A Mobile Application for Geographical Data Gathering and Validation in Fieldwork (Invited Talk)

Karine Reis Ferreira,
Lúbia Vinhas,
National Institute for Space Research (INPE), Brazil
{karine, lubia}@dpi.inpe.br

Cláudio Henrique Bogossian,
André F. Araújo de Carvalho
Foundation of Science, Technology and Space Applications (FUNCATE), Brazil
{claudio.bogossian, andre.carvalho}@funcate.org.br

ABSTRACT
Mobile devices, such as smartphones and tablets, are useful tools for *in situ* collecting information about spatial locations. In this paper, we describe the architecture of a mobile application for geographical data gathering and validation in fieldwork. This application is being developed based on well-established standards in order to assure spatial data interoperability between existing Spatial Data Infrastructures (SDI) and mobile systems.

Categories and Subject Descriptors
D.2.11 [**Software Engineering**]: Software Architecture – *domain-specific architectures.*

Keywords
Mobile application, spatial data, interoperability

1. INTRODUCTION
The recent advancements of GPS, wireless communication network and portable technologies have motivated the use of mobile devices for *in situ* gathering information about spatial locations and validating geographical data [1][2]. Tsou [1] defines the term *mobile Geographical Information System (mobile GIS)* to refer to an integrated technological framework for accessing geospatial data and location-based services through mobile devices, such as smartphones and tablets. He argues that there are two major application areas of mobile GIS, *field-based* GIS and *location-based* services. This work focuses on mobile field-based GIS, that is, mobile systems for geographical data collection and validation in the field.

Two examples of projects that need mobile field-based GIS are PRODES (Monitoring of Brazilian Amazon Rainforest) and DETER (Real Time Deforestation Detection System), developed by Brazilian Institute for Space Research (INPE) [3]. PRODES has been yearly monitoring deforestation since 1988 whereas DETER has been producing near real-time deforestation and forest degradation alerts for more than 5 million Km^2 in the Brazilian Legal Amazon. Specialists of these two projects require mobile systems to collect extra information about deforested regions (e.g. photos) and validate them in the field, including places where there is limited or any network connectivity available.

DeMobile'15, August 31, 2015, Bergamo, Italy
ACM. 978-1-4503-3815-8/15/08
http://dx.doi.org/10.1145/2804345.2804354

Therefore, an essential feature of geographical data collection and validation mobile systems is the capability of working *offline*. To meet the demands of these two projects, this paper presents an ongoing work on designing and implementing a mobile application for geographical data gathering and validation in fieldwork. Section 2 presents its architecture and section 3, its implementation issues.

2. ARCHITECTURE
TerraMobile App is the name of the mobile application for geographical data gathering and validation in fieldwork developed in this work. Figure 1 presents its general architecture.

TerraMobile App has two modules for accessing geographical data, "*Online Data Access*" and "*Offline Data Access*". The "Online Data Access" module accesses geographical data from Spatial Data Infrastructures (SDI) through two kinds of well-known Open Geospatial Consortium (OGC) web services, Web Map Server (WMS) and Web Feature Server (WFS) [4] [5]. This module only works online and will be used when there is network connectivity available in the fieldwork.

SDI is a sharing platform that facilitates the access and integration of multi-source spatial data in a holistic framework with a number of technological components including policies and standards [6]. Nowadays, many data providers throughout the world have created their own SDIs, organizing and disseminating their geospatial data sets and metadata on the Internet via OGC web services. Accessing spatial data sets from distinct SDIs can improve the geographical data collection and validation task.

The "Offline Data Access" module works offline and is responsible for accessing geographical data in the mobile storage memory. We propose to store them in OGC Geopackage files [7].

The Geopackage specification defines a SQL database schema designed for the SQLite software library. This schema contains a set of pre-defined tables with integrity assertions, format limitations and content constraints to store spatial data sets and their metadata. GeoPackage files are platform-independent SQLite database files that contain vector and tiled raster data sets as well as their metadata. They are interoperable across different platforms, including personal computing environments and mobile devices.

To prepare GeoPackage files to be used in the mobile application, we are developing a plugin, called **TerraMobile plugin**, for the Geographical Information System (GIS) TerraView. TerraView is a general-purpose GIS developed using the TerraLib GIS library [8]. TerraView supports the development of plugin to enhance its functionalities.

