i-me TOUCH: Detecting Human Touch Interaction

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Abstract

i-me TOUCH is able to detect when one human touches another. By observing the different patterns of conductivity between two humans, the system is also able to record touch gestures such as tapping and rubbing. It detects tap gestures with 95% accuracy and rub gestures with 92% accuracy. And, a new idea is developed in this paper. That is the ability to detect when one person touches his or her own body. As a principle of operation, we extend the "Body as an Antenna" concept (developed by [Cohn et al. 2011]), but focus on the case of human-to-human touch. The approach used by [Sato et al. 2012] is accurate and can determine the type of substance. Our prototype and some preliminary experiments are discussed in this poster.

CR Categories: H.5.2 [Information interfaces and presentation]: User Interfaces—Input devices & strategies

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We are interested in designing a wearable touch sensor that only responds to humans. The i-me TOUCH is minimal in that outside of the sensor, no other special devices are used. Because the sensor is light, there are many possible places on the body it can be worn (such as wrist, ankle, ear, etc.). According to a formula by [Du Bois and Du Bois 1916], a human being's skin surface area can be approximated by height and weight. For instance, a person who is $170cm$ and $65kg$ has approximately $1.75m^2$ of skin. That's quite a bit, so why not use this surface area?

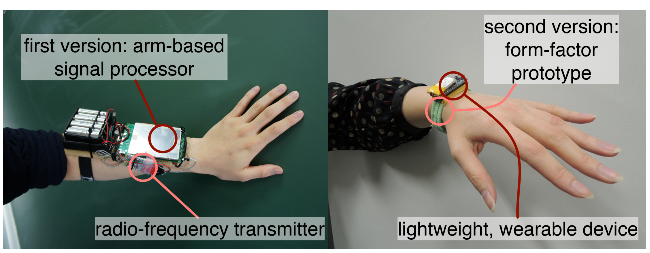

Figure 1: *Two iterations of i-me TOUCH, showing the shrinking form-factor.*

When a human approaches the antenna of an analog radio or television they can alter the signal reception. This ability to interact with the near field of a radio-frequency antenna is exploited by devices such as the Theremin. We became interested in this and related bioelectric phenomena. We began experiments to duplicate the human-antenna effect making use of our own radio-frequency beacon. Figure 1 above shows the first prototype. A Faraday cage shields the transmitter and is used as a reference signal for the receiver. An electrode from the transmitter is attached to the wearer's skin, effectively making his or her entire body an antenna. The received signal varies when conductive substances come in contact with the wearer including other humans. This early version was tested with $N = 11$ participants to detect tap gestures with 95% accuracy and rub gestures with 92% accuracy. The poster accompanying this paper shows that hand gestures are detected by variations of an intensity. And now, our new i-me TOUCH focuses on the phenomena that the received signal varies its power. Theremin and our old i-me TOUCH use an oscillator as a special device to emit an electromagnetic wave and that makes the system bigger and heavier. If the environmental noise from electrical goods, which is 50Hz (in Japan), can be used and no other device is needed, the system can take advantage of this phenomena and also be made more lightweight and useful to wear. We imagine i-me TOUCH being used in crowded places, which usually have environmental noise. The principle of operation for our new prototype is to allow the human wearer to manipulate the reception of environmental noise by his or her own body movement. To observe how the noise works when human's approach, we made some preliminary experiments. Figure 4 on the accompanying poster shows that when i-me TOUCH is given some mechanical vibration, the noise becomes bigger. The i-me TOUCH uses electrodes whose contacts are physically changed when mechanical force (such as a bump) is applied by the wearer or another person. Figure 5 on the poster shows that the received signal's power is varied when the i-me TOUCH is brought near wearer's other hand. By using this, like the Theremin, the i-me TOUCH can detect the wearer's gestures. Of course, more experiments are needed to understand how the motion artifacts can be used for interaction.

The i-me TOUCH is still a work-in-progress and many open research questions remain. One matter that we have not settled is the precise unit of measure for the sensor's readings. Our experiments looked at touching, rubbing, and clapping as input gestures but new experiments might consider a wider variety of gesture types using a real-time classifier. We feel further research rooted in bioelectric phenomena may lead us to a better understanding of our own mysterious skin.

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