Blucher Design Proceedings
Dezembro de 2014, Volume 1, Número 8
www.proceedings.blucher.com.br/evento/sigradi2014

Virtual Space: Exploring the Freedom of "Reality" in the Framework of Digital Heritage

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Abstract

This contribution discusses the benefits of panoramic representations for projects relating to the digital-heritage, a method which allows for an effective presentation and exploration of spatial relationships in structures that no longer exist. The paper provides information on existing software options for the creation of panoramic views. State-of the art representations of this kind derived from a 3D computer model will be discussed on the basis of a case study relating to the destroyed synagogue of Jablonec in the Czech Republic.

Keywords: Virtual reconstruction model; Digital heritage; Perception; Panoramic representation; Virtual walkthrough

Introduction

In the framework of ongoing virtual reconstruction activities, a growing number of highly detailed 3D-models has been created and maintained in the past 15 years. The objects of study are destroyed synagogues in Austria and neighbouring countries (erected around 1900). These destroyed sacral buildings will not be rebuilt for several reasons, mainly because the local usership has largely disappeared. Even if the former buildings were to be physically re-erected, a revival would probably fail.

This situation triggered the idea of a virtual reconstruction. The destroyed buildings are digitally 3D-modelled and can be viewed independently from the original (physical) space. Besides obtaining the necessary high level of detailing, the models show the buildings in their neighbouring context (urban fabric). A general audience cannot, however, instantly 'utilize' the created 3D CA(A)D-model, which explains the need for generating representations (stills, panoramic views, animations, walkthroughs etc.).

This paper focusses on panoramic representations. A user enters the virtual space at a predefined starting point and from there explores a sequence of spaces by him- or herself. To a certain degree, the field of view and the overall navigation through the virtual environment are rather similar to the normal 'real-life' experience. Requirements for the creation of panoramic views are described and demonstrated using the example of the reconstructed synagogue in Jablonec.

Panoramic representations

Historically speaking, this type of representation was first explored by painters since they wanted to create an impressively sweeping view of a scenery. When (stereo-) photography came up, a comprehensive depiction of reality seemed again desirable but was not easy to achieve. With the advent of digital image processing, the combination of individual images was greatly facilitated and the results were more precise.

Offering an unbroken view of the surroundings (360°) and a wide viewing angle, panoramic representations provide almost the same information as the live experience. This makes them highly interesting for projects relating to the "digital heritage", since they provide an option for reconstructing lost spatial relationships in a manner that closely mirrors reality.

If a three-dimensional CA(A)D model is available, there are several possibilities for creating and viewing a panoramic representation. One example is the CubicVR concept which is part of the Quicktime technology.

Six different (square) renderings corresponding to the sides of a cube are captured from a single point in space (see Fig. 1). This requires no preparatory work and the computing of the image is comparable to that of a single image (still).

Java is used to stitch the six images into a seamless wrap-around view. The viewer gets the impression of being able to look around freely from one stationary viewpoint. The image creates

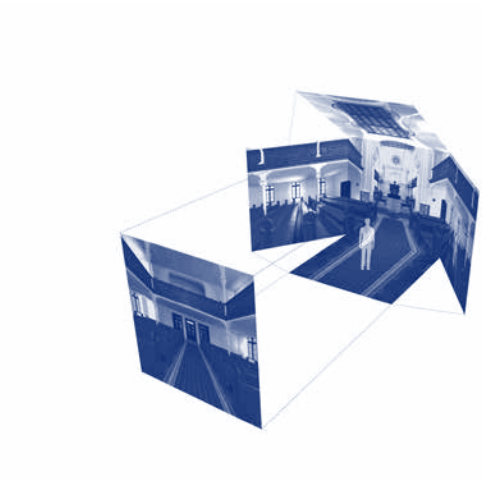

Figure 1: visualisation of the six sides constituting a panoramic representation (using cubicVR).

