Geospatial Information Service Based on Digital Measurable Image
—Take Image City • Wuhan as an Example

LI Deren, SHEN Xin
State Key Laboratory of Information Engineering in Surveying, Mapping and Remote Sensing, Wuhan University, 129 Luoyu Road, Wuhan 430079, China
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Abstract  LBS (location-based service) is a remarkable outcome of the development from GIS to geospatial information service. Faced by the requirements of geospatial information from the masses and the opportunity provided by the next generation Internet and Web 2.0, a new model of geospatial information service based on DMI (digital measurable image) is presented. First, the concept of LBS and the opportunities of Web 2.0 are introduced, then the characteristic of DMI is discussed. Taking the Image City-Wuhan as an example, the function of geospatial information service based on DMI is introduced. Finally, the feasibility for its industrialization is discussed.

Keywords  location-based service; digital measurable image; geospatial information service

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Introduction

With the rapid development of information and space technology, LBS (location-based service) has become a popular information service to common users. By means of LBS, people can easily obtain the information related to spatial location through a mobile terminal or PC. As a symbol of transformation from GIS to geospatial information service, it becomes a successful case of socialization of geospatial information service. Meanwhile, the third tide of the Internet represented by Web2.0 technology changes the model of information service. With the help of Web 2.0, a new kind of information service model appears: the users of the service become the provider through their participation in the service. For the spatial information service, the participation of common users will reduce the cost of data renewal and system maintenance. Undoubtedly, the rise of LBS and Web2.0 offers an opportunity for further development of geospatial information service.

In this paper, a novel model of spatial information service is presented by introducing DMI (digital measurable image)[1,2]. Taking the Image City-Wuhan (a website has been run on the Internet, http://map.wuhan.net) as an example, the functions and characteristics of the spatial information services based on DMI are introduced. Finally, some suggestions are put forward for the industrialization of the geospatial
1 Key techniques of geospatial information service based on DMI

1.1 Location-based services

LBS is an information and entertainment service, accessible by mobile devices through the mobile network and utilizing the ability to make use of the geographical position of the mobile device[3-5]. Nowadays, LBS has been a significant form of geospatial information service.

According to a survey by scientists from the United Nations, more than 80% of the information maintained by humans is associated with spatial position. Throughout the ages people have been using maps to get their geographic information, but the maps cannot provide personalized services to every “reader” as they are generated according to the same norms or standards. Furthermore, the rapid progress of information technologies, such as location, mobile communication and GIS constructs forceful technology support for LBS. Consequently, driven by the market need and progress of technology, LBS, a personalized service form with more abundant personalized information, has become prosperous.

The system structure of LBS is commonly designed as a three-layer architecture (see Fig.1). The presentation layers are the interfaces to the users, commonly composed of different terminal units that receive the command of users and retrieve the service, such as PDA, mobile phone, desktop PC, etc. The intermediate layer is the function provider of LBS according to the need of users. It contains wap gateway, radio tower, wap server and a special map server. The data layer is the data source of LBS. It has two sub-parts: spatial database and spatial data engine. The operating principle of LBS is described as follows. First, the demand of spatial information is received via different kinds of terminal units; then the demand information is transported to the web server through the Internet or mobile network. The web server in intermediate layer acts as a client of map server and a processor of user’s request, and the map server is a professional server for spatial information application with two functions: it evokes the interface of the spatial data engine to acquire data from the database. Meanwhile, it responds to the web server’s request after processing the spatial information acquired from the database. Finally, the useful spatial information can be transferred to the terminal devices through the Internet or wap network.

Fig.1 Architecture of LBS
LBS can provide information related to locations to users in various areas. It has been successfully employed in rapid response, logistics management and staff scheduling, etc. Along with the diversification of need and ripeness of the relative technologies, LBS will play important role in many applications. Compared to the ordinary GIS techniques, LBS has developed at a very fast speed in the 21st century. Its market portion increased with a second parapolitic trend, and would become to the “Sunday punch” of value-added service instead of SMS (short message service).

