Egocentric Smaller-person Experience through a Change in Visual Perspective

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ABSTRACT

This paper explores how human perceptions, actions, and interactions can be changed through an embodied and active experience of being a smaller person in a real-world environment, which we call an egocentric smaller person experience. We developed a wearable visual translator that provides the perspective of a smaller person by shifting the wearer's eyesight level down to their waist using a head-mounted display and a stereo camera module, while allowing for field of view control through head movements. In this study, we investigated how the developed device can modify the wearer's body representation and experiences based on a field study conducted at a nursing school and museums, and through lab studies. Using this device, designers and teachers can understand the perspectives of a smaller-person including a child in an existing environment.

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Figure 1: We explore a wearable visual device that allows a user to change their body representation, in realtime, to that of a small-person

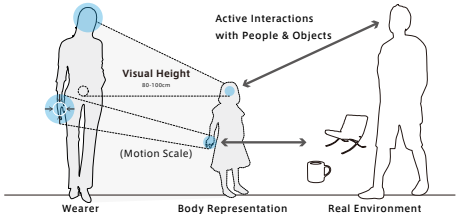

Figure 2: Concept of Egocentric Small-person Experience

Figure 3: Overview of the Developed Wearable Device

CCS CONCEPTS

• **Human-centered computing** → **Interaction design**.

KEYWORDS

Embodied Interaction; Egocentric Experience; Body Representation; Wearable Device; Virtual Reality

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INTRODUCTION

With the recent advancements in wearable technologies and virtual reality techniques, human's embodied experiences are being augmented beyond the limitations of space and time. Recent studies have also allowed users to not only extend their presence [2] but also extend their sense of ownership into an another person's body or another life form, or to provide a third eye on their back to see behind them. Interestingly, it was mentioned that changing bodily sensations through such technologies also changes one's perceptions, actions, and interactions [3]. If it becomes possible to change one's body representation and perspective into that of a smaller person in a real-world environment, a more empathic and active experience will be provided for product designers and educational staff when trying to design living environments or communicating with other people. Video materials, an illusion technique for extending the sense of ownership to a small doll [4], or an immersive virtual reality technique for converting the user's body into a smaller avatar [5] have been used to create the sense of being a smaller person, through which the user's experience may feel passive. Therefore, in this research, we provide the experience of a smaller person in an embodied and active manner in a real world environment, by changing the user's body representation, such as their visual and haptic perspectives, into that of a small-person on the user's body by means of a wearable system. With this form, the user's interaction capabilities, including reaching, walking, touching, and carrying on a conversation voluntarily would be preserved; thus it would provide more egocentric experience.

EGOCENTRIC SMALL-PERSON EXPERIENCE

In this study, we attempts to change the wearer's body representation to have a small-person's perspective in a real environment, with a capability of full body interaction by using wearable devices. We investigate the feasibility and properties of active small-person experience in RE through both field and lab studies, and discuss its challenges and opportunities. To allow this, the concept of a body

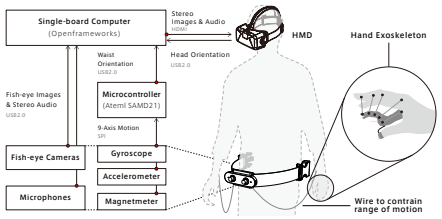

Figure 4: System Architecture

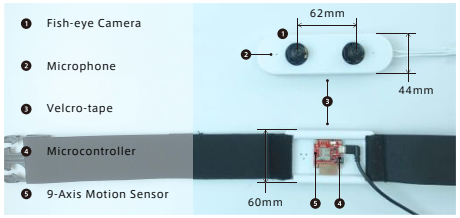

Figure 5: System Configuration of the Visual Translator

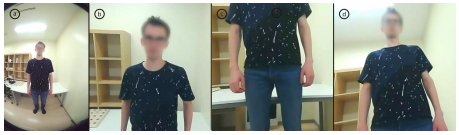

Figure 6: Visual Perspectives: (a) Captured image (b) Usual level (c) Waist level (d) Looking up from the waist level

Figure 7: Overview of the User Studies

representation transformation into a smaller person using a wearable VR device has been proposed [1], as depicted in Fig. 2. Visual stimuli plays an important role in recognizing the relationship between a user's own body representation. Changing the height of the eye level to a lower position while allowing for FOV control will allow an egocentric visual perspective of a smaller person to be achieved.

