

PolyShop

An eight-year-old girl builds a fairy tale castle from blocks, then shrinks herself down to a size where she can go inside her castle to play.

A SWAT team penetrates a building and rescues hostages within minutes. The team has not previously been in the building. Or have they "visited" the location before?

A student in France and a student in the United States stroll together through a landscape of changing objects. As each new object appears, they teach each other a phrase about it in their native language.

Previously, these experiences were only available through imagination. Now, networked virtual reality is opening up new channels of communication. PolyShop is an

attempt to create an immersive, interactive, responsive virtual environment as the underlying technology for a variety of applications that allow humans to not only exist in but also to manipulate the virtual world.

PolyShop is unique for several reasons. One of its most interesting aspects is the direct mapping between the virtual and the physical worlds. In order to decrease the fatigue caused by reaching out to interact with objects in the virtual world, PolyShop allows an application to be built around an actual desktop. For lengthy and exacting applications such as geometric modeling, the user sits at a drafting-table-style desk that is specially constructed to minimize interference with the trackers. The desktop is recreated as a 3D geometric model and displayed in the virtual world. The testbed is calibrated so that the physical and virtual desktops correspond. The desktop can be tilted to a comfortable angle for working, and the virtual model tracks it and tilts as well.

Another innovative aspect of PolyShop is found in its manipulation metaphor. Interaction with the virtual world is through a pair of chord gloves that have conductive pads on the palms and fingertips to detect simple electrical contacts. They can be used to emulate 3D mice or a chordic keyboard in a virtual environment, or as an intuitive picking interface. While wearing the gloves, the user can simply reach out and pinch on an object to select it at a precise point. While grasping an object with both hands, the user can rotate, stretch, or scale it just as if it were in the real world. The power of this interface is illustrated in one of PolyShop's baseline human factors tests, in which the user can scale, rotate, and translate a puzzle piece in one intuitive motion.



Once these basic abilities were established, more complex tools were added to PolyShop's repertoire. Cursor snapping and pivot points were developed to increase control and accuracy. By placing a pivot point between two objects, full-face alignment in 3D can easily be achieved. This, combined with the ability to texture, color, and glue objects together to form more complex objects, creates a powerful 3D modeling interface.

Modeling is, however, only one of the countless applications that are moving toward virtual environments. Long-distance networking allows two or more participants to enter PolyShop's environment for collaborative work, education, and training activities, or multi-person games. Adding sound gives the virtual space an extra dimension. Voice recognition increases the interaction bandwidth. Attaching behaviors to objects can create virtual shooting stars and scurrying insects. PolyShop gives the user the freedom to ignore real-world physical laws, which unleashes creativity and forges a new and unique interactive artistic medium.

PolyShop's History

Funding for PolyShop as a networked virtual CAD environment is provided by the Army's Simulation, Training and Instrumentation Command (STRICOM). The first-year (1993)

effort focused on a low-cost prototype platform. Two 486 PCs with SPEA Fireboards were used, with one PC generating the geometry for each eye. A Polhemus Fastrak with three sensors was utilized for the spatial tracking of the head and both hands, and the display was fed to a Virtual Research Flight Helmet.

The chord gloves, which were designed and developed at the Institute for Simulation and Training, detect electrical contact with a Motorola HCL1 development card. Extra functionality was added with DragonSpeak and GUS cards, used for voice recognition and sound, respectively. A specialized drafting table was designed and constructed in conjunction with University High School. The software was built on top of Sense8's World ToolKit, a C library which afforded both quick prototyping abilities and an easy port-up to a high-end graphics system in the second year of the project.

PolyShop combines cutting-edge VR technology with the inspiration of the human spirit and provides a responsive and highly intuitive virtual creation space. Several different demos are shown, including a virtual jigsaw puzzle and the 3D modeling environment, where users will be able to create their own worlds.

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