ART 03

Collaborative Augmented Sketching

Hartmut Seichter
Department of Architecture
The University of Hong Kong
seichter@hku.hk

Abstract

The aim of this paper is to demonstrate a software prototype using AR Toolkit [1] for collaborative augmented reality sketching in architectural design. I introduce a non-intrusive interaction technique developed for this prototype. Additionally, sketching and distribution mechanisms will be discussed and illustrated. The prototype uses non-photo-realistic rendering and an adaptive tessellation mechanism in the geometry kernel to provide a visual cue for the conceptual stage of an architectural design.

Keywords: Augmented Reality, conceptual architectural design, CSCW

1. Introduction

The application of Augmented Reality in Architecture is promising as it provides the possibility to see design proposals in the real context. Reviewing of architectural design has been demonstrated successfully [2]. However, the ultimate task will be to create architectural design within augmented environments.

Designing is a complex activity, which may be examined as sequential phases of simpler activities. One of the most interesting stages of the design is the conceptual phase at which point a designer may be concerned with formal investigation of possible solutions; this phase benefits from the use of a variety of media to explore and discuss a design.

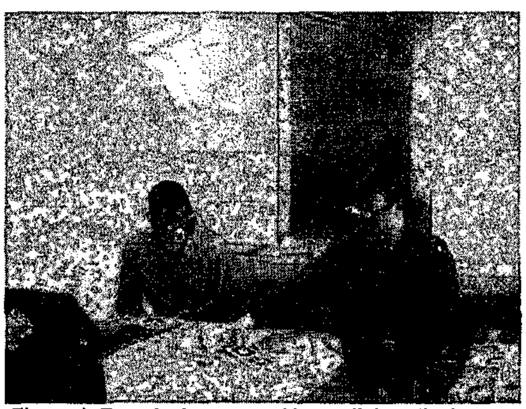

Figure 1: Two designers working collaboratively on a design

2. Technology

The base of the software is the TAP framework [3] accompanied with the pattern recognition of AR Toolkit. Additional libraries add a NURBS [4] geometry kernel, video and audio compression algorithms. On the hardware side the usual video-see-through equipment is complemented with an augmented WACOM digitizer as the main input device. To provide multi-user sketching (Figure 1, 2) a dedicated server needs to handle the distribution of data.

2.1. Interaction

A vital part of the system is the modeler. Performing a single stroke on the digitizer tablet produces control points for a curve, their separation dependent on the velocity of the pen. All altering strokes insert control-points into that particular NURBS curve.

Next, a search algorithm sorts the control-points into their respective sub-splines (Figure 3). With this behavior the software simulates the appearance of paper and pencil drawings where altering strokes can emphasise or reject a previous one – making a part of a design important or not. Meanwhile, this curve is extruded to give an initial spatial expression. Strokes performed with holding the second button on the digitizer pen will affect the extrusions rail-curve. Thus, the shape of the extrusion can be reconfigured, lengthened or shortened.

The AR Toolkit markers are very close in their interaction to that of physical site-models in urban design. There are two categories of markers: action markers and media markers. A media marker presents geometry, video, audio and text messages. An action marker "acts" on a media marker, when it shares an edge with it (Figure 4). Cues like animations and sounds provide feedback if the "action" was successfully applied to the medium. This interaction is used to share, copy and delete in an unobtrusive way for the user. The server in the background synchronizes the data and builds a design session repository.

2.2. Rendering

A fair amount of VR/AR software mimics realistic environments. However, especially for conceptual design in architecture, this is not appropriate because an initial and uncertain proposal could be perceived as an end product. Therefore the software sports a multi-pass NPR

rendering technique producing a sketchy comic-style appearance. The parameters here can be tweaked through the preferences menu.
The internal representation of the shapes is realised with NURBS surfaces whereas rendering is performed through the adaptive meshing of them. When performing a stroke, the initial geometry is very rough and will be refined through time or terminated by altering strokes. This approach compromises local performance, distribution issues and the interface response time.

