Augmented Reality Three-Dimensional Modeling System based on hand gesture recognition

Pei-Ying Chiang
National Taipei University of Technology
Taipei, Taiwan
peiyingc@csie.ntut.edu.tw

Wei-Yu Li
National Taipei University of Technology
Taipei, Taiwan
t101598058@ntut.edu.tw

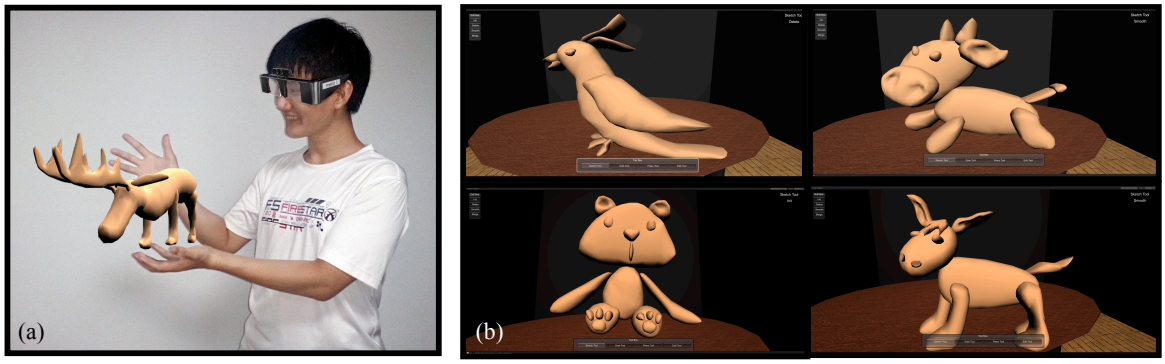

Figure 1. (a) Concept illustration. The user wearing augmented reality glasses can mold a 3D model as easily as shaping clay. (b)The 3D models created using our 3D modeling system.

ABSTRACT

We propose a gesture-based three-dimensional modeling system, which allows the user to create a three-dimensional model and sculpt it with hand-gestures. A delicate three-dimensional model can be easily created with the following process: The user first draws the two-dimensional contour of a desired three-dimensional shape with one finger. The system then automatically inflates this two-dimensional contour to generate an initial rotund two-dimensional model. The user can proceed to sculpt this three-dimensional model with our gesture-based sculpting tool including grab-to-extrude tool, slice-to-cut tool and press-to-dent tool, etc. Our system also provides the gesture-based navigation tool for enlarging /shrinking, moving and rotating the virtual object, which makes the sculpting process more convenient. The contribution of our system is to provide a more intuitive three-dimensional user interface than the traditional 2D ones which use a mouse or a touch pad as input. A series of hand gestures are designed for interacting with the 3D object and their corresponding mesh processing functions are developed. Therefore, the user can create a desired virtual 3D object in a way that is similar to how people shape clay.

INTRODUCTION AND RELATED WORK

Three-dimensional (3D) modeling is one of the most fundamental and important topics in computer graphics and other related fields. It has attracted intensive research interest ever since the birth of the field of computer graphics. As a result, many 3D modeling software systems such as Maya and 3D Studio MAX have been developed. While their capabilities of producing complex and realistic models are ever increasing, it may take days and even months for the users to get familiar with those dedicated 3D model creation software, and casual users may easily get frustrated. On the other hand, with the development of networking technologies and 3D graphics-based applications, users demand more flexibility in quick creation and sharing of their own 3D contents over the network. In light of these observations, we investigate in this work intuitive and simplified modeling techniques that enable the users to create and edit 3D models easily and flexibly.

A variety of efforts have been made to the research of creating 3D models from two-dimensional (2D) sketches, such as Teddy [1] and FiberMesh [2]. They offers a sketching interface for users to draw free-form models using the inflation technology and supports several modeling operations for mesh editing. Alexe et al. [3] reconstructed a 3D shape from its 2D sketch using convolution surfaces with polylines and polygons skeletons. Schmidt et al. [4] utilized hierarchical implicit volume models (BlobTrees) as an underlying shape representation to inflate 2D contours into 3D rounded implicit volumes. However, none of the previous works mentioned above allow users to edit 3D models in three-dimensions due to the limitations of traditional input devices such as a mouse and touch pad.

