Chapter 20

Olfactory Display Based on Ink Jet Printer Mechanism and Its Presentation Techniques

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ABSTRACT

Considering the recent increase of interest in the transmission of olfactory information alongside audio/visual information, the authors have developed an olfactory display, based on an inkjet printer mechanism, which emits scents for short periods of time and has high control and provides repeated stable pulse emissions of scents. By using pulse emission, the authors achieved chronological control for presentation of scents and were able to synchronize the pulse with human inspiration. Such synchronization is important because humans detect scents when they breathe in, inhaling scent molecules in the air. Applying pulse emission, the authors measured various human olfactory characteristics; furthermore, they developed scent presentation techniques to create perspective and to switch scents rapidly. This chapter introduces details about the olfactory display and scent presentation techniques using pulse ejection.

INTRODUCTION

Transmission of information via all five human senses is attracting much attention these days (Ministry of Posts and Telecommunications in Japan, 2007; Kim, et al., 2006). In particular, information acquired via the olfactory organs largely affects humans, as this information is transmitted to the cerebral limbic system governing emotions and memories (Michael, et al., 2003). In addition, unlike words, olfactory information can directly present details with an environment about the...
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atmosphere, presence of objects, a sense of the season, and can increase the sense of reality and understanding of contents.

However, it is difficult to synchronize scents with time-shifting information, such as movies and sounds, owing to scents lingering olfactory adaptation. These problems are often caused by the method used for scent emission; existing techniques to emit scents present a greater than necessary volume of scent, over too long a time, in order to make detection easy. This excess in the amount and time of scent emission stimulates olfactory receptors continuously and causes olfactory adaptation. Moreover, emitted scents remain in the space and cause mixing of newly presented and lingering scents. Because of the use of excess scent, chronological control of scents has therefore been difficult.

In an effort to resolve this problem, we have developed an olfactory display based on the hypothesis that a small amount of ejected scent will present discrete and transient bursts of olfactory stimulation, thereby reducing the effect of adaptation. Utilizing an inkjet printer mechanism, this system emits scents for short periods of time and has high control such that it can provide repeated stable pulse emission of scents. By using this pulse emission, we achieved chronological control of scents, and can synchronize the mechanism with human inspiration, which is important due to humans detecting scents when they breathe in and inhale the molecules in the air.

Thus, this scent presentation technique has enabled temporal control over the scents, and by applying this pulse ejection system, we have been able to measure certain human olfactory characteristics. Furthermore, we have constructed scent presentation techniques: perspective creation by scents and rapid switching of scents.

In the following sections, we introduce a detailed description of both the olfactory display and scent presentation techniques using pulse ejection.

BACKGROUND

Research on the transmission of olfactory information together with audio/visual information is ongoing. Work first started in the 1950s with Heilig (1962) developing Sensorama, the first Virtual Reality (VR) system presenting olfactory and audio/visual information together. More recently, the virtual space system “Friend Park,” developed by Tominaga et al. (2001), provides users with an increased sense of reality by generating the aroma of a virtual object or environment, where the aroma is defined as the area in which a scent can be perceived.

Kaye (2004) describes several systems that add scents to Web content, where computer-controlled olfactory displays, such as iSmell (Washburn, et al., 2004,) and Osmooze (2011), are utilized in these systems. Another type of display, the air cannon olfactory display (Yanagida, et al., 2003), has been proposed and generates toroidal vortices of a scent in order to present it within a restricted space.

Nakamoto et al. (2001) designed an odor blender device that presents scents of virtual objects remotely. The system first analyzes the odors to be transmitted and describes each odor by using a composition ratio of scent elements. By using the ratio found by the smell analysis, on the receiver side, the target smell is reproduced with a feedback control by emitting scent elements contained within the receiver. However, this system cannot be used to present a random scent.

A wearable olfactory display with position sensors has also been developed (Yamada, et al., 2006). This display can present spatiality of olfaction in an outdoor environment by controlling the density of odor molecules. The system for transmitting the olfactory information consists of the aforementioned display, a sensing unit with three gas sensors, and a matching database. Translating the obtained olfactory information, the
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