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## Abstract

**Purpose** – This paper aims to discuss the possibilities of using a mobile application in the process of conducting an inventory of library collection and present an application for the same. The application scans barcode labels on books and retrieves data about those books. Data regarding the status and call number of each book can be changed using this application.

**Design/methodology/approach** – This paper is based on a case study of developing an application for the Android platform, and this application is part of the BISIS library management system.

**Findings** – By analysing the procedure of conducting an inventory in the library of the Faculty of Science, University of Novi Sad, it is concluded that this procedure is tedious and can be simplified. To make this procedure more efficient, a mobile application enabling search and update of bibliographic records has been developed. That application communicates with the BISIS library management system using a specially designed service.

**Practical implications** – By introducing this application at the libraries, the process of inventory of a library collection can be simplified, the time needed for the inventory will be shorter and the inventory will require less physical effort.

**Originality/value** – The application is designed to help librarians during the process of inventory of library collections. During this process, librarians have to check status of every item on the shelves and to update catalogue with new information. This application enables mobility of librarians and updates information about items during checking the shelves.

**Keywords** Library management systems, Library collections, Android, Inventory, Mobile applications, BISIS

**Paper type** Research paper

## Introduction

Most of the libraries in Serbia use some kind of library management system and have their catalogues online. During the process of cataloguing, librarians usually sit in their offices, where they have computers with applications supporting cataloguing. However, sometimes the updating of bibliographic records may not take place in the office. For example, this may happen when a library is conducting an annual inventory of its collection.

An inventory requires checking all the items on a library's shelves against a list of holdings to identify lost, damaged or obsolete books. Once completed, the catalogue should be updated. Very often, portions of the library's collection are physically placed in some kind of a storage facility. Librarians must check the condition of every item in their collection during the inventory process. Serbian storage facilities usually do not have internet connections or supporting computer facilities. This thus requires

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librarians to write down the status of each item on a paper inventory and enter the data into the online system after returning to the office. Obviously, this procedure requires a lot of manual effort.

In Serbia, the inventory of a library's collection is regulated by law (Службенигласник, 2013). According to the law, an inventory should be done at least once every 10 years. The library will usually establish a special working group to conduct the inventory. At the end of this procedure, the working group submits a report to the appropriate authority about the overall condition of the materials. The report contains a list of lost, damaged, obsolete and overdue items. Based on the report, the administration will make decisions regarding weeding the collection.

An inventory is a time-consuming procedure. It could be simplified if librarians had some kind of mobile devices (PDA, laptop, smartphone, etc.), enabling them to enter new information on the spot. For example, Ernick (2005) described how an inventory was conducted in a small college library using a laptop and barcode scanners. Nixon (2009) discussed the benefits of using handheld barcode devices in the process of an inventory. Therefore, the development of modern mobile devices, such as smartphones or tablets, creates an environment for making the inventory easier. In this paper, an Android mobile application supporting the inventory process is presented. This application uses the camera of a mobile device for scanning barcodes and no additional handheld device is necessary.

The application being discussed is part of the BISIS library management system. BISIS is an integrated software solution fully meeting the demands of libraries and providing modules for cataloguing, circulation, reporting and acquisition. The presentation of this paper proceeds in seven sections. This paper provides a literature review; the functionalities and software architecture of the proposed application; implications of using this application in the library of the Faculty of Sciences at the University of Novi Sad, Serbia; concluding remarks; and plans for future work.

## Literature review

### *Mobile applications in libraries*

With the advent of mobile technology, use of mobile applications has significantly increased. Mobile devices have large colour displays, high resolution, multi-touch capabilities, significant computational power, high-speed connectivity and are suitable for replacing similar desktop devices. Mobile device applications have been created for nearly every imaginable use. Many research papers speak of the benefits of using mobile applications in libraries. According to surveys performed by Cummings *et al.* (2010) and Nowlan (2013), the majority of respondents who owned a web-enabled mobile device said that they would use small screen devices to search a library's Online Public Access Catalogue (OPAC). Broussard *et al.* (2010) described a prototype of a mobile search application for the University of Texas library catalogue. They concluded that development of such an application does not require a lot of effort and investment, but it has potential to significantly improve services available to the patrons. Barnett-Ellis and Vann (2014) conducted a survey among university students to determine user needs for mobile services at a medium-sized regional university. They discovered that if mobile access was offered, over one-half of the respondents would most likely use virtual reference services (54.9 per cent), online catalogue (51.6 per cent) and periodical databases (50.9 per cent).

