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Cuckoo Search Based Threshold Optimization for Initial Seed Selection in Seeded Region Growing

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ABSTRACT:
Image segmentation is the process of grouping pixels into different distinct regions. Seeded Region Growing (SRG) is a method of image segmentation, in which a pixel is used as seed pixel from which the regions start growing. Different seeds provide different results. In this paper we propose a threshold optimization technique using cuckoo search optimization algorithm for initial seed selection. The cuckoo search algorithm is used to find the optimal threshold values which maximize the fitness function.

KEYWORD: *Seeded Region Growing, Cuckoo Search, Optimization*

I. INTRODUCTION:

Image segmentation is the process of classification of pixels in an image into different clusters that exhibits similar features like color, intensity or texture. It should be noted that several general-purpose algorithms have been implemented for color image segmentation. A brief survey on image segmentation techniques is given in ref [1]. Segmentation process should be stopped when the region of interest is segmented from the input image. Image segmentation can be used in several applications and the region of interest may differ for different applications. Hence, none of the segmentation algorithm satisfy the global applications. Thus image segmentation is a challenging task for researchers. Image segmentation algorithms can be classified into four approaches namely: 1) Threshold-based 2) Boundary-based 3) Region –based 4) Hybrid-based techniques. Threshold-based techniques are based on the assumption that the neighboring pixels whose value lies below a certain range belong to same group[2]. Boundary-based techniques are based on the assumption that the pixels intensity change abruptly at the boundary between two regions [3,4]. Region-based techniques are based on the assumption that the neighboring pixels in the same region have similar features like grey-value, color-value or texture. Hybrid techniques integrate the results of both region based and boundary-based [5-7]. In region-based technique the performance of the segmented image mainly depends on the selected homogeneity criterion. Seeded Region Growing (SRG) technique is controlled by the set of initial seeds. Given the initial seeds, SRG tries to find the accurate segmentation of images into separate regions with the property that the neighboring pixels of a region meets exactly one of the seed. These initial seeds are the key point from which the regions start growing. Change in seed pixel will affect the final segmentation. Hence, selection of initial seed has a great impact on final segmentation. By optimizing the threshold values we can improve the accuracy of the segmented image. In this paper we propose an algorithm for initial seed selection which is optimized using cuckoo search algorithm.

Overview of the Algorithm: Fig:1 shows the general block diagram of our proposed algorithm. Initially the input color image is converted into grey scale image. Secondly, the histogram of the particular image is drawn. From the histogram thresholds are generated. From the generated threshold, using entropy as the fitness function optimal threshold is selected using cuckoo search algorithm for initial seed selection. Fig .2 shows the input image and the histogram of the gray scale image.

Threshold Optimization using Cuckoo Search: Optimization is a process of making something as fully perfect, effective or functional as possible. Optimization is restricted by the lack of full information about something and the lack of time to evaluate the full information. Hence optimization deals with finding best values of variables so that the values of a fitness function becomes optimum. This search starts with a random feasible solution, and then moves its neighborhood solution from its current position and accepts the new solution if and only if it improves the fitness function.

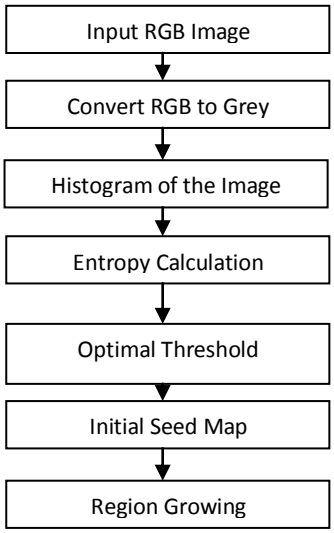

Fig 1: General Block Diagram

Fig 2: a) Input RGB Image b) Gray scale Image c) Histogram of the gray scale image

2.2 Cuckoo Search Algorithm: Cuckoos are brood parasite. They lay their eggs mostly in the nest of other host birds. If a host bird found that the egg in the nest is not their own, they will either destroy the eggs by throwing away or they will build a new nest elsewhere. Some cuckoo species can imitate the color and pattern of the eggs of the chosen nest. This mimicry will reduce the probability of cuckoo eggs being abandoned and therefore increases their re-productivity. Cuckoo search can be described by three generalized rule [8]: 1) Each cuckoo lays one egg at a time, and dump its egg in randomly chosen nest; 2) The best nests with high quality of eggs will carry over to the next generations; 3) The number of available host nests is fixed, and the egg laid by a cuckoo is discovered by the host bird with a probability pa = [0, 1]. In this case, the host bird can either throw the egg away or abandon the nest, and build a completely new nest. For an optimization problem the fitness is proportional to the value of objective function.

2.3 Implementation: This proposed method is based on the search of thresholds that optimizes the objective function such as entropy. Entropy based thresholding considers the histogram of the image as a probability distribution and selects an optimal threshold value that yields maximum entropy. A best entropy thresholded image contains more information. In seeded region growing the initial seeds selected should contain more information about a particular region. So pixel values greater than the optimized threshold are selected as the initial seeds. The entropy calculation as described by T.Pun [9] is summarized here:
Let $x_1, x_2, x_3, \ldots\ldots, x_n$ be the observed grey level and

$$p_i = \frac{x_i}{N}, \qquad \sum_{i=1}^{n} x_i = N \ , \qquad \text{I} = 1,2,3\ldots\ldots\text{N}$$

