Remote Sensing Image Server based on WMS for GMS (Greater Mekong Sub-Region) Countries.

Sarawut Ninsawat[1], Kiyoshi Honda[2], Teerayut Horanont[3], Ryuzo Yokoyama[4], Amor V.M. Ines[5].

[1,2,3,4] School of Advanced Technologies, Asian Institute of Technology
P.O. Box 4, Klongluang, Pathumthani 12120, Thailand
Email: [1] sarawut@ait.ac.th, [2] honda@ait.ac.th, [3] teerayut@ait.ac.th, [4] yokoyama@ait.ac.th, [5]avmines@ait.ac.th

Abstract: The remote sensing image server provides advanced image serving capabilities for geospatial image. Wide seamless image mosaics of Landsat 5 over GMS countries, which exceed a 15 GB or more in size per image, can integrate with other GIS map servers. The approach of two improvement algorithms leads to speed up the response time while preserving the data quality. This system does not only provide images on the web, but also provide GIS layers to WMS client map servers. The advantage of this approach is its efficiency lower cost in terms of cost, time and updating to obtain and utilize remote sensing image.

Keywords: Remote sensing image server, Web Map Service, Greater Mekong Sub-region

1. Introduction

In 1992, with the assistance of ADB, the six countries of the GMS, which is of composed of Cambodia, Lao PDR, Myanmar, Thailand, Vietnam, and Yunnan province of the People's Republic of China entered into a program of subregional economic cooperation, designed to enhance economic relations among the countries. About 240 million people live with GMS countries. The most of these people live in rural areas where they lead agriculture lifestyles. Combined, the lands of the GMS cover about 2.3 million square kilometers. It is a vast area of wealth and variety of natural resources, which including of a rich area of agriculture, timber, minerals, fisheries and energy. Sustainable development and environmental protection is also a main key of strategic development objective for this cooperation among GMS countries. [1]

The achievement of sustainable development needs to full-fill the necessary data for planning and implementation process. Remote sensing and GIS gave a revolution in research of sustainable development. Remote sensing data have been widely used in a wide range of applications including agriculture, land, water and marine resource. To use remotely sensed data, the researcher can facilitate the investigations, assessment provide more opportunities to understand more about the environment and the effects of development. In the last decade, many researchers have done numerous developments in utilizing GIS and RS data to various applications, such as in agriculture, water management, land management and conservation etc. However, despite all these developments, the potential of Geoinformatics have not been fully realized yet in the sense that data accessibility, integrity and their integration among existing GIS database are not up to their fullest. As a result, their contribution to the society and peoples' lives in particular is not yet significant. More than 80% of data has a spatial component and more than 80% of the time spent on spatial information projects is wasted on non-productive activities such as data acquisition, negotiation, loading and transformation. The idea to open data that will give people the right to access information from government institutions and other portals. But this cannot be easily implemented and realized because of inadequate infrastructures, especially in rural areas. Sometimes the cost is very high compared to the benefits in establishing high performance GIS and RS system for data processing, storing and distribution of large volume remote sensing data. One possible solution is by utilizing the Internet. People can use only the web browsers that are already built-in in existing Operating Systems to access the needed information. In here, they will be able to access the data and view the information through their web map server using the web interface, thus, reducing the required big storage system in their terminals.

Web Map Service (WMS) is an online discovery access, integration and exploitation of geo spatial information and visualization application. Access to multiple servers simultaneously, which also one of the core procedure provide more data sharing, can be done as easy as the normal URL linkage of Internet reference. The data will be more valuable by the easier of sharing data. In Thailand and other GMS countries, the main economic activity is agriculture. The Thai government, for example, has realized to fully use the potential of GIS and RS in sustainable agricultural development. In 2003, eight organizations and institutes agreed under the cooperation of IT for agriculture forum. NECTEC (National Electronics and Computer Technology Center) will act as secretariat of the steering committee. One of the main objectives of this initiative is to establish mutual links between the various organizations under MOAC (Ministry of Agriculture and Cooperatives) and members of IT for Agriculture Forum in information technology and agriculture risk assessment. In this regard, an Experimental Web Map Server in Thailand and GMS countries will showcase the benefits of sharing data among the forum members and linked organizations (in the GMS). Satellite image Map Server will be the main feature of the linkage with other GIS data from

various organizations using WMS technology. The GIS data overlaid on satellite image, which act as background image and has a geodata, will lead more visualization of information.

