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Demo of Odor Reproduction Using 20-component Olfactory Display

Hiroto Hayashi[1], Dani Prasetyawan[2], Masaaki Iseki[2], Takamichi Nakamoto[1,2]

[1]School of engineering, Tokyo Institute of Technology, Japan
[2]Institute of Innovative Research, Tokyo Institute of Technology, Japan

Abstract

An olfactory display is a device that presents an odor to a person. In this research, odor components, which can reproduce odor by mixing them at specified ratio, were used. By using odor components, the authors developed olfactory display capable of presenting various odors compared to conventional devices. A perfume is supplied from an electroosmotic pump to a microdispenser, and the multiple odor components ejected from the microdispensers are atomized by the SAW atomizer to produce the blended odor. Users can easily experience the odor, for example, just by clicking on the button labeled with the name of the scent displayed on the PC, they can experience the odor reproduction by the blending odor components.

CCS Concepts

• ***Hardware*** → *Hardware validation;* • ***Human-centered computing*** → *Human computer interaction (HCI);*

1. Introduction

Olfactory display is a device that presents odors to a person. Olfactory display has attracted attention in the medical and advertising fields, and have been studied as a device to enhance the immersive experience of VR, especially in recent years. However, conventional olfactory displays can only present as many perfumes as ones mounted on them, which reduces the number of smells and limits their applications [LLW*21].

To solve this problem, we worked on the development of 20 components olfactory display, which blends odor components for odor presentation. Odor components can be blended at the specified ratio to reproduce the odor. We reported that the odors of 185 essential oils can be reproduced with 20 odor component [PN19]. Although 20 component olfactory displays was developped [IPYN22], it was not fully automated and the manual adjustment of the liquid pump voltage was necessary. In this paper we developed the fully automated olfactory display suitable for the demo, we can show the demo of the odor reproduction using the olfactory display.

2. 20-component olfactory display

The atomization principle of the 20 components olfactory display is shown in Figure 1. As shown in Figure 1, the olfactory display atomizes perfumes ejected from the microdispenser by the acoustic streaming of Surface Acoustic Wave(SAW) device [SMU89] [KWH95] to present odor. The microdispensers are fixed by a hemispherical jig. By inserting the microdispenser into the hole in the hemisphere, droplets are ejected onto the atomizable area of the SAW device. The Electroosmotic(EO) pump [AHN12] supplies perfume to the microdispenser, and the discharge volume per droplet is kept constant and the driving of the microdispenser become stable due to the appropriate control of supply volume from the pump. The discharge volume per droplet is as small as approximately 3nl, so the effect of remaining perfume is smaller than that without the control.

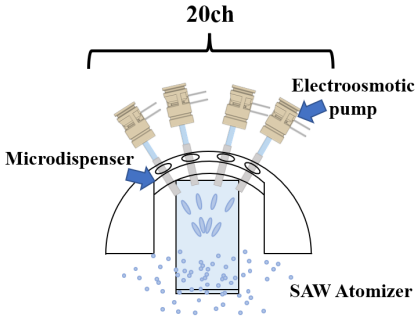

Figure 1: *scent atomization principle*

A system diagram of the olfactory display is shown in Figure 2. The electroosmotic pumps, microdispensers, function generator, and DC fan can be controlled by sending commands from a PC to the FPGA(Field Programable Gate Array). Since the applied voltage of the EO pump is between 0 and 200V, signals are sent from the FPGA to the DA converter, and the DA converter is controlled to optimize the amount of perfume supplied to the microdispenser.

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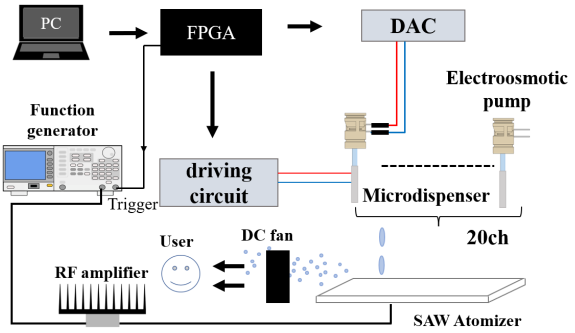

Figure 2: *System diagram of olfactory display*

3. Demonstration and Sensory test

A preliminary sensory test using the triangle test was conducted to confirm the odor reproduction accuracy of the olfactory display. Subjects were presented with the original sample twice and the mixture once, for a total of three times at random sequency, and then they answer when the mixture was presented. Six subjects joined the sensory test, and Lemon, Palmarosa, and Cypress were used as perfumes to be reproduced; Lemon and Palmarosa were reproduced by four odor components, and Cypress by two odor components. Figure 3 shows a subject sniffing the scent from the olfactory display. Odor components ejected by the microdispensers are atomized by the SAW device, and the odor is delivered to the user through the fan.

The results of the sensory test are shown in Table.1. Subjects could not discern any odor other than Lemon. However, many of subjects said could not distinguish between the two odors, including Lemon. The reason for the high percentage of correct responses for Lemon is thought to be that people perceive slight differences in the scent because it is a common scent in their daily lives. It can be also considered that there was a bias in the percentage of correct responses due to only six subjects.

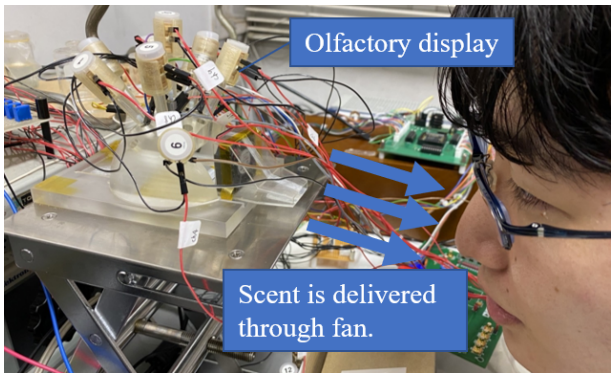

Figure 3: *User is experiencing the olfactory display*

Table 1: *Preliminary sensory test results*

	A	B	C	D	E	F
Palmarosa	○	×	×	×	×	○
Cypress	×	×	×	○	○	○
Lemon	○	○	×	○	○	○

4. Conclusion

We developed 20-component olfactory display with microdispensers that enables precise blending. The results of sensory tests and the opinions of those who experienced the demonstration showed that it was difficult to distinguish the original sample and the odor reproduced by the odor components. This suggests the sufficient odor reproduction accuracy. In the future, it will be necessary to increase the number of reproducible odors and make it possible to present a variety of odors.

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