inTouch: Interactive Multiresolution Modeling and 3D Painting with a Haptic Interface

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This rooster was modeled and painted using the inTouch system.

Highlights

- **An intuitive 3D interface for interactively editing and painting a polygonal mesh at various levels of detail using a force feedback device.**
- **The coupling of innovative haptic technology with visual feedback allows users to naturally create complex forms and patterns.**

The Challenge

While there are numerous commercial modeling systems, as well as scanning technologies available, simple, intuitive, and fast modeling remains a challenging problem. An ideal modeling package should allow the user to create a basic model, edit it with finer details, and further enhance its appearance by painting colors and textures, all with relative ease and flexibility via an intuitive and simple user interface.

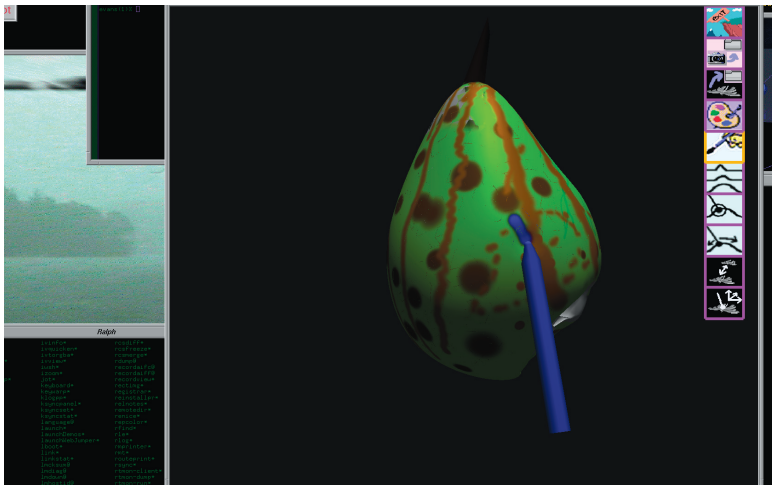
One of the limitations of existing commercial modeling systems is the lack of direct model interaction, because current desktop computing environments use typical 2D input and output devices. The resulting high learning curves deter many artists from freely expressing their creativity.

The Approach

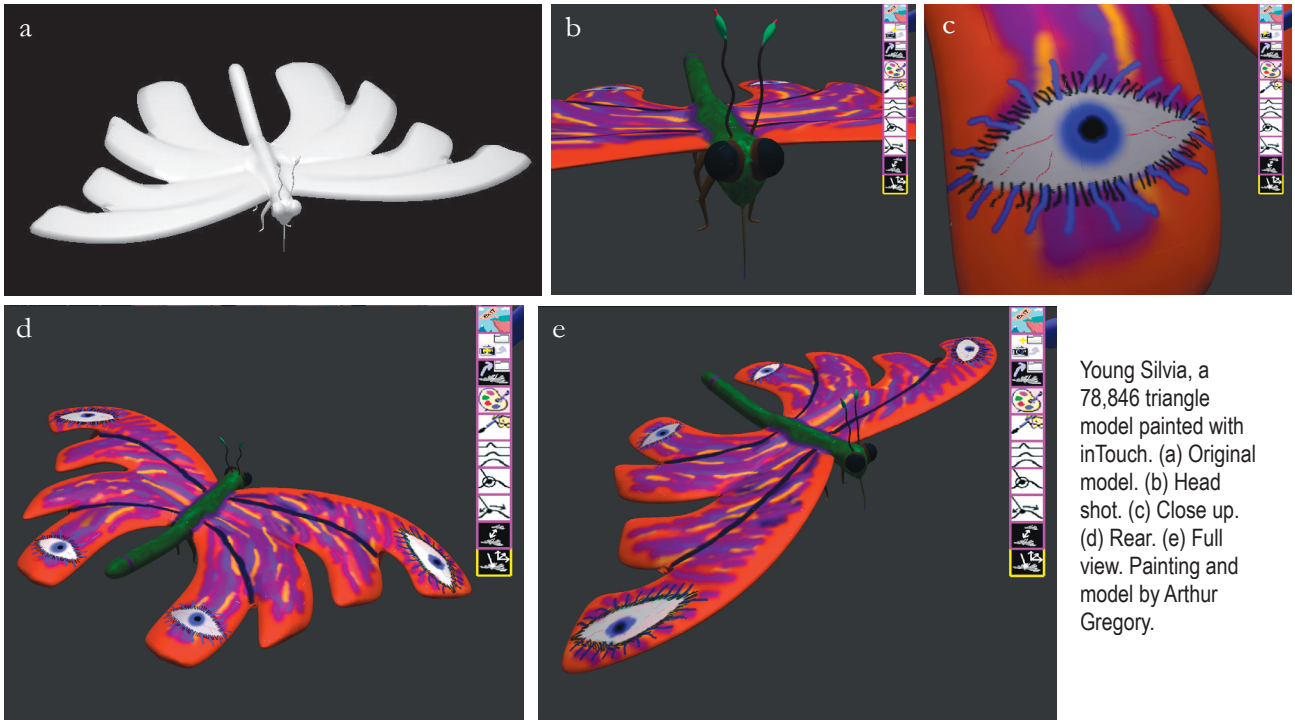
The inTouch system, which couples visual display with force feedback, can be used as a geometric modeler, as well as a 3D paint program. It can be used during the entire modeling process or it can be used to paint a model produced by another modeling package or by a scanner. It complements existing techniques and modeling software.

User Interface. There is a 2D menu drawn over the edge of a stereo projected 3D scene, which contains the model being worked on, along with a graphical representation of the tool being used. The user can effectively interact with the 3D scene and the 2D menu without ever having to let go of a stylus, which is a PHANToM three-degree-of-freedom force-feedback device. The user can position, orient, and scale the models. For shape deformation, the interface allows the user to pick the feature size and then directly manipulate the surface. For 3D painting, the user can interactively choose the color, saturation, and luminance of the brush stroke, as well as its radius and falloff by naturally dragging in a 2D canvas. At all times, the surface of the model can be felt through the input device. The use of stereoscopic display further enhances the visual cues for complex interactions in three dimensional space.

Mesh Editing. We use a subdivision mesh to represent the geometry of the model. This type of representation allows for modifications to occur at multiple levels of detail. The advantage of this approach is that the user can perform relative modeling. The user can select a coarse edit level and deform the mesh. A change occurs in the overall shape of the model, with the finer features following the coarser edit without getting lost.



This pear was modeled and painted using our system. The user interface simply consists of the buttons on the right.



Young Silvia, a 78,846 triangle model painted with inTouch. (a) Original model. (b) Head shot. (c) Close up. (d) Rear. (e) Full view. Painting and model by Arthur Gregory.

3D Painting. A hard problem in computer graphics is parameterizations for texture mapping. By allowing the user to paint directly onto the model, the inTouch system removes this problem, because the painting is done with a direct correspondence to the model. Thus, correct textures can be easily created during the modeling process. To paint on the model, the user selects the color, the brush radius, and the brush falloff. Paint is applied by touching the model and depressing the stylus button.

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Selected Publications
Gregory, A., S. Ehmann, and M. C. Lin. "inTouch: Interactive Multiresolution Modeling and 3D Painting with a Haptic Interface," *Proc. IEEE Virtual Reality Conference*, March 2000, 45–52.

Gregory, A., M. Lin, S. Gottschalk, and R. Taylor. "H-Collide: A Framework for Fast and Accurate Collision Detection for Haptic Interaction," *Proc. IEEE Virtual Reality Conference*, 1999.

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Haptics; human-computer interaction; collision detection

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