論文 / 著書情報
Article / Book Information

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Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

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論 文 要 旨

THESIS SUMMARY

専攻： Department of	電子物理工学　専攻	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of　（　工学　）
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要旨（英文 800 語程度）

Thesis Summary (approx.800 English Words)

Incorporating the sense of smell into media like the sense of seeing and the sense of hearing is one of the rising challenge researches. Despite the fact that olfaction is rather difficult to be handled than those two senses since it depends on chemical substances, enabling the odor stimuli into media can cause massive benefits in a variety of applications, such as entertainment, arts, education, advertisement, and medicine. For this reason, an odor presenting device or olfactory display is indispensable.

The olfactory display for all general purpose should be able to present all kinds of smells vividly and reproducibly, start and stop the odor presentation as fast as possible, adjust the intensity and amount of the presented odor precisely and in real time, and blend smells to present a variety of odors from a limited number of odor components. Additionally, it should be miniaturized and does not produce any disturbance such as noise or heat. Even though a variety of olfactory displays have been developed based on various techniques and standards, the olfactory display that can be used appropriately in all general usage still does not exist.

In this study, electroosmotic pumps and a SAW (Surface Acoustic Wave) device were utilized to propose the olfactory display that presents scents by atomization. The electroosmotic pump conveyed tiny odorant droplets onto the SAW device so that the droplet can be atomized into smell. At the first stage of the research, the approaches to use the electroosmotic pumps and the SAW device effectively were investigated individually. The experimental results showed that the SAW device can atomize odorant droplets into vapor and its atomization capability can be enhanced by increasing the number of its IDT pairs. Besides, the pump should be driven by a one shot pulse or DC voltage so that the amount of a droplet can be adjusted by varying the pulse width or amplitude of the applied voltage.

The preliminary olfactory display was developed by cooperating the electroosmotic pumps and SAW device together. Its capability to present odor using SAW atomization was confirmed through an odor sensing system. The odor sensing system was then improved to be more suitable to measure the intensity of a vapor released by SAW atomization. The capability to control odor intensity by adjusting pulse width of the driving pulse applied to the electroosmotic pump was confirmed. However, it was found that the atomization performance was still not sufficient to atomize a droplet of an odorant with low volatility completely. Thus, the SAW device with higher performance was then developed.

Subsequently, the device structure was improved by using two metal blocks to maintain the device structure. The device consists of six electroosmotic pumps and a SAW device. Very thin stainless tubes were placed closely to the SAW propagation path to supply the liquid droplets to be atomized. Based on this configuration, the repeatability of the released odor was improved from the preliminary device. According to the experimental results, this six-component olfactory display can present even the scents of low volatile substances rapidly and it its capability to control the intensity of the released odor were also confirmed.

Subsequently, in order to further miniaturize the dimension of the entire device, the new structure of the olfactory display was developed on a single PCB (Printed Circuit Board). Even though the device was composed of eight electroosmotic pumps, its size is rather smaller than any other odor blender and compact enough to be equipped on a headset. Its atomization performance was also enhanced by developing a higher-performance SAW device. As a result, it can atomize some odorants that the previous olfactory display cannot such as, vanilla flavor and some odorants in perfumes. The capability to blend smells was also confirmed by using the odor sensing system.

However, due to the fact that the sensor response obtained from the gas sensor did not return to the baseline, sensory evaluation technique was also performed to verify whether it was caused by the odor residue on the device or in the sensor cell. As a result, the participants did not feel any smell

remaining on the device. Subsequently, a visual-olfactory system was developed to verify the proposed olfactory display in practical use. An experiment was performed to verify whether participants can feel the fragrant of Eau de Givenchy, a perfume with relatively low volatility, presented by the system. The result shows that all participants could feel the smell when it is presented. The validity of the proposed olfactory display was confirmed.

In conclusion, the proposed device can present odors abruptly even the scents of low volatile substances. It can adjust the intensity and amount of the presented odor and can blend smells without producing heat to the nearby environment. Thus, the purpose of this research was achieved.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 2 部提出してください。

Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 2 copies of 800 Words (English).