The increased use of mobile devices has led to the adjustment of websites to be more mobile-friendly, and some sites have developed mobile versions. Iglesias and Meesangnil (2011) described the development of the mobile website of the Burritt Library at Central Connecticut State University. A mobile site frequently does not contain all of the information found in the regular site, but it allows users to search a library catalogue and often provides contact to a reference librarian through instant messenger.

The use of mobile applications in libraries is not something new. With the growing popularity and opportunities afforded by mobile phones, libraries have used them as a tool to provide better library services to their users. Verma and Kumar (2014) discussed the use of mobile technology in libraries and identified several groups of potentially useful services in a library. Some of these are notification services (providing alerts to users regarding new arrivals, due dates, renewals, outstanding fines and so on), browsing services, access to e-resources, personal space services (users can create their own profiles, manage online resources, categorize their favourite resources and check loaned items on their accounts, as well as due dates, overdue charges and so on), QR code-based services and other applications. Wong (2013) discussed the implementation of a mobile application at the National Institute of Education Library to provide library services accessible through smartphones and tablets. The author discussed the design considerations for the type of library services provided, the challenges encountered and the solutions to overcome such challenges. An in-house mobile application was developed which allowed users to search the catalogue, place holds or reservations, view e-mailed records, access their library account to view checked out items, examine reservations and fines, renew checked out items, create a personalized reading list, snap a picture of the barcode/ISBN on a book for checking the availability information, download electronic journals, access e-books, contact a librarian and find open hours.

An example of a notification service in a library is described by Wang *et al.* (2012). The authors described the experience of the Oriental Institute of Technology Library in Taiwan using due-day reminders and renewal-request mobile web services. After analysing system logs and patron questionnaires, the authors concluded that the two services effectively reduced the amount of overdue fines and overdue rates, which consequently increased the users' willingness to borrow books.

Gallagher (2010) presented a location-aware mobile library service in the form of a mobile application which provides map-based guidance to books and collections of the Wayne State University Libraries. The application guides the user from his/her present location to the book's location on the bookshelf.

Using of QR codes is also popular among libraries. Ashford (2010) summarized several possible scenarios and best practices for using QR codes. There are many examples of mobile applications using QR codes. For example, Pons *et al.* (2011) offered some examples of using QR codes at the Universitat Politècnica de València Libraries in Spain. They used QR codes to give access to the library's mobile website, to download documents and to promote the library's literature blog.

All of the previously mentioned papers describe mobile applications designed for library users and discuss their possible benefits. The majority of library mobile applications are for the use of users. However, there are several mobile applications aimed at library staff. For example, a librarian using the MobileCirc application by SirsiDynix can check out items, register users, process holds and perform an inventory.

Similar functions are provided by Follett Destiny from Follett School Solutions and iMLS from Micro Librarian Systems. In addition, there are more specific applications, such as ShelvAR which is an augmented reality shelf-reading system designed for organizing books on shelves and helping patrons to locate them. The authors present an application which is designed for library staff. Specifically, it will help librarians while performing an inventory.

*BISIS library management system*

The BISIS library management system was developed in 1993 at the University of Novi Sad, Serbia. BISIS is used in public libraries, faculty libraries and some specific-purpose libraries (archives, galleries and the regional government in the province of Vojvodina). Currently, the BISIS community comprises over 40 medium-sized libraries in Serbia (LMS BISIS, 2015). The fourth version is the most recent, uses open source components and was developed on a Java platform. The primary modules of the BISIS system comprise cataloguing, bibliography reports, circulation, OPAC, bibliographic data interchange and administration.

