Prototype Sonic Assistive Technology for Training Designers Using Computer-Assisted Modelling Software

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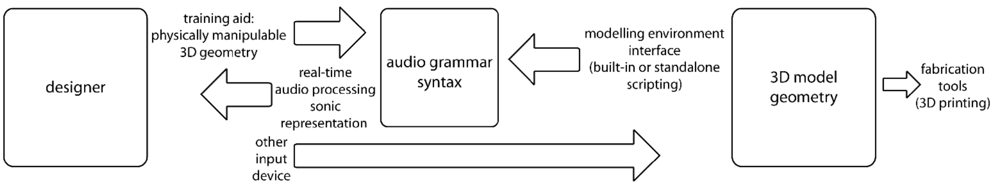
Abstract. SAT-CAD is a proposed sonic assistive technology for retooling students of design, by modifying popular design software in a way that will accommodate designers who are usually excluded by computer-aided design (CAD) packages.

1. BACKGROUND

Based on a survey of the fields of architecture, computer-aided design, human-computer interaction and the physics of sound, a framework dubbed SAT-CAD is proposed here. Some components are in the prototyping stage and suited to a more substantive iteration.

2. COMPONENTS

The manner of mapping a designer's 'spatial will' to spatialized sonic properties makes use of a specialized interface, in addition to its specialized sonic syntax. The components of the prototype include: a non-visual input device to interface with an existing three dimensional modelling environment; a translation of the internal representation of geometries into broadcast spatialized sound based on a consistent set of rules (an audio grammar); and existing technologies for fabrication of physical prototype translations of the internal representation. The relationship of these components is diagrammatized below:



2.1. Audio Grammar

SAT-CAD will deploy a simple audio grammar. This sonic representation of three dimensional location is not a soundrealistic representation--it is does not attempt to strictly imitate an observable phenomenon, but rather to abstract a system for translating information about a geometry into sonic terms. The prototype sonic system employs familiar cues of amplitude to help intuit leftmost from rightmost panning, yet it is largely a symbolic space. The analoguous visual system would share similarities with the representation of space for a two dimensional page, but where the abstraction is taken even further and some quantities such as depth or height might be rendered as a shade of grey rather than points on an axis.

2.2. Training Aids

A multi-stage input system where the first stage used a motion-tracked haptic objects as training aids. During the first stage, the user manipulates a member of a series of material physical objects, such as planes, tiny "point" spheres, pliable stiff membranes that hold their shapes and deformable surfaces. This kit of parts can be motion tracked for gestural and haptic input. Each material object is considered a mass of points. An object is a pointmesh, a sampling of points that can be increased or decreased in density. Each point (x,y,z) has a sonic existence (amplitude, pitch, other). The translations, rotations and deformation are tracked using motion-tracking, and the the sonic representation linked to the embedded point-mesh is updated in real-time. Rotations and deformations can be executed and perceived directly, with these material objects being taken in hand, fostering an understanding of the system of sonic representation.

2.3. Real-time Processing

The current prototype uses a freely distributed real time programming environment for audio and video synthesis called Pure Data (PD) [Puckette 2001]. Modest tests using PD have yielded some useful results: as a prototype the streaming of coordinates into amplitude and frequencies is successful; for this prototype, each of the two variables, frequency and dBAs have been associated dimension, x and y respectively. Additional exploration may substitute these for a different pair of the three conventionally experienced dimensions. The decision that positions of points will constitute a massing of the geometry being tracked and translated into sonic properties needs further investigation.

2.4. Input Devices

The human brain's ability to learn to "hear" abstracted visual descriptions is exploited: designers could be trained to "hear the geometry". Although of a limited range compared to the possibilities--notably instantaneous rescaling of objects--available within the three dimensional modelling environment, this first stage is for training the ear. Once someone has acquired a facility with the mapping between spatial translations and sonic representations, then the motion-tracked material objects are no longer necessary, except as training aids that can be revisited. Next, instead of the point geometry passing from the material object to sonic representation, the point geometry of the three dimensional virtual model is translated into sonic representation, interfacing directly with the existing three dimensional modelling environment.

2.5. Rapid Prototyping

The final, undeveloped stage for SAT-CAD is the re-output of geometry into a physical model that can be perceived non-visually. A three dimensional print could serve to verify the perceived schematicization of space and reinforce or verify sonic intuition.

REFERENCES AND ACKNOWLEDGEMENTS

[Puckette 2001] Pure Data software, Copyright (c) Miller Puckette and others 1997-2001. URL: http://www.crca.ucsd.edu/~msp/Software/

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