

A 3D GIS TO DESIGN TOUR FOR TOURISTS IN WEST LAKE AND SURROUNDING AREA, HANOI CAPITAL, VIETNAM

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KEYWORD: 3D GIS, visualization, geometric modeling, spatial database, standardization.

Abstract: Increasingly, GIS technologies now are focusing to real 3D visualization to meet the needs of diverse user groups. 3D maps have also become common in many products in developed countries. This wave is expanding over the world.

The type of these map products is very diverse and rich, from the map printed on paper to electronic 3D maps or maps in the internet. The products in the form of 3D map derived from database can serve many fields such as science, economics, and culture - society. Model of 3D map of West Lake area has been built on Skyline software package with two modules as Terra Explorer and Terra Builder through three main stages:

- + Data collection process to create 3D vector model;
- + Complete 3D models from the geometric model for the objects what is shown in detail;
- + Show all contents in 3D map based on 3D GIS.

The virtual tours on the 3D terrain map are made for tourists so they can image the landscape and can keep strong impression in memory about tourist area forever. Besides, 3D map can also provide information on infrastructure, hotels, entertainments and other outdoor activities etc based on searching functions in GIS environment.

1. INTRODUCTION

3D-GIS is receiving increasing interest. The possible contribution of photogrammetry to 3D-GIS is demonstrated. In this paper, our interest is not on spatial modeling of sub-surface phenomena or on monitoring global environmental change, but exclusively on topographic objects in designing for tourists. These are objects with discernible boundaries such as church, buildings, streets, and the ground surface. They are traditionally subject to surface mapping but now turning out to be 3D objects. Designing, manipulating and graphically presenting 3D objects can conveniently be done by commercially available 3D GIS systems. They do offer photo realistic views, animation, and interactive virtual reality.

GIS product is not only used in one task but it will be shared and used for multipurpose so the spatial data quality is now interested in widely. Bernard Kumi-Boateng et. al. (2010) mentioned the sources according to historical order of appearance as Aronoff (1989), USA-SDTS (1992), Gupta and Morrison (1995) published the book entitled "Elements of Spatial Quality", ISO/TC211 (Kresse and Fadaie 2004), Technical committee 211 of the International Standardization organization (ISO/TC211) developed a number of international standards for geographic information.

3D map is new development of cartography especially since the information technology bloom in many industries, that the main thing has accelerated the development of 3D maps. Products 3D map in cartography make stronger impression to the map reader. A number of proposed applications such as establishment of atlas with 3D maps in Switzerland to teach geography for children (Clemens Oberholzer, Lorenz Hurni, 2000), 3D maps for navigation service to facilitate rapid understanding and more accurate navigation in reaching to ports and at the sea, reduce accidents, reduce stress and nerve, support better decisions for sailors at sea as well as the authorities who have been in charge of monitoring sea traffic (Goralski R. et. al., 2011).

The 3D maps can be created with different level of detail, accuracy as well as generalization issue so that map need to have some guiding principles in order to provide the mapping basis from which own maps could be developed. The 3D mapping has brought the contributions to the design and creative arts. Without instructions, maps can become confusing and the reader can not catch up the main idea of the map when gathering geographic information. The guidelines need to look forward to helping build successful 3D maps in professional way and this is the reason for the need to study more theoretical issues to satisfy the user requirements of this map.

3D-GIS promise better accessible inventories, extended spatial analysis, refined simulations, and more appealing visualization than either 2D-GIS. A first trial for an inventory of design variables relevant for map concepts and production has been assembled in Haeberling (2004). The list is structured along the design process of 3D maps with the steps of modeling, symbolization and visualization. It is structured in 13 design aspects relevant for the 3D map image and its content in the table 1. At the same time, a 3D map is always affected by two basic aspects of design, the degree of abstraction and dimension that is the proportions of map objects.

Table 1: Design aspects of modeling, symbolization and visualization

1	<i>Modeling</i>	Modeling of digital terrain model objects Modeling of (topographic) map objects Modeling of orientating map objects
2	<i>Symbolization</i>	Graphic appearance Special graphic aspects Textures Text objects Object animation
3	<i>Visualization</i>	Perspective (projection) Camera (viewing) Lighting Shading and shadow Atmospheric effects and natural phenomenon

Techniques for visualization is changing from 2D to 3D, from static to dynamic, from isolating to integrating, from only one way in a single cartographic representation for only a certain aspect of data and their attributes to all data structure that could be shown (Clemens Oberholzer et. al., 2000).



