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A SURVEY ON DIFFERENT COLOR IMAGE SEGMENTATION TECHNIQUES USING MULTILEVEL THRESHOLDING

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ABSTRACT: Image segmentation is a crucial and challenging problem in image processing and often a basic step for high level analysis. The intent of image segmentation is to divide an image into different classes based on features, such as color, intensity or histogram, where each pixel in the image should go to one class and only one class. According to the thresholds the segmented results whether or not consistent to the image is also an issue should be considered. In this paper, comparison of different models for color image segmentation using Image processing is provided. This paper expresses different techniques, its advantages and disadvantages and proposes a new method for color image segmentation using multilevel thresholding. This paper proposes multilevel thresholding for color image segmentation using Cooperative Bacterial Foraging Algorithm (CBFA), which mixed cell-to-cell communication, bacterial chemo taxis, and an adaptive foraging mechanism to enhance original Bacterial Foraging Algorithm (BFA) which is motivated by the social foraging behavior of Escherichia coli (E. Coli Bacteria).

I. INTRODUCTION

Image segmentation is a technique to divide an image into multiple segments and extract the meaningful objects, which is the difficult step in image processing and image analysis. The aim of dividing an image into different region is to make an image more meaningful and easier to analyze and understand. Here and now image segmentation has been universally used in many practical applications such as medical imaging, remote sensing, Optical Character Recognition (OCR) and object detection.

The intention of segmentation is to clarify the image and change the representation of an image into something that is more important, useful and easier to study or examine. Image segmentation is mostly used to detect objects and background in images. More precisely, image segmentation is the mechanism of assigning a label to each pixel in an image such that pixels with the same tag share certain visual characteristics. Image segmentation is an important signal processing tool that is universally occupied in many applications including medical imaging, remote sensing, Optical Character Recognition (OCR) and object detection.

The basic method of image segmentation is thresholding. From a grayscale image, thresholding can be used to generate binary images. The idea use in this method is to select the threshold value. Lots of conventional methods are used in engineering including the k-means clustering, Otsu's method that uses maximum entropy and maximum variance method. The main intent is that, the proposed segmentation can be work effectively for image, based on automatic thresholding and color model based image segmentation. Image segmentation is considered as an important basic operation for interpretation of acquired images and for meaningful study or analysis of the images. It is a classic inverse problem which consists of achieving a compact region-based description of the image scene by decomposing it into meaningful or spatially coherent regions sharing similar attributes.

One of the key problems in color image analysis is that of segmentation. Image segmentation is a technique and process which divide the image into different feature of region and extract out the interested target. Properties like intensity, texture, depth, gray-level, color help to recognize similar regions; such properties are used to form groups of regions having a similar meaning. Segmentation is a valuable tool in several fields including industry, health care, pattern recognition, image processing, content based image, remote sensing, traffic image, videos and computer vision. After complete study of different methods here we will projected the new thresholding mechanism. To achieve thresholding, global and local analysis, and assessment of the color image data will be explored. Main aim of our work is to develop a segmentation mechanism for color images based on multilevel thresholding. To accomplish the main goal of the work focus is on automatic thresholding by representing image into completely different color models [Yuan and Chen, 2009].

II. LITERATURE SURVEY

[Hedley and Yan, 1992][1] Has been applied with success the Sobel operator to any of the 3 planes within the RGB house and therefore the gradients were summed to get the resultant edges. They work out the Sobel operator on every of the 3 RGB planes and so add the results. For map processing application where colors and object square measure well outline this appears to be adequate technique for edge detection. However, for additional complicated color pictures wherever it's necessary to capture higher the correlation between the planes, this approach would most likely be inadequate.

[Carron et. al., 1994][2] Applied the Sobel operator to every element of the HSI area and therefore the individual results were combined employing a trade-off parameter between hue and intensity. The remarkable feature of this trade-off parameter was its dependence on the extent saturation. The results of this combination are not convincing given the test images used (there are solely little differences between results where hue information is used as compared to those where it is not). Color image scenes containing shadows might need provided an improved indication of the capabilities of mixing the data contained inside the individual HSI planes.

