Drawing, Painting, and Sculpting in the Air: Development Studies about an Immersive Free-Hand Interface for Artists

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Abstract

The main problems in immersive free-hand interfaces for artists are devices and methods to reach the level of fine motor skills in the human artistic capacity. The artist needs more solutions to flexibly master how the hand traces are left in the graphics.

Leaving traces in immersion should not be only an action of controlling the route, but controlling also a variable outlook of the becoming line. For instance, as stretching the mouth of a tube, wherefrom fresh clay comes out when drawing it thru the air. This involves innovations about both drawing device and the handling of graphical primitives.

We present our idea of a low prize palm-attachable device 'Näprä', a natural 3d finger tip control for elastic drawing profiles, and ideas about shaping both triangle meshes and particle clouds with it.

1. Introduction

Connecting two separate disciplines, we give a two-voiced paper, presenting artistic and technologist approaches to the research.

The first part, chapters 2-4, including an artist's introduction, our current triangle mesh tool from the user's viewpoint, and an artistic work study illuminating the basic problems, are written by Wille Mäkelä.

Tommi Ilmonen adds an engineer's viewpoint in chapters 5-6, about our two current interfaces and planned improvements: Näprä, two-handed interaction methods, particle modeling and animation.

2. Wille Mäkelä: background in art

Artist I am, that of a conventional tradition. I studied oil painting in the 70's, film in 80's, in the leading art schools of Finland. I made some animation, feature films, television drama and theatre. Around the millennium I returned to painting, but in a digital context: I started my doctoral studies in the Media Laboratory of the University of Art and Design, Helsinki. Today, I work as a researcher in the Experimental Virtual Environment (EVE) [1] of the Telecommunications and Multimedia Laboratory in Helsinki University of Technology.

I draw in the air, because it is a more natural way, compared to stooping over a desktop and keyboard with a mouse. Still globally, I have found only Steven Schkolne in Caltech University [2] and Daniel Keefe in Brown University [3] using and developing tools for immersive free hand operations in fine art purposes.

There is no atelier CAVE on earth yet, dedicated solely for artistic work. That is a pity, with respect to millions of individual artists with remarkable drawing skills.

I have initiated an artistic development in the EVE. My first aim is to prove in the Finnish practice that the art potential can be proved even with a rare prototype, if it is made for an artist.

3. About my tool: Picture opens out of the line.

The basic idea is of course to celebrate the immersive tech possibility of 3d free-hand art working in all dimensions of the EVE, a three walled and floor projected immersive environment with 3x3x3 meters space.

The current prototype is an immersive drawing tool, making triangle mesh tubes on the route your hand drives a radio mouse. The tube profile in use is supposed to be adjusted rather small, for the tube to form practically a 3d line. This was my start subscription for a group of tech students, committing their programming course, and this is mainly what I got.

A picture, no matter 3d or 2d, opens its structure to the spectator out of first understanding where any

kinds of concepts of lines can be seen, what they close inside and outside, how they vary, where they move, and so on. The line is also the basic element in drawing. Theoretically, after solving line positions, it is easy for the artist to complete the rest.

An immersive interface of course makes this theory much more complicated. Basically the line of the hand's route is easy to read into the graphs. The difficulty is where and how the computer should spread the graphs from that line, under a real time control of the user – to make it possible to him and her to leave viable traces by hand.

4. A case work with simple vector stripes

Some 20 months now, I have had to do with the current prototype. I have lately settled to a manner of painting mainly with two profiles, a vertical vector, and a horizontal one. A vertical human figure gets done mostly with the vertical vector, leaving structures of something like rolls of toilet paper, with the centre pulled out. The horizontal vector is needed only when I have to cover the hollows at the top openings.

The case showed here is made February 2004 in the EVE, a day after an experience of a ski trip, my kid's skis sliding backwards in every uphill. It is an edition of three separate pictures: my son, his friend (in natural sizes), and a scale model of the landscape.

4.1. Working the case

I started with the main character with the slippery skies. I first made a skeleton, just with the vector profiles, because they are light in data (Fig. 1). It became a bit unclear at the hams and pelvis, but somehow interesting, reminding me some Vladimir Tatlin's works, or car strings.

I continued with the 'toilet paper'. This method is especially sufficient when doing people in winter clothes. A naked model would be much more difficult, as with any medium.

The pelvis and hams could not be totally fixed anymore, that part of the body became too big, but characteristic to the position. After 130 minutes I saved the final Son, with data of 1601 KB (Fig. 2).

The friend of his had better waxing. I made him with similar methods, into a twisted position, leaning on his sticks, frustrated of waiting (Fig. 3). I added a pair of eye buttons for him with the same tiny round profile I used for the sticks. That forced me to add a nose, too. Not much more was realistic anymore, with total data of 1834 KB and jerking display. I saved the final Friend after 120 minutes work.

Figure 1. 'Son', first state

Figure 2. 'Son', final state

Figure 3. Close up of 'Friend', final state

The scale model of the Landscape was just a quick sketch about the ski trail in a glen, with snowy trees all around. It had been impossible to make straight skis with the magnetic tracker and free hand, so I started with the problem of making two parallel grooves for the trail. I ended up to copying the first acceptable groove. I even made a copy of the trail then, to add a blue shadow to peek in the grooves (Fig. 6). I used a wide transparent white horizontal vector to cover some lights on the snow. With transparency it would have been possible to soften the borders with time, but I had a hurry and concern about data. I tossed vertical logs all around, by the same profile I had used for the ski

sticks, and covered their upper ends with vertical toilet paper. In 60 minutes I ended to 2215 KB, due to the round log profile with 3 times more vertices than in the vectors.

