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Sense-Roid: Emotional Haptic Communication with Yourself

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Abstract—**What type of emotions could be obtained if you were able to hug yourself? When we hug someone, we feel a sense of ease coming from emotions such as belief, security and love. However, it is not possible to hug oneself, who is the closest person. To experience this situation, we proposed a tactile device called the Sense-Roid. The system is composed of a lay figure with tactile sensors to detect the user's caressing motion, and a tactile jacket with vibrators and artificial muscles to reflect the caressing motion to the user. As a result, users caress themselves through our Sense-Roid. We believe that this self-caressing experience will enlighten people about the value of caressing.**

Keywords-communication; haptic; intrapersonal; tactile

I. INTRODUCTION

Hugging someone gives people a great sense of ease. This fact indicates that haptic communications such as touching, stroking and caressing are one of the basic communication channels that sometimes are more effective than verbal or visual communications such as conversation or eye-contact.

On the other hand, there is a limitation to hugging. It always requires a partner for the experience. Furthermore, telling a partner how to react is quite difficult, since verbalizing the haptic experience and reproducing are difficult tasks.

We have developed the idea of using "oneself" as a partner, since each individual knows themselves best.

II. RELATED WORK

Currently, there are a lot of tactile communication devices that transmit presence and warmth. Brave et al. [1] developed inTouch that feels others' motions in a hand by sharing a remotely connected roller operation. RobotPHONE [2] can transmit gestures via movement of stuffed animals. These approaches achieve tactile communication using a commonly held "tool" that is outside of our body.

On the other hand, other inventions have achieved a more direct tactile transmission by reproducing embracement. Huggy pajama [3] tries to represent an embracing feeling to a child from a distance, by expanding a jacket with air. HaptiHug [4] enables embracement in the 3D VR world such as Second Life [5], by feedbacking embracement to the user's chest, which is synchronized with the avatar's embracement.

All these devices have tried to achieve tactile communication with a remote user. However, tactile communication with oneself has not been investigated. Therefore, we developed a device to communicate with oneself.

III. TECHNOROGY

A. System configuration

The system consists of the humanoid device "Sense-Roid" and a tactile jacket. An overview of the system is shown in Figure 1.

Figure 1 Tactile jacket and Sense-Roid

The system configuration is shown in Figure 2. Embracing and stroking actions by the user to the Sense-Roid are detected with built-in pressure sensors and micro switches, and fed back through the tactile jacket that the user is wearing. There are actuators to feed back hugging and caressing sensations inside the tactile jacket.

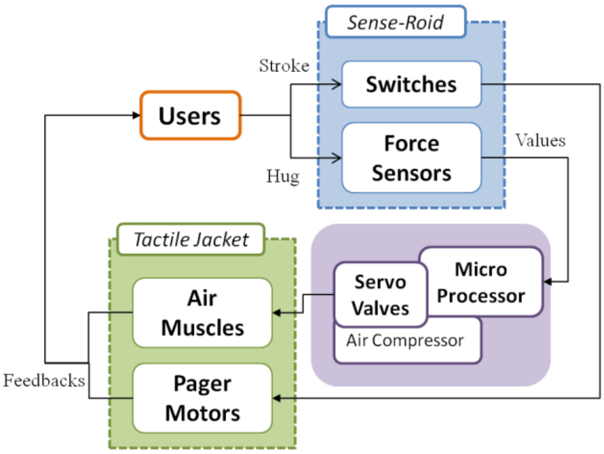

Figure 2 System overview

B. *Sense-Roid*

The Sense-Roid is shaped like the human upper body and is covered with silicone skin. The hardness of the silicone skin is set close to the human skin.

Two types of sensors, pressure sensors and micro switches, are embedded. They sense low frequency and high frequency components of tactile information, which are associated with hugging and caressing motions of the user (Figure 3).

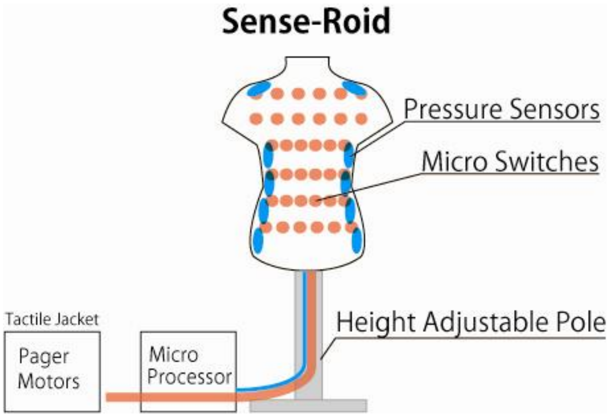

Figure 3 Sense-Roid

C. *Tactile Jacket*

A strong output force is necessary for the reproduction of hugging; however, the softness of human hugging is also required. Therefore, we adopted the McKibben actuator, which is a type of artificial muscle [6][7]. This actuator expands in the direction of the diameter and contracts axially by sending air using an air compressor (Figure 4).

