Abstract

In this paper, we focus on the hugging motion, which is one of the most common touching motions between people in their daily lives.

The hugging motion involves touching a wide area of the human body using the palms of the hands, arms, and upper body in a close and enveloping manner. In addition, hugging is not just about hugging the other person tightly; there are indeed a variety of hugging motions, depending on the situation in which the hug is performed and the degree of intimacy between the hugger and the other person. For example, when greeting someone, the touching may be limited to a light touch rather than a strong hug. On the other hand, a strong hug may be used for an emotional reunion. If the intimacy with the other person is not high, direct touching may be avoided, and only hugging motions may be used to avoid touching the other person as much as possible.

It is difficult for existing flat touch detection methods and pressure sensors to detect such movements that involve a wide range of body touching a three-dimensional object or a mixture of touching and non-touching movements.

Therefore, in this paper, we developed an Omnidirectional Touch Screen Display with a 3D display having a life-size, upper-body-shaped for detecting this hugging motion, using an all-surrounding projector camera system. We also developed a touch detection method that extends the Diffused Illumination method to all-surroundings as a touch detection method capable of detecting hugging motions with non-contact and contact on this all-surroundings display. The system can capture hugging motions and processing the images in real time around a human body-sized upper body display. Then, from the captured images, the algorithm proposed by this research for detecting hugging motion using the size of the contact area and the luminance average in the area can detect various parameters necessary for detecting hugging motion, such as touching or not touching in the approaching state, the strength of the hug, and the time the touching has been sustained.

In this study, we built a prototype of these systems, and further conducted experiments to verify the intensity of hugging, including hugging in a state of close approaching, based on the size of the hugging touching area and the luminance average in the area using the prototype system.

From the results of these experiments, it was clarified that the change in touching due to hugging can be inferred from two detected values: "the size of the touching area" and "the luminance average in the area. We also visualized the changes in the detected values on a time axis by drawing a graph of hugging touched by the implemented graph visualization software, and discussed them based on the subject's attitudes and interview responses. We have summarized useful knowledge for the future development of the application.

Based on these results, we proposed and implemented an application that visualizes touching by hugging and an application that presents an objective experience of head stroking.

In the application chapter, as one of the application techniques of the proposed system, we also presented a proposed implementation that can detect the "head stroking experience" using a Head-Shaped Omnidirectional Touch Screen Display. This is an example of application of the proposed method to other display shapes, where the user can

experience feedback by detecting the input of the position of head stroking and projecting the facial expression on the display by rear projection.

Finally, we discuss the technical limitations of our system using the Diffused Illumination method in detecting touching on an Omnidirectional Touch Screen Display, and as a future work, we present a method to improve the problem of luminance increase in detecting touching on a Omnidirectional Touch Screen Display.