

SmartLibrary – Location-Aware Mobile Library Service

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Abstract. Searching books in large libraries can be a difficult task for novice library users. This paper presents SmartLibrary, a location-aware mobile library service demonstrated in the main library of the University of Oulu. The service provides map-based guidance to books and collections on a PDA. SmartLibrary is a completely software-based solution, which can be provisioned atop a WLAN installed for wireless Internet access, without any additional hardware. In a user evaluation conducted with over 30 patrons SmartLibrary was preferred over traditional shelf classification for finding books. After user evaluation the main library added SmartLibrary into their standard customer service.

1 Introduction

Many location-aware mobile services have been proposed for public spaces such as museums and exhibition areas. Costa Aquarium in Genoa, Italy [1], and Exploratorium in San Francisco, US [2], are examples of exhibition areas enhancing the visitor experience with mobile multimedia guides. User tests have also been conducted on those guides to find out usability issues and user acceptance.

In museum multimedia systems, location information is typically used in one hand to aid navigation, and in other hand to show user information of the exhibits nearby. In libraries, the user needs are different. Library patrons are typically searching for a particular book, or books concerning a certain topic. The problem is how to locate the target material from the numerous shelves of the library. The traditional solution is to classify the books into holdings and shelf classes. The solution works well if the user is familiar with the shelf classification. For larger libraries, however, there can be tens of holdings, hundreds of classes and thousands of shelves. This results in especially novice library users consulting the library personnel for personal guidance, which consumes the library's resources.

This paper describes SmartLibrary, a location-aware mobile library service, which helps users to find books and other material from the library. The help is provided in form of map-based guidance to the target bookshelf on a PDA. The guidance is integrated to the online catalog of library, so that books retrieved from the catalog can

be located. Using a mobile device, the patrons of the library can access the online resources anywhere within the library, not only from the public stationary terminals available in the library. Wireless connectivity is provided in form of WLAN (IEEE 802.11b). The devices can also be positioned, which enables dynamic guidance from user's location to the books. The service is a completely software-based solution, which can be provisioned atop a WLAN installed for wireless Internet access, without any additional hardware. We demonstrate the service in the main library of University of Oulu. We also present a user evaluation of the service with real patrons of the library.

To our best knowledge, there are not many proposals for location-aware services for libraries. Jones et al. [3] conducted a scenario-based user survey to find out what kind of mobile library services the patrons would prefer to use. The survey included a scenario where a user is provided with mobile access to the on-line catalogs of the library. The scenario was evaluated with a service prototype, which included static map-based guidance functionality in a small library. The test users were enthusiastic about the ability to access on-line catalogs from all locations in the library building. The users suggested, however, that the map-based guidance might be more useful within larger libraries.

Reitmayr & Schmalstieg [4] and Nagao & Rekimoto [5] have proposed mobile augmented reality applications for locating books from library bookshelves. Their systems, used with wearable computers, locate users and books using visual tracking of markers or barcodes attached to the shelves and books. The required equipment and changes to physical shelves, however, make it difficult and expensive to employ those systems in large public libraries.

2 SmartLibrary

We illustrate the use of SmartLibrary with a following scenario: *“A user is visiting the library the first time. He is intended to find a certain novel by Tolkien. The user takes his mobile client and opens the library web pages. He inputs the name of the novel as search parameter. He is returned the result entry of the book. The location code of the book is “P L 820/89engl Tolkien J. R. R.”, pointing to the publicly available holding of English books. The user does not know where the holding is located in the library, so he asks SmartLibrary for guidance. The shelf containing the book is shown on a library map, as well as the shortest path from the user's current location to the shelf. The user follows the guidance to the shelf and finds the book easily.”*

SmartLibrary service is built on top of two existing systems, namely OULA and SmartWare [6]. OULA is the online catalog of the library of University of Oulu. SmartWare is a prototype system architecture built in University of Oulu for providing context-aware mobile multimedia services.

