

PROTOTYPE DEVELOPMENT OF VALUE-ADDING INTERNET MAP SERVICE BASED ON GEOSPATIAL WEB SERVICE

Chiao-Ling Kuo

Ph. D. student

Department of Geomatics, National Cheng Kung University

No.1, University Road, Tainan City 70101, China Taipei

Tel: (886)-6-2370-876#851

Tel: (886)-6-2370-876#837

Fax: (886)-6-2375-764

E-mail: chauoling@gmail.com

junghong@mail.ncku.edu.tw

KEY WORDS: WebGIS, Value-adding Service, Middleware, Customized Map.

ABSTRACT: The development of geospatial web service has revolutionized how geographic data is used today and offered brand new possibilities for innovated applications. One noteworthy evolution is the easier making of customized maps that meets particular domain needs. To take full advantage of the abundant and distributed geospatial web service as the source of map contents, we proposed a middleware prototype to aid customized maps making in this paper. The adoption of geospatial web service complying with the OGC standards not only simplifies the accessibility of geographic data, but also improves its interoperability at clients' environment. As the number of internet-based georesource continues to grow in the future, the proposed prototype can be practically applied to create new applications and brings positive impact to the future GIS environment.

1. INTRODUCTION

Maps are widely used tools in human daily lives [Robinson et al., 1995]. The making of traditional paper maps required professional cartographic knowledge and it was technically impossible for ordinary users to produce high-quality maps. Thanks to the technological evolution of electronic maps and internet, users nowadays can turn to internet map platforms or mechanisms like Google Maps, baidu, city8; TAIWAN Map, UrMap to easily acquire map-based information about their point-of-interests (POI). Though these mechanisms indeed provide good coverage (maps or satellite images) about the interested area, users' are often provided rather limited functionality to control map contents. As more and more georesource available in internet, it is straightforward to expect users, no matter naïve or professional, can flexibly take advantages of all accessible georesource to meet their particular application needs. To be more specific, users demand a working environment that can simultaneously handle heterogeneous nature of distributed geographic data and allow them to develop their applications easily and freely. From a system prototype perspective, this no doubt requires to establish successful links to remote and distributed data resource and furthermore develop a working environment with common and domain-specific GIS functionalities. The innovated geospatial web service technology appears to be a very good solution to this challenge [Wu, S.-H., 2005].

“The making of customized maps” is chosen as the major topic of this paper. With the abundant availability of distributed georesource, we wish to propose a prototype that can collect necessary map information from distributed environment and use intelligent mechanism to help the making of customized maps. The major merit of this prototype is that the distributed and independent georesource are “coupled” together to create new applications, i.e., we are adding and creating new values based on existing georesource, which can rapidly facilitate the use of

spatial information in internet. The rest of this paper is organized as follows, section 2 discusses the use of OpenGIS web service standards to bridge the data supply-need relationship and discuss the design of customized mapping environment, section 3 demonstrates the developed system and finally section 4 concludes our major findings and suggests possible future research directions.

2. SYSTEM ARCHITECTURE DEVELOPMENT

The proposed prototype is capable of bridging the users and the distributed geospatial web service [Lin, F.-T., 2006], such that users can take complete advantage of the various spatial information geospatial web service can provide as the contents of customized maps. Middleware is responsible for connecting necessary geospatial web services and process required data according to users' needs [Deng, Y.-C., 2007]. Based on the prototype, geospatial web service and middleware can be expanded whenever necessary. These three major roles, namely, users, middleware and geospatial web service, can therefore be modeled with a 3-tier framework.

