Next Generation Library: Automatic book management system with ubiquitous sensors

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I. INTRODUCTION

Ubiquitous environment is supposed to show various automation system according to increase in miscellaneous sensors. For example, when a user puts a book out from bookshelf in a library, the user wants the ubiquitous environment to proceed with checkout automatically. Also, a user can return a book by adverse action in such a Next Generation Library[1]. Furthermore, the librarians can devote themselves to their primary work such as helping a user to find books and other documents. To realize the Next Generation Library, a system should observe location of users and books in the real world. By the way, an existing library has ceiling cameras for security, and RFID (Radio Frequency Identification) tags embedded into books to manage books quickly. Therefore, we propose an automatic book management system utilizing existing devices in a library. There are two challenging issues. One is how to trace the user through cameras. The other is how to trace a book even though the camera is located far from it.

- A function of tracing a user
  We utilize an object recognition technology based on image processing to trace a user. It extracts a frame of the user by background subtraction and labeling method. Then, it traces a person by nearest neighbor method for median point of each frame. Therefore, this method doesn't need to attach a transmitter to a user. When a user enters a library by using his/her contactless ID card, a function for tracing users starts with binding user-ID and the moving user.
- A function of tracing books
  It's difficult to trace by pixels of a book less than that of a user. First, we embed an RFID reader in a bookshelf to check whether a book is in a bookshelf or not. Then, we bind a book and a user when a user takes a book in/out.

Also, we utilize location based P2P agent network (PIAX[2] with LL-net[3]) to access each sensors by sensors' location and semantics.

II. APPLICATION

Fig.**??** shows an overview of the automatic book management system. The camera sensor located near a user extracts a frame of the user as soon as the user puts contactless IC card on the RFID reader. The user in the library is traced by multiple cameras. Each book has an RFID tag, and a bookshelf has a built-in RFID tag reader. The RFID tag reader observes taking books in/out. In addition, a user who takes and returns a book can be recognized by cameras. Therefore, the user
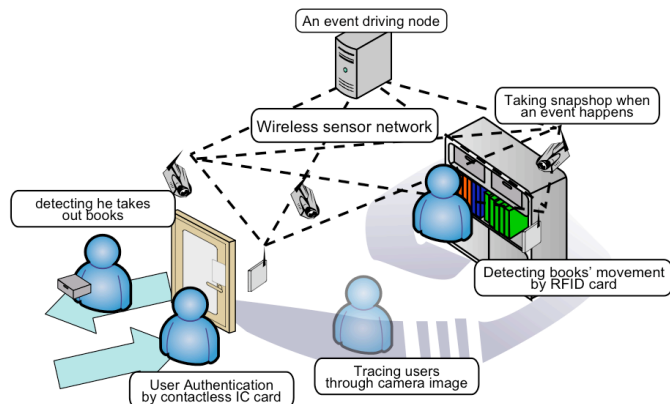

Fig. 1. An overview of the automatic book management system

doesn't have to bring books to the librarian to borrow/return books. We let visitors experience above flows by using the prototype of an automatic book management system.

III. DEMO REQUIREMENTS

We need a space (2m x 5m), a desk (90cm x 180cm), a power supply (an AC outlet, 1500W) and a channel assignment of 802.11b/g. Since the demonstration works on a private network, we don't need Internet connection.

IV. CONTRIBUTION

We confirm that the system reduces users' and librarians' tasks for book management by implementing prototype. To develop a prototype system, we (network and image processing researchers) discussed how to construct the automatic book management system with the existing facility in a library. By adding RFID readers to the entrance and bookshelves, this automatic book management system works in existing libraries. We need more discussion with visitors of Percom2007 to improve the proposed system.

SHORT BIO OF KEY PERSON

Ismail Arai is PhD candidate at NAIST since spring 2004. His research interests are Information retrieval utilizing metadata of the Web, Context-Aware system, and P2P network.

REFERENCES

[1] "Next Generation Library," http://inet-lab.naist.jp/˜ismail-a/nglibrary/.
[2] "PIAX," http://www.piax.org/.
[3] Y. Kaneko, K. Harumoto, S. Fukumura, S. Shimojo, and S. Nishio, "A location-based peer-to-peer network for context-aware services in a ubiquitous environment," *SAINT-2005 Workshop*, February 2005.