3D Graphics for Everyday Communication

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Abstract: It is still difficult for casual users to author 3D models from scratch. Our goal is to design easy-to-use 3D graphics authoring tools so that people can use 3D graphics as an everyday communication tool such as word processors and emails. This paper introduces some of our projects toward the goal. To be specific, we introduce a sketch-based modeling system, a 3D painting system, a 3D sketching system with automatic suggestions, and a clothing manipulation technique.

Keywords: 3D graphics, User Interface, Sketching, Modeling.

1. Introduction

People enjoy computer-generated three-dimensional graphics in everyday life ranging from TV commercial films to high-quality Hollywood movies. However, the construction of these three-dimensional graphics is still difficult and is restricted to trained experts today. The general public just consumes the high-quality graphics produced by such experts. This is unfortunate. Three-dimensional graphics is a powerful tool to express and communicate important ideas, and we should be able to enrich our daily communication by making the most of it. Our goal is to make three-dimensional graphics an everyday communication tool for everyone, such as word processors and emails, by providing easy-to-use authoring tools. We believe that such tools can enrich human communication in various domains, including medicine, biology, architecture, and education. This paper introduces some of our efforts toward the goal and discusses future possibilities.

2. Teddy: A Sketch-based 3D Freeform Modeling System [1]

This system allows the user to quickly and easily design freeform models, such as stuffed animals and other rotund objects, using freeform strokes. The user draws several 2D freeform strokes interactively on the screen and the system automatically constructs plausible 3D polygonal surfaces. Our system supports several modeling operations, including the operation to construct a 3D polygonal surface from a 2D silhouette drawn by the user: the system inflates the region surrounded by the silhouette, making wide areas fat and narrow areas thin. Teddy, our prototype system, is implemented as a Java program, and the mesh construction is done in real-time on a standard PC. Our informal user study showed that a first-time user typically masters the operations within 10 minutes, and can construct interesting 3D models within minutes.

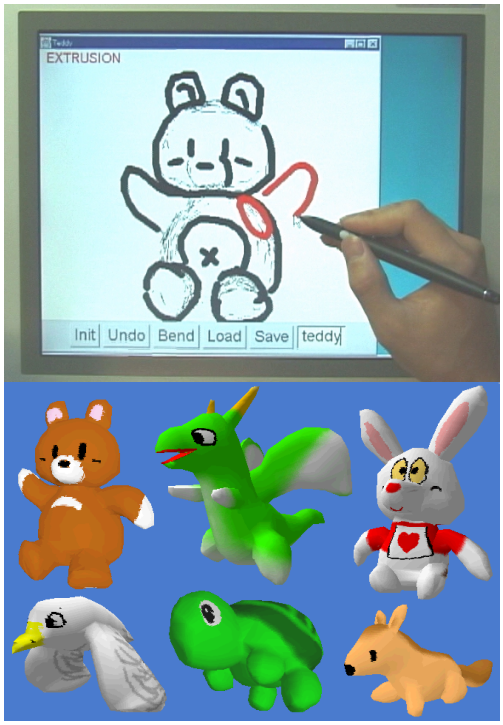

Fig. 1. Teddy in use on a video tablet (top). Example 3D models designed using Teddy (bottom).

3. Chameleon: Painting 3D Models with Adaptive unwrapping [2]

This is an interactive texture painting system for 3D models that dynamically generates an efficient texture bitmap and its associated UV-mapping. Typical texture painting programs update texture the bitmap only as the user paints strokes on the 3D view. The user defines the underlying UV-mapping from 3D geometry to 2D bitmap before painting, and this mapping remains unchanged during the painting. However, a predefined UV-mapping can cause distortion at arbitrary locations, and unpainted areas in the bitmap waste memory. To solve these problems, we

propose an adaptive unwrapping mechanism where the system dynamically creates a tailored UV-mapping to newly painted polygons during the interactive painting process. As a result, the distortion of brush strokes disappears, and the resulting texture bitmap is more compact because the system allocates texture space only for the painted polygons. In addition, this dynamic texture allocation allows the user to paint smoothly at any zoom level. This technique can be efficiently implemented using standard 3D rendering engines, and the painted models are stored as standard textured polygonal models. We implemented a prototype system, called Chameleon, and our user experience suggests that our technique is very useful for simple painting by casual users.

