A Design for Library Marketing System and Its Possible Applications

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Abstract. Library marketing system is a system that helps with improving patrons' convenience and library management based on the data in libraries by analyzing them with data mining methods, including statistical ones. In this paper we present a design of such a system which deals with usage data of materials and extracts knowledge and tips that are useful, for example, for better arrangements of bookshelves and for providing patrons with information which will attract the patrons. Two methods are proposed for collecting usage data from bookshelves; one is with RFID and the other is with two-dimensional code, such as the QR code that is very popularly used in mobile phones. By combining several analysis methods, we can construct a library marketing system, which will give benefits to library management and patron services.

Keywords: Library Marketing, RFID (Radio Frequency Identification), 2-dimensional Code, Intelligent Bookshelf, Data Mining.

1   Introduction

The aim of the system presented in this paper is to help libraries and librarians with improving their patron services so that they can get better satisfaction from their patrons. The system also aims to directly provide the library patrons with useful information that helps them with choosing reading materials, finding useful information, exchanging their views with other patrons, and so on.

In order to achieve these aims, the system collects data about the patrons and about how they use the library materials. We consider two types of data collection methods in this paper; with RFID and with 2-dimensional code. With RFID we collect usage data of library materials and with 2-dimensional code we collect who is interested in which books. The system then helps the librarians with analyzing these data and extracting various kinds of tips that are supposed to be helpful for better library management in collection of books, shelf arrangement, patron services, and so on. We will call such a system a library marketing system.

In this introductory section, we start with describing our motivation and the concept of library marketing in Section 1.1 followed by discussing its importance for libraries in Section 1.2.

1.1 Library Marketing

Marketing is one of the most important concepts for profit organizations in order to get good reputatons from customers and to have more profits. This concept is also important for non-profit organizations such as libraries, not in the sense of to increase profits but in the sense of to increase their good reputations and have better customer satisfaction (CS), or perhaps you may also call patron satisfaction (PS) as well.

There may be a lot of types of library marketing methods. In this paper we focus on the one using databases in a library, including log data of services provided by the library.

Figure 1 shows the basic structure for the library marketing in this type. It is the mutual depending structure between databases and services. In the right part of the figure are library services provided by the library. "OPAC" (Online Public Access Catalog) is a search engine for the library materials. "My Library" is a relatively new service that provides patrons with individual information such as which books they are borrowing and have been borrowed, a list of books the patrons might like to read, and so on. "Reference" means the online reference service. These are basic and at the same time very useful online library services.

These services depend on the databases that consist of catalog data, circulation data, patrons' profile data, etc. These data are collected at a circulation counter, at a self checkout machine, and in other ways. The log data, which are collected as the system provides various services to patrons, are also collected and are used as the service log database.
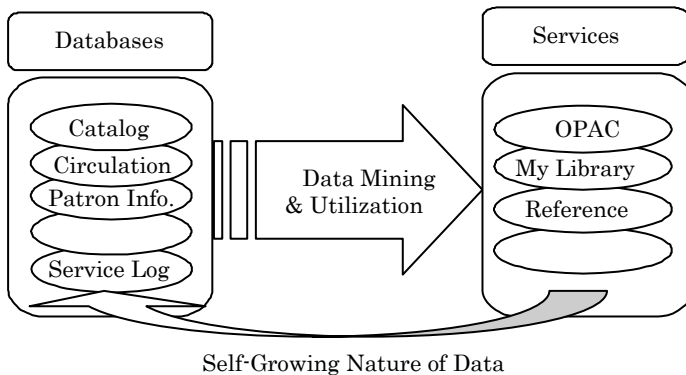

Fig. 1. Library Marketing with Databases and Services

The collected data are supposed to be analyzed, or data mined, and the result should be reflected to the services in order to improve the quality of patron services. As the quality of services gets higher, more patrons will use the library and the system

so that the system gets more service log data, and they can be used for better services for increasing CS, or PS. Such a natural self-growing mechanism is very important for library marketing with databases and services.

