Poster Abstract: Digital Taste & Smell for Remote Multisensory Interactions

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ABSTRACT

This poster presents an approach to enhance remote multisensory interactions through digital taste (gustation) and smell (olfaction) senses on human. This approach mainly facilitates the digital actuation of taste and smell sensations on human. It utilizes electrical, thermal, and magnetic stimulation technologies to stimulate taste and smell sensations digitally. First, we present the initial prototype for digital taste actuation and then discuss the method for digital smell actuation.

Categories and Subject Descriptors

H5.2 [Information interfaces and presentation]: User Interfaces. - *Input devices and strategies, Prototyping*.

General Terms

Design, Measurement, Experimentation.

Keywords

Taste, Smell, Gustation, Olfaction, User interfaces, Control systems, Virtual reality.

1. INTRODUCTION

With the continuous advancements in computing and media, the technology has widened to include the multisensory experiences in remote digital interactions. Although there are quite a lot of digital systems in auditory, vision, and haptic domains, remarkably few attempts has been made on taste and smell domains. As an attempt to bridge this gap, this poster formulates the initial step towards a digital taste and smell stimulation system.

First, we propose the novel control system for the sense of taste, The Digital Taste Interface (Figure 1). The system is capable of generating taste sensations based on noninvasive electrical [1] and thermal [2] stimulations on human tongue. The novelty of this work has two aspects: firstly, the control system that actuates the taste sensations digitally, secondly, the method of actuating tastes by combining electrical and thermal stimulations.

Then, we propose a new mechanism based on deep brain magnetic flux stimulation in order to activate both taste and smell sensations digitally. As shown in Figure 2, this will be achieved in two distinct phases. In the first phase, associated nucleus on the brain for basic taste and smell sensations will be identified using Electroencephalography (EEG), and functional Magnetic Resonance Imaging (fMRI) techniques. In the second phase, an improved `Transcranial magnetic stimulation' (TMS) method is proposed to stimulate nucleus identified during the first phase. It induces weak electric signals on analogous areas of the brain by rapidly changing magnetic fields produced by the outside circuitry.

2. DIGITAL TASTE

Figure 1 depicts the main components of the digital taste interface, the control system itself and the tongue interface. The taste actuating methodology of the proposed system consists of two sub modules: the control system (electrical and thermal) and the tongue interface. The tongue interface acts as an interface between the control system and the tongue.

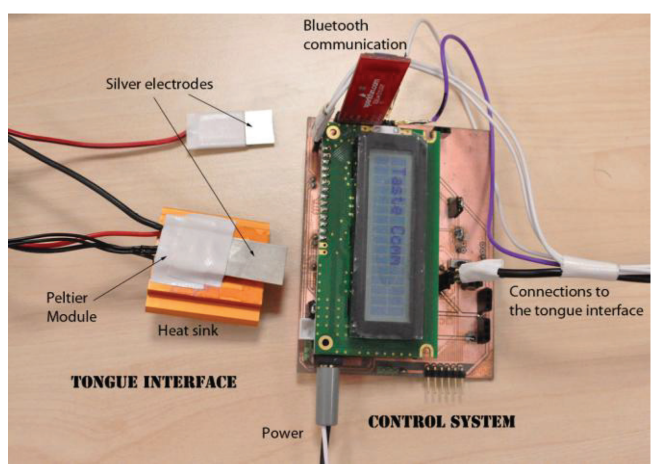

Figure 1. The digital taste interface.

