i-me TOUCH

Detecting Human Touch Interaction

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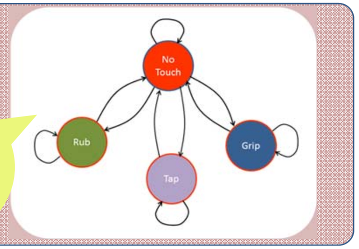
Flow Chart



Abstract

i-me TOUCH can detect when one human touches another. By observing the different patterns of conductivity between two humans, the system can also 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 here, the ability to detect when one person touches his or her own body. As a principle of operation, we use the body as an antenna concept.

Our prototype and some preliminary experiments are discussed in this poster.

Introduction

Idea: Human as antenna

When a touch sensor is used as part of interaction the focus is often on a computer system that acquires a human's touch as input. However, humans touch other things besides input devices. Cohn *et al.* proposed the "Body as an Antenna" concept, and we extend this idea to focus on the case of human-to-human touch.

Accuracy of touch sensors

The approach used by Sato *et al.* is accurate and can determine the type of substance but their device isn't wearable. 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.).

Skin is our large space

According to a formula by Du Bois *et al.*, a human's skin surface area can be approximated by height and weight. For instance, a person who is 170 *cm* and 65 *kg* has approximately 1.75 m^2 of skin. So why not use this surface area?

Operation

1. When a human approaches the antenna of an analog radio or television they can alter the signal reception. 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 (Fig. 3). A Faraday cage shields the transmitter and is used as a 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.

2. 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 50 *Hz* (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.

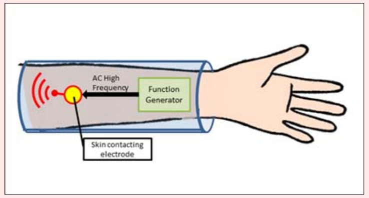


Figure 1: our system's components

- 20 *cm* x 6 *cm* x 4 *cm*
- 500 *grams*.

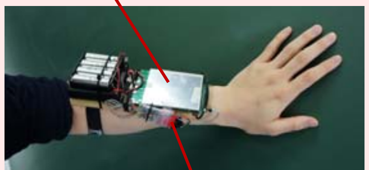


Figure 2: the first prototype

A Faraday cage houses an RF transmitter using a 5 volt sine wave at a frequency of 1 *MHz*.

- 4.5 *cm* x 2 *cm* x 2 *cm*
- 15.5 *grams*.

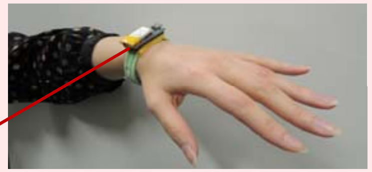


Figure 3: the second form-factor prototype

Experiments

Experiment 1: Early version's performance

conditions

* Indoor environment
* N=11 participants
* function generator: Agilent 33220A
* frequency: 1 *MHz*
* ADC: 10-bit ATMega328
* an electrode on the back of examinees' left hand with Parker SIGNAGEL

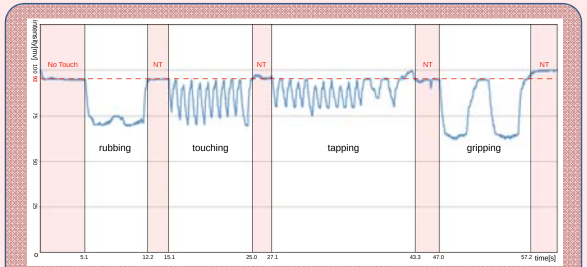


Figure 4: detected hand gestures.

It can detect different gestures. The gestures here are hand labeled.

results

- tap gestures detection rate: 95 %
- rub gestures detection rate: 92 %

Experiment 2: How the noise works during self-touch gestures

conditions

* Indoor environment
* preliminary data
* same ADC as experiment 1

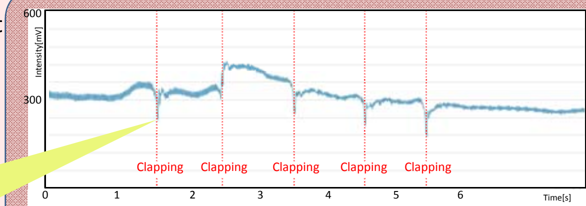


Figure 5: detected clapping gesture

Some mechanical vibrations make the noise bigger.

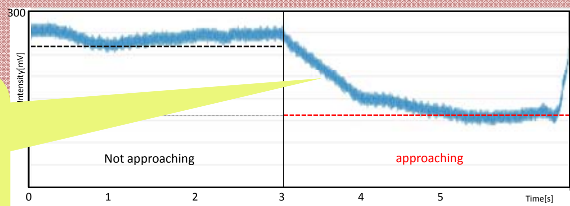


Figure 6: detected hand approaching

The received signal's power is varied when the i-me TOUCH is brought near wearer's other hand.

Related Work

[1] COHN, G., MORRIS, D., PATEL, S. N., AND TAN, D. S. Your noise is my command. 2011.

[2] SATO, M., POUPYREV, I., AND HARRISON, C. Touché. 2012.

[3] DU BOIS, D., AND DU BOIS, E. Clinical calorimetry: tenth paper a formula to estimate the approximate surface area if height and weight be known. 1916.