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Geospatially aware social software and Africa

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Abstract

We present a proposal for the development and implementation of a group of tools that will support the collection and sharing of georeferenced information. Locations such as rural Africa suffer from a technical problem hampering their participation in the global information community: infrastructures and terminals for Internet access are non-existent or of poor quality. We believe that cell-phone software can be leveraged as a way to bridge this. One important contribution that local communities can provide to the global community is local knowledge. By providing a cell-phone application, people living in low-tech areas can gain the ability to make available worldwide that knowledge, taking full advantage of georeferenced functionalities. This proposal envisages the use of a wiki backbone connected to a map server, allowing information to be added, consulted, edited, and searched, providing strong version management across several users. The georeferenced information can be useful for tackling specific development issues, such as drought problems, outbreaks of diseases, etc. – giving NGOs and governments a better framework upon which to act. By allowing local people to gather, organize and transfer data directly, organizations both local and worldwide can act on timely and accurate local information, as can farmers, local businesspeople, etc. Education is yet another area of application for such a system: teachers would be able to use it to provide a widespread audience for their students' tasks and engage students in collaborative tasks across regions. This ability to publish and retrieve local information can be used by students to share local history and local traditions, contributing to the awareness and preservation of ancient knowledge and customs, and benefiting from cooperation with similar projects in other towns, whether in their own countries or abroad.

Keywords

Mobile devices, georeferenced data, wiki, maps, education, Africa.

1. Introduction

Large part of the African continent is still today victimized by constant crisis, due to both natural and human causes, which are not the least favorable to a fast and healthy development. Also at the level of information and telecommunication systems one frequently finds areas seriously lacking. And yet, such systems form a critical basis for the fast, fair, and effective development of a community, by allowing more and better information to be provided by and to its members. Only by receiving correct information from communities and making it reach those who require it, can measures be taken and solutions found for problems affecting people's lives. The use of georeferenced information, in particular, is of major importance to allow any organization to achieve the greatest possible impact within a population.

Currently, information supporting the field activity of various organizations is frequently incomplete and not entirely up-to-date. And this, to a great extent, is due to the aforementioned communication and information deficiencies, which strongly contribute to constrain the success possibilities of any initiative. The proposal we put forth here aims to provide a technological means which can contribute to solve this problem. Traditional methods for harvesting information within a community are not entirely reliable and suffer from a long time gap between the time of their collection and the time of information use. Consequently, the direct contribution of those better acquainted with local issues – local citizens – is often partially or entirely ignored. The intent of our proposal is to establish a basis for development field work, allowing local populations to contribute with their knowledge on the spot, so that one can benefit from that information globally.

We selected Ethiopia as the regional location for the field tests, once a prototype is developed. This selection was made in view of existing cooperation between local institutions and the organization AHEAD, connected to one of the authors of this paper.

2. Technological overview

Our proposal is based on the use of a central server for information processing and storage, with which geographically-dispersed user terminals communicate (*vd.* Figure 1).

In a country like Ethiopia, with a mainland area of 1.119.683 km², the use of mobile communications stands out as a low-cost infrastructure solution to bring connectivity to

various parts of the country. At this level, one can resort to various forms of communication between mobile devices and a central information store. For instance, GPRS packets, GSM or satellite dial-up, or automated transmission of SMS by adequate software. We propose that the software installed in the mobile device can adapt itself to the various situations, and be capable of employing the better solution, either in terms of communication bandwidth or costs for the user.

