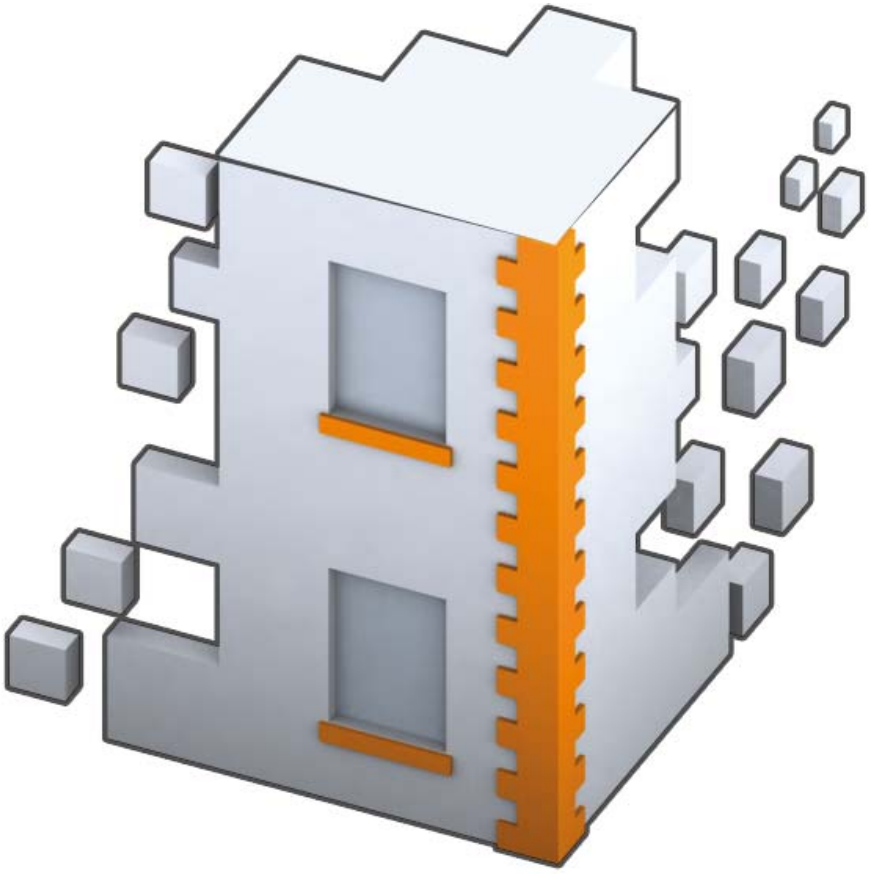


V-City

The Virtual City

RECONSTRUCT

EXPLORE

INTERACT

http://vcity.diginext.fr

V-City
The Virtual City

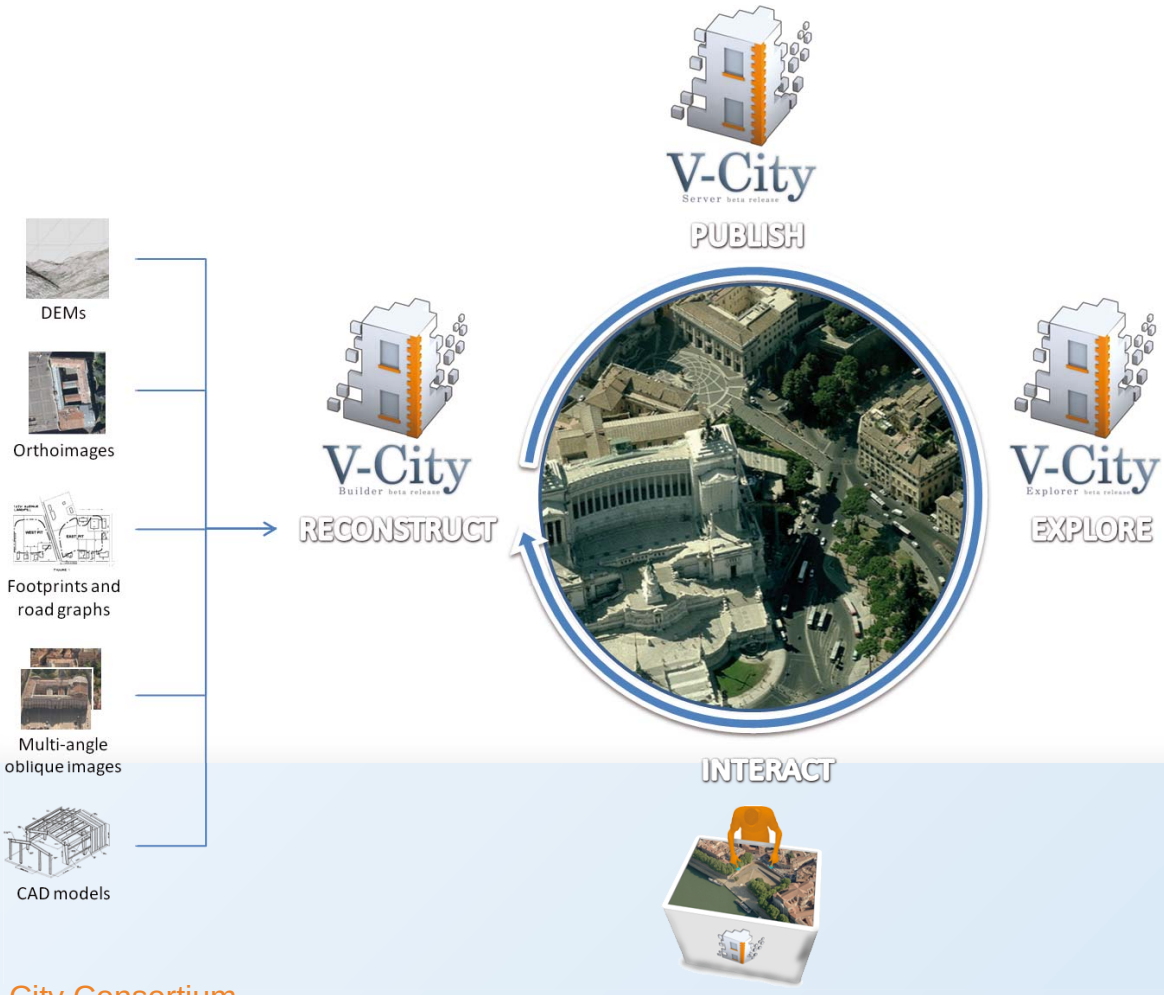
SEVENTH FRAMEWORK PROGRAMME

The Virtual City Project

3D geo-informatics has entered the digital age, hesitantly in some areas, and rampantly in others. Google Earth and Microsoft Virtual Earth are household names.Although as yet limited to landscapes, only few landmarks and low detail buildings, these massive digital geographic libraries are already today regularly used by millions of people. They also spawn new forms of content and novel applications. However, these pale in comparison to those that will be made possible as soon as highly detailed urban digital libraries will be fully available and exploitable.

Behind the V-City project stands a consortium of European research organisations and companies. They combine expertise in 3D Modelling, Computer Vision, and Virtual Reality. Together, they aim to develop and validate a pipeline for the rapid and cost-effective reconstruction, visualisation, and interactive exploration of large-scale, urban environments. The project focuses on such environments as a key part of human cultural heritage.

The V-City project will produce three main results that will form a consistent, user-friendly and automated framework.



