

# The Virtual Showcase: A Projection-Based Multi-User Augmented Reality Display

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The Virtual Showcase is a new projection-based and application-specific Augmented Reality display that offers an innovative way of accessing, presenting, and interacting with scientific and cultural content. Conceptually, the Virtual Showcase is compatible with the conventional showcases used, for instance, by museums. However, it allows the display of computer generated 3D graphics and animations together with real artifacts within the same space. From the technological point of view, the Virtual Showcase provides perspective correct stereoscopic viewing for multiple users, high resolution, low parallax (reflected projection plane inside the showcase), and support for mutual occlusion between real and virtual objects.

The Virtual Showcase consists of a convex assembly of half-silvered mirrors and a graphics display. The showcases' contents are illuminated with a controllable light source while view-dependent stereoscopic graphics are presented to head-tracked observers. Using a regular light bulb to illuminate physical objects located inside the showcase results in a semi-transparent appearance of the virtual objects. The real objects can be seen through the overlaid graphics. This results in conflicting occlusion cues. The use of video projectors as illumination sources allows the generation of shadows on the physical objects surface where the corresponding graphical content is overlaid. Appearance parameters of the projected light such as color, blending, and geometry can be controlled statically or dynamically (considering the current point of view during rendering) on a pixel-precise basis. This results in a realistic mutual occlusion of real objects by virtual ones. We use a digital light projector (DLP) and additional full mirror optics to realize a pixel-precise illumination. The full mirror optics are used to redirect the projected light into the Virtual Showcase.

The Virtual Showcase turns the exploration of cultural and scientific objects into an interactive process, which significantly enhances the visitor's museum experience and facilitates the learning process. Visitors can change from their passive role of an observer to the active role of an investigator. Multiple users can interact simultaneously with virtual content displayed in a single showcase stimulating communication and encouraging joint discovery of the presented pieces.

## Reference

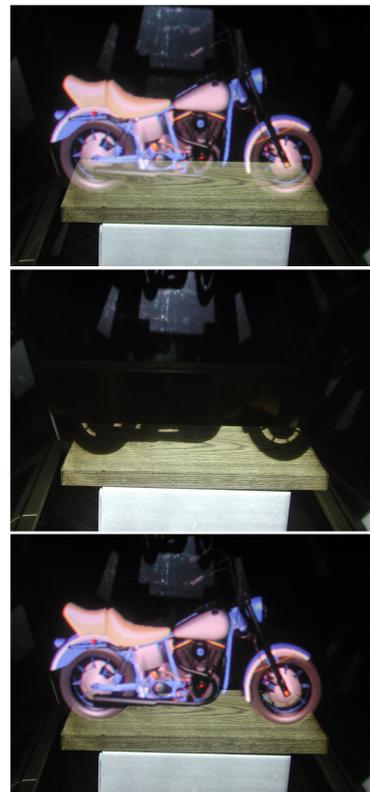
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The Virtual Showcase prototype supports pixel-precise illumination..



Illumination through a simple light bulb causes conflicting occlusion cues (top) and virtual objects appear always semi-transparent. To overcome this, a view-dependent shadow is generated on the physical objects' surface (center) before the virtual object is overlaid (bottom).