International Journal of Advanced Smart Convergence Vol. 3 No.1 11-14 (2014)
DOI 10.7236/IJASC.2014.3.1.3

IJASC 14-1-3

Towards Designing Human Interactions for Learning Support System using Virtual Reality Technology

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Abstract

We have been designing human interactions for some learning support system or education system. The design is based on a symbol grounding model. The model is applicable to many learning domains using virtual reality technology. The design policy is simple and compact. In order to realize the policy we use/reuse some devices from the viewpoint of virtual reality. This paper introduces basic ideas and explains several example cases based on the idea.

Keywords: *Symbol Grounding, Virtual Reality, Embodiment, Haptic Interface, View Control*

1. Introduction

A lot of learning styles have been appearing with the progression in ICT, e.g. ubiquitous learning [1], e-learning, distance or online learning, and so on. The transition owes to Internet technology and media technology such as video and audio. Also roles of computer system are changing from learning support in micro world to virtual world. The former will support conceptual or symbol level knowledge to learn i.e., there is no reality in interactions between human and computer. Then the computer supported learning was changed to interactive learning environment, but still the reality was a little. On the other hand virtual reality (VR) technology has been researched in many fields but the devices were expensive and the application systems were large-scaled. Recently many low cost devices are developed by commercial use. Though these devices are not so accurate as a sensor or effect or, it is available easily and reusable on ideas.

In this paper an idea is introduced as a model to reuse these devices. We have been designing human interactions for some learning support system or education system based on the model. The model is able to relate between symbol level knowledge in conceptual world and experiential knowledge in real world by means of VR technology. The model makes an application system simple and compact. Several application systems as example cases based on the model are also explained briefly.

2. Basic Idea of Human Interactions

Figure 1 shows a model of symbol grounding to relate knowledge and experience using VR technology. In order to make system simple and compact, a part of body, e.g., head, upper body, arm, or so on, is focused. And the intention of human action is reasoned by simple mapping function based on the part movement. Feedbacks to human according to the movement are also another mapping function. Usually these function is

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mathematical equation that is not necessary to be accurate because there exit already fuzziness in the movement. So the idea is applicable just to such a system that will not be needed in accurate feedback or sensing. In other word the system is not for expert level knowledge and experience.

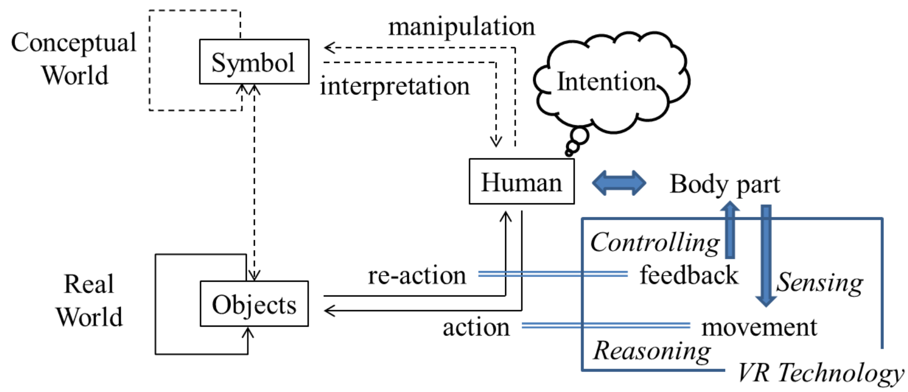


Figure 1. Symbol Grounding Mode

3. Examples of Human Interaction Design

3.1Case1: Astronomical Observation

Figure 2 shows an application of the model for astronomical observations. In the domain the characteristic actions are lookup night sky in real world and overlooking the heavenly body from the out of real world as