The V-City Consortium

The V-City consortium was founded in 2008 by a number of world-class organisations in the field of computer vision, computer graphics and geographic information. The consortium is focused on the creation of a tightly integrated tool suite for the reconstruction of urban environments and their real-time 3D visualisation.

DIGINEXT Simulation & Virtual Reality Systems

KATHOLIEKE UNIVERSITEIT LEUVEN

Istituto di Scienza e Tecnologie dell'Informazione
Consiglio Nazionale delle Ricerche

IMMERSION imagination, interaction...

procedural

BLOM IMAGING THE WORLD

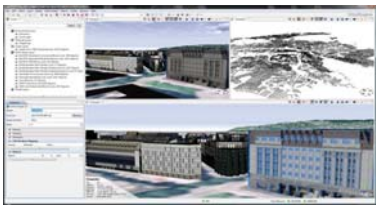
CRS4 IDEAS BECOME LIFE

The V-City project is supported by the European Commission through the Information & Communication Technologies programme under FP7.

V-City
The Virtual City

SEVENTH FRAMEWORK PROGRAMME

The V-City Builder



The V-City Builder automatically reconstructs large-scale urban environments with high quality from input cadastral data, aerial oblique images and ground pictures. First, data from multiple input sources is processed and a textured mass model is generated for each building. Second, topological and semantic information is automatically extracted and put into a compact procedural representation of the facades.

