Ants in the Pants
-Ticklish tactile display using rotating brushes-

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Abstract: We create a new entertainment named “Ants in the Pants”. A user can see many ants living in the visual display. When the user’s hand is placed on the display with the original tactile display, the user can feel a sensation as if the ant is crawling up the arm. Our original tactile display is the glove which has a matrix of small motor with brush inside. We have conducted a questionnaire on our work, about 75% people responded “enjoyable” and 54% people responded “realistic”. Moreover, our work was able to entertain most of people regardless of their preferring to ant or his or her experience. We can say “Ants in the Pants” become successful entertainment.

Keywords: Virtual reality, Tactile display, Ticklish, Insect, Ant, Creepy, Glove, Wearable interface.

1. INTRODUCTION

Nobody likes to imagine that insects are crawling over the skin. However, this apparently horrifying situation sometimes leads to certain pleasure. For example, many of us have had the experience of playing with insects when we were children. We caught them, collected them and mounted them on our arms.

This might indicate that an apparently disagreeable sensation can sometimes changes to a funny, thrilling, or even a pleasant experience. The aim of our work is to highlight this fact, and to create a new entertainment that we have, named “Ants in the Pants” (Figure 1).

Fig. 1 Ants in the Pants

The system is composed of a visual display with a touch senor and a wearable tactile display. The visual display presents ants visually, and the wearable tactile display presents ants haptically. A user can see many ants living in the visual display. When the user’s hand is placed on the display with the glove, the ants gather around the hand. Just after the ant reaches the hand and then disappears, the user begins to feel a sensation, as if the ant is crawling up the arm. As ants have a habit of climbing up almost anything, once they started moving on ones hand they would soon move up to the arm. When the hand is raised, the ants crawl back onto the hand. If the user puts his/her hand back on the display for a while, more ants will enter into the glove. If the user feels bad or sick, he/she can easily shake off the ants by shaking the hand.

2. RELATED WORKS

Bugs or insects often appear on the interactive art. “Delicate Boundaries” [1] make us contact with small bugs made of light. The small bugs crawl out of the computer screen onto our bodies. “Phantasm” [2] is an interactive installation that white butterflies in profusion, which are projected to the screen, gather to the light a participant hold. However bugs and insects tend to be hated normally, the works mentioned above offer us a kind of entertainment which playing with them.

Kume et al. [3], make a game that player tramples down a cockroach with wearing the slipper attached two vibrators in the sole. If you trample the cockroach, you can feel vibration under your feet. It is just one of the applications of “Foot interface”, so the sensation that insect crawl on the skin is not this research essence. The tactile displays which focus on the reality of this sensation have never proposed.

Tamura et al. [4] develop the wearable haptic interface which is put on the forearm. They use vibratory motor array to generate pressure touch. This interface aimed to display touching something in the virtual world. Kajimoto et al. [5] develop the wearable tactile interface for convert edge of 2D image to tactile electrical stimulation pattern. User wrap this around his/her head to makes the aspect of 512 electrodes array fit forehead.

But the stimulus given by the legs and antennas of an insect are actually a very soft tickle that previous tactile displays have not been able to generate. So we made our original tactile display specialized in the sensation which insects are crawling over the skin.

3. TICKLISH TACTILE DISPLAY

Our tactile display is a glove with a matrix of motors inside (Fig.2). Brushes made up of two fishing lines with certain elasticity are attached on the motors. In this way a realistic "insect's legs" feeling can be realized. The brushes touch the skin when the motor rotates. After giving the stimulus, the motor rotates backward. The glove covers and wraps the hand and forearm, with the stimulating points arranged on the back of the hand and forearm.

The distance between each motor (20mm) is set to be shorter than the two-point discrimination thresholds on the arm [6]. By using this distance, spatially continuous motion can be expressed.

