# Book Cover Image Color Reduction A Bacteria Foraging Optimization Approach

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**Abstract:** *this paper aims at reducing the colors of a book cover page. This approach has mainly two steps. First is to apply an edge preserving technique and then perform the color quantization. Canny edge detector has been used to get the edge points in the text image and bacteria foraging id used to optimize the quantization. L*a*b color model is used to consider the visual perception of human eye. CMC distance is used as the fitness function for checking the closeness of colors.*

**Keywords:** color reduction, L*a*b color model, CMC distance, Bacteria Foraging Optimization.

## I. Introduction

Color Image Quantization is process of reducing number of distinct colors in an Image and the perceived difference between original and

quantized Image should be as small as possible. Basically Color Quantization is to reduce number of bits in color representation with minimum distortion. Let I be the original Image represented by A={a[i],i=1,2..N} and J be the quantized Image represented by B={b[j],j=1,2…K} such that K<N and Quantization is a Mapping from A->B such that each color of Image I of A is mapped into reduced color set J. This mapping is done by Nearest Neighbor Principal. In Color Quantization we first find out the actual number of colors presents in the Image with the help of any color model like RGB, LAB, CMY etc .Then using different types of distance formula techniques color distance or their closeness is studied. Then the mapping of close colors is done and the far off colors are dropped. Based on particular requirement we can decide the final number of colors in the Image and stop the further reduction of colors.

For color document Images objects on printed documents that appear uniform for human perception, become noisy with unwanted color variations because of digitization process. This is more obvious in color cover pages and, generally, in complex color documents where we have non uniform background, line graphs, color texture, etc. For this reason, digitized documents contain thousands of colors that make the segmentation of complex color documents a difficult task. To overcome this problem, a color quantization preprocessing stage is usually applied. The purpose of this stage is to create a simplified version of the initial Image with significantly less colors, i.e., to create a segmented document Image where character elements can be easily extracted as connected components[1].

### *A.* ***Canny Edge Detector***

Canny edge detector is basically edge detection multistage algorithm that detects wide range of edges in an image and it outperforms many of the newer algorithms that have been developed. The main steps are: Smooth the Image with a two dimensional Gaussian because it is susceptible to noise present on raw unprocessed image data and result is a slightly blurred version of the original which is not affected by a single noisy pixel to any significant degree. Then take the intensity gradient of the Image. This shows changes in intensity, which indicates the presence of edges. The Canny algorithm uses four filters to detect horizontal, vertical and diagonal edges in the blurred image. This actually gives two results, the gradient in the x direction and the gradient in the y direction. Edges will occur at points the where the gradient is at a maximum. The Canny algorithm is adaptable to various environments and its parameters allow it to be tailored to recognition of edges of differing characteristics depending on the particular requirements of a given implementation.

### *B.* ***Bacteria Foraging Optimization***

Bacteria Foraging Optimization Algorithm (BFOA) was proposed by Passino. It is basically swarm intelligence technique. In this algorithm EColi bacteria search for nutrients in a manner to maximize energy obtained per unit time. Individual bacteria also communicate with other bacteria by sending signals considering these factors bacteria takes foraging decisions. This algorithm has drawn attention of researchers due to its effectiveness in the optimization domain and large number of modifications has already been undertaken to improve its performance. The original Bacterial Foraging Optimization

system consists of three principal mechanisms, namely, chemo taxis, reproduction, and elimination-dispersal. These are described as follows [2].

### *1.1.1 Chemotaxis*

In the original BFO, unit's walk of the bacteria with random direction represents a "tumble" and a unit walk with the same direction in the last step indicates a "swim". Bacteria swim or tumble in search of food. A chemotaxis step is a set of consequence swim steps following by tumble.

### *1.1.2 Reproduction*

The fitness value of each bacterium is calculated as the sum of the step fitness during its life and all bacteria are sorted in descending order according to health status. In the reproduction step, only the first half of population survives. The surviving population is divided into two identical ones, which are then placed in the same locations at which their parents were. Thus, the total population of bacteria will be constant [2].

