MOBILE APPLICATION OF OPEN SOURCE REMOTE SENSING USING DORIS AND OTB AS APPLICATION SERVER

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ABSTRACT: In recent, applications and services on mobile device such as smartphone keep exponentially growing, and are regarded as one of the main streams for scientific engineering. In addition, freely accessible information resources such as Google earth or Google mapping API (Application Programming Interface) have greatly contributed to general and wide uses of remote sensing. Furthermore, there are many types of open sources for geo-spatial data processing. Geo-based applications using them are world-widely increasing in many domains. Accordingly, open source remote sensing is one of prominent areas, but there are a few applications till now. Thus, the development of application software and its service based on open source remote sensing is the main theme in this study. Especially, among many kinds of approaches, mobile application is focused on. For this works, a survey on open source remote sensing is carried out, and it covers optical processing and SAR processing: the former ones of OSSIM, Opticks, and ORFEO Toolbox (OTB), and the latter ones of DORIS, GMTSAR and ROT_PAC. Based on this survey, OTB and DORIS are chosen for implementing sources in this study. OTB is used for general optical remote sensing image processing and analysis, and DORIS is for DInSAR (Differential Interferometric SAR) processing. The implementation system is composed of multi-tier structure: client layer, application server layer, and data server layer. Among them, middle layer is an integrated environment using open source remote sensing of OTB and DORIS. For client layer on mobile device, gvSIG-Mini, another open source, is used, and database server is open source database management system of PostgreSQL/PostGIS. This implementation result is for general users and experts, so that general functions and specific features for a certain domain application are provided. In conclusion, it is expected that applications using open source remote sensing will be extended to widen social impacts of remote sensing in the smartphone age.

1. INTRODUCTION

In these days, it is general that smartphone users can get their interested information through the fast and easy application, abbreviated as app. According to a report related to app store market, over 430,000 apps in various categories have been released at the Apple app store. From the composing period of the smartphone app market, map services or map-based contents including remote sensing images are the most attractive app among them. As well, spatial-based contents and mashup services provide new type of information. However, most of them use open API (Application Programming Interface) and map sets by enterprise portal or search engine companies such as Yahoo map, Google maps or Microsoft virtual earth. Furthermore, those services using geo-based images and map sets are mainly for the map visualization for the location recognition and base mapping purposes. Thus, there are few mobile apps for application experts and operational analysts in the remote sensing domain, till now. It is the initial stage to investigate applicability and necessity of mobile app for remote sensing. As the previous studies related to this research, West and Mace(2010) emphasized the importance of developing app to perform the browsing function, and Meng et al. (2004) summarized types of mobile map applications.

In this study, two themes of open source remote sensing and smartphone app are dealt with, and a prototype of app using open source is implemented with some useful features of image processing and analysis. The contents in this work are composed with three parts: open source remote sensing, smartphone app for optical sensor images, and a portable system implementation for InSAR processing.

2. OPEN SOURCE REMOTE SENSING (OSRS)

In this study, OSRS is separately surveyed as optical image processing and SAR processing. Further, OSRS is one of emerging and prominent fields in the remote sensing area, so that many kinds of open sources exists and are developing. Among the numerous open sources for remote sensing, three kinds of optical image processing open sources are discussed: OTB, OSSIM, and Opticks. While, other three open sources such as DORIS, ROI_PAC, and GMTSAR are SAR processing for InSAR and DInSAR. The selection criteria are activities of users and developers

communities and the number of featured function types provided from open source.

As a preliminary result of this survey, Table 1 shows comparative summary of optical image processing open source of OTB, OSSIM and Opticks. Table 2 is comparative one with respect to open sources for SAR processing: DORIS, ROI_PAC, and GMTSAR. Most open sources provide InSAR and DInSAR processing functions, but they need theoretical basis including mathematical formulization or principle, and work-flow for SAR processing beginners is not easy. These aspects maybe act as barriers for persons who want parts of SAR image processing or full processing. Thus, approach using open sources is necessary and affordable because possibilities for customizing and optimizing.

