A Proposal for User's Intervention in Interactive Evolutionary Computation for Optimizing Fragrance Composition

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Abstract. Fragrance is one of important media types that effect on our psycho-physiological states. However, adjustment of fragrance composition is difficult for most of users. Interactive Evolutionary Computation (IEC) is known as an efficient method to optimize media contents, and we have already proposed IECs for optimizing fragrance composition. To enhance the optimization ability of IEC, some previous studies proposed that IEC accepts user's active intervention as operations on solution candidate. Referring to these previous studies, this study proposes a new IEC for optimizing fragrance composition with user's intervention. While the user just evaluates the presented fragrance with scoring or comparison in the conventional IECs, the user not only evaluates the fragrance but also operates the composition in the proposed IEC. The user's intervention is performed on solution candidate directly. In construction of the system, Aromageur, which blends six aroma sources, is used to create the fragrance based on the composition.

Keywords: Interactive Evolutionary Computation, Fragrance, Optimization, Intervention.

1 Introduction

Recently, we use various types of media contents in various situations. We enjoy these media contents, furthermore, some of them are effective to change mood. In the use of the media contents, it is ideal that each of the users use the media contents suited to each user's preference. However, it is still difficult to obtain the media contents, because preference of the users is very different and complex.

Interactive Evolutionary Computation (IEC) is known as an effective method to create contents suited to each user, and IEC was applied for creating various media contents [1]. Most of IEC applications were related to sense of sight such as image, movie, and graphics [1, 2]. Music and sound were next candidates of IEC applications. In recent years, with helps of development of information technology, the area of IEC applications were spread to various fields related to other human senses such as taste [3], touch [4], smell [5-8].

The present study focuses on IEC for optimizing fragrance composition. Fragrance is important for us. Some persons wear fragrance every day, and the fragrance is used

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for therapeutic purposes. However, these fragrances are ready-made: Most of the users do NOT use fragrance suited to each user's preference and objectives to use. Fragrance is composed of various source materials. If we could obtain the fragrance suited to each of us, the effect of the fragrance must be stronger than ever.

Objective this study is to propose a new IEC optimizing fragrance composition with user's intervention. We have already proposed IEC methods for optimizing the fragrance composition [5-8]. However, there have not been proposed any IEC optimizing fragrance pattern with the user's intervention, which is direct operation by the user on solution candidate in IEC.

2 Related Works of Optimization of Fragrance with IEC and Intervention in IEC

Evolutionary Computation (EC) is used for optimizing several variables suited to certain problem. In other words, EC searches best combination of several variables for solving the problem. IEC is an interactive type of EC by using human as a function of problem (Fig. 1). Therefore, IEC searches best combination of several variables suited to each user's subjective evaluation.

Before we describe the proposed IEC, this chapter shows previous related works of IECs optimizing fragrance composition. Most of them were works of us. Furthermore, the section 2.2 explains what IECs with user's intervention by introducing previous related studies.

2.1 IEC Optimizing Fragrance Composition

Obtaining fragrance suited to each user is difficult because preference of each user is very different and fragrance composition is complex. Optimizing fragrance composition is also difficult task, however, there is a possibility of the optimization by using information technology related to fragrance. A previous study has proposed a method to obtain fragrances by manually adjusting the fragrance composition. Zhang et al. have tried to obtain the fragrance suited to image of a university by manually adjusting the fragrance composition [9]. In the previous study, Aromajeur, blending six aroma sources was used. Although the user's task was adjusting just six variables related to each aroma's intensity, it seems difficult to obtain the fragrance composition suited to image. Furthermore, if the user was satisfied with the obtained fragrance, it must not be the best composition.

IEC is effective method to obtain good combination of variables related to media contents. In IEC, the user sees or smells presented media contents and evaluate them subjectively by scoring or selecting. The authors have proposed IEC method searching the fragrance composition suited to each user [5-8]. First try [5] of the IEC used Genetic Algorithm [10,11] as Evolutionary Algorithm (EA). In next study [6], we have adopted Differential Evolution [12] as EA. In recent approach [7, 8], Tabu Search (TS) [13] was employed.

