GML Based Tourism Information System for Location Based Service

Yeong-Jee Chung, Chang-Won Jeong, *Member, KIMICS*

Abstract – At present, GML becomes the global standard for the XML encoding of geographic information and is the foundation for the Geo-Web. GML is being applied to a wide range of geographic applications including GIS and location-based services, telematics and intelligent transportation systems. In this paper, we propose the tourism information system for supporting the location based service application. We made an effort to design and implement a GIS computing environment by thin client for mobile web mapping service. We are interested in the GML applications that include traditional GIS system for navigation service and location finder for points of interest (POI) services. This paper summarizes the Tourism information system for location based service of a small area (Han-Ok Village with the Korean traditional houses in Jeonju-city), in which moving travelers can obtain proper information services at the current location associated with traditional monuments, cultural products, food, and conveniences. In the paper, we report on the design of the thin client/ server system for a mobile environment. This paper is divided into three parts. First, we give a general overview of the organization of the system and of the important concerns of our design. Second we focus on our system supports for location and POI determination, and design concerns. Finally, we show the graphic user interface of PDA, the procedures involved in the service, and the executed results.

Index Terms – GML, Mobile tourism service, GIS, SVG

I. INTRODUCTION AND RELATED WORKS

In recent years, the World Wide Web has become a popular vehicle for information distribution and web based geographic information systems (GIS) are rapidly evolving and adapting to these new environments[1].

Wireless networks will enable new forms of mobile services. Location Based Service (LBS) are such services for mobile users to take the current position of the user into account when performing their task.[2,3] For LBS, map information, GIS service and infrastructures are crucial helper services. LBS application for tourism ranges from tour planning and navigation support to yellow page services and m-commerce[4]. To make interactive maps for internet applications in tourism has become widespreaded.

But, the existing GIS services have been separately developed and have not supported with the interoperability due to various file format of maps.

For this reason, GML is a new way to deal with geographic data and information in Web. It is an XML encoding for the transport and the storage of geographic information, including both the spatial and non-spatial properties of geographic feature [5, 6, 7].

GML is important to draw some clear distinctions between geographic data and graphic interpretations of the data as it might appear on a map or other form of visualization. It is concerned with a representation of the real world in spatial terms that is independent of any particular visualization of the data. GML will do the same in the real world of geography and mapping.

To make a map with GML data, one must style the GML geographical content into a suitable graphical presentation. In the majority of cases the GML data are styled into an XML graphical format using SVG (Scalable Vector Graphics), VML(Vector Markup Language), X3D technologies.

During the last years some prototype systems for distributing vector data on the Internet have been developed. Many of these systems are based on the two XML-standards, GML and SVG. These two standards are complementary : GML is used for string and distributing geographic data and SVG is used for presenting data[8, 9].

When a request for a map is performed to the database, a GML file is to be created. The GML file is then translated into an SVG file. In this step it is also possible to perform some generalization transformations. Our information system described in this paper also follows this workflow.

With the wide applications of personal communication and portable devices, such as cell phones, GPS devices, PDAs, and Palm tops, geo-referenced information(GRI) and its applications are undergoing the significant changes.

Geographical Information System(GIS) vendors, such as ESRI[10], MapInfo[11], Intergraph[12] and AutoDesk[13], provide software components to publish geographical data online. However, the data as well as the software in such systems are proprietary and completely controlled by vendors. For this reason, the maps generated usually either in image formats or in embedded objects with browsers, make it very difficult, if not impossible, for users to integrate search results from different systems or with other applications.

LBS is an integrated technology of telecommunication and GIS. The key idea of LBS is that a portable device sends its location information to a gateway, the gateway

Manuscript received May 11, 2005.

Yeong-Jee Chung is with the College of Electrical, Electronic and information Engineering, Wonkwang University, 344-2 shinyong-dong, Iksan Chonbuk 570-749, South Korea (e-mail:yjchung@ wonkwang.ac.kr)

Chang-Won Jeong is with the Research Center for Advanced LBS Technology of Chonbuk National University, 664-12 1ga Duckjin-dong Duckjin gu, Jeonju Chonbuk 561-756, South Korea (e-mail: mediblue@ chonbuk.ac.kr)

search through its database to find the most relevant information near the location and sends it back to the client for further use. A problem with this technology is that the gateway must maintain a centralized GRI database to support queries.

XML-based data integration architectures are becoming more and more popular since XML is a kind of text-based protocol that is easily processed and exchanged between users. GML, which is an extension of XML, is proposed by OGC to solve the GRI interoperability problem. Several spatial data types, such as points, polylines and polygons, as well as earth projection types are defined in GML DTD. Any software that supports GML can use geographical data in a GML document. An XML-based spatial data mediation infrastructure for global interoperability study is conducted in San Diego Supercomputer Center[13].

