Virtual Tasting Device – Design

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There is already some similar work in the field of electrical taste stimulation with varying prototype designs, which I used as reference to create this design, which consists of two major parts: the tongue interface connects to the user's tongue and the control module configures the electric output.

Tongue Interface

For the tongue interface I chose to base my design on a straw-like design by Nimesha Ranasinghe et al. [2] [3]. That design is however aimed at augmenting the taste of actual beverages, so the straw has to work like an actual straw. As my goal does not involve actual drinking I don't have those limitations, so I adjusted the design to not have any opening at the side near the tongue and use the inside of the straw for wiring.
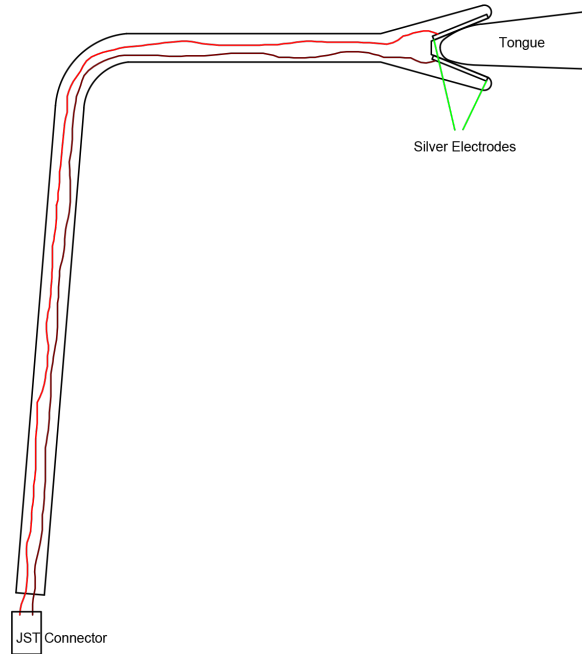

Figure 1: Sketch for the tongue interface (cross-section)

This design has the advantage that it should be comfortable and easy to use. It is also planned to be easy to stabilize with your lips, so it doesn't have to be held in place by hand, which is very important if you have to use your hands to do something else, like holding a controller, while using the device. Furthermore, thanks to the JST connectors between the tongue interface and the control module, it is very easy to disconnect the tongue interface from the control module, for easier cleaning or to exchange both parts separately.

One concern with this design however is that the interface has to be properly cleaned between usages. An approach to avoid this concern could have been to use disposable mouthpieces, but the electrodes have to have direct contact with the tongue and it would be uneconomic to always replace those, so even then it would be hard to avoid all cleaning.

Control Module

As for the control module the design is taken from an approach by Adrian David Cheok and Kasun Karunanayaka [1], where the control module is similar to, but a bit simpler than the one by Ranasinghe [4].
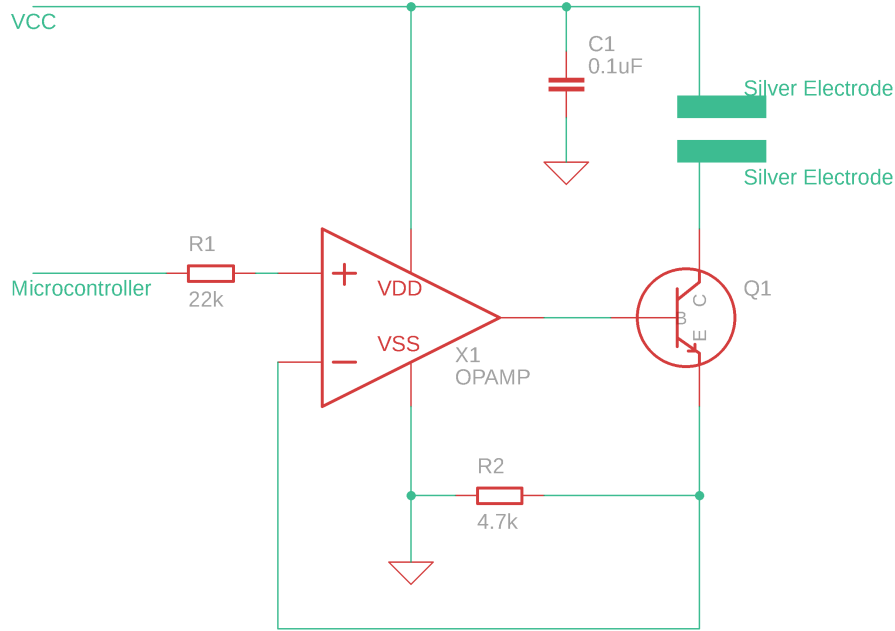

Figure 2: Control module schematic, as described in Fig. 4.4 on page 57 in [1]

Using PWM a microcontroller sends square wave pulses to the users tongue via the tongue interfaces two silver electrodes. However, as the resistance of the tongue varies from person to person, a constant current source, consisting of an op-amp and an NPN transistor, is implemented to still provide roughly the same current.

As microcontroller I would use a NodeMCU ESP8266, which are pretty cheap boards with a built-in wifi module, enough PWM pins and a usb port. They are also pretty similar to the arduino pro mini used by Cheok and Karunanayaka, but with the advantages of having a usb port built-in, but also having built-in wifi to easily enable wireless communication.

References

[1] Adrian David Cheok and Kasun Karunanayaka. *Virtual Taste and Smell Technologies for Multisensory Internet and Virtual Reality*. Springer, 2018.

[2] Nimesha Ranasinghe, Kuan-Yi Lee, and Ellen Do. Funrasa: An interactive drinking platform. pages 133–136, 02 2014.

[3] Nimesha Ranasinghe, Kuan-Yi Lee, Gajan Suthokumar, and Ellen Do. Virtual ingredients for food and beverages to create immersive taste experiences. *Multimedia Tools and Applications*, 75, 01 2016.

[4] R. A. Nimesha Ranasinghe. *Digitally stimulating the sensation of taste through electrical and thermal stimulation*. PhD thesis, 2012.