Table 1. Comparison of OTB, OSSIM and Opticks, for optical image processing

Main Category	Sub Category	OTB	OSSIM	Opticks
Reading and Writing Data	Image and Vector	●	●	●
Basic Filtering	Threshold	●	●	▲
	Edge Detection	●	▲	□
	Neighborhood Filter	●	●	▲
	Smoothing Filter	●	▲	▲
	Convert	▲	●	▲
Feature Extraction		●	▲	□
Image Segmentation	Region growing	●	▲	□
	Level Set	●	□	□
	SVM based region growing	●	□	□
Classification	K-Means, SVM, SOM	●	□	□
Change Detection		●	□	□
Disparity Map Estimation	Estimation	●	□	□
Radiometry	NDVI, ARVI, AVI	●	▲	▲
Orthorectification and Map Projection		●	●	●
Image Registration		●	▲	▲
Band	Band Processing	●	●	●
Correction	Radiometry	●	●	□
Spectral Processing		□	□	●

[Note] ●: Supported Feature, ▲: Partly Supported Feature, □: Weakly Supported Feature

Table 2. Comparison of ROI_PAC, DORIS and GMTSAR

		ROI_PAC	DORIS	GMTSAR
Command Line		●	●	●
GUI		X	X	X
InSAR		●	●	●
Atmospheric Correction		●	□	□
D-InSAR		●	●	●
Geocoding		●	●	●
Supported SAR Data	ERS	●	●	●
	ENVISAT	●	●	●
	RADASAT	●	●	□
	JERS-1	●	●	□
	ALOS	●	●	●
	TERRASAR-X	□	●	□

[Note] ●: Supported Feature, ▲: Partly Supported Feature, □: Weakly Supported Feature

3. REMOTE SENSING SMARTPHONE APP: ARCHITECTURE AND IMPLEMENTATION

Table 3 is open source list, applied in the smartphone app implementation attempted in this work. The purpose of this implementation is for demonstration and proof for further remote sensing application for smartphone markets and research areas, as well as OSRS applicability. In fact, Kang and Lee (2011(a)) developed a prototype; in this work, some functions are newly added. Briefly, this system is client-server structure. As the image viewer with display functions, gvSIG Mini on Android smartphone is for client (Carrasco and Romeu, 2010).

. As server-side, OTB is used as application processing server. OTB is chosen as the most useful open source in this study in Table 1 and Kang and Lee (2011(b)).

Figure 1 represents system components and main features in the smartphone app.

Figure 2 is image processing menu system provided by app and some actual processing results such as canny edge detection or Harris point detection, with KOMPSAT-2 images by geo-correction and mosaic processes. Vector layers can be operated in this app.

Table 3. Open source list for smartphone app

	Environment	Version
Server-side	Operating System	Fedora 12
	Orfeo Toolbox	3.8
	GDAL	1.8.1
	PostgreSQL	8.4.4
	PostGIS	1.4.2
	Python	2.6.2
Client-side	Operating System	Android 2.2
	gvSIG mini	0.2.0
	Java JDK	1.6.0_18

