Comparison of Scoring Methods for Interactive Evolutionary Computation based Image Retouching System

Du-Mim Yoon
Dept. Computer Engineering
Sejong University
Seoul, South Korea
+82-2-3408-3838
krad@hanmir.com

Kyung-Joong Kim *
Dept. Computer Engineering
Sejong University
Seoul, South korea
+82-2-3408-3838
kimkj@sejong.ac.kr

ABSTRACT
Interactive evolutionary computation (IEC) is a useful tool to automate human's creative process such as image drawing, music composition, and so on. In this paper, we apply the IEC to generate a new image from the original one using a set of filters. In professional image editing software, there provides us with a lot of filters and sometimes the sequential use of several filters produces interesting results. Usually, searching for the useful combination of filters is a kind of trial-and-error tasks. Or, only experts can define a good combination of filters from their long experience. In this work, our system incrementally adds or deletes filters based on user's evaluation on the results of image retouching. Recently, people take photos using their smartphones and it is not a trivial to give a number of consecutive evaluations to guide the IEC search. Based on the observation, we try to compare several scoring methods for the IEC to get the best results for the image retouching system. They are a simple binary scoring (Good & Bad), discrete multiple choices (Five Star), and real-valued scoring (Slider). Experimental results on five human subjects show that the Good & Bad is appropriate for the retouching system.

Categories and Subject Descriptors
I.2.1 [**Computing Methodologies**]: Artificial Intelligence – Applications and Expert Systems

General Terms
Algorithms, Measurement, Design, Human Factors

Keywords
Interactive genetic algorithm, Scoring method, Photo retouching, Variable-length genetic algorithm, Subject test, Personal photo, Image filters, GIMP.

1. INTRODUCTION
Interactive evolutionary computation has been a promising tool for generating a novel artistic piece from the synergism of human's subjective evaluation and evolutionary computation [1]. In this work, we try to apply the interactive evolutionary computation (IEC) for retouching photos (Figure 1). Recently, professional software provides with a lot of specialized image filters to generate novel images from the original one. However, the number of filters is huge and each filter has its own parameters to be tuned by user. If the user considers to applying multiple filters sequentially, the number of possible choices increases exponentially. It is common practice that users repeat do and undo filters to the original image until they find a good one.

Cho *et al*. used the IEC to enhance original images damaged by noise using a combination of multiple filters [2]. Unlike the work, we try to find a set of filters using IEC to generate a novel and interesting images from the original one. In this work, we choose about 40 image filters from GIMP (GNU Image Manipulation Program). The IEC tries to find a good combination of the multiple filters and individual filter's parameters. Our system supports three different scoring methods to get user's evaluation on the filtered images. They're Good & Bad, Five Star and Slider. Five human subjects evaluate the goodness of the system and appropriate scoring methods for this kind of tasks.

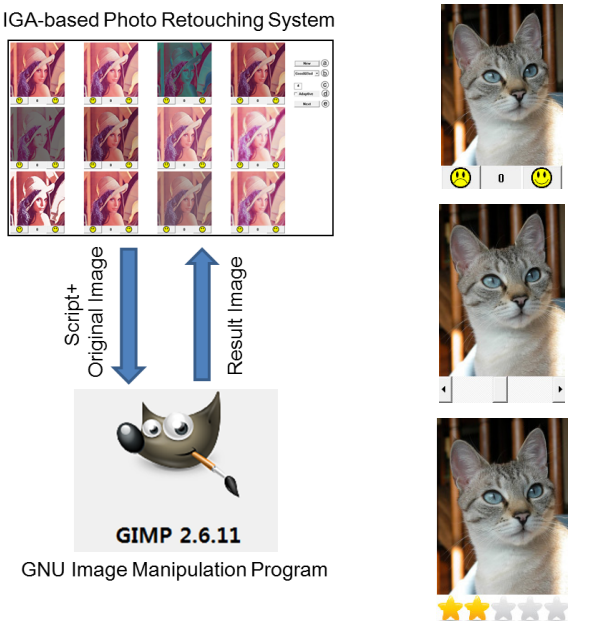

Figure 1. An overview of the proposed photo retouching system (left) and three different scoring methods (right)