Innovation

Current solutions for urban reconstruction are either inaccurate or not sufficiently automatic and do not provide sufficient architectural information such as positions of doors, windows or floors. Further, these methods leave occlusions (such as trees) on the facades. The V-City Builder will overcome these limits by automatic processing of multiple angle pictures and correlation of these images with other geo-referenced data.

Novel image analysis methods are developed both for occlusion detection as well as for automatic processing of facade textures into a compact representation based on procedural rules. The extraction of the procedural representation goes hand-in-hand with detection of elements such as floors, windows, doors etc. The procedural representation allows for a compact representation, semantic meta tagging and detailed reconstruction through application of the rules.

Usage of the System

The user starts by providing input data in a number of formats (e.g. cadastral data, multi-angle oblique pictures). Then, a number of building footprints can be selected to automatically reconstruct the textured mass models of the corresponding buildings.

In a next step, the mass models' facades are analyzed and a 3D representation based on procedural rules is generated. By application of these rules, detailed but compact 3D models of the buildings are generated.

The user can either interactively examine the models or publish them on a V-City Server, from where they can then be accessed by the V-City Explorer.

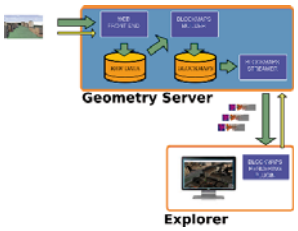
The V-City Server

The V-City Server is in charge of transforming large scale representations of urban environments into good quality low-bitrate multiresolution representations suitable for streaming and rendering. It automatically optimises, compresses and stores the geographical and architectural data published by the V-City Builder and streams them in realtime over a network connection.

Innovation

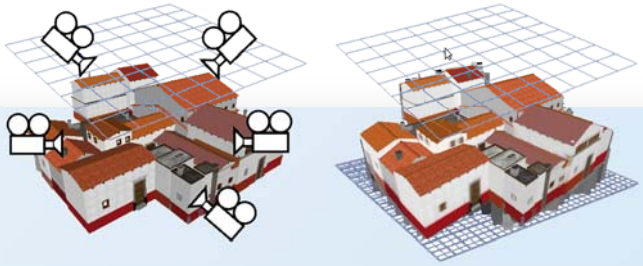
Exploring large detailed urban models on the Web, seamlessly going from high altitude flight views to street level views, is extremely challenging. What makes urban models so peculiar is that their geometry is made of many small connected components, i.e., the buildings, which are often similar in shape, adjoining, rich in details, and unevenly distributed. While multiresolution texturing and geometric levels of detail may provide an acceptable solution for buildings near to the viewer and moderate degrees of simplification, and may therefore be used for few landmark buildings, major problems arise when rendering clusters of distant buildings, hard to faithfully and compactly represent with simplified textured meshes. We focus on a novel customized representation, the BlockMap, which has been specially designed to provide a high quality but low-bitrate representation of city portions, and can be used as a building block for a multiresolution streaming and rendering of whole cityscapes.

Usage of the System



The V-City Server is in charge of transforming textured data models of city blocks into an efficient representation. The user uploads the textured models from the V-City Builder to the Server, which stores them in a database of raw data. A single upload consists of a 3D textured model and some descriptive metadata.

The Blockmaps Builder processes and optimizes the content of the published dataset into the BlockMaps data structure.



The processing is entirely render based, meaning that no access to the geometric description other than for the pure rendering is done. This characteristic allows BlockMaps to be abstracted from specific types of geometry encoding and to be useful for any model which can be rendered. The BlockMaps Streamer on the server side and the Blockmaps Rendering Plugin on the client side implement the remote rendering of the urban environment.

The Blockmaps Rendering Plugin handles the rendering inside the V-City Explorer. For each frame, it reads the viewing position from the application, computes the necessary set of BlockMaps and issues the query to the streamer.

Both client and server implement caching for optimizing the rendering speed and minimizing bandwidth and memory consumption. Thanks to the simplicitly and compactness of the BlockMaps representation, this scheme can also be replicated in low-end host clients.