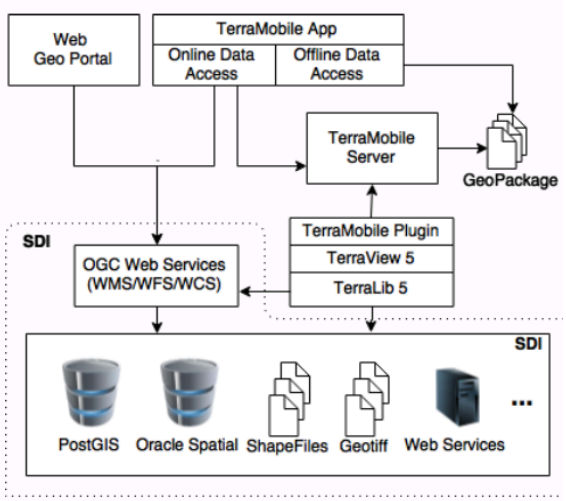

Figure 1 – TerraMobile architecture

TerraMobile plugin allows users to delimit an interesting area, access spatiotemporal data sets from different kinds of data sources and generate Geopackage files from these data sets. The generated files will be available through the **TerraMobile server**. Besides that, users can define the forms for acquiring data on fieldwork and synchronize the gathering data with the SDI using the TerraMobile plugin.

3. IMPLEMENTATION

TerraMobile App is being implemented for Android operation systems. We are using Android SDK (Software Development Kit) and Java language. Figure 2 shows the TerraMobile App.

In most cases, we are using native Android graphic components. However, we are also using some third party libraries to show components like maps and access geospatial data. We are using the following technologies:

- **Android SDK Api 15+ (4.0.3 ICS)**: the lowest version of the Android SDK.
- **OSMDroid Map Library**: an open source mapping library that replaces Android Native MapView. It allows users to implement an abstract tile provider for offline or online data and also to plot overlays over the map, like icons, tracking locations and drawing geometries.
- **Java Open Mobility Library**: an open source library that allows the creation, insertion, query and update of geospatial vector features and raster tiles on OGC GeoPackage Standard for Android applications. It uses JTS Topology Suite and GeoAPI to stores data on OGC Simple Features Specification.

4. ACKNOWLEDGMENTS

Our thanks to Boeing Research and Technology – Brazil (BR&TB) that is funding the development of the TerraMobile App under the INPE-Boeing project "Geotechnologies for Efficient Energy Crop Management".

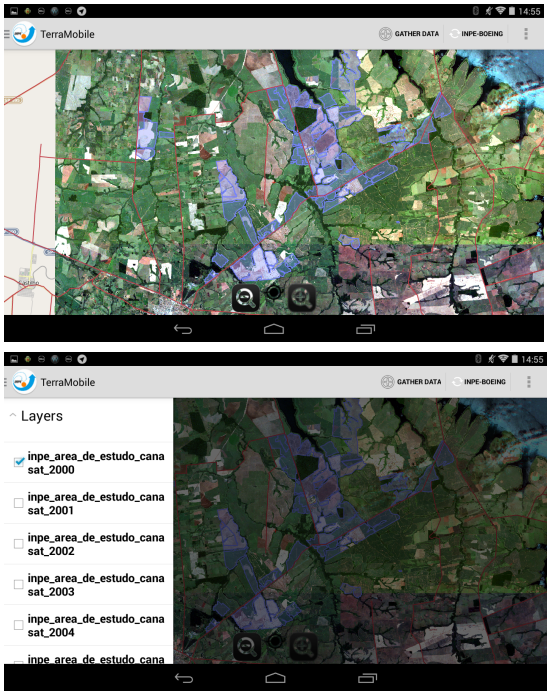

Figure 2 – TerraMobile App.

5. REFERENCES

[1] Tsou, M. H. 2004. *Integrated mobile GIS and wireless internet map servers for environmental monitoring and management*. In: Special issue on Mobile Mapping and Geographic Information Systems, Cartography and Geographic Information Science 31 (3): 153–165.

[2] Poorazizi, E., Alesheikh, A. A. and Behzadi, S. 2008. *Developing a Mobile GIS for Field Geospatial Data Acquisition*. Journal of Applied Sciences, 8(18), 3279-3283.

[3] INPE. 2014. *Monitoramento da Floresta Amazônica Brasileira por Satélite* (*Monitoring the Brazilian Amazon Forest by Satellite*). Available at www.obt.inpe.br/prodes.

[4] OGC. 2006. "OpenGIS Web Map Server Implementation Specification". Available at: http://www.opengeospatial.org/

[5] OGC. 2010. "OpenGIS Web Feature Service 2.0 Interface Standard". Available at: http://www.opengeospatial.org/

[6] Rajabifard, A., Feeny and M. E., Williamson, I. 2002. *Future Directions for SDI Development*. International Journal of Applied Earth Observation and Geoinformation 4 (1), 11-22.

[7] OGC. 2014. *GeoPackage Encoding Standard*. Available at: http://www.opengeospatial.org/

[8] Camara, G.; Vinhas, L.; Queiroz, G. R.; Ferreira, K. R.; Monteiro, A. M. V.; Carvalho, M. T. M. and Casanova, M. A. 2008. *TerraLib: An open-source GIS library for large-scale environmental and sócio-economic applications*. Open Source Approaches to Spatial Data Handling. Berlin: Springer-Verlag