Wide Field-of-View Augmented Reality Display with Occlusion by Projective Illumination

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Figure 1: Prototype optical see-through head-mounted display.

Traditionally, optical see-through head-mounted displays have suffered from narrow field of view and lack of occlusion. We present both a wide field-of-view optical see-through display and a system for making the virtual objects appear solid with proper occlusion by manipulating room illumination through projectors. The basis of our display is an Oculus Rift DK2, which was disassembled and modified by inserting curved beam splitters[1] in the optical path. We chose a geometric arrangement of the beam splitters and display which minimizes focal variance of the virtual image, reduces crosstalk between eyes from the single OLED panel, and balances stereo overlap vs. field of view. The resulting head-mounted display has a total diagonal field of view of 82° as shown in Figure 3. The Oculus system provides low-latency orientation and position tracking.

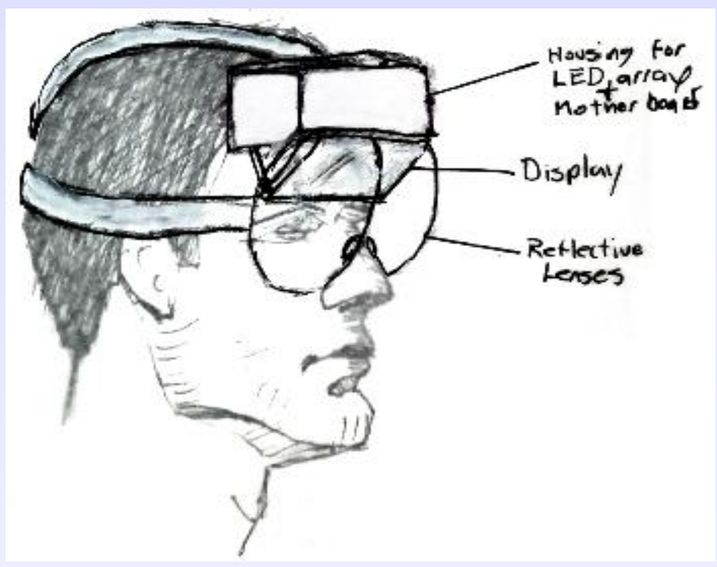

Figure 2: Concept drawing of an optical see-through head-mounted display using curved beam splitters as optical combiners.

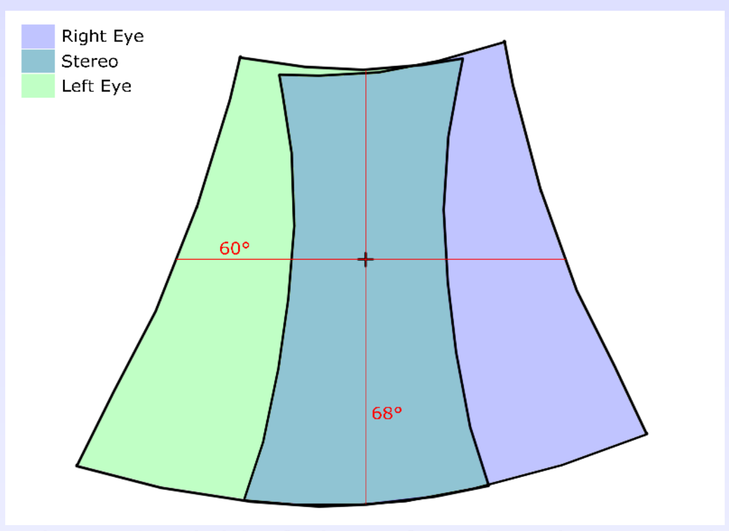

Figure 3: Field-of-view of our head-mounted display for an inter-pupillary distance of 61mm. The central vertical and horizontal fields of view are 68° and 60° respectively; the overall diagonal FOV is 82°.

The proposed system extends the one presented by Maimone[2], which supports a monocular view. Using lighting provided by multiple ceiling-mounted projectors, they illuminated a live-scanned room in order to create solid-looking virtual objects. Our new system aims to support proper stereo views by projecting different, stereoscopically-correct illumination for each eye.

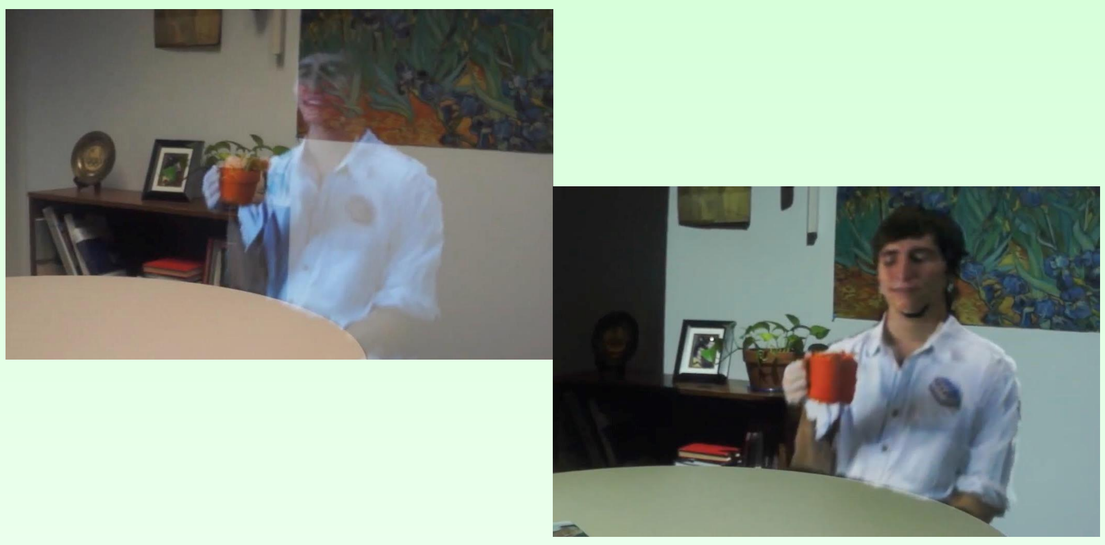

Figure 4: Remote person seen using AR display[2]. Left: without occlusion. Right: with occlusion support using projector-based lighting.

Figure 5: Concept drawing illustrating a virtual dragon appearing solid on the user's desk. Projector lighting creates the occluded view. The dual shadows are presented to each eye separately.

[1] Curved beam splitters were provided curtesy of Tracy McSheery of PhaseSpace and Mark Bolas of USC MxR Lab.

[2] Maimone, A., Yang, X., Dierk, N., State, A., Dou, M., and Fuchs, H. General-Purpose Telepresence with Head-Worn Optical See-Through Displays and Projector-Based Lighting. IEEE Virtual Reality 2013, best short paper

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