Regarding the server, several collaborative software technologies do exist. These technologies, usually referred to as groupware, are implementations on the scientific field known as Computer-Supported Cooperative Work (CSCW) (Borghoff & Schlichter, 1998, p. 529). Generically, they allow geographically-distant people to break physical barriers, form on-line communities and collaborate, through the Internet. This collaboration can be either synchronous or asynchronous, depending on the simultaneous or non-simultaneous presence of the collaborators. Typical synchronous collaboration scenarios are electronically supported meetings and group awareness systems; examples of asynchronous scenarios are workflow management, collaborative editing and shared information workspaces (Mackay, 1999, pp. 55-82). The system we propose in this paper fits in the latter category. A well-known example of such systems is the collaborative on-line encyclopedia, Wikipedia (Wikipedia, 2006), which is based on a technology known as *wiki*. Wikis are tools that allow a group of people, with few technological resources and in a short time, to create, edit and change – collaboratively – content available on a web server. The wiki system provides an automated registry and version control for documents, collaboratively edited by the various users (Ebersbach, Glaser, & Heigl, 2005). The flexibility, robustness and popularity of wiki technology motivated its adoption in our proposal as the technological component at the server level.

In order for the user to enter georeferenced information, we propose that such actions take place by directly pointing out on a map the place to which he/she desires to associate some information. Several alternatives can be considered, depending on the mobile phone capabilities and connectivity features: use of either vector or raster (bitmap) maps; hosting the maps directly in the system server, or using pre-existing map-server services (*e.g.*, Google Maps); lastly, one can also consider that maps may be transferred to the mobile phones while the application is being used, or that they are preloaded and then updated only

in high-connectivity conditions (and in this last case, only positioning data is transmitted, besides those entered by the user).

3. Proposed system configuration

We propose that mobile devices are used as the front-end for a system made of the following elements: mobile devices, wiki server, and map server (*vd.* Figure 1).

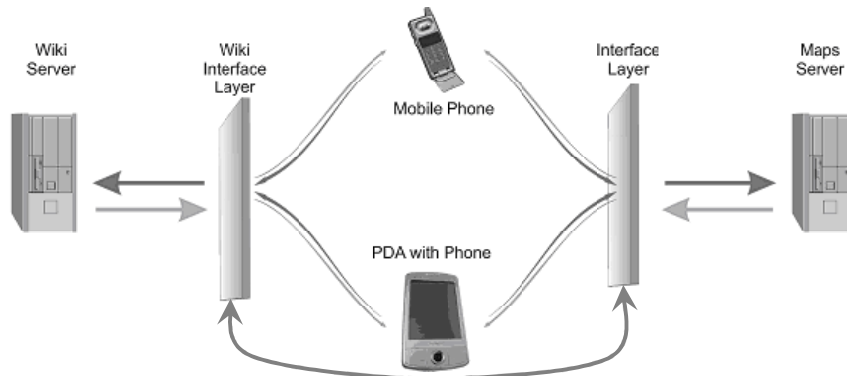


Figure 1: Operational scheme of the proposed system.

The mobile devices used as front-end for the system, which can be mobile phones, PDAs, or even the OLPC – now called 2B1 (One Laptop Per Child, 2006), provide the user with a convenient interface. This interface will consist of maps, navigation menus, and options for searching, editing, and entering georeferenced information (*vd.* Figure 2).

We emphasize that in the proposed system the front-end devices should only perform as little data processing as necessary in order for the user to employ the application. All major logic processing takes place at the server (*i.e.*, map manipulation and vector-to-bitmap conversions), thus avoiding burdening of the scarce processing power of mobile devices. When maps are found preloaded in the mobile device, such maps are just a set of bitmap images presenting a limited area, and those bitmaps are simply selected and displayed by the application running on the device.



Figure 2: Mock-up examples, with the proposed front-end interface

The interface should respond to the features of the mobile device employed by the user, in order to ensure that it can run on various devices with different levels of hardware resources. The minimum equipment requirements for the front-end interface should be: ability to connect to the Internet and/or use SMS; and have enough display resolution for presenting maps. In order for the operation of wiki and map servers to be independent of actual mobile devices, an interposing software layer must be developed (“Interface Layer”), with components adapted to each kind of device. Its function is to convert requests native to each device into generic request, which will then be interpreted by the servers. We also propose that data communication between all system components is performed, as much as possible, with standard XML-encoded data.

