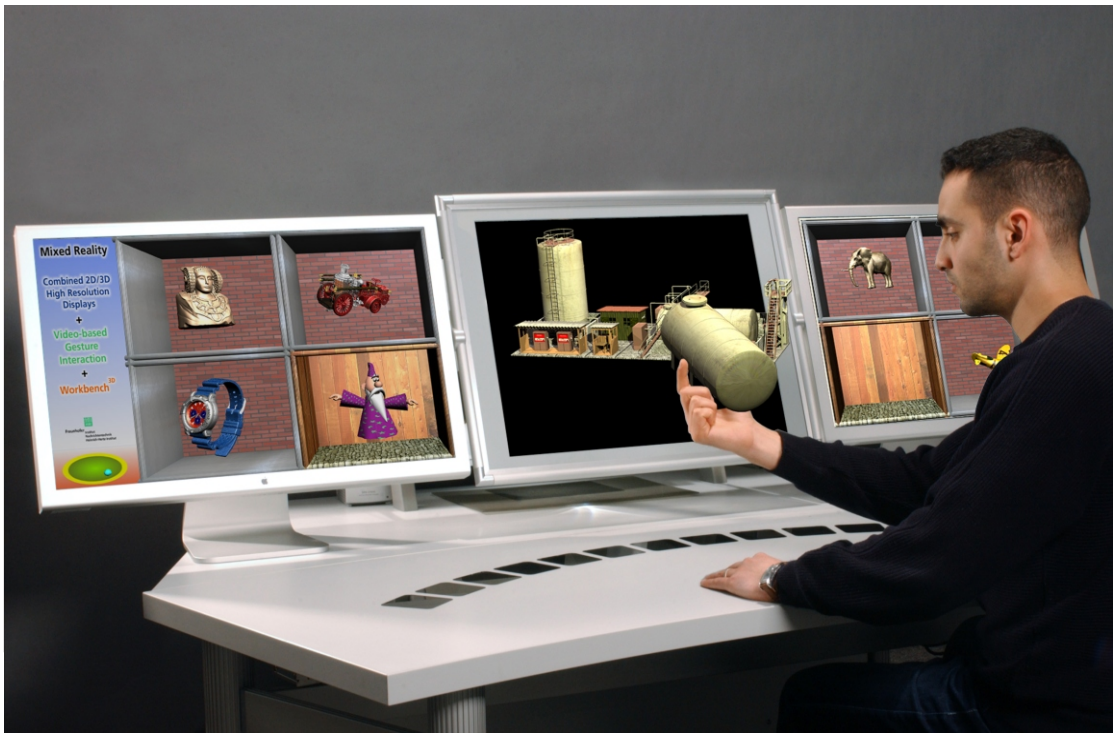
Fraunhofer Institut Nachrichtentechnik Heinrich-Hertz-Institut

Desktop Mixed Reality

Interactive workstation with combined 2D/3D displays and gesture interpretation

Mixed Reality displays seamlessly merge real and virtual worlds.



Mixed Reality workstation with combined 2D/3D displays and gesture interaction in a pointing range of more than 100°

Features

The novel combined 2D/3D displays bring Mixed Reality applications to your desk top. The images of two high resolution video projectors, with 1600 by 1200 RGB pixels each, are projected onto a special 30" filter panel. As a result, computer generated objects float above the desktop in holografic quality (symmetric resolution, excellent stereo separation). The patented system perfectly embeds virtual objects in the real environment.

The 3D display is flanked by two high-resolution 2D monitors. The displays share a joint data space. With a simple hand gesture the user can move computer-generated objects shown on the 2D screens to the 3D display area (drag & drop operation). There, the user may touch it like a real object. Hand gestures are recognized remotely by a video-based multiple-baseline stereo hand tracker embedded in the desktop. Optionally, haptic feedback when touching the virtual object can be provided by a force-feedback device.

Since the 3D objects appear in about the same optical distance as the hand or tool used for manipulation, there is no visual conflict.

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System Description

The modular display system consists of a special stereo video projector flanked by two large LCD displays, an array of multiple-baseline stereo video hand trackers and three small desktop PCs, with all components integrated into a workbench.

In total, the 3D display provides a native resolution of 3,200 x 1,200 RGB pixels. The stereo image is rendered by one of the PCs in UXGA resolution and projected as a real aerial image pair. A special rectangular 30" Fresnel-type condenser lens focuses the images within reach of the observer. The display creates a comfortable stereoscopic sweet spot, measuring 2x 65 mm x 100 mm in size. The flanking 30" flat panel displays provide 2,560 x 1,600 RGB pixel resolution each.

The gesture recognition device is set-up of an array of nine chip cameras connected by serial interfaces. The hand detection algorithm selects an appropriate pair of cameras capturing the user's hand at its current location. The 3D position of a finger tip is computed 50 times per second. When the hand moves, leaving the viewing angle of the currently selected cameras, the algorithm automatically switches to another pair of cameras. Six sets of infrared light-emitting diodes mounted close to the cameras illuminate the hand from the bottom, thus supporting the hand segmentation process under unfavourable ambient light conditions.

Applications for this novel display system can be created with the HHI Workbench^{3D} development tool. Workbench^{3D} consists of a .NET library written in C# and a corresponding core application which manages plug-ins and drivers written with this API. The software supports multimodal interaction using speech and gestures in combination with conventional input devices.

Applications

Prospective applications are e.g. in the fields of engineering (CAD, CAM), medicine (diagnosis, operation planning and instruction), and for natural visualization in a virtual museum.

Combined 2D/3D Mixed Reality display using a 100" rear projection screen

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