2.2 IEC with User's Intervention

As described in Introduction, IEC is effective method to search media contents suited to each user. However, less number of evaluation times with small population size and short generations remains as problem in IEC [1]. The problem is come from fatigue of human users. Therefore, effective search method is demanded.

Some previous IEC studies have proposed IEC method with user's intervention. The user's interventions are done by several ways. Bleeding enables the user to select parent individual [14]. HIEC permits the user to select the parent and operations (crossover and mutation) [15]. Ono et al. enables the user to operate directly individuals. These previous studies with the intervention are applied for only problem related to computer graphics [16].

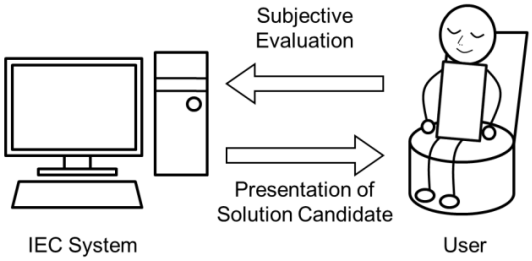

Fig. 1. A fundamental relationship between IEC system and a user

Table 1. Example of Setting Intensities of Fragrande Composition

	Aroma Source 1	Aroma Source 2	⋯	Aroma Source *N*
Intensity of Aroma Source	10	92		53

3 Proposed Method: IEC for Optimizing Fragrance with User's Intervention

By combining the IEC optimizing fragrance composition and intervention technique in IEC, this study proposes an IEC optimizing the fragrance composition with user's intervention. Fig. 2 shows outline of the proposed IEC. The user evaluates the presented fragrance by scoring and selecting, and the IEC system progress search of the fragrance composition. As the intervention, the user can manually adjust the intensity of each aroma in the composition of the presented fragrance when user wanted to. After the intervention, the user smells the fragrance and evaluates it.

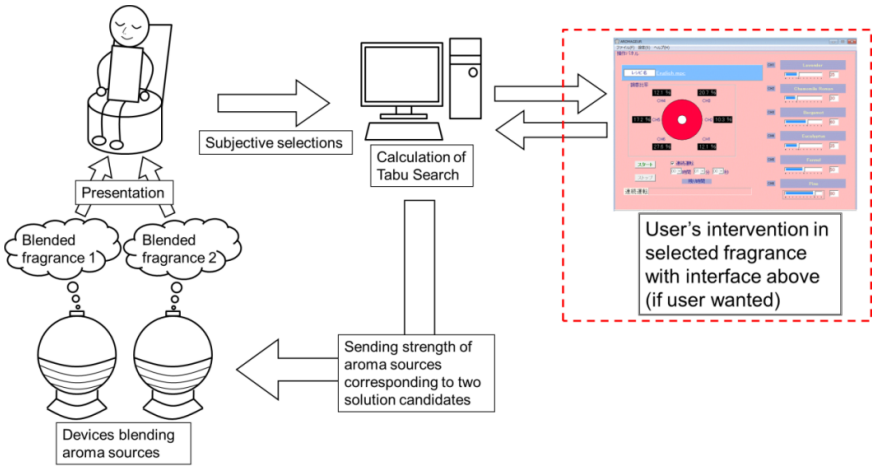

Fig. 2. Outline of proposed IEC optimizing fragrance composition with user's intervention

4 Discussion and Conclusion

This study proposed the IEC optimizing the fragrance composition with user's intervention. Different from the conventional IECs, the proposed method searches better fragrance composition with user's manipulation. A concrete system was constructed based on ITS.

As next step, we will investigate efficacies of the proposed IEC method through smelling experiment as same as the previous IEC studies: efficacy of EA for searching better and best solutions is guaranteed, however, the efficacy of IEC is not because human feelings are unstable.

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