Second City

A Three-dimensional City Model as Interdisciplinary Platform for Research

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In the era of communication, the participation in internet-communities has grown to become a motor for innovation in software and community platforms. The paper describes the hypothesis that, by creating a virtual city (or a second city) a new type of social, economic and scientific network is established, which is supported through visual communication technologies. The various users bring, per se, their own intrinsic motivation and requirements to the system. Nonetheless, a personal identification with a city/neighbourhood/house/apartment can be used to awake awareness and to foster participation. This is especially important when dealing with the city inhabitants. City modelling itself has been carried out for over a decade. Projects such as the city model of Graz have shown how city models can be established so as to be scalable for new information (Dokonal et al 2000). Furthermore, these city models have been used in the education of future architects and urban planners. The project described here moves in the opposite direction: the model moves out of the classroom to an interdisciplinary city-model-platform. The work described here is the conceptual model for a multi-dimensional data set that models the city. This has spawned a host of other projects using the model as a foundation for further interactivity development and the extension of the model itself. The paper describes the structure of the conceptual model and the first experience of incorporating diverse projects such those mentioned above. The model also is structured so as to be compatible with the XML standards being developed for city information (CityGML). The goal of the project is to create a data set describing the city that not only describes the geometry, but also the history (including planned histories) and nature of the city. In contrast to virtual realities, which attempt to create a separate world (e.g. Second Life), the Second City is intended as an interdisciplinary repository for the geometrical, historical and cultural information of the city.

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> The sheer difference in scale between architects and their models allows them to assume a Gulliver-like position of authority vis-à-vis the actual site of their proposals. Entire districts may be erased at the cut of a scalpel in an exercise that operates merely at the level of the aesthetic. The consequence of this, one might suppose, is not simply that within every fascist dictator there is a potential architect, but also that within every architect there is a potential fascist (Leach 2000).

Models of cities

Modelling is a central part of architectural and urban design. The inherent abstraction of remaking a building or city to another scale helps designers to understand the object of study. Likewise, it also allows us to simulate various designs and to test them, at the least against our own aesthetic principles and more importantly, against other models of the world. What was once instigated in paper or wooden blocks is often carried out now in digital models. This is true for both models of buildings and models of cities. Unlike buildings, however, city models are inherently more complex not only because of their size, but as owing to the host of additional aspects (transport, for example) that affect the city's form.

There are a host of city model projects and many of these have addressed issues of scalability, which became important in this project (Dokanal et al 2000). In the interests of building local know-how, a similar city-modelling project was initialised with the knowledge that many of the well-documented problems would resurface.

The Project described is an attempt to not only address the complexity of the city model, but also to address issues related to citizen involvement and control of the city's development. Using recent community building web-based technologies, often referred to as "Web 2.0", the project aims to engage the citizens of the actual city (the first city) with the digital model (the second city). Encompassing the citizens in a digital representation of the city brings social, technical and legal problems that are not yet solved, but have at least been identified.

Additionally, the project described here is meant as a catalyst for further citizen involvement.

Modelling

The project started out as a team based modelling exercise as part of the upper level coursework. The city in question, Aachen, Germany, was parcelled into 16 sectors and a group of two to four students was given the task of modelling that sector. The city of Aachen provided the cadastral information and aerial laser data from the state surveys provided rough height information. Further individual surveys were carried out by the students themselves to verify roof forms and tree position and size (see figure 1).

The city was then modelled in 15 separate 3Dstudio files with common file structures in order to allow a common large file to be created. After one semester, about ninety percent of the city had been modelled to the level of roof form and building cubature. Additionally, interpolated topography was included, which meant that special scripts were needed to automatically place the buildings and trees at the correct height.

Flythroughs and other films were generated by rendering the same paths within all partial models and then recompiling the layers into single films. This process allowed for quicker individual films as well as for corrections to certain sectors, without rerendering the entire film. Using a pool of 20 computers, the films still took up to 3 days to render.

At this point, the city model has little semantic information other than the object type and a spatial location. Nonetheless, the model size meant that it became unwieldy for a single user to use or manipulate the entire model. This means that additional levels of detail in the model and/or other semantic information will require a different strategy. Still, using the layer structure of 3Dstudio, it was possible to highlight various aspects of the city. For example in figure 2, the buildings of the RWTH Aachen are rendered using a different colour than the rest of the city.

Access to the model

The fly-through and fly-around films were tantalising, but naturally lacked in interactivity. The goal of allowing the user the chance to experience the city in real time meant using other types of technologies. The first experiments focussed on exploiting the scripting potential and rendering power of Quest3D.

The size of the city model in 3DStudio (3Gb) meant that initially, for the work Quest 3D, only parts of some sectors were imported into the software environment. The scripting environment meant that additional semantic information could be layered to

Figure 1
The City of Aachen

the objects without additional modelling. The open format of Quest3D meant that the interface had to be scripted as well and indeed, this took more work than imparting the semantic information itself.

