APPLICATION OF HIGH RESOLUTION SATELLITE IMAGERY ON X3D-BASED SEMANTIC WEB USING SMART GRAPHICS

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ABSTRACT: High resolution satellite imagery is regarded as one of the important data sets to engineering application, as well as conventional scientific application. However, despite this general view, there are a few target applications using this information. In this study, the possibility for the future wide uses in associated with smart graphics of this information is investigated. The concept of smart graphics can be termed intelligent graphics with XML-based structure and knowledge related to semantic web, which is a useful component for the data dissemination framework model in a multi-layered web-based application. In the first step in this study, high resolution imagery is transformed to GML (Geographic Markup Language)-based structure with attribute schema and geo-references. In the second, this information is linked with GIS data sets, and this fused data set is represented in the X3D (eXtensible 3D), ISO-based web 3D graphic standard, with styling attributes, in the next stop. The main advantages of this approach using GML and X3D are the flourished representations of a source data according to user/clients' needs and structured 3D visualization linked with other XML-based application. As for the demonstration of this scheme, 3D urban modelling case with actual data sets is presented.

1. INTRODUCTION

High resolution satellite imagery can provide more geography information for us than low resolution satellite imagery. We can get more information, which is road, building, terrain, etc, in IKONOS and Quickbird imagery more than one meter's resolution. However there are a few target applications using this information. In present, high resolution satellite imagery map services are operated on some website. But almost there are some limitations that they have two dimensional coordinate and not structured standard format. Therefore In this study, the possibility for the future wide uses in associated with smart graphics of this information is investigated by using GML of Open Geosptial Consortium, Inc. (OGC-GML) and X3D of Web3D Consortium, Inc.

2. GEOGRAPHY MARKUP LANGUAGE

As many various geography information data were built, users are interested in standard format that can share them. For response, OGC, published GML, as an international eXtensible markup Language (XML) standard for geo-spatial information. XML published by World Wide Web Consortium (W3C) is international standard data format and it is encoding data to tree layer structure. It is also an independent devices and environment because of simple data format based text. So, it make wide use of exchanging data format in web environment and else where. GML is derived from XML can be exchange data format of geography information

Table 1. GML Schema [8]

• Base schemas, general syntax, feature model, metadata mechanisms	• Topology
• Basic geometry (0d, 1d, 2d)	• Temporal information and dynamic features
• Additional geometric primitives (0d, 1d, 2d, 3d)	• Definitions and dictionaries
• Geometric composites	• Units, measures and values
• Geometric aggregates	• Directions
• Coordinate reference systems	• Observations
• Default styling	• Coverages

GML is composed of two kinds of document. One is schema document of defining structure, The other is schema's instance document.

In present, GML was published version 3.0. It supports encoding spatial and non-spatial properties. It was defined 26 schemas for supporting coordinate reference system, 3 Dimension, Unit of Measure, Coverage and Topology, etc, such as Table 1. The core concept of GML is Feature, Geometry and xLinks. Feature is physical objects and abstract objects in the world. It is described by properties (name, type, value). FeatureCollection is one of feature's types for complex type of it. Geometry is used for describing geometry properties of feature. It supports both 2D and 3D geometry component, such as Point, Polyline, Polygon, MultiPoint, MulitPolyline, solid and etc. xLinks is used for object's reference relationship.

GML users create application schema that suit their application domain, which is Land Use, Traffic, Telecom and etc, using GML core schema such as Fig 1.

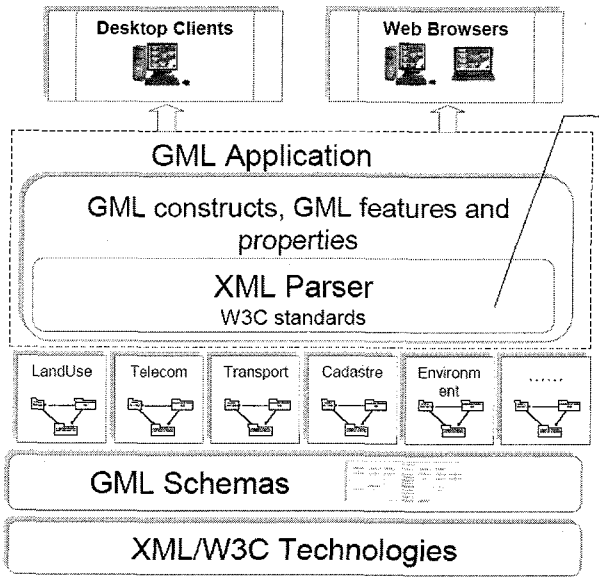

Figure 1. GML Application Schemas [8]

