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# Simulation of 3D Models in Real-World Context

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The 3D visualization methods are turning into powerful and widely used tools for architects during the design and development process of urban planning, visibility analysis, urban engineering, urban landscape planning, urban infrastructure management, and communication design and tourism promotion. Advanced information technologies provide increasingly affordable and accessible opportunities to quicken these processes considerably. Real-time 3D simulations serve as a presentation tool, empowering both the designer and the client in understanding the buildings in real-word context well before they are built. Theoretically, nowadays the 3D visualization technologies can provide the potential to streamline all phases of an architectural project from schematic design to construction and maintenance.

Urban simulation is a rather new 3D computer technology that offers the ability to quickly model existing and new buildings within their context. Through 3D visualization technique, 3D city model can be presented in a real-time view. There are various terms used for 3D city models such as “Virtual City”, “Cybertown”, “Cybercity”, and “Digital City”. Classification for all terms has been made by [1].

It is possible to interact with the environment online as the computer renders the scenes in real-time. Buildings, trees, streets, sidewalks, etc. are represented using digital photo-textures that are rendered in the 3D models. Unlike a non-interactive animation, or still rendering applications, real-time simulation will allow to walk, drive, or fly anywhere in an existing neighbourhood that is fully textured with images of concrete, wood, brick, grass, etc. With the use of a mouse one can control the walk along the terrain up to a proposed shopping centre, enter into the building, go up the escalator to the second level, walk up to proposed storefront designs of commercial tenants, and look up at the skylights and trusses hanging from the ceiling.

In Pilsen community planning process, 3D modelling software was employed to help participants visualize a proposed development [2]. The program, called Iron CAD (the name of former version Trispectives) enabled the quick creation of conceptual 3D models. One project involved evaluating a 100-unit housing development proposal. A site plan that had been created by an architectural firm was used to create an animated 3D model.

Nowadays Virtual Reality based geographic information systems (VRGIS) are successfully employed for real-time visualization in such diverse fields as urban planning, city planning, and architectural design. Today a VRGIS based

software solution has to facilitate the interactive visualization of high-resolution 3D terrain data over inter- and intranet. Due to advanced software technology and innovative data management concepts, large amounts of data may be processed in real-time. Digital elevation models, high-resolution orthophotos, satellite images, 3D buildings and vector data provide the real time application with the information to display excellent high quality representations of complex terrains and landscapes.

An important factor in a 3D GIS is remote access to the data [3]. Recent developments on the Web, i.e. VRML make possible visualization and interaction with 3D models. The exploration of the 3D worlds in the VR browsers ensures a certain level of virtual reality techniques. Existing VRML, HTML and other Web standards and software modules allow the development of graphic user interface, relying on some operations included already in browsers. This project was associated with the visualization of 3D city model of Stuttgart to give the user the ability to interact with the 3D scene and to have access to the attributes information by clicking on the objects.

All the numerous existing software and systems used for these purposes and analysed in more details [4] and a very few ones mentioned above first require quite expensive software. Second, the process of developing the applications is time consuming and requires professional knowledge. Further, a very simple and effective method will be discussed, which can solve some 3D urban planning visualization tasks in a short time with little effort.

SketchUp software, which was developed by @Last Software and released in early 2001 is a 3D modelling software designed for professional architects, civil engineers, filmmakers, game developers, and related professions. It is not regarded as traditional CAD software, though it was marketed as an easy-to-use conceptual general-purpose 3D content creation tool. It quickly found a market in architecture and building design industries and helped to solve many tasks. The success key to its fast adoption by the professionals was in its learning curve, which was much shallower than other commercially available 3D tools. Some of its key features include:

- A smart drawing cursor (inference) system that allows users to draw 3D object using a 2D screen and mouse.
- Simple massing study capability via "push-pull" tool.
- An interactive Heliodon or sun angle simulator.
- A fast, easy way to animate camera and sun movements.
- Models can be individually coloured with an assortment of solid colours, textures and materials.

The SketchUp version 5 possesses options to allow the user to extrude and widen as well as the ability for a face to "follow" the cursor around an object. Simplified terrain modelling with a SandBox tool is another highlight. It includes also internal scripting language named Ruby, which is interpreted scripting language for quick and easy object-oriented programming. It has

many features to process text files and to do system management tasks (as in Perl). It is simple, straightforward, extensible, and portable allowing to program wide range of user applications.