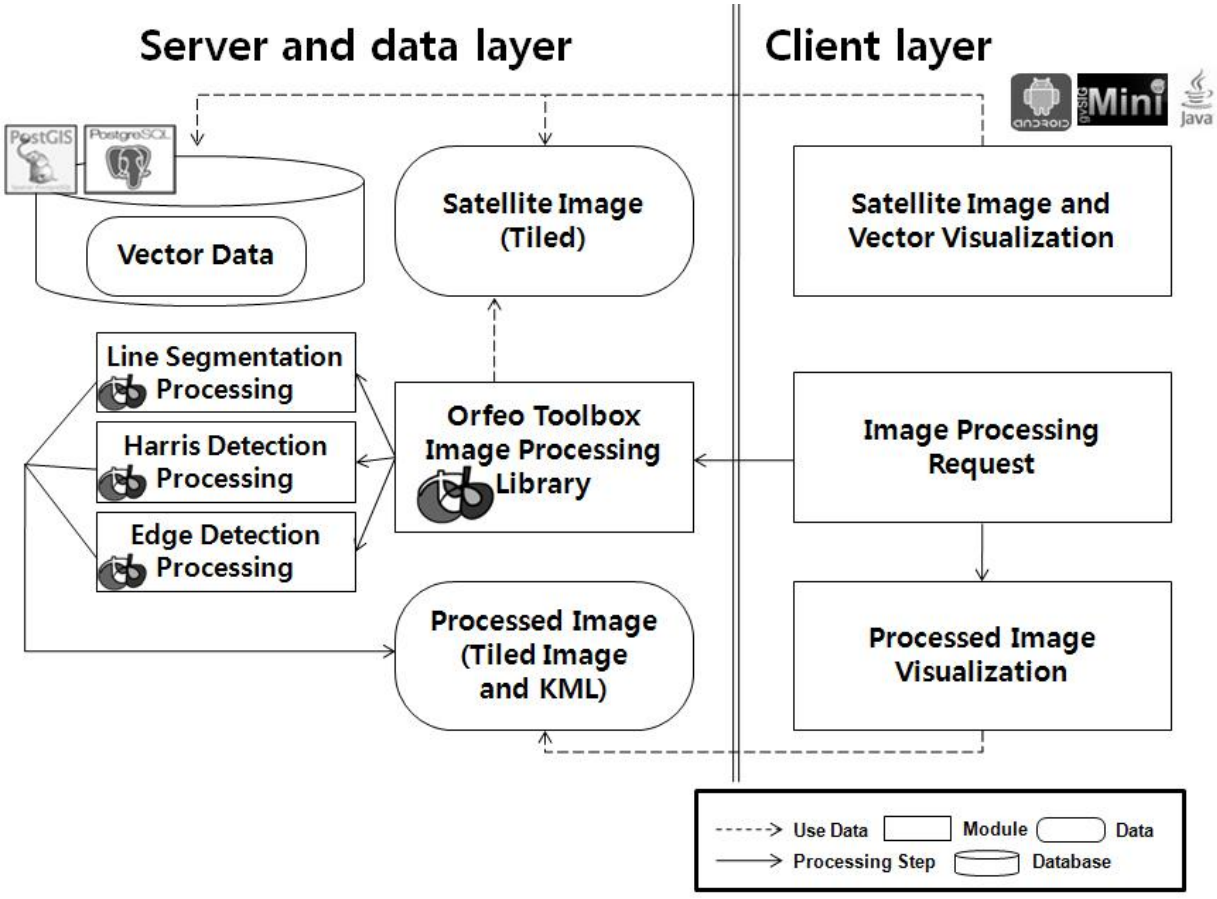

Fig. 1. Remote sensing smartphone app: System components and main features.