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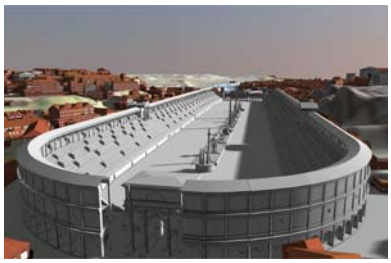
V-City
The Virtual City

SEVENTH FRAMEWORK PROGRAMME

The V-City Explorer



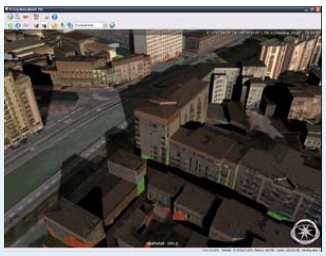
The V-City Explorer is a next-generation globe viewer based on Diginext's future VirtualGeo3 system offering unprecedented rendering capabilities. It can display massive and extremely detailed urban environments, seamlessly integrated into the 3D landscape. Thanks to the BlockMap technology, developed expressly for this project by CNR and CRS4, the V-City Explorer can navigate through massive cities, complete with picture-perfect facades and architectural details, at breakneck speeds.

With the V-City Explorer, you can fly through a city in 3D, experiencing it in unprecedented detail, and visualising the city evolution along the time. The Explorer can even take you inside buildings, where you can discover the same hallways, rooms, and furniture that existed or still exists in real life!

The Explorer is a powerful tool for architects, historians, land planners, and other professionals. It includes sophisticated querying, analysis, or measurement tools. Professionals can analyze virtual cities with precision to draw accurate conclusions without having to leave the tool to consult other sources.

Innovation

The Explorer boasts graphical capabilities previously reserved to AAA video games, such as detailed shadows and ambient occlusion. The Explorer enables you to dive into photorealistic interactive 3D, with support for both active and passive 3D viewing technologies. It can even display multiple simultaneous views, each of which with its own projection (choose between the globe view, or one of several flat map views), and in true 3D. Rather than limiting itself to a restricted or proprietary dataset, the V-City Explorer can stream data from third-party providers, including maps, wind, clouds, temperature and a variety of scientific data. OpenStreetMap provides up-to-date road and bike maps. Finally, the V-City Explorer can import modeled buildings through a variety of popular file formats such as KML, 3DS, Collada...



Usage of the System

Simply launch the Explorer and connect to a V-City Server to get complete urban environments. Add multiple additional geographic, cartographic and architectural data sources, import detailed landmarks, navigate, make measurements, and capture images, all without leaving the Explorer!

Though powerful, the V-City Explorer is easy to use. It is controlled through a simple and clear graphical interface. Sophisticated users can even automate their work through the embedded Lua interpreter.

The most demanding users can connect the innovative multitouch, multiuser, stereoscopic V-City Table developed in the project for a unique and cutting edge interactive experience.

The V-City Table

The V-City map table is intended as a multitouch, multiuser, stereoscopic interface to allow both the visualization and interaction with the massive urban data that are displayed by the V-City Explorer. It had to cope with specific constraints such as the real-time display of 3D data, the intuitive and efficient manipulation and edition of the content, as well as to provide collaborative visualization capabilities. Two technologies have been identified, which are the immersive 3D visualization equipment and multitouch tactile input. They have been brought together into the V-City map table.

Innovation

Both technologies are not new, but they have never been integrated into a single solution. Such a combination involves obvious mechanical design issues, such as the screen which requires contradictory features such as a strong directivity, an homogeneous horizontal visualization, good light polarization and high infrared diffusion. Even displaying 3D images on a tabletop is not that simple, since at least two viewpoints are required for the image not to look upside down for the opposite side viewers. As soon as several viewers are touching the same single surface where the projected images appear different for each of them, proper software input and feedback techniques have to be proposed in order to support interaction tasks that would look consistent for all of them. Solutions to those issues have been prototyped and addressed in the software mockup that was accepted and demonstrated at the Siggraph 2010 Emerging Technologies, and are to be part of the V-City Map Table. The table currently relies on standard dual viewpoint stereo projection technologies and therefore requires the users to wear special glasses, but solutions to get rid of such equipment are being investigated.

Usage of the System

The V-City Map Table provides an interface to visualize and navigate through massive urban environments. In its two-viewer configuration, head tracking is used for the users standing on opposite sides of the table and allows them to observe the digital mockup exactly as they would do with a real one. All the proper tools are supported by this interface to ensure their input and feedback is relevant : shadows are displayed beneath the hands even when no contact is made, users are recognized so that the virtual input rays can be cast orthogonal to the surface or from their eyes, the feedback is adapted to each user viewpoint… The table is also capable to support several users on both opposite sides of the table using a median viewpoint, and therefore allows to go beyond the two-viewer limitation.

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