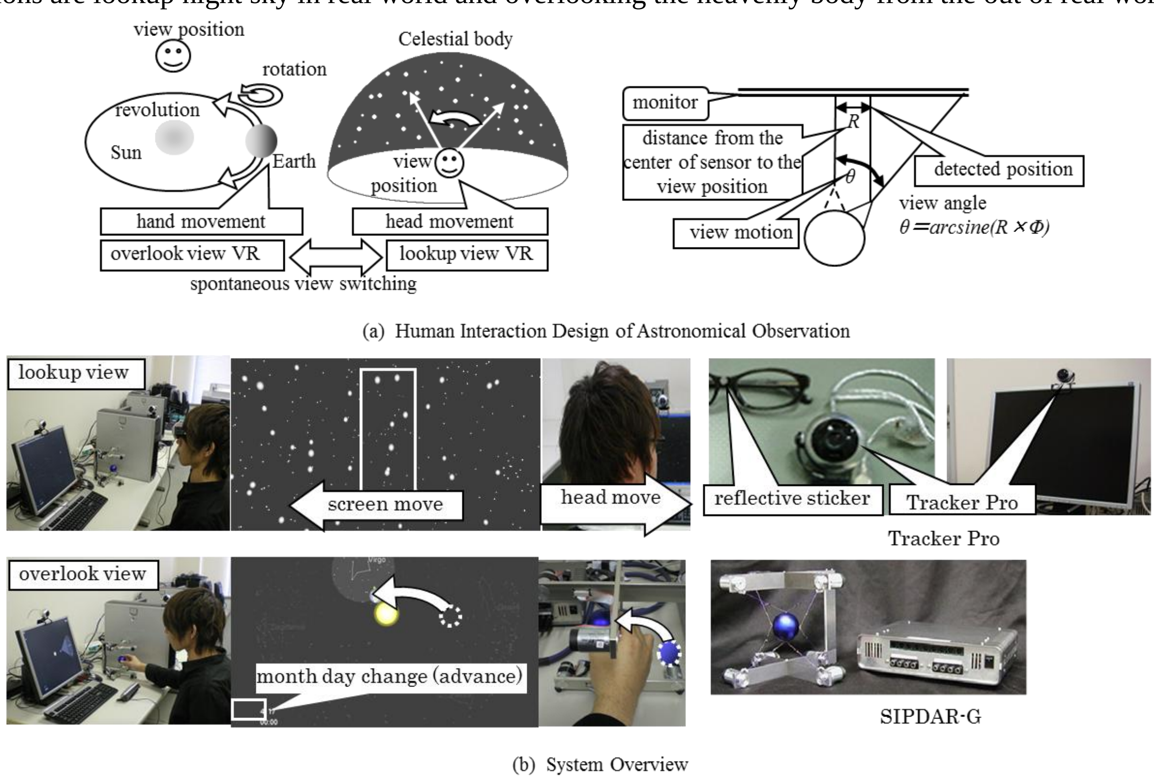
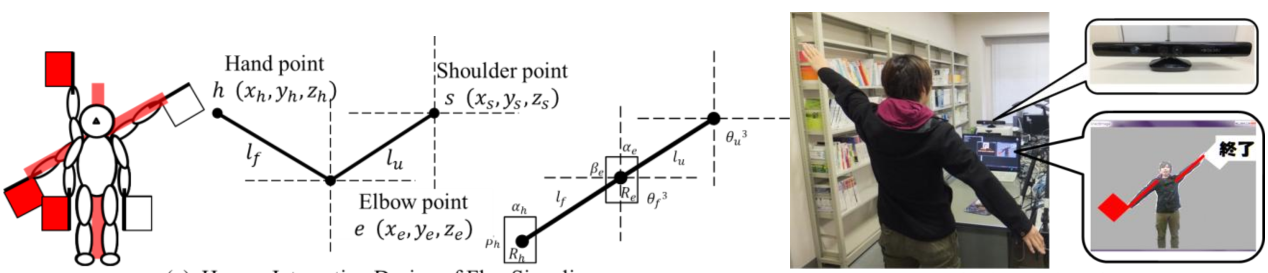


Figure 2. Astronomical Observation

shown in (a). For the lookup action with a head mounted display, the head movement will be sensed by an infrared light and camera and calculated by the horizontal position of head mounted display that a reflected sticker is on it. It means that the head rotating angle will be mapped by the planar coordinate point. On the other hand for overlook action, human hand movements will be sensed as shown in the figure (b). Head and hand action will be sensed and feed backed by the devices shown in right side of the figure respectively. Tracker Pro is a hand free mouse for disabled person originally and it consists of an infrared light and camera. SPDAR-G is a haptic device by means of 8 lines tension. In the system the revolution and rotation of Earth are realized by hand action with a ball of the device.

3.2Case2: Flag Signaling

Figure 3 shows an application of the model for a training of Japanese flag signaling [3]. Japanese flag semaphore system is based on the shape of characters called katakana. Each character is composed by a semaphore form or several semaphore forms from 1st to 14th form. The figure (a) shows an example semaphore form. Each semaphore form can be represented by hand, elbow, and shoulder points. So in this application both arms are focused and mapped to corresponding form by these points. The figure (b) shows the system overview using Kinect sensor to detect arm position. This application is suitable for Microsoft Kinect sensor because the arm movement will not be so fast and posed at each form. Of course the system is not supposed to train expert level human that will be fast arm movement and quick pose.