In this paper, suggesting the thin client/server information system for LBS of a small area (Han-Ok Village with the Korean traditional folk houses in Jeonju-city), in which moving travelers can obtain proper information services at the current location associated with traditional monu-ments, cultural products, foods, and conveniences. This paper is organized as follows; Section 2 describes a general overview of the information system. Section 3 shows the servicing procedures respectively. Our prototyped implemen-tation described in Section 4 is showed as the implemented physical environment and logical design concerns. And the executing procedures results of components consisting of information system for LBS we suggested. Finally, in Section 5, we discuss the conclusions and future works.

II. PROPOSED SYSTEM ARCHITECTURE

In this section, the overall architecture of the system is shown in Fig. 1. We simply explained that the system architecture is structured by the following. The system adopts a three-tier architecture. Proposed System is designed to be a generic infrastructure that can be accessed by all kinds of LBS applications. For this reason, a well-formed interface has to be provided that allows the appropriate use of the services for the different applications.

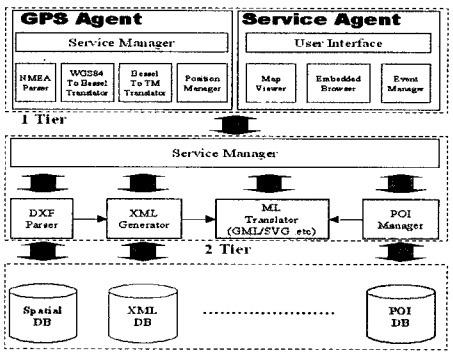

Fig. 1 Proposed System Architecture

The first tier is a client side. Client has two components : GPS agent and Service agent. GPS agent is providing real location of an user to the TM(Transverse Mercator) [14], that is, GPS receiver with deferential correction (DGPS) is used to determine location and to track the path of travel. And a position information is provided to use map matching. The components of Service agent supports geographical view utilities based on Map and POI.

The second tier is the mediator. Whenever the mediator receives a request from a client, it first determines which service manager is related map and breaks the query into a sub-queries. It then finds the corresponding map in its database. Service manager consists of four modules (in Fig.1). It is regarded as a GIS-based solution; DXF to SVG/GML translating, collecting, storing, searching and retrieving maps.

The third tier is the database side. It supports data management of spatial or non-spatial data. For POI service, database contains oid for object identification, name for presentation of map, x, y, z for the coordination system and additionally an information field.

The role of each component is described like below.

- **Client side**
  - Service Manager : managing total services that is invok-ed by web service, process of response message and control of each components.
  - NMEA Parser : extracting a valid information which is parced from obtained NMEA information of GPS receiver.
  - WGS84 to Bessel Translator : translating Bessel to WG S84. (using Molodensky-Badekas model)
  - Bessel to TM Translator : translating Transverse Mercator.
  - Position Manager : managing with log file and user position tracking
  - User Interface : providing two-way communication interface between the GPS agent and the user.
  - Map Viewer : supports for SVG and GML display
  - Embedded Browser : providing additional POI information based on HTML
  - Event Manager : responsible for managing all layer control and POI events.
- **Server side**
  - Service Manager : responsible for managing service modules in server side, receives the service request from the client, and then returns the information of the created XML byte stream to service agent of client.
  - DXF Parser : translating DXF file into Tag Tree
  - XML Generator : generating well-formed XML document from Tag Tree
  - ML Translator : translating Markup language using XSLT schema which is suitable for client GIS environments. (SVG, GML, etc.)
  - POI Manager : extracting a POI information requested from client

III. SERVICE PROCEDURE

The steps numbered and described below are related to the flow of both control commands and information contents in the system. In detailed service procedures of the system, The Step 1 perform an acquisition of the location information, the Step 2, a request from the client reaches the service manager by means of the xml

soap/http protocol through the communication layer. That is, selected information and position information are sent to service manager. The Step 3-5 is executed under POI environments using client's selection, and then, given position information from the Step 2, this step filters a map of service area. In Step 6, the response information with the xml byte stream in XML format is now collected from the Service manager. It is generated and passed to the communication layer in order to be transformed in the appropriate format.

