Eyewear to Make Me Smile – Can Electric Muscle Stimulation increase Happiness?

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Abstract
This paper suggests a prototype system making users smile using electrical muscle stimulation (EMS). We present design considerations, our approach, and the current system setup. We continue to describe our first insights into using an unobtrusive EMS setup to stimulate smiles and show first findings from our entry in this year's UIST student innovation competition. We also outline our approach and follow-up experiments to potentially use this technology to improve user's mood.

Author Keywords
Electric Muscle Stimulation; Smile; Smart Glasses

ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous

Introduction
With the increases in mental issues and disorders on the rise, we want to explore if we can change or better enhance our mood using technology [3, 6]. Given James-Lange Theory of Emotion that suggests that physiological reactions can induce feelings and emotions, people can feel happier just by smiling more throughout the day [2]. We want to create technologies to manage better our affect. This paper presents an initial small step towards that direction.

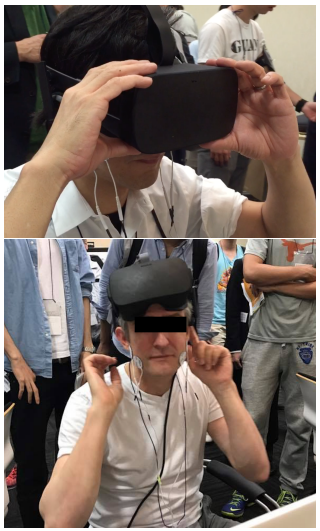

Figure 1: Setup and pictures from the student competition

Our contributions are as follows: (1) we evaluate if it's possible to induce smiles using a relative unobtrusive Electric Muscle Stimulation (EMS) setup, (2) we discuss a electrode placements and other issues suitable for inducing smiles with the potential to integrate them in a smart glasses design, (3) we show insights learned from participating in the UIST student innovation competition with our prototype system, (4) we present an initial experimental design to evaluate if induces smiles from EMS can actually change the user's emotion.

Overall, we believe it's an important first step to investigate EMS for emotion control.Given we will get clearance from the ethics board of our institution, participants at TEI can try an excellent demonstration of our technology at TEI (after signing a consent form).

Approach

There are already technologies utilizing James-Lange Theory of emotion; most prominently, the Smile-encouraging digital appliances by Tsujita and Rekimoto [9]. However, their approach is to "force" the user to smile for interactions with digital devices. For example, to turn your alarm clock off in the morning you have to smile to your alarm clock.

Our approach is different. We are following embodiment theory and some indication of psychology that it might be possible to induce emotions by physically changing your appearance using external stimuli. In our case by making you smile using electric muscle stimulation. Of course, the movement is very different from a voluntary or "forced" smile (like in Tusjita's work): only a few muscles can be activated etc. Yet, there is interesting work from Barrett et al. in constrained psychology lab studies that it might be feasible [1].

In this paper, we are introducing our first step to induce smiles with unobtrusive hardware. In a next step, in future work, we will evaluate the mental effects of EMS.

Student Competition Entry: FaceCook

We participated in a Student Innovation Competition at UIST a large international HCI conference with an application to induce smiles using EMS. The basic idea for our competition entry was to create a game between 2 users. One user is in a virtual environment and gets different smile intensities (smirk, smile, stronger smile). See Figure 1 for pictures from the competition. A user outside of the virtual environment has to guess which smile intensity the other user sees. Our entry won the "Innovative UI Award" in the competition. In the following we will go over the system setup as well as the initial trials during the competition.

Experimental Setup

We use a modification[1] to the EMS toolkit prototype by Peiffer et al. [7].

To generates a smiling facial expression by actuating the usersâĂŹ facial muscles with an electrical muscle stimulation (EMS) unit. This unit provides 2 independent channels with an intensity of up to 70 mA. Each channel has 2 round electrode pads sized 32mm in diameter.

Electrode Placement

The electrodes were placed on specific locations of the cheek to maximize the cheek muscle stimulation. These locations were selected due to the nerve position on the human face, as shown in figure. In order to generate a smiling facial expression, we put electrode pads around zygomatic branches and buccal branches.

[1] http://plopes.org/ems

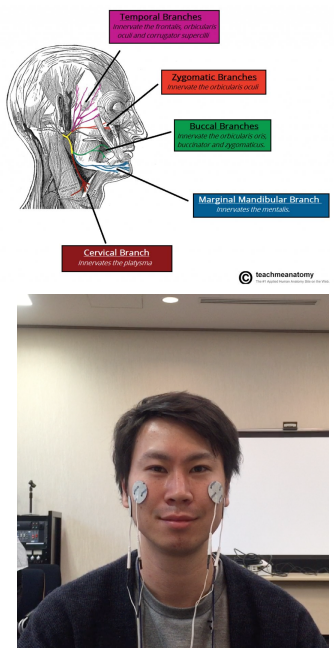

Figure 2: The top schematic shows the facial nerve. ⓒⓄ 2015-2016 TeachMeAnatomy.com [CC-BY-NC-ND 4.0] The second picture shows the electrode placement used in our trials: we put electrode pads at the zygomatic branches and buccal branches to induce the smile

We conducted an experiment on 23 participants in the Student Innovation Contest held at the large international HCI conference.

