MakeVR: An Immersive Content Creation Experience

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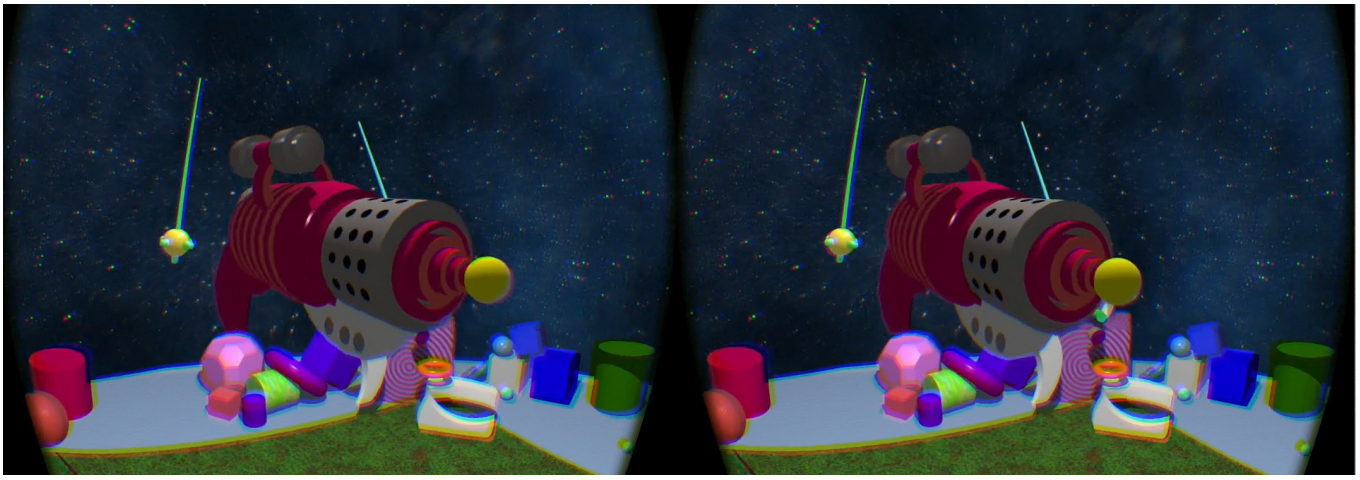

Figure 1: MakeVR session

Abstract

MakeVR combines immersive, realtime 3D control with a powerful, professional-grade CAD engine to create a groundbreaking modeling paradigm. MakeVR enables a new generation of artists, gamers, students, researchers, children and aspiring modelers to imagine, create, and share together in 3D. A key advantage to MakeVR is its learning curve; novices are productive on Day 1. Another key advantage is its rapid workflow; professionals create as quickly as they think.

Keywords: virtual reality, modeling, CAD, immersive interaction

Concepts: **• Human-centered computing ~ Human computer interaction (HCI) ~ Interaction paradigms ~ Virtual Reality;**

1 MakeVR = 3D Multitouch + CAD Engine

MakeVR presents a deep and powerful CAD feature set through a natural and easy to learn Two-Handed Interface (THI). This interface is similar to the Multitouch common to modern tablets and phones; only in 3D. Consequently, it requires little or no training.

2 Implementation

The MakeVR software consists of the Sixense application, driven by the Two Handed Interface (THI), combined with Spatial Technology's ACIS CAD engine. The MakeVR hardware consists of two 6DoF controllers (as exemplified by the Sixense STEM System, Razer Hydra, Oculus Touch, or Steam Controller), a PC, and a display (standard monitor, 3D monitor, or HMD). The user controls the system via THI/MakeVR's virtual panel that floats over the user's non-dominant hand (Figure 2). With just a few buttons on each controller and THI/MakeVR's virtual panel, the user accesses functionality that requires deep menus and dialog boxes in other programs.

2.1 Two-Handed Interface (THI)

The Two-Handed Interface allows users to reach into space to control their viewpoint and manipulate tools and data. THI can be thought of as 3D Multitouch, but instead of two 2D points on the surface of a flat display, THI gives the user two 6 Degree-of-Freedom (3 positional and 3 rotational) points in space. Combining these two points in novel ways enables an intuitive method of interacting with applications.

There is anecdotal evidence that MakeVR's style of 3D Multitouch circumvents motion sickness in the HMD for many of its users. We believe that this benefit can be explained by an inversion in the way the user thinks about moving through the world. Rather than navigating the viewpoint through the world, the user perceives that he/she is grabbing the world and pulling it past the eyes. Operating from this fixed frame of reference bypasses the expectation of a vestibular sensation of motion. For most THI users, this radically extends session duration and many users are able to comfortably spend several hours in the HMD.

Also anecdotally, THI has been observed to circumvent Repetitive Stress Injury (RPI), possibly because the hand position during button presses varies during 3D interaction. This makes the motion inherently non-repetitive as compared to mouse button presses where the hand is in a relatively fixed position at all times. THI has been applied to many applications including medical imaging, design, command & control, and education.

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2.2 CAD Engine

MakeVR incorporates a professional-grade CAD engine, Spatial Technology's ACIS Modeler to afford a robust set of solid modeling features. ACIS' depth and reliability is due to a long history of development (e.g. over 100 man-years in the Booleans alone). MakeVR exposes many of ACIS' features in its current form and continues to expose more over time.

3 Features

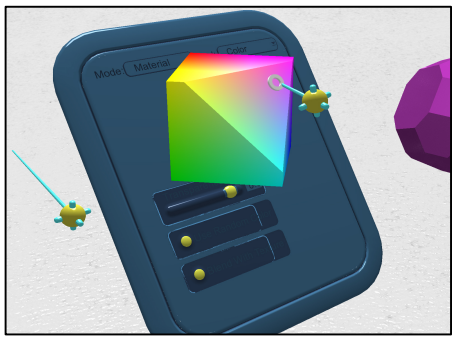

Figure 2: Floating tool panel with color cube

MakeVR supports many operations, including:

- Motion Controlled Viewpoint Movement and Object Manipulation: The user navigates through worlds (position, orientation, and scale) and manipulates objects with either or both hands via THI.
- Solid Modeling: Booleans (Cut, Join, Slice). Sweeps (the creation of volumes by translating/rotating planar closed contours (hoops) through space). Copy, deform, scale, mirror, and loft.
- Freestyle Design: Make virtual objects and entire worlds composed of many individual complex solid objects, starting with a shape library or saved/imported objects and worlds.
- Precision Design: Through the use of digital jigs (snap-together guides (grids, rulers), and objects in the scene whose surfaces can be tracked upon) objects are placed exactly and their paths are precisely controlled to effect precision cuts, in a manner similar to physical jigs in a carpenter's or machinist's shop.
- Every object is a tool: Utilize any object as a tool to shape other objects. Save useful shapes you've built or download others for use in future cutting operations.
- Spectrum of Immersive Visualization: Reach into space via standard 2D displays, consumer 3D displays, or head-mounted displays (HMDs).
- Materials: Manually set material properties via texture browsers and a 3D color cube (Figure 2). Automatically impart material properties during Boolean cuts.
- Laser Selection: Hand-driven laser selection tools designate objects to be cut (stock) and objects to cut them with (blades).
- Virtual Toolbox that floats over the user's hand for control modeling options and setting modes.
- Import / Export: Import and export of multiple CAD and polygonal formats, including STL for 3D printing what you make in MakeVR.
- Collaboration: Work on the same object with other users. Remote users are represented by avatars with independent viewpoints (position, orientation, and scale). When they grow their worlds, you see their avatars shrink.

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