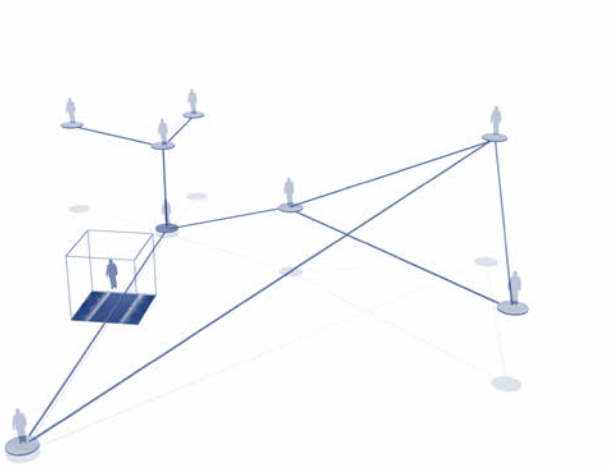

Figure 2: Schematic view of the relationships between panoramic nodes (hotspots) and the connections between them (routes).

the illusion that one may look up, down, left or right without restriction. Unlike an animation, this type of representation gives a certain freedom of choice and certainly encourages interaction. The resolution permitting, there is even the possibility to 'zoom in', corresponding to stepping closer in the physical world.

Any desired number of viewpoints can be interlinked. While the single panorama is quite interesting in itself, the concept is essentially enhanced by the possibility of "virtual teleportation", created by interlinking the individual viewpoints (called nodes or hotspots). The viewer navigates from one pre-defined viewing point to the next. The sequence does not have to be linear, a node may branch out to two or even more other viewpoints (see Fig. 2). Different routes can be predefined and the viewer's 'journey' can be staged according to dramaturgical considerations.

In order to direct this experience, the entry point and a meaningful route has to be designed which supports the viewer in finding his or her bearings. Extremely wide "virtual jumps" are therefore counterproductive. An aspect of particular importance in this context is the shift between inside and outside views that helps users to better understand the interior design and also the structure's position within the urban fabric. Panoramic renderings allow designers to put the focus on the crucial points of their reconstruction. In this case, virtual synagogue models can be displayed from the best reconstructed positions and even give the users free choice between them.

Methods and materials

Research must start with the question as to what type of information about the building has survived (planning and design documents, photographs, descriptions, etc.). In the process, contradictory information needs to be checked for plausibility and/or information gaps filled in a plausible manner (Affleck & Kvan, 2005; Tan & Rahaman, 2009). The process of building a 3D model will not, however, be described in this contribution (Martens & Peter, 2002 and 2014).

Whereas several software packages exist that could be used for the above-mentioned process of image generation, it seems recommendable to opt for a seamless integration of existing model files, including textures, light sources, etc. In this way, the panoramic representation could be generated as a kind of spin-off, and the increase of processing time is the main determining factor for the number of single panoramas to be computed.

In the present project, "Artlantis Studio" is normally used for generating the representations, as it cooperates well with the "iVisit" display software (".pno" file format). It is also possible to link "AutoCAD-data" with "iVisit". The user is offered two kinds of representation and the result can be embedded in a website. JAVA is the only software that needs to be installed on the end-user's computer. He or she can start immediately with the intuitive and mouse-based navigation through the representation. The user interface is simple and self-explanatory.

A tablet (iOS or Android) may also be used for viewing. In this case, the iVisit app needs to be installed. The navigation through the panoramas loaded into iVisit can be done offline and requires

Figure 3a: Panoramic scenery in a tablet app.

no particular computer savviness, i.e. even non-gamers will be able to manage the navigation which is not keyboard-controlled.

Tablets offer an additional viewing mode. Navigation through the panorama is achieved by rotating or tilting the tablet. When the user turns the device to the right, the view will also shift to the right - turning left will change the view accordingly. This mode is enabled by the gyroscopic sensors which recognise the device's position in space.

