Development of Very Large Image Data Service System with Web Image Processing Technology

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Abstract: Satellite and aerial images are very useful means to monitor ecological and environmental situation. Nowadays more and more officials at Ministry of Environment in Korea need to access and use these image data through networks like internet or intranet. However it is very hard to manage and service these image data through internet or intranet, because of its size problem. In this paper very large image data service system for Ministry of Environment is constructed on web environment using image compression and web based image processing technology. Through this system, not only can officials in Ministry of Environment access and use all the image data but also can achieve several image processing effects on web environment. Moreover officials can retrieve attribute information from vector GIS data that are also integrated with the system.
Keywords: Image Compression, Web Image Processing, Web GIS, Remote Sensing

1. Introduction

Satellite and aerial images have much significant information on environmental situation. Ministry of Environment, Korea, has many kinds of large image data for its purpose. These image data include satellite image, aerial image and scanned topo-map. The size of these image data exceeds 300GB in uncompressed format.

Usually government officials, authorities and researchers use their local desktop PC to acquire useful information from image data with large image data stored in their own PC. However many officials want to access, process, analysis these image data through networks like internet or intranet recently, as networks technology and speed escalated fast.

In order to service image data through networks, large storage and long transmission time are required. The simplest way to solve these limitations is to compress large image data into smaller one. Commercial image compression and transmission solutions - e.g. ER-Mappers's ECW, LizardTech's MrSID - are already developed to sort out these limitations and also in use nowadays. However this kind of solutions have several limitations in practical use at Ministry of Environment as follows: (1) lack of multiple image overlay functionality, (2) only service pre-processed image data, (3) lack of real time image processing like histogram adjustment on web environment, (4) lack of transparency adjustment more than 2 images on web environment, (5) don't support lossy/lossless dual codec.

In this paper, we introduce the "Very Large Image Data Service System" directed by Ministry of Environment. This system provides the solutions for the above-mentioned limitations. This introduction of the project includes the data construction, system architecture and system functions.

Thanks to this system, officials in Ministry of Environment can obtain various kinds of information related to image data such as path-row information, meta-data. In addition, official can overlay several kinds of image data in one screen at the same time and can compare one image with another image using geo-link, image processing and transparency adjustment functionality. Finally, officials can overlay already published vector GIS data on image data to find out relationship between vector GIS data and image data.

2. Design of Very Large Image Data Service System

This system aims at the efficient use of satellite and aerial image data at Ministry of Environment by serving image data through intranet. The final goal of this system is that officials can find the meaningful information on environment situation by integrating image data with vector GIS data.

To achieve this goal, this system was designed and constructed in following steps: (1) compress very large image data into smaller ones considering characteristics of image dataset, (2) service image data through networks with real time image processing function, (3) integrate image data with vector GIS data.

1) System Design Concepts and Requirement

System design should be based on real user's application. This system should be simple and convenient in its use. Therefore user interface should be friendly so that it can improve officials' works efficiently. Some important system function requirements are as follows: (1) easy image search and retrieving function using gazetteer, geo-

graphic coordinates, map index and AOI(Area of Interest), (2) some utility functions such as measuring distances, measuring areas and adding user annotation, (3) several web based image processing functions such as color histogram/brightness/contrast/transparency adjustment, geo-link control, (4) integration with vector GIS data including vector GIS data overlay on image data and retrieving attribute data from GIS data.

2) Target Image Data and Compression Method

This system serves several kinds of image data including satellite image, aerial image, scanned maps and landcover map. Each image has unique characteristics. Therefore different compressing method should be selected considering unique characteristics of image. For example, each color values in landcover map have respective unique meaning. So, if any lossy compression method was selected to compress landcover map, there would be a possibility to lose or confuse real meaning of that color. At this case lossless image compression method should be selected to avoid confusion.

Table 1. shows entire list and compression method of image data in this system

Table 1. Target image datasets and compression method in this system.

Category	Image Name	Scale or Resolution	Compression Method
Satellite Image	LandsatTM	30m	Lossy-JPEG2000
	IRS-1C/D	5m	Lossy-JPEG2000
	SPOT5	2.5m	Lossy-JPEG2000
	IKONOS	1m	Lossy-JPEG2000
Aerial Image	Aerial Image	0.8m	Lossy-JPEG2000
Landcover Map	7 Class Landcover Map	30m	Lossless-ZLIB
	23 Class Landcover Map	5m	Lossless-ZLIB
Scanned Map	Scanned Topo-Map	1:25,000	Lossy-JPEG2000
	Administrative Map	1:25,000	Lossy-JPEG

3) System Architecture

To serve compressed image data through intranet, this system uses proprietary TCP/IP protocol, MIPP(Multiple Image Provider Protocol). As you see in Fig. 1, this system is based on client-server architecture. Only the viewing portion of the image will be transmitted to client side and then image process will be performed on client side to minimize data traffic and server side load.

This system is composed of main 3 parts. One is image data server that transmits compressed image data to client, another is vector server that transmits vector GIS data to client, and the third is client ActiveX. ActiveX receives compressed image and vector data from image server and vector server respectively, then decompress these data.

All officials who want to access this system through intranet are should be certified by ID and password.

