USES OF OPEN SOURCE REMOTE SENSING SOFTWARE FOR INTEROPERABLE GEO-WEB IMPLEMENTATION

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WG VIII/8

KEY WORDS: Internet/Web, Design, Interoperability, Open Systems, Standards, Software, Interface

ABSTRACT:

In the geo-spatial domain, new web-based computing technologies for interoperable geo-web are emerged. software as a service, asynchronous particle update, mashup, open sources, rich user experiences, collaborate tagging, open interoperability and structured information. Among them, open source developments or their applications in the geo-spatial community have somewhat long history, and nowadays they are regarded on the maturing stage in both the academics and industries. The main theme in this work is to use of the open source remote sensing (OSRS) software covering satellite image processing. Currently, OSRS software can be categorized into some types: full source codes, application programming interface (API) and development libraries. Furthermore, compared to proprietary remote sensing tools, some OSRS software provides highly advanced functions to fit specific target applications, as well as basic pre-processing or post-processing ones. However, till now, there are a few comparative and guidance studies to OSRS specialties. In this study, OSRS classification and its summary concerning features and especial specifications are presented in the consideration to land applications. Finally, geo-web architecture and system design with several OSRS software is shown in order to land applications to construct remote sensing contents and to provide interoperable web services in geo-web. It is thought that the application and implementation of OSRS software can widen uses-scope of remote sensing applications as IT main stream.

1. INTRODUCTION

Since the mid 2000s, geo-spatial technologies have reflected web-based computing methodologies toward the interoperable geo-web: software as a service, asynchronous particle update, mashup, open sources, rich user experiences, collaborate tagging, open interoperability and structured information. Among them, open source developments or their releases and applications in the geo-spatial community have somewhat on the maturing stage in both the academics and industries.

The main theme in this work is to use of the open source remote sensing (OSRS) software covering satellite image processing. Briefly, OSRS software can be categorized into several types: full source codes, application programming interface (API) and development libraries. Although remote sensing data themselves and their processing schemes are geo-spatial resources in the wide view, they are basically different from geo-information or its schemes by vector-centric data model. Over the last few years, it is reported that the users' or developers' communities of free and open source geo-spatial software including OSRS and GIS (Geographic Information System) have progressively advanced, according to communities' notices for open source geo-spatial software such as FreeGIS.org or OSGeo foundation. Overall description regarding those is beyond in this work, and the state of the art of OSRS software is the main theme, being distinguished from comprehensive free or open GIS software. Furthermore, open source software for geo-spatial information manipulation and processing is categorized in many types: desktop viewer, web client and server, middleware, database management, file converter and so forth (Hall and Leahy, 2008).

On web paradigm movement, open source software plays a role in the current web paradigm called web 2.0, location 2.0 or where 2.0. In general, geo-spatial web is now regarded as one of the important technically advanced and integrated fields in the geo-spatial communities. Portal sites providing web map services such as Google map with Google earth, Yahoo, and so forth have promoted the wide use of geo-spatial resources, as well as web-mapping mashup applications using open APIs. This trend evokes the general significance of open standards which are on the limited understanding in the specialized geo-based principles, for interoperability of information and system resources.

Despite these paradigm shifts, geo-spatial web and OSRS as two main issues in this paper are inclined to be independent areas still. Thus, these two aspects are briefly overviewed, and then the relation-building strategy and technological bases are discussed.

2. GEO-WEB

The web paradigm pursuing openness, sharing, and participation is the mainstream in comprehensive information technology communities, besides in the geospatial domain with the viewpoint of standardization and industrial needs.

Geospatial web or geo-web implies the merging of geographical information with the abstract information that currently dominates the Internet. As well, it is extended that the geospatial web has a profound impact on managing knowledge, structuring workflows within and across organizations, and communicating with like-minded individuals in virtual communities, being characterized by the self synchronization of network addressing, time and location. It is conceived that the geo-web is regarded as a visual medium and geospatial platform for data self-organization, discovery and use. The geo-browsers which revolutionize the production and consumption of media products are the important and enabling technologies for the geo-web (Scharl and Tochtermann, 2007).

