Report of “What is Pseudo-Haptics”

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This article describes the results of a survey of Pseudo-Haptics technology based on several papers. In the following sections, we will discuss Pseudo-Haptics in the following order: conceptual meaning of Pseudo-Haptics itself, specific technologies and their principles, research examples, and future possibilities.

Pseudo-Haptics means designing the boundaries of the self, and the term refers to the technology that makes this possible. This is a very abstract and difficult definition, but to understand it, we first need to know about Haptic Design, Sense of Ownership and Sense of Agency. First, Haptic Design is a tactile design. The Greek word "Haptic" in Haptic Design means "touch," and Haptic Design is about designing the sense of touch and presence that you feel when you touch something. In other words, Pseudo-Haptics is a concept that belongs to this Haptic Design in the sense that it determines the boundary between the self and other things and is basically a design for the sense of touch that humans feel.

Next, Sense of Ownership and Sense of Agency are related to "boundaries of self. If we consider these two based on the example of hitting a ball with a racket in tennis, the Sense of Ownership is to feel that the racket is a part of one's body, and the Sense of Agency is to feel that the racket moved because one swung one's arm. Currently, in the former, the racket is a part of the body, whereas the latter perceives the racket and himself as separate. In this case, the former recognizes that the racket is a part of his body, while the latter recognizes that the racket and himself are separate. This is the idea of the boundaries of the self. In other words, Pseudo-Haptics is a technology that controls the human "boundary of self" by designing the sense of touch.

One of the things that can be done with Pseudo-Haptics technology is the presentation of tactile sensations that are not present in situ. Specifically, by simply

showing images, visitors can experience the sensation of touching an object and feel as if the object were there, even if there is no actual object on the spot. This is a technique that applies the Sense of Agency's "That the object moves as I intend it to move" concept and reverses it. In other words, if a thing moves, it is what you should have intended. Pseudo-Haptics applies this misunderstanding to create the illusion of the feeling at that moment. The appeal of this technology is that by playing appropriate images, it is possible to give the sensation without physical stimulation.

Here are two examples of Pseudo-Haptics research. The first is one that produces the sensation of an object in the palm of the hand. Using a see-through HMD, air is applied to the palm of the hand only when the palm is in contact with a virtual object to express that feeling. The second is the illusion of elasticity: the illusion of elasticity is created by presenting movements in VR space that differ from those. In this experiment, auditory as well as visual stimuli were used, and the combined use of these stimuli succeeded in creating the illusion of stronger tactile sensation.

And here are two examples of applications. The first is the illusion of weight. In mixed reality space, Pseudo-Haptics was successfully used to create the illusion that the dumbbells were lighter than they were, resulting in a 9% increase in the upper limit of the number of times they could be raised and lowered. And the second is Pseudo-Haptics in monitors. Visual Haptics is a content that creates the tactile illusion of roughness, resistance, and spatial depth by changing the mouse cursor on the screen.

Pseudo-Haptics, by its very nature, allows people to be far away from each other and have the same experience at the same time. This is very much in line with the current corona disaster situation and has the potential to become a new means of communication. In the future, it is also expected that technology will be developed to

enable the sensing of ultrasonic waves that cannot be detected by humans as a sense of touch, as well as motion guidance based on this sense of touch. The number of papers published related to Pseudo-Haptics has increased compared to previous years, which also indicates that the content is worthy of attention.

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