1.2 Importance of Library Marketing

Patron orientedness is very important for libraries and it is well described in "The five laws of library science" advocated by the famous Indian library scientist S. R. Ranganathan [10], which was published way back in 1960s. They are: (1) Books are for use, (2) Every reader his book, (3) Every book his reader, (4) Save the time of the reader, and (5) The library is a growing organism.

Even though these laws consider only the books and thus look old, they are still new and applicable even now as we rephrase them by replacing "book" with "information," "material," or "service." In order to be patron oriented, libraries have been growing, or changing, continuously by introducing up-to-date technologies.

For examples, libraries have introduced computers and started computerized processing for library jobs a couple of decades ago. They are one of the earlies organizations in computerization. With computer systems, libraries are able to provide OPAC service for book retrieval and connected the computers to the Internet so that their patrons are able to access to library services such as Web-OPAC, online referencing and other library services in 1990s. Now they are starting to provide the so called Web 2.0 services as new kind of library services. The SNS (Social Networking Service) is a typical example of such services.

Even now the most important service of libraries which we expect to libraries to provide is the one that helps the patrons with providing information materials, e.g. books, magazines, newspapers, etc. Suppose a patron is searching for a book and it is not in the collection of the library where he or she belongs to as a member, the library will try to find out other libraries that have the book and then it will choose and ask one the libraries for let it borrow the book for the patron. The book may be sent to the library for borrowing or a copy of a part of the book may be sent instead of the book itself. This is a rough sketch how the ILL (Inter-Library Loan) service is carried out.

Recently, not only the service of providing materials but also other services such as supporting the patrons with training their information literacy skills are considered to be very important for libraries.

Due to the advancement of network society, such library services are requested to be extended so that they are shifted to be more network-based, more collaborative with other libraries, hopefully providing 24 hours, and so on. In order to realize such services, libraries and library systems should change themselves to be more network-oriented and automated ones so that patrons are able to access to their libraries at any time from wherever they want.

As was illustrated in Figure 1, the network services suit to library marketing because the log data of these services are easy to collect in the system and these data are stored as a service log database.

The library services with physical materials such as printed books, printed magazines, CDs, DVDs, and etc. do not give data automatically. In a decade RFID (Radio Frequency Identification) [3] technology has been introduced to many libraries; the number is over 200 in Japan (by 2009). An RFID tag is attached to a physical material,

e.g. a book, and an RFID reader can detect the tag's ID without contacting it. In this way the data relating to these materials can be automatically collected and will be stored in a database.

There is a report relating to library marketing, where they collect data on the numbers of patrons in a library's rooms together with entrance data and they propose a better space arrangement plan by analyzing the patrons' behavioral properties [4].

2 Tools for Library Marketing

As was described in the previous Section 1, we need some AIDC (Automatic Identification and Data Capture) technology [1] in order to collect data for physical materials. In this paper we deal with two types of technologies; RFID and 2-dimensional code. We will briefly describe the former one in Section 2.1 and the latter one in Section 2.2.

2.1 RFID and Intelligent Bookshelf

The principles of RFID tag system is illustrated in Figure 2(a). The RFID tag system consists of two major components; tags and reader/writers (R/Ws). A tag is able to communicate with a reader/writer when they are located sufficiently close each other.

