

BLUIsculpt™

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BLUIsculpt™ is an interactive virtual reality application that permits a user to freely sketch voxels inside a ten foot cube for output as physical objects. It connects the imagination to physical form. Our interface presents the user with real-time feedback in the form of surfaces. We save a file representing the surface in rapid prototyping format. Generating a solid-by-rapid prototyping completes the cycle of perception and imagination that starts in the physical world, proceeds through vision, thought, imagination and the dance of drawing to finally arrive at tangible sculpture. Our enterprise is based on the premise that symbolic representation, of which drawing is an exemplar, derives from perception, imagination and thought. We hold that these mental activities recruit and employ the same brain machinery that is fundamental to voluntary physical movement. Such is the common wisdom of generations of artists, and is well-supported by a mass of more recent studies in cognitive and evolutionary neuroscience.

1. Interactive Voxel Graphics

Interactive voxel graphics in virtual reality poses significant research challenges in terms of interface, file I/O, and real-time algorithms. Voxel graphics is not so new as it is the focus of a good deal of scientific visualization. Interactive voxel creation and manipulation is much more innovative. Our support for taking the product of sketching voxels into the tangible world of rapid prototyping is unique. Scientists are understandably reluctant to manipulate data. They collect, model and predict data. The scientific analogy to interactive graphics is the generation of initial conditions to some system. It is used as a method to test scientific models. We, however, are in the business of creating new imagery. In our endeavor, science is a tool and not an end. Nevertheless, we suggest there is a whole class of interactions and associated data generation scenarios that are natural to our way of working and that are also appropriate to scientific inquiry. Annotation by sketching or painting to point to and distinguish interesting and important information is very significant for science as well as art. Annotation in 3D is difficult without a good 3D interface. Our interface is three-dimensional. In particular, our method of navigation tracks exactly with the motion of the grabbing hand.



Figure 1. Two objects created in BLUIsculpt™

2. Drawing in VR

Everything we do in BLUIsculpt™ is based on drawing. Drawing is fundamentally gestural. We are developing tools to draw in virtual reality. This has been a four-year research project based on the premise that the body language of pointing and grasping is an appropriate focal point for the development of a human-centered user interface. We call our approach BLUI for Body Language User Interface.

The minimal act of drawing is the trace of a moving point. A minimal gesture is the motion of a single point of focus. Interesting gestures are dynamic relationships between at least two points of interest. The meaning that derives from the physical presence of a drawing comes from the character of the path taken by the point of the drawing instrument. Another component of the meaning of a drawing derives from the empathetic perception of a viewer who connects the path with their own presumptions of what they might have felt or seen or done if they made the same drawing, i.e. moved a point along the same path.

Drawing has historically been an activity that relied on the contact between a drawing instrument and a surface. In a virtual reality application such as BLUIsculpt™, however, the requirement of any surface is absent. Indeed, a significant issue in virtual drawing is how to signal the start and finish of a line absent visual and tactile feedback from contact with a surface. A very important part of the training of an artist is how to represent the world of three dimensions on a two dimensional surface. An artist does not move the point of their drawing instrument farther away to represent distant objects, but rather laboriously learns to incorporate the rigors of two-dimensional projection into their perceptual framework. Drawing with more pressure often represents closer objects. There are artists whose mastery of this kind of drawing permit them to represent the three dimensional world of mass and form and often the sense of motion and interaction between tangible forms.

Individuals who work skillfully in the three-dimensional world, individuals such as architects, sculptors, mechanics and cabinet-makers, often describe the world to others through drawing-like gestures. These gestures are made as if the hand or hands were touching and handling tangible objects. They are gestures that often incorporate imaginary objects. At other times the gestures are sensual, performed on tangible objects, representing contemplated manipulations or how it is to feel a texture. Dancers, musicians and others use gestures to represent the paths taken by bodies as well as symbolic representations of volume, pitch and the like. Our approach is to take this analysis literally by making gestures tangible.

BLUIsculpt™ enables the user to simply and naturally sketch in space. It incorporates the purity and economy of drawing on paper with the capacity to tangibly and permanently represent form. This presents a whole new set of opportunities and challenges to expressive technology. Our process of taking freely generated sketches into the realm of physical objects completes the cycle of perception and imagination that starts in the physical world, proceeds through vision, thought, imagination and the dance of drawing to finally arrive at an object you can touch. For a more complete discussion of the concepts presented here, please look at the BLUI web site, <http://www.blui.org>.