

# HaptoMIRAGE

## Mid-air Autostereoscopic Display for Seamless Interaction with Mixed Reality Environments

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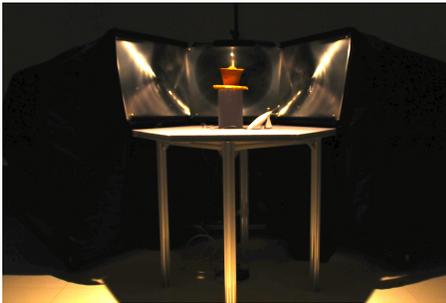


Figure 1: System Appearance

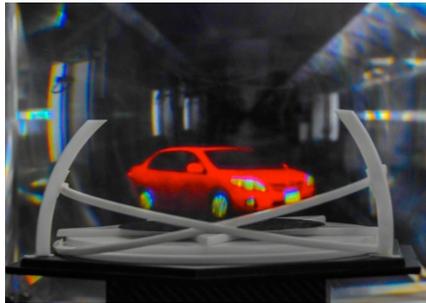


Figure 2: Superimposing 3DCG (Red Car) on the Real Object (Stage)



Figure 3: Drawing 3DCG (Flower) on the Real Object (Pot)

### Overview

HaptoMIRAGE is a simultaneous multi-user autostereoscopic display for seamless interaction with mixed reality environments. This system can project 3D contents in mid-air and enable as many as three participants observe the same contents with a 150 degrees wide-angle view. The system can be used in several scenarios, such as superimposition of 3D content onto real objects, and multi-user collaborative drawing in the real world. Further, users can interact with the 3D content, such as rotating it and viewing it from different angles, allowing them to easily create and feel the mixed reality world via tangible objects with multi-modal sensations.

### Active-shuttered Real-Image Autostereoscopy

As shown in Figure 4, Active-shuttered Real-Image Autostereoscopy (ARIA) (Nii et al, 2012) technology comprises an LCD display, an active shutter, and a Fresnel lens. The Fresnel lens makes the real image from the LCD display, while the transparent LCD panel-based active shutter provides time-divided rays of light for the left and right eyes. The user's point of view (PoV) is calculated with a camera-based motion capture system and the projected 3D content transformed to his/her viewpoint. The proposed HaptoMIRAGE system (Ueda et al, 2013) comprises three ARIA units, each with 50 degrees autostereoscopic field of view, resulting in a total of 150 degrees, which enables three users to experience the contents from different viewpoints simultaneously.

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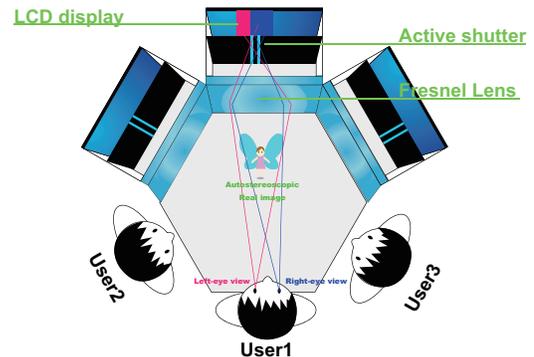


Figure 4: HaptoMIRAGE System Overview

### User Experience

Siggraph attendees can observe and interact with mid-air 3D contents superimposed onto real objects without wearing any special glasses. They can also create colorful line drawings on real objects using a pen-shaped device, as they would naturally do with their hand in the real world. These line arts can be created in collaboration with multiple users and do not fade over time, so they can be edited anytime thereafter.

### Acknowledgment

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### References

- Y. Ueda, N. Hanamitsu, Y. Mizushina, M. Shibasaki, K. Minamizawa, H. Nii, S. Tachi, HaptoMIRAGE: A multi-user autostereoscopic visio-haptic display, ACM SIGGRAPH 2013 Posters, p. 73, 2013.
- H. Nii, K. Zhu, H. Yoshikawa, N. L. Htat, R. Aigner, R. Nakatsu, Fuwa-Vision: An auto-stereoscopic floating-image display, SIGGRAPH Asia 2012 Emerging Technologies, pp. 1-4, 2012.