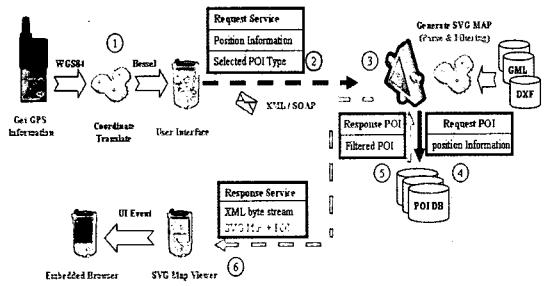

Fig. 2 Service Flow

Figure 3 shows an Message Flow for representing the whole management procedures mentioned above.

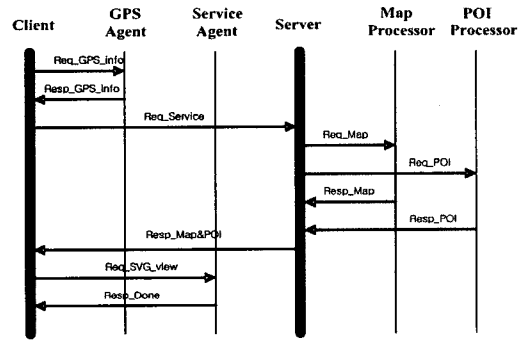

Fig. 3 Message Flow

IV. IMPLEMENTATION OF THE TOURISM INFORMATION SYSTEM FOR LBS

In this section, we are explaining a prototyped implementation of the Tourism information system for LBS. The main implementation goal is the processing of spatial data, and to handle both the geometry and the properties of the geographical elements; this allows the various data providers to share heterogeneous data sets and the users to access the data in a completely transparent way. We also explain the processing of XML/GML documents and their visualization in a graphical way with the interaction of the user. Since the GML data structure is XML compliant, it can be transformed in a SVG document format and then easily displayed on a standard web browser with SVG viewing utility.

The physical environment for implementation is shown in Figure 4. We constructed a web service term, and server computer with Windows 2003 server for distributed systems with .Net framework for interacting among components and/or service objects. In our model, components of the client and the server are implemented by C# language. Information of the POI is constructed to relational databases. These databases are defined and manipulated by the MS SQL 2000. In this section, from The Prototyped Implementation Environment as shown in Figure 3, the executing results of the navigation service and an example of the POI services in the system are provided. For displaying the procedures and the executing results of services on our system, we implemented the GUI-window interface.

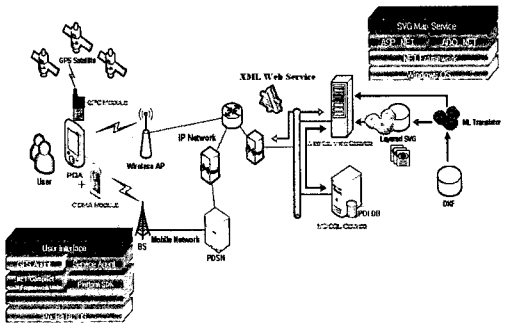

Fig. 4 Service Configuration

To demonstrate how the introduced service is operated, a small part of Jeonju-City has been selected and spatial data and POI information's have been converted from a GIS formats of DXF to SVG.

The client side supports zoom in/zoom out and full extent of geometric data for visualization and POI listing of textural data. Also selected POI results can be overlapped on base maps that can be given from the other GML document, or directly from flat geographical data files as well as spatial databases.

Figure 5 illustrates the screens displayed on the PDA. Click setting button of first phase of Figure 4, after pointing which one you like, you fill the choosing POI out in check space, and then click WMSCall button. You can see the map and POI information corresponding to a given service. These GUI is displaying user position by red dot on the base map in PDA, and then, selecting the POI displayed on the map. And these screens are displayed in first page and user can browse the map and select the POI to be displayed in GUI. And then it shows the related information with the position information as results executed by the UI event.

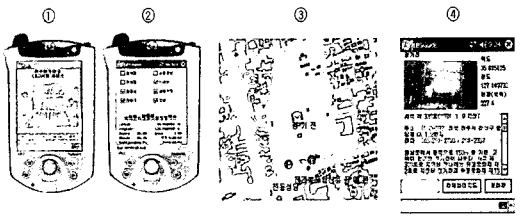

Fig. 5 The map of Han-Ok Village with the Korean traditional houses in Jeonju-city and POI information.

As it was mentioned before, all processes in this system, either spatial analysis or invoking XML-based map contents are carried out in server side and just a response in XML form is sent to client. XML parsers in client side interpret the XML contents and a service

agent displays the spatial data and/or POI information's in the form of image and texts. Bellow fig. 6. show the map of small area query results returned from server.

