

Movie with Scents Generated by Olfactory Display Using Solenoid Valves

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ABSTRACT

We developed the olfactory display to blend 8 component odors at any composition. The solenoid valves controlled by the algorithm of the delta sigma modulation showed the sufficient capability. Then, we developed the system for presenting a movie together with scents. We actually made the content of the movie with scents and evaluated it using questionnaire survey. It was found that the scene with smell attracted the people's attention and, moreover, the contrast of the pleasant smell with the offensive one emphasized their attention. Furthermore, we established several guidelines to make the contents of the movies with scents.

Keywords: Olfactory display, solenoid valve, delta-sigma modulation, odor sensing system, odor recorder, cinema

1 INTRODUCTION

Visual and audio information can be nowadays handled in a computer quite easily. However, it is not the case when olfactory information is required. When we watch "IRON CHEF" on TV, the TV program lacks the most important information. We can see delicious foods but cannot enjoy smells. If we have olfactory display controlled by a computer, we can have more presence.

Our group has studied an odor sensing system to recognize smells [1-2]. Although artificial sensors for odor discrimination are required, a presentation device is also necessary to have presence about smells. We proposed an odor recorder to reproduce smells as well as record them [3] and have performed several works [4-5]. In the present study, we focused on an olfactory display to present olfactory information.

Our group proposed the olfactory display with function of blending multiple component odors at any recipe [6-7]. It can present a variety of smells by blending component odors. Since primary smells [8] have not been so far found, olfactory information is different from visual one expressed by three primary colors. However, a number of smells to be presented can be much increased when mixing function is available. Moreover, the dynamically-changing odor can be presented using this olfactory display.

Olfactory information contributes to the presence when it is presented together with visual information [9]. Thus, we applied the olfactory display to the realization of movie with scents. Tomono et al. reported that 3 to 15 kinds of smells are typically required in one cinema [10]. Although we cannot use unlimited number of smells in the olfactory display, it is feasible to realize

the movie with smells because the required number of smells is moderate. The purpose of this study is to realize a movie with scents generated by the developed olfactory display. We show the production of the movie with scents and the results of sensory tests.

2. System for presenting movie with scents

There are several types of olfactory displays with the function of blending component odors. Those are composed of MFC (Mass Flow Controller)s, inkjet devices and solenoid valves.

The principle of an olfactory display composed of solenoid valves is shown in Fig.1. Although a solenoid valve is a fluidic switching device with only two states such as ON and OFF, the high-speed switching enables any concentration since the frequency of ON state corresponds to the odor concentration.

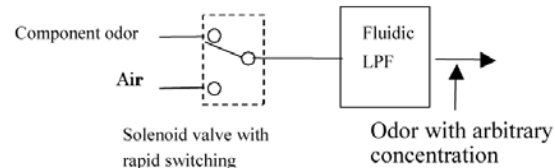


Fig.1 Olfactory display using solenoid valves

The algorithm to control the solenoid valves was the delta-sigma modulation known as 1-bit A/D conversion technique with high accuracy. The solenoid valve is controlled by the bit stream via a digital port of a computer. Although the quantized noise occurs in the delta-sigma modulator, the noise power in the signal band can be remarkably reduced by noise shaping effect. In our developed system, up to 8 component odors can be blended at any composition.

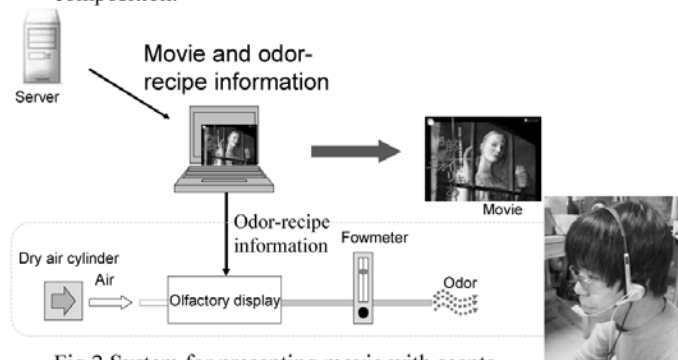


Fig.2 System for presenting movie with scents

The total system for presenting movie with smell is illustrated in Fig.2. Movie and the odor-recipe information accumulated at the server are downloaded to a computer connected to an olfactory display. The smell is generated synchronously with movie using our developed software. In addition, we made the nose interface made of acrylic resin. The odor is emitted from the slit in the nose interface attached to the microphone with the headphone. The

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nose interface was introduced to keep the distance between the point of the smell generation and the nose constant.