Figure 1. LoD of 3D models

2. MATERIALS AND METHODS

Materials

- Orthor image at scale 1:10 000 in VN2000 foundation published in 2011.
- Image and DEM at scale 1: 25 000 and 1: 2 000.
- Field survey data.
- Existing 3D Models.
- Existing map and 2D GIS.

Methods

Tourism is an inevitable product of socio - economic development of human society in a certain historical period. The essence of tourism is an active high-consumption society, it arises in the development of social productive reaching up to high level. When human life have both materially and spiritually completed, demand for traveling would be arising more frequently so that the tourist routes, tourist programs will be designed and completed more than to meet the increasing demand of tourists. In this article we use the theoretical basis for designing tourist routes, tourist programs (also called a "tour").

CityGML is an open-data model based on XML for storing and exchanging 3D virtual city model data developed by Professor Thomas Kolbe and his team at the University of Berlin, Germany. Standardized software have been established and used in 3D City model construction projects of Berlin.

In 2008, CityGML has been evaluated and selected as international standards for 3D City model by the OGC and ISO TC 211. CityGML indicated 5 levels of detail for 3D City model (figure 1).

CityGML defined information groups and relationships between them for almost object appearing in the city and their faces such as dimension and geometric location, topology, sematic and visualization. CityGML also set up the object's hierarchy.

Therefore, CityGML become very popular in representing 3D object in the city. CityGML is operating as open data based on XML that offer the ability to store and to share between virtual 3D model of city. Those models are implemented as application scheme for Geography Markup Language 3 (GML3). First of all, CityGML is designed in order to become open standard that could be used for free.

General flowchart for 3D mapping (figure 2)

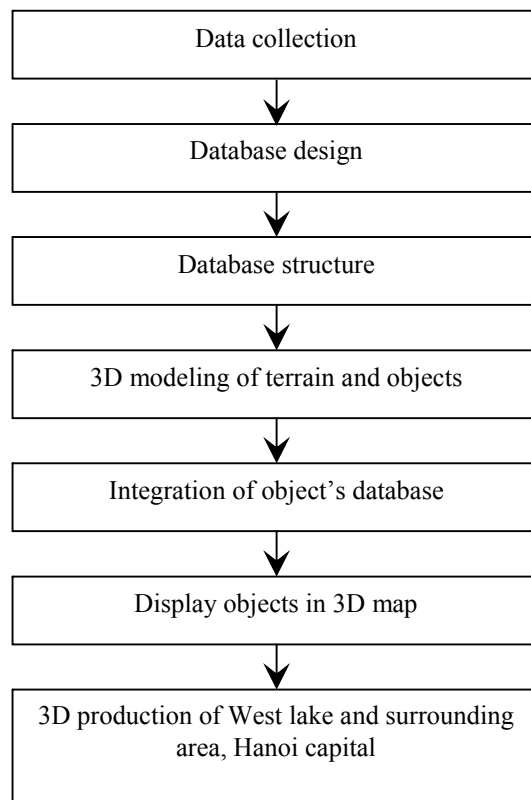


Figure 2: General flowchart

Level of detail of 3D map: Process of building 3D terrain mapping could be separated into 2 main steps following:

Step 1: Geometric modeling including building DEM and modeling 3D for terrain.

Level of detail (LoD) concept is applied in order to keep degree of geometric detail, such as DEM accuracy, object's selection and object's generalization.

Step 2: Visualistion modeling objects.

Level of detail (LoD) concept is applied in order to decide degree of similarity for objects modeled when comparing to the real world in this step.

The balance should be cared when applying LoD for DEM creating process, for geometric detail of 3D model object or for visualization steps (figure 3).