As is shown in Figure 2(a) the RFID tag at the right-hand side consists of an IC chip and an antenna. It has no batteries and thus cannot run by itself. At the left-hand side is an R/W, which provides energy to the tag with its antenna. The RFID tag gets energy from the R/W with electro-magnetic induction via its antenna. It waits until sufficient energy is charged in it and when it is ready, it starts running and communicates with R/W and exchanges data such as its ID and status data by making use of the same antenna. There are two types of tags; one is read-only and the other is read-write. Normally the latter type is used in library application.
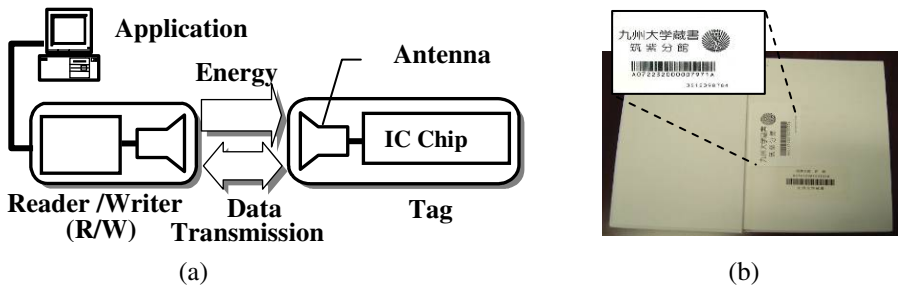

(a)   (b)

Fig. 2. (a) Principle of RFID (b) RFID Tag Attachment on a Book

Figure 2(b) shows an example of how RFID tag is attached on a book. It is an RFID tag used in Chikushi Branch Library of Kyushu University Library [5], Japan. The tag is built as a label on which the library name is marked together with the university logo. The material ID is also marked in barcode on the label. The barcode is

supposed to be used when this material is carried to another library in the ILL program, i.e. for interoperability, and when the tag has been bad and does not respond to R/Ws for just in case.

Comparing to the barcode system which is mostly used in libraries now and is considered to be the standard technology to libraries, RFID tag system has an advantage that it is much easier to put material in an appropriate position. In order to read the book ID, you have to put the barcode part of a book in the appropriate area so that the barcode can be optically scanned by the scanner while with RFID tag all you have to do is to put the book in a designated area. As a result self checkout machine is easier to operate so that it is easy enough for children and elderly patrons to use. This is a very important difference.

So far the dominating reason for the libraries whey they introduce the RFID tag system is that it let the processes be more efficient; i.e. it is faster to proceed circulation, it is supposed to have less running cost, and thus the number of librarians needed will be smaller, etc., even though its initial cost is very high.

Typical usages of R/Ws in libraries are shown in Figure 3. They are security gate (Figure 3(a)), those for circulation counter (Figure 3(b)), self checkout machine (Figure 3(c)), and handy R/W for inventory (Figure 3(d)).

Application of RFID technology makes the following advantages:

(1) Efficient Checkout and Checkin
    Checkout and checkin processing with RFID is much faster than with barcode. Furthermore use of RFID self-checkout and self-checkin machines will reduce the burden of library staff a lot as well. University of Nevada, Las Vegas library [12] has reduced the number of the circulation counters in half by adding self checkout/return machines.

(2) Easy to Use Checkout and Checkin
    Furthermore, the self-checkout/checkin machines are much easier to use for patrons because the locationing restrictions for RFID tags are less than barcode tags, and because of the multiple reading with anti-collision mechanism of RFID that is impossible with barcode.
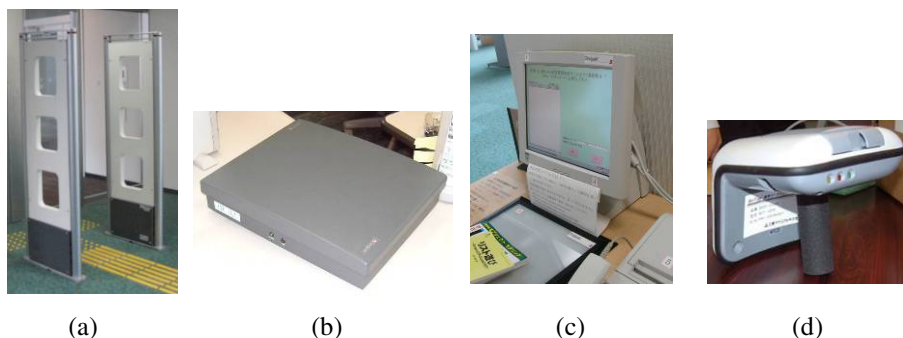

| (a) | (b) | (c) | (d) |

Fig. 3. RFID Reader/Writers for Libraries: (a) Security Gate, (b) Desktop Type for Circulation Counter, (c) Self Checkout Machine, and (d) Handy Type for Book Inventory