Where n is the grey level and N is the total number of pixels. The entropy is given as

$$H_n^{'} = -P_s ln P_s - (1 - P_s)\ln(1 - P_s)$$

Where,

$$P_s = \sum_{i=1}^{s} P_i \text{ and } 1 - P_s = \sum_{i=s+1}^{n} P_i$$

Finally,

$$\frac{H_n^{'}}{H_n} \leq f(s)$$

Where, $f(s) = \left[\frac{H_s}{H_n}\frac{lnP_s}{ln[\max(P_1,P_2,\ldots\ldots,P_n]} + (1+\frac{H_s}{H_n})\frac{\ln(1-P_s)}{ln[\max(P_{s+1},P_{s+2},\ldots\ldots,P_n]}\right]$ and $H_n = -\sum_{i=1}^{n} P_i lnP_i$

This function f(s)is taken as the fitness function. S is the threshold value which maximizes the fitness function f(s).To implement cuckoo search, the population of the host nest x_i = 1, 2, ……. , N is randomly initiated. From the population of the host nest, a cuckoo, say 'I' is randomly chosen and its fitness function F_i is evaluated. Choose a nest 'j' randomly and calculate its fitness function F_j. If $F_i > F_j$, replace j by the new solution 'I'. Thus a fraction of worst nest is abandoned as new ones are built. Keep the best solutions and find the current best. Thus the threshold for initial seed selection is optimized using cuckoo search and this optimized threshold is used for initial seed selection.

II. RESULTS AND DISCUSSION:

The performance of the proposed seed selection algorithm based on cuckoo search optimization technique is evaluated. Some experiments with test images from publically available Berkely dataset are presented to illustrate the key features of the proposed method.

Table 1: Optimal Threshold value and their fitness value

Input Image	Thresholds Generated	Optimal Threshold	Fitness value
	173	173	0.8448
	33		
	216		
	235		
	178		
	195		
	192		
	113		
	172		
	64		
	124	125	0.8398
	111		
	197		
	204		
	67		
	135		
	125		
	170		
	185		
	195		

Table: 1 shows the test image, number of thresholds generated and the optimal threshold values and the objective values achieved by the proposed method. Fig 3 and fig 4 shows the input image and the initial seed map for the optimal threshold.

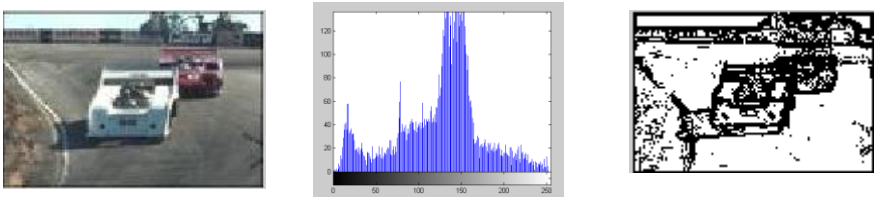

Fig 3: a) Input Image b) Histogram of gray scale image c) Initial Seed Map

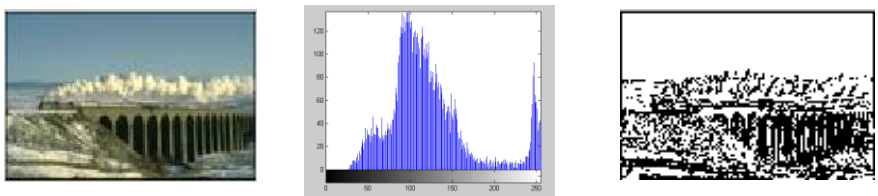

Fig 4: a) Input Image b) Histogram of gray scale image c) Initial Seed Map

III. CONCLUSION:

A seed selection algorithm using cuckoo search optimization is proposed in this paper. The population of the host nest is randomly initiated and from the population best threshold is chosen using the fitness function. This threshold is used as the optimal threshold for initial seed selection. A best entropy thresholded image contains more information. Hence, seeds generated using entropy thresholding will contain more information about a region and will provide better segmented image.

REFERENCES

[1] H. Cheng, X. Jiang, Y. Sun, and J. Wang, "Color image segmentation: Advances & prospects," Pattern Recognit., vol. 34, no. 12, pp.2259–2281, Dec. 2001.

[2] Y. W. Lim and S. U. Lee, "On the color image segmentation algorithm based on the thresholding and the fuzzy C-means technique,"
Pattern Recognit., vol. 23, no. 9, pp. 935–952, 1990.

[3] M. Kass, A. Witkin, and D. Terzopoulos, "Snakes: Active contour models," in Proc. 1st ICCV, 1987, pp. 259–267.

[4] P. L. Palmer, H. Dabis, and J. Kittler, "A performance measure for boundary detection algorithms," comput. Vis. Image Understand.,
vol. 63, pp. 476–494, 1996. [5] T. Pavlidis and Y. T. Liow, "Integrating region growing and edge detection," IEEE Trans. Pattern Anal. Machine Intell., vol. 12, pp. 225–233, 1990.

[6] J. Haddon and J. Boyce, "Image segmentation by unifying region and boundary information," IEEE Trans. Pattern Anal. Machine
Intell., vol. 12, pp. 929–948, 1990.

[7] C. Chu and J. K. Aggarwal, "The integration of image segmentation maps using region and edge information," IEEE Trans. Pattern
Anal. Machine Intell., vol. 15, pp. 1241–1252, 1993.

[8] Yang XS, Deb S (2009) Cuckoo search via Lévy flights, In: Proceeings of World Congress on Nature & biologically Inspired Computing (NaBIC 2009, India), 210-214.

[9] T.Pun, " A new method for gray-level picture thresholding using the entropy of the histogram", Signal processing 2(1980), 223-237.