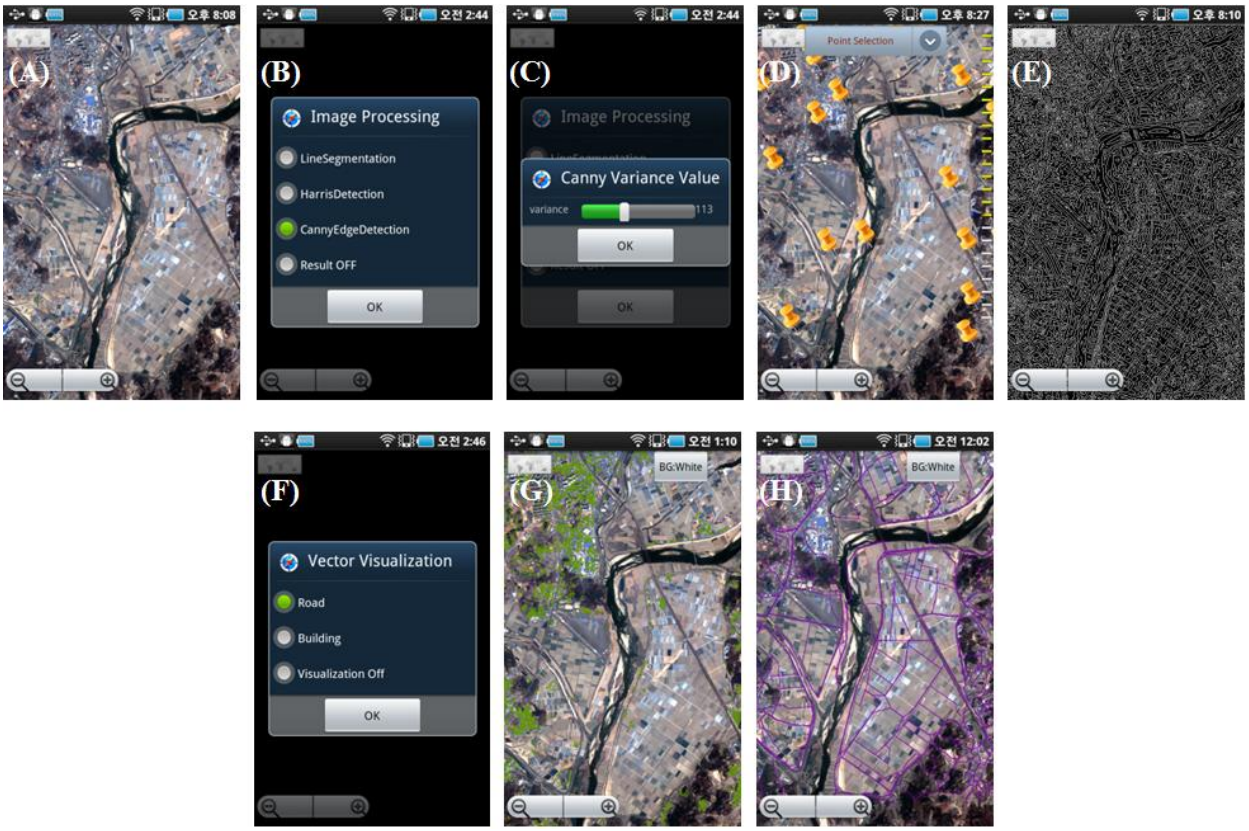

Fig. 2. (A) Image set as initial data, (B) Image processing menu, (C) Canny edge detection menu, (D) Harris point extraction result, (E) Canny edge detection result, (F) Vector visualization menu, (G) Building visualization and (H) Road visualization.

4. DORIS-GUI: ARCHITECTURE AND IMPLEMENTATION

OSRS for SAR processing needs different processing scheme from optical sensor image. Remote sensing software system provide optical image processing functions and SAR functions, but most cases are modular. Therefore, integrated system for optical images and SAR images, using OSRS, is possible to implement. However, separate system for InSAR and DInSAR is presented in this stage. This system is based on DORIS, one of OSRS SAR. The reasons of this selection are well-documentation and accuracy test of processing results with other proprietary SAR software (TUDelft, 2008; Simonetto and Follin, 2009).

DORIS-GUI, a development product in this study, provides InSAR functions of original DORIS with user-friendly interfaces. A module for semi-automatic geometry processing with the processed SAR results is added (Figure 3). Table 4 is open source list, applied in the DORIS-GUI. Figure 4 shows development product of DORIS-GUI and actual processed results using ALOS SAR data sets: (A) Coherence image and (B) fused result Interferogram with Amplitude. Figure 5 is the visualization results for InSAR images searched and browsed by Android app.

