Augmented Reflection of Reality

http://augmented-mirror.onthewings.net/

Wing Ho Andy LI
City University of Hong Kong
andy@onthewings.net

Hongbo FU
City University of Hong Kong
fuplus@gmail.com

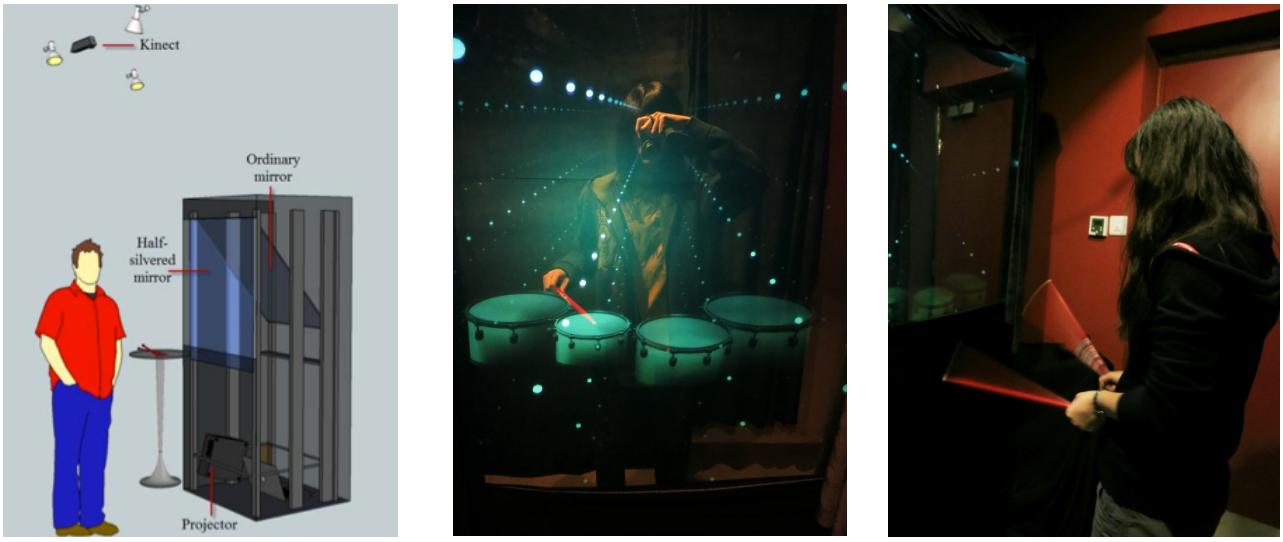

Figure 1: With our system for augmented reflection of reality, the user is able to interact with virtual objects (e.g., playing virtual drums) in a mixed world through optical combination between optical reflection of the user and rear-projected synthetic data. (Left) Installation design. (Middle) The augmented reflection from the user's perspective. (Right) Drum playing in action (from the third-person point of view).

To support augmented reality (AR), various display systems have been proposed to mix the real and virtual worlds together. The existing display technologies can be mainly categorized into two classes: video-based mixing and optical combination [Azuma et al. 2001; Bimber and Raskar 2005]. Both technologies have their own advantages and disadvantages. This work falls into the second category. Traditional AR applications focus on interacting with the augmented physical environment surrounding a user. Therefore, although half-silvered mirrors are sometimes used, they mainly serve as see-through displays (i.e., the real world is behind the mirrors).

The reflective nature of half-silvered mirrors has been limitedly explored in several interactive applications [Fujinami et al. 2005; Infiniti]. By displaying rear-projected content onto the back side of a half-silvered mirror, those applications let users have unusual sensation of seeing their reflection and the projected content simultaneously. However, those systems largely support touch-based interactivity only and the interaction with digital content is thus limited to the surface of the mirror.

Inspired by the above technologies, this work introduces the concept of *augmented reflection of reality* for user-centered interactivity. A half-silvered mirror is used to provide a mixed world through optical combination between the reflection of the user (standing in front of the mirror) and rear-projected synthetic data (Figure 1). In other words, compared to traditional AR scenarios, the real and virtual worlds here are swapped with respect to the mirror. With a live and direct view of the user himself/herself and the surrounding environment, our system allows the user to intuitively control virtual objects (e.g., playing virtual drums) via such augmented reflection.

To properly align virtual objects with the user in the reflection, the Kinect system of Microsoft is employed. The Kinect system enables users to control and interact with the digital world through a natural user interface using gestures. It has been extensively used to achieve user-centered interactivity but typically based on video-based mixing, which significantly limits the richness of interaction experience given the low resolution of the Kinect video camera (640 x 480 pixels). Instead, since the real world is already naturally reflected in the mirror, our work employs the Kinect only as a tool for capturing the position and movement of the user instead of the real-world scene.

We demonstrate the usefulness of our system using an application, we call *Air Drum*, where the user standing in front of the mirror controls and plays a set of virtual drums via the augmented reflection. The mirror enables the natural fusion of the virtual and real worlds, serving as a window through which we see the virtual world. In this application, the Kinect is mounted on the ceiling, since we care more about the position of the drumsticks in the horizontal plane instead of the full-body motion of the user. Such setup allows the user to stand closely to the mirror and to carefully observe his/her performance through the augmented reflection. Please see the accompanying video for demonstration.

Our system can be applied to scenarios other than musical instrument practice or performance. One idea is to demonstrate usage of wearable equipment. Users can put on equipment in front of our system where visual guideline can be displayed. Additional check on the usage of equipment can also be done and user will be alerted if necessary. Another idea is to use our system as a special tool for psychology session, where virtual objects (e.g. faces with emotion) or scenes (e.g. diving into ocean) can be displayed to assist a process called mirror meditation.

References

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