Computer Graphics Group
http://www.cgg.cvut.cz

Web-Based Presentations of Large Urban Scenes

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Content

1. Requirements
2. Models and Structures
3. Data Acquisition
4. Virtual Old Prague project
5. Virtual Heart of Central Europe

What is the Virtual City?

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

Richness of 3D Virtual Cities

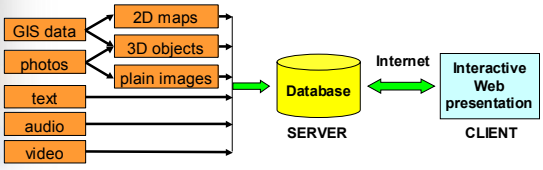
- Additional info (text, images)
- Hyperlinks
- Interactivity (animations)
- Virtual bus tour (animated viewpoint)
- 2D map and 3D model synchronized
- Search function
- Automatic navigation (route planning)

Web-based Virtual Cities

- Distributed application (client-server)
- Huge number of visitors (users)
- Providers' needs (publicity)
- Users' expectations (information source)

Specific features of Virtual Cities

- Large virtual space to be modeled [km]
- High number of real objects [100]
- Extensive use of textures/photos [1000]



Talk progress

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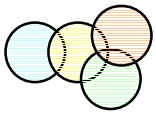
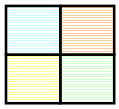
Part 2: Structuring Virtual Cities

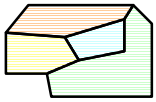
- Panoramic VR



- Regular space partitioning



- General shapes



QuickTime VR

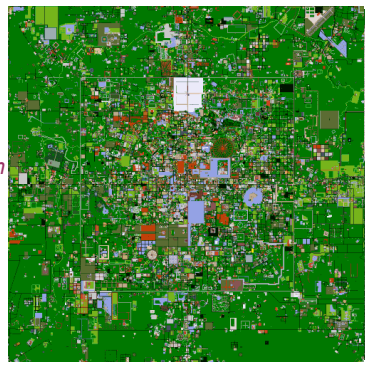
- Panoramic VR, Image based rendering
- Based on QuickTime movie technology
- Sensitive regions (hyperlinks)

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

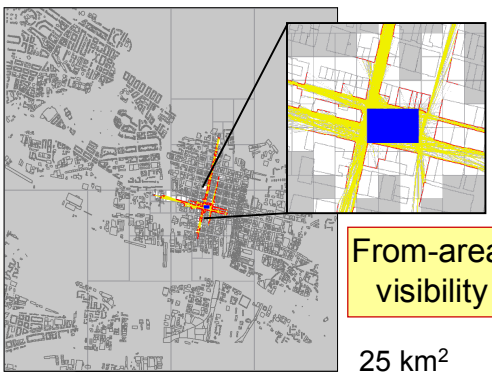
Grid layout - Alpha world

Multi-user cybercity

www.activeworlds.com



Study case: Dublin



From-area visibility

25 km^2

Large Urban Areas

- Cells with a general shape
- Progressive data transfer
- Topology map (planar graph)
- Visibility preprocessing

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Part 3: Data acquisition

How to create a 3D model?

- 3D reconstruction
  (photos, laser)
- 3D modeling
  (3DS Max)
- Combined approaches
  (Canoma, PhotoModeler, Outline)

3D reconstruction (contd.)

+ High precision process
– Not fully automated yet
– Large unorganized meshes produced

