Working 3D Meshes and Particles with Finger Tips
Towards an Immersive Artists' Interface

Wille Mäkelä
Helsinki University of Technology, University of Art and Design Helsinki
wmakela@tml.hut.fi, wmakela@uiah.fi

Abstract

We have built a low-cost hand device for finger tips interaction in immersive graphic creation. We have tested it in practical artistic work in our VR environment. The interface prototype provides combining mesh and particle graphics, which may open multiple ways for traditional artistic expression in immersion. Using a real-time fingertip interaction device, as opposed to using a wand, gives better chances for mastering these graphical variations. Using the devices one in both hands adds clearly the possibilities to develop a quick and smooth interface for artistic purposes.

Figure1. Rembrandt in the year 1659

1. Introduction and First step

The concept of stereoscopic immersion has existed a dozen of years, allowing man to naturally walk among three dimensional graphics, enjoying stereo vision when looking at any direction [1]. However, the situation of man among graphics has not been too much applied to making the very graphics. Delightful exceptions are Steven Schkölne's SurfaceDrawing [2] and Daniel Keefe's CavePainting [3], both showing methods of immersive interaction for artistic graphics creation.

In the CAVE-like environment EVE in Helsinki University of Technology (HUT), I test and suggest interaction methods by practical artistic work in our artist's interface prototype [4]. This paper introduces four steps on my path for a realistic human face, and some notions about two handed interaction.

Realism in art makes a clear distance to modeling the physical world in 3D. Consider the flat oil painting, Rembrandt's self-portrait in Fig. 1. Could it be reproduced in immersion, in 3D? Figures 2A and 2B show two angles at one of my early works, let's call it First step. Mesh tubes are drawn around a flat mask with a wand. It shows free hand painting possible in three dimensions, but for artistic expression, a tube with regular thickness is rather a dull method, and causes heavy files.

Figures 2A and 2B. Painted in immersion

2. Second step: Particle clouds

Aside the option of meshes, we added particle clouds. In a “cloud”, flat particles were programmed billboard, to always face the tracked user. This gave a low-data volumetric tool to contrast the flat mesh surfaces. I found it very effective to combine the two structures. Fig. 3A shows my first attempt to imagine Rembrandt’s head volume and position in 3D. A bit more mature version is shown in Fig. 3B.

A mesh was typically made by dragging a 2D profile, e.g. a ring profile produced a tube. Particle clouds were drawn with a 3D wire frame sphere, indicating the desired parts of space to emit billboard particles. At this state, we already had tools also for erasing graphic objects or their parts, re-coloring, moving, stretching, grouping them, etc. A usual pointer was the wire frame sphere.

With the already rather versatile interface, I still felt awkward trying to place meshes in exact positions with the wrist-eating wand. Also the particle clouds were still a limited feature: they could only be used for marking loose volumetric areas, and a more accurate role was gradually wanted from them. One disturbing fact more was that you had to go all the time forth and back to the main menu, just to adjust the size of a profile or wire ball, or the color of mesh or particle texture, for instance.

Figure 3A

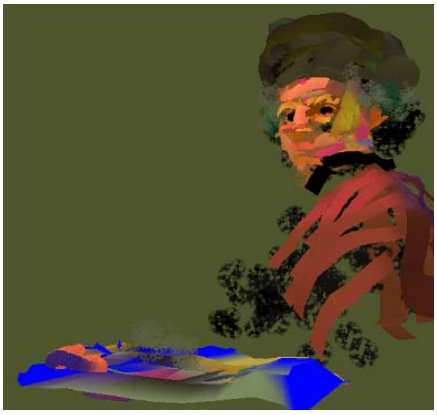

Figure 3B

3. Third step: Näprä

A new low-cost device, Näprä, was developed for both hands. It is partly wearable, partly tangible. Three fingers can position and stretch a virtual triangle between them, giving a base for multiple tools. The magnetic sensor of the environment is attached to the backhand (Fig. 4A) and locked with the ultrasound transmitters in the palm that measure the spatial spots of fingertips (Fig. 4B). The weakest fingers are saved for triggering graphic actions in a fashion much like that of tangible tools.

In technical tests with the Näprä prototype, bad inaccuracy in the finger tip tracking was verified at blind angle positions of fingers, far back from the transmitters or too close of them. Still a relatively wide middle area gave fine results.

From the beginning with Näpräs, the size and position of any mesh profile were adjustable in real time during the stroke. The wire spheres with particles and many other tools worked also intuitively: pointing desired parts of space with an elastic ball in your fingers is quick and intuitive.