The BISIS system has been the subject of many research papers. For example, BISIS supports cataloguing according to UNIMARC and MARC 21 format using an XML editor for bibliographic material processing (Dimić and Surla, 2009, 2012, 2013). Milosavljević *et al.* (2010) described the BISIS search engine as using a Lucene engine. Because there is a high demand for interoperability between different library information systems, the BISIS system supports Z39.50 and SRU protocols for the search and retrieval of bibliographic records (Boberić and Surla, 2009; Boberić-Krstićev, 2013; Zarić *et al.*, 2012). The protocols are also used for developing a BISIS service for searching and downloading electronic materials by the Audio Library System for visually impaired people (Tešendić and Boberić-Krstićev, 2015). In addition, BISIS provides sharing of bibliographic records with the union catalogue of University of Novi Sad (Boberić-Krstićev and Tešendić, 2015). The module for circulation features all standard activities for managing users: registration, charging, discharging, searching users and publications and generating different kinds of reports, as well as user reminders (Tešendić *et al.*, 2009). The module for circulation can operate in different network configurations (Milosavljević and Tešendić, 2010).

## Mobile application for book inventory

To simplify the procedure of inventory, the researchers have developed a mobile application, called *MobiLib*, which enables the searching and updating of bibliographic records. This application communicates with the BISIS library management system using a specially designed service. An example of using the service will be presented later. The *MobiLib* application is designed to help librarians during an inventory of library collections. During this process, librarians have to check the status of every item on the shelves and to update the catalogue with new information. The experimental application enables the mobility of the librarians and updates information about items during checking the shelves.

Traditionally, librarians print lists of holdings and go to the storage areas and stacks to check the statuses of the items. With changes on the list, librarians then return to the office and update the data in the system. By using the *MobiLib* application, librarians would be able to update data while they are with the books. Librarians just need to scan

a barcode label on the book, and the application will retrieve data about the book and allow librarians to change it. The *MobiLib* application requires that the librarian be logged in, and they must log in with the same account that he/she uses inside the BISIS system. This ensures that only authorized librarians can use this application. After the application is launched, the login form is shown. The login form, which is shown in Figure 1, contains text fields for the librarian to enter his/her username and password.

If the login is successful, the application shows the screen presented in Figure 2. *MobiLib* application has two working modes, single and batch mode. In single mode, the librarian can choose either to scan a barcode label or to manually enter a book identification number. Choosing the first option, the application shows a screen with a

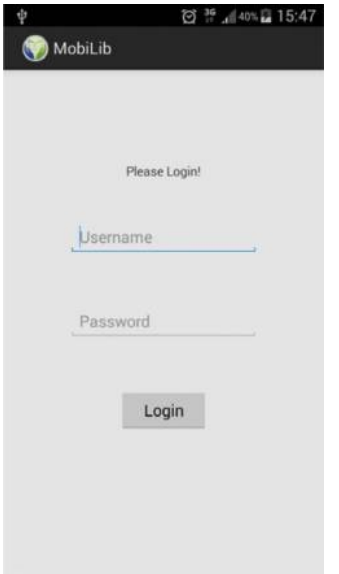


**Figure 1.**
Login screen

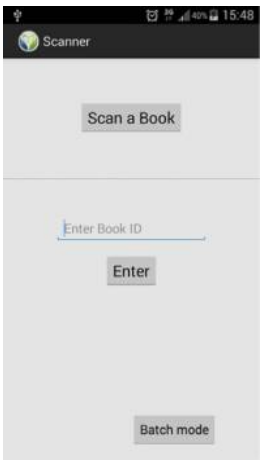


**Figure 2.**
Finding a book

barcode reader waiting for the scanning of a book identification number, shown in Figure 3. The BISIS system supports printing barcode labels, and they are usually printed during the cataloguing of the book and are attached at that time. A barcode label contains information with the unique identification number of the book in the catalogue, as well as some additional information, such as the call number of the book and the name of the library. Normally, a librarian will use the option to scan a barcode label placed on the cover. In the case where a barcode may be damaged or otherwise unreadable, a librarian must manually enter a book identification number. Also, this option can be useful in the situation when a book is not on the proper shelf where it should be according to the holdings list. Then, a librarian can use this application to check whether the book is borrowed. If the book is not on loan, it may be mis-shelved or lost.

