Bacteria Foraging Based Image Segmentation

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Abstract: *Image segmentation is very essential and critical part of image processing and image analysis. The image segmentation has been and still is relevant research area due to its wide spread applications. The literature on color image segmentation is very wide and many important core issues related to it. Many methods are available for image segmentation but still lack of reliable way for image segmentation. The goal of this paper is to provide the best algorithm for image segmentation. On the basis of issues, objectives, usage we can present a color image segmentation approach.*

Keywords: color image segmentation, Bacteria foraging optimization, image quantization.

I. Introduction

Image segmentation is the process of dividing the image into different regions. The goal of the image segmentation is to find the certain objects of interest which are depicted in the image. It is a computer vision problem and there are wide variety of approaches are used for image segmentation.

Different types of approaches are suited to different types of images. These approaches can be categorized as follows:-

1. Histogram thresholding: It assumes that images are made up of regions with different gray or color ranges, and than separates it into a number of peaks, each corresponding to one region.

2. Edge-based approaches: It uses edge detection operators. If regions are not connected than edges need to be joined.

3. Region-based approaches: It based on similarity of regional image data. Approaches used in this are: Thresholding, Region growing, Clustering Splitting and merging, hybrid which includes both edges and regions.

II. Bacteria Foraging Optimization

Bacterial Foraging Optimization (BFO) is a population-based numerical optimization algorithm. Until date, BFO has been applied successfully to some engineering problems, such as optimal control [3], harmonic estimation [4], transmission loss reduction [5] and machine learning [6].

A. Algorithm

In BFO, the motile bacteria such as Escherichia coli propel themselves by rotating their flagella. They rotate their flagella counter clockwise to move forward rotate also called as “swimming” (or “runs”). But to move the bacteria in random direction i.e. “tumble” they rotate their flagella clockwise and then swims again. Tumbling just changes the direction of movement of bacteria. The bacteria first of all tumble in random direction to search for food. As the bacteria found the food in a particular direction it then swims toward the food in that direction. An alternation between “swim” and “tumble” enables the bacteria to search for food in random directions [2].

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) **Chemotaxis**

In the original BFO, a unit walk of the bacteria with random direction represents a “tumble” and a unit walk with the same direction in the last step indicates a “run.”

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 remains constant [2].

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].

III. Literature review

Research on color image segmentation has been privously done using different approches and algorithms.Constructing hierarchical classifiers using cluster analysis ,this concept is described by Dmitriy Fradkin, Ilya Muchnik in 2004 also improvements in each of these approaches and suggests new methods.For constructing features to improve Classification accuracy new method is also suggested. For Improving Classification Accuracy of Multi- Class SVM K-Means Clustering is studied. [7]

Frank Y. Shih, Shouxian Cheng presented an automatic seeded region growing algorithm for color image segmentation. In this paper first of all, the input RGB color image is transformed into YCbCr color space.Than, automatically selected the initial seeds .After that, in each region corresponds to a seed, the color image is segmented into regions.And finally, to merge similar, and region-merging is used. It has been presented as an efficient segmentation algorithm for developing the strategies to avoid order dependencies and for segmentated the color images with automatic seetd selection [8].

In this, a novel level set method for color image segmentation. **Using Binary Level-set Partitioning Approach is i**ntroduced in 2009 by M. Sujaritha and S. Annadurai. It is based on the Binary Space Partitioning (BSP) tree technique developed by Pei and Cheng and the multiphase level-set framework developed by T. Chan and L. Vese. It presents a new variational formulation by using binary quaternion moment that divides the image region in a binary fashion, preserving thresholding technique for geometric contours. It eliminates the need of the re-initialization, calculation of number of regions procedure which is very costly. [9]

Jun Zhang, Qieshi Zhang and Jinglu Hu in 2009 introduced the concept of new color thresholding method for detecting and tracking multiple faces in video sequences.It intoduced the creating the color triangular from RGB color space and analyzing the characters of centriods region for color segmentation [10]

Khang Siang Tan, Nor Ashidi Mat Isa in 2010 presents a novel histogram thresholding – fuzzy C-means hybrid (HTFCM) approach that could find different application in pattern recognition as well as in computer vision to obtain all possible uniform regions in the color image [11].

