

Emotional Touch

- A novel interface to display "Emotional" tactile information to a palm -

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Introduction

Recently, specifications for handheld devices have been dramatically improved. As the information has become richer, we need to consider a new type of user interface that will co-exist with existing interfaces. These might be audio and visual interfaces that are sufficiently intuitive to reduce a user's load. A tactile interface is one such possibility.

Many projects have attempted to develop haptic/tactile sensations in handheld devices [1][2][3]. Although these approaches succeeded in presenting literal information, the quality of the sensation is not high and users can feel just a single or only a few kinds of sensations.

There are two types of resolution in a tactile display; spatial and temporal. Conventional tactile displays, such as Braille, seek to achieve higher spatial resolution to display rich "literal" information. We call these, "temporally low, spatially high resolution" tactile displays. On the other hand, as with conventional "wearable" tactile displays, because of limitations of mounting space and power source, one or just a few vibration motors or solenoids are used. Thus, temporal bandwidth is notably narrow. We call these "temporally low, spatially low resolution" tactile displays. In a different approach to these tactile displays, our goal is to display "emotional", not "literal" information. Because handheld devices already can present figures, photographs, and video through visual displays, they do not need to present shape by tactile sensation. For our goal, temporal bandwidth is much more important than spatial resolution. Our strategy is thus to present richer expressions of tactile sensations by improving the temporal bandwidth while keeping the spatial resolution low (Figure 1 right).

Method and System Configuration

Our basic strategy is for a user to hold one or two speakers with their hands while an rubberized band around the circumference of the speaker cone seals the air between the palm and the cone (Figure 1 left). If the cone of the speaker is pulled, the user feels suction, or negative pressure. If the cone is pushed, the user feels positive pressure. By controlling frequency and amplitude, our system can present temporally rich tactile sensations.

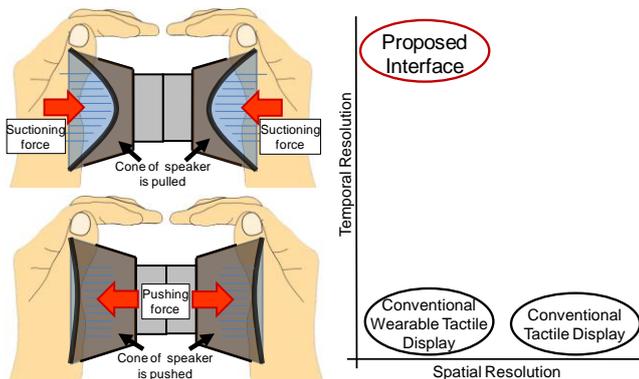


Figure 1. Left: Method of our system

Right: Feature of conventional tactile display and the proposed interface

We used a speaker in our tactile device because it has great potential for actuating from very low (about 1Hz) frequencies to very high (about 20kHz) ones. In our method, the speaker presents very soft and comfortable tactile feelings at 1-30Hz. Normal vibrations are felt at 30-1kHz. As a speaker can obviously present sound, it is a simple and natural multimodal interface device.

Using air pressure also has another merit. For a mechanical tactile display, the spatial distribution of any distortion is not uniform. Users then experience

some sort of "shape", which can be unnecessary and cumbersome information. Conversely, when we use air pressure, we can present purely uniform pressure onto the palm, and the user feels only the pressure without any feeling of edges.

Our prototype is composed of one or two speakers, a force sensor, an acceleration sensor, a microprocessor board, and a stereo amplifier (figure 2). In this system, the microprocessor generates sinusoidal waves. A sound play unit also generates sound waveforms. The two waveforms are synthesized and transmitted to the speakers via a stereo amplifier. The values of the force sensor and the acceleration sensor are monitored by the microprocessor. Thus we can change frequency and amplitude of the wave through these values in real time.

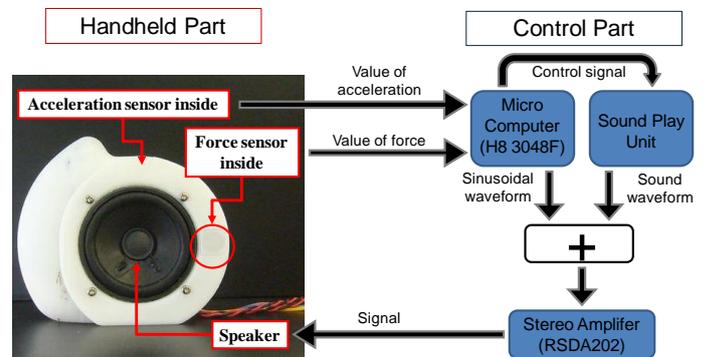


Figure 2. Overview of our system

We have already demonstrated our system, with about a hundred people experiencing it to date. From the 1 to 30Hz frequency vibration, most people felt a soft tactile sensation to the palms; rather like living matter. They described it as a marvelous sensation that something living seemed to be in between their palms. As a result of other application using two sensors people felt as if some liquid or small object was moving inside the device. This type of feeling of "physical dynamics" has previously been presented by haptic (force) displays; our system, however, just stimulated tactile or skin sensations.



Figure 3. Scene of experience

Clearly, our system is able to present very rich tactile sensations so that users can imagine some sort of a living matter is present. We achieved this by using a temporally high, spatially low resolution tactile presentation.

References

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