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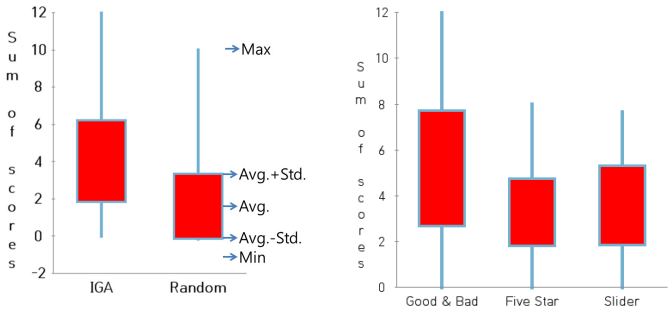
* Corresponding Author

2. PROPOSED SYSTEM

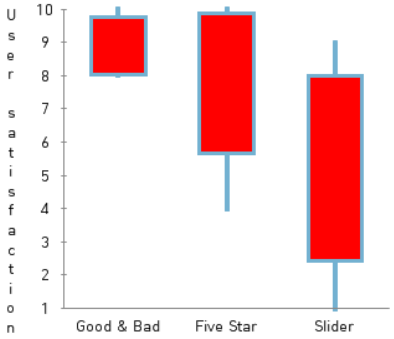
The chromosome encodes a sequence of filters to be applied and individual filter's parameters. There are about 40 filters for blur, enhancing, distortion, artistic effect, and edging. The parameters of each filter are encoded into 24 bits. The length of the chromosome is not fixed and it is proportionate to the number of filters used. Initially, each individual has only one filter chosen randomly. The communication between the IEC program and the GIMP is done by file I/O and its protocol is based on the GIMP script language. Based on user's evaluation, the roulette wheel section algorithm chooses individuals proportionate to their fitness. A new population is created by applying crossover and mutation operators (increase, decrease and random change of filters).

3. EXPERIMENTAL RESULTS

Five human subjects use the system to find a set of filters to generate "funny" images. Each person should run the system eight times ((three scoring methods with IEC + one random mode) x two runs). All the evaluation by the users is recorded as a separate log file. Figure 2 shows that the IGA is better than the random selection and the Good & Bad is the best scoring method in terms of objective and subjective tests. Figure 3 shows some successful images and their filters evolved.

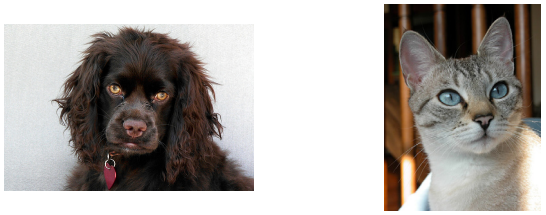


(a) IGA vs. Random **(b) Sum of scores (0~12)**



(c) User satisfaction (1~10 scores) collected from user survey

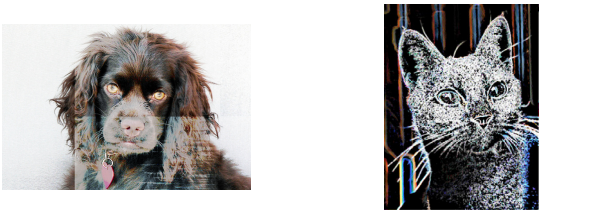
Figure 2. Results on human subject test (In the random mode, the fitness of all individual is the same. A fitness is normalized (0~1) and summed over all individuals in the population (population size is 12). The maximum value of the sum is 12. The average of the maximum over all generation (16 generations) is defined as the sum of scores.)



(a) Original Images

Softglow → Ripple → Cartoon → Antialias

Erode→ Copy Layer→ Oilify→ Cubism→ Destripe



Copy Layer→ Pixelize→ Loop→ Deinterlace→ Wind→ Antialias

Edge→Softglow→Cartoon

Unsharp Mask → VPropagate → VPropagate

Video→Copy Layer→Dilate→Wind→Ripple→Red-Eye-Removal

(b) Successful "funny" images

Figure 3. The results of the IGA-based photo retouching system and the evolved sequence of filters applied (the parameters of each filter is not shown)

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5. REFERENCES

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