Table 4. Open source list for DORIS-GUI

	Environment	**Version**
DORIS-GUI	Operating System	Fedora 12
	FLTK	1.1.9
	DORIS	4.02
	Orfeo Toolbox	3.8
	SNAPHU	1.4.2
	Python	2.6.2
	GDAL	1.8.1

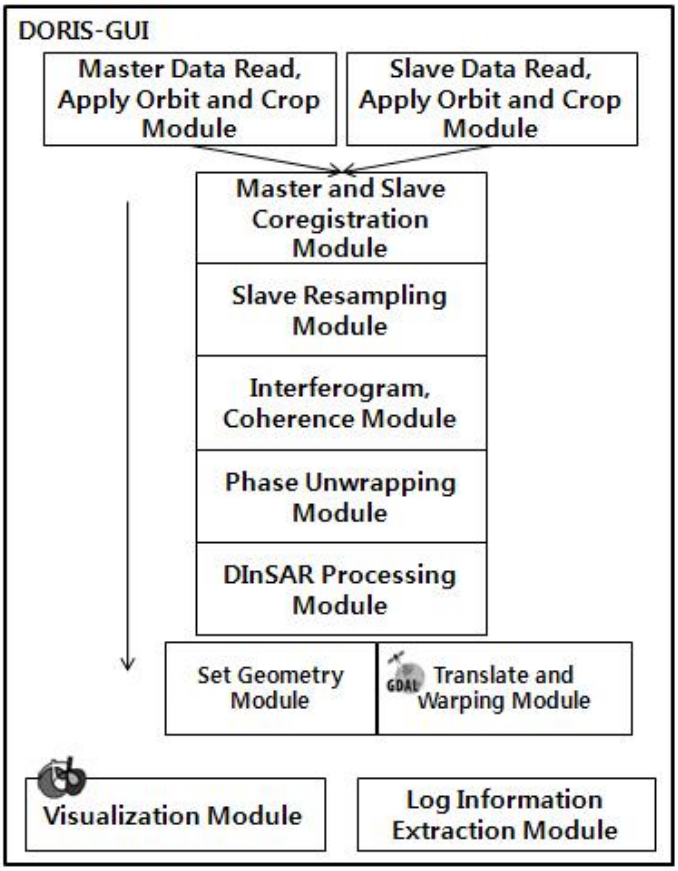

Fig. 3. DInSAR processing work flow and implementation environments applied in this study.