The Quest3D files are also substantial (~20 Mb), but manageable for individual PCs. The Quest3D sector parts can be navigated in real time and filters can be set using the interface. This allows types of use, for example commercial, residential etc.) to be highlighted. This is a considerable step forward for the user over the pre-rendered flythroughs (see figure 3).

This is, however, a step backwards in two respects. Firstly, Quest3D is able to only run on Windows systems, which negates a considerable part of the community. Secondly, the program must be purchased and installed on each system. Notwithstanding the high performance of the application, the scalability of the system would meet limits in either the complexity of the model or in its sheer size. As such, the next step in the project lies in another direction. Nonetheless the port to Quest3D lent valuable lessons in urban model semantics and also showed the level of performance that is needed to achieve a model worthy of the name, "the second city" (see figure 3).

Distribution

The goal of the system being constructed is based on the principles of user participation and collaboration that are collectively known as Web 2.0. This layer of openness is the so-called "long tail" of media users (see figure 4). The idea is not to produce the city model as finished for viewing, but to see the city model as a platform for other information, often unforeseen.

To do this, the model will have to be taken apart and reconstructed using a much more elaborate format than a program such as 3Dstudio or Quest3D can offer. In short, we need a database. This will entail deconstructing the 3D and limited semantic

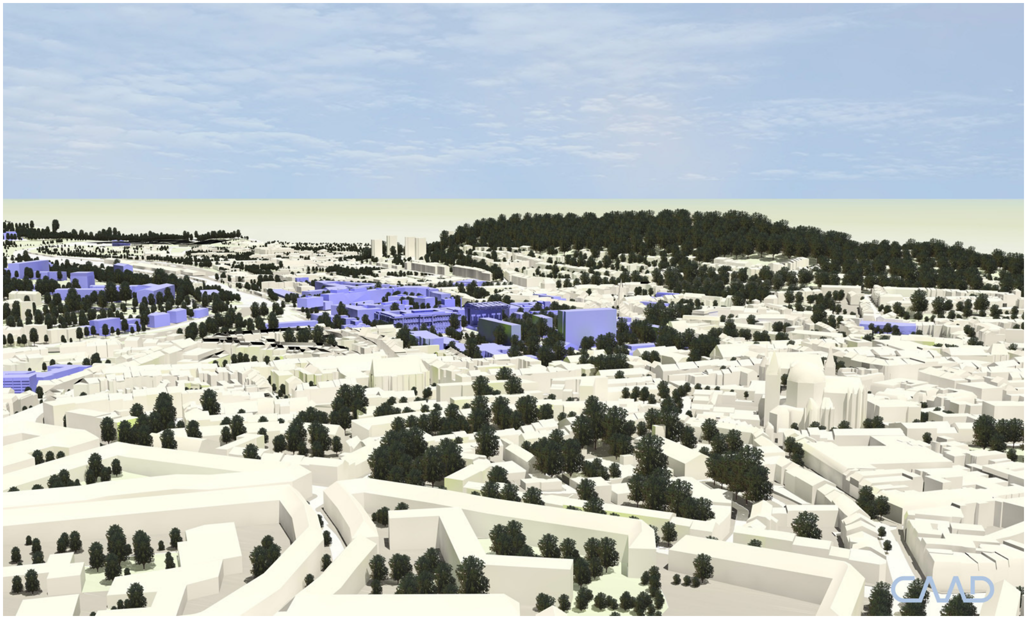

Figure 2
The RWTH Aachen within Aachen

information in order to set up the relational database. While this is cumbersome, it is better than following a dead-end street of single file city modelling.

It must be noted at this point, that the decision was made to not use available multi-user "worlds" such as second life or active worlds. While these provide basic functionality, they lack the control and expansion that is sought in the second city. As well, independent of the costs for development (against the rental costs in worlds like Second Life), the community exists in the real world an as such, it is not necessary to link up physically separate groups and individuals.

There are two open questions as to how to get the platform up and running. At the very back end is the question of data structure. At the front end is the question of viewing and presentation. Primarily, this could be considered as a technical question, but the authors maintain, that the involvement of the citizenry is essential for the success of such a platform.

City data structures

The organisation of data about cities has been attempted many times. In recent years, the widespread use of XML data structures has also come to the City Modelling community. Since 1994, the open geospatial community has sought to establish open source data standards in order to enable data exchange as well as the re-use of data manipulation methods (http://www.opengeospatial.org). Currently, the Geospatial Markup Language (GML), also known as