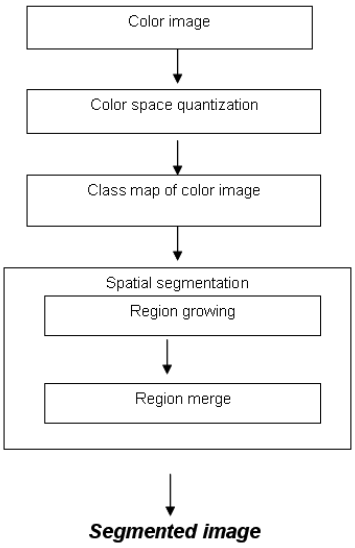
In 2011 V M Viswanatha, Nagaraj B Patil, Dr. Sanjay Pande M B proposed a method for segmentation of color regions in images. It can be consist of two steps namely color quantization and segmentation. But, it has does not handle pictures where there is no clear visual boundary and where smooth transition takes place between adjacent regions [12].

A novel colour segmentation algorithm can work in various illumination circumstances. This colour segmentation algorithm proposed by Chiunhsiun Lin, Chin-Hung Su, Hsuan Shu Huang, and Kuo-Ching Fan .and without the need of color space transformation it operates directly on RGB color space and to various illuminations conditions it is very robust. In extracting human skin color and examining the maturity evaluation of tomatoes, this proposed color segmentation algorithm is very effective [13].

IV. Proposed Algorithm

First of all, without degrading the color quality of an image colors in the image are quantized. To differentiate neighboring regions in the image few representing colors are extracted. Normally 8-18 colors are needed in the images. After the process of quantization, labels are assigned to quantized colors know as color class labels. A color class is the set of image pixels that are quantized to the same color and the pixel colors that are replaced by it. The new quantized image of labels is called a class-map. After color quantization, the necessary color information for segmentation process is extracted and stored in a simple class-map. From a small subset of the color classes each image contains pixels and each class is distributed in a few image regions. This is called region growing. After region growing, distance between the two adjacent regions is computed and region with smallest distance is merged. This is called region merge. In this way, after computing all the regions segmentations are obtained and we can obtain objects of interest.

Steps in algorithm



The Bacterial Foraging Optimization algorithm is used to segment an image in an efficient way. This system consists of three principal mechanisms chemo taxis, reproduction, and elimination-dispersal. We start with chemo taxis process where every pixel tumbles to check that to which segment it belongs. We start with group of four neighboring pixels and assumed that these pixels belong to same segment. For the checking fitness, every time central pixel of first group is checked against the central pixel of second group. The L*a*b values of both the pixels are considered for computed the CMC distance between the pixels. If value computed is less than the threshold value then they belong to the same segment and

their neighboring remaining 8 pixels also do belong to the same segment. If the value computed is greater then threshold then reproduction takes place in which we divide the first group of pixels in two, make two pixel heads and check their fitness. If again value is less than threshold, then they belongs to the same segment otherwise elimination & dispersal takes place. The different pixel group will be eliminated from this segment & is dispersed to the next segment. This is repeated for the entire image.

V. Results of proposed technique

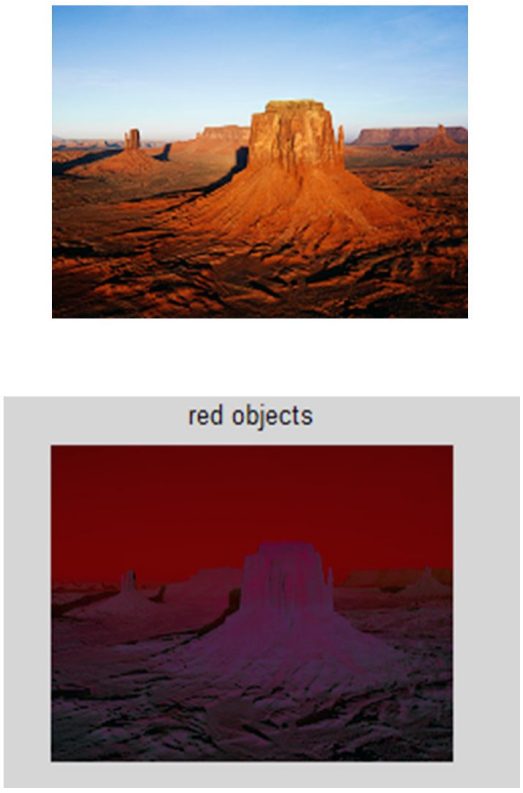


Figure 1. Original image and egmented red image

VI. Conclusion

The proposed algorithm follows the biological actions of bacteria to optimize the segmentation process. The processes of chemo taxis, reproduction and elimination are replicated. The presented algorithm is fast and robust.

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