Web-Based Presentations of Large Urban Scenes

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

Large Urban Areas

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

From-area visibility
25 km²
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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
PhotoModeler
  – 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

Outline tool

Example
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
facade
3D object
Granularity
Scaleability
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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

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

Data transfer

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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

Jiří Žára