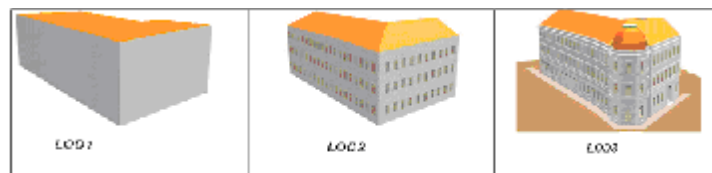


Figure 3: LoD for building block

Symbol set in 3D mapping consisting of 5 types as follows:

- A. 3D object's model (3D model*.xpc,* .xpl);
- B. Icons (Icon.gif);
- C. Textured image (Textured Image.gif);

- D. Signs or symbols (Map_Signs.gif);
- E. Text (Text Label).

The text below is explained more detail:

A. 3D object's model

The object model is designed to represent for the shaped objects having very similar architecture, characterized from region to region in Vietnam such as churches, temples, houses, shrines etc and applied to all objects of the same type (figure 4a).

Shaped objects having popular structure to worldwide such as electric poles, traffic lights, masts etc will use the model that is available in the library of Skyline and model is searched on the Internet. Set of 3D symbol have been collected and packed in the directory named geophysical model (figure 4b).

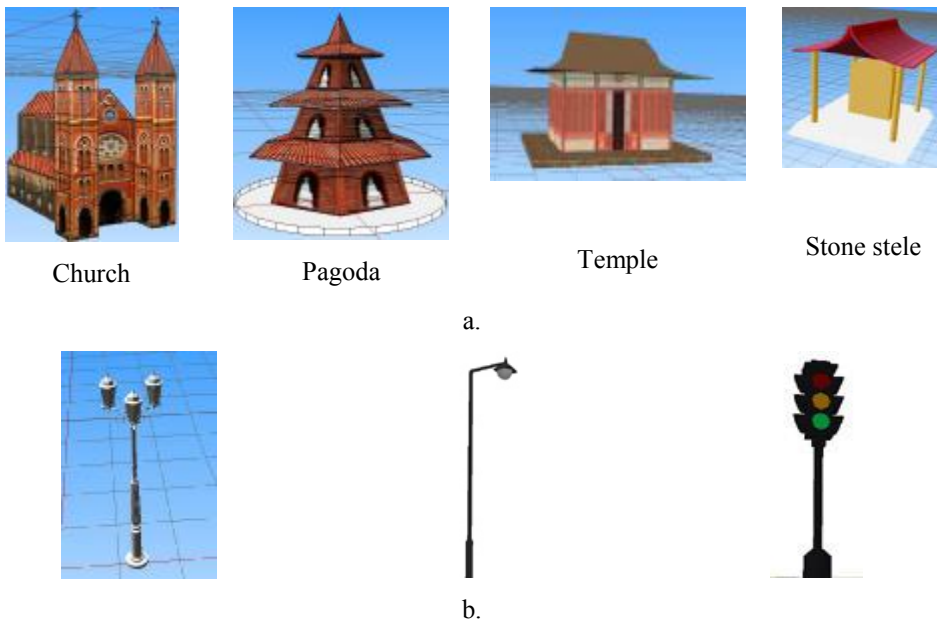


Figure 4. a. Object's model designed; b. Object's model in library

B. Icon

Icons are used to support 3D map's reader so map's symbols should be familiar to map's users. The terrain symbol at scale of 1/2000 -1/5000 is converted into icons.

C. Texture image

Photographing some type of object having some structure characteristics such as building fences, fortifications, walls, pavement, side yard etc then sorted and packed into the folder of structure pictures in the 3D symbol library.

D. Map's signs or map's symbols

The annotation is mainly used for land cover which is mainly plant objects. The trees photographed representing land cover are fruit trees, shrubs, short-term industrial trees, coconut palm trees, other food crops, ornamental flowers, mixed trees, conifers, wide leaf trees, rice, acidic halophilic plants, bamboo trees, vegetables, long-term industrial crops (figure 5).



Figure 5: Symbols for land cover's objects

E. Text: Geographic name including name of administration units, name of streets, name of restaurants, name of hotels, name of geographic objects etc.

