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Key Centre of Design Computing and Cognition, University of Sydney, 2001, pp. 319-322.

CONTINUING WORK ON A 3-D CITY MODEL FOR ARCHITECTURAL EDUCATION

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Abstract. This paper describes continuing experiences with the creation of a 3D-City Model at Graz University of Technology. It presents an innovative approach in establishing a city model with the substantial support of students in the study fields of architecture and surveying. Doubtlessly other projects already revealed similar issues, but so far without direct collaborative input by students.

1. Introduction

In recent years city modeling has become a commonplace because there exists a growing demand for city models in different qualities for specific uses. Major reasons for the creation of city models are network planning of telecommunication companies and the use within a city information system for citizens and tourists. The differing uses are matched by the suited approaches towards city modeling. A recent study of CASA (Center for Advanced Spatial Analysis at UCL London) carried out a review of more than 60 3-D City Models worldwide. According to this study there is no standard or predominant method in city modeling. CASA [1] identifies three different approaches: Traditional 3-D CAAD, Photogrammetric Analysis resp. Surveying and GIS. The significance of the City Model developed at Graz University of Technology is the combination of those three approaches and the main focus is not only laid on the model itself, but also on the impact of the model and its creation within the framework of architectural education.

2. Starting Point

Soon after beginning implementation of CAAD at Graz University of Technology the creation of (crude) 3-D urban models began [2]. Over the years the growing skills of the users (in combination with sophisticated software and powerful resp. affordable hardware) led to a situation that more and more

design and urban projects were modeled individually at the Faculty of Architecture.

Even the Municipality of Graz performed a few projects on 3-D visualization of special points of interest within the city limits. All these computer-based models were created for several purposes and accidentally - in different ways. Unfortunately, re-using these models for other projects was not possible and in the course of the time several parts of the city were modeled again and again. However, this work improved the skills of the students basically in computer modeling, but did not deliver any further benefits or any added values for the faculty or the city. However, the increasing demand of the availability of digital data for Urban Analysis, Visualization and design projects led to the idea of the Graz City Model.

Our first intention was to get something like a city model to work on from the Municipal Department of Survey. But although they had already discussed the necessity of a 3-D city model they have failed so far in producing even a simple due to a variety of reasons.

Although several research projects in differing aspects of automatic and semi-automatic creation of city models and the texturing of the façades were successfully completed at Graz University, it was not feasible to (re-) use these results.

The main idea behind our special procedure for the creation of the Graz 3-D city model is the potential contribution by a large number of students. By means of bundling and coordinating all efforts in city modeling a perspective for collecting and assembling all the entire parts of the city modeled in the framework of different study courses has been developed - and partially failed (mainly because of the rather liberal study conditions in Austria). Therefore, particular attention is now being given to special courses focusing on collaborative modeling.

3. The Creation of the Model

The main principles for the creation of the city model have been described in previous papers (Dokonal et.al., 2000). These papers present more in detail the process of creation including data sources, building of the CAD models, concept of the levels of detail (LoD's) and the data management system. The 3-D city model is based on models of individual buildings within the city. For every building an AutoCAD-drawing is produced by using 3-D polylines. After conversion into 3-D faces, there is still a possibility of changing the model of every individual building. The main data sources for this model is the photogrammetrical evaluation of aerial pictures supplied by the Department of Survey and a site analysis of the students. The governing data principles are to be defined unambiguously and are to allow for tracing back in order to grant

usefulness. As data gathering done by different individuals delivers patchwork the pertaining defined guidelines are to be carefully observed. Any information to be added to the 3-D city model is for this reason recorded on a data sheet Building data are entered into the database at varying LoD's (level of detail), depending on availability of basic data. The necessary information for the different LoD's are stored in individual files and linked to the basic model if required.

A detailed documentation sheet on every individual building is kept up-to-date stating clearly data source, any mistakes regarding basic data, data corrections, etc. This documentation represents an essential component of the data records.

4. Experiences

The first two years upon commencement of this project were full of struggles. It turned out to be very time-consuming gathering the necessary basic data to set off the students working. In the beginning it became obvious that a lot of students neither understood the importance of the rules (e.g. that everyone is to create his buildings in a defined way) nor the importance of the documentation.

In order to involve as many students as possible the city model project was linked to several different study courses. But this concept brought the problem of varying degrees of motivation on behalf of the students due to the differing usefulness of the model products within the framework of the specific study course. Therefore "drop-outs" leave us with "white spots" (unfinished geometries) in the current state of the city model.

The new concept is based on a "Studio" of collaborative modeling, where groups of 3 to 4 students are working on all aspects of a model area, i.e. not just a single building (from basic geometry to the textures of the façades). Experiences will be available in the course of spring 2001.

Still the main goal behind the creation of this 3-D city model is to establish improved resources for architectural education - both on levels of urban design as well as those of (architectural) project design - by using the potential of a "mass university" on a low budget. Other schools of architecture might benefit from this experience. As an educational approach, the experience can serve as a starting point for future studies.

Notes

[1] *http://www.casa.ucl.ac.uk/3dcities* which contains a brief summary of their research an 3D-city models and a list of more than 60 different models.

[2] *http://www.digcity.tu-graz.ac.at* contains a more detailed description concerning the guidelines and working procedure. A careful explanation of techniques is further more presented here.

References

Benner, C.: 2000, Towards fully automatic generation of city models, in *IAPRS Vol. XXXIII, Part B3/1,* **Comm. III** (ISPRS Congress), pp. 85-92.

Brenner, C. and Haala, N.: 1999, Rapid production of virtual reality city models, *GIS - Geo-Informationssysteme* **12**(3), 22–28.

Brenner, C. and Haala, N.: 1999, Towards virtual maps: On the production of 3d city models, *GeoInformatics* **2**(5), 10–13.

Day, Alan K. and Radford, Anthony D.: 1995, Imaging change: The computer city model as a laboratory for urban design research,. *Sixth International Conference on Computer-Aided Architectural Design Futures,* pp. 495-506.

Dokonal, W., Martens, B. and Plösch, R.: 2000, Graz: The creation of a 3D city model for architectural education, *ECAADE,* pp. 171-175.

Dokonal, W., Martens, B. and Plösch, R.: 2000, Architectural education: Students creating a city model, *ACADIA 2000*.

Kaga, A., Shimazu, Y., Yamauchi, T., Ishihara, H. and Sasada, T.: 1998, City information visualizer using 3-D model and computer graphics, *CAADRIA '98*, pp. 193-202.

Radford, A., Woodbury, R., Braithwaite, G., Kirkby, S., Sweeting, R. and Huang, E.: 1997, Issues of abstraction, accuracy and realism in large scale computer urban models, *CAAD Futures 1997,* pp. 679-690.