DEVICE IMPLEMENTATION

To realize the concept of changing a body representation into that of a smaller person, we have been developing a wearable device to change the visual perspective, as shown in Fig. 3. The visual translator comprises an HMD, a stereo camera module, a sensor belt, a single-board computer with processing software, and a mobile battery (Fig. 4). We use an Oculus HMD (Development Kit 2, Oculus, Inc.) to provide an immersive experience. The wearer's head orientation can be captured in yaw-pitch-roll format. Figure 5 shows the developed stereo camera module and the sensor belt, which is equipped with two fish-eye cameras (ELP-USBFHD01M-L180, Ailipu Technology Co., Ltd, HD@60fps). Each camera module has a 180° fish-eye lens.

The wearer attaches the sensor belt at their waist position. It has a nine-axis motion sensor (MPU-9250, Invensense, Inc.) and a microcontroller (Atmel SAMD21, Atmel) for measuring the wearer's waist orientation in the yaw-pitch-roll format. It also has a hook and loop tape for securing the stereo camera module such that the wear can âĂIJmove their eyesâĂİ from the HMD position to the belt position. This interaction causes a strong feeling of being a smaller. Figure 6 shows a wearer's normal view, and a reproduced view of a smaller person. The images are captured from 180° lenses, and thus they should be transformed into rectilinear images, as shown in Fig. 6. We configured the rendering software, which can map the captured spherical image onto a 3D sphere model as a texture, and then project onto a 2D image using an openFrameworks environment.

USER STUDIES

To investigate how the wearer's perceptions, actions, and interactions can be modified through the proposed egocentric experience of a smaller person, we investigated the following three factors, which are essential for the understanding of the users, as shown in Fig. 7.

1) **Wearer's perception:** In this study, which was a personal space evaluation, when the participant felt smaller using the developed device (WC_STA condition), the largest personal distance was observed (Fig. 8). This could have been caused by an oppressive feeling toward the approaching experimenter induced by the feeling of being small.

2) **Wearer's action:** It was observed that the participants raised their hands higher than usual when trying to shake hands with the experimenter because they perceived their own body representation as being smaller (Fig. 9). It was confirmed that the experience of being a smaller person changed the physical relationship of the wearer and the surroundings.

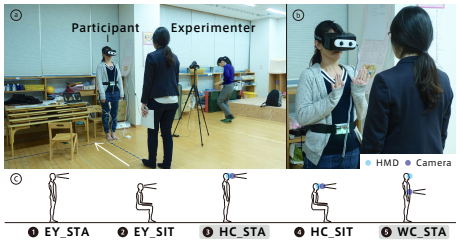

Figure 8: Wearer's Perception: (a) Experiment overview (b) When the participant calls "stop" (c) Experiment conditions

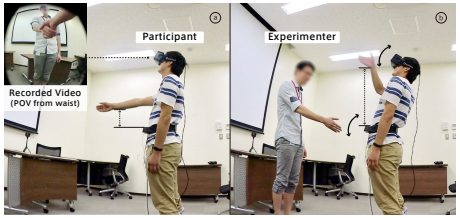

Figure 9: Wearer's Action: Experiment Setup and Conditions: (a) Watching a Video (b) Small-person Experience

Figure 10: Wearer's Interaction: Interaction Observation

3) **Wearer's interaction:** We observed the wearer's interactions during demonstrations at conferences and exhibitions (Fig. 10). It was often observed that the visitors behaved like a child, such as performing a protective pose when surrounded by adults, or talking like a baby. Interestingly, surrounding people such as young students also treated the wearers like a child, and behaved as teachers or parents by acting in an overbearing manner.

DISCUSSIONS

The participants could think their arm length had become shorter, as had their height, resulting in an increase in the perceived distance between hands. A similar phenomenon was also reported in which the arm length changed the perceived distance in a virtual environment [6]. Several participants stated that they realized the change in eye level only after they saw the experimenter facing them, although they had visited the experiment room several times before. The participants could use more familiar objects as a reference to recognize the physical relationship between their body and space.

CONCLUSION

In this research, we explored how human perceptions and actions can be changed through the experience of a smaller person in a real world environment. To achieve this, we have developed a wearable visual translator that changes the wearer's body representation into that of a small-person, by shifting the wearer's eyesight level down to their waist level by using a HMD and a stereo camera module, while allowing for FOV control through head movements. Three user studies were conducted to investigate the wearer's changes in their social and physical relationships, and to observe a feedback experience. These findings, challenges, and design considerations will benefit further studies on the design of user experiences based on changes in body representation while preserving active and embodied interactions in a real-world environment.

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