An Effective Method for Generating Color Images Using Genetic Algorithm

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Abstract

In this paper, we proposed two methods to automatically generate color images similar to existing images using genetic algorithms. Experiments were performed on two different sizes(256x256, 512x512) of color images using each of the proposed methods. Experimental results show that evolving the whole image into sub-images evolves much more effective than modeling and evolving it into a single gene, and the generated images are much more sophisticated. Therefore, we could find that gene modeling should be carefully decided in order to generate an image similar to the existing image in the future, or to learn quickly and naturally to generate an image synthesized from different images.

Index Terms: Genetic algorithm, Image generation, Gene modeling, Color image

I. INTRODUCTION

As artificial intelligence is developing, many techniques for image generating automatically are introduced by computer algorithms[1,2]. Especially, some innovative techniques for imitating an existing images using genetic algorithm, are announced[3]. Genetic algorithm is a search algorithm implemented by modeling the evolution process of nature. The basic concept is to express possible solutions in a given form for a given problem, then change them, and then select the ones with high relevance and continue to change. This is similar to Darwin's theory of evolutionary survival of the fittest as if the dominant trait of the parental genetic elements flourished[4]. Recently, lots of interesting results of generated images using various kinds of genetic algorithms are posed in YouTube site[5,6]. In addition, it is possible to use a genetic algorithm to generate images of a plurality of different images, which are more secure than existing CAPTCHA images[7].

In this paper, we proposed two different methods for generating color images using existing images. We used two kinds of color images of different size(256x256, 512x512) for experiment. We describe the proposed two genetic algorithms and experimental methods for generating images in chapter II, and describe experiment results in chapter III. In chapter IV, we conclude with discussion and conclusions.

II. THE PROPOSED GENETIC ALGORITHMS AND EXPERIMENTAL METHODS

We proposed two kinds of genetic algorithms for image generation. The first one is described in section A and the second one is described section B. General configuration for experiments are described in section C.

A. The First Proposed Genetic Algorithm

In the first proposed method, three genes were used for each of the three images in which the color image was converted to RGB. In other words, the whole pixel information is modeled as one gene for each image decomposed. In this method, the length of gene is 65,536 in case of 256x256 image size and 262,144 in case of 512x512 image size for each RGB image.

B. The Second Proposed Genetic Algorithm

In the second proposed method, the color images are divided into sub-images of 16x16 for each of the three images converted to RGB, and the genes are set for each sub-image. In other words, 16x16 sub image pixel information is modeled as one gene for each image and the evolution is performed for each sub-image. In this method, the length of gene is 256, regardless of image size for each RGB image.

C. General Configuration for Experiments

We use same setting values on general configuration for the two proposed genetic algorithms. The specific configuration methods and setting values are shown in Table 1. Two color images for experiment are shown in Figure 1.

Table 1. General configuration settings

Configuration	Method and value
Number of gene in each generation	50
Selection method	Pseudo roulette wheel selection
Crossover method	Simple crossover
Fitness function	Σ|gray_of_generated_pixel-gray_of_original_pixel|
Number of elitism	2
Mutation ratio	20%

III. EXPERIMENTAL RESULTS

A. Results of the First Proposed Method

The experimental results of the first proposed method using two color images of 256x256 size and 512x512 are shown in Figure 2. The ‘gen.’ in the image means the number of generation.

(a) 256 x 256 (b) 512 x 512

Fig. 1. Two color images for experiment

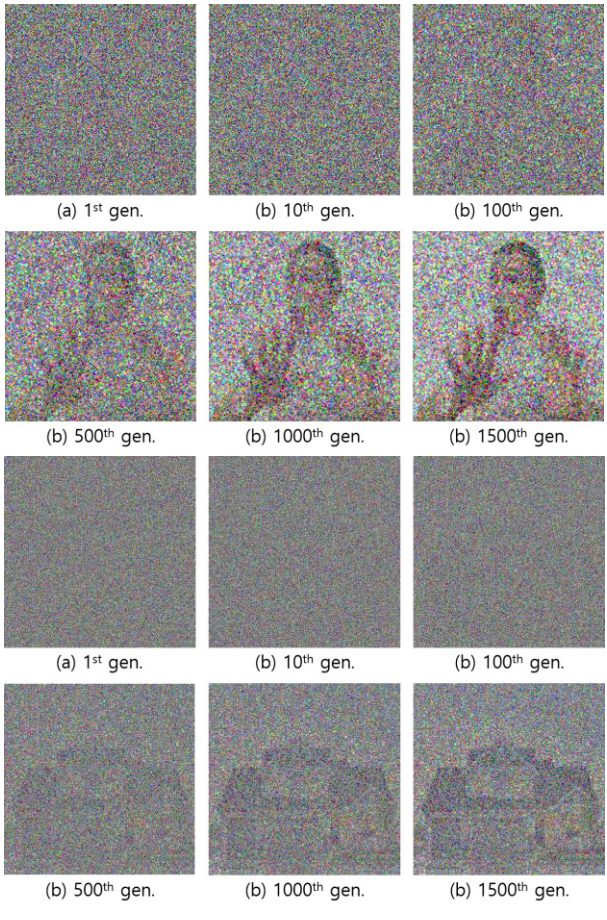

Fig. 2. Experimental results of 256x256 and 512x512 color images using the first proposed method

B. Results of the Second Proposed Method

The experimental results of the second proposed method using two color images of 256x256 size and 512x512 are shown in Figure 3. The 'gen.' in the image means the number of generation.

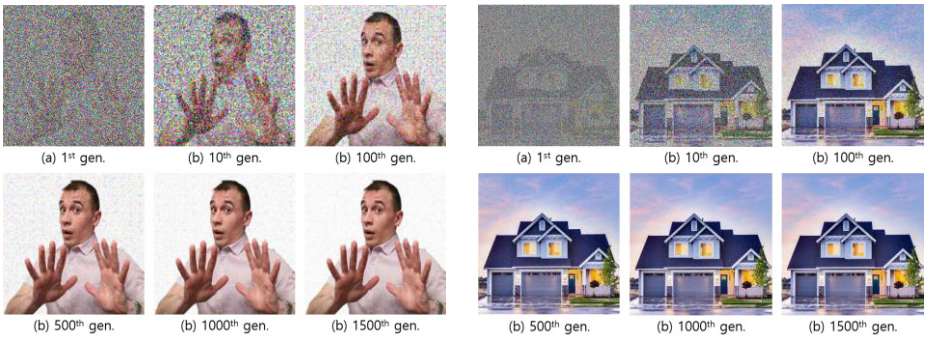

Fig. 3. Experimental results of 256x256 and 512x512 color images using the second proposed method

IV. DISCUSSION AND CONCLUSIONS

In this paper, we proposed and compared two genetic algorithms for automatic color image generation. The first proposed method was to evolve the whole image by modeling with one gene. The second proposed method divides the image into 16x16 sub-images and evolved individually. Experimental results show that evolving the whole image into sub-images evolves much more effective than modeling and evolving it into a single gene, and the generated images are much more sophisticated. In order to generate more sophisticated images, it is necessary to grasp the size of the sub-images and it is necessary to develop a genetic algorithm for generating natural composite images using two or more images. In addition, it is necessary to develop algorithms for generating various types of images through pixel based gene design as well as graphical shape based gene design.

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