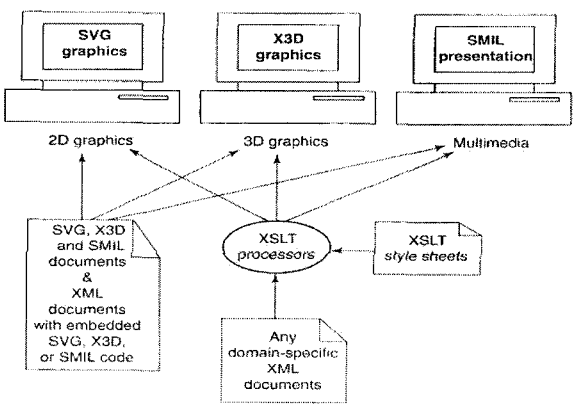

Figure 2. Smart graphic concept in Web environments [3].

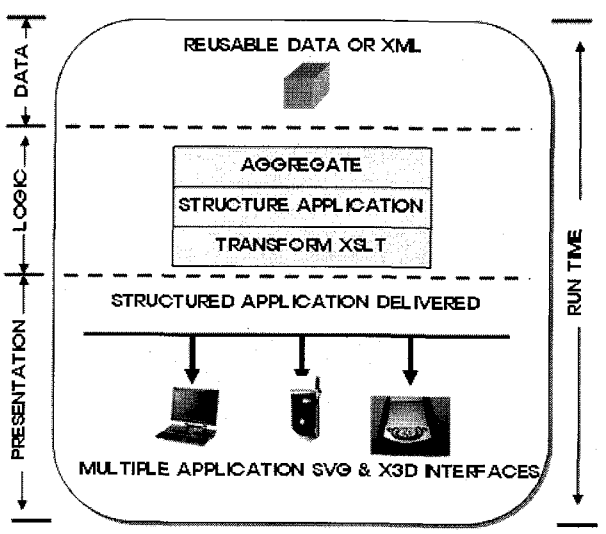

Figure 3. End To End XML System [3]

GML supports Coverage. In general, it is used that is encoding for satellite imagery, aerial photo, and distribution of land, climate, elevation. In this study, Grid Coverage used for high resolution satellite imagery [1][2].

3. EXTENSIBLE 3D

Geography information is important to graphic visualization because of representing information all around world. But GML is impossible for itself to visualize because of text format. The visualization of GML needs for linking another graphic format.

X3D is extension version of the earlier Virtual Reality Modeling Language 97 (VRML 97), as 3D web graphic format, and support encoding of XML. It import concept of profile that is built from components. This concept improves a weak point of a huge specification of VRML97, and also decreases responsibility of development. There are some good point using X3D. First, because X3D is represented by the XML, It is easily developed. Second, It can be interactive programming connection to Java, C, C++, Javascript and etc. Last, it is open and royalty free standard.

An efficient application based web services is separation of data, logic and presentation. Applications depends on data are modified whole architecture as data structure is changed. It may cause several problems to duplicate data and increase cost for maintaining application. XML system separates data, logic and presentation by transformation in logic layer [3]. Smart web graphic can be summarized in Fig. 2 and 3.

4. APPROCH & IMPLEMENTATION

We tried to examine and search for the efficient architecture for 3D geo-service system with some methodologies and standard scheme mentioned above.

At the first step for this work, we attempted design and modeling process shown at the Fig. 4. This is an example of GML application scheme, represented in UML diagram. This model is a framework model for urban city modeling: road, building, city facilities and terrain components. This can be derived from GML feature type, and city model, as compound type, can be derived from FeatureCollection. In this modeling and implementation, 3D urban features are focused on.

