3D Palette: A Virtual Reality Content Creation Tool

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ABSTRACT
3D Palette is a new interface for rapid 3D virtual scene creation, combining three different interface elements: two dimensional tablet input; six degree of freedom direct input; multimodal input.

Keywords: Virtual Reality, 3D Modeling, Multimodal Input

INTRODUCTION
Content creation is often the most time consuming aspect of virtual world development. Alternative input devices allow the development of new interfaces for rapid 3D scene creation. Previously, researchers have shown how users prefer combined voice and gestural input for graphical manipulation [1], and how six degree of freedom electromagnetic trackers can be used for intuitive 3D modeling [2,3,4]. 3D Palette is a unique interface which combines these and adds high resolution two-dimensional tablet input to provide tactile feedback and compensate for the resolution limits of electromagnetic trackers.

THE INTERFACE
3D Palette consists of a Wacom tablet and digitizing pen, both of which are tracked in space using Polhemus Fastrak electromagnetic sensors, a head-mounted microphone and a pair of CrystalEyes stereoscopic shutter glasses. The user holds the tablet in one hand while interacting with the scene using 2D and 3D pen gestures and voice commands (Figure 1). Onscreen, the user can see a virtual tablet and pen and the scene they are creating, rendered stereoscopically to give true 3D depth cues (Figure 2). Since the virtual tablet is part of the modeling scene, users can stay focused on the work region at all times.

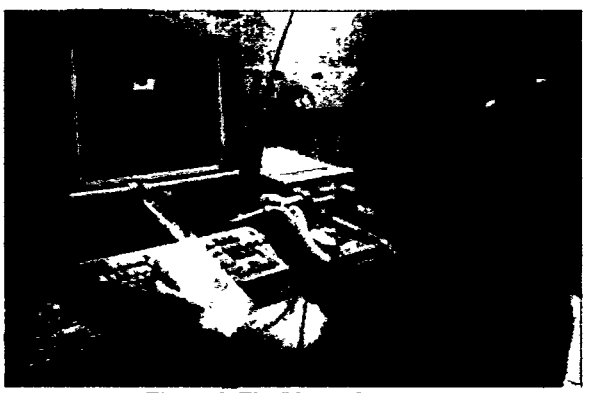

Figure 1. The Physical Interface

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Figure 2. The Virtual Interface

Tablet Input
Tablet input is used for rapid 3D object creation and specification of object parameters using 3D widgets. These widgets appear in response to touching 3D menus on the virtual tablet surface or vocal commands; for example, touching the "C" icon or saying "Color" will cause a color widget to appear (Figure 3). Users can create, delete, load, save, scale, and texture objects. Since the tablet supports high resolution 2D input and provides a surface to push against, users can specify object parameters very precisely.

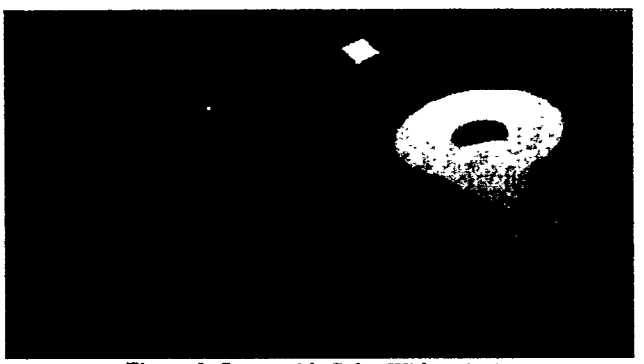

Figure 3. Scene with Color Widget Active.

The tablet can also be used for drawing on. Users can move their viewpoint through the scene by drawing movement vectors on the tablet surface. The camera translates in the same direction as the movement vector at a speed set by the vector magnitude. Buttons on the pen can be used to toggle between horizontal and vertical motion. Users can also draw object profiles directly on the tablet which are then rotated into a volume of revolution or extruded out of the tablet surface (Figure 4). Once objects are created they are initially attached to the tablet surface which can be easily turned to view the object from any angle. Finally, users can sketch texture maps which can subsequently be applied to object surfaces

(Figure 5). For detailed work, a snap-to command makes the tablet surface fill the screen, reproducing a traditional 2D modeling interface.

