Virtual Reality to Go: A USC ICT Mixed Reality Lab Demonstration

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Abstract

Our demonstration will exhibit a number of low cost virtual reality systems built using smartphones, inexpensive optics, and game engine software. These systems will demonstrate how VR researchers and developers can leverage current trends in commodity hardware and software to bring virtual reality to a wider audience. This demonstration dovetails with the Workshop on Off-the-Shelf Virtual Reality (OTSVR), which we will also be organizing at the VR conference.

The Mixed Reality Lab at the USC Institute for Creative Technologies works to advance the design and practice of mixed reality and virtual reality. The lab is particularly focused on the research and development of new technologies and techniques to enhance immersion and interaction for learning and training.

Index Terms: H.5.1 [Information Interfaces and Presentation (I.7)]: Multimedia Information Systems—Artificial, augmented, and virtual realities B.4.2 [Input/Output and Data Communications]: Input/Output Devices—Image display

1 Demonstration

Early virtual reality systems required substantial technical and financial resources due to the limited computing capability of the time. Accordingly, image generation, tracking, and content creation were costly and difficult. Moore's Law and other trends in gaming and mobile devices have dramatically changed the landscapes of computing and virtual reality.

The Mixed Reality Lab at the University of Southern California's Institute for Creative Technologies (USC ICT) has embarked on a number of projects which appropriate off-the-shelf technologies to lower the cost of virtual reality systems. Examples of our work in this area includes a gesture control toolkit that utilizes the Kinect depth camera [7] and a smartphone based head mounted display using LEEP optics [4] (see Figure 4).

We have continued to develop a number of low cost virtual reality systems that utilize commodity hardware and software, such as smartphones, inexpensive 3D stereoscopic optics, and commodity game engines. This has yielded systems such as a smartphone based virtual reality system using Hasbro My3D optics [1].

At Virtual Reality 2012, we propose to demonstrate several of these systems using both Google Android and Apple iOS based devices, in conjuction with our workshop on Off-the-Shelf Virtual Reality (OTSVR). These devices utilize off-the-shelf optics, like the Hasbro my3D add-on for Apple iOS devices, and inexpensive, custom optics designed by our lab, for Android devices.

We have created a number of immersive training games and demonstration environments using the Unity game engine which showcase the capabilities of these smartphone based virtual reality systems. These include a memory game that tests a user's ability to observe changes in an environment (see Figure 2) and 360 degree stereoscopic photo panoramas (see Figure 3). Users interact with these virtual scenes using head orientation and position (sensed either by built-in gyroscopes or external motion capture systems). Bluetooth keyboards allow additional navigation and object selection capabilities.

Visitors to our demo will have the opportunity to try our different low cost systems and learn about how they were constructed. We will have software and technical specifications available for download. We plan to have folding optical kits available in envelopes and software available for download so that researchers and developers can immediately try our demos with their own phones and develop their own applications.

Figure 1: A commodity smartphone based virtual reality system using Hasbro my3D optics.

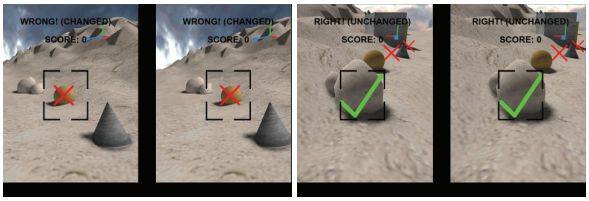

Figure 2: Screen images from the smartphone based virtual reality system displaying stereo pairs from a memory training game.

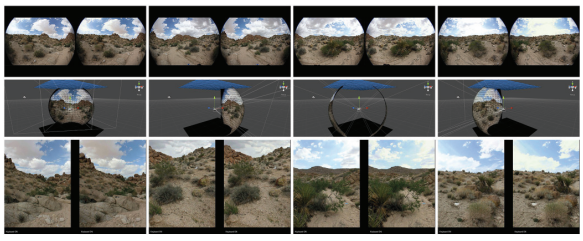

Figure 3: A complete 360 degree stereoscopic photo panorama can be created for smartphone based virtual reality systems. The panoramas are processed from stereo photo pairs taken with fisheye lenses.

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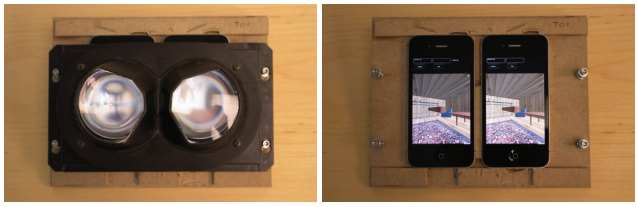

Figure 4: A low cost, experimental head mounted display with LEEP lenses in place and removed, revealing the two smartphones that render and display imagery.

2 The ICT Mixed Reality Lab

The Mixed Reality Lab (http://mxrlab.com) at the USC Institute for Creative Technologies develops new techniques and technologies to advance immersive learning and training. The lab is led by Professor Mark Bolas, the Associate Director for Immersion at ICT and an Associate Professor of Interactive Media at the USC School of Cinematic Arts. Professor Bolas is an early pioneer of virtual reality. His thesis work "Design and Virtual Environments" was among the first efforts to map the breadth of virtual reality as a new medium and led toward a basic model for immersive experience design. He co-founded Fakespace Inc. which pioneered many technologies used by the VR and scientific visualization communities.

Figure 5: A head mounted projector developed by the lab which provides personal perspective correct imagery on retroreflective screens without bulky optics in front of the user's eyes.

The Mixed Reality Lab has developed and contributed to the design of several innovative displays included head mounted projectors (see Figure 5) [3], the lightfield display [2], and the Wide5 head mounted display (see Figure 6), which can provide a horizontal field of view of approximately 150 degrees. Other research projects at the Mixed Reality Lab include investigations of redirected walking [5, 6], displays for virtual humans, and audio.

The Mixed Reality Lab is part of the USC Institute for Creative Technologies. The ICT is a university affliated research center (UARC), founded in 1999 by the University of Southern California with a multi-year contract from the US Army. The institute brings together academia and the creative talents of Hollywood to advance digital media for learning, simulation, and training. The goal is to create synthetic experiences so compelling that participants react as if they are real.

References

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Figure 6: The Wide5 head mounted display provides a horizontal field of view of about 150 degrees. It is used in studies of redirected walking and virtual human interaction.

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