Processing flowchart in Terra Builder (figure 6)

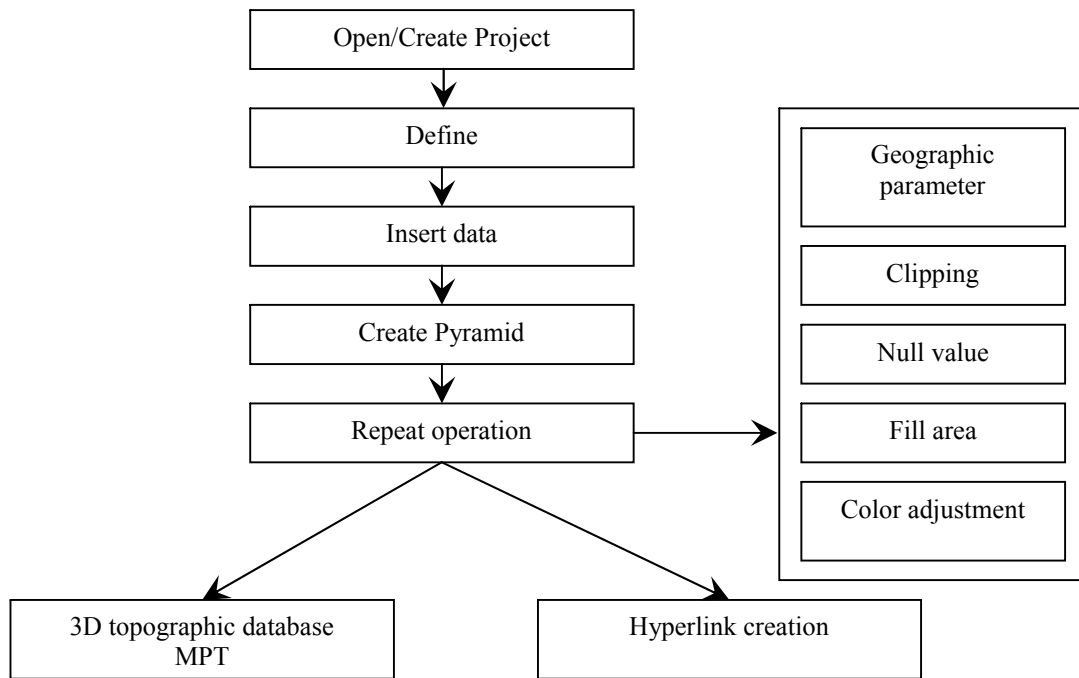


Figure 6: Processing flowchart in Terra Builder

- Step 1: Create Project in Tap home bar
- Step 2: Name the folder and configuration
- Step 3: Insert background data (Image + DEM) (Figure 7)
- Southeast Asia data: Image + DEM

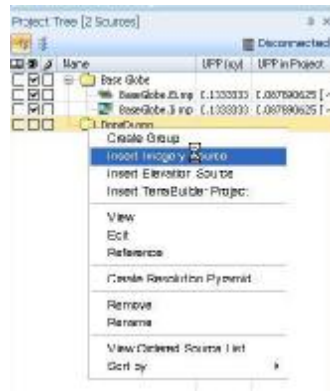


Figure 7: Step 3 illustration

Step 4: Make Pyramid resolution for image and DEM of Southeast Asia

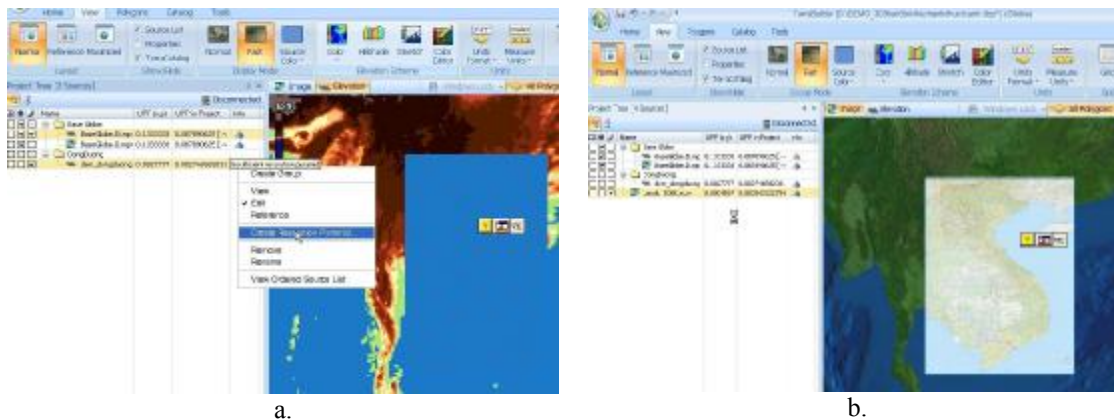


Figure 8: Step 4 illustration. a) Make Pyramid resolution for image and b) DEM of Southeast Asia.