[Liu and rule, 1994] prompt image segmentation classification techniques for image segmentation into 3 categories: histogram-based, physically-based, and neighborhood-based strategies. Histogram-based technique generally performs some kind of clustering in a pre-defined measurement space, e.g. RGB. The implementation proposed by neighborhood-based mechanism considers small local neighborhoods in an image and use this info to compensation in decision-making. The [Deng and Majunath, 1999] paper proposes a system that falls generally into this class. The third sort of methodologies uses the real material science of light and the shading development procedure to perform division, and the strategy proposed by [Healey et.al., 1992] in is a prime illustration.by [Healey et.al., 1992] in is a prime example.

[Eli A. Murat Tekalpa, Gozde Bozdagic 1997] proposed a new method for combined color image segmentation and edge linking. The image is first segmented based on color information only. The segmentation map is modeled by a Gibbs random field, to ensure formation of spatially contiguous regions. Next, spatial edge locations are determined using the magnitude of the gradient of the 3-channel image vector field. Finally, regions in the segmentation map are split and merged by a region-labeling procedure to enforce their consistency with the edge map. The boundaries of the final segmentation map constitute a linked edge map. Experimental results are reported. The color segmentation module generates contiguous regions by the virtue of GRF modeling of the segmentation field. Regions are later merged by one of two region labeling algorithms to obtain the desired results. The merging criterion favors combining two regions if there is no spatial edge between the region boundaries. Despite the fact that both region merging algorithms (Algorithms A and B) provided more accurate segmentations when compared with the basic GRF approach, our experiments indicate that Algorithm B provides a more meaningful segmentation than Algorithm A, and reaches the final solution at a quicker rate.

[S. Dasgupta, S. Das, A. Abraham, A. Biswas 2009][16] Bacterial Foraging Optimization Algorithm (BFOA) has been widely accepted as a global optimization algorithm of current interest for distributed optimization and control. BFOA is inspired by the social foraging behavior of Escherichia coli. BFOA has already drawn the attention of researchers because of its efficiency in solving real-world optimization problems arising in several application domains. The underlying biology behind the foraging strategy of E.coli is emulated in an extraordinary manner and used as a simple optimization algorithm. This chapter starts with a lucid outline of the classical BFOA. It then analyses the dynamics of the simulated chemotaxis step in BFOA with the help of a simple mathematical model. Taking a cue from the analysis, it presents a new adaptive variant of BFOA, where the chemotactic step size is adjusted on the run according to the current fitness of a virtual bacterium. Nest, an analysis of the dynamics of reproduction operator in BFOA is also discussed. The chapter discusses the hybridization of BFOA with other optimization techniques and also provides an account of most of the significant applications of BFOA until date.

[Harrabi and Braiek, 2012**]** presented a new color image segmentation technique, based on multilevel threshold and data fusion techniques which aim at combining different data sources associated to the same color image in order to increase the information quality and to get a more reliable and accurate segmentation effect. The projected segmentation approach is conceptually different and explores a novel strategy. In fact, in its place of considering only one image for every application, the method consists in combining many realizations of the identical image, together, in categorize to increase the information quality and to get an best segmented image. They used an optimal multi-level thresholding is based on the two-stage Otsu optimization approach and The notion of mass functions, in the Dempster-Shafer (DS) evidence theory technology, is linked to the Gaussian distribution, and the final segmentation is realized, on an input image, that is expressed in different color spaces.

[Rafika HARRABI and Ezzedine BEN BRAIEK 2014][14] Propose a new color image segmentation method based on a multilevel thresholding algorithm and data fusion techniques. We have revised the Otsu method for selecting optimal threshold values for both unimodal and bimodal distributions, and tested the performance of the new automatic thresholding method called the TSMO (Two-Stage Multi-level Thresholding) on the color images segmentation. This algorithm is iterative and outperforms Otsu's method by greatly reducing the iterations required for computing the between-class variance in an image. For segmentation, we proceed in two steps. In the first step, we begin by identifying the optimal threshold of the tristimuli (R, G and B). In the second step, segmentation results for the three color components are integrated through the fusion rule, in order to get a final reliable and accurate segmentation result. Experimental segmentation results on medical and textured color images demonstrate the value of combing the thresholding technique and fusion rule for color image segmentation. The obtained results show the robustness of the proposed method.