2. Methodology

The WMS map server was setup on Linux, which is an open source system and a free operating system. In this case, the Minnesota mapserver is used for Satellite image map server, which supported WMS technology. It is also an open development environment for building spatially enabled Internet applications. Thus, updating new features and detecting bugs were done very frequently by users around the world. This mapserver is not a full-featured GIS system, however it provides enough core functionality to support a wide variety of web application. Other popular open source and free software such as Shapelib, FreeType, Proj.4, libTIFF, Perl are integrated with the Minnesota mapserver for more efficient tool. For the reason that mapserver is an open source system so the customized configuration can be done during compiling. This system was configured to support various type of image file format such as PNG, GIF, JPEG and TIFF using GDAL and GD capabilities. The integration of different map projection data can be solved by the Proj.4 with "on the fly projection" capabilities. The OGR library was included to support various type of vector file format, thus even different data source can be integrated together. [2]

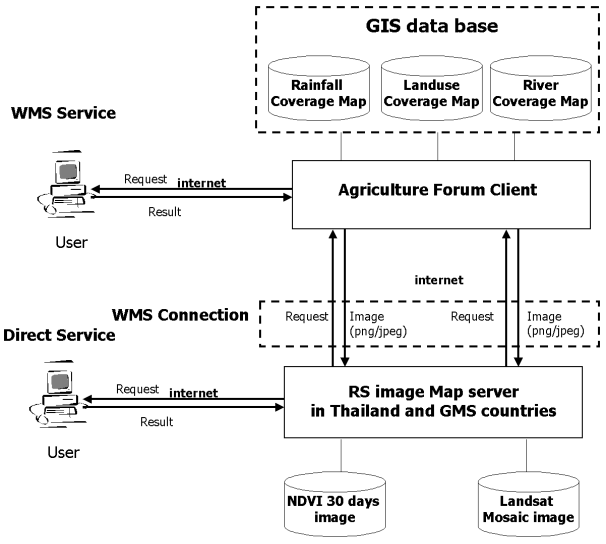

Fig. 1. Overview of process steps

The main interface of this mapserver was divided in to two parts. The system process step is shown in Figure 1. First, the direct user interface that allow user surf Satellite image and some GIS data direct to this server system, which provide Zoom and Pan function and function of identify some database related to GIS data can be done also. The second interface is WMS interface. The other WMS capabilities enable mapserver can get the map data through Internet to integrate with their own data or other WMS mapserver to show on there. The customized function and interface can be done and also client side can specific layer data from the multiple layer provide by WMS server. Three type of satellite image were provided by this system. The Mosaic image of GMS countries using Landsat 5 images at spatial resolution 28.5 m. x 28.5 m is the highest spatial resolution available in this prototype. Also Low resolution satellite image NOAA/AVHRR NDVI 30-days composite and NOAA/AVHRR 30-days composite shown as FCC (False color composite) 121 are available.

3. Web Map Service

The emergence of WMS was a breakthrough for interoperable Web mapping technology. The interoperability is a standard interface between client and server via WWW by request map across the Internet to a Web map service without having to know the underlying GIS format, or even what type of software is in use. Many vendors now include WMS capabilities in their products such as ArcIMS, MapXtreme and UMN mapserver product. This prototype has also one important service that is WMS (Web Map Service). A Web Map Service produces maps of georeferenced data, which are a visual representation of geodata. These maps are rendered in a normal image format such as PNG, GIF or JPEG. [3]

4. Results and Discussion

After setting up the WMS map server prototype, it was tested with GIS data first before integrating with remote sensing data. The Mosaic image of GMS countries was done using Landsat 5 images at spatial resolution 28.5 m. x 28.5 m. The Mosaic data project was divided in to two-steps because of a very huge remote sensing dataset. First, East side of GMS countries was covered by 78 Landsat 5 scenes. It composed of around 80,000 samples and 91,000 lines of pixels entire this area. Next, West side of it around Myanmar will be covered. The maximum capacity size of input image data for GDAL library and most graphic program without pyramid algorithm is less than 2 Gigabyte. But the entire size of the dataset is around 20 Gigabyte. The reading of this huge dataset needs much memory and processing time on server side. The solution to this problem is a tile indexing. When handling very large amount of raster layer it is often convenient, and with higher performance to split the raster image into a number of smaller images. Each file is a tile of the larger raster mosaic available for display. The list of file forming a layer can be stored in a shapefile with polygons representing the footprint of each file. Mapserver will first scan the tile index and ensure that only raster file overlapping the current display request will be opened.

