Proposed Method for Color Image Quantization: Honey Bee

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Abstract— Honey Bee Optimization a nature-inspired optimization has drawn the attention of researchers because of its efficiency in solving real-world optimization problems arising in several application domains. Color image quantization is an important process of representing true color images using a small number of colors. Existing color reduction techniques tend to alter image color structure and distribution. Thus the researchers are always finding alternative strategies for color quantization. In color spaces like CMYK, A wide range of colors can be created by the primary colors of pigment (cyan (C), magenta (M), yellow (Y), and black (K)). . The objective of this research work is to design an algorithm for Image Quantization using CMYK color space based on Honey Bee Optimization. To implement and test the proposed algorithm. To compare the designed algorithm with other quantization techniques. The conducted experiments indicate that proposed algorithm generally results in a significant improvement of image quality compared to other well-known approaches.

***Keywords*— Color reduction, Honey Bee Optimization, CMYK color space, Euclidean distance, Swarm intelligence.**

1. INTRODUCTION

Honey Bee Optimization are used as a source of engineering applications and computational model. A few models have been developed to Honey Bee Optimization behaviors and been applied for solving practical problems Artificial Bee Colony (ABC) is a relatively new member of swarm intelligence. ABC tries to model natural behaviour of real honey bees in food foraging. Honey bees use several mechanisms like waggle dance to optimally locate food sources and to search new ones. This makes them a good candidate for developing new intelligent search algorithms branch of nature inspired algorithms which are called as swarm intelligence is focused on insect behaviour in order to develop some meta-heuristics which can mimic insect's problem solution abilities.

A. Honey BEE Optimization

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 behavior the recruitment to a nectar source and the abandonment of a source.

1) ***Food Sources*:** The value of a food source depends on many factors such as its proximity to the nest, its richness or concentration of its energy, and the ease of extracting this energy. For the sake of simplicity, the "profitability" of a food source can be represented with a single quantity.

2) ***Employed foragers*:** They are associated with a particular food source which they are currently exploiting or are "employed" at. They carry with them information about this particular source, its distance and direction from the nest, the profitability of the source and share this information with a certain probability.

3) ***Unemployed foragers*:** They are continually at look out for a food source to exploit. There are two types of unemployed foragers: Scouts, searching the environment surrounding the nest for new food sources and Onlookers waiting in the nest and establishing a food source through the information shared by employed foragers. The mean number of scouts averaged over conditions is about 5-10%.The exchange of information among bees is the most important occurrence in the formation of the collective knowledge. While examining the entire hive it is possible to distinguish between some parts that commonly exist in all hives. The most important part of the hive with respect to exchanging information is the dancing area. Communication among bees related to the quality of food sources takes place in the dancing area. This dance is called a waggle dance. Since information about all the current rich sources is available to an onlooker on the dance floor, probably she can watch numerous dances and decides to employ herself at the most profitable source. There is a greater probability of onlookers choosing more profitable sources since more information is circulated about the more profitable sources. Employed foragers share their information with a probability proportional to the profitability of the food source, and the sharing of this information through waggle dancing is longer in duration. Hence, the recruitment is proportional to the profitability of the food source.

4) ***Bees in Nature:*** Bees **communicate** through this waggle dance which contains the following information, as shown in fig. 1.

- The **direction** of flower patches (angle between the sun and the patch)
- The **distance** from the hive (duration of the dance)
- The **quality** of food (frequency of the dance)

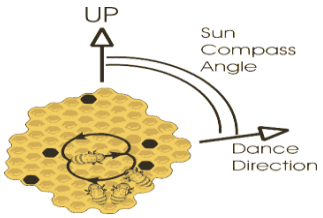

Fig 1. Nature of bee's

These information helps the colony to send its bees precisely. Follower bees go after the dancer bee to the patch to gather food efficiently and quickly.

5) ***Experienced foragers*****:** These types of forager use their historical memories for the location and quality of food sources.It can be an inspector which controls the recent status of food source already discovered.It can be a reactivated forager by using the information from waggle dance.

- It tries to explore the same food source discovered by itself if there are some other bees confirm the quality of same food source (RF in Figure 1).
- It can be scout bee to search new patches if the whole food source is exhausted (ES in Figure 1).
- It can be a recruit bee which is searching a new food source declared in dancing area by another employed bee (ER in Figure 1).