1.2 Opportunity for geospatial information service provided by Web 2.0

The boom of the third generation of Internet, mobile communication network and the emergence of Google Earth make it easy for common people to obtain and use geospatial data and “3S” technologies for their daily lives. Nowadays, every Internet user can work upon the framework of the unique spatial information service, and the advantages of geospatial information service can be enjoyed by everyone. The public-oriented geospatial information service will contribute greatly to the popularization and application of geospatial information, and can promote the development of the industry of spatial information by reducing the fund input of related application engineering.

Web2.0[6-8] and the third tide of the Internet as well as their technical system bring brand-new concepts to geospatial information service: Web 2.0 can offer personalized and interactive service for every user, which is characterized by experience, communication, variation, creativity and relation. For the users, visualization is the basis of experience (such as Google Earth and Virtual Earth); on-demand measurability is the guarantee of variation and creativity; spatial-temporal ability provides support to the relative application. The service platform based on spatial information grid could provide interactive spatial information service via the integration of Web 2.0 technology (Ajax, for instance). Predictably, geospatial information service should take advantage of these advanced technologies mentioned above to offer more convenience to common people in their daily lives.

1.3 Digital measurable image

1.3.1 Defects of current geospatial information service based on traditional “4D” products

The data source of current geospatial information service consists merely of “4D” products, i.e., digital elevation model (DEM), digital orthophoto map (DOM), digital line graphics (DLG) and digital raster graphics (DRG). These products are manufactured upon the original aerial or space-borne photograph by the operators, according the norms and standards of surveying and mapping. “4D” products are the limited sets of fundamental information or the so-called fundamental geographic information. They are difficult to meet the needs of different industries and the public demand for spatial information. However, the service customers of geospatial information service commonly demand information service with specialized or personalized features, for instance, the electric power facilities for power companies, the municipal facilities for city management, the traffic information for drivers and other demands for personalized location information (such as the position of the nearest KFC from a shopping mall). The traditional “4D” products cannot satisfy these demands because of the limited amount of information within them.

1.3.2 Characteristics of DMI

How do we overcome the shortcomings of spatial information services that merely depend on “4D” products? The author believes that we can make up for their deficiency by combining digital measurable image (DMI)[1,2,9] with the “4D” products, because the DMI is characterized by reality, integrity, interpretability and measurability.

Digital measurable image is the general designation of aerial, space-borne and ground stereo images with absolute orientation elements in spatio-temporal sequence, which are integrated in a unique management platform. With the help of plug-in tools or API together with DMI, application systems for various use could be developed to provide suitable functions based on DMI, including image browsing, relative measurement (height of a building or slope of a hill),
absolute positioning from analytical photogrammetry or annotation, etc. Furthermore, there is a great difference between vertical photography used in aerial or space-borne imaging and visual habit of human beings. The measurement or data mining based on traditional aerial or space-borne images is required for specialized training, and these images do not contain the streetscape information of the third dimension which is perpendicular to the earth surface. On the contrary, the ground stereo images of DMI conform to the visual habit of human beings. They can provide the streetscape images to the public which is more customary. DMI is a new kind of digital product that represents the span of from norm-guided measurement for professional staff to demand-oriented measurement for common users. It reflects the trend from geographic information systems to spatial information services.

The “Digital Earth” spatial information platform that satisfies the demand of information from various applications can be built by combining DMI and “4D” products. Professional spatial information services will be put forward to various industries depending on this platform.

1.3.3 Geospatial information service based on DMI

The most significant progress of geospatial information service to GIS is the transformation from data provider to service provider: geospatial information service provides personalized solutions to users according to their different demand, while GIS simply provides limited geography data in a unique format to different users. The advantages of geospatial information service based on DMI mainly include the following.

1) DMI increases the amount of information of geospatial information service. DMI contains facade images of buildings that represent the natural and social information with visual, measurable and minable characteristics. Contrarily, there is no detailed information mentioned above in the “4D” products.

2) DMI meets the need for focused services and demand-oriented measurement. The geospatial information service based on DMI has the ability to meet the spatial information need of different industries for the most degree; it plays a role as a bridge between the “4D” products and the customers’ demand.

3) DMI improves the accuracy of geospatial information service. DMI has good real-time performance for its short production period.