A previous conference paper (Martens & Peter, 2011) described the possibility of a self-running software application, then called "Virtual Building Explorer", now known as "BIMx-explorer". While the way in which rooms are viewed is similar, the much larger freedom of movement may give rise to the impression that navigation and orientation are a complicated matter. In the absence of co-ordinated hotspots, the users should be supported by a "collision detection" feature. The quality of representation is lower (compared to single-image computing), and the hardware on which the software is used may have a limiting effect on the user experience. Overall, this software involves much longer computing times.

In conclusion, the authors present possible results using the example of the reconstructed synagogue in *Jablonec nad Nisou* (Lazewski, 2014), although it must be said that a paper-based medium gives scant impression of the user experience.

A two-year effort, based on previous work on Wilhelm Stiassny's synagogues, gave rise to a particularly detailed model of the temple he designed in *Jablonec nad Nisou* in the north of Bohemia, which was destroyed in 1938. With the help of a great number of historical postcards, the authors were able to capture and model urban development from 1892 onward in a large radius around the structure.

Outlook and Discussion

The C(A)AD model of a three-dimensional reconstruction is hardly accessible to a large number of users. In many cases, it would not even be useful or desirable to make this data source available. As an enhanced way of viewing a series of unconnected single images,

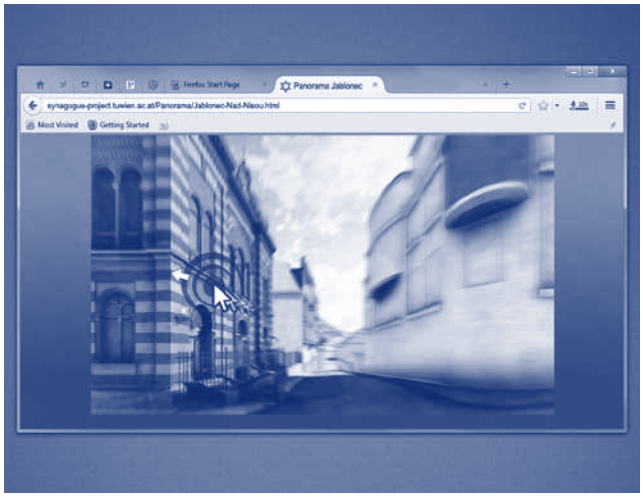

Figure 3b: Panoramic scenery in a web browser.

Figure 4a: Case Study Jablonec: exterior viewpoints.

Figure 4b-c: Case Study Jablonec: interior viewpoints.

panoramic representation provides users with an effective way of exploring a virtual space on their own. Moreover, this manner of viewing is not restricted to a single platform (!) and can also be carried out on non-high-end devices. In a museum context this might be a useful option, and one that could also be installed on

related websites. This way of representation comes quite near to a real-life experience and mimics human viewing conditions. By interconnecting individual hotspots the users can get a sense of moving through space. It should be noted, however, that such routes require careful pre-definition and a certain "mise en scène".

In the future, an interlinking of individual *.pno-files would be useful. Currently, users have to exit a scenery and enter the software again to view another representation. For the time being, neither the light situation (day/night, etc.) nor the building stock or environment can be changed within one *.pno-file.

There exist several ways to create a panoramic representation of an existing CA(A)D-model. An essential issue is the manipulation of the digital 3D data towards the creation of six different images for each panoramic representation. Another rather crucial aspect is the "ease-of-use" of the application that displays the panorama. Is any installation required (standard software) or is, for example, a self-running package implemented?

One could question the consistency of this submission with the 2014 conference theme "Design in Freedom". Indeed, "overcoming the old boundaries of design with the help of new tools" plays a dominant role. First of all, freedom of interpretation is an issue in projects relating to the digital heritage. Gaps in the set of acquired data are a permanent point on the agenda, and the desire to re-design the previous situation necessitates these information gaps to be closed. On top of this, virtual reconstructive modelling recreates the architectonic concept, as it provides information on the interplay of form and function in a specific building.

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