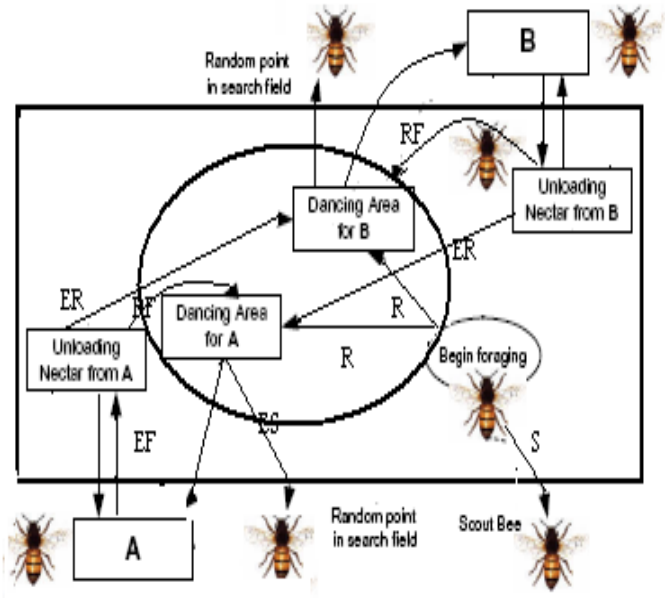

Fig.2 The behaviour of honey bee foraging for nectar

B. Color Image Quantization

Color image quantization is an important process of representing true color images using a small number of colors. With a good color quantization algorithm and some lossy compression algorithms (such as ones used by .jpg formats), the same image quality (at least visually) can mostly be restored from a much smaller file. The color image quantization can reduce not only storage requirement but also the transfer time of the image. These reductions are quite important for multimedia applications in the Internet where the communication delays are very concerned.

Moreover, the color image quantization can be implemented as a preprocessing step for image compression algorithm.

The color image quantization algorithm typically consists of four phases.

- The first phase, called sampling the original image, computes the image histogram for color statistics i.e. a number of distinct colors and their frequencies.
- The second phase, called color map design, chooses the best possible set of representative colors from the color statistics.
- The third phase, called pixel mapping, maps each color in the original image to a representative color in the color map.
- The fourth phase, called image quantizing, redraws the image by replacing the original color in every pixel with a representative color. applied.

Color quantization is important because quantized image can be used in many applications including the following.

- It can be used 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.
- Most graphics hardware use color lookup tables with a limited number of colors

C. CMYK Color Model

CMYK is a scheme for combining primary pigments. The C stands for cyan (aqua), M stands for magenta (pink), Y for yellow, and K for Key. The key color in today's printing world is black but it has not always been. During the early days of printing, the colors used for Key have been brown, blue, or black -- whichever was the cheapest ink to acquire at any given time. The CMYK pigment model works like an "upside-down" version of the RGB (red, green, and blue) color model. Many paint and draw programs can make use of either the RGB or the CMYK model. The RGB scheme is used mainly for computer displays, while the CMYK model is used for printed color illustrations (hard copy), as shown in fig. 3.

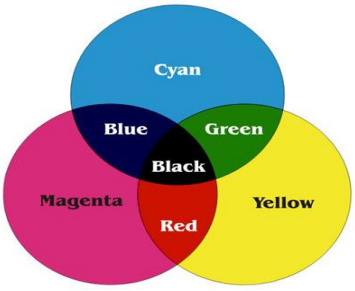

Fig.3 CMYK color model

1) *Euclidean Distance*: A central problem in image recognition and computer vision is determining the distance between images. Considerable efforts have been made to define image distances that provide intuitively reasonable results. Among all the image metrics, Euclidean distance is the most commonly used due to its simplicity. The key advantages of this metric are:

a) Relative insensitivity to small perturbation (deformation);
b) Simplicity of computation;
c) It can be efficiently embedded in most of the powerful image recognition techniques.

II. 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. 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.

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.

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. 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.

III. DESIGN

Step 1: Design an algorithm for color image quantization of CMYK images by mimicking the behavior of Honey Bee as in HBOA.
Step 2: Validate the proposed algorithm by running on various types of images.
Step 3: Compare the results of previous work with the results generated in step 2.