3. Evaluation of movie with scents

The cinema we selected was “Spirited away”, famous Japanese movie [11]. We made the digest of “Spirited away” just spending 4 minutes. Its digest consists of 11 scenes including 8 ones with smells and 3 ones without smell. The scenes in the digest are tabulated in Table 1. The seven component odors used here are also listed in Table 2.

Table 1 Scenes in digest of Spirited away and smells attached to it (Chihiro:Heroine, Haku:Character)

No	Scene	Odor
1	Parents were selecting foods.	Food1
2	Mother had her mouth full of meat.	Food1+Food2
3	Mother became a pig.	Smell of pig
4	Chiro asked Haku if her parents did not become pigs.	No smell
5	She was told that important and delicious foods were eaten by parents.	No smell
6	She went to a pigsty through flower garden.	A few scents of flowers
7	She told her parents to help them at pigsty.	Smell of pig
8	She remembered her name at flower garden.	Scent of flower
9	She was told to take care of stink god.	No smell
10	Stink god appeared.	Offensive smell
11	Stink god was soaked in medicated bath.	Offensive smell and herbal one

Table 2 Component odors used in digest of Spirited away

Odor	Description
Food1	Chinese food
Food2	Mabo tofu
Scent of flower	Muguet
Smell instead of flower at scene 6	Patchouli (Exotic and spicy note associated with soil)
Smell of pig	Methyl mercaptan
Offensive smell	Hydrogen sulfide
Herb	Sage

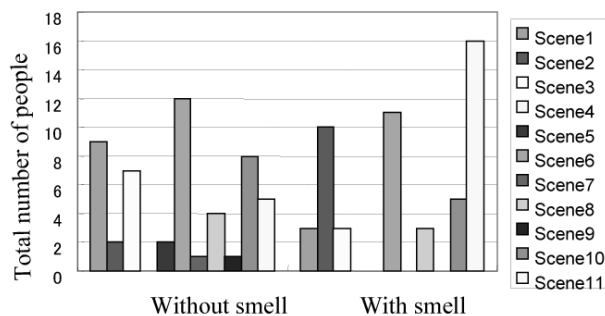


Fig.3 Impressive scenes of “Spirited away” without smell and with smell

We tried to know the impact of the olfactory information in the cinema. 17 students of Tokyo National University of Fine Arts and Music first experienced the digest of “Spirited away” without smell and next experienced the one with smell. They were

required to pick up the three most impressive scenes among 11 ones in each case. The subjects had never experienced the movie with scents before.

The result of the questionnaire survey is summarized in Fig.3. No one picked up the scenes 4,5 and 9 when the movie with scents was presented. Their impressions at scenes 2 and 11 with scents changed drastically compared with those without scents.

In case of scene 2, the pleasant smell was enhanced compared with that in scene 1, and its contrast with scene 3 (bad smell) again emphasized the impression.

In scene 11, the pleasant smell (herb) was presented and its contrast with the bad smell in scene 10 enhanced the impression of the movie with scents.

Thus, it was found that the scene with smell attracted the people’s attention and, moreover, the contrast of the pleasant smell with the offensive one emphasized their attention.

We have several guidelines to make a movie with smells through the experience here.

1. The period between certain smell and another different smell should be longer than 5s considering the breath timing.
2. When the smell to be focused on is presented under the existence of the background smell lasting for long time, the background smell should be stopped during the presentation of another smell.
3. When smell change is expressed, the drastic change of the smell enables people to have much attention.

4. Summary

We showed the system to present movie with scents and made the digest of the cinema “Spirited away” with various smells and evaluated the impression when the smell was presented together with movie. We found that the scene with smell attracted the people’s attention.

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