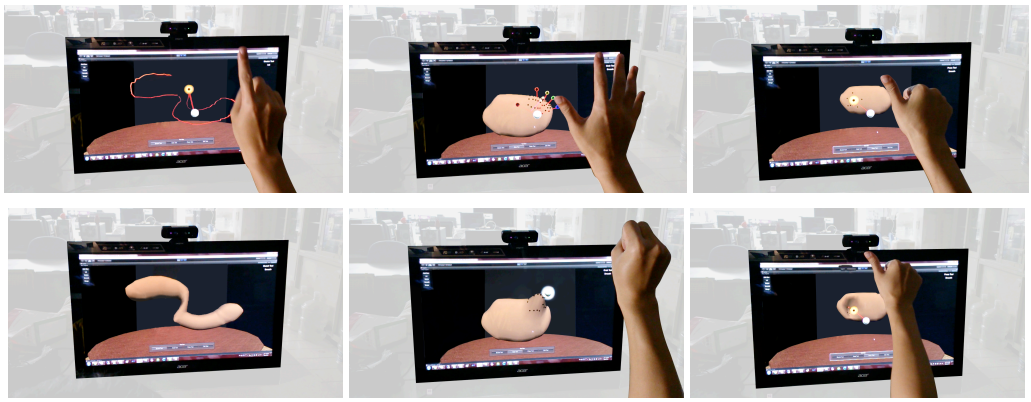

Figure 2. (a)The draw-to-create tool. (b) The grab-to-extrude tool. (c) The press-to-dent tool.

We extend the sketch-based 3D modeling system from 2D to 3D user input. Our 3D modeling system allows the users to create 3D models with hand gestures. Our main goal is to develop an Augmented Reality 3D modeling system user interface. As long as the user is wearing an augmented reality glasses as Figure.1(a), he or she can sculpt the 3D model with their hands just as if they were molding clay.

SYSTEM OVERVIEW AND GESTURE DESIGN

The hand-gesture recognition function of our system is developed based on Intel *Gesture Camera Developer Kit* [5]. We adopt it because their skeletal hand tracking research [6] was more promising than other available hand gesture recognition libraries during our evaluation stage. The idea of how we design our hand gestures came from how people made pottery. We aim to design simple and easy-to-learn gestures. Here we list our main modeling functions and their corresponding hand-gestures:

Draw-to-Create tool allows the user to create an initial 3D model by drawing its 2D contour as Figure.2(a). This rotund 3D model is inflated from the 2D contour using Teddy [1]'s approach and then smoothen automatically.

Grab-to-Extrude tool allows the user to grab/select the surface area of a 3D model with five fingers for further extrusion; the selected area will be first highlighted for guidance; the size of this extrusion area increases as the hand moves away from the selected surface until released as Figure 2(b).

Slice-to-Cut tool allows the user discard a part of the 3D model with a slicing gesture.

Press-to-Dent tool allows the user to select the surface area and dent it by pressing with a thumb as Figure2.(c).

Navigation tool allows the user to grab and then move a object with one hand, or enlarge/shrink an object with two hands. This tool is developed because it makes the editing process, such as merging two objects, much more convenient.

The experimental result of our work is shown in Figure.1(b).

CONCLUSION & FUTURE WORK

We develop a gesture-based 3D modeling system. The user can easily create a 3D model with hand gestures. The main contribution of our system is providing an intuitive 3D user interface that improves traditional 2D input approaches. We develop a series of useful mesh processing functions and define their corresponding hand gestures for editing the 3D model. Therefore, the user can create a desired virtual 3D object as molding clay. We are currently developing more advanced mesh processing functions, and an easy-to-use animation system which can continue to animate the 3D model we generated. The user can pose a sequence of key frames of the skeleton with multiple postures. The animation will be generated by interpolating different postures specified by the key frames.

REFERENCES

1. Takeo Igarashi, Satoshi Matsuoka, and Hidehiko Tanaka. Teddy: a sketching interface for 3D freeform design. In Proc. SIGGRAPH 1999. ACM Press, New York, NY, USA, 409-416.
2. Andrew Nealen, Takeo Igarashi, Olga Sorkine, and Marc Alexa. FiberMesh: designing freeform surfaces with 3D curves. In Proc. SIGGRAPH 2007 ACM, New York, NY, USA, Article 41.
3. Anca Alexe, Loic Barthe, Marie Paule Cani, and Véronique Gaildrat. Shape modeling by sketching using convolution surfaces. In ACM SIGGRAPH 2007 courses. ACM, New York, NY, USA, Article 39.
4. R. Schmidt, B. Wyvill, M. C. Sousa, and J. A. Jorge. ShapeShop: sketch-based solid modeling with BlobTrees. In ACM SIGGRAPH 2007 courses. ACM, New York, NY, USA, Article 43.
5. Intel perceptual computing. https://software.intel.com/en-us/vcsource/tools/perceptual-computing-sdk/home
6. Stan Melax, Leonid Keselman, and Sterling Orsten. Dynamics based 3D skeletal hand tracking. In Proc. of Graphics Interface 2013. Canadian Information Processing Society, Toronto, Ont., Canada, 63-70.