CHILDHOOD: Wearable Suit for Augmented Child Experience

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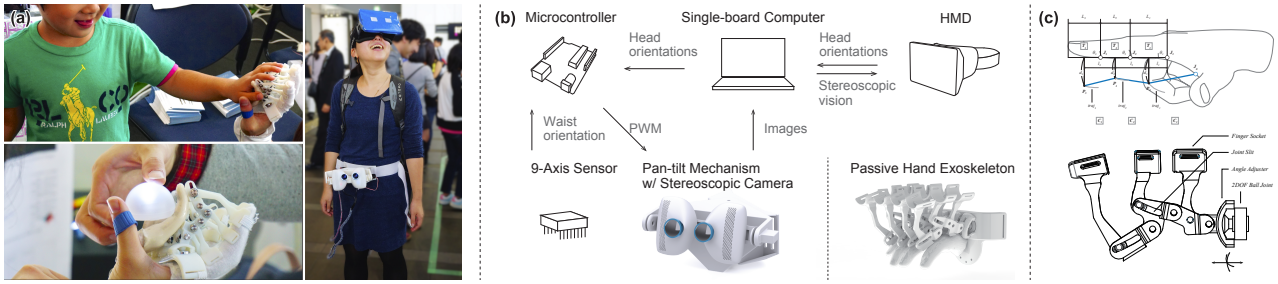

Figure 1: *(a) The system was demonstrated at the National Museum of Emerging Science and Innovation in Tokyo, Japan. (b) The components and operation model of the system. (c) Schematic and CAD model of the passive hand exoskeleton.*

1 Introduction

Understanding and perceiving the world from a child's perspective is a very important key not only to design products and architecture, but also to remind staff who work closely with children, such as hospitals and kindergartens. Ida et al. investigated the universality of devices and architecture in public spaces by recording videos through a hand-held camera positioned at a child's eye level [Ida et al. 2010]. In this study, we propose a novel wearable suit called CHILDHOOD that virtually realizes a child's eye and hand movements by attaching a viewpoint translator and hand exoskeletons (Figure 1a). We hypothesized that virtualizing a child's body size by transforming our own body while preserving embodied interactions with actual surroundings would provide an augmented experience of a child's perspective. This could assist designers in evaluating product accessibility through their own body interactions in real time. In addition, augmented child experience can help staff and parents remember how children feel and touch the world.

2 Design and Technology

The suit CHILDHOOD consists of a viewpoint translator, two passive hand exoskeletons, and hooded outerwear that contains both devices so that the user can easily attach these devices (Figure 1b).

The viewpoint translator realizes a child's stature and eyesight, while preserving the user's head movements. It is composed of a pan-tilt stereo camera attached at the waist and a Head-Mounted Display (HMD). The distance of the camera lenses is adjustable so that the system can reproduce children's pupillary distance. The pan-tilt mechanism follows the user's head behavior with low latency. This technique makes it possible to reproduce a child's spatial perception while preserving the user's head movement.

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People, including children, interact with the world by touching, grasping, and/or throwing objects with their hands. The passive hand exoskeletons simulate a child's small grasping motion using multiple quadric crank mechanisms and a child-size rubber hand. We analyzed the grasping motion using a motion capture system, and designed the exoskeletons based on our findings (Figure 1c). The hand exoskeletons have no actuators or sensors, and it is manipulated passively through the user's actions. Therefore, the user can receive complete and real-time haptic feedback.

3 Demonstration

Users can wear the developed system easily and quickly. First, the user mounts the viewpoint translator and lowers his/her viewpoint height. The user can walk freely and interact with others at a child's eye level. He/she can experience the expansiveness of the space and the feeling of oppression from taller people. Subsequently, the user unmounts the viewpoint translator and wears the passive hand exoskeletons. The user can touch and grip objects, such as toys and plastic bottles, and experience the difficulty of grasping objects used daily. We consider that parents can communicate with their child through CHILDHOOD at the same eyesight and hand size.

We demonstrated the developed system at the International Collegiate Virtual Reality Contest held at the National Museum of Emerging Science and Innovation in Tokyo, Japan, and this project received first prize. Because users can easily attach CHILDHOOD, more than 400 visitors were able to experience the system. In addition, we conducted a feasibility study at the University of Tsukuba Hospital, Dept. of Neurosurgery. Medical doctors were asked to wear the device and walk around the hospital ward.

4 Conclusions

In this work, we introduced a novel wearable suit that virtually realizes, on an adult's body, the embodiment of a child and the child's experience by simply wearing the CHILDHOOD suit. At the feasibility study performed in a museum and hospital, the proposed system performed successfully in providing the experience of a child's view and grasp. CHILDHOOD offers novel experiences and allows us to understand how children see and interact with the world.

References

IDA, S., AND YAMANAKA, T. 2000. A study in the usability of environment objects by the difference in eye level. *In Proc. of the 47th Annual Conf. of JSSD*, 396–397.