(3) Efficient Inventory

The inventory time reduces notably, probably from half to one tenth or even less. In a typical case service-closing period of the library for inventory changes from one to two weeks to a couple of days. City of Kita Central Library in Tokyo [2] spends about five to ten minitues for inventory every day, and finishes one cycle of inventory in a month for 300 thousand books.

An intelligent bookshelf (IBS) (Figure 4) is a bookshelf which has shelf type RFID R/W, where its RFID antennas are installed in the bookshelves so that the R/W can detect what books are put in which shelf in real time [6][7]. There are a couple of types of antennas. The book-end type is the one the antennas are put next to books like spacers as is in Figure 4. Another one is the shelf-board type, of which the antennas are put under the books either in between the books and the shelf-board or the boards themselves. Furthermore some IBS's antennas are put behind the books. For example if you use UHF type RFID tag system it is natural to put the anntennas behind the shelves so that they can be installed additionally on the popularly used bookshelves.

By using such equipments we can collect the usage data of books. By analyzing the usage data we may extract useful knowledge, i.e. library marketing [6][7][8][13]. For example, we can get the information how often a specific book is used and the differences of usage patterns according to the day of the week, time zone in a day, etc. We can provide such information to the library patrons. It may be used by library staff for planning improved services as well.

2.2 Two-Dimensional Codes and Mobile Phone

As was pointed out in Section 2.1, RFID technology has great advantages in material management. However not only the R/Ws but also the price of RFID tag is very high compared with that of barcode.

Fig. 4. Intelligent Bookshelf for Library Marketing

2-dimensional code is a technology inbetween RFID and barcode technologies in many aspects, thus it can be used as an alternative to RFID. Figure 5 shows a sample of barcode and 2-dimensional code (QR code). Other 2-dimensional codes include PDF417, DataMatrix, and Maxi Code [8]. 2-dimensional code has the following advantages in general.

(1) Low Cost
Just like barcode, we can print 2-dimensional code with ordinary printers.

(2) Large Recordable Data Size
The recordable, or printable, size of data is about tens of digits in barcode, while it is much large in 2-dimensional code system; for example some thousands digits or characters. In terms of recordable size it is competitive with RFID tags. A disadvantage of 2-dimensional code in comparison with RFID is that it is read-only, while some RFID tags are read-write type.

(3) Small Area Size
Comparing to barcode, the area size of 2-dimensional code can be small so that we can print a small lable and attach them to the backs of books. This is one of the two notable advantages of 2-dimensional code against barcode. They use the barcode labels for books in the National Library and other libraries in Singapore [9]. Their book labels are excellently designed; a label consists of barcode part and classification data part. They put the label so that the classification data part comes on the back part of the book and the barcode part comes on the cover part. With 2-dimensional code we can put these data on the back of the books with ease.

(4) Readable by and Displayable to Mobile Phones
Mobile phones are excellent input/output equipment for 2-dimensional code. Many mobile phones are equipped with cameras and they are able to read the data in 2-dimensional code; typically QR code, for example. Also, in the other way, mobile phones can be used for displaying 2-dimensional code, which is used as paperless ticket, library's user ID, and others.

(5) Error Correction Facility
2-dimensional code is designed so that even if part of the encoded area gets dirt or something and get impossible to read, the total information can be recognized with error correcting algorithm. This is a big advantage to barcode.