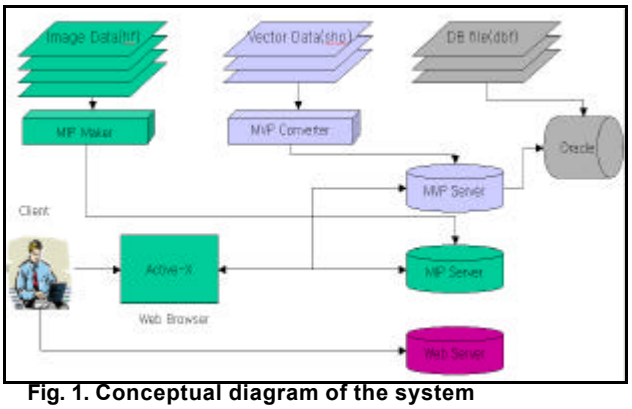

Fig. 1. Conceptual diagram of the system

4) System Function

This system stored almost all the image data and vector GIS data that was already published by Ministry of Environment. With the support of vector GIS platform, this system function can improve the work efficiency and decision power.

Table 2. List of System Functions

Category	Functions
Basic Functions	● User authentication ● Search by map index ● Search by gazetteer table ● Search by geographic coordinate ● Search by AOI(area of interest) ● Distance, area measuring ● Zoom in/out, panning ● Zoom to scale ● Display latitude, longitude, X, Y ● Save screen to image format ● Print image with user annotation
Advanced Functions	● Multiple image overlay and display ● Web based histogram adjustment ● Web based brightness adjustment ● Web based contrast adjustment ● Web based transparency adjustment ● Multiple image layer order control ● Integration with vector GIS data ● Vector query ● Window/screen mode geo-link ● User annotation

3. Implementation of Very Large Image Data Service System

To implement this system, IIS5.0 of Microsoft is used as web server and Oracle 8i and ASP(Active Server Page) are used for vector GIS attribute database construction and dynamic web page operation, respectively. MIP2.0 of Gaia3D is used to transmit compressed image data to client through intranet using Java and HTML as system development language. MVP1.0 of Gaia3D is used to serve vector map data through intranet.

As shown in Fig. 2, practical system structure consists

of client side, application side, web server side, DBMS side, respectively.

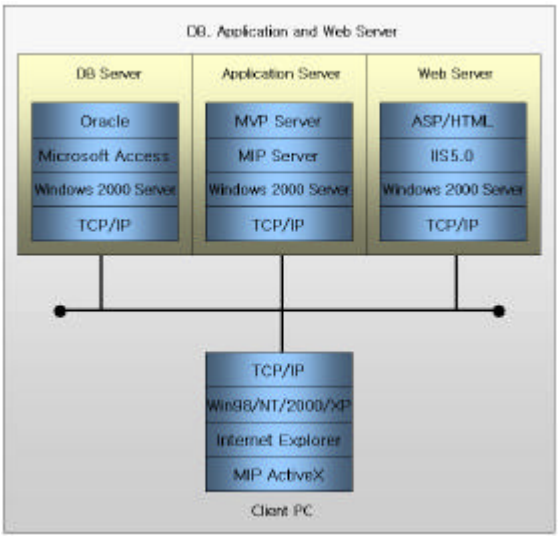

Fig. 2. System architecture

1) Search and Retrieval Implementation

In this system, officials who are ignorant of any knowledge of SQL can search proper image and retrieve attribute data of vector GIS data. Officials are able to search image and GIS data using several search method such as search-by-gazetteer, search-by-map-index, search-by-geographic-coordinate, search-by-AOI.

Fig. 3. Search and Retrieval interface

2) Web Based Image Processing Implementation

Current commercial image compression and transmission solutions have limitations such as lacking of real time image processing functionality, lacking of multiple image overlay. Using this system, officials can adjust color histogram/brightness/contrast/transparency of images on his web browser. Without this functionality, officials only view the pre-processed image and are not able to acquire meaningful information that can be extracted by simple image manipulation.

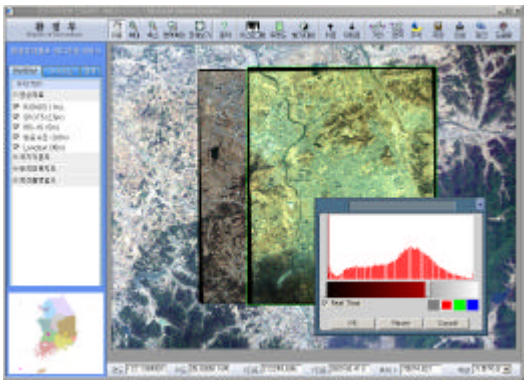

Fig. 4. Web Based Image Processing

3) Vector Integration Implementation

Ministry of Environment, Korea, produces many kinds of environment thematic maps like ecological-nature map in digital format. All vector GIS data were also integrated with this system to make officials' works more efficiently and easier.

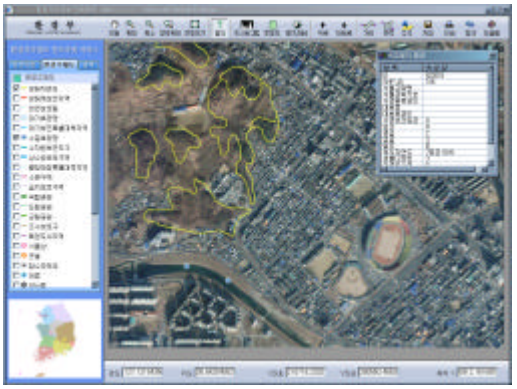

Fig. 5. Vector Integration and Retrieving Data

4. Conclusions

In this paper very large image data service system is designed and implemented to service very large image data and vector GIS data to related officials through intranet. Following description indicate the effect of this system briefly. (1) This system plays a role as decision support system for officials in Ministry of Environment by providing not only all the available geo-data but also web based image processing functions, (2) officials can reduce their manpower, time and cost to collect and analyze image or vector GIS data using this intranet-based system, (3) officials can find out what's wrong in already published maps by comparing with image data or field survey data.

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