Fabrication of Detailed Scale Models for Eye Level Visualisation

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Introduction

Putting a camera close to a scale-model requires deliberately chosen abstractions and refinements in order to communicate the required architectural insights. Depending on what aspects exactly have to be evaluated (e.g. the visualisation of urban space, building blocks, façade structures, urban furniture, traffic, day and night situations, general atmosphere of a place etc.) different choices can be made for level of detail and materialisation of the scale-models.

Specific computer controlled tools can be employed to gain high-precision control over model making. In this conference contribution an overview is provided of possibilities from our newly established Computer-Aided-Modelling-lab (CAM-lab). A selection of applications, made by students and researchers, will be presented.

Specific choices can make or break the quality of the final presentation. Insight and knowledge of many available techniques, using the right tools and materials, can bring appropriate scenes before the camera. The input from unbiased and freely experimenting students can give happy surprises and new insights. While looking at the broad range of possibilities, inspired by innovative experiments of students in the workshop we work towards a set of best practices. Especially the integration of different digital and traditional techniques remains interesting.

The Aspern workshop and the Imaging Imagination workshop
Back in 1995, during the EAEA conference in Vienna, a very interesting workshop was arranged [Martens, 1995/ Stellingwerff, Breen 1995, 1996], which can now be seen as a starting point for several visualisation experiments in the Delft Form & Media research group. The workshop brought the possibility to work both in digital and “optical/ analogue” ways. Each participating research group was asked to make interesting visual explorations on the basis of a physical scale model and a digital model that were sent to each group. Subject was the suburban Aspern area, near Vienna, which had to be redeveloped. Around that time also a special interest group for city modelling, as part of the eCAADe conferences, was established. Both initiatives were pivotal for the research direction in the thesis on Virtual Context, defended in 2005 (Stellingwerff, 2005).
In 1997, during the EAEA conference in Delft the digital versus traditional endoscopy discussion was driven to new heights during the Imaging Imagination workshop. Here the “competition” between optical and computer aided visualisation techniques was again subject of several discussions. The results (see: http://www.bk.tudelft.nl/media/eaea/imim/index.html) showed clearly that both techniques were convincing, each in particular ways.

Texture-maps of reduced facade patterns and real facades were applied to the model. Texture-maps were scanned with a computer from photos of buildings. The facade photos were originally in perspective. A computer photo-editor was used to straighten and to multiply the facade images. The facade textures were then printed on scale 1:200, and were glued onto the building blocks of the model. This use of texture maps gives the urban model a more architectural impression. The scale and the distances in the urban design can be judged much better with these textures which are flat but give a suggestion of depth. Using different patterns, colours, structures and textures can enhance the resulting images.

**Thesis on Virtual Context**

The PhD thesis research addressed the issue of Design in relation to Virtual Context.

Central to this study are the innovative potentials and instrumental opportunities of computer based media techniques, capable of generating interactive models and changing perspectives for the benefit of urban and architectural design. The ambition was to not only make a contribution to the existing body of knowledge concerning digital technologies and their applications, but also explore theoretical conditions, which might help define and stimulate further study.

From the outset, the focus was on furthering the opportunities for computer based representation media in creative design. On the basis of a series of explorative studies the subject of this research was targeted: the issue of Design in Context, or more specifically: Design(ing) in a Virtual Context. During the process there was a marked shift in the conception of the subject from – more or less immersive – VR technologies in the direction of approaches, which might be expected to become readily available in
practice and education and could be effective in actual design processes. This insight also brought about a shift in emphasis from realism per-se towards creating a sense of situatedness. For the explanation of the term ‘situatedness, see: (Gero, website).

The design representation system was intended to not just allow for one type of model view, but to afford an array of different views, from which the designer would be able to choose freely, depending on the phase and focus of design as well as personal preferences. A series of interface prototypes and support tools were developed especially and successively tested experimentally.

For the intended final design driven experimental study, different virtual context models were considered. Eventually, an integral – purely fictitious – design ‘environment’ was constructed in the computer, so that the workings of the proposed system and its components would be tested systematically.

A conscious choice was made for an in depth study, on a relatively modest scale, which would provide a certain amount of mutual involvement between designer and researcher, to confront the participants with the finer aspects of the proposed system in a relatively short time and to gather detailed data. A half dozen design professionals were invited to participate in a closely monitored experimental exercise.

The results of this study therefore did not offer straightforward, indisputable facts, to be considered representative for the design community as a whole, but indicated that the working methods of the individual designers – when discovering aspects of the site, developing and presenting proposals and reflecting on the qualities of represented designs – tended to vary considerably. For this reason the interactive representation system proved to be of value. Participants could express different view preferences, with more or less realistic image modes being used in different phases of their design developments, with varying experiences of situatedness. Some of the design participants were very appreciative of the system’s capabilities; others tended to be more ‘set in their ways’.