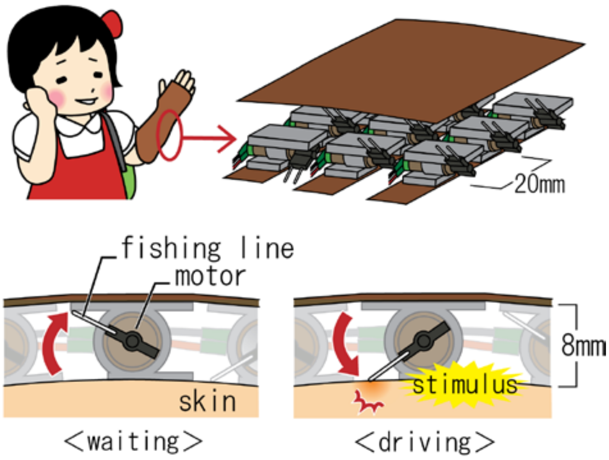

Fig. 2 Method of stimulation

4. SYSTEM OVERVIEW

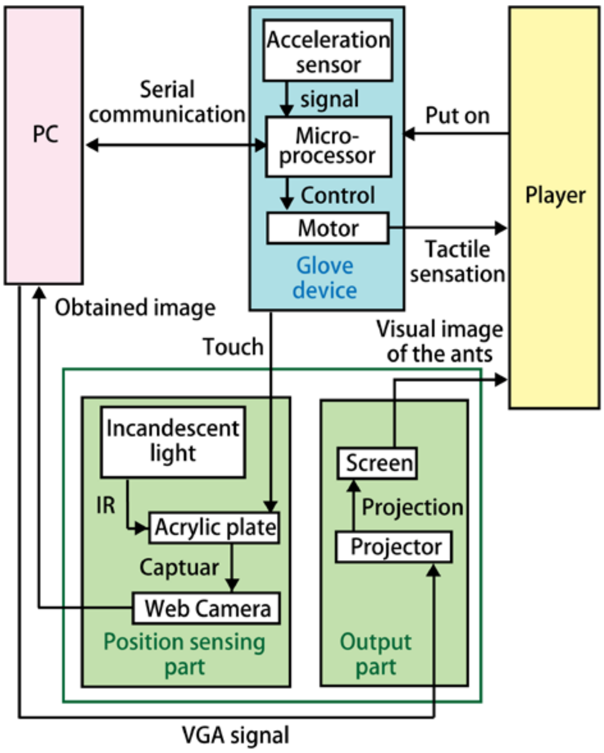

Fig. 3 System architecture

Fig.3 shows the system architecture. Our system is composed of glove device, position sensing part and image output part.

4.1 Implementation of glove device

Inside the glove device (Fig.4), 34 special motor cases are stitched and motors (Matsushita, KHN4NZ1AA) which attached brushes are set in the each case. An acceleration sensor (Kionix, KXM52-1050) is used to measure tilt angle and detect shaking behavior of the glove (Fig.5). The microprocessor (Renesas Technology, H8 3048F) controls tactile motion of the ants by driving matrix of motors. If "tactile" ants fall down from the glove, the microprocessor informs to PC.

Fig. 4 Inside of glove device

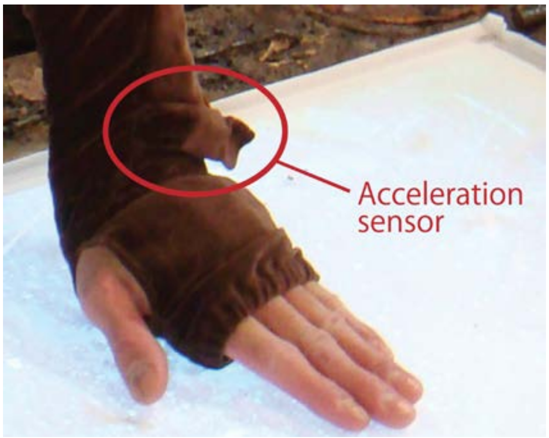

Fig. 5 The position of acceleration sensor

We made following three stimulus pattern.

