Wearable System for Generating Mediated Social Touch through Force Mapping

Xin Zhu, Tiantian Feng, Heather Culbertson

***Abstract*—Due to the COVID-19 crisis, social distancing has been a necessary and effective means of reducing disease through decreased close human contact. However, there has been a corresponding increase in touch starvation due to limited physical contact. Our research seeks to create a solution for allowing individuals to safely communicate through touch over a distance. Our system consists of wearable sensors to measure the social touch gesture, which is then processed and sent to an array of voice coils in an actuator device.**

In this demo, we present a wearable system (Fig. 1) for generating mediated social touch through forces mapped from a sensor array to actuator array. The aim is to generate complex human touch using voice coil actuators, taking advantage of haptic illusions [1] that can create the sensation of motion across the skin when only normal indentation is applied. Our system records touch applied to a pressure sensor array, measuring the applied forces and mapping them to signals to be displayed using normal indentation with an array of voice coil actuators.

We created separate sensing and actuating systems designed as sleeves to be worn on the lower arm, both covering the same area of sensing or actuating. The applied gesture is measured using an 2×4 array of force-sensing resistors (FRS) (Sparkfun, SEN-09376), which are embedded in the sensing sleeve. When the user applies a touch to the sensing areas, the signals are transmitted into voltage readings, which are read into a Sensoray 826 PCI card at a frequency of 1 kHz. Calibration is performed before each data collection and the signals are low-pass filtered at 10 Hz to remove noise. Different signal processing strategies are applied to make gestures realistic and smooth since there is difference in the gesture patterns. For example, processing a stroking motion involves identifying and tracking the moving center of pressure, whereas a poke involves only a single sensor. Fig. 2 shows an example of a poke gesture on a single FSR.

These processed signals are then sent to voice coil actuators (Tectonic Elements, TEAX19C01-8), which are embedded in the actuator sleeve in a 2×4 array, and used to apply normal force to the skin. These actuators have been shown to be effective at generating human-like forces in previous work [2]. The inside of actuation sleeve is shown in Fig. 1. After processing, the gesture signals are replayed at 1 kHz. Our system is capable of generating 6 common social touch gestures. During the live demo, audiences will get to understand how the signals are generated through force sensing sleeve. We will have the FSRs ready and signals will be plotted before they are sent to actuation sleeve. The inside structure of actuation sleeve will be exposed to show how the voice coils cooperate with each other to generate a gesture. Audiences will get a taste of multiple gesture patterns.

[xinzhu, tiantiaf, hculbert]@usc.edu, Department of Computer Science, University of Southern California, Los Angeles, CA, USA.

Fig. 1. System Setup: (top-left) person with sensor sleeve, (top-right) person with voice coil sleeve, (bottom) voice coils inside the actuation sleeve.

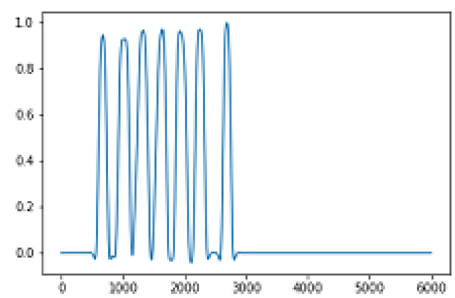

Fig. 2. Example of a poke signal after processing.

References

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[2] H. Culbertson, C. M. Nunez, A. Israr, F. Lau, F. Abnousi and A. M. Okamura, "A social haptic device to create continuous lateral motion using sequential normal indentation," Proceedings IEEE Haptics Symposium, 2018, pp. 32-39.