The results of this experimental study indicate that there may particularly be opportunities for interface applications which are able to function
interactively, offering individual designers – as well as others involved in evaluating design proposals – a variety of tools with which to approach specific design artefacts in their changing contexts. Virtual models can play not only an important role as a ‘reminder’ for the designer but also to other parties playing an active role in the design and implementation processes. Interactive environment models are not only promising as exploration tools for existing sites, but could be valuable to test the impact of a design on its location. This could be especially interesting if the site is difficult or impossible to visit or as yet a virtual construction. In addition such an approach might be beneficial for objective comparison and evaluation of design proposals in competitions and in education as well as in on-line collaborative design projects where the context is still in the process of being developed.

**Recent developments in the CAM-lab: digital development of physical models**

The CAM-lab is a facility for students and researchers to make parts of their models by means of a 3D-printer, a CNC milling machine or a laser-cutter. These techniques offer the possibility to make much more refined model parts that compete with the previously mentioned photo-texture-maps.

- **Student work / house reconstructions**
  In a BSc course, we (Robert Nottrot and the author) let students analyse and interpret the work of Dutch architects. Reconstructing the design at a scale of 1:50 gives the opportunity to translate architectural details into scale-model details. The educational effort in this course is to let the students keep the original architectural qualities, in details and spatial layout, as close as possible in the produced scale-model.

- **Polder models**
  From the department of Landscape Architecture and the Netherlands Architecture Institute, half a year ago the Section of Form and Media Studies received the commission to build fifteen scale models of typical Dutch polders. The models should tell the story of design and organization of the original polder and their current state. Learning about the history of the polders and their rural and spatial qualities would facilitate the “reading”
of the existing polder landscape. As the models would be shown to a large public at the 2nd International Architecture Biennale Rotterdam, the story of the polders had to be presented in a crystal clear way. The spatial claims of various kinds - “red” (urbanization), “green” (recreation areas) and “blue” (water storage) - should come out in the typical organization of each of the fifteen polders.

The task to build the scale models in time with a consistent high level of detail forced us to come with several innovative approaches, ranging from scale-model production techniques to the manipulation of scale and use of iconic elements.

First, there was the problem of scale. The wide horizontal layout of Dutch landscapes makes it difficult to show subtle aspects of different heights in the water management system. We solved this by combining a scale of 1:10000 in the horizontal plane, while the height was consistently oversized by a factor of 10 (1:1000). This trick made the ditches, dikes, trees (green lines and surfaces) more clearly visible in the relief of the scale models.

Secondly, there was the problem of time. There were only a few months to complete a total of 30 square meters of very detailed scale-models. We received digital maps to be used as cutting lines for several layers of cardboard. The digital maps were used to employ a digital laser-cutting machine during each available moment. The layers were then glued together to form the basis of the models that showed the heights in the landscape. The elements to furniture the polder landscape also consisted of laser-cut parts combined with highly detailed 3D-prints from a rapid prototyping machine. Thus a manufactory of soil, trees, houses and windmills was set-up.

Thirdly, there was the control over colours. The green, the red and the blue had to be used in an iconic way to clearly show the polder system that manages with wind the water, to make efficient use of economic values in the agricultural areas. These colours had to be consistent between the fifteen polders, some models showing the original design of the polder (from 1364 till 1980) and some models showing the current urbanized state. All aspects of land-use, in different sorts of red, green and blue, had to be translated into an attractive palette of colours.
- Synagogue
In collaboration with Bob Martens and one of his students, Christoph Oberhofer, from Vienna University of Technology we produced a scale model of a destroyed synagogue. This work again shows the possibility to integrate two new production techniques: lasercutting for the general wall surfaces and 3D-printing for the ornament [Martens, Stellingwerff 2005].

Figure 6: Section showing the different levels of scale to have the right expression of features in the polder landscape models.

Conclusions

During all previous EAEA conferences the exchange of digital and analogue techniques has brought fruitful insights. It can be seen as a best practice to not exclude one or the other technique. Both physical and virtual / digital models can reveal specific parts of an imagined world, to be presented or investigated. New fabrication techniques bring us possibilities to translate digital models into tangible physical models. The level of detail can become much higher by applying lasercutter and 3D-printer techniques. The optical endoscope could find new visual qualities by using such detailed scale models. Research on Virtual Context revealed that a variety of impressions could be helpful to an architect to relate a design to its context and to vary the insights on design and environment. We will continue to relate digital and physical modes of representation to develop and experience existing and imagined environments.
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