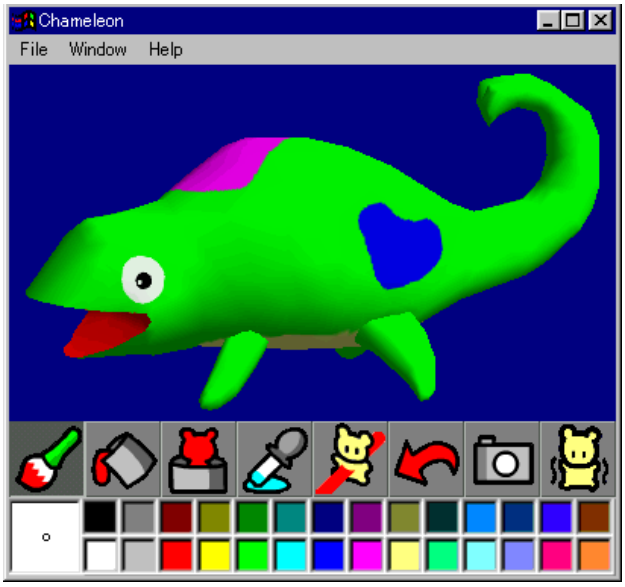

Fig. 2. A screen snapshot of Chameleon. The user paints strokes on the 3D model directly without specifying the UV mapping beforehand.

4. Chateau: A Suggestive Interface for 3D Drawing [3]

This system introduces a new type of interface for 3D drawings that improves the usability of gestural interfaces and augments typical command-based modeling systems. In our suggestive interface, the user gives hints about a desired operation to the system by highlighting related geometric components in the scene. The system then infers possible operations based on the hints and presents the results of these operations as small thumbnails. The user completes the editing operation simply by clicking on the desired thumbnail. The hinting mechanism lets the user specify geometric relations among graphical components in the scene, and the multiple thumbnail suggestions make it possible to define many operations with relatively few distinct hint patterns. The suggestive interface system is implemented as a set of suggestion engines working in parallel, and is easily extended by adding customized engines. Our prototype 3D drawing system, Chateau, shows that a suggestive interface can effectively support construction of various 3D drawings.

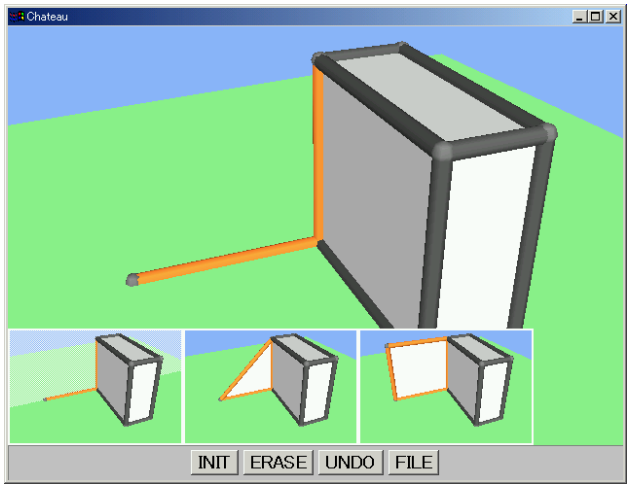

Fig. 3. A screen snapshot of our prototype system Chateau. The user gives the hints to the system by highlighting related lines (red lines), and the system suggests possible operations (thumbnails at bottom) based on the hints.

5. Clothing Manipulation [4]

This system presents interaction techniques (and the underlying implementations) for putting clothes on a 3D character and manipulating them. The user paints freeform marks on the clothes and corresponding marks on the 3D character; the system then puts the clothes around the body so that corresponding marks match. Internally, the system grows the clothes on the body surface around the marks while maintaining basic cloth constraints via simple relaxation steps. The entire computation takes a few seconds. After that, the user can adjust the placement of the clothes by an enhanced dragging operation. Unlike standard dragging where the user moves a set of vertices in a single direction in 3D space, our dragging operation moves the cloth along the body surface to make possible more flexible operations. The user can apply pushpins to fix certain cloth points during dragging. The techniques are ideal for specifying an initial cloth configuration before applying a more sophisticated cloth simulation.

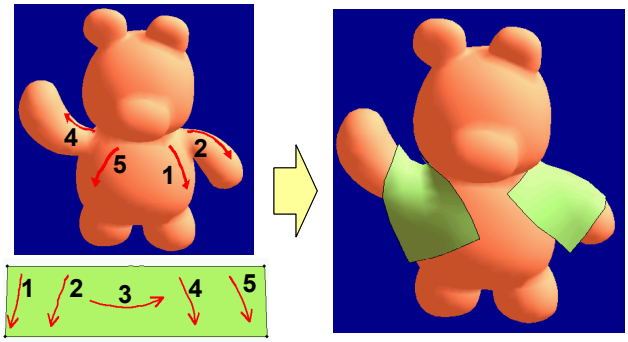

Fig. 4. The user paints pairs of freeform marks on the target body and on the clothes (left); the system places the clothes on the body so that the corresponding marks match (right). The result appears almost instantly. (The mark numbering has been added by hand to clarify the correspondences.)

References

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