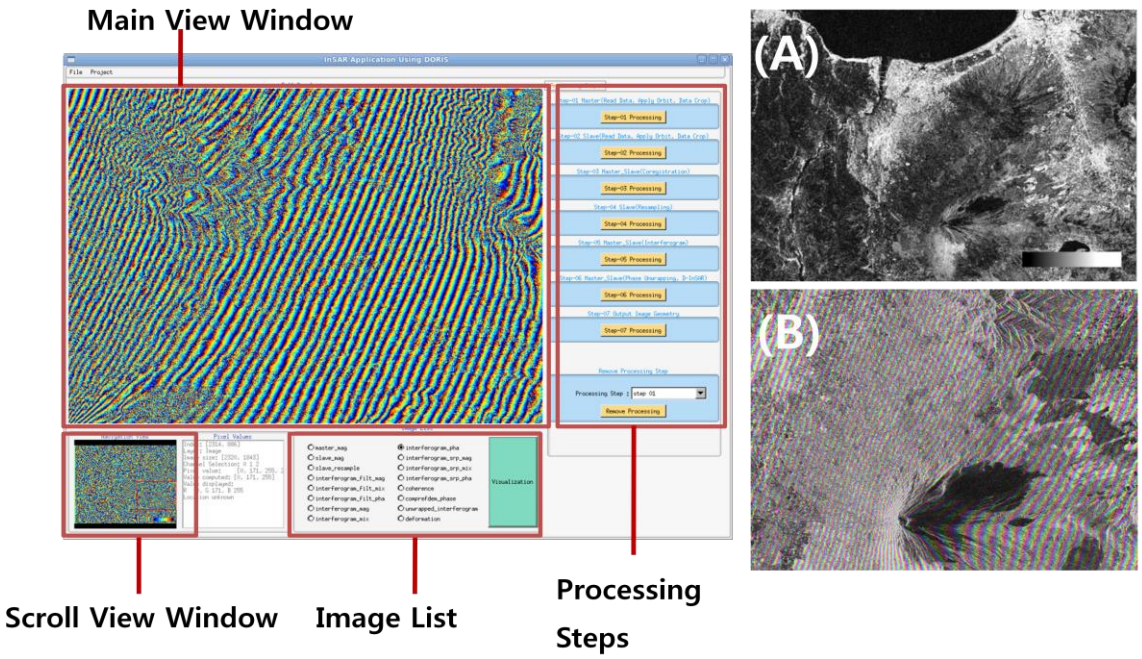

Fig. 4. Development product of DORIS-GUI and actual processed results: (A) Coherence image and (B) Interferogram + Amplitude.

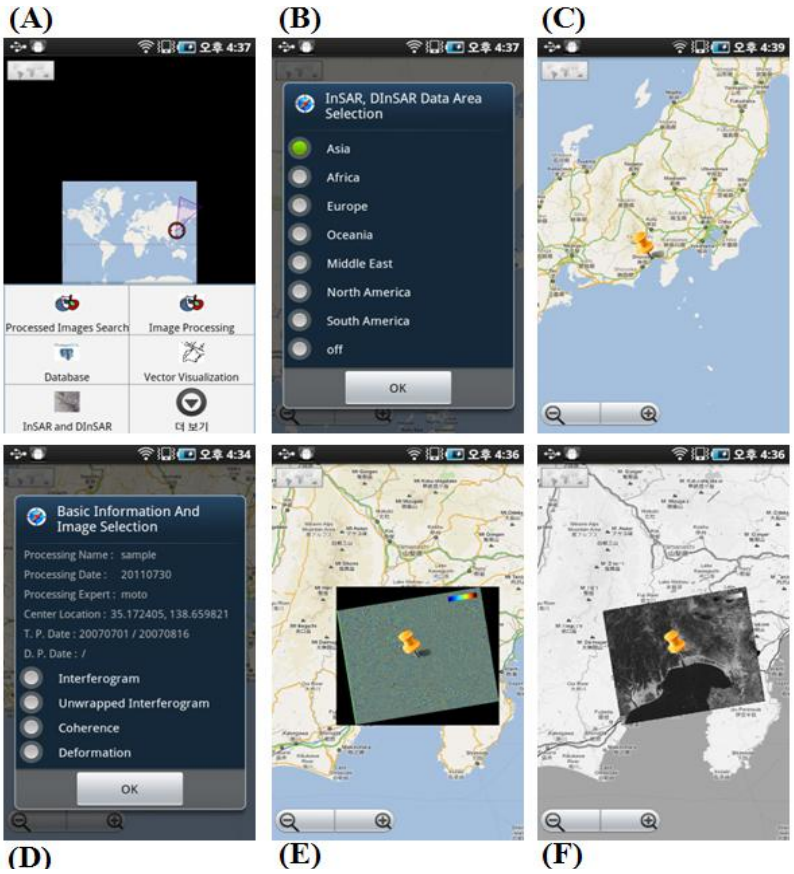

Fig. 5. (A) Main menu, (B) Area selection menu, (C) InSAR data location marker, (D) Processed InSAR image selection, (E) Interferogram visualization and (F) Coherence map visualization.

5. CONCLUDING REMARKS

OSRS is one of emerging fields in remote sensing. As well, mobile application such as the smartphone app is also needed to consider for the remote sensing application expansion in future. These trends are somewhat different from conventional and traditional approaches in the remote sensing.

Three contents are dealt with for those. First, OSRS survey and the comparison are carried out, and the results are summarized with the focus of supporting functionalities. Second, open source for optical image processing is applied for the smartphone implementation. This system can be extended as a specialized app for a given target application with the requirements of remote sensing data processing and analysis, even to classification, unlike current map services offered by web portal. Last, OSRS for InSAR and DInSAR processing is examined and surveyed. With these works, DORIS-GUI is implemented for general users or beginners, even for experts. InSAR or DInSAR results can be provided as mobile contents.

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