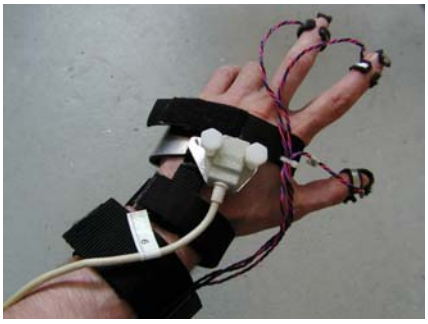

Figure 4A. Näprä

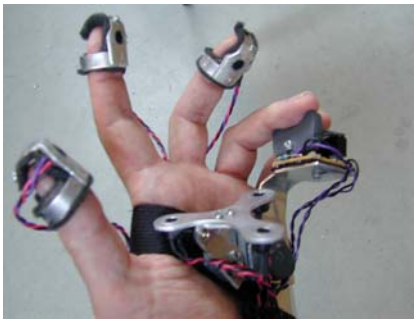

Figure 4B. Näprä

3.1. Billboard particles among meshes, drawn with Näprä

The black stripes in the quick sketch in Fig. 5 are drawn with Näprä, adjusting the size and position of stroke in real time. The few colored particles in the same sketch tend to face the spectator from random and restless positions, as they are still programmed billboard as "cloud particles".

4. Fourth step: Fixed particles, new textures

Interesting new challenges showed up when we added the option to fix the particles to the position of the fingertip triangle of Näprä. Until this we had used simple symmetric particle textures, typically the round soft spot in Fig. 5. Now I found dynamics in chains of asymmetric particles. The direction of asymmetry mattered, giving illusions of movement, like in the strokes in Fig. 6. Also I found again the need for empty spaces inside the textures, for transparency. I prepared some more variations of these "comb textures".

4.1. Fixed particles on a mesh base, with Näprä

As an exercise for the Rembrandt, I drew a convex mesh for a base mask. Fig. 7 from left to right shows the following process: I marked some important spots with short mesh stripes and erased and distorted the mask to a convenient shape (3D form shown with some extra illumination in the third mask). With fixed comb-particles I was now able to make softer marks, producing an optical mixture with the base mesh color. However, it was still too difficult to see and control some of the smallest comb marks to stay close to the mask, without drowning them behind. A break thru happened only when we added a simple hairline cross to serve as pointer and indicate the particle plane.

Then I painted rather quickly with fixed particles at a short distance in front of the mesh. Fig. 8 from left to right show how particles with a comb texture are painted in air in front of the mesh bone, gradually increasing the volume of the face where wanted.

Figure 5

Figure 6. Asymmetric textures

Figure 7

Figure 8

Fig. 9A give different angles of the finished 3D sketch in Fig 9B, already looking a bit like a human, on the current state of the reach for Rembrandt.

5. About two-handed interaction

So far, our main menu has been just a flat list of virtual buttons, pointed with a tetrahedral, for saving and loading files and changing creation tools in both hands respectively. Several virtual sliders are included in the menu for adjusting tool parameters.

With Näprä, drawing in air and clicking buttons in the main menu were done by the desired hand's little finger. Another Näprä in the assistant hand helped to commit many operations without interruptions with the menu.

Comfortable states of two-handed working with two Näpräs was to have the eraser or transport tool ready in the assistant hand, while painting with the dominant one. In color-picking, a cylinder-formed HSV space could be triggered by assistant hand directly to the spot of the dominant hand's pointer. In the last Rembrandt (Fig:s 9A and 9B), a still quicker color mixing mode was in use: For adding to the base tone some red, green, or blue, I could just lift the assistant hand's corresponding finger. I did not have to look at the fingers, but at the stroke that changed tone in real time.

The dominant hand ring finger was used to show and hide the main menu. This action was easy to learn, in a relaxed position without looking at hands. However, back and forth the flat menu is still a problem ahead.

6. Conclusions and the future

The Näprä concept is basically suitable for a future instrument of immersive art creation. Its ergonomics and tracking problems are worth studying further. Particles may turn out to be really useful in works of immersion. The interface menus should become more intuitive and three dimensional, standing more on muscular memory of the spatial human body. Working with two Näpräs will give good base to this development.

By utilizing free hand art traditions, I expect immersion to bring new ways of expression and esthetics into the field of 3D graphics.

In future, more steps might be found at:
http://www.tml.hut.fi/Research/HELMA/

Figure 9A

Figure 9B

7. Acknowledgements

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8. References

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