In editing these three pictures, I started with the Friend, imported the Landscape model, and scaled it to fit the skis of the Friend. I had to stretch it a lot, because the ski trail was too curly, so all the wood stretched too, in the direction of the trail. Then I moved the whole thing thru the EVE wall, to find a proper place lower in the hill, imported the Son and placed him on the trail. The final 'Slippery skis' is 5625 KB (Figures 4 - 6).

Figure 4, 'Slippery skis'

Figure 5, 'Slippery skis'

Figure 6, 'Slippery skis' seen from under the back edge of the ski trail

4.2. Notes about the result and future tools

When scrutinizing the result, the most disturbing detail in the work to me is that the crosswise whites on the ground pose like horizontal platforms, not a slope.

The toilet paper on the trees does not look natural, either. This is the prize of saving data, that is, vertices, with a big profile. However, my handwriting can be well seen in the human figures, where the stiff tube profile is smaller.

All together, even these stripes of inflexible vector profiles can show that it is possible to give a personal free hand touch to the trace form. Human drawing skills still have much to give when the tool improves.

The next step in the development is to give a better chance to the artist to handle the hand trace. That is, to master in real time the lines as edges of a form - the surface or mass next to it.

Finger tips are at our focus. We must find out fluent methods for real time elastic profiles, and adequate data structures to represent material volumes for artistic use.

5. Tommi Ilmonen: The starting point

The current application - named Antrum - was made as a programming assignment by students in Helsinki University of Technology. All in all this is a very simple CAVE-based drawing application with one kind of geometric primitive: the tube. The tube is drawn with the wand. In practice the application collects motion data from the artist and coats the path of the wand with a triangle mesh.

Antrum has a WIMP-like graphical user interface that is used to select color, size, and the profile of the tube. These parameters cannot be altered when drawing. One can also erase, group, cut, copy, paste, load, and save tubes.

Besides Antrum we have an EVE-based particle animation application AnimaLand that we will use as the technical groundwork in future development. AnimaLand has tools to spread particles in real-time and control their motion via forces - winds, vortices and explosions.

6. How to shape surfaces? How to visualize and operate material volume?

In the following we will outline the plans we have for near-term technical development. The technical work will be carried out by two engineers with Wille as the artist/client.

6.1. Fine finger movements at the tool tip: Näprä

We are developing a new user interface device and metaphor - called Näprä. This is a device similar to data gloves. Näprä is a hand-mounted "finger-tracker" that tracks the motion of thumb, index and middle finger in relation to the palm. A metaphorical triangle is controlled with finger-tips' motion. This triangle provides means to create tubes with accurate real-time control of the tube profile shape and orientation. Näprä also includes touch detectors in the finger tips and some knobs. These will be linked to triggering commands and multiple selection tasks in the user interface.

Many Näprä's features could be implemented with a data glove (in particular tracking the locations of the finger tips). Unfortunately data gloves that are up to the task with sufficient accuracy are very expensive. Also the knobs and touch detectors are features lacking in ordinary data glove. While they could be implemented with pure motion tracking we believe tactile feedback is essential for good feel and usability of these components.

6.2. Flexible two-handed interface

An artist typically uses both hands - there is the primary hand that does most of the work and a support hand with different tasks.

Our system has relied on a single hand with a wand user interface. One of the user interface research goals is to take two Näpräs and create an interface that takes input from both hands.

6.3. Spreading and plowing particle masses with 'hard' tools

Besides the tubes we will also use particles [4] as basic graphical primitives for 3D modeling. The look and feel of particles is very different from traditional polygon-, spline- or solid modeling. Based on preliminary tests it seems that there is a great deal of artistic potential in using particles to create shapes.

Particles can be edited more freely than polygon data - there is no risk of breaking the object since the object is effectively a particle (or point) cloud. The artist can wipe off, color, retexture and animate the cloud free from caution in regard to the object topology. We can also create a natural way of plowing the particles with different friction properties.

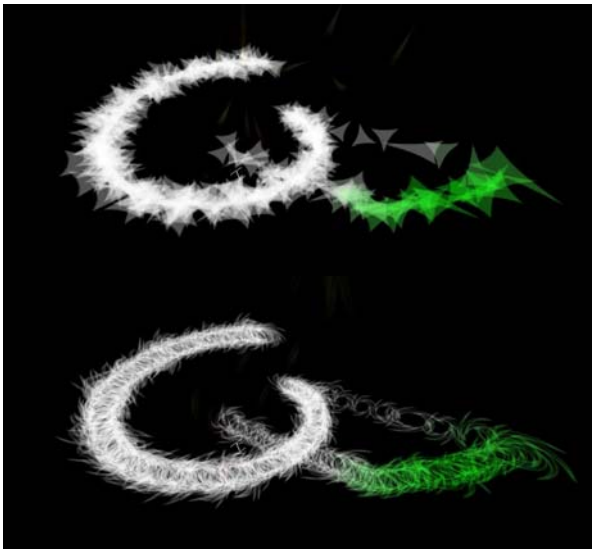

Figure 7, A Preliminary test with particle modeling. The same drawing route is shown twice with different texturing. Some particles have been re-colored with a green brush after the cloud has been drawn.

6.4. Animation

So far few projects have tried animation in VR. We will incorporate animation features into our system. This includes animation of the drawing process, animation of objects and classical particle animation. In all cases we try to get as close as possible to direct manipulation. For example the user might specify the trajectory of an object by simply moving his/her hand along the desired path.

7. References

[1] http://eve.hut.fi

[2] http://www.schkolne.com/findex.html

[3] http://www.cs.brown.edu/people/dfk/index.html

[4] W. Reeves. "Particle systems - a technique for modeling a class of fuzzy objects", Proceedings of ACM SIGGRAPH 83, Detroit, Michigan, United States, 1983, pp. 359-375