We demonstrate SmartLibrary in the main library of University of Oulu. Fig. 1(a) shows the locations of the WLAN access points installed in the first floor of the library for wireless Internet access. We used six access points to ensure more accurate WLAN positioning of the mobile device. Positioning is implemented with Ekahau's positioning technology [7], based on WLAN signal strength measurements.

Fig. 1(b) shows the run-time view of the architecture of SmartLibrary. There are three executables in the client domain: Ekahau client, SmartServices software and a

web browser. Ekahau client measures the WLAN signal properties on the client device and sends them to Ekahau Positioning Engine, which calculates the location estimate for the client. Web browser is used to browse the OULA-pda user interface. OULA-pda is a web application tailored for small devices such as PDA's, providing a simple yet powerful access to the OULA database. User invokes the guidance service in SmartServices software by clicking a hyperlink. SmartServices communicates with SmartWare server in order to locate the user and the shelves. The locations of the bookshelves are stored in the SmartWare database. The location information of the user and the shelves are transferred to the guidance service user interface via the SmartWare server.

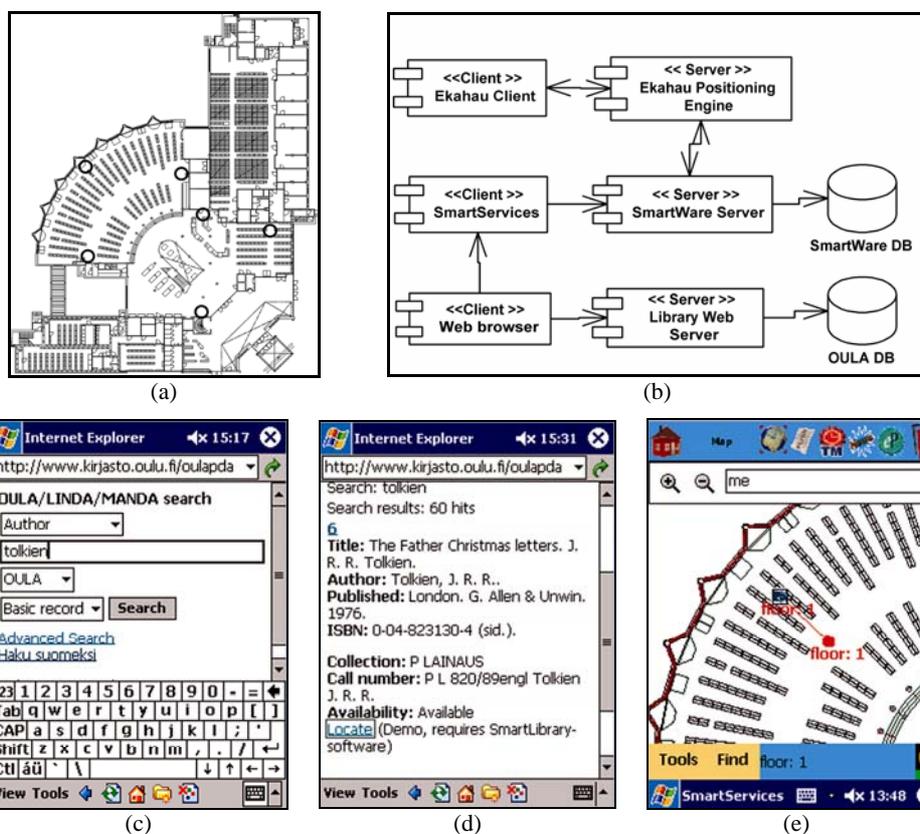


Fig. 1. (a) The locations of WLAN base stations in the first floor of the main library of University of Oulu. (b) The run-time architecture diagram of SmartLibrary. (c) The query definition UI of OULA-pda. (d) The results of the query. (e) Visualization of the map-based guidance to the shelf containing the book searched for.