+ The result after creating image with Pymaid resolution in Terra Builder

Step 5: Repeat previous steps with image and DEM in scale of 1: 25 000 and 1: 2 000

Step 6: Create *.mpt data for data block designed previously:

In order to open DEM data directly and image background in Terra Explorer, *.mpt data format is needed. Terra Builder software is used to create *.mpt file.

Step 7: Export to *.fly format

Results have been completed as database for 3D topographic map consisting of DEM, image stacked and exported to *.fly format for compyling in Terra Explorer further.

3. RESULTS AND DISCUSSION

West Lake over the years been known as a landscape, a worth place for traveling with many aspects of history and culture and attractions people from near and far to find out and discover.

In the journey of about 18km length, tourists visit and find out more than 20 monuments, landscapes that is typical of Hanoi such as the Tao Sach temple, Van Nien pagoda, Chich Sai, Vong Thi Pagoda, Ly Tu Trong flower garden, Quan Thanh temple, Cau Nhi temple, Tran Quoc Pagoda, Yen Phu pagoda, Kim Lien pagoda, Yellow Taurus temple, Hoang An temple, West Lake water Park with the following stops and locations:

Location 1: West Lake water Park

Location 11: The gate of Thang Loi hotel

Location 21: Temple of Span (village of Ho Khau, Buoï Ward, Tay Ho, Hanoi).

Location 2: Lotus pond of diplomatic corps

Sopt 12: Yen Phu Temple

Location 22: Pagoda of Round

Location 3: Quang An flower-garden

Location 13: Flower-garden at Tran Quoc Pagoda

Stop 23: Trich Sai Temple

Location 4: Temple of Quang Ba in Quang Ba Village, Quang An Ward

Stop 14: Cau Nhi Temple - Temple of Children's Bridge

Stop 24: Thien Nien Pagoda

Location 5: An Hoang Pagoda (Quang An Ward, Tay Ho district).

Stop 15: West Lake shrimp cake restaurant - Located in the famous tourist Hanoi: Co Ngu Street, Tran Quoc Pagoda, West Lake, Truc Bach Lake ... space with fresh, airy, West Lake shrimp cake restaurant is the ideal place for you to meet a warm gathering.

Location 25: Flower-garden at alley 322/7 Lac Long Quan

Location 6: Phu Tay Ho Tay Ho and Taurus village temple (Quang An Ward, Tay Ho District, Hanoi)

Sopt 16: Quan Thanh Temple

Stop 26: Van Nien Pagoda (Ten Thousand Year Pagoda)

Location 7: Xuan Dieu flower-garden

Location 17: Ly Tu Trong flower-garden

Stop 27: Tao Sach Pagoda (Nhat Tan commune)

Location 8: The gate of Sheraton hotel

Location 18: Turn to alley 128 – Thuy Khue

Location 28: Lac Long Quan flower-garden

Location 9: The gate of Intercontinental hotel

Location 19: Turn to Van Cao street

Location 29: Flower-garden behind water park

Stop 10: Kim Lien Pagoda

Location 20: Flower-garden beside Ho Village



Figure 9: Overview West lake landscape from sky (remote sensing imagery on top)



Figure 10: 3D cartography in West lake and surrounding area along Thanh Nien street



Figure 11: 3D model of Sofitel hotel beside West lake

4. CONCLUSION AND RECOMENDATION

The paper has launched the process of building 3D maps at large scale from the combination of remote sensing and 3D – GIS. The result has demonstrated that impression from 3D GIS for tourism is very great and should be expressed widely to use as reference, analysis, and display etc. This is a new research on 3D GIS to accelerate the application of technology in 3D mapping, to contribute both theory and practice in the cartographic field.

A display of 3D GIS means that the relationship between 3D objects in GIS have been defined and described. Thus, the only problem remaining is how to convert them from 2D into 3D to describe so many diverse objects as well as spatial relationships between them. However, the challenges face in the data transfer process when modeling 3D objects. Moreover, a very basic problem would be occurred typically when identifying an object at different angles, as have been seen from above, horizontal, looking through another 3D object.

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