### *1.1.3 Elimination and Dispersal*

The chemotaxis provides a basis for searching the local best solution, and the reproduction process speeds up the convergence which has been simulated by the classical BFO. The bacteria with the best positions are kept and the remaining bacteria population is killed. The bacteria with best positions are then moved to another position within the environment [2].

## II. Related Work

Image quantization has been implemented using several techniques. Some of them are discussed using octree methods has been described for performing color Quantization on full color RGB Images, using an octree data structure. The advantage of the octree is that it is simple to generate

both a good partitioning of the color space and a fast inverse color table to find the color index for each pixel in the Image. Octree color Quantization in one pass and two pass were used and results were compared with best median cut algorithms and are as good as can be done with 256 colors[4]. In Color Image Quantization using distances between adjacent colors along the color axis with highest color variance author describes a simple splitting algorithm for hierarchically divisive color map design technique for color Image Quantization [5].

Oleg Verevka in his paper on Local K means algorithm for window system [6] describes how post clustering scheme can be used for efficient Quantization within window systems.

It has also been implemented as Color Quantization in document Images using biogeography based optimization in which species are distributed among neighboring island and using this approach Quantization has been implemented in which far off colors moved to more close color islands. [7]. Omran in his paper proposes Color Image quantization based on PSO. The proposed approach is of the class of quantization techniques that performs clustering of the color space. The proposed algorithm randomly initializes each particle in the swarm to contain K centroids (i.e. color triplets). The K-means clustering algorithm is then applied to each particle at a user-specified probability to refine the chosen centroids. Each pixel is then assigned to the cluster with the closest centroid. The PSO is then applied to refine the centroids obtained from the K means algorithm [8].

Another approach is a Gamut preserving color Image Quantization in which is based on Image dependent color gamut sampling of L*a*b color space which preserve the color gamut shape of an Image[9].

## III. Proposed Algorithm

Concept of this algorithm has been taken to implement color document Image Quantization. In the proposed algorithm first step is to find the edges of text in the Image and then perform the Quantization by considering the pixels other then on edges. The canny edge detector algorithm is used to calculate the pixels on edges. This is listed in matrix. Then the L*a*b color model and CMC distance is used to find the color distances. The colors are quantized using BFO.

Pixel of Image is considered as bacteria and color as bacteria food and the aim of using this algorithm is to minimize the food i.e. to reduce the number of colors. First we find popular and unpopular colors. Popular colors are those which are present in too many pixels and unpopular colors that are less present. Our aim is to find the similar colors and eliminate them. These colors can be found with the help of CMC distance. The algorithm works as follows:

1) Initially in this process, the bacteria take small steps while searching for nutrients. EColi moves through two processes swimming and tumbling .It can swim for a period of time in the same direction or it may tumble, and alternate between these two modes of operation for the entire lifetime.
2) A unit step of size one is taken by bacteria in the same direction to find its nutrient i.e. each pixel takes unit's step of size one to find the most

similar color. By fulfilling the fitness function i.e. CMC distance if the pixel find the most similar color after a unit walk then it is called as swim where the pixel color is replaced with the color of that next pixel.

3) Next process is elimination in which bacteria can be eliminated based on the health status. It is divided into two categories surviving i.e. popular and the un-surviving i.e. unpopular colors. The un-surviving colors following the fitness function become candidate for the elimination.
4) Next process is reproduction in which weak bacteria dies and healthy bacteria splits into two and two weak bacteria combine. Similarly unpopular colors are compared and based on CMC distance they are evaluated and combined to produce new color.
5) Last process is dispersal in which the two unpopular colors from which the new color was reproduced are eliminated and new color is dispersed to new location. After the quantization process the edges are further added to improve the text identification.


**Figure 1 : Book cover before and after**

## V. Conclusion

The presented algorithm gives an innovative idea of applying BFO the image processing problems like document color reduction without effecting the visual perception. The presented algorithm is robust & less time consuming.

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