Saliency Detection with Hybrid Artificial Bee Colony- Firefly Optimization Method

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ABSTRACT

Implementation of optimization algorithms in image processing is a quite common area of research. Detecting salient fields in images can be used for problems such as object recognition, image segmentation or video tracking problems. This case makes the determination of saliency an important factor in image processing. The algorithms developed for salient region detection are divided into two approaches as bottom-up and top-down. The bottom-up techniques determine salient regions according to the data, and the top-down techniques discover these regions by the learning of visual information of a certain object. This paper presents an optimization technique for bottom-up saliency detection algorithm based on Hybrid Artificial Bee Colony- Firefly algorithm.

KEYWORDS - *Saliency detection, Artificial bee colony algorithm, Firefly algorithm.*

1. INTRODUCTION

Visual saliency has increasingly become very popular topic in the field of computer vision. Detection of salient regions is so important for objects or events in the images can be estimated with the information obtained. The evolved applications of human visual system (HVS) for detecting salient regions can be represented in two main categories [1]: namely top-down and bottom-up. Top-down methods need to use pre-specified information to analyze and process saliency information. Bottom-up methods detect saliency using basic image characteristics such as colour, edge, texture, brightness, etc. In this paper, hybrid ABC-FA optimization by combining Artificial Bee Colony (ABC) Algorithm (Karaboga, 2005) and Firefly Algorithm (FA) (Yang, 2009) will be applied for the determination of the salient regions in the images. Our proposed approach could be classified in Bottom-up region detection methods.

The paper is organized as follows. The basic concepts of Artificial Bee Colony algorithm and Firefly optimization algorithm are defined in Section 2. In Section 3, proposed hybrid approach by combining Artificial Bee Colony (ABC) Algorithm and Firefly Algorithm (FA) is described in detail. Experimental results about detecting saliency are presented in Section 4. Finally, conclusions are presented in Section 5.

2. MATERIALS AND METHODS

Optimization is the process of finding the maximum or minimum intended target. In some cases, the search space can be very large, and testing all solutions may require more time than is acceptable. Heuristic optimization algorithms are based on intelligent predictions which lead to the discovery of new solutions. In this work, an optimization technique for bottom-up saliency detection algorithm based on Hybrid Artificial Bee Colony- Firefly algorithm.

2.1. Artificial Bee Colony Optimization Algorithm

Artificial Bee Colony (ABC) algorithm was developed by Karaboga (2005) is an optimization algorithm which is modelling the behaviour of foraging bees. In ABC algorithm, an artificial bee colony contains three type of bee. These are employed, onlooker and scout bees. Algorithm has

three control parameters which are the number of food sources (SN), the maximum cycle number and the value of limit.

2.2. Firefly Optimization Algorithm

Yang developed Firefly optimization algorithm (FA) (Yang, 2009) which is inspired by the brightness and movement directions of fireflies. Firefly algorithm is applied based on three principles. First, fireflies are considered as unisex and can affect each other without discrimination. Second, the attractiveness of fireflies is proportional to their brightness and the brightest fireflies attract them to the less bright ones. Last principle is that brightness is determined by the value which produces from the functions to be optimized.

2.3. Proposed Hybrid ABC-FA Saliency Detection Approach

In this hybrid method, individuals in the population can behave like bees and fireflies. The probabilities of solutions are evaluated according to their fitness values which are calculated by the concept of brightness in the FA algorithm and the search for a better quality resource in the ABC algorithm. In the pre-processing stage, we apply segmentation algorithm to the input image by using ABC-FA optimization technique. Then this technique is also used for generate a saliency map. The steps composing the algorithm are detailed in the following sections.

2.3.1. Pre-Processing

In our approach we used ABC-FA optimization technique for a multilevel thresholding step. Before saliency detection, each image must be segmented for the less complexity. Because pixel based identifying can be more difficult. Thus, pixel groups are generated by segmentation process according to their colour and location information. First, we split a colour input image into its three RGB channels. Multilevel thresholding is realized on each one by ABC- FA optimization technique. In this part, three optimal threshold values are found. Than segmentation step generated using these optimal values.

2.3.2. Detection of Salient Regions

In this paper, we focus on the bottom-up saliency detection approach based on background information. The border regions of the image have been proved to be good visual cues for background priors in saliency detection [2].

Proposed method can find proposed salient images according to their optimal background value. The framework of saliency detection on images is shown in Figure 1. Fitness values are calculated with the standard deviation of related image. This method is applied on each three segmented images. Than we combine their salient images to achieve final salient image. In FA part of algorithm, probabilities of each source are taken as brightness for adapting FA algorithm. Comparison of the brightness and flying to more bright ones in r distance takes place at this stage. Checking that whether the failure count values exceed the limit value are handled in ABC part. In ABC-FA, colony size which is defined by K and varies with N rows and M columns of image is equal with the total number of sources. Employed bee number is equal to located source number.