2.3. Annotation

Annotations are realized as audio and text messages. A comment-marker sharing an edge with the respective media marker records a voice message. Additional meta-data descriptions are generated and applied to the repository. In reviews this data can be used to show the decision path a designer underwent. All participants in a multi-user session can access the comments by holding the play-marker at the edge of the model.

2.4. Output

In order to let non-augmented users watch the design process, the system automatically exports the sketched geometries to VRML97 files (and RIB, RenderMan™), integrates them in a website and adds all annotations, pictures and textual notes. This repository is synchronized in the background with a web server for wide range access.

3. Conclusion and future work

Some limitations arise mainly due to the small manipulation area available on the handy graphic digitizer and an occlusion problem caused while sketching on such a device. Also the sketch modeling itself needs some refinement and enhancement to provide more precise and powerful manipulations.
To conclude, I have briefly introduced the possibilities of augmented reality sketching in architecture. Current tests with a further developed prototype are proving most promising in the field of mobile design support.

[1] M. Billinghurst and H. Kato, "Real World Teleconferencing," presented at ACM CHI'99, Pittsburgh, PA, 1999.
[2] C. Ganser, "AR-Model: Collaborative Building Visualization," presented at Augmented Reality Workshop, Darmstadt, Germany, 2002.
[3] H. Seichter, D. Donath, and F. Petzold, "TAP - The Architectural Playground," presented at 20th Conference on Education in Computer Aided Architectural Design in Europe (eCAADe 2002), Warsaw, Poland, 2002.
[4] L. Piegl, "On NURBS: a Survey," *IEEE Computer Graphics and Applications*, vol. 11, pp. 55-71, 1991.

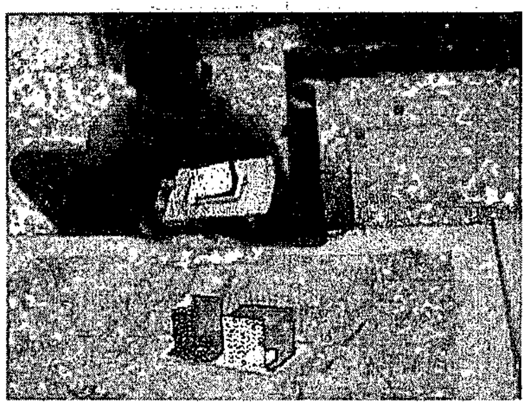

Figure 2: Face to Face, sketching with proposals

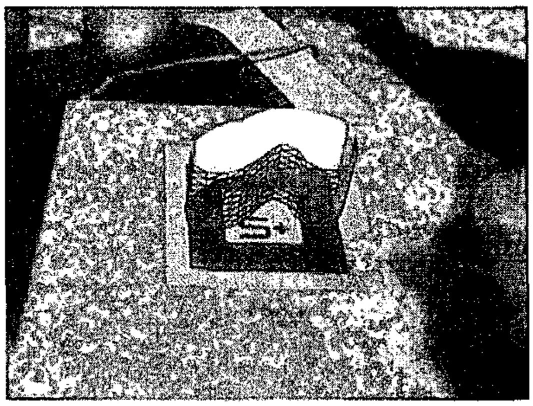

Figure 3: Shape as a result of consecutive rectangular c-shape strokes

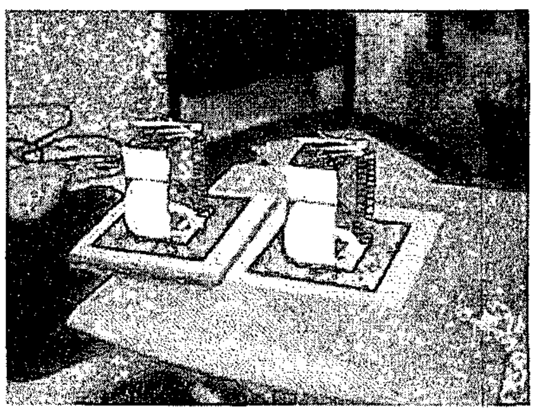

Figure 4: Sharing a proposal with marker connected on the edge