However only with tile indexing, the speed is still quite slow when users zoom to all entire area. For this reason, the full resolution dataset at 28.5 meters was resampled into two different pixel sizes (57 and 114 meters), which have set double and 4 times resolution to increase the speed to serve images at various resolution requested. And scale control was integrated to select a suitable pixel size dataset in at each map scale as show in Figure2. Example, at map scales more than 1:750,000 meters. The 114 meters pixel size was opened and display only in overlapping the current display request. With this 114 meters pixel size data set at less map scale, all the feature are shown as same as full resolution pixel size but it is very less physical data size when compared with full resolution pixel size data set. The integration of both algorithms is an important key to improve the speed of this kind of service.

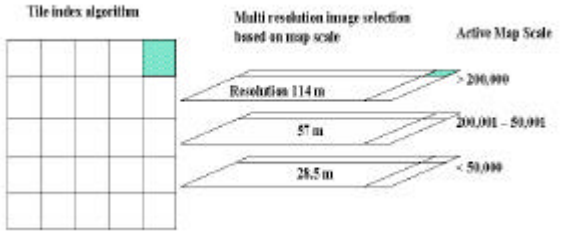

Fig.2. Improvement algorithms for Satellite image server

Without both of improvement of algorithms, the speed of response time is very slow or sometime lost connection while wait a resample process on server side. The improvement is very successful. Consequently, the return response time is acceptable around 3 or 4 seconds even loading the entire area. Te main objective of the improvement is to speed up of the response time while preserving the data quality. As a result, a user can more clearly distinguish around the interesting area from RS data incorporated with GIS data and zoom into actual pixel size of remote sensing data.

Fig.3. Direct interface to mosaic of Landsat 5 image

Linking with other WMS is one of the main objectives in this prototype to promote the data sharing. This satellite image mapserver was setup and link with IT for agriculture forum using the Minnesota Mapserver running on Windows platform, which has only their own agriculture GIS database. The WMS GetMap operation enables the creation of a network of distributed Map Servers from which clients can build customized map. Even if they have different of map projection or cover extent of them are overlap or subset, the GetMap operation can be done easily by just add one map layer to the map file, which the server side already prepared. Thus, number of WMS server and client will increase easily by this approach.

5. Conclusion

With this prototype remote sensing image server based on WMS for GMS countries, the potential of Geoinformatics will be fully utilized and developed contributing significant benefits to the society in general. And the realization of data sharing through Open GIS and Web GIS, will showcase the potential of the technology in achieving the goals, and open the possibilities to provide valuable services information by combining data from multiple servers using web mapping technology, promoting more linkage and cooperation. Through this experiment, we are going to clear some issues on legal (e.g. ownership of data, copyright issues etc), infrastructure (hardware) technical level problems (level of know-how in implementing and using the system) and the required new GIS function, in Thailand and GMS countries. In addition, the redundancy of data was reduced; especially with remote sensing where data size is very huge and data processing need a remote sensing specialist to make a accurate data set.

Acknowledgement

This project is a part of Education and Research Project for Sustainable Development in the Greater Mekong Sub Region supported by Japanese Government. The raw Landsat 5 data are downloaded from Global land cover facility homepage, University of Maryland. (http://www.glcf.umiacs.umd.edu/index.shtml)

References

[1] **URL:** Asian development Bank Organization. Greater Mekong Subregion Project: about GMS document. Available at: http://www.adb.org/GMS/about.asp.

[2] **URL:** Doyle, A.,2000. Open GIS Consortium. OpenGIS Web Map Service Interface Specification 1.0.0. Available at: http://www.opengis.org/techno/specs/00-028.pdf.

[3] **URL:** Beaujardière, J. L.,2001. Open GIS Consortium. OpenGIS Web Map Service Interface Specification 1.0.0. Available at: http://www.opengis.org/techno/specs/01-047r2.pdf.

[4] **URL:** Vlugt, M.V.D and Doig, J., 2003. Open GIS Consortium. OGC Magazine August 2003 Available at: http://www.opengis.org/pressrm/ogcuser/20030813_ogcuser.htm