In this paper, they proposed a new method to color image segmentation based on multi-level thresholding technique and data fusion. In the first phase, uniform regions are identified in each primitive color via a thresholding operation. Then, the combination rule is applied to fuse the three primitive colors. Instead of considering an elaborate and better designed segmentation model of biomedical and textured images, our technique rather explores the possible alternative of combining two segmentation techniques in order to get a good consistency segmentation results. The results obtained demonstrated the significant improved performance in segmentation. The proposed method can be useful for color image segmentation.

[Lifang He and Songwei Huang 2016] [10] The thresholding process finds the proper threshold values by optimizing a criterion, which can be considered as a constrained optimization problem. The computation time of traditional thresholding techniques will increase dramatically for multilevel thresholding. To greatly overcome this problem, swarm intelligence algorithm is widely used to search optimal thresholds. In this paper, an Improved Glowworm Swarm Optimization (IGSO) algorithm has been presented to find the optimal multilevel thresholds of color image based on the between-class variance and Minimum Cross Entropy (MCE). The proposed methods are examined on standard set of color test images by using various numbers of threshold values. The results are then compared with those of basic glowworm swarm optimization, Adaptive Particle Swarm Optimization (APSO), and Self-Adaptive Differential Evolution (SADE).The simulation results show that the proposed method can find the optimal thresholds accurately and efficiently and is an effective multilevel thresholding method for color image segmentation.

III. PROPOSED SYSTEM DESIGN

Here we proposes multilevel thresholding for color image segmentation using Cooperative Bacterial Foraging Algorithm (CBFA), to extend original Bacterial Foraging Algorithm (BFA) here we combined cell-to-cell communication, bacterial chemo taxis, and an adaptive foraging mechanism. The proposed algorithm can gives us a higher quality more useful segmentation and reduce the CPU processing time, which is demonstrated by comparing CBFA with other algorithm. In this paper, the novel Cooperative Bacterial Foraging Algorithm is applied to find the optimal threshold values by applying two manipulated steps, namely a cell-to-cell communication and a self-adaptive foraging strategy, which is extended by the classical BFA algorithm.

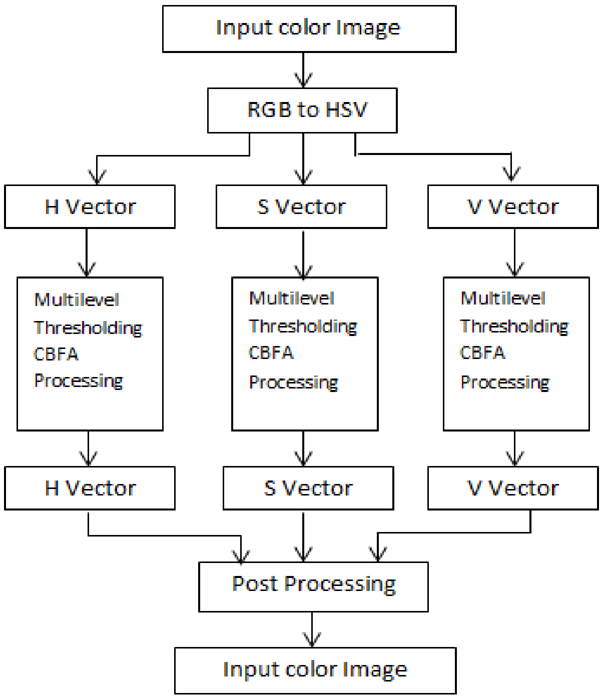

Fig:- Flow chart of proposed system

The proposed method which is tested that the Multi-level thresholding method based on Cooperative Bacterial Foraging Algorithm (CBFA) for color image segmentation is considered as an optimization problem is more stable and can execute faster than the other traditional algorithms.

