite images, Color images, Quantization, Image processing

## Introduction

The 24-bit true color cards are becoming popular, but SVGA (256-color) cards remain the high resolution standard and likely to continue so for at least few years. At the same time, the 24-bit video frame capture systems are also popular but cannot be readily displayed on SVGA systems (Ezzeu, 1997).

To display a full – color of satellite image, the computer must be chosen an appropriate set of representative colors and map the image into these colors. The process is called "color quantization" or called "color reduction". Therefore, color image quantization can be defined as the process of selecting a set of colors to represent the color gamut of an image, and computing the mapping, from color space to representative colors "color map". True color space is finite, it runs from black to white, or rather, from point (0,0,0) to (255,255,255) (Ezzeu, 1997 and Foley *et al* 1995)

Conversion potential palette of 16 million colors $(2^{24} = 16.777.216)$, to a palette of 256 color or less colors (for example 16 colors) does seem to be a considerable degradation of image quality. However, a typical image will contain a much smaller range of actual colors perhaps as many as 400 or 500 distinct shades. But usually fewer, and even when the color variation is high, many shades that are technically different will still be relatively close in hue and can be represented by a single palette entry (Sangwine 1998, Gomies 1997, Umbaugh 1998)

The RGB color available for displaying are stored in the graphic system palette table, essentially an array indexed from 0 to 255, each palette entry contains three bytes (red, green, blue). The software sets a color on the screen by specifying the index of palette entry, and set this pixel on the screen (Clark 1995 and Dome System 1999)

**Color Quantization System:** The algorithm for color image quantization is consist of the following four phases:

1. Convert the 24-bit image to RGB color model (split the image to its three bands red, green, and blue).
2. Choice a color map.
3. Compute quantization map from 24 bit colors to represent colors (color in the color map).
4. Redraw the image with a new color specification and displaying it.

Choosing the color map is the most challenging task. Once this is done, computing the mapping table from color to pixel values is a straight forward. To display the new (quantize) image each pixel mapped to the palette entry with the same red, green, and blue values of the pixel. For the image colors that do not exactly match a palette color, the closest color in a qualitative sense, is the color in the table that is least distinguishable from the color in the image. In qualitative terms it is the colors in the table that is the shortest straight-line distance from the actual color. Due do the colors are inside a 3 –D cube, then the distance between two colors is d=C2-C1, where C1 and C2 are two points in the color table defined by their individual R, G, and B values.

In algebraic terms,

$$d=\sqrt{(r2-r1)^2+(g2-g1)^2+(b2-b1)^2} \qquad (1)$$

Where d is always non-negative because of the squared terms and implying that (C2 – C1) =(C1 – C2). If d is 0, than the colors is the same (Kruger 1994 and Levine 1997)

**Frequency Ordered (Popularity) Algorithm:** This algorithm used the most frequently occurring colors in the image as the palette colors. All the other color is then mapped to the popular color to it is closest. The algorithm steps are:

1. Scans the image, building a list of all the colors found in the image. Keep a count of the number of occurrences of each distinct color.
2. Sort the colors in descending order by counting (ties can be broken arbitrarily) and selecting the top 256 colors, or 16 colors for the palette map.

