Embodied Communication Support Using a Presence Sharing System under Teleworking

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Abstract. We have proposed the concept of a presence sharing system Ghatcha [GHost Avatar on a Telework CHAir] in which the users' embodiment is not indicated by the avatars but by the chairs that suggest the presence of avatars. This system provides the same communication space for the users' embodiment, thus creating a feeling of working alongside remote workers. In this paper, we develop prototype systems using a virtual or a real environment. And the effectiveness of the virtual prototype system is confirmed in the experiment.

Keywords: Embodied Interaction, Avatar, Remote Communication, Telework, Remote Operating Chair.

1 Introduction

A telework increases productivity and operational efficiency by offering employees the flexibility to work from their home offices. It would gain popularity as it can be utilized in different ways. However, the quality or efficiency of work might deteriorate as a result of a telework as it leads to a sense of isolation or a lack of concentration. Thus, it is important to examine remote collaboration support in detail.

Remote collaboration has various purposes and applications, and it is expected to support for each situation. The subjects of this research are not remote users performing a group task but individual users performing their own specific tasks wherein all their co-workers also perform tasks with the same aim such as a job of a home-based worker or individually pursuing online distance learning. In the case of tasks that are not synchronized, however, the video image might contradict our expectations. In order to solve the problem, Honda et al. proposed a virtual office system "Valentine" using an awareness space and provided a work support environment for home-based workers [1]. Moreover, various media communication methods have been proposed for practical use, such as the design of a communication environment, which aims at maintaining and fostering human relations for family members living apart, or a communication system wherein the furniture or daily necessities, which are separated in different rooms, can be linked [2],[3].

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However, when a user's own avatar is used as a communication media for an embodied interaction, many issues arise with regard to the relation between the users and their avatars. For example, if a human-type avatar is used, the correspondence of the user's motion and that of the avatar's would be hindered by input devices. Otherwise, the appearance of an avatar cannot appropriately represent a user's embodiment.

The embodiment is not always indicative of the avatar information in the input/output of the smooth interaction system. It would be useful to integrate the embodiment with the environment information for the development of an effective interaction support system. Hence, this paper proposes a new presence sharing system called Ghatcha: GHost Avatar on a Telework CHAir [4]. The Ghatcha system is based on the embodiment of the environment information of the chair motion rather than that of the avatar. The present study aims to recreate the environment in which remote users interact with their co-workers in the same virtual office, and enhance their motivation in performing their tasks. In this paper, a prototype of the system using a virtual environment is developed, and the effectiveness of this system is demonstrated by an evaluation experiment.

2 Development of the Prototype System Using CG

The prototype system using a CG avatar was developed. In this system design, the chair motions are measured by various sensors such as a gyroscope, an accelerometer, or a magnetic sensor. The virtual chair motions are represented based on the measurements, and are shared on the network. The mutual motions of each user are transmitted to the office model from the shared communication space. This collaborative system determines the third interaction space with the chairs for each remote co-worker. The CG prototype system is generated by an HP workstation xw4200 (CPU: Pentium4 3.6GHz, RAM: 512MB, NVIDIA Quadro FX3400), OS: Windows XP Professional SP1, and DirectX9.0b. The frame rate is 30 fps. The chair motions are measured by a laser sensor mouse (Logicool MX Air) attached under the chair. The communication scene using the system is shown in Fig. 1. This example displays only the user's human type avatar.

Fig. 1. Communication scene using the prototype system

3 Development of the System in the Real Environment

Not only a virtual environment, the prototype system in a real environment was developed as shown in Fig. 2. The system was constructed by the 4 servo motors through the USB cable. User's chair motions were measured by the same way as the virtual system. User can put any objects for the substitute of his/her partners on the chairs, including the one of himself/herself. This miniature system provide interaction awareness between users using their embodiments.