1. COLOR IMAGE SEGMENTATION STEPS:-

A] The Conversion of Color Space**:**

Here RGB components of color image are converted to HSV vector. The conversion formula of RGB and HSV is shown in Eq. (1):

$$\begin{cases} S = 1 - \frac{3}{R+B+G}[\min(R,G,B)] \\ H = \cos^{-1}\left\{\frac{(R-G)+(R-B)}{2\sqrt{(R-G)^2+(R-B)(G-B)}}\right\} \\ R \neq B or R \neq G, \text{if} B > G, \quad H = (2\pi - H) \\ V = \frac{R+B+G}{3} \end{cases} \quad (1)$$

B] Multilevel Thresholding for Image Segmentation:

Get the corresponding segmentation image at the three vectors by using CBFA (Cooperative Bacterial Foraging Algorithm) for solving the problem for delineating multilevel threshold values, and which can overcome the disadvantages of the conventional Bacterial Forging Algorithm. Then Combine the three vector results, and then get the finial segmentation image.

Four Main Steps in CBFA:

- Chemotaxis-

  This procedure reenacts the development of an E.coli cell (Bacteria) through swimming and tumbling by means of flagella. Naturally an E.coli bacterium can move in two diverse ways. It can swim for a timeframe in a similar heading (direction) or it might tumble (by and large unique bearing), and exchange between these two methods of operation for the whole lifetime [16].
- Swarming-

  It is always wanted that the bacterium that has searched the most advantageous path of food should try to attract other bacteria so they reach the desired place more quickly. Swarming makes the bacteria bunch up into groups and hence move as a concentric pattern of groups with high bacterial density [16].

- Reproduction-

  The least healthy bacteria eventually die while each of the healthier bacteria (those yielding lower value of the objective function) asexually divided into 2 bacteria, which are then placed in the same location. This keeps the swarm size as it is [16].

- Elimination/ dispersal-

  Quick changes in the local environment where a bacterium community lives may occur due to various reasons e.g. a significant local rise of temperature may kill a group of bacteria that are currently in a region with a high concentration of nutrient gradients. Events can take place in such a fashion that all the bacteria in a region are killed or a collection is dispersed into a brand new location [16].

We are going to test the performance of the proposed algorithm with various standard test images and compared the result with traditional Bacterial Forging Algorithm. According to expected results the Cooperative Bacterial Foraging Algorithm is better than the other algorithms, not only in terms of computation efficiency, but also in solution quality and stability, specifically when the image segmentation of the multi-level is processed, the novel method for image segmentation based on the Cooperative Bacterial Foraging Algorithm can show better performance to find the better thresholds with more stability in less CPU processing time.

STD and CPU Processing Time:-

Standard deviation is a number used to tell how measurements for a group are spread out from the average (mean), or expected value. A low standard deviation means that most of the numbers are very close to the average. A high standard deviation means that the numbers are spread out. We are going compare BFA and CBFA according to STD (Standard Deviation) and CPU Processing Time. According to expected results CBFA is more stable than BFA because CBFA has less STD values. Also it required less CPU processing time for image to find multi-level thresholds in comparison to the BFA method.

The given image contains multiple features. The pixels of the image would be divided into n classes. In order to judge the stability of the algorithm, the standard deviation can be calculated by the STD, which is defined as:

$$STD = \sqrt{\sum_{i=1}^{n} \frac{(\sigma_i - \mu)^2}{N}}$$

Assuming $\boldsymbol{\sigma}_i$ as the best fitness value of the i^{th} run of the algorithm, μ as the average value of $\boldsymbol{\sigma}_i$ and N as the repeated times of each algorithm.

As compare to conventional Bacterial Foraging Algorithm such as BFA our proposed system is more useful to solve the problem, and this method is more suitable when the image segmentation of multilevel is under consideration, which can find the better thresholds in less CPU processing time with more stability.

IV. CONCLUSION

Here we have studied different types for image segmentation techniques, such as clustering, texture analysis, region based split and merging and histogram thresholding, etc. In all of them, the thresholding method is universally used for the segmentation of images due to its accuracy, simplicity, and robustness. Efficiently selecting the optimal threshold to group pixels within meaningful regions is the key of the thresholding method. Here we propose a new color image segmentation technique, based on multilevel thresholding which aim to use maximum number of features of the same color image in order get a more valuable and accurate segmented effect. Here useful conversion of color spaces is done. Here we perform feature (RGB component) extraction and color space conversion to HSV. Then we make use of the CBFA algorithm which determine threshold automatically from the picture content and perform the segmentation. According to expected results CBFA is more stable than BFA because CBFA has less STD values. Also it required less CPU processing time for image to find multi-level thresholds in comparison to the BFA method.

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