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A PDA-based See-through-the-Lens Interface for Large Display Systems

Cybermedia Center, Osaka University, Japan

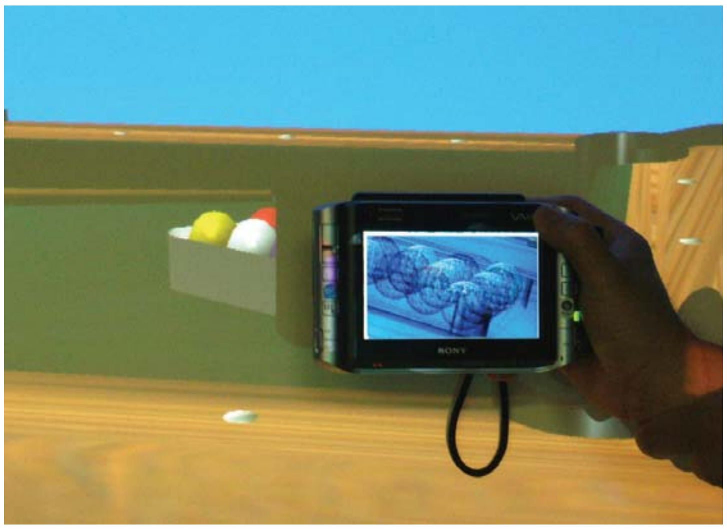

Fig.1 Our user interface in use

Introduction

Interaction in an immersive virtual environment is still limited by several factors such as imperfect depth cues and unstable hand placement in midair. In this poster, we summarize the design and implementation of a see-through the lens interface within an immersive environment (see Figure 1) to alleviate the abovementioned problems by simplifying the selection and manipulation processes using image based interaction techniques. A handheld device such as a PDA or a UMPC receives a video streaming in real-time corresponding to the area behind the PDA screen from the user's viewpoint. This gives an impression that the scene is seen through the PDA screen. Because most PDA screens are touch-sensitive, and because its 2D interface is fully programmable, flexibility in designing a 2D interface is quite high. Images on the screen can be used for direct manipulation, or stored for future reference. Selecting an element by touching the screen gives the user valuable feedback information that enhances the experience of the interface.

System Architecture

The prototype system was implemented as a client-server application for video streaming using the FFmpeg library (see Figure 2). We selected the MPEG codec using a TS (Transport Stream) over a UDP/IP protocol. To minimize the latency, our application produces only I-frames in the MPEG video streaming. We take advantage of the PTS (Presentation Time Stamp) that is included in every frame for performing the selection of objects on the PDA images. Every time an image destined to the PDA is rendered, we register its frustum and the user's viewpoint. Then, when the encoder assigns its PTS to the image, we store it together with its corresponding frustum and the user's viewpoint. On the client side, when the stream arrives, we decode and check for the PTS every frame. When user selects an object or freezes an image, we send its PTS, the command to be performed, and the touched screen position back to the server using a TCP/IP connection. Finally the server checks for the PTS and recovers the corresponding frustum and the user's viewpoint for rendering the image one more time in a background process and performs the selection test.

Performance Results

We employed the VR Juggler framework for high flexibility and interoperability. The server application has been tested on Linux and Windows using a Pentium 4 3.2GHz desktop computer with 1GB memory. A CAVE system using a Windows XP cluster with 17 nodes (Xeon 1.60GHz/1066MHz/Dual core, GPU ATI FireGL 7350/1GB Memory) has also been tested. A VAIO VGN-UX72 Intel Centrino Core 2 Solo, 1MB memory and a display of 1024 x 600 running Windows Vista was tested for the client's side. IEEE802.11g was used for the wireless connection. For the tracking system Flock of Birds and HiBall systems were used. With these equipments, the mobile device displayed 800 x 600 24-bits color images at 25 frames per second with a delay of around 1 sec.

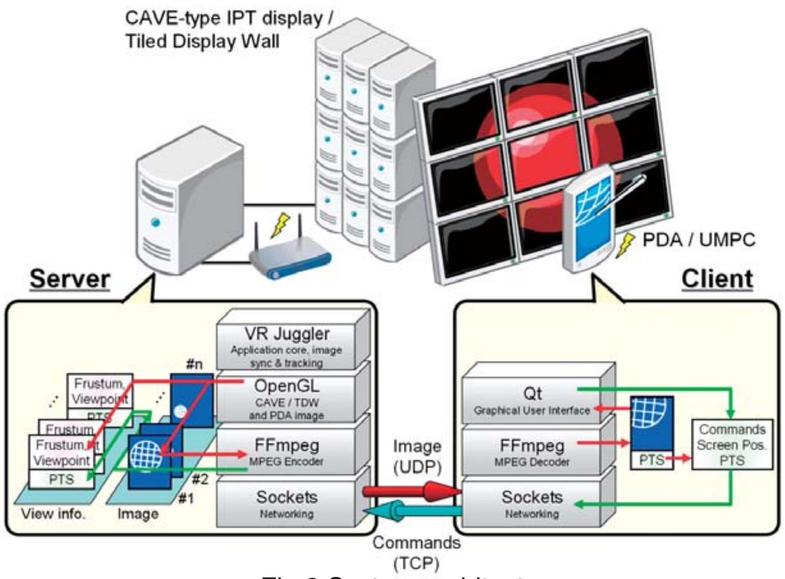

Fig.2 System architecture

Conclusion

We have proposed a PDA-based see-through the lens technique for interaction in an immersive virtual environment. With this interface the user is able to perform 3D operations on a 2D view of a virtual 3D space easily, which otherwise would be difficult or confusing to perform in 3D space. Future work includes conducting a rigorous user study and implementing various user interaction techniques.

Contact : Haruo Takemura and Kiyoshi Kiyokawa
E-mail : sc@ime.cmc.osaka-u.ac.jp