Framework for Malaysian 3D SDI in CityGML

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Introduction

• Spatial Data Infrastructure is used to describe metadata relevant to the collection of technologies, technical methods and processes, policies and institutional arrangements that facilitate the access to 3D spatial data.

• The external code lists based on local culture, vegetation and heritage landmarks were proposed and approved by OGC for indexing 3D city objects of Malaysia.

Introduction

• **BIM vs. CityGML**
  – until now there is no complete interoperability and transfer of semantic data and spatial relationships from BIM to the geospatial environment due to following reasons.
  • Weakness of CAD models to store semantic information and spatial relationships.
  • Although BIMs contain geometric and semantic information about the building elements in an object oriented data structure, the geospatial information models handled and treated the data in a different manner than BIMs, and were insufficient in representing all the aspects of the building Information Models.
  • BIM supports more detailed and accurate data than 3D SDI because of the type of application.
Introduction

CityGML is a standardized information model which puts focus not only on the objects' geometry but also on their semantics, topology, and appearance.

- Objects may comprise coexisting geometric representations for different LOD’s.
- Topological relations between objects can be recognized via links between geometries (XLink concept).
- Complexity of the variable in the geometry, semantic and coherent structures (Stadler & Kolbe, 2007).
- Aggregation hierarchies on the part of both geometry and semantics support complex object structures (hierarchical structuring).

Servers and Clients of CityServer3D

- What are the necessary tools for the clients system
  - A web based visualisation system
  - Management of the database for importing and exporting data
The Malaysian 3D SDI aims to provide 3D information to many users within the existing Malaysian Geospatial Data Infrastructure (MyGDI) framework.

MyGDI contains various 2D spatial data and layers.

Malaysian 3D SDI will be used to serve the community with appropriate interface especially applications like navigation, urban planning, police simulation and crime monitoring system, building management, homeland security, ...
How create your CityGML file form SketchUp 3D models

C:\Program Files (x86)\SketchUp\SketchUp 2013\Plugins

Filename:
CityGML_Editor_18.zip
A sustainable 3DSDI

- Standardized Web Services
  - how to make use of the data
  - which formats are available
  - how to update and maintain and etc.
  - web atlas is fed by four different OGC-Web-Services (OWS)
    - WMS for the 2D map presentation
    - WFS for vector data
    - WPS for analysis processing
    - W3DS for the 3D scenes
A sustainable 3DSDI

- Integration of Data Infrastructure Design

Interoperability and 3D conversion process

3D model Interoperability and production pipeline

<table>
<thead>
<tr>
<th>Data collection</th>
<th>3D Interoperability</th>
<th>Texturing</th>
<th>Conversion and semantic database</th>
<th>Query, Analysis and visualization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filtered out LiDAR data</td>
<td>MicroStation</td>
<td>DPF or other texture enhancing techniques</td>
<td>Google Earth</td>
<td>CityServer3D</td>
</tr>
<tr>
<td>Hectometry</td>
<td>SketchUp VRML</td>
<td>SketchUp</td>
<td>CityGML</td>
<td>MySQL DB</td>
</tr>
<tr>
<td>CAD</td>
<td>SketchUp 3DS</td>
<td></td>
<td>FME or CityGML plugins</td>
<td>Web3D-Service Interface</td>
</tr>
<tr>
<td>Stereo photogrammetry</td>
<td>SketchUp 3DMax</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Orthophotos</td>
<td>Collada(.dae)</td>
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<tr>
<td>Terrestrial Photos</td>
<td>ArcGisene</td>
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<td></td>
</tr>
</tbody>
</table>

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Implicit geometry in CityGML

- CityGML supports implicit geometries, prototypic objects, scene graph concepts such as vegetation model, city furniture and generic objects. Implicit geometry is a kind of prototypical geometry which can be generated once and reused unlimited number of times based on 7 well known parameters (3 for rotation, 3 for translation and 1 scale factor). The implicit geometry can be an external file in different formats such as VRML, DXF or 3D Studio MAX on a local or remote machine and loaded to CityGML scene via URL. Alternatively, it can be defined by a GML3 geometry object (Gröger et al., 2008). This concept can be utilized to represent uniform shapes such as coconut or palm trees, street furniture and so etc. It can solve the lagging and rendering problems while visualization.

Code lists and External Code lists

- To represent the object attributes of the city, having an enumerative range of values is needed.
  - CityGML_ExternalCodeLists.xml
    - BuildingClassType
    - BuildingFunctionType
    - BuildingUsageType
    - RoofTypeType
    - BuildingInstallationClassType
    - BuildingInstallationFunctionType
    - BuildingInstallationUsageType
    - IntBuildingInstallationClassType
    - IntBuildingInstallationFunctionType
    - IntBuildingInstallationUsageType
    - BuildingFurnitureClassType
    - BuildingFurnitureFunctionType
    - BuildingFurnitureUsageType
    - RoomClassType
    - RoomFunctionType
    - RoomUsageType
Proposed external code lists for Putrajaya area

<table>
<thead>
<tr>
<th>Code list for Roof Type</th>
<th>1000</th>
<th>1070</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat roof</td>
<td>1010</td>
<td>monopitch roof</td>
</tr>
<tr>
<td>monopitch roof</td>
<td>1020</td>
<td>skip pent roof</td>
</tr>
<tr>
<td>skip pent roof</td>
<td>1030</td>
<td>gabled roof</td>
</tr>
<tr>
<td>gabled roof</td>
<td>1040</td>
<td>hipped roof</td>
</tr>
<tr>
<td>hipped roof</td>
<td>1050</td>
<td>half-hipped roof</td>
</tr>
<tr>
<td>half-hipped roof</td>
<td>1060</td>
<td>mansard roof</td>
</tr>
<tr>
<td>mansard roof</td>
<td>1131</td>
<td>hip and gabled roof</td>
</tr>
<tr>
<td>hip and gabled roof</td>
<td>1141</td>
<td>dome roof</td>
</tr>
<tr>
<td>dome roof</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Conclusions & Remarks

- The code lists can also be used for the objects on the façade in different layers such as windows, doors and backgrounds to enhance the usage of 3D SDI for a variety of privileges from end-users to professionals in the near future.
- DPF can be used in the near future to generate the CityGML file automatically for whole facades of the 3D virtual model along with semantic information of the components on the façade and their external code lists.
Acknowledgement

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Thank you for your attention!

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