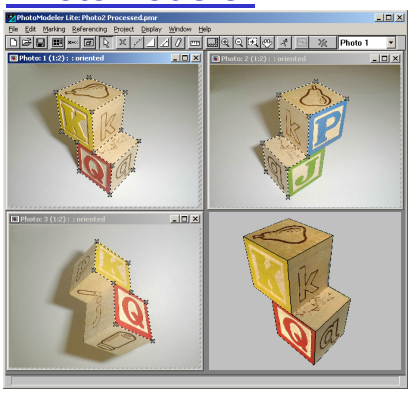
Modeling tools

PhotoModeller
– mapping vertices and faces to photos

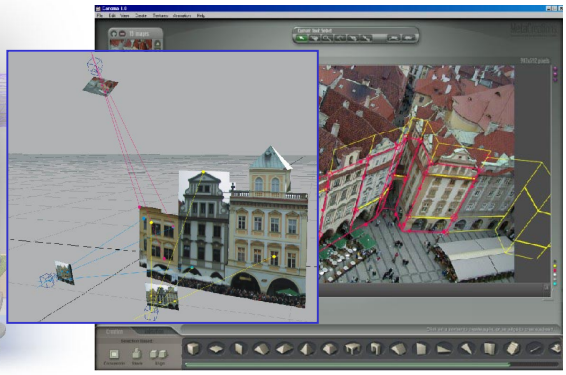
Canoma
– mapping 3D primitives (box, pyramid) to photos

Outline
– mapping 2D objects (window, door, roof) to a single photo of a façade

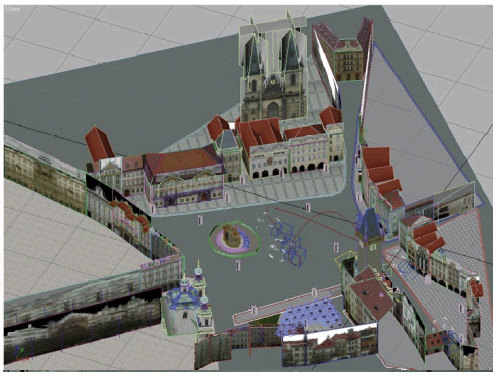
PhotoModeler



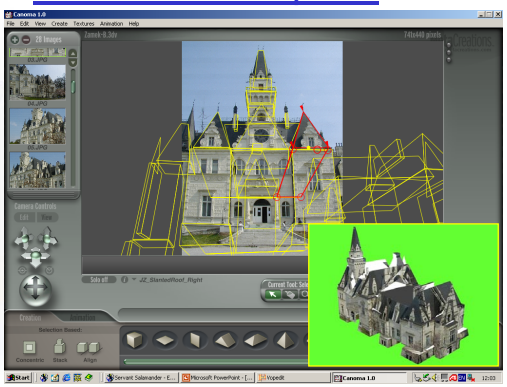
Canoma



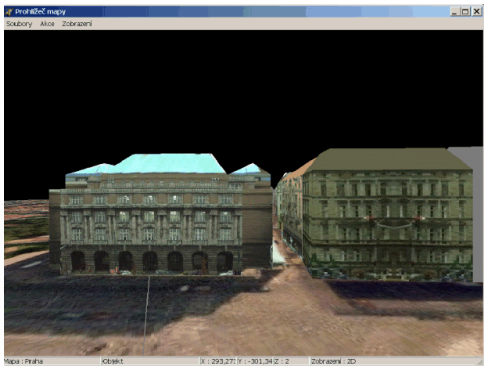
Canoma example 1



Canoma example 2



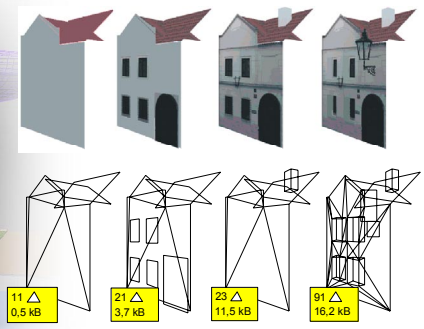
Using aerial photos



"Outline" tool

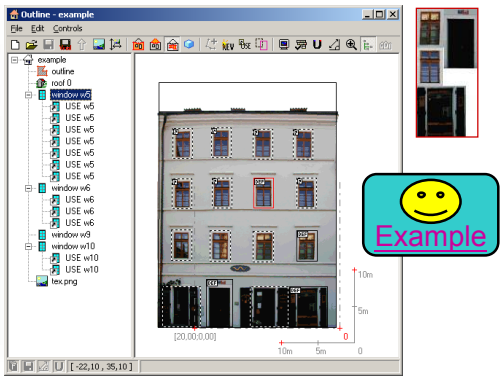
- Developed for the Virtual Old Prague project
- Produces composite texture files
- Generates "Urban LOD" for VRML