After receiving data from the BISIS service, the application shows brief details about a book (Figure 4). Along with details such as author and title, the application shows the status of the book. In Figure 4, the status has a numeric value 2, which means that the book is in the appropriate location and in a usable state. Furthermore, the application provides the circulation status of the book, which may be on loan or available for borrowing. The application shows two buttons: *Update Status* for changing the status of the book and *Update Call Number* for changing the call number of the book.

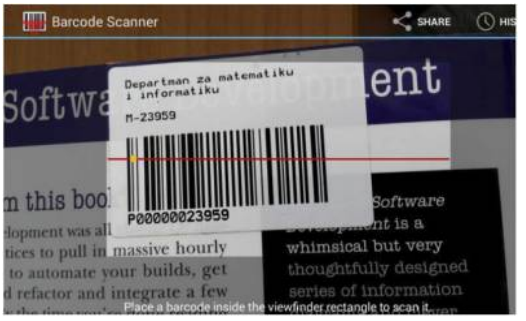


**Figure 3.**
Barcode scanner


**Figure 4.**
Book details

If a librarian chooses to change the status, the application shows the screen presented in Figure 5, which contains a drop-down list of predefined values for status and a calendar for selecting the date of status change. Predefined values for status are obtained through the BISIS service, and every library can define its own values using the BISIS system. By default, the *MobiLib* application sets the date of the status to the current date, so librarians do not need to set it manually.

During the inventory of the collection, librarians may decide to change the location of some of the books on the shelves. In that case, they need to update the call numbers of the books. Even though this situation occurs rarely, the *MobiLib* application supports this functionality. Thus, when a librarian chooses the option to update the call number of a selected book (Figure 4), the application shows the screen presented in Figure 6. Serbian libraries have their own format for structuring call numbers, and they do not use any well-known classification. A call number in the BISIS system is composed of six fields which are shown in Figure 6. Those fields are not mandatory, and every library can choose which of those fields will be part of a call number. However, processing every book separately during an inventory and going back and forth between scanning and changing a book's status would be very tedious. Usually, a number of books in the process of an inventory will get the same status and date. Thus, scanning a number of books and changing their status at the same time would make the inventory faster and easier. This option is provided through the batch mode of the *MobiLib* application (Figure 2). By choosing batch mode, librarians can scan more than one book and all of the scanned items will be added to the list shown on the screen in Figure 7. Once finished scanning the books, the librarian can change the status and/or call number of all the books from the list in the same way as previously explained for the single mode (Figures 5 and 6). Using the batch option, the inventory process becomes more efficient because the status can be changed in a single step for a large number of books.

This application works for the Serbian, Hindi and English languages and can be easily customised for any other language. Also, the application allows manually setting

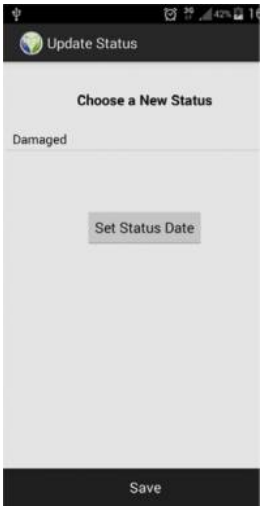


**Figure 5.**
Update status

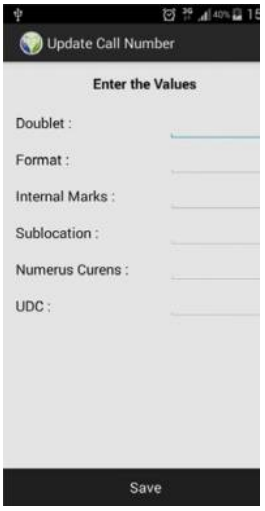


**Figure 6.**
Update call number


**Figure 7.**
Batch mode

the address of the service for communication with the library management system. Those functionalities are implemented in the settings menu of the application.