At the second step, we constructed GML instance based on the previous schema. To encode satellite images into GML, Gridcoverage should be used, according to OGC specification. Gridcoverage can be stored and processed in the ASCII and Binary [1], but binary encoding is needed for large sized images.

Table 2. Development Environment

Operation System	Windows XP
Tools	Visual C++ 6.0 MFC MSXML 4.0 SDK
Parser	MSXML 4.0
X3D Viewer	Octaga Viewer

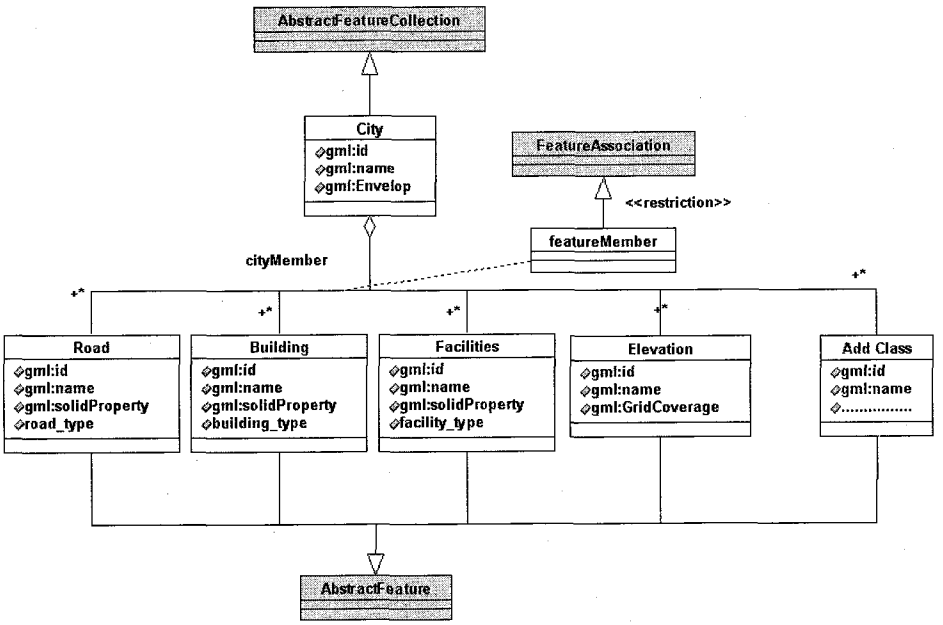

Figure 4. An example of urban modeling in UML diagram.

At the third, using DOM API, we tried to implement to transform GML instance into X3D to visualize on web browsing environment. DOM represents Document Object Model, and this is a XML-based technology. The basic principle of transformation is to extract image range or size and pixel information for web visualization from GML instance. After this, X3D document is generated by using DOM API. Fig. 5 shows a summary of this mechanism. Table 2 is the development environment of this implementation, and Fig. 6 represents graphical user interface, as this implementation result.