Among several definitions or concepts for the geo-web as a platform, these sentences are rationalized (Maguire, 2006;

Homes, 2007): 'spatially enabled and access over the internet', 'complete integration and use of location at all levels of the internet and the web' and 'internet technologies to get and share geospatial information'. Compared to conventional web services handling geo-data and web mapping, geo-web emphasizes on dynamic, participation-oriented, user-centric, distributed, loosely-coupled services. Furthermore, in other aspects for geo-web as data presentation platform, it is important that new types of geo-based data can be exchanged transferred, and published through geo-web implemented. The comparative summary of web paradigm shift for schematic view is shown in figure 1. Web paradigm shift from passive web to interoperable web influences web services and their contents, to fit user demand and industry needs. This should be considered to implement web mapping or web map service associated with portal search engines. However, currently most search engines do not reach to interoperable geo-spatial web. Especially, remote sensing resources including satellite or airborne imageries and processors could utilize to establish web pattern for geo-spatial web. For example, SaaS and mashup focused on technological aspects, among factors for interoperable geo-web, are closely related to open sources and geo-based standards.

Table 1 is the summary of Google maps APIs for mashup, and an example case using these open APIs is shown figure 2. In this case, general users can execute simple geo-processing such as imagery searching and viewing, manual or semi-automatic feature extraction, storage in KML, linking to Google earth and so on. But this is not enough for remote sensing communities. If someone charged of actual geo-data applications wants to perform more specialized functions, it is difficult task to find solutions, and additionally complicated development is necessary to meet his/her aims.

Table 2 shows types of open source software for geo-processing, supporting some OGC standards for resources interoperability, which classify into open standard specifications and their users (Torre, 2005; Bruce, 2007; Benthall, 2009; Steiniger and Bocher, 2009). Recently, these geospatial open sources listed are widely used for parts or whole of a given target system.

Figure 3 is an example case for mashup and open source stack supporting OGC standards, and this is for data interoperability and exchange functions linked to users' geo-databases.

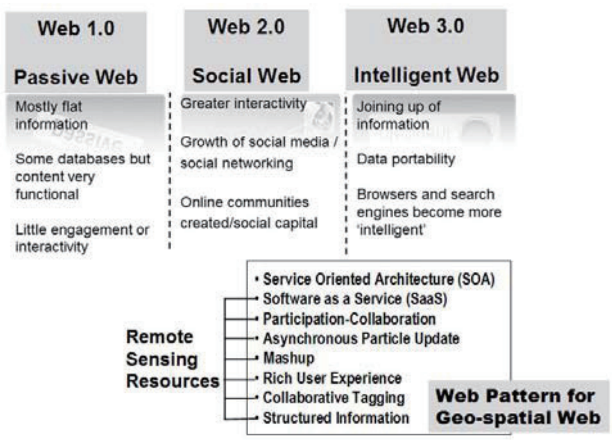

Figure 1. Web paradigm shift from anonymous source and its relevant technological aspects for geospatial web, presumably related to remote sensing resources.

Figure 2 and 3 are regarded as a kind of geo-web, following extended definition, in the viewpoint of improving user interactivity, and of framework of social networking.

Table 1. Summary of Google Maps APIs (Purvis *et al*., 2006)

Category	Some Classes of Google Maps API
Core Object	GMap2, GLatLng, GLatLngBounds and more …
Map Control	GLargeMapControl, GSmallMapControl, GSmallZoomControl, GMapTypeControl, GScaleControl, GOverviewMapControl, GControlPosition, GSize, GMapType and more …
User Data	GMarker GIcon, GInfoWindowTab, GPolyline, and more …
AJAX	GXmlHttp, GXml, GDownloadUrl, and more …
Event	GEvent and more …

Table 2. Types of Geo-processing open sources software supporting OGC standards. URL sources concerned are omitted for brevity.

Standards		Supporting Open Source
WMS	Provider	Deegree, Geoserver, Mapserver
	Consumer	GeoTools, gvSIG, Ka-Map, MapBlender, OpenLayers, OpenJump, uDig, iGeoPortal
WFS	Server	Deegree, Geoserver
	Client	GeoTools, gvSIG, Ka-Map, MapBlender, OpenLayers, OpenJump, uDig, iGeoPortal, OneMap
WCS		Deegree
WTS/WPS		Deegree

Figure 2. Example case: Geo-data authoring and tagging using Google maps APIs (Park and Lee, 2008).

