Chapter 15
A Web and Mobile System for Environmental Decision Support

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ABSTRACT

Current field data collection methods for many of today's scientific and other observer/monitor type applications are still entrenched in the “clipboard age”, requiring manual data transcription to a database management system at some (often much) later date, and only allows for visualisation and analysis of recently captured field data “back in the lab”. This chapter is targeted at progressing today's pen & paper methodology into the spatially enabled mobile computing age of real-time multi-media data input, integration, visualisation, and analysis simultaneously both in the field and the lab. The system described is customized to the specific needs of the Canadian Great Lakes Laboratory for Fisheries and Aquatic Sciences Fish Habitat Management Group requirements for fish species at risk assessment, but is ready for adaptation to other environmental agency applications (e.g. forestry, health-pesticide monitoring, agriculture, etc.). The chapter is ideally suited to all agencies responsible for collecting field data of any type that have not yet moved to a state-of-the-art mobile and wireless data collection, visualisation, and analysis work methodology.

INTRODUCTION

The latest developments in Internet and mobile technologies have given rise to the implementation of applications easily accessible anytime and anywhere (Hinze et al., 2003; Schiller, 2000; Talukder et al., 2006). Many such applications provide context-based information that can be especially useful for field work, where the manipulation of
spatial datasets, including maps of the areas visited, is often required. Examples of professional users that avail of spatial data during their field work are environmental scientists, surveyors, geographers. Spatially enabled computing has the potential to provide crucial decision support to such users by exploiting positional information and associated contextual knowledge. However, notwithstanding the recent advances in spatial and GIS technologies and the availability of increasingly more detailed spatial data, there is still a lack of effective spatial decision support systems.

This chapter describes our experience in the development of a Web-based and Mobile Environmental Management System (MEMS) tailored to deliver context-aware functionality aided by visualization, analysis and manipulation of spatial and attribute datasets. The MEMS datasets are provided by the Canadian Department of Fisheries and Oceans (DFO) and the system is customized to the specific needs of the Great Lakes Laboratory for Fisheries and Aquatic Sciences (GLLFAS) Fish Habitat Management Group requirements for fish species at risk assessment. Before the MEMS system was developed, biologists had only access to the fisheries data from their office. This prevented interacting with the data in a real-time environment, reducing their productivity and effectiveness in the field. Spatially enabling a mobile device allows mobile GLLFAS biologists to make informed decision immediately.

The functionality required by GLLFAS biologists includes access to geo-referenced maps and imagery, to overlay the current position on a map and to manipulate (e.g. input/edit/query) attribute data in the field while wirelessly connected (where possible) to the office database. Additional functionality also required is the ability to record, edit and view multimedia annotations, perform scientific/common-name conversion and graph generations of results. The traditional “fish species at risk” work-flow, whereby scientists enter textual/pictorial information on paper field data sheets is inefficient, has potential for inaccuracies during both initial recording and subsequent data entry phases, and does not facilitate knowledge-sharing between staff. Also, different types of information may be stored in different locations and valuable time can often be lost trying to correlate data in order to make decisions.

On the contrary, the MEMS system provides many advantages over traditional practice for the GLLFAS scientists. Firstly, it facilitates knowledge-sharing and data analysis/synthesis: indeed, it supports effective communication between different staff at different physical locations (e.g. scientists in the laboratory and colleagues in the field). A standard web-browser is crucial for presenting a familiar “look and feel” interface for staff to input and access information anywhere at any time without having to return to dedicated access points (e.g. in the office).

Furthermore the advanced functionality provided by MEMS allows important multimedia data and associated annotations to be combined with traditional text-based records. Such a system deploys the most recent GIS and mobile technologies and therefore provides a high level of functionality not just for collection and manipulation but also for spatial analysis of the data that was not available to these scientists before. MEMS not only facilitates the work of the GLLFAS biologists but also makes their collected data more reliable and accessible by eliminating both transcription errors and the time elapsed between data collection and data entry, thus saving time as well as tedious paperwork.

MEMS presents important advantages over other existing mobile environmental systems as it provide its users with the possibility of availing of both an on-line version, when network connectivity is available, and an off-line version when network connectivity is lost. The two versions can be automatically and accurately synchronized,