## Software architecture of the *MobiLib* application

In this section, technical details regarding the development of a mobile application for the inventory of a library collection will be described. For development of this application, the Android system was chosen as the main development and test platform. Android is the first truly open platform for modern mobile devices, and there are no proprietary obstacles that hinder mobile innovation. Android is expected to be a major platform for application developers.

Software architecture of *MobiLib* is presented in Figure 8 using a Unified Modelling Language component diagram. The *MobiLib* application communicates with the BISIS system through a service called *MobileService* using the HTTP protocol. *MobileService* is implemented as part of the BISIS system. In addition, *MobiLib* consists of six packages. The package called *main* contains Java classes responsible for controlling the application workflow. Classes from this package use the package *layout* for creating the user interface and the *httpclient* package for communication with the *MobileService* service. Also, this package uses some open source software libraries to implement the described functionalities. The package *ZXing* is an open source library for 1D/2D barcode processing using the built-in camera on mobile phones to scan barcodes. The packages *JDOM* and *xmlPull* represent open source libraries used for manipulating XML documents. Data between the *MobiLib* and the *MobileService* are exchanged in the form of XML documents, and those software are needed for processing.

### *MobileService* implementation

To support the functionalities described earlier, *MobiLib* needs to communicate with a special service called *MobileService*, designed inside the BISIS library management system. This service is designed for web access and particularly for this mobile application. The service supports the following functionalities:

- logging on to the system;
- searching a collection by book ID, retrieving bibliographic records; and
- updating bibliographic records.

Bibliographic records are exchanged in the form of XML documents. For the purpose of this application, an internal XML representation of a record is used. This XML representation is based on the UNIMARC format used for cataloguing books in the BISIS system. According to the UNIMARC format, block 9 is used for local and national purposes. In the BISIS system, this block contains field 996 for storing information about the book. The field 996 is designed to suit the needs of libraries in Serbia. An example of a bibliographic record is given in listing 1 showing just a few fields, including 996. Some of subfields of field 996 are subfield *f* containing the book id, subfield *d* containing the call number divided into additional subfields, subfield *q* containing the status of an item and subfield *t* containing the last date that the status was changed.

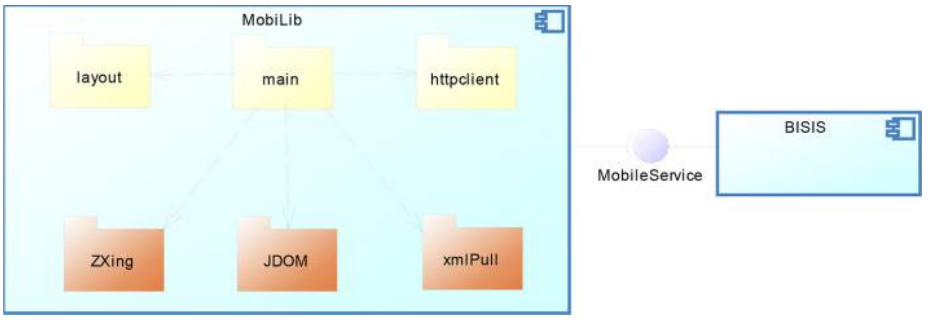


**Figure 8.**
Software architecture

Listing 1. Example of a bibliographic record:

```
<record recordID="26852" pubType="1">
<field name="200" ind1="0" ind2="">
<subfield name="a">Concurrent and Real-Time Programming in Java</subfield>
<subfield name="e"></subfield>
<subfield name="f">Andy Wellings</subfield>
<subfield name="g"></subfield>
</field>
<field name="210" ind1="" ind2="">
<subfield name="a">West Sussex</subfield>
<subfield name="c">John Wiley & Sons</subfield>
<subfield name="d">2004</subfield>
<subfield name="e"></subfield>
<subfield name="g"></subfield>
</field>
<field name="996" ind1="0" ind2="">
<subfield name="d">
<subsubfield name="l">Mt</subsubfield>
<subsubfield name="n">235</subsubfield>
</subfield>
<subfield name="f">00150000235</subfield>
<subfield name="o">20050817</subfield>
<subfield name="q">1</subfield>
<subfield name="r">Tempus</subfield>
<subfield name="s">b</subfield>
<subfield name="v">c</subfield>
<subfield name="w">00</subfield>
<subfield name="t">20130617</subfield>
<subfield name="9">1</subfield>
</field>
</record>
```