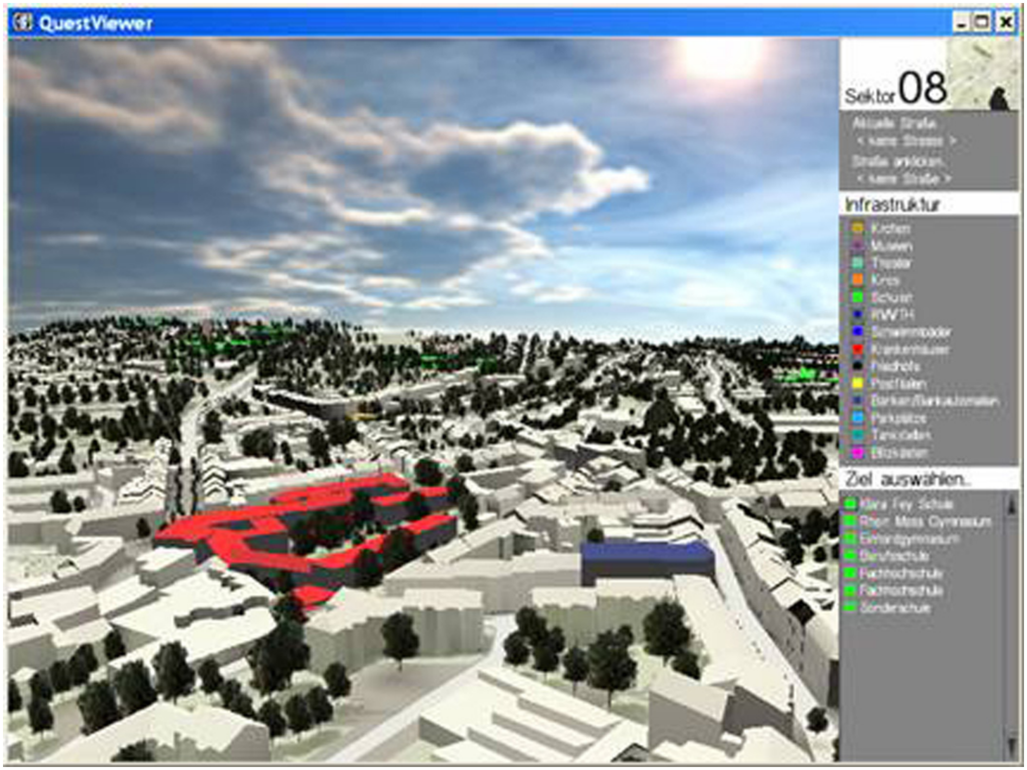

Figure 3
Quest3D View of Aachen

OpenGIS, is an XML Markup Language that is crafted specially for the kinds of data sets in GIS and City Modelling.
The use of OpenGIS will speed up the reconfiguration of the second city. However, the layering of Web 2.0 user access with the GML data structures will be the real challenge.

City presentation

The success of the platform will depend heavily on the ability to distribute high quality images to the maximum number of citizens. This means effectively using web-based technologies. Here, the experience gained in collaborative shared models (Heidrich et al., 2007) using the Java Open GL Libraries provides proven methods, albeit at a smaller scale. Scalability deems to be workable and this should allow reasonable performance on platform independent web-browsers. Additional media including Photos, Audio and Quicktime VR panoramas are also easily made available through a web browser and for the city of Aachen, these all exist, but on separate platforms. All of these performance and platform conditions point to a comprehensive and integrated city model, which allows citizens to add their input to the cityscape.

Our vision is of a city model that serves as a scaffold for community, civic and engineering information about the city. This can and should be fed by the people responsible for this information. By utilising web-based-community methods, the chance to create a second version of the real city will enable the citizens to animate a future that has hitherto be hidden from them.

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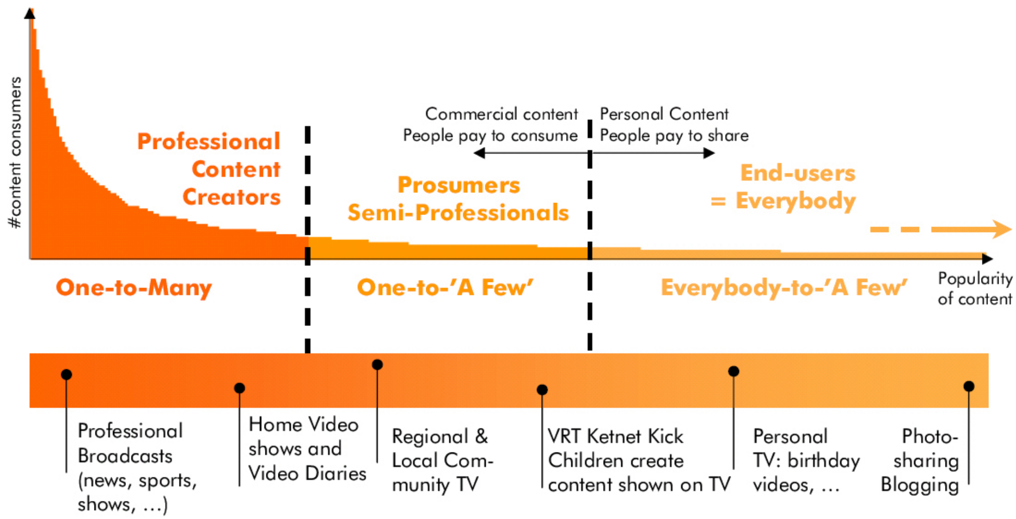

Figure 4
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