A) An ant mode
B) Two ants mode
C) Swarm mode

When the microprocessor is informed an ant start to climb up on user's arm, it starts "An ant mode". If the microprocessor is informed one more ant comes in, it starts "Two ants mode". About these modes, the number of ants corresponds one-to-one with number of driven motors. An ant's walking is simulated to drive a left, right, front or back nearby motor every step randomly

(Fig.6). But if the glove are tilted over plus or minus 40-degree, the first ant stop moving the only lower side (It means ant crawl up). The more the glove is tipped the shorter interval of stimulus becomes from about 1000msec to 200msec.

When the microprocessor is informed three ants climb up on user's arm, it starts "Swarm mode". The number of ants not correspond one-to-one with number of motor in "Swam mode", because we suppose it is enough that you don't know how many ants are climb up but you can feel many ants climbing up". So, as can be seen Fig. 7, the three motors are driven every other row from first to third. Next, the motors are driven every other row from second to fourth. We tried to express the feeling of many ants climbing upper gradually by repeating this stimulus pattern. If this stimulus reaches end of the glove, three motors which are selected randomly every time from the upper thee row is driven. The interval of stimulus is always about 200msec.

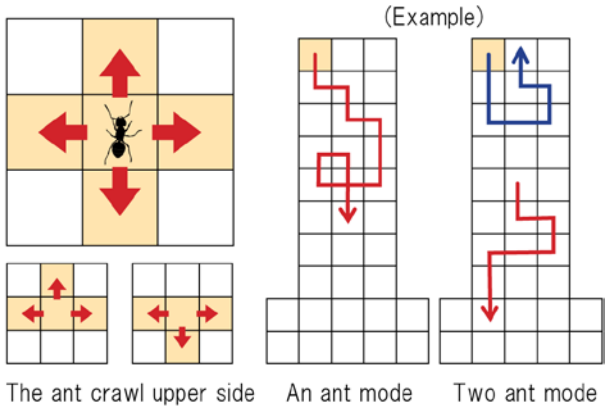

Fig. 6 The pattern of stimulus

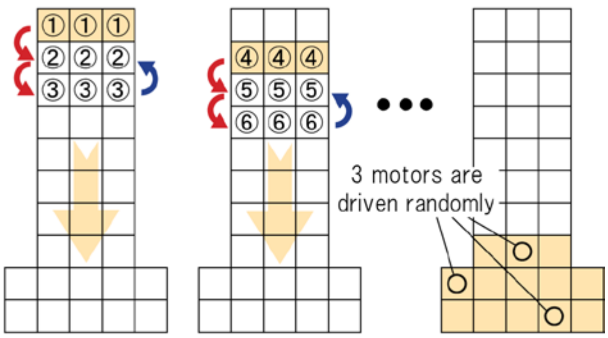

Fig. 7 The pattern of stimulus (Swarm mode)

4.2 Position sensing and image output part

Fig.8 shows the implementation of position sensing and image output part. An incandescent light is radiated from top of the display. If acrylic plate was touch, the shade of the glove was captured by a web camera (Creative, LC-VIP-SE) with infrared transmitting filter (FUJIFILM, IR 80). The obtained image is sent to PC, which determines whether the hand touched the screen, and calculates the contact position. It also controls action of "visual" ants. A projector with infrared cut filter (Kenko, DR655) is connected to the PC, and the visual image of the moving ants is projected on the screen. If an ant reaches the contact position, PC informs to a microprocessor and vanishes the ant image. If microprocessor informs that ants fall down to PC, the "visual" ants appear again. If the glove has no ants or runs "An ant/Two ant mode" with touching screen, an ant nearest to the glove comes. If the glove runs "Swarm mode", all of the ants in the screen gather to the glove.