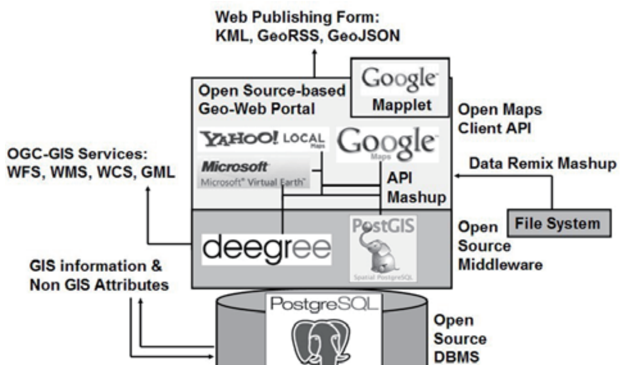

Figure 3. Example case: web mapping mashup with open source stack and OGC standards(Park and Lee, 2009).

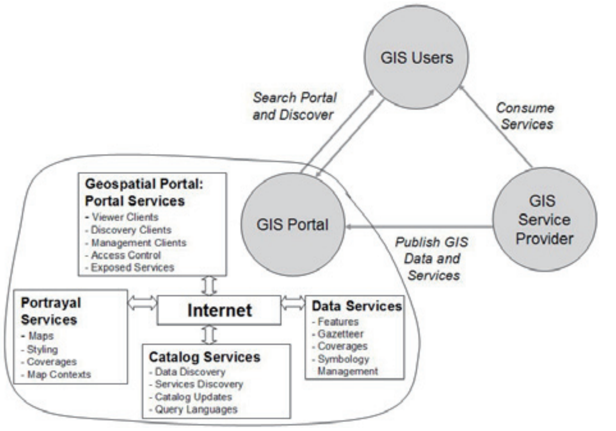

Figure 4. General geo portal scheme in ESRI and portal functionalities by OGC (Rose, 2004).

But these cases are not interoperable system, because they provide somewhat limited functionalities and do not include inference engine with smart search functions. As shown in figure 1, interoperable web emphasizes joining and browsing for searched information. Actual design and implementation of interoperable geo-web can be carried out in many strategy and ways. While, main functions of geo portal are summarized: considering points, evaluating data sets, viewing data, GIS data contributions, data availability, registering services, metadata, and technology. Moreover, these are just one cases, not commonly recognizable definitions.

Figure 4 shows another cases regarding conceptualization of geo portal, although these are simple schemes. Interoperable geospatial web is also difficult to conceptualize in this stage. For this reason, definition and conceptualization for this are not the main theme in this work.

Figure 5 shows structure for geo-web in three tiers; in the serving and publishing tier, open sources for remote sensing can be directly applied in some parts. Anyhow, from technical aspects, interoperable geospatial web contains many components such as mashup, web mapping and geo portal and other general web computing technologies. As well, open source for remote sensing will contribute to realize and implement interoperable geo spatial web.

3. OSRS SOFTWARE

Currently, many web sites introduce free or open source for geo-information processing: freegis.org, opensourcegis.org, geocomm.com, sourgeforge.net, GIS lounge, Osgeo.org, and remotesensing.org. However, as the matter of facts, type classification for user-sided or developer-sided intension is not enough in these most sites. Focusing on remote sensing, three products are selected in this work: OSSIM, Opticks, and Orfeo. Brief reviews are follows (refer to Figure 6).

It is known that OSSIM (Open Source Software Image Map: www.ossim.org) is a high performance software system for remote sensing, image processing, geographical information systems and photogrammetry. It has been developed as an open source software project since the mid-1990s, being funded by several US government agencies in the intelligence and defense community. Designed as a series of high performance software libraries, it is written in C++ employing the latest techniques in object oriented software design. As the second OSRS software, Opticks is open-source software offerings to include new extensions that perform hyper-spectral, multispectral and image spectroscopy analysis, by Ball Aerospace.