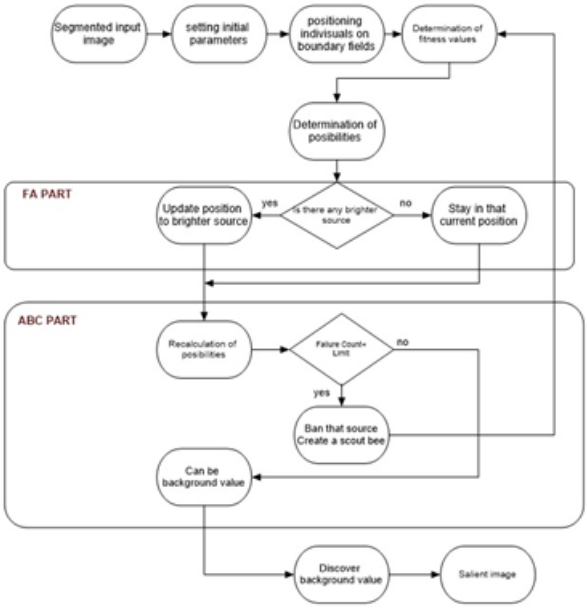

Figure 1. *Detection of salient regions with ABC-FA technique*

3. EXPERIMENTAL RESULTS

All the experiments are implemented using MATLAB on Intel i5-8250U CPU (1.8 GHz) workstation having 8GB of RAM. We evaluate the presented algorithm on one of the public datasets: MSRA-1000. The MSRA-1000 dataset [3] contains 1000 images with pixel-wise labelled ground-truth for salient objects. Our method ABCFA is compared against the six methods of IT [4], MZ [5], GB [6], SR [7], IG [3] and AC [8] on 5 images of this dataset as shown in Figure 2.

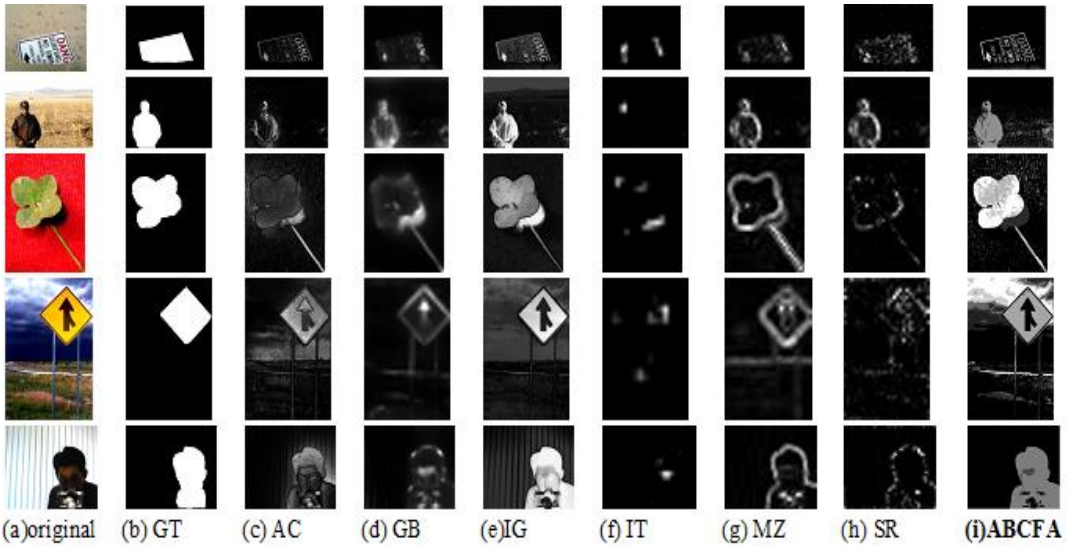

Figure 2. *Visual comparison of saliency maps. (a) original image, (b) Ground truth images, (c) saliency maps using the method AC, (d) GB, (e) IG, (f) IT (g) MZ, (h) SR and (i) our method*

All methods' results are shown in ROC curve as in Figure 3:

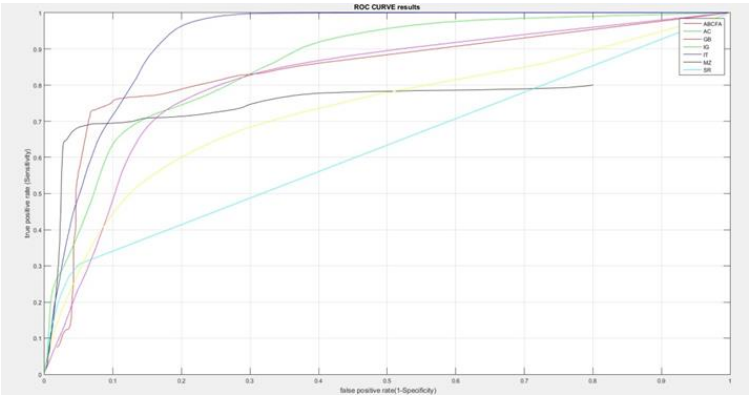

Figure 3. *ROC curves for AC, GB, IG, IT, MZ, SR and ABCFA.*

4. CONCLUSION

This paper presents a saliency detection with hybrid ABC-FA optimization algorithm by combining artificial bee colony (ABC) and firefly (FA) optimization algorithms. We focus on the bottom-up saliency detection approach based on background information. We also performed six state-of-the-art algorithms and compared these results' with our results. Our experiments showed that hybrid ABC-FA algorithm can be use as an alternative method to determine saliency maps.

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