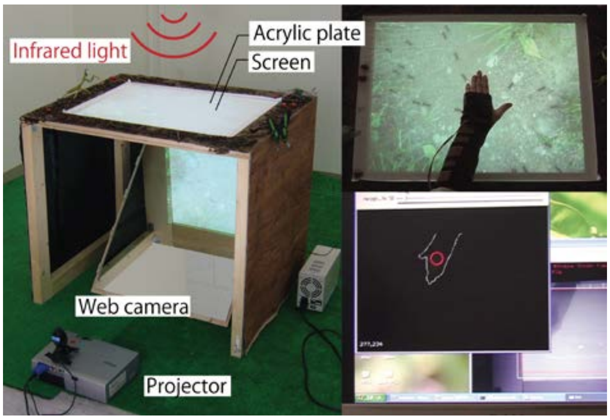

Fig.8 Position sensing and image output part

6. SURVEY

Fig.9 Exhibition of our work at Laval Virtual 2008

We exhibited at Laval Virtual 2008[1] which was held in France from 9 to 13 April 2008 (Fig.9). We have conducted a questionnaire on our work. The number of respondent to a questionnaire is 553. We make respondents to evaluate 5-point scale (1. Definitely no, 2. Sort of no, 3. Moderate, 4. Sort of yes, 5. Definitely yes), expect of the question about age and gender. We make the space at the last of questionnaire which respondents can feel free to write some comments. We show respondents' profile to Fig. 10, contents of questionnaire and average of response score to Table 1.

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1 http://www.laval-virtual.org/

Table 1 Questionnaire and average score

	Question	Ave.
Q1	Have you ever played with or kept ants or other insects?	2.33
Q2	Do you, by nature, like ants?	2.64
Q3	Did you enjoy playing with this work?	4.02
Q4	Do you want to play more?	3.19
Q5	Do you wish to play again when you get a chance?	3.73
Q6	Did you feel like real ants were crawling on your arm?	3.62
Q7	Did you feel that the image of ants was creepy?	1.65
Q8	Did you hesitate to touch the display?	1.53
Q9	Do you think the adjective “exciting” applies to this work?	2.88
Q10	Do you think the adjective “pleasant” applies to this work?	3.28

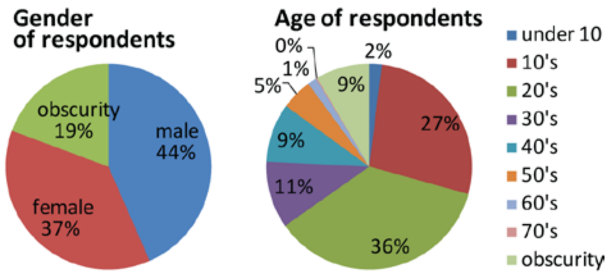

Fig. 10 Respondents’ profile

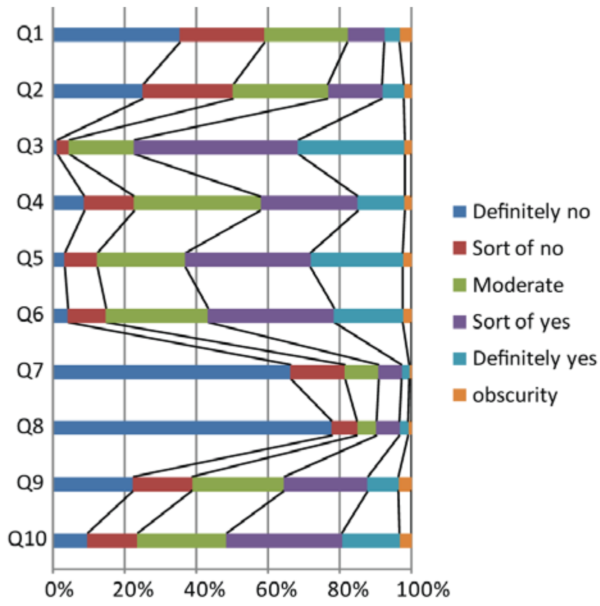

Fig. 11 Rate of respondents who chose each grade

According to Table 1 and Fig. 11, about Q3 and Q5, the many people enjoy and wish to play again our work. The rate of respondents who respond “I enjoyed (score 4 and 5)” is about 75%. In addition, about Q6, about 54% respondents feel like real ants were crawling (score 4 and 5).