Fig. 5. Barcode (left) and 2-Dimensional Code: QR Code (right)

Conclusively 2-dimensional code system has advantages to as a recording media in terms of data size, recognision speed, area size, and others. It has advantages to RFID in terms of cost and readability by mobile phones. On the other hand RFID has advantages to barcode and 2-dimensional code in terms of locationing, ability to recognize the tags in hidden places, recognition speed, etc.

One of the good uses of advantage of 2-dimensional code in library is to put a label with 2-dimensional code to the back of a book so that the book's ID, its catalog data, and other related data can be recognized as the book is set on a bookshelf. Then such data are easily recognized with patrons' mobile phones and with code readers by the library staff for inventory and for other purposes.

3   Library Marketing System

The aim of the library marketing system is to help libraries with improving patrons' convenience and library management based on the data collected and stored in the libraries and with analyzing them with data mining methods.

In this section we consider two types of AIDC (Automatic Identification and Data Capture) technology, RFID and 2-dimensional code, as basic technologies that support library marketing.

3.1   Library Marketing System with RFID

Figure 6 illustrates a model for library marketing system with RFID, which is an extention to the system in Figure 1. In addition to the data that can be collected with barcode system, it can collect usage data for shelved materials by using intelligent bookshelf (IBS). Applicability to bookshelves is one of the most important advantages of RFID system because it is impossible to realize IBS with other types of AIDC technologies such as barcode, 2-dimensional code, etc.
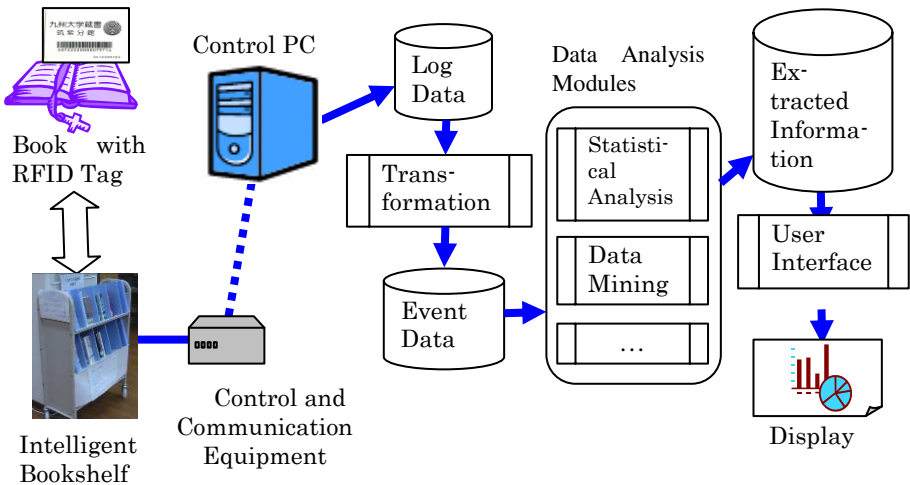

Fig. 6. An Experimental Library Marketing System with RFID

We have tried an experiment with the IBS in Figures 4 and 6 [13]. Original log data obtained from the IBS look as is shown in Figure 7. The first few lines are the headers from the controller system, followed with command lines. A command line start with the timestamp data followed with the command and its responding data, which are quoted with double quotation marks.

The command part starts with "<" character and the respond part with "<" character. The string "ST" stands for the status of the bookshelf. The following data proves status, shelf ID, reading time, the number of detected tags, and the list of tag IDs with 16 characters. For example, the first long line indicates that 9 tag IDs are detected and the IDs are "E00401000314CBA2," "E00401000314E148," followed by several other IDs and lastly "E004010003150040."

The log data are redundant because the status will not change for a long time we consider the frequency of data sampling and thus the detected tag IDs are same in a long line of data. So it is better to transform this log data format into the format that can be dealt with ease. We call the data in this transformed format the event data. The transformation program converts the original log data into event data.