2.1 Middleware approach

Following the above discussion, Figure 1 illustrates the major components of the proposed prototype:

1. **Geospatial web services:** Geospatial web services provide a variety of data contents or functionalities, e.g., street data, ATM data, address matching, etc. Geospatial web service can be developed and maintained by professional organizations and the middleware can access required geospatial web services via standardized web service interface.
2. **Domain knowledge:** Middleware is designed to fulfill users' particular demands. It should be able to effectively handle all connected geospatial web service and in the mean time process acquired data with formalized domain knowledge. Different application needs will require different domain knowledge, e.g., we will be focusing on the selection of thematic map contents in this paper.
3. **Database:** Except the data acquired from remote geospatial web service, middleware can also include its own data. This type of data is often included to meet specific middleware needs.
4. **Editing tools:** It is necessary to include some handy map editing tools to help users to complete their map editing tasks.
5. **Browser interface:** Users should be able to access the middleware via their own browsers, meaning a low technological requirement on users' software and even hardware.

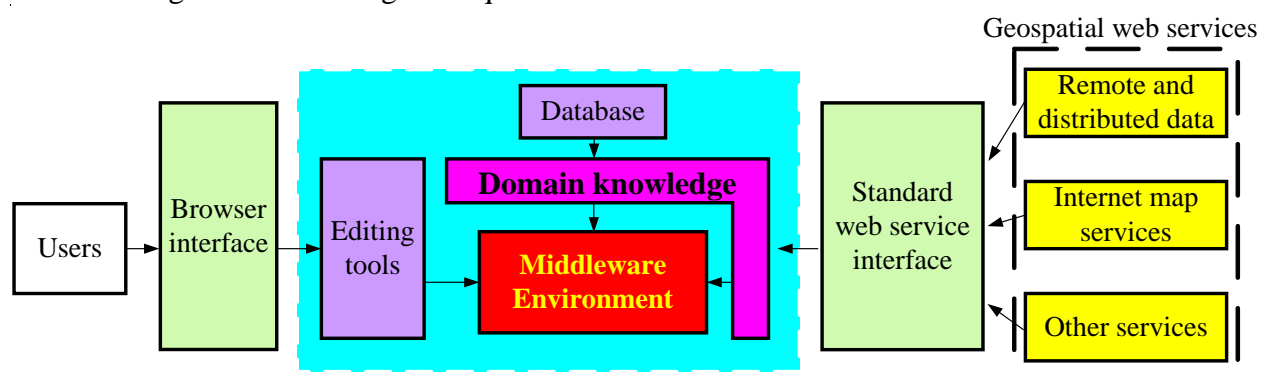


Figure 1. Middleware architecture of the proposed prototype

In this paper, the proposed prototype will allow users to participate in making a “customized” map with the help of professional cartographic knowledge (from middleware) and geospatial

web services. As the number and variety of geospatial web services continue to increase, it will become much easier to develop new middleware applications because the developers only need to concentrate on the formalization of the particular application needs. For example, a geospatial web service providing reference maps can dramatically reduce the cost for developing location-based service.

2.2 Geospatial web service standards

In Figure 1, every geospatial web service has its own interface and the middleware has to follow its regulations to access required data or functionalities. Theoretically we can develop corresponding processing modules for each individual geospatial web service, but the possible heterogeneous nature of data, particularly spatial data, may tremendously impede the processing in the middleware environment. To improve the interoperability of geographic information, the ISO/TC211 and OGC (Open Geospatial Consortium) both proposed their series of international standards. Web Map Services (WMS) and Web Feature Service (WFS) are two types of service standards widely supported by GIS vendors nowadays [MapInfo, 2005; UMN, OGC]. Both standards provide a standardized interface to request data stored in the servers and response with either an image or data encoded in open and interoperable format, e.g. GML. As for the prototype development, if all geospatial web service can follow common and consensus web service standards, the processing of data acquisition and integration in the middleware can be largely simplified.

Geocoder service [OGC, 2003] allows users to submit text-based address as request and the server responses with its corresponding location description (e.g., coordinate). We simulated a website that contains only the name and address of 7-11 convenient stores in the city of Tainan. Whenever there is a need for such information, the middleware automatically retrieves the name and address data from the website and sends the request to the geocoder service to acquire the coordinates of every store. The acquired coordinate can then be treated as a point-based map layer and illustrated in the map interface with its business logo (Figure 2). Even if the 7-11 website does not include any coordinate information, we can still generate appropriate map contents by connecting available geospatial web service. The whole process can be modeled as a “workflow” of geospatial web service.

