Enhanced Touch: A Wearable Device for Social Playware

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1. INTRODUCTION

Physical touch is a fundamental element of human communication and several benefits and positive effects were reported at the communication and therapeutic domain such as Positive Touch and Deep Touch Pressure, for instance [1]. Typical symptoms of autism among children include avoiding direct touch with other people in addition to the tendency to lone activities. Some studies reported that training of touching by therapists contributes in the alleviation of these symptoms. In those studies, measuring the time of touching is vital, but is only done by visual checking. Until today, there is no actual equipment for this purpose, although the device [5] can be used in similar cases, but its usability is still restrained, due to the limitation that all participants should grasp the device together.

In addition to the development of several Social Networking Services (SNS), communication between people was also rediscovered in the sense of direct contact between people. Nevertheless, only few devices that support direct communication like [5] between people were developed. These device will support direct communication between people by inducing touching with appropriate feedbacks. We have been investigating "Social Playware" which aims at flexible sensing and encouraging interaction among people by using devices in order to provide social interaction (see also [2]). In this study, we propose a novel wearable device for sensing physical contact among people. The device is realized to detect and record the touches of users by simply wearing the device on their wrists (See Figure 1). Also, the device is designed to motivate touching among users by lighting LEDs or by playing interactive social games. We believe that the proposed device can be practically used not only in the entertainment domain but also in building and rehabilitating of social behavior of children.

2. SYSTEM OVERVIEW

To detect touching between people communication through human body is used in our proposed method. We use the

Figure 1: Enhanced Touch: Sensing touches and identifying others can be done by the wearable device with electrodes.

communication technology based on personal area network [3], which was often used for communication between humans and objects but it has not yet been utilized for sensing physical contact among people. The developed bracelet-type device consists of microprocessor, electrodes, amplifier, analog switch, LEDs, battery, among others. The six full color LEDs are installed in the bracelet, and other components are installed in a small case (See Figure 2). The pair of electrodes is located on the inside of the case as to fit the wrist the best.

An analog switch is used in order to share the conductor (human body) and the electrodes among transmitting and receiving procedures. The microprocessor in each devices communicates with other microprocessors using a specific protocol. It have been found earlier that 10 [MHz] signals can be conducted through human body quite effectively [4], thus we modulated the transmission signal by On-off keying with a 10 [MHz] square wave. the received conducted signal is first amplified and demodulated, and then handled by the microprocessor. Every microprocessor tries to transmit a synchronous signal at random intervals within 10 [ms] to detect if touching has occurred and to synchronize with other device. And when the microprocessor is not transmitting, it will be waiting to receive signals from other devices. This synchronous method is required because there is no master-slave relationship in this type of communication.

Figure 3 shows an example of the communication procedure between two devices. The phase (a) indicates the no synchronization period, where the devices try to transmit at random intervals, but these transmissions are not synchronized since the transmission channel has not been established yet. In phase (b), the transmission channel is established, but the synchronization is faulty because of a collision

Figure 2: Overview of the developed device.

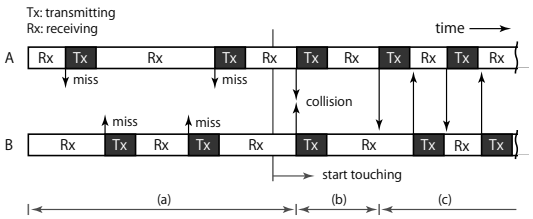

Figure 3: Procedure of communication between two developed devices.

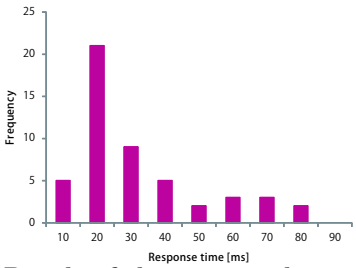

Figure 4: Result of the measured response time.

Figure 5: Physical Contact Network: Correlation diagram from measured data.

between transmitted signals. In phase (c), the synchronization finally succeeds, and the two devices can communicate smoothly. So, each device detects touching according to the synchronization with other device. By using this method, the proposed device does not require any cables, and it can exchange data such as users IDs simply and effectively.

Another feature which is color mixing is implemented for visual feedback. Each of the devices has a unique color, the three primary colors (Red, green, blue) for instance. When users wear the devices and touch each other by their hands, the devices light up LEDs each with its unique color. The colors are then blended gradually as long as the touching lasts. In other words, the degree of color mixing expresses the duration of the touching time, and finally, the LED colors in the two devices in touch become united. This manner of lighting allows our proposed method to measure the duration of physical contact along with the device's ability to identify other devices.

3. VALIDATION

The response time of the developed device has some variance of its expected value because of possible collisions. Therefore, we conducted an experiment to measure the response time. We defined the response time as the period of time from the moment the touching occurs to the moment the LEDs of the device are lit up. The subjects were two males in their twenties, and they touched each other by the tip of the fingers. The experiment was recorded by a high-speed camera with 1200 [fps], and the time was calculated from the number of frames between those two actions. Touching was done fifty times. The histogram of measured response time is shown in Figure 4. The horizontal axis shows response time, and the vertical axis shows the number of touches belonging to each response time. The average of response time is 27.7 [ms], and the standard deviation is 19.2 [ms]. The minimum value is 6.7 [ms], which is almost equal to the transmitting time plus receiving time, thus the value is valid. The maximum value is 80.0 [ms]. These results show that the response is good enough for recording daily life touching or for games that include touching activity, even in the worst case of response time.

4. POTENTIAL APPLICATIONS

The device will be able to record and show the physical contact log among people, such as the number of shake-hands and/or amount of touching time over a long term. These logs show the degree of friendship or relationship among people. For example, it can be shown as a correlation diagram among users by exporting the data to another device with display such as a smart phone. A correlation diagram is shown in Figure 5. Where the circles indicate users, and the lines show the relationship among these users as the line's width indicates the degree of friendship between two users. Such application will provide a new measuring method of relationship in an easily understandable way.

5. REFERENCES

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