The event data can be represented as a list of events as is shown in Figure 8; the first two columns are timestamp data that consist of date and hour-minute-second, followed with two columns of shelf ID, i.e. tier ID and shelf ID, one column of tag ID, and the type of event, or the change of status, which is either IN or OUT. The status IN means that the book is put on the denoted shelf and OUY means the other way.

```
*,2006/09/25 15:55:47, 0 ,"Log Start"
*,2006/09/25 15:55:47, 0 ,"TCP/IP Connection"
*,2006/09/25 15:55:47, 0 ,"Local Port:0, Remote Host [172.18.25.112:10001]"
<,2006/09/25 15:55:48, 6 ,">ST00"
>,2006/09/25 15:55:56, 20 ,"<ST0011000005500000"
>,2006/09/25 15:55:58, 20 ,"<ST0012000005590000"
>,2006/09/25 15:55:59, 20 ,"<ST0013000005500000"
>,2006/09/25 15:56:01, 164 ,"<ST0014000005E20009E00401000314CBA2E00401000314E1
48E004010003150DB9E00401000314F6ADE004010003150DBBE00401000314D735E00401
000314EA2DE00401000315382FE004010003150040"
>,2006/09/25 15:56:02, 20 ,"<ST0015000005500000"
>,2006/09/25 15:56:04, 20 ,"<ST0011000005500000"
>,2006/09/25 15:56:05, 20 ,"<ST0012000005590000"
>,2006/09/25 15:56:07, 20 ,"<ST0013000005500000"
>,2006/09/25 15:56:08, 164 ,"<ST0014000005B10009E00401000314CBA2E00401000314E1
48E004010003150DB9E00401000314F6ADE004010003150DBBE00401000314D735E00401
000314EA2DE00401000315382FE004010003150040"
```

Fig. 7. A Sample Original Data of the Intelligent Bookshelf Used in the Experiment

To formulate, the i-th event data collected in this IBS is represented as a quadruple in the following format:

$$d_i = (In/Out, Shelf\text{-}ID, Tag\text{-}ID, Time)$$

where "In/Out" specifies book is stored in a bookshelf or removed from a bookshelf, "Shelf-ID" and "Tag-ID" specify which shelf the book is stored to or removed from and which book is it, respectively. The "Time" is the timestamp which specifies date and time of this status change.

2006/6/2	15:57:06	1	2	E004010003153ED1	IN
2006/6/2	15:57:20	1	2	E004010003153ED1	OUT
2006/6/2	16:06:38	1	2	E00401000314EA68	IN
2006/6/2	16:06:38	1	2	E00401000314D6F0	IN
2006/6/2	16:06:53	1	2	E00401000314EA68	OUT
2006/6/2	16:07:15	1	2	E00401000314EA68	IN
2006/6/2	16:07:29	1	2	E00401000314EA68	OUT

Fig. 8. A Sample Event Data

The system log file is a list of, or a collection of, such data. Initially it is sorted according to Time. If we extract the data by specifying the Tag-ID, say TID, we get the following collection of data.

$D(TID) = \{ (In/Out, Shelf\text{-}ID, Time) \mid d_i = (In/Out, Shelf\text{-}ID, TID, Time)$ *for some In/Out, Shelf-ID, and Time}*

From this data, we can get the frequency of the usage about book which has the specified tag-id "TID". We can also get information something like, which time zone of a day, which day of the week it is read most often, etc.

The most important part of the library marketing system is the data analysis, or assisting data analysis, part because the usefulness of the system depends mostly on the capability of extracting useful information and/or knowledge for library patrons and library staff. However we have to point out here, that the extracted information/knowledge is basically a guess. We have to start with a low level guess and to improve its accuracy.

Among the analysis methods we take some possibly useful information that is extracted from the usage data.

(1) Frequencies of Use

Suppose we have a list of event data that are collected in a week. For a fixed material (i.e. book, magazine, CD, etc.) an OUT-IN pair of data for it indicates that it is taken out from a shelf and is returned afterward. This is a session of use of the material.