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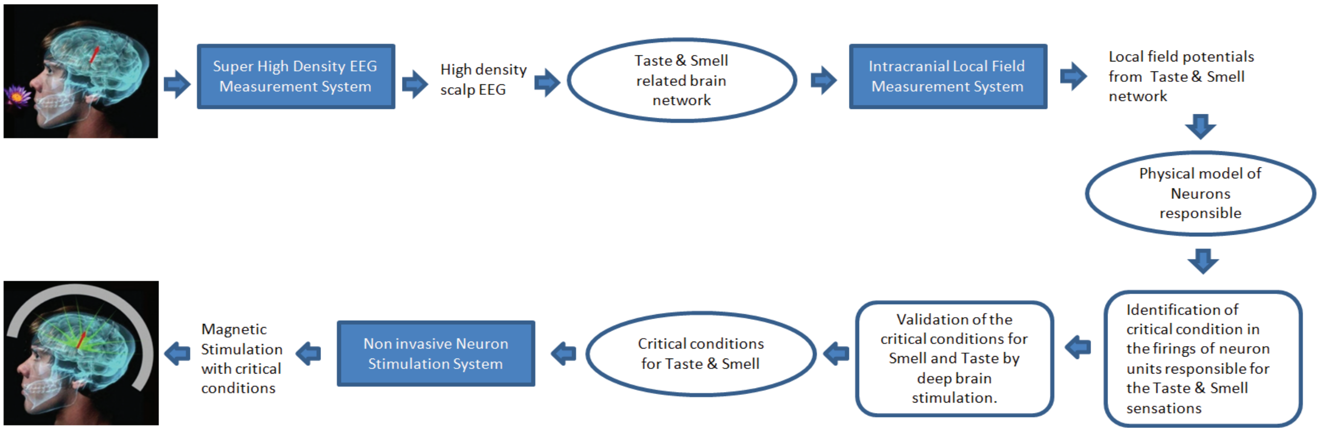

Figure 2. Flow of regenerating taste and smell perceptions by Magnetic Stimulation.

The impedance of the tongue is varying person to person due to the differences in types and density of papillae on the tongue surface [3]. Thus, in electrical stimulation subsystem, we use a digital potentiometer with a constant current source to provide a constant current to the end user. The electrical stimulation module provides square wave pulses to the silver electrode with diverse current from 0µA to 200µA and frequency from 50Hz to 1000Hz. In thermal stimulation subsystem, we use a Peltier semiconductor module (Peltier Junctions) to change the temperature on the tongue (both cooling and heating within 20^0C – 35^0C).

The initial experimental results suggested that sourness (electrical stimulation) and saltiness (electrical stimulation) are the main sensations that could be evoked besides several evidences of sweet (thermal stimulation) and bitter (electrical stimulation) sensations. Furthermore, several subjects reported that they felt the minty taste (when cooling down from 35^0C to 20^0C), and also slight spiciness (when heating up from 20^0C to 35^0C).

3. DIGITAL SMELL

Human brain registers its functions or perceptions as sets of neural firings in individual units or clusters at specific locations on the brain [4]. In the same manner, there are neural firings in brain for taste and smell perceptions. Understanding these firings for taste and smell perceptions could potentially provide the basis for modifying, reproducing, or creating the perception by regenerating the neural firing with electrical means. Physically such a duplication of neural firing can be achieved by applying electrical stimulation at the local field [5]. The process requires three steps to be fulfilled (Figure 2),

1. To locate the neural firing on the brain for smell and taste perceptions
2. To investigate and model the dynamic behaviors of the neural firings for smell and taste perceptions
3. To identify and validate the critical conditions of the neural firings and accompanying local field potentials for each of the perceptions (by stimulating identified critical conditions we would stimulate the perception)

4. CONCLUSION

A method for digitally actuating the sense of taste and smell through electrical, thermal, and magnetic stimulations has been presented in this poster. The taste actuation device developed is currently able to stimulate sourness, bitterness, sweetness, and saltiness successfully although it needs further experiments and developments. Furthermore, this poster focuses on development of such technology for remote smell actuation by improved transcranial magnetic stimulation technique. In the future, this technology can be further enhanced to develop new applications in multisensory remote interactions such as communicate the sense of taste; for example, the possibility of tasting food remotely without eating it. Furthermore, it will enable the theorized concepts such as the next generation World Wide Web (WWW) with embedded gustatory interactions.

5. ACKNOWLEGEMENT

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