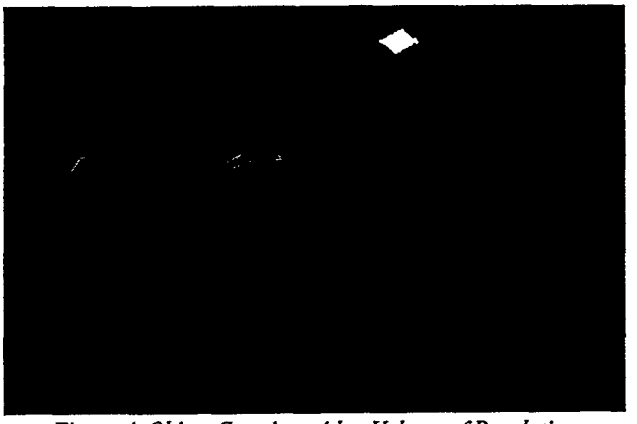

Figure 4. Object Creation with a Volume of Revolution

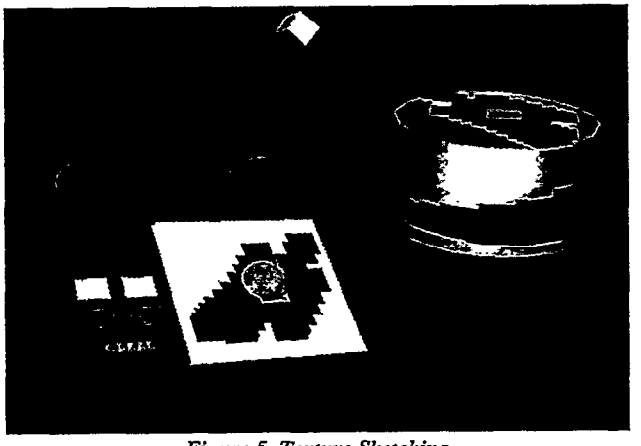

Figure 5. Texture Sketching

To speed scene creation, objects and texture maps can be loaded onto the tablet surface from predefined libraries and selected with the pen input (Figure 6). For example, saying "Show me animals", will cause a set of animals to appear on the tablet. The entire scene can be scaled down and represented on the tablet in a World in Miniature view[5]. Manipulating objects in the miniature view causes changes in the full scale scene.

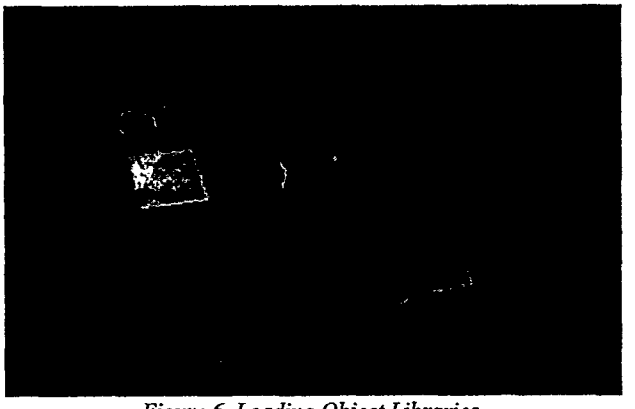

Figure 6. Loading Object Libraries.

Direct 3D Input

Electromagnetic trackers on the pen and tablet allow six degree of freedom input. Once objects have been created or loaded, they can be plucked off the tablet surface and dropped directly into the scene at the desired position and orientation. Objects already in the scene can be selected by touching them with the virtual pen and moved, copied, scaled, textured, colored or deleted. However, the Wacom tablet emits a small magnetic field which interferes with the Fastrak's magnetic sensing near the tablet surface. To compensate for this, when the pen is touching the tablet surface the Fastrak orientation values are ignored and the virtual pen drawn between the pen tracker position and the contact point on the tablet surface.

Voice Commands

Voice input speeds command entry by enabling users to have hands-free access to any function in the interface with a single spoken phrase. Speech also allows combined multimodal voice and gestural commands, reducing the number of commands that need to be used: for example, touching an object and saying "Color this red". Speaker independent continuous speech recognition software is used so no training is required. The system recognizes 43 command phrases with an accuracy of better than 95%. As commands are recognized the relevant command key word is shown attached to the virtual tablet, so users are kept aware of the words returned by the recognition system. The microphone can be turned on and off by touching a region on the virtual tablet, so users can carry on normal conversation between voice commands.

CONCLUSIONS

3D Palette has been designed for rapid 3D scene building without relying on traditional keyboard or mouse input. The use of a digitizing tablet allows for accurate object construction and parameter specification; electromagnetic trackers facilitates 3D scene assembly using direct input; and voice control speeds the command selection process. Users have generally found the interface easy to use and have particularly enjoyed the multimodal input capabilities. We are currently adding support for relational voice commands ("Put a tree on that box"), and handwriting recognition for written command and text input. More work also needs to be done on intuitive camera control and object selection techniques, especially selecting multiple objects.

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