A Novel Hybrid Color Image Quantization Using Different Model Techniqes

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***Abstract*—Image quantization plays important role in representing true color of images by reducing the number of colors. Existing different methods may change image color structure and distribution. Thus, researchers are always finding alternative strategies for color quantization.**

In this present work image quantization algorithm is developed using HSI based on Bacteria Foraging Optimization. Further algorithm was Implement and validation with the already existed quantization colors model like, LAB and VBA colors models. Further comparative analysis of results of the proposed algorithm with existing techniques was done in the terms of colors after quantization, Euclidean Distance, Lease Mean Sqaured Error, Average Difference and RMSE. It was observed that proposed algorithm gives good image quality as compared to techniques.

Keywords— Color reduction, BFO, HIS color model, LAB & VBA color model ,Euclidean distance, Swarm intelligence, RMSE and Lease Mean Squared Error.

I. Introduction

Swarm intelligence has become a research interest to many research scientists of related fields in recent years. Bonabeau has defined the swarm intelligence as "any attempt to design algorithms or distributed problem-solving devices inspired by the collective behaviour of social insect colonies and other animal societies". Bonabeau et al. focused their viewpoint on social insects alone such as termites, bees, wasps as well as other different ant species [1]. However, the term swarm is used in a general manner to refer to any restrained collection of interacting agents or individuals. The classical example of a swarm is bees swarming around their hive; nevertheless the metaphor can easily be extended to other systems with a similar architecture. An ant colony can be thought of as a swarm whose individual agents are ants. Similarly a flock of birds is a swarm of birds. An immune system is a swarm of cells and molecules as well as a crowd is a swarm of people. Particle Swarm Optimization (PSO) Algorithm models the social behaviour of bird flocking or fish schooling.

The minimal model of forage selection that leads to the emergence of collective intelligence of honey bee swarms consists of three essential components: food sources, employed foragers and unemployed foragers and the model defines two leading modes of the behaviour: the recruitment to a nectar source and the abandonment of a source. So, the main objective of color image quantization is to map the set of colors in the original color image to a much smaller set of colors in the quantized image. Colour is the way the HVS (the human visual system) measures a part of the electromagnetic spectrum, approximately between 300 and 830 nm. Because of certain properties of the HVS one is not able to see all of the possible combinations of the visible spectrum but tend to group various spectra into colours. A colour space is a notation by which we can specify colours, the human perception of the visible electromagnetic spectrum.

In the previous research works surveyed so far, it is found that color image has already been quantized using PSO (Particle Swarm Optimization) different colors models. Bacteria Foraging Optimization (BFO) with HSI is a burgeoning technique of Swarm Intelligence for evaluating the optimized results. This optimization technique has been used only with few color spaces for color image quantization.

2. METHODOLOGY:

Color image quantization can be viewed as stepwise process in figure 1

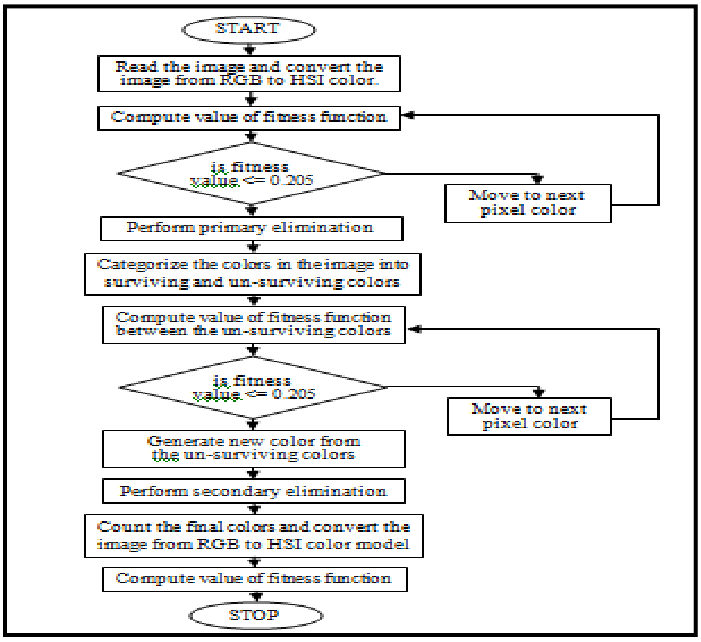


Figure 1: Flowchart Work

3. RELATED WORK IN THE FIELD OF COLOR IMAGE QUANTIZATION

Many Techniques for color image quantization have been proposed in the literature. Some of them are discussed below The popularity algorithm generates the color map by finding the densest regions in color distribution of the image [10]. Hence, it simply selects the K colors with the highest occurrences from the image histogram and uses these K colors as the representative colors in the color map [11]. The median-cut algorithm uses the splitting approach to repeatedly divide the color space into two smaller individual cells containing an approximately equal number of pixels at each step. The orientation of cutting plane is normal to one of the coordinate axes with a largest range of image pixels and passes through the median point of the color distribution projected on this axis: At the end of this operation, the final cells contain an equal number of image pixels [5]. The variance-based algorithm is schematically similar to the median cut algorithm, with an exception that, at each step, a cell for further partition is the cell with the largest weighted variances of color distribution. The cutting plane is chosen to be perpendicular to the coordinate axis where the expected variance is most reduced. The octree algorithm relies on a tree structure. The root of the octree is an entire cell and at each level of the tree each node has eight successors [6]. The maximum depth of the octree is 8. At level 8, the terminal nodes of the octree are individual colors. The octree is then reduced by a process that replaces the terminal node with their parent node containing an average of the color in the terminal node. This process continues until the number of terminal nodes is equal K. Finally, the K terminal nodes are chosen as the representative colors in the color map [7][8].