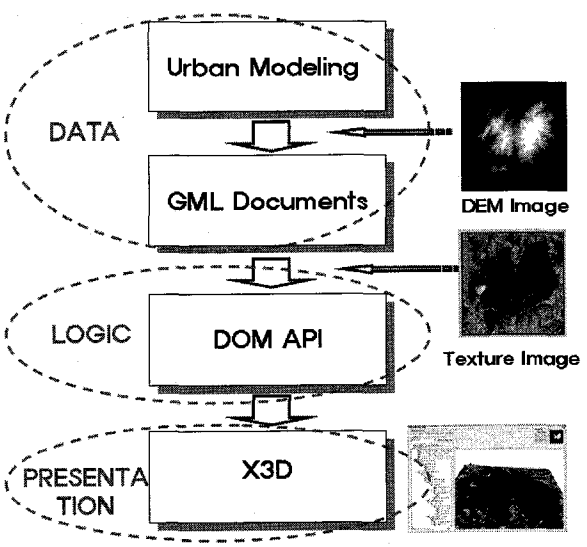

Figure 5. Schematic view of the Process flow of this Study

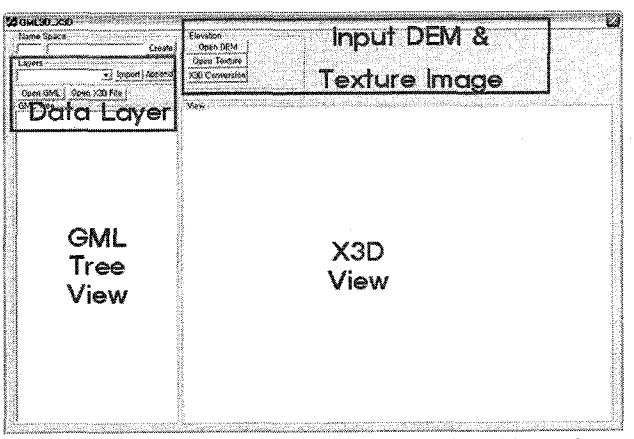

Figure 6. Application GUI, implemented in this study.

Figures 7 and 8 are the results of wireframe model and texture mapped terrain model using X3D-based GRID Elevation of DEM and high resolution satellite imagery, respectively. GML tree can be revealed in the left frame in this scene.

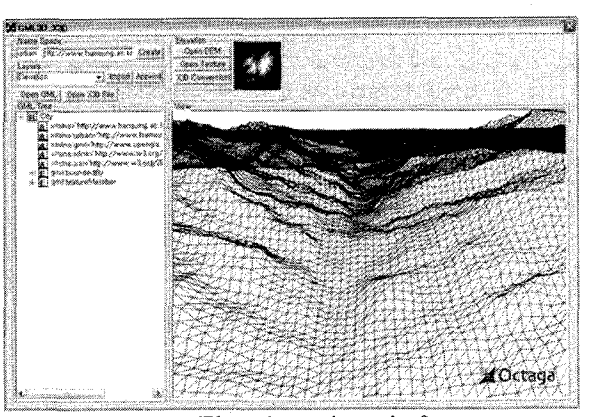

Figure 7. Elevation using wireframe

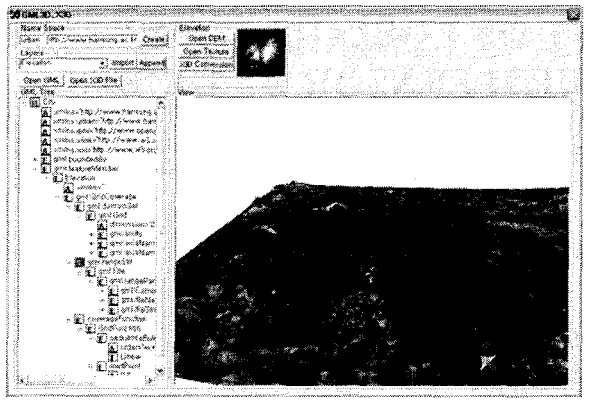

Figure 8. Elevation using texture mapping

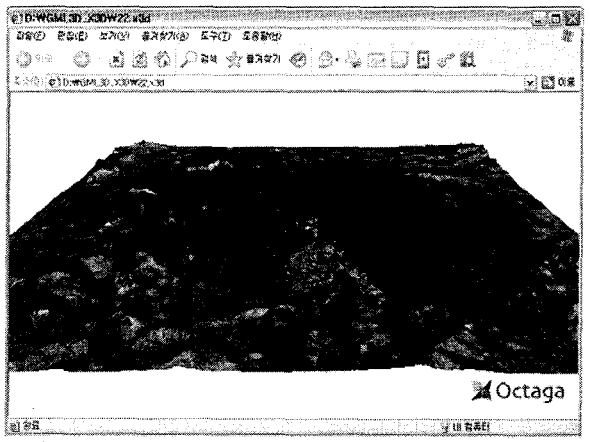

Figure 9. X3D scene plug-in on Internet Explorer

Fig. 9 is an actual X3D scene generation and publishing case in the form of plugged-in on Internet Explorer.

5. CONCLUSION

We implemented and examined an efficient 3D web services using satellite imagery using GML in the OGC-standard specification and X3D in the standard Web 3D specification. In this study, terrain component, one of the main elements for 3D urban model was dealt with and presented. Web 3D graphics is an essential component of smart graphics which could be structured and semantic graphics. Furthermore, the main advantages of this approach are cost effective and data sharing aspect.

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