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A Scalable Approach to Visualization of Large Virtual Cities

Contents

1. Requirements
2. Approaches
3. Scalable Model
4. Virtual Old Prague project
5. Texture acquisition

Part 1: What is the Virtual City?

- A model of **existing city** and real environment
 - *Applications*: cultural, tourist, GIS
- Fully artificial environment - **Cybertown** (often with multi-user interaction)
 - *Applications*: games, social interaction
- **Combination** of real and virtual objects
 - *Applications*: architectural, artistic

Richness of Virtual Cities

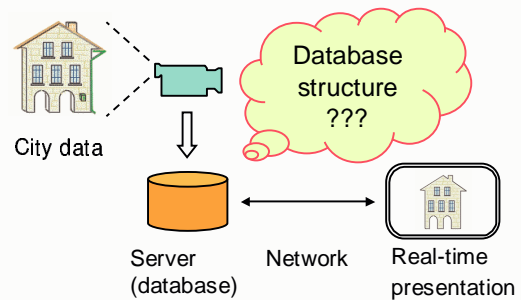
- 3D model synchronized with 2D map
- Additional textual information
- Interactivity (animations, switches)
- Virtual bus tour (animated viewpoint)
- Hyperlinks
- Search function
- Automatic navigation

Specific features of Virtual Cities

- Large virtual space to be modeled [km]
 - High number of real objects [100]
 - Extensive use of textures/photos [1000]
 - How to capture?
 - How to process?
 - How to fast render?
- ... **image processing**

! A scalable model must be structured !

Part 2: Client/Server approach

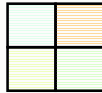


Structuring cities

- Panoramic VR



- Regular grid partitioning



- General cells



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QuickTime VR

- Panoramic VR, Image based rendering
- Based on QuickTime movie technology
- Sensitive regions (hyperlinks)

- + high speed of rendering
- + highly realistic look
- large files (movies)



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VRML & Connected cells

Special Client (plug-in) + Server

- blaxxun (www.blaxxun.com)
- Virtual Turku (www.virtuaaliturku.fi)

Standard VRML browser + Java applet

- Connectivity & Visibility structures
- Virtual Old Prague project

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Part 3: A scalable model

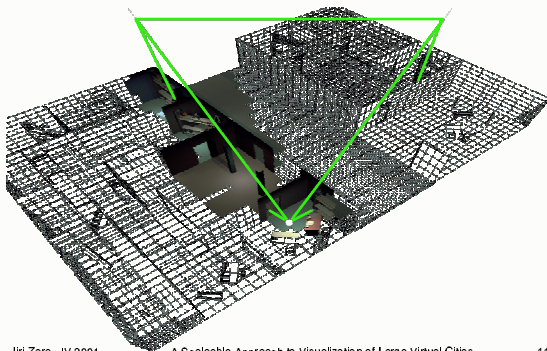
- General space subdivision
- Database support
- Topology & Visibility utilization

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Topology versus Visibility



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Study case: Dublin

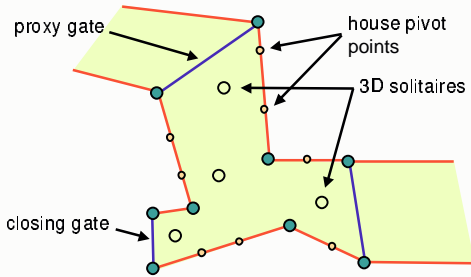


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2D arrangement (contd.)

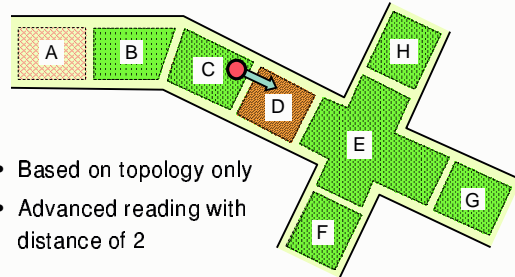


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Memory management



- Based on topology only
- Advanced reading with distance of 2

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„Urban“ LOD



1. Outline
2. Outline with repeated small textures
3. Full textured face (frontage)
4. Textured 3D model

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Part 4: Virtual Old Prague

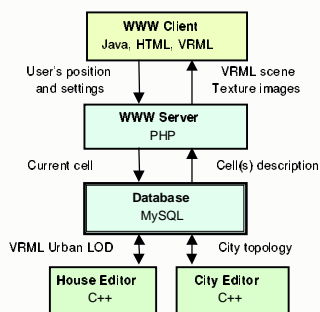
- Student project (3 semesters)
- Standard VRML files in a database
- Dynamic loading/unloading:
 - detected by ProximitySensors
 - processed by Script node