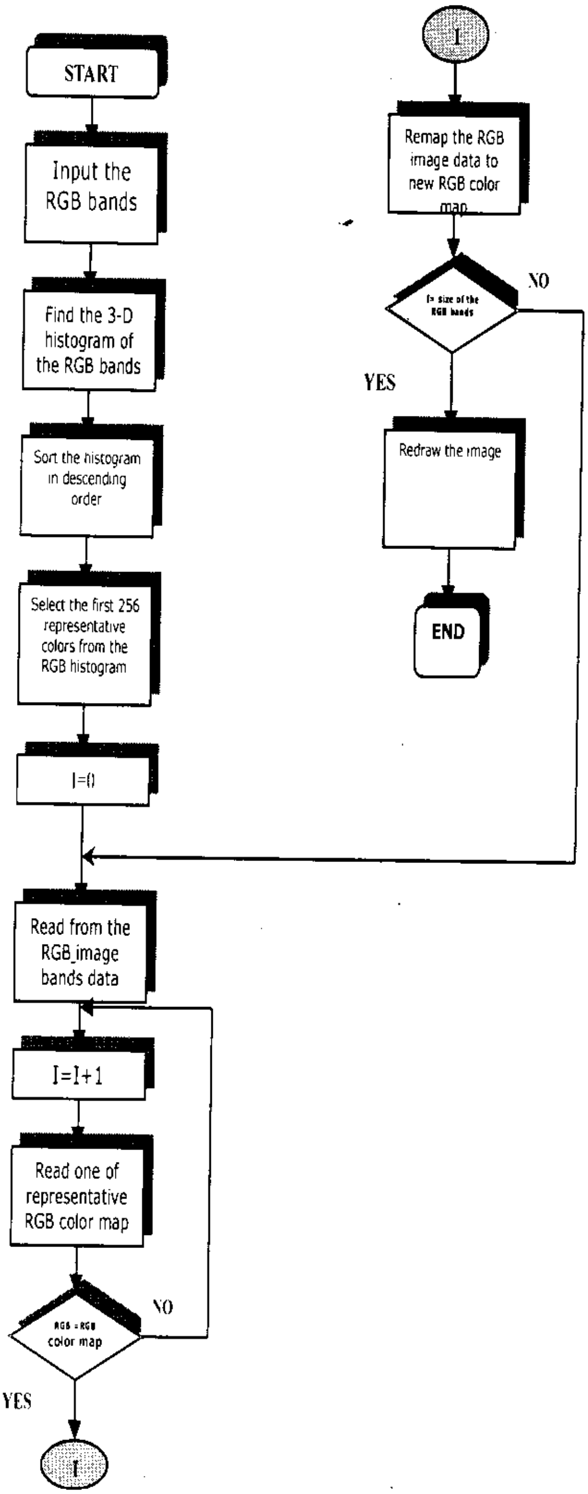


Fig. 1: Flow Chart of the Popularity Algorithm

Fig 2: True Color Image

Fig. 3 (a): Reduction to 256 Colors

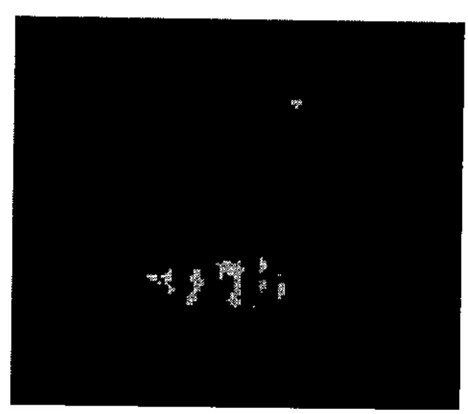

Fig.3(b): Reduction to 16 Colors

Fig. 3: Applying Popularity Quantization Method on Image in Fig. 2

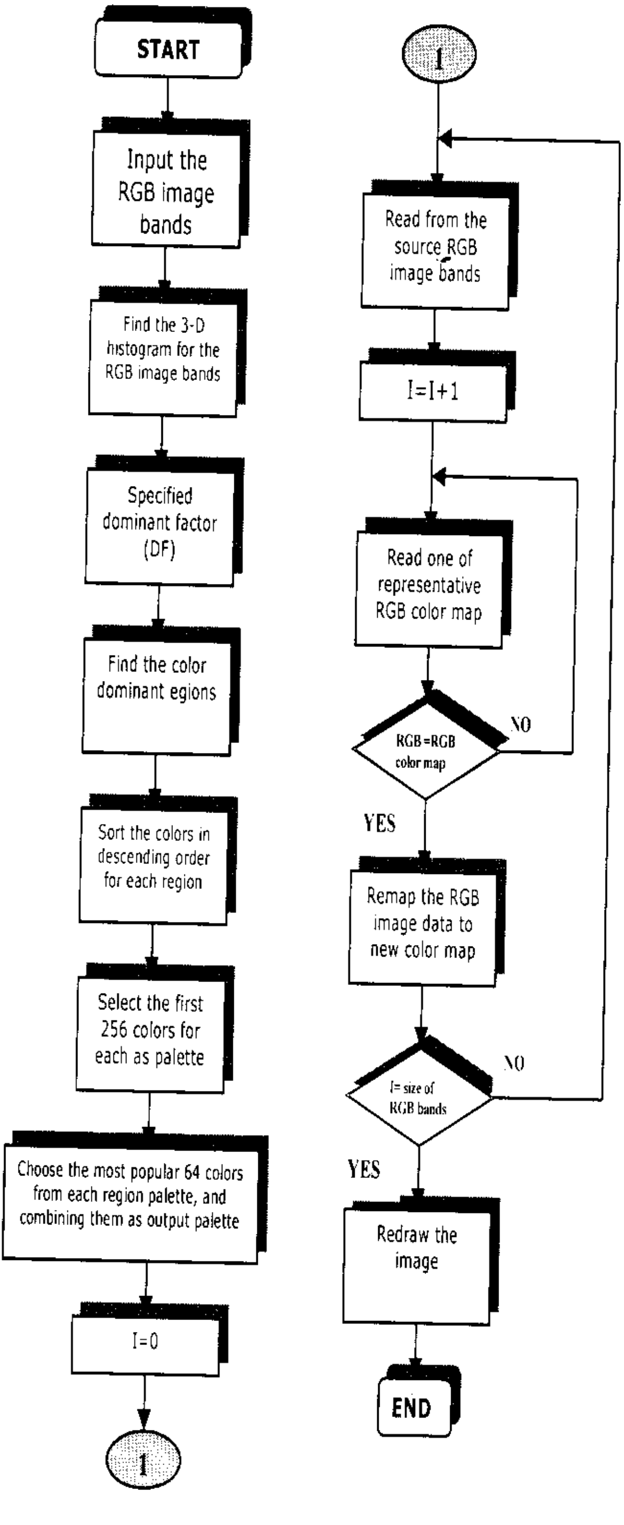


Fig. 4: The Flowchart of the modified Popularity Algorithm

Fig. 5(a): Reduction to 256 Colors

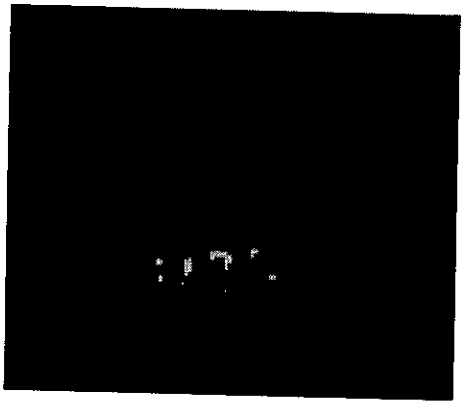

Fig. 5(b): Reduction to 16 Colors

Fig. 5: Applying Modified Popularity Quantization Methods on Image

3. Rescan the image to map image colors to palette colors. The image colors that do not exactly match a palette color, by using the closest color in the palette by applying equation (1).

Fig. 1 shows the flow chart of the popularity algorithm (Foley 1995).
Fig. 2 shows the true color of Spot satellite image that will be used in the quantization techniques.
Fig. 3a and 3b show the result of implementing the popularity algorithm for the image shown in Fig. 1 to reduce the image colors to 256 and 16 colors only.
**Modified Popularity Algorithm**: The popularity algorithm method improved by making sure a representative sampling to get from different regions in the color cube. The algorithm steps are:

1. Scans the image, building a list of all colors found in the image. Keep a count of the number of occurrences of each distinct color.
2. Find red dominant, green dominant, blue dominant, and gray dominant colors according to the dominant factor (user-defined factor).

The primary color is called a dominant color if it greater than other colors by the specified dominant factor (DF), for example if the (DF=15) so that RGB value (56, 57, 8) is red dominant but (12, 1, 2) is not.

3-Sort the color in descending order by a count for each dominant color region and select the up 256 colors as a palette for each region.

The 256 output palette is a combination from the most popular 64 colors for region palette, if a region does not have 64 distinct color, it is left over a palette space is distributed among the others. Fig. 4 shows the flowchart of the modified popularity algorithm. Fig. 5a and 5b shows the result of implementing the modified popularity algorithm for the image shown in Fig. 2 to reduction the image colors to 256 and 16 colors only.

## Discussion

The development of the quantization system was used to quantize the true color of satellite images, which have been crowded data into palette images of 256 and 16 number of color palettes. Among these images a reported true colored image of the size 124*122 pixels was shown in Fig. 2. Fig. 3 shows the system output using the popularity quantization 256 and 16 color palette driven image obtained from 24-bit true color image. Fig. 4 shows the output by using the modified popularity and binary tree respectively. By comparing these Fig.s we can be concluded that the images obtained by using the modified popularity method is better than popularity results, the reduction of the data (loss) in modified popularity quantization, is much less than the popularity quantization method.

The popularity quantization might miss significant areas of colors if non-of them are popular enough. It may work well for many images, but it performs poorly on those with wide range of colors or small number of colors.

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