We studied the relation of each question. First, Fig.12 shows the graph relating Q6 to Q3. The number of respondents who responded “not enjoyable” is 25 (score 1 and 2). It is under 5% of all. According to Fig. 12, the respondents who evaluate “enjoyable” highly tend to evaluate “reality” highly too outside of score 1. It is not enough to analyze because there are only 6 people who chose 1.We cannot know either that respondents felt reality because of enjoy or that they enjoyed because of reality. But it is sure the glove device which we make for this work accomplished a purpose. And Fig.13 shows the graph relating Q9 and Q10 to Q6. The score is not so high. But it is interesting that the respondents who evaluate “reality” highly tend to evaluate “pleasant” highly too.

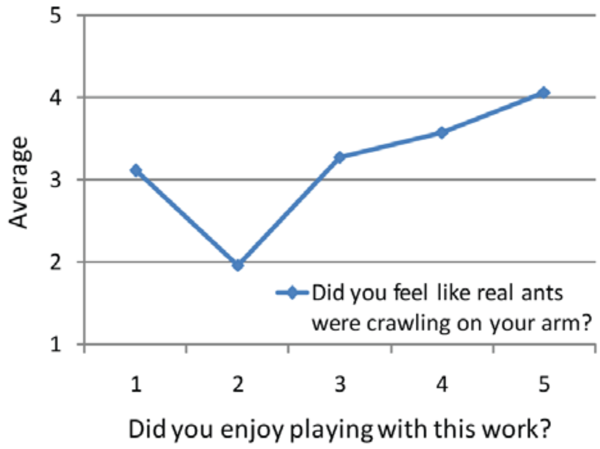

Fig.12 Relation of reality to enjoyable

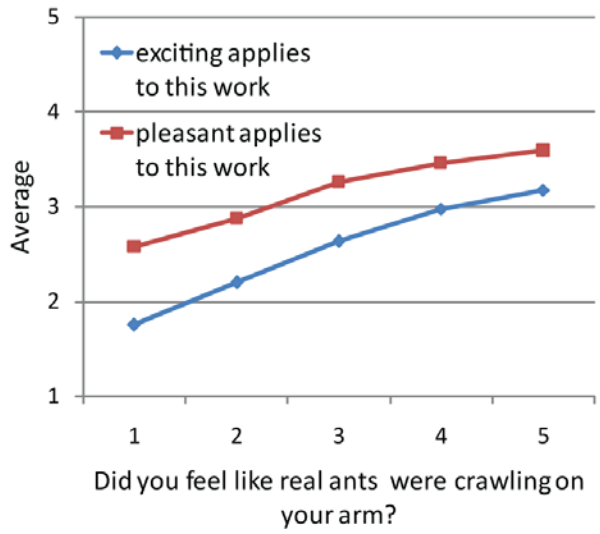

Fig.13 Relation of “exciting” “pleasant” to reality

Next, Fig. 14 and Fig. 15 show the graph relating Q3 to Q1 and Q2. It seems the preferring to ants and have played with ants relate to enjoyable this work. But he slope of collinear approximate is small (about 0.095 and 0.147 respectively). Moreover, most of the respondents who don't like ants in Q2 responded enjoyable (its average is from about 3.8 to 4.0). Therefore, our work can entertain most of people regardless of their preferring or experience.