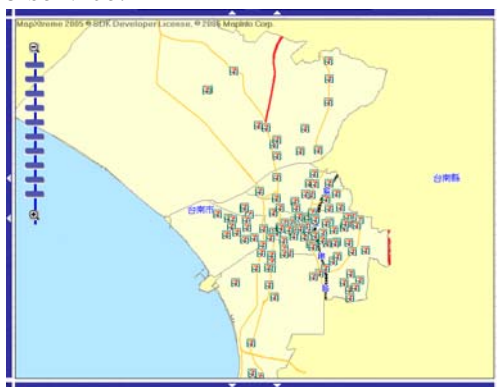


Figure 2. Geocoder services example: the illustration of 7-11 convenient store

2.3 Pre-analysis procedure for selected thematic data

There is no limitation regarding what geospatial web service the middleware can connect, therefore there is also no limitation about the contents of the customized maps, as long as the geosource is available. This is however not necessarily an advantage, as the loading of selecting required information from internet may be overwhelming for users to handle. In fact what data themes should be included in the map should largely depend on the purpose of the

applications and can be designed if the application has been specified beforehand. We therefore proposed a pre-analysis procedure to examine the data themes that should be included in the map design task and formalize the analyzed result as cartographic rules in the middleware. The major purpose of the pre-analysis procedure is to determine whether a thematic data (acquired from geospatial web service) will be included in the customized map or not. For a particular application, available thematic data is subdivided into three groups: highly-related, auxiliary and exclusive. Highly-related thematic data is data that has a close relationship with the selected application and should be included by default. Auxiliary thematic data means data that can provide additional visual aids when included, but users should be given a chance to determine whether to include such information or not. Exclusive thematic data is data that is not included in the customized map by default. For example, when designing customized maps for a hotel, the owners normally prefer to provide the information about restaurant and convenient store, but surely want to exclude information about competing hotels from the maps (Figure 3). Under this circumstance, restaurant and convenient store data will be regarded as highly-related data and hotel data will be regarded as exclusive data. When users begin their map design task, all highly-related data is included and all exclusive data is excluded by default. Since the pre-analysis result is totally dependent on the application, every application will have its own cartographic rules regarding selected thematic data. Figure 3 illustrates the scenario of the three data theme groups for the “hotel” customized maps.

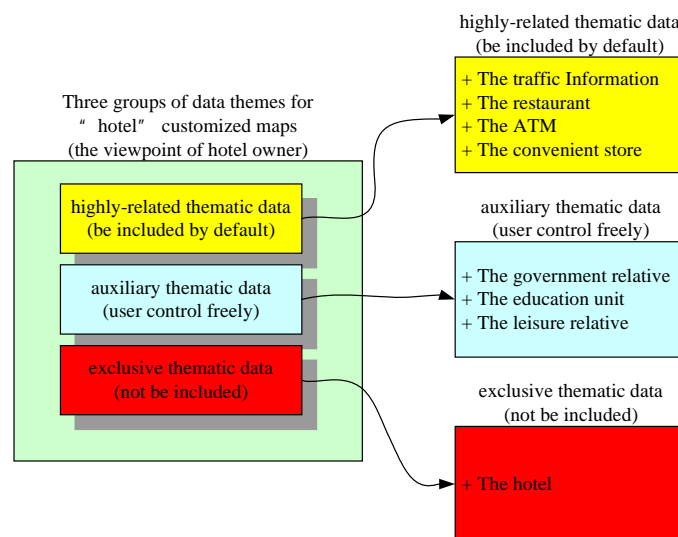


Figure 3. Three groups of data themes for “hotel” customized maps

3. EXPERIMENTS AND ANALYSIST

In the following example, the step-by-step procedure of making customized map for a hotel named “The Tainan Hotel” is further discussed:

- Step1: Choose the theme of the customized map (“hotel”, marked by rectangle in Figure 4).
- Step2: Specify locational constraint by either its name or address. Address constraint will automatically trigger the interaction with the appropriate Geocoder service (Figure 5).
- Step3: Specify the types of the users, which will determine the associated thematic data accordingly. Figure 6.a and Figure 6.b show the different map layouts for owners and consumers. Different sets of map layers are selected based on the above-mentioned pre-analysis procedure.
- Step4: Use map editing tool to adjust the location of the icon (Figure 7 and Figure 8).

The illustrated data includes image-type reference maps (acquired from WMS) and additional feature-type data, e.g., ATM (acquired from WFS). Since the data selection is nearly automatic, users only need to make some simple choices to complete the making of customized maps.

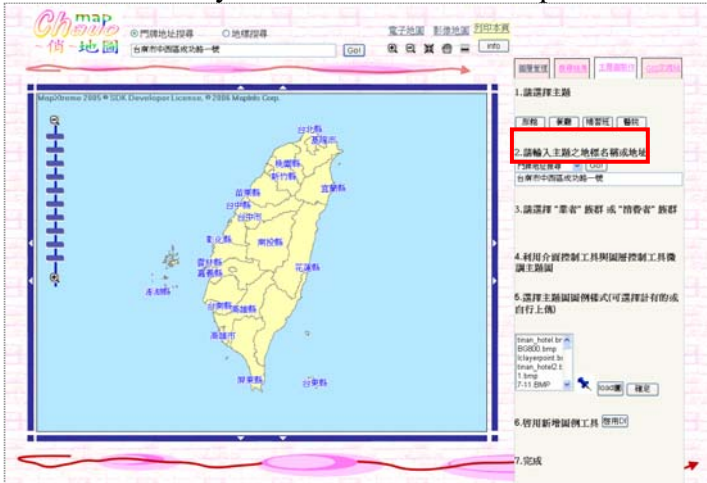


Figure 4. Choose the theme of the customized maps



Figure 5. Positioning (by landmark or address)

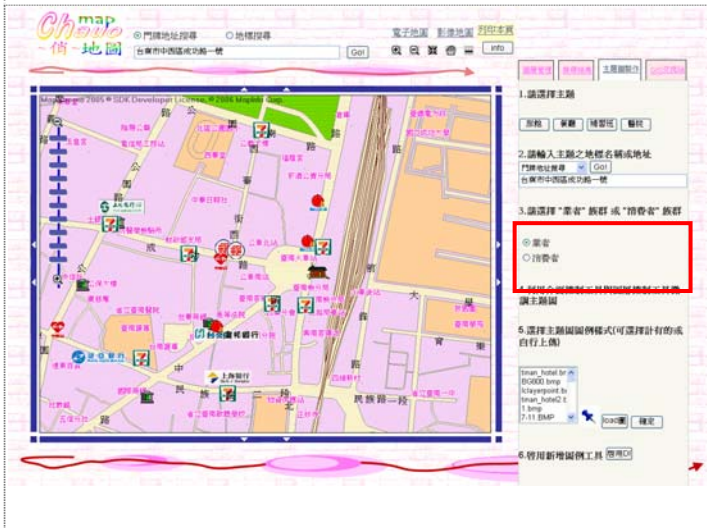


Figure 6.a User type selection (hotel owner)