As for content storage and access control, these functions will be performed by a wiki server, as mentioned earlier. The actual wiki server software can be one of those readily available for free use; for instance, Tikiwiki (Tikiwiki Community, 2006). Whichever is used, it will have to be modified to support all the system requirements. To achieve this, we propose the development of an external software layer,—acting as an interface to the wiki

system (“Wiki Interface Layer”). This way, it’s possible to use the logic structure of a wiki server, and avoid basing the entire system on the specific interface of the chosen wiki server software.

4. Internet access in Ethiopia

In general, Internet-access infrastructures in rural Africa are non-existent or of low quality. In the specific case of Ethiopia, Ethiopian Telecommunications Corporation (ETC) is the only provider of land-line or mobile communications networks. Its range of operation is quite limited, reaching less than 1% of the total population (74,777,981 inhabitants was the July 2006 estimate – Central Intelligence Agency – CIA, 2006): it’s limited to the outskirts of 15 major towns. As for Internet use, *"Even by the standards of the worlds least wired continent, Ethiopian internet usage is low: less than 0.1% of the population goes online"* (Cross 2005). However, this coverage is sufficiently dispersed across the country for the use of a mobile-based software solution to make a difference in terms of community impact: the towns with coverage are located around the central capital, Addis Ababa, but also to the North, West, East, and South, several hundred kilometers from one another.

Within a country of immense cultural and ethnical diversity, where part of the population are extremely isolated, spread across considerable distances, the cost of implementing a physical communication infrastructure are extremely high; particularly so if one takes into account that this is one of the world’s poorest countries. Its estimated GDP per capita in 2005 was USD 900 (CIA, 2006), and its 2005 Human Development Index was 0,367, which ranks Ethiopia as 170 among 177 countries (United Nations Development Programme, 2005, p. 222).

Both governmental and non-governmental organizations come across serious communications difficulties in order to collect, store, and disseminate information throughout the rural areas of the country. Aiming to overcome this problem, recent years have seen considerable investments in the Ethiopian mobile communications infrastructure (Afrol News, 1998; ETC, 2006a).

Therefore, we believe that after a system such as the one we propose is developed, its potential geographical use range is likely to increase in coming years. As mentioned earlier, we intend to develop a prototype of the proposed system and field-test it in Ethiopia, in order to bring to people living in rural areas the means to provide, globally, information on

local issues. These can range from economic development themes to educational issues (disease outbreaks, droughts, soil data, environment data, local customs and traditions, etc.).

5. Final thoughts on social software and education

“(...) social software is also characterised by community gains: (...) many users benefit from other users acting in sociable and community-oriented ways. This stems from the belief that a whole can be greater than sum of its parts – that the concerted social actions of strangers benefit us all. Social software and the changing goals in education seem to be moving in the same direction.” (Owen, Grant, Sayers, & Facer, 2006).

This kind of software, used by and for all, is of great importance, because it allows a group of people to communicate amongst themselves and with global partners, publishing experiences and knowledge, and developing with this exchange of information: developing themselves and developing their integration within the global community. The deficiencies of information infrastructures in Ethiopia deny that integration, preventing its people (especially the younger generations), from obtaining the benefits that can be achieved through contact with other students from different towns, regions, even countries. This exchange of information would contribute to education, and could lead to the creation of a more capable information-age generation. A generation holding the potential to bring this country to a higher development standard. This is what we wish to contribute to.

Education is not the single or even major area of application of our proposed system, but simply one amongst many. For instance, teachers would be able to improve their methodology regarding the tasks of gathering, organizing and transferring data, by allowing central organizations to act and cooperate with them based on timely and accurate local information. And at length, this ability to publish and retrieve local information can be used by local students to share local history and local traditions, contributing to the preservation of ancient local knowledge and customs, and benefiting from cooperation with similar projects in other towns, whether in their own countries or abroad. But these are mere glimpses of what might become achievable.

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