Figure 4 McKibben actuator

These expansions and contractions compress the user's body, achieving a natural embracing sensation (Figure 5). Because the range of motion of a McKibben actuator is limited, the possibility of damaging the user is low, even if the air compressor accidentally does not stop. Air flow to the actuator is controlled by a valve attached to servo motors. The motion of the servo motors is controlled by a microcomputer (H8-3052F, Renesas). The microcomputer monitors pressure sensors inside the Sense-Roid to drive servo valves depending on the sensor's value.

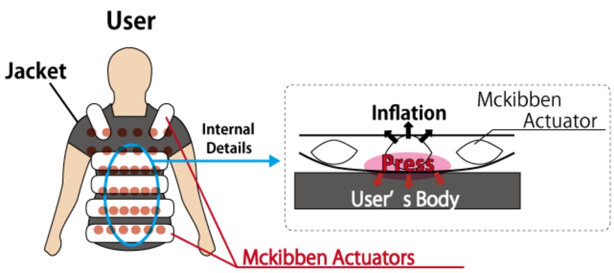

Figure 5 Overview of the hugging system

The jacket has six McKibben actuators embedded; one for each shoulder and four are arranged from the chest to the abdomen in parallel. This configuration was determined by observing real hugging. Each actuator is driven independently. Therefore, it is possible to reproduce various form of embracement by driving actuators with arbitrary combinations.

D. *Stroking sensations*

People usually stroke each other's back when hugging. Therefore, our system also has a function that reproduces a stroking sensation on the back part of the jacket. A 6 × 6 matrix of pager motors is embedded in the back part of the jacket to provide stroking sensations (Figure 6). Stroking motions of the user are detected by micro switches placed on the back of the Sense-Roid. The switches and the pager motors are placed with one-to-one correspondence. Thus, the user can obtain a stroking sensation in exactly the same position that they are stroking.

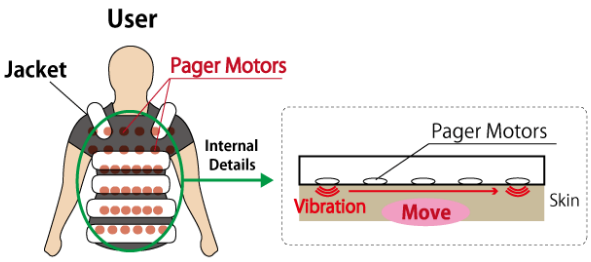

Figure 6 Overview of the stroking system

IV. DEMONSTRATION SCENARIO

A demonstration scenario of the Sense-Roid system is shown below.

1. A user wears the tactile jacket (Figure 7).

Figure 7 Step 1

2. Standing just in front of the Sense-Roid face-to-face, the user starts touching, hugging, and stroking the Sense-Roid (Figure 8).

Figure 8 Step 2

3. These actions are fed back to the user through sensors and actuators of the Sense-Roid system. The user then comes to realize that he/she is actually touching himself/herself (Figure 9).

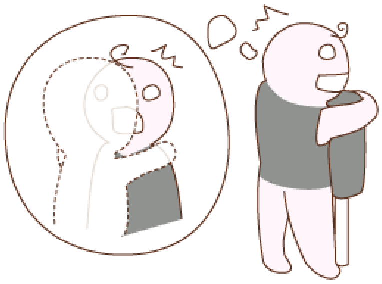

Figure 9 Step 3

4. The user will soon feel comfort of the ultimate "me to me" feedback and be aware of narcissism (Figure 10).

Figure 10 Step 4

V. RESULTS

We have demonstrated our system at several exhibitions and many people have experienced the Sense-Roid. TABLE I. shows the approximate number of visitors and people who have experienced Sense-Roid. Our first exhibition was at the 18th International Collegiate Virtual Reality Contest (IVRC), hosted by the Virtual Reality Society of Japan (VRSJ) [8]. We won first prize among 80 groups of student competitors. We were also invited to the Digital Content Expo 2010 hosted by the Japanese Ministry of Economy, Trade and Industry [9] (Figure 11).

TABLE I. EXHIBITION OVERVIEW

Name of exhibitions	Session	Number of experiences/number of visits
18th International Collegiate Virtual Reality Contest	23–25 Aug 2010	500/1300
DIGITAL CONTENT EXPO 2010	14–18 Oct 2010	800/16000

Figure 11 DIGITAL CONTENT EXPO 2010

According to impressions from people who experienced the Sense-Roid, many people felt mysterious, unpleasant sensations. This is because embracing oneself is an unusual experience for everyone.

VI. CONCLUSION

We have developed a device to communicate with oneself. We demonstrated the system at several exhibitions and a lot of people experienced its use.

We intend to optimize the design of this device to become similar to real human hugging focusing on other elements such as body temperature and material composition.

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