SketchUp is supported by add-ons, which can be downloaded from developer's website. One of such add-ons allows the user to export the 3D model renderings as a .kmz (Keyhole Markup Language) file, which can then be opened in Google Earth. This add-on has a co-ordinate database where the user can select a particular place on the globe to place the object. An interactive 3D observation from wide range of views is possible using Google Earth software.

In turn, Google Earth (formerly known as Earth Viewer) was developed by Keyhole Inc. Google acquired that company in 2004. The product was renamed Google Earth in 2005 and is currently available for use on personal computers. Google Earth is available in a free version or in licensed versions for commercial use. Many large cities are available in high enough resolution to see individual buildings, houses, and even cars. The degree of resolution available is based somewhat on the points of interest, but most places are available at at least 15 meters of resolution, which might seem reasonable for some urban planning applications. A new feature implemented by Google after its acquisition of Keyhole is a 3D dataset (provided by Sanborn Citysets) for 39 cities, all in the USA (data of December 2005). This feature is limited to displaying grey overlaying "blocky" buildings.

Google Earth also includes digital terrain model data collected by NASA's Shuttle Radar Topography Mission. This means one can view, e.g. the Grand Canyon in 3D, instead of 2D like other map programs or internet resources. In addition, Google has provided a layering system like the one used in CAD applications, allowing seeing 3D buildings for some of the major cities, though predominantly in the US. Many people using the applications are adding their own data and making them available through various sources.

One of such successive applications is SketchUp. Recently, on March 14, 2006, Google, attracted by their plug-in for Google Earth, acquired @Last Software Company along with the SketchUp software. Two weeks later Google announced Google SketchUp, a freely downloadable version of SketchUp. The free version is not as capable at SketchUp Pro 5, but it includes integrated tools for uploading content to Google Earth and to the Google 3D Warehouse, a library of models created in SketchUp.

However, difficulties stemming from inaccurate coordinate placement limit this tool's functionality somewhat so far. Another problem is limited resolution of the satellite data for rural areas. The Galileo positioning system is a proposed satellite navigation system, to be built by the European Union (EU) as an alternative to the Global Positioning System controlled by the military of the United States, and the Russian GLONASS. The system should be operational

by 2010, two years later than originally anticipated. That could be a solution for wider use of urban planning solutions in our countries in near future.

The procedure for the 3D city model creation includes several steps. SketchUp and Google Earth software should run at the same time and an internet access is required. The sequence of the model creation is as follows:

- Find the urban area in Google Earth and zoom to proper extent (Fig. 1).
- Import into SketchUp the chosen in Google Earth area map data.
- Model the buildings on the imported area background in SketchUp (Fig. 2).
- Save the 3D model data in .kmz file format for distribution and interactive browsing in Google Earth (Fig. 3).

Example shows urban area planning studies in Riga, Kipsala, where Riga Technical University is located. The method was introduced in the architectural studies in master level, but next academic year it will be used in the bachelor studies as well.

Figure 1. Zoomed area in Ķīpsala, Riga in Goggle Earth interface.

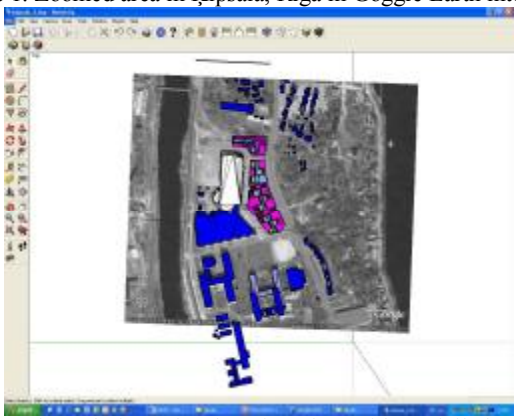

Figure 2. Area brought into SketchUp interface with modelled 3D buildings.

Figure 3. Real-time browsing through the modelled area in Google Earth.

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## Summary


The 3D visualization methods used in urban planning are turning into important tools for architects during the design and development process. The paper deals with simple and relatively inexpensive method of 3D data presentation in a real word context using SketchUp software and Google Earth explorer in connection with special plug-in, which serves as a data converter. This method can considerably reduce the development costs well before the commencement of the construction process. Real-time 3D simulations serve as a presentation tool, empowering both the designer and the client in understanding the buildings in real-word context well before they are built. Practical exercise shows the method in urban planning studies used by architectural students of Riga Technical University.