Definitely Affordable Virtual Enviroment

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1 Introduction

The DAVE [2] is an immersive projection environment, a four-sided CAVE. DAVE stands for 'definitely affordable virtual environment'. 'Affordable' means that by mostly using standard hardware components we can greatly reduce costs compared to other commercial systems. We show the hardware setup and some applications in the accompaning video.

In 2005 we buildt a new version of our DAVE at the University of Technology in Graz, Austria. Room restrictions motivated a new compact design to optimally use the available space. The back projection material with a custom shape is streched to the wooden frame to provide a flat surface without ripples. [5],[4]

Figure 1: The DAVE installation in Graz, Austria.

2 Hardware

The floor is a front projection on a grey surface matching the brightness of the back projection walls. Our projectors from digitalImage [3] use time sequential stereo and are synchronized with custom hardware. Using the projector image buffers we can avoid a genlock in the graphics hardware. The synchronization signal is transmitted to the stereo glasses via infrared pulses. One pair of the lightweight glasses is equiped with retroreflective markers for the infrared tracking system. With about 45 Hz the user's eye positions are computed to get a correct perspective view.

Our selfmade low-cost system uses four cameras connected to a dedicated tracking server. Beside the glasses, the input devices are also located by the optical tracking system. Electronic components from commercial gamepads are used to realize wireless buttons. The one controlling server and the eight render clients are normal off-the-shelf PCs. Updating PCs or just graphics boards is inexpensive and keeps the performance up-to-date. The PCs and also a file server are connected via a gigabit network.

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3 Applications

A PDA is used to start applications and for frequently needed system controls. Most of the applications in the DAVE use the scene graph OpenSG or our self developed DAVELib. These libraries provide functions for program synchronization, perspectively correct rendering and input devices. The most suited applications for a CAVE are virtual walk- and fly-throughs. Scenes with precomputed radiosity are especially appealing.

As the user's movements are restricted to the size of the DAVE, an additional navigation concept is needed for large virtual worlds. For fly-through scenarios we use a joystick shaped device with an analogue trigger to fly in the direction the arrow is pointing in. Since there is no back wall the scene automatically rotates to the front wall when pointing to the side while moving. The game 'ppracer' has been partially ported to the DAVE using the DAVELib. While the 2D GUI elements could not be exchanged quickly, the main 3D content required little source code modifications to run in the DAVE. The penguin is directed by the user's head position. For an architectural scene based on OpenSG we recently added the AGEIA PhysX engine [1] for placing furniture. At the moment we only use static precomputed lighting. The two most recent undergraduate student projects are an underwater world with animated fish and a glider simulation where the user holds a marker in each hand to control the plane. In cooperation with the Laboratory of Brain-Computer Interfaces in Graz the DAVE was used for a simple navigation task, purely by thoughts. [6]

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