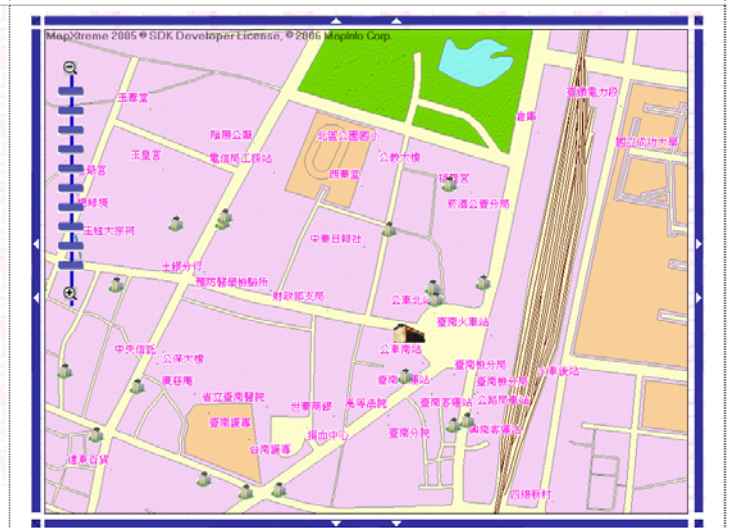


Figure 6.b User type selection (consumer)



Figure 7. Map editing tools



Figure 8. Adjusting icons of the hotel

4. CONCLUSIONS AND SUGGESION

Geospatial web service provides a innovated solution for developing internet-based applications. Immediate challenges ahead are how to effectively establish connections to remote and

distributed geosource and remove technological barrier for naïve users. The proposed prototype successfully demonstrates its capability to access heterogeneous nature of distributed spatial data and response to users' particular application needs with built-in cartographic knowledge. It is obvious that geospatial web services following OGC web service standards can simplify the data supply-need procedure and improve data interoperability in the middleware environment. If all the distributed data can be maintained and supplied by its administrative organizations in a professional fashion, then its quality and correctness can be further assured. With the pre-analysis procedure, we can largely reduce the tedious data selection loading and help naïve users to quickly complete their map design task. Though we only focuses on the issue of customized maps design in this paper, the proposed prototype can be practically applied to create additional domain-specific applications. As more and more geospatial web service available in internet, it will be much easier to develop new applications in middleware environment and facilitate a solid foundation for national spatial data infrastructure.

REFERENCES:

- Arthur H. Robinson, Joel L. Morrison, Phillip C. Muehrcke, A. Jon Kimerling, Stephen C. Guptill ,Elements of Cartography , 6th , John Wiley & Sons, 1995
- baidu, <http://maps.baidu.com/>, 2007
- city8, <http://www.city8.com/>
- Deng, Y.-C.,Map Interface Content Interoperability in Geospatial SOA Environment with Open Geographic Data, Department of Geomatics, N.C.K.U. Master, 2006 (in Chinese)
- Google Maps, <http://maps.google.com/>
- Lin, F.-T., The Application of OpenGIS to Local Governments- the Taipei City Experience, OpenGIS and WebGIS Conference, Taipei, 2006 (in Chinese).
- MapInfo, MapXtreme2005 Developer Guide, http://reference.mapinfo.com/software/mapxtreme_windows/english/2005_6_5/MapXtreme2005_65_DeveloperGuide.pdf, 2005
- MapInfo, MapXtreme 2005 WFS Server Setup Tutorial , http://reference.mapinfo.com/software/mapxtreme_windows/english/2005_6_5/MapXtreme2005_WFS_Server_Setup_Tutorial.pdf, 2005
- MapInfo, MapXtreme 2005 WMS Server Setup Tutorial, http://reference.mapinfo.com/software/mapxtreme_windows/english/2005_6_5/MapXtreme2005_WMS_Server_Setup_Tutorial.pdf, 2005
- OGC, <http://www.opengeospatial.org/>, 1994-2007
- TAIWAN Map, <http://www.map.com.tw/>, 2000-2007
- UrMap, <http://www.urmap.com/>, 2005-2007
- University of Minnesota(UMN), MAPSERVER, <http://mapserver.gis.umn.edu/>, 1996-2007
- Wu, S.-H, Introduction to Web Service Technology, 《information technology》 , 2005 (in Chinese)