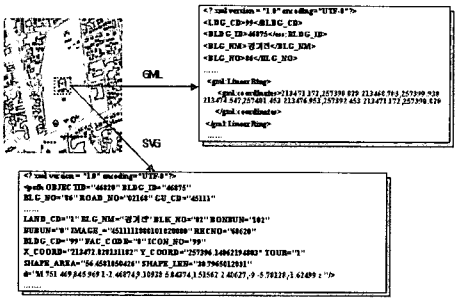

Fig. 6 Map of area showing GML and SVG

V. CONCLUSIONS AND FUTURE WORK

Recently, many WMS(Web Mapping Services) and POI(Point of Interest) services come to be in service on the Internet using Mobile GIS as Information Technology and computer HW are evolved faster in its speed, network bandwidth and features.

Also, Location based services are going to become the most signification part of wireless application. With increase- ing the bandwidth of wireless communication, LBS systems users want to get more services from wireless system.

This paper described the thin client/server information system for location based service of a small area (Han-Ok Village with the Korean traditional houses in Jeonju-city), in which moving travelers can obtain proper information services at the current location associated with traditional monuments, cultural products, food, and conveniences. This case study tries to expose the potential of wireless technology to serve LBSs.

In the future, the spatial data must be stored within large databases to be capable of handling huge data amounts. Therefore, the functionalities of object-oriented databases based on LBS will also be investigated.

ACKNOWLEDGMENT

This research was supported by University IT Research Center Project. The University ITRC is an IT Research Center for Advances LBS Technology in Chonbuk National University designated by Institute of Information Technology Assessment and Ministry of Information and Communication.

REFERENCES

[1] Shashi Shekhar, Ranga Raju Vatasavi, Namita Sahay, Thomas E.Burk, Stephen Lime : WMS and GML based Interoperable Web Mapping System. In proceedings of the 9th ACM International Symposium on Advances in Geographic Information Systems. ISBN 1-58113-443-6. ACMGIS 2001 (Nov. 2001).

[2] Zipf, A. and Malaka, R.(2001) : Developing "Location Based Services"(LBS) for tourism–The service providers view. In: Sheldon, P., Wober, K. and Fesenmaier D.(Eds.): Information and Communication Technologies in TOURISM 2001. Proceedings of ENTER 2001, 8th International Conference. Montreal. Springer Computer Science. Wien, NewYork. 83-92.

[3] Barbara Schmidt-Belz, Milla Makelainen, Achim Nick, Stefan Poslad(2002) : Intelligent Brokering of Tourism Services for Mobile Users. Accepted for ENTER 2002. Innsbruck. January 23-25, 2002.

[4] Stephanidis, C., Paramythis, A., Sfyrakis, M., Stergou, A., Maou, N., Leventis, A., Paparoulis, G., & Kaagiannidis, C., (1998). Adaptable and Adaptive User Interfaces for Disabled Users in the AVANTI Project. In S. Trigila, A. Mullery, M. Campolargo, H. Vander-straeten & M. Mampaey(Eds.), Intelligence in Services and Network : Technology for Ubiquitous Telecommunications Services–Proceedings of the 5th International Conference on Intelligence in Services and Networks(IS&N '98), Antwerp, Belgium, 153-166.

[5] OpenGIS Consortium, Geography Markup Language, http://www.opengis.net/gml/

[6] Open GIS Consortium, Simple Feature Specification, http://www.opengis.org/specs/?page=specs

[7] W3Consortium, XML, http://www.w3.org/xml/

[8] SVG Explorer of GML Data, Bonati L. P., Fortunati L., Fresta G., 2003.

[9] Making maps with Geography Markup Language (GML), Lake R., Galdos Systems Inc, October 2000.

[10] MapInfo, http://www.mapinfo.com

[11] InterGraph, http://www.intergraph.com

[12] AutoDesk, http://www.autodesk.com

[13] GML3.0 specification, http://www.opengis.org/docs/02-023r4.pdf

[14] Welcome to CommLinx Solutions - GPS Tracking Systems, http://www.commlinx.com.au/default.htm

[15] Lassi Lehto, Standards-Based Service Architecture for Mobile Map Applications, 5th AGILE Conference on Geographical Information Science, Palma (Balearic Islands, Spain) April 25th - 27th 2002.

Yeong-Jee Chung
Received the M.S degree in electrical engineering in 1984, and Ph.D. degree in electrical engineering in 1993 all from Yonsei University. He is presently professor of the College of Electrical, Electronic and Information Engineering, Wonkwang University. He is interested in data communications, computer networks, mobile computing and USN.

Chang-Won Jeong
Received the M.S degree in computer engineering in 1998, and Ph.D. degree in computer engineering in 2003 all from Wonkwang University. He is presently research professor of Research Center for Advanced LBS Technology of Chonbuk National University. He is interested in distributed object computing, multimedia database and LBS.