Urban LOD



speed of data transfer
X
rendering speed
X
quality of rendering

Outline tool



Texture acquisition

Photographic conditions:

Dark (against the sun)

"The best weather is a bad weather"

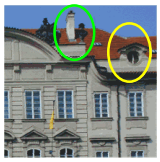
Obstacles

Texture acquisition (contd.)

Perspective distortion

horizontal ⟵ vertical ⟶

Objects appearing on different positions



Texture acquisition (contd.)

Cleaning process

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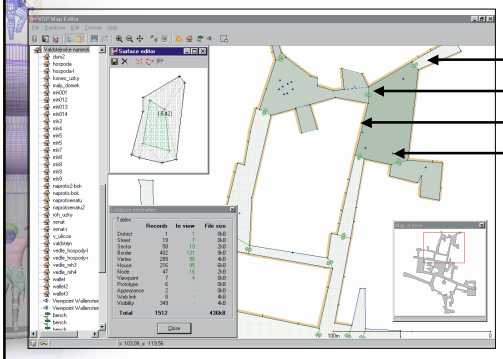
4. Virtual Old Prague

- Based on VRML
- Data loaded/unloaded on the fly
- Visibility preprocessing (PVS)
- Tuned for web presentation (Urban LOD)

Structuring the city

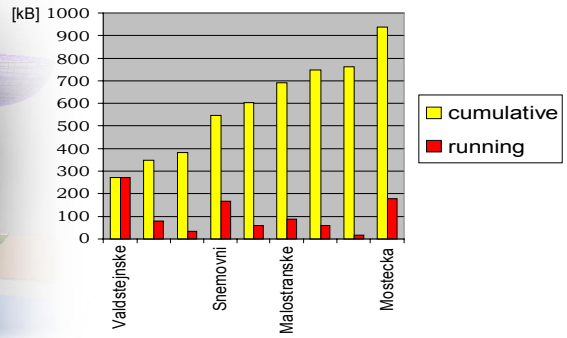


sector
gate
facade
3D object

Granularity

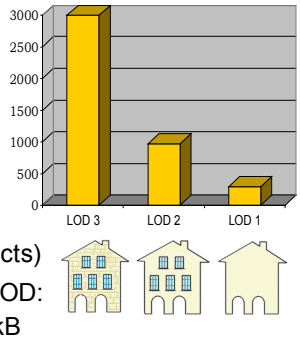
Scaleability

Data transfer



Statistics

- About 270 houses
- 20 streets
- 5 squares
- **80 cells**
- 40 solitaires (3D objects)
- Amount of data per LOD: 3 MB / 970 kB / 300 kB



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5. Virtual Heart of Central Europe

- Culture 2000 programme (EU)
- Web-based visualization of selected historical and cultural objects from **Bratislava**, Graz, Maribor, and Prague
- Integration of various technologies: images, video, QTVR, VRML, sound

Education and Culture
Culture 2000

VHCE project - examples

1. Single objects
2. Object & environment (imposters)

Optimization Advices

- Small textures (resolution, not file size)
- DEF once, USE many (objects, urls)
- Remove normal vectors, set creaseAngle
- Use primitives & low poly meshes
- Limit light sources (max. 8)
- Avoid collision detection

Conclusion

Main issues to be solved?

1. 3D reconstruction
2. Web visualization
3. User interface

} Specialized

– Common

Conclusion contd.

Virtual cities require synchronized effort of experts from various fields:

- Computer vision
- Computer graphics
- Databases, GIS
- Networking
- Architecture
- History
- Gaming
- Education
- Business
- … any other?

Methods — Motivations

Presentations online

www.cgg.cvut.cz/vsp/

www.vhce.info/

Thank you for your attention

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