Initial Experiments

As inducing smiles is highly dependent on the right electrode placement and time for the placement was limited (to 1-2 minutes per participant), it was unfortunately unpractical to play the game as introduced above. Therefore, in each trial, we set up a virtual environment using the Oculus Rift head mount display(HMD) with 3 videos presenting different levels of smiling/laughing faces. Each video triggers a different intensity of electrical stimulation which generated different facial muscles movements on the participants.

Initial Results

8 participants had their cheek muscles stimulated accurately to create a smiling expression of three levels. For 14 participants we could see a "smiling effect" (twitching) for the correct facial muscles, however the 3 stages for smiling were not distinguishable. For one participant we could not induce an effect at all. This seems at the first glance not so encouraging, however given the short setup phase (1-2 minutes) to find the right muscles. We believe that this can be improved. After the competition we found also another electrode placement (placing the second electrode on the lower cheek underneath the mouth) that seems to work more reliable for a quick setup (and for some application field). Yet, we will continue to use the previous setup as it is better integratabtle in a smart glasses design.

In the following we give a couple of qualitative statements from the participants. The participants stated that "With this system, I feel it is easier for me to smile." And one of the participants also described the feeling as "It is tricky because I did feel that I was smiling more when my facial muscles moved but the stimulation also made me feel uneasy." For the content in our experiment design, some participants thought "It is good that the stimulation and the content were showing the same level of smiling/laughing. It made the system easier to understand." However, one of the participants commented that it was difficult to differentiate between the effectiveness of the system, or the general idea of the proposed work that was amusing, that caused him or her to smile.

Next Steps

The major next steps are for us to make the smile stimulation over EMS more reliable. Here we made already a couple of improvements, as it's easier for us to find the right positions for the electrodes. Also just increasing the time for electrode adjustments to around 5 minutes already helps (not possible during the contest).

The most interesting follow up research is of course if changing a user's face using EMS actually can influence their perceived happiness over a short or longer time. Here we will follow the controlled experimental setups from psychology first and assessing the effects for shorter durations [1].

If these experiments go well, we will integrate the technology in a smart eyewear design and will explore long term, more unconstrained mood effects using an EMS glasses design (as shown in the sketches in Figure 3).

Related Work

As mentioned before the closest to our work is Tsujita et al.'s research using smiles as an interaction modality and "happiness counter" [9].

Regarding EMS, there is also exiting research using it for interactive systems as an output modality from pedestrian cruise control to guiding drawings [8, 5].

Figure 3: Concept: from electrodes to a smart eyewear device to induce smiles

There are a couple of psychologists, most prominently Barrett and Ekman, assessing the effects of inducing smiles over EMS [1, 4]. We see these studies as complimentary as they strengthen our hypothesis about the emotional influence of smiling, however they are conducted in highly constrained lab environments with more obtrusive setups (more electrodes etc.).

We are unaware of any work that uses EMS in the face as a interaction technology.

Conclusion

We have presented our first insights in how to use EMS to stimulate smiles and showed first findings from the student innovation competition at a large international HCI conference.

We believe that EMS is an interesting technology to evaluate in terms of embodiment and would like to show our findings and spark discussions demonstrating our system for the TEI community.

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REFERENCES

1. Lisa Feldman Barrett. 2012. Emotions are real. *Emotion* 12, 3 (2012), 413.
2. Walter B Cannon. 1927. The James-Lange theory of emotions: A critical examination and an alternative theory. *The American journal of psychology* 39, 1/4 (1927), 106–124.
3. Alain Ehrenberg. 2016. *The weariness of the self: Diagnosing the history of depression in the contemporary age*. McGill-Queen's Press-MQUP.
4. Paul Ekman, Richard J Davidson, and Wallace V Friesen. 1990. The Duchenne smile: Emotional expression and brain physiology: II. *Journal of personality and social psychology* 58, 2 (1990), 342.
5. Pedro Lopes, Doăa Yüksel, François Guimbretière, and Patrick Baudisch. 2016. Muscle-plotter: An Interactive System based on Electrical Muscle Stimulation that Produces Spatial Output. In *Proceedings of the 29th Annual Symposium on User Interface Software and Technology*. ACM, 207–217.
6. Mark Olfson, Benjamin G Druss, and Steven C Marcus. 2015. Trends in mental health care among children and adolescents. *New England Journal of Medicine* 372, 21 (2015), 2029–2038.
7. Max Pfeiffer, Tim Duente, and Michael Rohs. 2016. Let your body move: a prototyping toolkit for wearable force feedback with electrical muscle stimulation. In *Proceedings of the 18th International Conference on Human-Computer Interaction with Mobile Devices and Services*. ACM, 418–427.
8. Max Pfeiffer, Tim Dünte, Stefan Schneegass, Florian Alt, and Michael Rohs. 2015. Cruise Control for Pedestrians: Controlling Walking Direction using Electrical Muscle Stimulation. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. ACM, 2505–2514.
9. Hitomi Tsujita and Jun Rekimoto. 2013. Smile-encouraging digital appliances. *IEEE Pervasive Computing* 4, 12 (2013), 5–7.