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System structure



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The Little Quarter
 Lesser Town was established in 1257, built on the slopes below Prague Castle. In 1541 it was badly damaged by a great fire and then erected again during 17th and 18th century. It is part of Prague least affected by recent history having an image as the ultimate Baroque city. The centre of the Little Quarter is the Little Quarter Square, originally a market place. Dominating the square is the Church of St Nicholas, the masterpiece of Baroque architects, the Dienzenhofers. Hardly any new

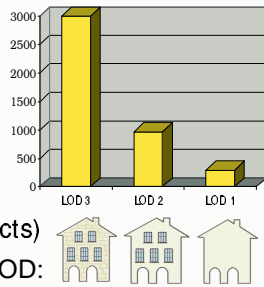
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Statistics

- About 150 houses
- 15 streets
- 3 squares
- **50 cells**
- 40 solitaires (3D objects)
- Amount of data per LOD:
3 MB / 970 kB / 300 kB

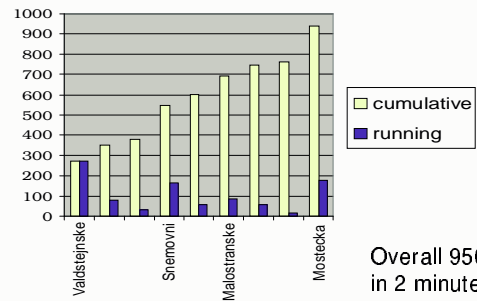


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Data transfer



Overall 950kB
in 2 minutes

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Part 5: Texture acquisition

Photographic conditions:



Dark (against the sun)
*"The best weather is
a bad weather"*



Hidden by undesirable
objects

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Texture acquisition (contd.)



Perspective distortion
horizontal vertical



Objects appearing
on different
positions

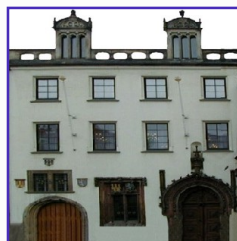


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Texture acquisition (contd.)



Cleaning process

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Software tools

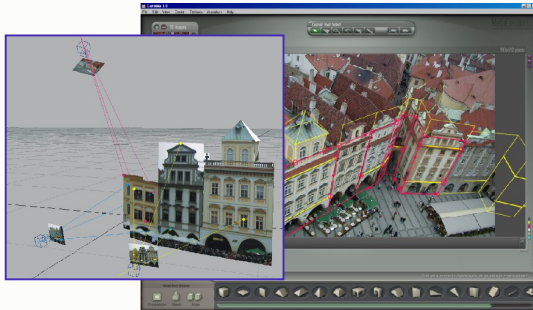
- All-purpose image editors
 - Adobe Photoshop
 - Corel Photopaint
- **Canoma** (MetaCreation, Adobe)
 - 3D reconstruction from photos
 - mapping images on 3D primitives (box, pyramid)

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Canoma

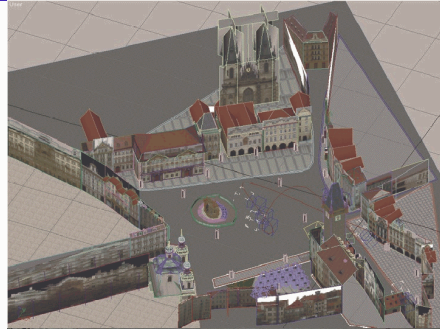


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From images to models

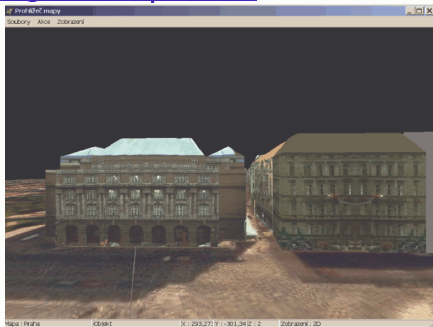


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Using aerial photos



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The End

Thank you for your attention

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