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3D input devices and interaction concepts for optical tracking in immersive environments

Oliver Stefani, Jörg Rauschenbach

Fraunhofer Institute Industrial Engineering, Nobelstrasse 12, 70569 Stuttgart, Germany

Abstract

In this poster abstract we present an interaction concept and input devices for optical tracking in virtual immersive environments. Requirements to input devices for immersive environments will be based on a document, outlining major requirements for VR-systems. A preliminary testing of the usability will be discussed. We conclude this abstract by presenting our interim findings.

Keywords:

Virtual Reality, Immersive Virtual Environments, User Interfaces, Input Devices, Optical Tracking, Interaction Concepts, Ergonomics of Handheld Devices, Wireless, CAD Evaluation,

Categories and Subject Descriptors (according to ACM CSS): H.5.2 [User Interfaces]: Input devices and strategies; Ergonomics; Interaction Styles

1. Introduction

For the design of handheld devices, anthropometrical measurements of the human hand are essential.[1] There is a great variety of ergonomic grips comprising different kinds of handles, all of which have their advantages.[2] For interacting with a virtual environments a suitable alternative for a handle has to provide a shape to allow for precise and well-aimed movements. It should also allow for a variation between different grip possibilities to avoid fatigue. At the same time the devices have to include the technological equipment, needed for real time tracking.

2. Requirements for Input Devices

In the framework of the European Union Project "VIEW of the Future"* users of virtual environments (Volvo, Alenia, PSA and John Deere) have produced a document which addresses the users' needs regarding a virtual environment. The requirements regarding the interaction devices can be summarized as follows: It should be wireless and precise with high resolution, quick response time and 6 DOF and it should suit the physical ergonomics of the hand.

* IST-2000-26089

3. Interaction Concept for Optical Tracking

Humans are used to working with two hands. Usually the two hands work together according to their capability. This shall be the basic idea for an interface: a smart distribution between both hands for a faster and more intuitive interaction with virtual environments.[3]

Interaction with menus is difficult. Pointing at a certain menu item is very difficult because one has to control 6 DOF. Therefore a tracking-decoupled menu concept has been integrated. The menu will be used with a jog-dial. By turning the jog-dial the user can scroll through the menu.

A button on the "Bug" in combination with a virtual ray, coming out of the dragonfly, serves as the selection tool and activates navigation/manipulation. The dragonfly does not have any buttons. The virtual object is connected to the "dragonfly" and follows directly its movements as long as the button on the "Bug" is pressed.

When evaluating a CAD model, the most important and most performed task is the positioning of the object relative to the user. The most natural way to do that is to actually play with the object in the hand. With an optically tracked system, the user has the possibility to interact with an object wireless and using lightweight interaction devices. The user is able to watch the object from all sides by just turning the device in his fingers.

4. Input Devices for Optical Tracking

4.1. Input device for the dominant hand

To prevent fatigue of the hand, the "dragonfly" has been designed to give the user a great variety of ergonomic grips (figure 1). The device is designed for left- and right-handed persons. Six retro-reflective spheres in combination with the narrow form of the device allow for a precise identification of the device, its position and orientation in the 3D virtual environment, independent of the user's grip position. Having this basic structure the input device shows a dragonfly-like shape which is intensified with additional design elements. The dragonfly-metaphor is supposed to bring to mind a fast, precise, feathery and acrobatic flying input device.

4.2. Input device for the non-dominant hand

The input device "Bug" comprises a jog-dial, identical to those in standard computer mice, and two additional buttons, which are well reachable for right- and left-handed persons (figure 2). Two retro-reflective spheres allow for the identification and position detection of the device. Since it is recommended to provide redundant interaction techniques[4], the Bug also offers the possibility to be used as a stand-alone device. The shape of the Bug is also designed in a way to allow for a great variety of grip positions.

5. Evaluation

The new input devices have been tested by expert users at Fraunhofer IAO only. So far, the practical experience has shown that use of tracking-decoupled menus makes the work in a virtual environment much more comfortable. The opinions concerning the button-less concept are manifold. Although the ergonomic shape is appreciated by many users, having no button on the device can lead to difficulties. The Bug seems to convince users due to its simple shape and of course due to its integrated jog-dial. Further extensive testing in the context of VIEW is planned.

6. Conclusions

The new devices for optical tracking feature an integration of the technology into a form which suits the ergonomic requirements for hand-held input devices, while making use of the advantages an optically tracked system can provide. Although extensive testing is not yet finished, we have found an improvement concerning comfort and usability. Following our preliminary tests we assume that the new devices are very efficient for the evaluation of CAD models.

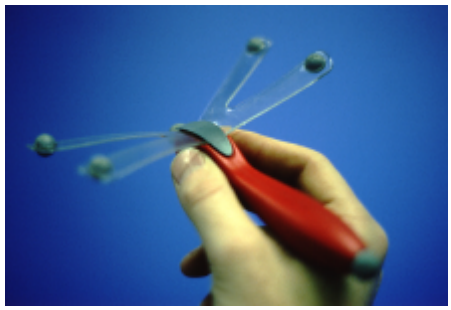

Figure 1: *Dragonfly in right hand with pinch grip*

Figure 2: *Non-dominant input device "Bug"*

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