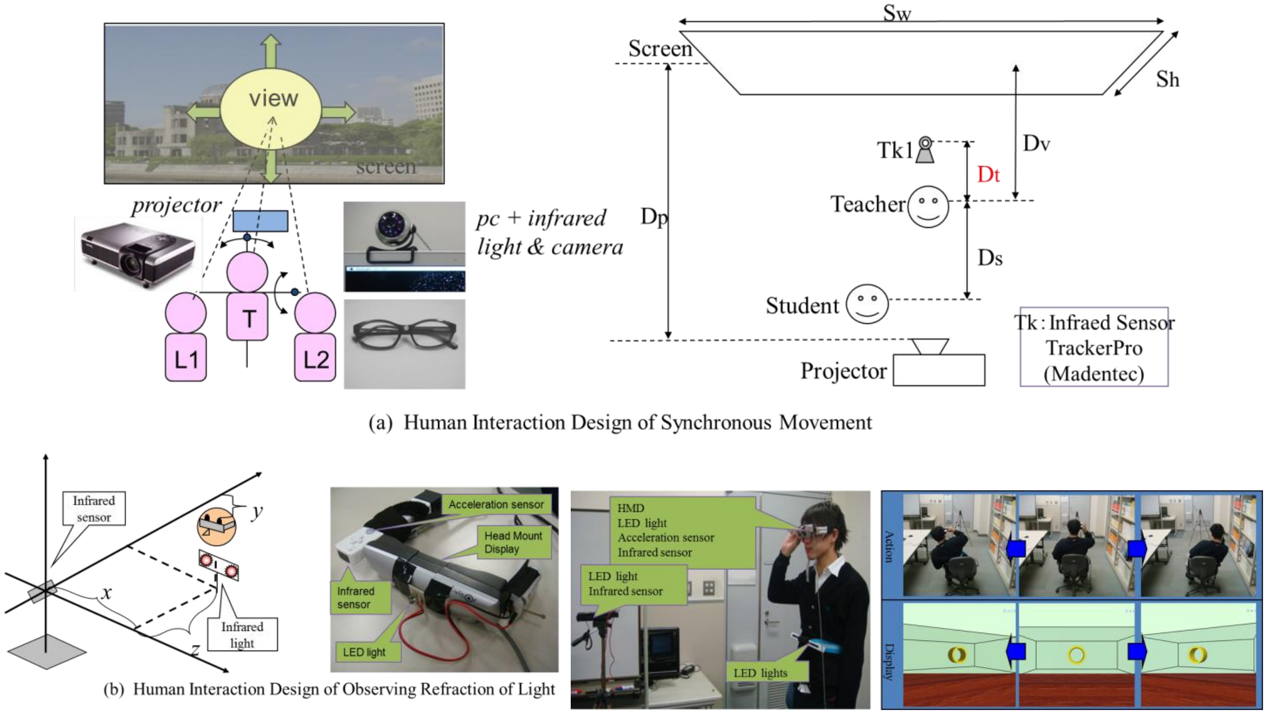
(a) Human Interaction Design of Flag Signaling (b) System Overview

Figure 3. FlagSignaling

3.3Other Cases

Figure 4 shows other example applications. The figure (a) is a group learning system especially to share a teacher’s experience with students. This system is theoretically based on the chameleon effect [4] and students will be look at objects in accordance with the head movement of the teacher. These synchronous movements should lead the students’ concentration. The system consists of an infrared light and camera and a projector with a PC but is under construction. The system is almost the same human interaction as the astronomical observation for lookup view. But in this system a reflective sticker is on a glass without lenses in the figure and the space is larger than the previous application.

The figure (b) shows the other example application to learn knowledge about light reflection [5]. In this application two Nintendo Wiimote are reused in the application. One is attached on a head mount display and the other is set at opposite side of a learner. Also hand making sensors are used for the upper body action. Using these devices a learner can observe the reflection of light by going around or looking into a box. The box is filled in a kind of fluid that will be changed by the refractive index. In the figure a person is observing a hollow column by going around from left and right side. And the corresponding under figures shows the views displayed on the head mounted display.



(a) Human Interaction Design of Synchronous Movement

(b) Human Interaction Design of Observing Refraction of Light

Figure 4. Other Examples

4. Conclusion

This paper introduced a symbol grounding model to design human interactions for learning support system simply and compactly. Based on the model, some example design of human interactions was explained briefly. These systems reasoned the intention of action by means of the movement of some body part and feed backed to the learner with simple mapping function. Also these systems were compact at most desktop or class room because of focusing the body part.

Now we are developing another application of hand writing with a tablet PC and stylus pen [6]. The human interaction of the system will become more natural and like real world comparing to conventional computer interface. It will be a solution of how to integrate digital world/computer world and analog world/real world at interaction level.

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