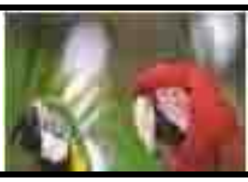
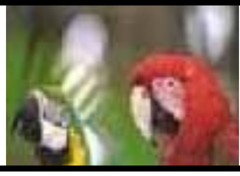
Quantization Technique	Quantization using HSI based on Bacteria Foraging Optimization	BFO-CIQ using LAB	VBA
Original Image			
Image After Quantization			
Colors	8806		
Colors after Quantization	5503	5930	5503
Euclidean Distance	226.57	226.80	226.82
Lease Mean Sqaured Error	0.0076	0.0336	0.0267
Average Difference	0.0890	0.0962	0.2344
RMSE	0.0026	0.0210	0.0129

Table 1: Computational Result Analysis of different

4.. RESULTS AND DISCUSSIONS

In the proposed work, the results which have been achieved using proposed BFO for color quantization using HSI color model are compared with the already existed technique like, Variance Based Algorithm (VBA) and BFO for color quantization using LAB color model. The comparison is made using Euclidean Distance, Least Mean square error (LMSE), Average Difference and RMSE. Table 1 shows comparison of three techniques.

The values for the proposed BFO algorithm for color image quantization based on Euclidean Distance, LMSE, Average Difference and RMSE are less than the existing VBA and BFO-CIQ using LAB color model. These values show that the performance of proposed algorithm is better than the technique based on VBA and BFO-CIQ using LAB color mo

5. FUTURE WORK

The present work is based on Bacteria Foraging Optimization and has results in a significant improvement in the image quantization. The results presented are preliminary and there is a lot of scope for improvement to develop this algorithm. The results presented in the previous chapter conclude that the image quantization based on Bacteria foraging optimization gives better results than the technique based on VBA and BFO-CIQ using LAB color model. While implementing the color image quantization using Bacteria Foraging Optimization we have considered the HSI color model as compared to RGB color model. Although RGB color space is the most common color representation today, it has some drawbacks which make researchers look to the other color spaces in computer vision tasks. One drawback is high correlation between R, G and B components caused by aliasing of spectral sensitivity curves of three types of cones. Further, RGB components does not correspond the way human perceives and describes colors. For example, it is hard to say, solely looking at the color, how much of R, G and B components comprise the color. In cylindrical color spaces like HSI color is represented by hue, saturation and intensity (value, brightness). These components are closer to the way human perceives and describes color. Hue, saturation and intensity can also reveal image features that are not so obvious in RGB color space. Also, in HSI color space chromatic (hue and saturation) and achromatic (intensity) information are separated.

Quantization techniques

Different images but in this only one is shown which is of .bmp, .jpg, .png format including the phantom images and the images have shown very good results of quantization as compared to the quantization based on VBA and BFO-CIQ using LAB color model. This validates the proposed algorithm and it gives optimized results when implemented on the phantom images. Image quantization has a limited application area because during image quantization some of the contents in the image are lost. But Image quantization can be applied in lossy compression techniques. It is suitable for mobile and hand-held devices where memory is usually small. It is suitable for low-cost color display and printing devices where only a small number of colors can be displayed or printed simultaneously. It can be used to send images over the internet because the quantized image requires less network bandwidth. Image quantization is also applicable in the application stegnography. Image quantization is highly suitable to hide some important information or to hide messages in such a way that no one, apart from the sender and intended recipient, suspects the existence of the message. Image quantization is implemented using "Bacteria Foraging Optimization" and the "Variance Based Algorithm (VBA)" and the results are compared for both the techniques based on Least Mean Square Error (LMSE), Euclidean distance, Average Difference and Normalized Absolute Error. The proposed technique results in significant memory save and the low bandwidth requirements which results in saving time.

The future scope of this work is:

Each pixel in the image is considered while implementing the proposed work and for large images the proposed algorithm may become slow. So the further research may focus on some modification of the proposed algorithm to enhance the speed.

Further research work may focus on developing some new algorithms related to bacterial foraging to decrease the computational cost and time during global optimization.

The fitness function taken in present work is Euclidean Distance (HSI Color Difference), future research may try to apply BFO for image quantization by considering some other distance metrics.

The threshold value in the proposed algorithm is considered as 0.205, some modifications of the threshold value can be undertaken to enhance the performance of the said algorithm in the field of image quantization and image processing.

The color space taken in the present work is HSI color space, future research may try to apply the BFO-CIQ to other color spaces.

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