The performance matrix comprise of following image quality measures:

A. Mean Square Error (MSE)

The large value of MSE means that image is poor quality.

B. Peak Signal to Noise Ratio (PSNR)

The small value of Peak Signal to Noise Ratio (PSNR) means that image is poor quality.

C. Maximum Difference (MD)

The large value of Maximum Difference (MD) means that image is poor quality.

III. PROPOSED ALGORITHM

The main steps of the algorithm are given below:
1) Send the scouts onto the initial food sources
2) REPEAT
3) Send the employed bees onto the food sources and determine their nectar amounts
4) Calculate the probability value of the sources with which they are preferred by the onlooker bees
5) Stop the exploitation process of the sources abandoned by the bees
6) Send the scouts into the search area for discovering new food sources, randomly
7) Memorize the best food source found so far
8) UNTIL (requirements are met)

IV. RESULTS AND DISCUSSIONS

Our objective is to use the proposed Honey Bee Optimization algorithm for Color image quantization using CMYK color model. Honey Bee Optimization using CMYK color model has been applying the algorithm on images as well as phantom images by varying the size of image and number of bees. Phantom images are also called as computer generated images. This category collects images that are scans, screen captures, photos, and/or illustrations of the Phantom and related characters and intellectual properties.The following figures show input image with original number of colors and resulting image with quantized colors.

V. FUTURE WORK

In the proposed algorithm we have to consider each pixel 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 Honey Bee Optimization to decrease the computational cost and time during global optimization. Future research may try to apply the Honey Bee Optimization algorithm for color image quantization to other color spaces.

REFERENCES

[1] E. Bonabeau, M. Dorigo, G. Theraulaz, "Swarm Intelligence: From Natural to Artificial Systems", New York, NY: Oxford University Press, 1999.
[2] L.N. De Castro, F.J. Von Zuben, "Artificial Immune Systems. Part I. Basic Theory And Applications", Technical Report No. Rt Dca 01/99, Feec/Unicamp, Brazil, 1999.
[3] J. Vesterstrøm, J. Riget, Particle Swarms Extensions for improved local, multi-modal, and dynamic search in numerical optimization, MSc.Thesis, May 2002
[4] J. Kennedy, R. C. Eberhart, "Particle swarm optimization", In Proceedings of the 1995 IEEE International Conference on Neural Networks", Vol. 4, pp. 1942–1948, 1995.
[5] V. Tereshko, "Reaction-diffusion model of a honeybee colony's foraging behaviour, M. Schoenauer, et al, Eds., Parallel Problem Solving from Nature VI", Lecture Notes in

Computer Science, vol. 1917, Springer-Verlag: Berlin, p. 807-816, 2000.

[6] T. D. Seeley, The Wisdom of the Hive (Harvard University Press, Cambridge, MA, 1995).

[7] V. Tereshko, A. Loengarov, "Collective Decision-Making in Honey Bee Foraging Dynamics", Computing and Information Systems Journal, ISSN 1352-9404, vol. 9, No 3, October 2005.

[8] T. D. Seeley, Visscher P.K., "Assessing the benefits of cooperation in honeybee foraging: search costs, forage quality, and competitive ability", Behav. Ecol. Sociobiol., 22: 229-237, 1988.

[9] Freisleben B, Schrader A, "**An evolutionary approach to color image quantization"**, Proceedings of IEEE International Conference on Evolutionary Computation, 459-464, 1997.

[10] M. G. Omran, A. P. Engelbrecht, and A. Salman, **"A Color Image Quantization Algorithm Based on Particle Swarm Optimization,"** Journal of Informatica, Vol.29, No.3, pp. 261-269, 2005.

[11]. Kaur Rajinder; Girdhar Akshay; Gupta Surbhi, "**Color Image Quantization based on Bacteria Foraging Optimization",** International Journal of Computer Applications, vol. 25, issue 7, pp. 33-42, July 2011.

[12] Kumar Dharminder , Chopra Vinay , "Image Quantization Using Hsi Based On Bacteria Foraging Optimization", International Journal of Information Technology and Knowledge Management July-December 2012, Volume 5, No. 2, pp. 335-343.