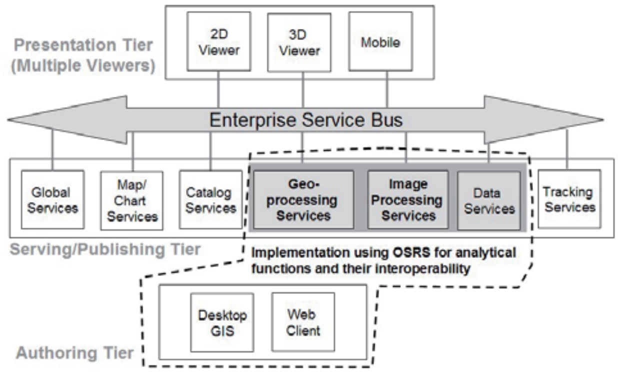

Figure 5. Geo-web structure in three tiers, taken into account of OSRS.

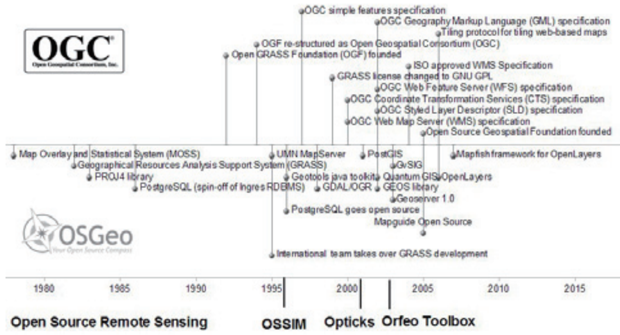

Figure 6. Timeline for OGC standards, open source GIS, and OSRS.

It supports traditional imagery and multi-spectral data as well as SAR, hyper-spectral, and motion imagery. Its expansion includes tools to convert imagery from radiance to reflectance, as well as tools to load and display signatures, specifically wavelength versus reflectance.

As the third, Orfeo Toolbox (OTB) is the definition and the development of tools for the operational exploitation of the future sub-metric optic and radar images for rapid mapping, multi-dimensional aspects, change detection, texture analysis, pattern matching, optic and radar complementarities. The goal of OTB is to enable the user to process satellite images from different sources including satellite and image provider with different levels of pre-processing such as ortho-rectification or radiometric corrections. OTB proposes the basic functions that need to be interconnected to meet the needs of a particular user.

Table 3 is the summary of development environment of these three open sources. Figure 7 represents source components including core classes and extensions and dependency with other open libraries in OSSIM, Opticks, and OTB.

This implies that cross-access between them is possible since these three open sources are closely related. Figure 8 is an example of web services of OSSIM and OTB, concerning OGC WMS. Although these are different interfaces and results, users can use these interoperable functionalities by the integrated design and its implementation.

Table 3. Development environment of OSSIM, Opticks, and ORFEO toolbox

Environment	OSSIM	Opticks	OTB
Operating System	Windows, Linux, Mac, Solaris	Windows, Solaris	Windows, Linux, Mac, Unix
Programming Language	C++, Python	C++, Python	C++, Python, Java

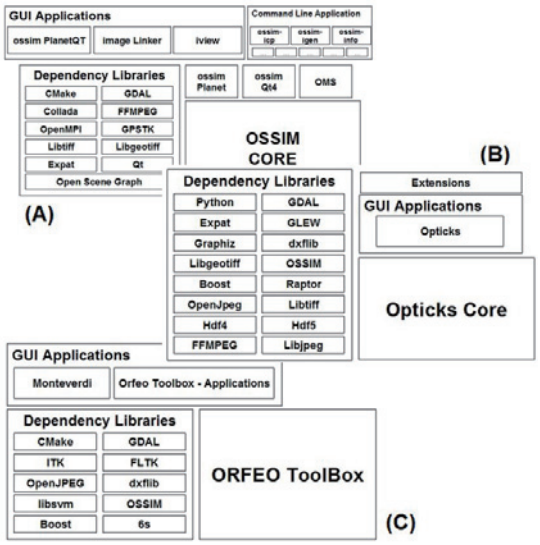

Figure 7. Open source components and dependency with other libraries in OSSIM, Opticks, and ORFEO toolbox.