Fig. 2. Prototype system in the real environment

4 Evaluation of the Experiment Using the Virtual System

4.1 Experimental Setup

The system evaluation experiment was performed by the prototype system using CG in the previous chapter 2. The subjects consisted of 10 pairs, and they worked on a simple task wherein they made paper cranes by folding pieces of paper. The task was repeated twice using two scenes: one where the chair system was connected with the motions of the user and another where they were not connected. The subjects were ordered to fold the papers as much as they could. After the task was finished in each scene, the user's behavior was observed during a waiting period of 3 minutes. The only information that was shared through the system was the motion of the chair. Only the user's human type avatar was displayed in addition to both the users' chairs. Thus, the user makes his/her presence felt not as the chair but as the avatar. The partner's avatar was not represented in the virtual space. The subjects answered the questionnaire after the task in each scene. They were provided an explanation of the conditions and the setting of the experiment, and they agreed to the experiment before the experiment started. The time taken to conduct the experiment was about 40 minutes on average including the waiting time and the time taken to answer the questionnaire. The example of the evaluation experiment scene is shown in Fig. 3.

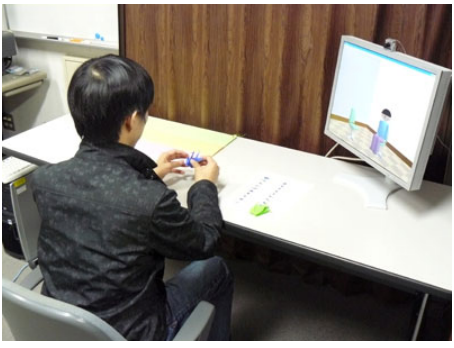

Fig. 3. Example of an evaluation experiment

4.2 Sensory Evaluation

The two scenes were evaluated on a seven-point bipolar rating scale ranging from –3 (lowest) to 3 (highest), in which 0 denotes a moderate score. For the sake of convenience, the results of the means and the standard deviations are shown in Fig. 4. The questionnaire consisted of eight categories: four categories on the impression of the work and the other four categories on the evaluation of media communication. In most of the categories, the significant difference between the two scenes was obtained by administering the Wilcoxon's rank sum test; a significance level of 0.1% for the items of "Do you feel like sharing the same space with a partner?", and "Do you feel like working together with a partner?" A significance level of 1% was obtained for the items "Do you enjoy your task?" "Do you believe that you could associate yourself with the character?" and "Do you recognize a partner's motion?" The effectiveness of the prototype system is evinced by the positive evaluation of each category in the scene that the chair motions were connected. The scene that the chair motions weren't connected has a negative evaluation that is significant at the 5% level for the item "Are you bored by your task?"

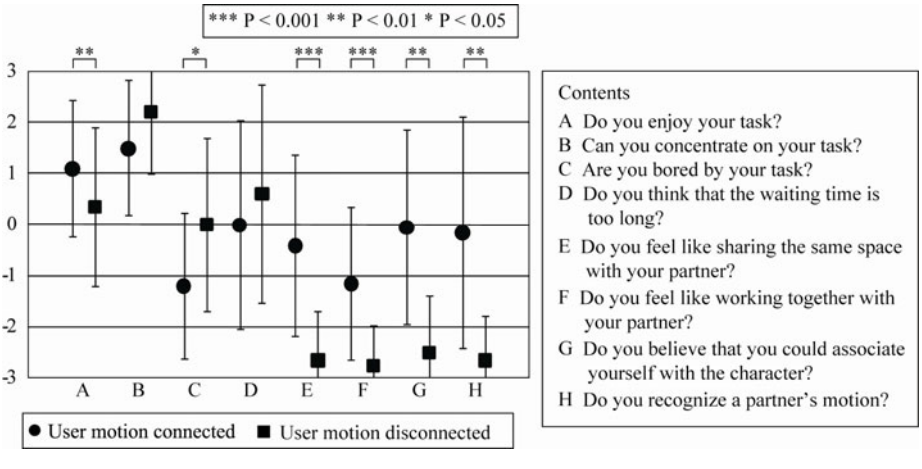

Fig. 4. Results of the questionnaire

In addition, comments such as “I didn’t move too much while folding pieces of paper into the figure of a crane” and “I was pleasant to manipulate my chair after working the task” are obtained as responses of a free description of the respondents’ opinions in the questionnaire. The effectiveness of the system can be observed in the waiting time after working rather than during the working time.

5 Conclusion

In this paper, the prototype systems using a virtual or a real environments were developed. And, the evaluation experiment was performed using the virtual prototype of the system, and the effectiveness of the system was demonstrated by a sensory evaluation.

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