Fig. 1(c) illustrates the definition of a query for a book authored by Tolkien. Fig. 1(d) shows the presentation of the entries matching the query. By clicking the “Locate”- link of the book of interest the user gets access to the map-based guidance

visualized in Fig. 1(e). In the map view the red dot denotes the location of the user, while the rectangular icon shows the shelf where the requested book resides.

3 Evaluation

A user test was conducted to find out if SmartLibrary really helps the library users in finding books. The goal was also to get feedback on usability and user experience.

In the test, the supervisor first gave the user a brief description of the SmartLibrary service and taught her how to use it by showing an example. The user was then given two tasks: first, to find a certain book by Tolkien, and second, any issue of a certain economic science periodical. Half of the users completed the first task using public desktop library terminals providing shelf classification, and the other half using SmartLibrary providing map-based guidance. The terminal was changed between the tasks. The supervisor followed the user and he was the only one the user was allowed to ask for help. After the tasks were completed, the users were asked to fill in a questionnaire containing multiple-choice questions and space for feedback.

Total 32 users, 14 females and 18 males, participated in the evaluation. The users were randomly selected among the library customers. The age of the participants varied between 19 and 49 years with median of 24, and most of them were university students. 66 % of the subjects had been customers of the library over two years. 46 % used OULA every week, while 9 % had never used OULA before. 25 % of the users had used a PDA device before the test. The users were also asked to estimate their experience in using the shelf classification system on a four-level scale (1 = low, 4 = high), most of them grading their experience to level 2.

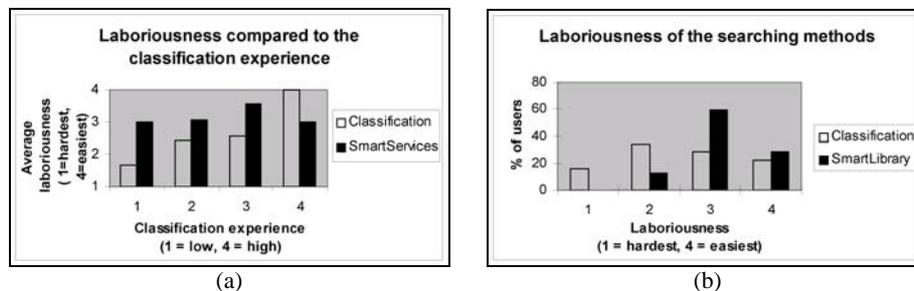


Fig. 2. Laboriousness of the book searching methods.

After completing the two tasks, the users were asked which of the two methods they would prefer for finding books in the library and why. All males and 64 % of females chose map-based guidance. The users were also asked to judge how laborious it was to find a book from the library using shelf classification or map-based guidance, on a four-level scale (1 = very laborious, 4 = very easy). Fig. 2(a) shows that the laboriousness of shelf classification correlated heavily with the users' experience in using the shelf classification system. The average laboriousness value for the shelf classification was 2.53, while the corresponding value for map-based guidance was somewhat better 3.16. Fig. 2(b) shows the distribution of the

laboriousness estimates of the two searching methods. 16 % of the users considered the shelf classification as 'very laborious', and 22 % 'very easy'. None of the users regarded map-based guidance as 'very laborious'. The figures show that finding books with map-based guidance of SmartLibrary was considered generally easier in comparison to shelf classification.

4 Conclusions and Future Work

We presented SmartLibrary, location-aware mobile library service. User evaluation conducted in the main library of University of Oulu showed that SmartLibrary helps the library users to find books easier in comparison to conventional shelf classification. After evaluation the library added SmartLibrary into their standard customer service. To promote the use of the service the library loans out PDA's to its customers. As the customers use the service, we continue collecting user feedback for further improvements of the user interface.

We consider adding textual instructions and landmarks into the guidance information. As there are collections also in other floors of the main library, we are developing solutions for guiding the customers between floors, as well. We are also building support for mobile phones, especially for the new smart phones equipped with a web browser.

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