

AudiIndex: Library Access for the Visually Challenged Using an RFID-based Point and Listen Interface

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ABSTRACT

We present the AudioIndex prototype that allows visually impaired users to browse and search for audio books within a public library without the need for library staff guidance. AudioIndex is a light-weight mobile system based on a combination of RFID, PDA, and wireless technologies allowing users to point at objects in the library environment, typically audio books and bookshelves, to get audio feedback about their nature in the form of synthesized speech, including information about the book's author, title, and a summary of its content.

Keywords

Pointing Interface, RFID, Mobile, Visually Impaired

INTRODUCTION

Following the devise that 'knowledge is power', public libraries stand out as important resources in serving the information need of the citizens of a society. Public access to library services can even be seen as essential for strengthening democracy, as literacy and free access to information are fundamental conditions for anyone seeking to participate in the democratic process.

Nevertheless, a number of people do not have access to libraries in the same way as most people do, due to limitations in their cognitive or physical abilities [1]. A high-level guiding vision for the AudioIndex project has been to try to find ways for the services provided by the library to be accessible for all members of the society.

THE AUDIOINDEX PROJECT

The prototype system presented in this paper, AudioIndex, is specifically aimed for allowing visually impaired users access public libraries, providing assistance with wayfinding [1] and with browsing and searching for audio books without the need for library staff guidance.

Throughout the project, we have been working in close collaboration with the Swedish Association of the Visually Impaired, where representatives from this organization have been taking active part in all phases of the project. The prototype system—eight copies of which are currently in operation and undergoing long-term public use and testing at Umeå City Library, Sweden—is the result of a larger accessibility project containing four stages:

Guidelines and Recommendations for Accessibility

In the first phase, we compiled existing guidelines and carried out field studies and interviews. Based on this, we provided recommendations for enhanced accessibility to libraries for people with various kinds of cognitive and physical disabilities.

Ideation and Scenarios

In a second phase, we started generating ideas for increased accessibility to libraries especially for visually impaired visitors, using creative group methods and techniques such as brainstorming. All ideas were presented, discussed, and worked through thoroughly with members of the intended user groups, which eventually led to agreement around a final concept and use scenario. In brief, in this use scenario—which the prototype implementation reported in this paper is based on—visually impaired users employ the system to browse for audio books by pointing directly with their index fingers on the spine of the audio book as it stands in the shelf. The system then recognizes which audio book it is and very quickly provides the user with information about the author, the title, and a summary of the contents of that particular book in the form of synthesized speech. Users are also able to point at other objects in the library, such as bookshelf, to find out what kinds of books are to be found in that particular shelf.

Experience Prototyping

To be able to test and evaluate with users in a real library environment early on in the project, we developed a Wizard-of-Oz prototype based on this concept. The purpose was to allow intended users to experience using the system, without us actually having to fully develop the underlying technology at this stage. The results of these trials provided positive feedback from the intended users, as well as a number of ideas for improvement.

Development of Finalized Prototype

From these tests, we set out to develop a finalized prototype system in eight copies that were installed in Umeå City Library in March 2006 and is now in full operation. This project phase is described below.

AUDIOINDEX PROTOTYPE DEVELOPMENT

The finalized AudioIndex prototype was developed over the course of about a year. Compared to typical research prototypes, we were faced with a number of considerations. First, as the system was to be used by the general public on a day-to-day basis, the system had to be robust and fail-safe both when it comes to its physical design as well as to its software implementation. Second, as the system would be managed by librarians rather than computer scientists, it had to be easy to recharge, trouble-shoot, and reset. Third, as we were to make eight copies of the system, it had also to be reasonable in terms of the cost of each device.



Figure 1: AudioIndex in use (left); pointing device (right)

Physical Design

The system consists of three interconnected physical parts. First, the main device—worn around the neck using straps—contains a Dell Axim X30 PDA. The PDA is however fully enclosed in a custom-made plastic container, thus not being exposed to the user. Second, an earpiece provides the auditory information to the user. Its cable is integrated with the straps of the main device. Volume is controlled using a small control attached to the cable. Third, a small pointing device is worn on the index finger. It consists of a custom-made plastic cover holding a battery and a dismantled MicroSensys iID PEN, connecting wirelessly using Bluetooth to the main device.

Hardware and Software Implementation

As the user points at the spine of a specific audio book, the RFID reader in the finger-mounted pointing device reads the identification number of the iCode-type RFID tag embedded in the book's spine and sends it to the PDA using Bluetooth. The PDA then sends a request over Wireless LAN to a SQL server in the library server room asking for all data for that particular book ID, including information about title, author, summary, year of publication, size, etc. After receiving this data, the PDA device employs speech synthesis software [3] to produce an audio stream that is fed to the user through the earpiece in the order of author, title, and summary. The entire system has been written in C# using Microsoft Visual Studio .NET 2003

DISCUSSION

The AudioIndex system is currently subject to long term testing and evaluation at the Umeå City Library. Early results indicate some interesting ways in which the system is being used, as well as points us to why it is sometimes not used, that will help us refine the concept and develop the system further. While data from our evaluation is currently being collected and analyzed, to be published elsewhere, some early observations are discussed below.

An especially important design goal of this project has been to hide both interactional and computational complexity from the user. The only means by which the user interacts is actually by pointing at things in the physical library environment to get synthesized speech descriptions about that object, or, whenever the user wishes, immediately silence any current audio stream by pointing at the main device itself. All other screens, knobs, and buttons that make up the system are hidden from the user. While this knowingly limits use in terms of traditional interaction styles, we believe it is also the system's key strength. Users seem to employ the system and the information it provides in two different ways, which appear to come from its simple, efficient, and *modeless* interaction style. First, users frequently use the system for *wayfinding* [1] and for *browsing*—by pointing at shelves to find content categories or individual books to browse by author names. Second, the system also allows the user to *review*, i.e. pointing at an individual book to get the summary of the content to help the user deciding whether or not that book is of interest.

CONCLUSIONS

We have introduced the AudioIndex prototype, part of a larger effort in making public libraries more accessible. It allows visually impaired users to browse and search for audio books without the need for library staff guidance. AudioIndex is a light-weight mobile system based on a combination of using RFID, PDA, and wireless technologies, allowing users to point at objects (typically audio books and bookshelves) to get audio feedback about their nature in the form of synthesized speech.

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