2 An instance of geospatial information service based on DMI: Image City-Wuhan

Taking the website “Image City-Wuhan” launched in December 2007 as an example, the functions of geospatial information service based on DMI are introduced following. (For security reasons, it has not provided the function for absolute measurement based on façade image yet). The purpose of developing this website is to provide a public geospatial information service platform to common citizens. With the help of this platform, the common user can enjoy advantages in daily life while enterprises can release and obtain the commercial information conveniently. As the first public urban geospatial information platform of China, the data quantity managed by the platform has reached more than 2TB, including electronic maps, imagery maps, façade images of buildings as well as 300000 points of interest. The website has already provided geospatial information service based on DMI, and its homepage is shown in Fig.2.

Image City-Wuhan provides a lot of convenience to the Internet users based on DMI. Its main features are as follows.

(1) Rich information by map searching
By comparison with traditional electronic map searching, it provides the function of map searching by category or geographic area, the search result contains not only the location of the object but also its real image. Especially, the panorama of scenic spots and commercial net sites can greatly enhance the user’s sense of immersion. The users can get more detailed information about the surrounding environment of the queried locations. Fig.3 shows the function of location searching in an electronic map, the floating window shows a 360-degree panorama of the queried sight spot.

(2) Navigation supported by videos of streetscape
Apart from navigation by traditional electronic maps, the website offers another approach, i.e., navigation supported by videos of streetscape. By just entering the place name of the start and terminal point of a route, or simply clicking on the electronic map, users can obtain navigation supported by videos of streetscape. Fig.4 shows the function of streetscape navigation, the blue line represents the route from origin to destination, and the upper-left part of the page shows the streetscape of the route, the texts and pictures on the right represent the detailed information about the selected route, such as the distance of this route, number of running and real-image of running, etc. This new mode will greatly improve the practicability of navigation.

(3) Virtual advertisement and annotation based on image or map
Image City·Wuhan is an interactive geospatial platform for every citizen. Supported by Web 2.0 technology, the website can be used to distribute information through users’ annotation. After registration as a commercial user, enterprises can disseminate advertisements of their products or services. The advertised information can be composed of text or images. For the common users, they can release their interesting information related to the location for no fee, such as a comment on a store, image of a good, and so on.

With the coming of age of 3G, Image City·Wuhan will provide spatial information services to mobile users via mobile communication networks. Users will enjoy the convenience of geospatial information service via mobile and fixed terminal ultimately.

3 Industrialized approach of spatial information service based on DMI

The website “Image City·Wuhan” is a beneficial attempt for the industrialization of geospatial information services, and has obtained good social benefits and economic benefits since its set up. On the one hand, the general public can get a lot of useful information from it free of charge to improve their material and cultural lives remarkably. The companies can promote their commodity sales using the annotation for commercial purposes at a fee. To date, more than 300000 shops has registered as POI on the website. They can make use of annotation to release the advertisements with graph, image and text. Naturally, the common users can get more information about daily life along with the rise of the companies’ annotation. It is predictable that the geospatial information service based on real image will become a new growth point of the communication industry. Its development
will enormously enrich the content of communication value-added services. The website is running upon the principle of “free for public, cheapness for business”: the common users can access the website to get geographic and other interesting information without cost; the companies only pay small fees for the annotation of advertisements (for instance a few hundred Yuan per year). However, for a megacity, the output value of these advertisements may exceed several million Yuan. Obviously, the geospatial information service based on real image can reach a Win-Win situation in economic and social benefit, and its industrialized conditions are ripe.

With the development of socialization of geospatial information, the geospatial information service based on real image will enter a period of rapid growth. More geospatial information services will be launched in many more cities. The author believes that efforts on the following aspects should be made for the industrialization of geospatial information service based on DMI. First, the demand for geospatial information in different industries should be concentrated, the content of the service should be enriched according to the demand. Second, the combination with the communication technology should be enhanced, because the bandwidth and speed of the communication network are the key issues between the service provider and customers. Third, we should enhance publicity to attract more attention from customers. The extent of services can be expanded by the interactivity between the providers and customers. Finally, we should promote the research and practice of the specific business model of spatial information service. Only in this way can the operational models of its market be found.

It is a great opportunity for geospatial information services based on DMI.

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