Web Visualization of 3D Strata Objects based on CityJSON and LADM

*Faraliyana Hanafi, Imzan Hassan, Alias Abdul Rahman, Hanis Rashidan
3D GIS Research Lab, UTM (Malaysia)
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Introduction

• Population growth in Malaysia, significant stratified subsurface - densely populated areas, pose a challenge to the current land administration system and the urge to constantly improve.

• This work attempts to expand the depiction of those strata objects in 3D by implementing CityJSON based encoding.

• Focus - visualization of the 3D strata parcels above ground, CityJSON data format for 3D spatial data modelling, and to link the 3D Strata Viewer with the database (legal information) of the 3D parcel using a web-based platform.

• Describes the implementation of the conceptual model of strata objects based on the Malaysian LADM Country Profile for the representation of spatial and non-spatial strata data.
What is strata?

The term ‘Strata’ was first introduced legally in 1985, as a result of urbanization in major Malaysian cities.

Implementation of Strata Management Act 2013 (SMA 2013), provides clearer provisions for the management of stratified property including residential, commercial, and mixed-use development.
Malaysian LADM Country Profile

- **Land Administration Domain Model (LADM)** is a standard established by the International Organization for Standardization (ISO) to cover related components and information of land administration that include surface above water, land, and elements above and below the Earth’s surface.

- One strata object type remains to be represented in 2D, MY_LandParcel (with building no more than 4 storeys).

- The other strata objects are all proposed to be in 3D.
• The non-spatial component consist of object classes used to represent the legal part in LADM.

• It consists of the Party and Administrative packages.
CityJSON – Why?

- Provide support for almost all the features of CityGML, while maintaining a simple file structure, allowing developers to easily manipulate CityJSON files.
- One of the main reasons for CityGML’s poor interoperability is the complex and verbose nature of its main encoding, which is based on GML.
- CityJSON is more compact than CityGML, lightweight dataset.

JSON-based exchange format for the CityGML data model

Open data format – to store digital 3D models of physical objects and is standardized by OGC

Defines different LODs for 3D objects – allows representing 3D city objects for different applications and purposes
The Experiment

- Architecture Design
- Data model
  - LADM
  - Strata ADE
- Data conversion
- Visualization
Web Architecture Design

3D model (Melana Apartment)

Administrative Information (Existing data)

LADM Country Profile (Malaysia)

Data Conversion

.ipk

.kmz (Geometry Filter)

CityJSON

Database Server

Internet

HTTP Request

HTTP Response

User/Client (Visualization)

HTML Bootstrap JavaScript

CityJSON Viewer

PostgreSQL

.innovative ● entrepreneurial ● global
Conceptual data model (Strata Objects)

- **Spatial component**
  - The strata objects are all proposed to be in 3D (blue classes).
  - Inherit from an abstract class (MY_Shared3DInfo) with strata specializations (and mutual aggregation relationship) called as MY_BuildingUnit, MY_ParcelUnit, MY_AccessoryUnit, MY_CommonPropertyUnit, and MY_LimitedCommonPropertyUnit.
- **Non-spatial component**

  - consists of object classes that are used to represent the legal aspect of LADM.
  - It consists of the Party (green classes) and Administrative packages (yellow classes).
Strata ADE

CityJSON also support extensions the core data model of CityGML for specific applications and use-cases called ADE’s

- The Strata extension is developed to support 3D spatial data modelling, that links with the database (legal information) of the 3D parcel based on LADM Country Profile.

- New attributes added to the Building object based on CityJSON classes.
- The Building object class will have additional attributes (legal information) inherited from the tables MY_AdministrativeSource and MY_Shared3DInfo.
- These tables contain legal data related to the administrative (surveyor, party, submission, etc.) and spatial 3D info (area, dimension, floor no, ownership, volume, etc.)
Data conversion

- FME provides built-in support to simply read and write data in order to convert it from one format to another.

- Placemark is chosen as the selected feature type as it carries geometry details.

- The administrative information was retrieved from the database by establishing the connection with PostgreSQL.

- Several transformers were used such as the Geometry filter, Feature Joiner, Attribute Creator, and Feature Merger.
Visualization

• Visualization is done on Ninja for viewing in CityJSON file format on the web application.

Why Ninja?

• Support MultiSurfaces
• Good for semantic aspect (City model)
• Capacity to display specific information or properties of the objects
• User's ability to access and alter raw CityJSON information.
Thank you