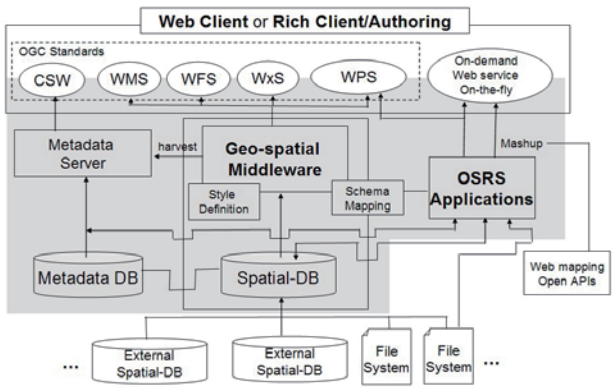

Figure 8. Basic architecture for OSRS applications in the geo-web.

4. CONCLUDING REMARKS

Compared to the proprietary remote sensing tools, some OSRS software provides highly advanced functions to fit specific target applications, as well as basic pre-processing or post-processing ones. However, till now, there are a few comparative and guidance studies to OSRS specialties. In this study, OSRS classification and its summary concerning features and especial specifications are presented in the consideration to land applications, geo-based spatial image databases updating, and geo-spatial web services. The geo-web architecture and system design with several OSRS software is shown in order to land applications to construct remote sensing contents and to provide interoperable web services in geo-web. It is thought that the application and implementation of OSRS software can widen uses-scope of remote sensing applications as IT main stream. It will be extended as geo semantic web with consideration to ontology building for remote sensing resources.

Acknowledgements

This research was partly supported by a grant (07KLSGC03) from Cutting-edge Urban Development - Korean Land Spatialization Research Project funded by Ministry of Land, Transport and Maritime Affairs of Korean government.

References

Benthall, S., 2009. An Open Source Web GIS Solution-The OpenGeo Stack, *GEO informatics*, 12, pp. 40-43.

Bruce, B., 2007. A Survey of Open Source Geospatial Software, presented at MUUG Meeting.

Hall G. B. and M. G. Leahy, 2008. *Open Source Approaches in Spatial Data Handling*, Springer.

Holmes, C, 2007. Towards an Open Geo Web: Linking Open Source's 'Architectures of Participation' to the Global SDI Initiative, *The 9th Conference of Global Spatial Data Infrastructure*.

Maguire, D., 2006. GeoWeb 2.0: Implications for ESDI, 12th EC-GIS&GIS Workshop.

Opticks url http://opticks.org

Orfeo Toolbox url http://www.orfeo-toolbox.org/otb/

OSSIM url http://www.ossim.org/OSSIM/OSSIM_Home.html

Park, Y. J. and K. Lee, 2008. Mashup Application for Geo-spatial Feature Generation on Web Browser using Google Maps API, *Korean Journal of Remote Sensing*, 24, pp. 389-396.

Park, Y. J. and K. Lee, 2009. Application of Deegree of Open Source Middleware to Geo-Portal Implementation, *Korean Journal of Remote Sensing*, 25(4), pp. 367-374.

Purvis, M. J., Sambells, and C. Turner, 2006. *Beginning Google Maps Applications with PHP and Ajax*, APRESS.

Rose, L. C., 2004. Geospatial Portal Reference Architecture: A Community Guide to Implementing Standards-based Geospatial Portals, OpenGIS Disscusion Paper, OGC 04-039.

Scharl, A. and K. Tochtermann (ed), 2007. *The geospatial web: how geobrowers, social software and the web 2.0 are sharing the network society*, Springer.

Sherman, G. E., 2008. *Desktop GIS: Mapping the Planet with Open Source Tools*, Pragmatic Bookshelf.

Steiniger, S. and E. Bocher, 2009. An overview on current free and open source desktop GIS developments, *International Journal of Geographical Information Science*, 23(10), pp. 1345–1370.

Torre, J., 2005. Report of existing GIS standards and software - Deliverable 3.6.1, Core GIS 6.1,ices-SYNTHESYS NA-D 3.6 report, 11p.