In the future, this XML can be replaced with a more standard XML representation of the bibliographic record, such as UNIMARCSlim XML Schema, Marc21Slim XML Schema or DublinCore XML Schema. Additionally, standard protocols for bibliographic record retrieval, including SRU and SRU Update, can be used instead of the *MobileService* service.

## Implications

The *MobiLib* application is developed as an enhancement of the BISIS system and is completely functional. The application will be tested in the Faculty of Sciences library. This library has five different collections (mathematics, physics, chemistry, biology and geography), and the BISIS system and the UNIMARC format are used for cataloguing records. Each collection belongs to a specific department of the faculty. The researchers plan to test the real usability of this mobile application during the next inventory of the mathematics books collection. This collection comprises about 32,000 bibliographic records with 43,000 items. All items have barcode labels with 20 per cent of the items are on open shelves and the other items in separate storage units. Books stored in separate storage units are also available for circulation.

The library of the Faculty of Science performs an inventory every five years. The last inventory of the mathematics collection was done in 2012 by four librarians and it took two months to finish. Librarians had the printed holdings list, and they went to the storage units, where they checked every item on the list. They noted any changes of the status on the paper list and, after returning to the office, manually updated the status of each item in the system, along with the date of the inventory. The process of the inventory was slightly different for books on the open shelves, where those books were located near the librarians' workstations. Librarians would bring books from the shelves to their desk and update the status of a single item in real time. The books which were not found on the shelves could be on loan, lost or misplaced, so librarians had to check further to determine the status and change it if needed.

By using the mobile application, librarians will not have to print paper holdings lists or pull books from the shelves. They will be able to conduct the inventory in real time while among the shelves. For every book on the shelf, librarians will scan a barcode label and, in real time, get information about the status of that book in the catalogue. If there is a need to change the status or call number of the book, they will also do it in real time. At the end of the inventory, librarians can obtain various reports from the BISIS system. These reports include lists of items based on their status or status date. Using these reports, librarians can generate a list of items for possible weeding or a list of items not processed during the inventory. It is obvious that the time needed for an inventory will be shorter and the inventory will require less physical effort with the use of *MobiLib*. This approach requires that every librarian has a mobile device with the Android platform. However, these devices are very popular and their prices are constantly falling, so this should not be a disadvantage for the new approach.

## Conclusion

The increased use of mobile devices has led to their ubiquitous introduction in libraries. There are a number of mobile applications designed to support daily activities in the libraries. In this paper, the researchers presented a mobile application which will help librarians conduct a collection inventory. The application is developed on the Android platform and it is part of the BISIS library management system.

The *MobiLib* application allows the search of a library catalogue using a book identification number obtained by scanning a barcode label. The book identification number can also be entered manually. Librarians will use this application to change the status and the call number of particular books. By using this application, an inventory is more timely and, especially if batch mode is used. Researchers plan to test the usability and efficiency of the application during the next inventory at the Faculty of Sciences Library which uses the BISIS system.

Currently, this application can work only as part of the BISIS system because it depends on an internal representation of bibliographic records and service. Because of this, the code is not shared to any online repository. However, if it is shown that this application can be useful in libraries, it can be redesigned to use standard protocols for bibliographic record exchange. This change would make this application independent of the BISIS system, and it could be used with any other

library system supporting the protocols. In that case, sharing the application to an online repository would be reasonable. Also, the barcode scanner used for this application supports scanning other barcode formats, such as QR codes or Data Matrix, so libraries are not limited to the barcode format shown in this paper.

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