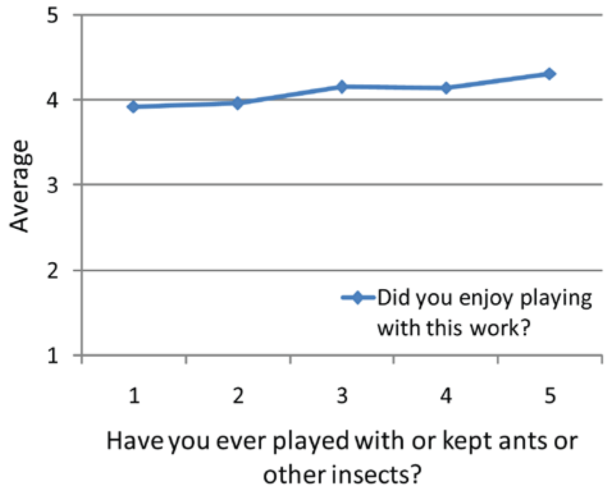

Fig.14 Relation of experience to like ants

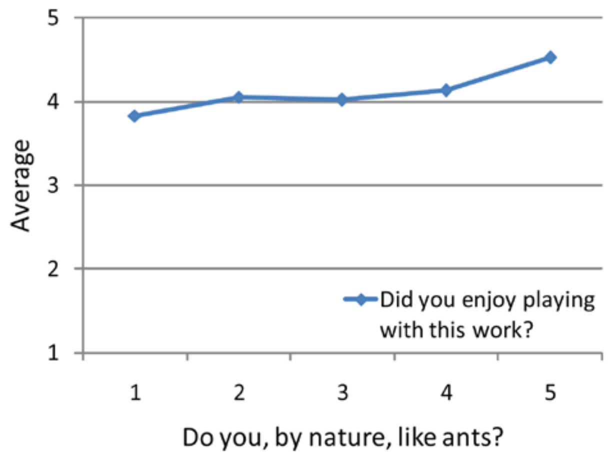

Fig.15 Relation of enjoy to like ants

7. DISCUSSION

Why the most of respondents who felt like real ants also evaluate enjoyable and pleasant? We expected that the more real this work is, the harder to enjoy. Maybe many people can suffer to be crawl by one ant or two ants, and some of them say enjoyable. But the man who wants to be crawled real ants in profusion not only arm but also all over the skin is scarce.

People originally are willing to some danger for thrill or exciting. It is like haunted house in amusement park. People can enjoyable even if the experience is creepy, because they know it is not harmful. Insect is also creepy, but almost all people who play our work aggressively when they know the ants can climb up only elbow-high. According to the result of our questionnaire (Q7 and Q8), we understand few people have difficulty to try our work. Or it's highly likely that ants are inner allowable range naturally. But you imagine that there are "nonpoisonous tarantula" and "slug which doesn't leave sticky liquid on your arm" for example. We guess many people want go through them in similar ways. In this case, people maybe evaluate it is exciting but unpleasant. Anyway, "Ants in the pants" was able to give many people a curtain real and pleasant experience. We can say "Ants in the Pants" become successful entertainment.

The Ant is the insect whose weight is so much as light as not cause any pressure. In addition, their antennas and legs move rapidly and touch our skin softly. For rendering this stimulus, we designed the glove device mentioned above. The method of stimulus that uses rotating stimulator with motor holds the possibility of expanding tactile valuation by changing the material of stimulator than just insects. For example, the gooey sensation using silicon and smooth sensation using clothe are attributed. If we choose the material depending on the purpose, we may be able to display the sensations which have never been generated to any part and large area of the body.

8. CONCLUSION

We developed an interactive system named "Ants in the Pants" that presents a sense that ants crawl on your arm. And we have conducted a questionnaire on our work. The results suggest that our original tactile display is success to render the stimulus which ants crawl over the skin. Some of them who evaluate "enjoyable" also felt "pleasant" and "exciting". Moreover, everybody could enjoy our work averagely regardless of their preferring or experience.

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