By counting the number of sessions for this material we can get how many times the material is used in this week. This information is helpful for both patrons and library staff. A patron can use this information when she or he wants to find a material that would be helpful for her or his study. We can suppose that a material that is used, i.e. probably means is read, by many people will be more useful than other ones.

The library staff can use this information when they choose which books to purchase. By analyzing the frequency data together with their classification number and other data, librarians can get information what kind of books are more used than other kinds. If they can guess by using this information that a specific book might be used very much in advance they can purchase more than one volumes of it.

Furthermore a material which is used very much will be damaged faster than those which are used not so much. So by accumulating the frequencies of use of a material, librarians can use the data and decides when to check it for restoration and when to discard.

(2) Accumulated Time of Use

Suppose again that we have a list of event data for a week. This time, for each material, we sum up all the session times, where session time is the duration of time from OUT-time to IN-time of the material.

A patron can use this information as an index for usefulness of material. If a material has long duration time, it might mean that it is more useful for students. Of course it is possible that a book which has just a short duration time even though it is potentially highly useful because of that it is just purchased and/or it is now well known to many students. However the duration time and usefulness should have some correlation each other.

Frequency and duration time are similar in a sense because both of them reflect popularity in some senses. The big difference lies that the former is an index for attractiveness of the material. If a material looks good in a first glance, it will be taken out very often and thus the frequency is high. However if it is not a useful book for the students, it will be returned in a short time and the total duration time will not be very long.

(3) Max, Min and Average Session Times

The maximum, the minimum and the average session times of a material will be able to be used to know how the material is used by students; very roughly. If the average time is very close to the maximum time of the sessions of the material and it is a long time, it means that the material is used for a long time, most of time it is used. Then we can guess the material is used as a textbook or something like that.

On the other hand, the average time is close to the minimum time and it is relatively short, then it may mean that the material is normally used like a dictionary or something like a reference book.

In order to estimate more precisely and accurately we will need more information about the material. However just by analyzing the usage data collected by an IBS, we can extract such estimated information and it will be helpful for patrons, or students, when they need to decide which material to use and in what way they use it.

Such information extracted from usage data is also helpful for library staff when they decide which material to purchase, when they decide where and in what way they put the materials. By combining this data and information with other information such as circulation data, catalog data of materials, we will be able to extract more information and extracted information and knowledge will become more helpful not only for students but also for librarians. We have to keep researching on this issue as one of the most important topics.

3.2   Library Marketing System with 2-Dimensional Code

As has been pointed out, quite a lot of mobile phones have equipped with cameras and can recoginize 2-dimensional code such as QR Code. This is a great advantage for 2-dimensional code in comparison with RFID based library marketing system.

Let us suppose we put 2-dimensional code label to books in a library. The shelves might look like the one shown in the left part of Figure 9. A patron can identify the ID of a book that he or she is interested in. By aiming the mobile phone and take a picture

of the 2-dimensional code, the book's ID data is easily taken into the mobile phone. Then the ID data is transmitted to the server for it, and the information relating to the book will be displayed on the phone. Starting from this point, the patron can go further. For example, he or she can get further information, put the data to his or her own blog, record the book to the personal virtual shelf, and even go to an e-commerce site and purchase the book.

One possible URL format recorded in the 2-dimensional code for such service is as follows:

http://<SeverIP>/bookinfo.cgi?id=<BookID>

It should be good if the system can recognize the reader's ID in order to differentiate the responses to the terminals. One possible mechanism is the use of security QR code [11], with which a part of a QR code data can be recorded as hidden data and can be recognized by some designated terminals only. In our case, the information that only concerns with the library jobs are recorded as such a hidden data so that the terminals for library jobs only can use such information.

Another possible mechanism is to organize the system so that when a terminal connects to the server, it sends its ID to the server as well as the ID of the material. The URL format for this might be like this:

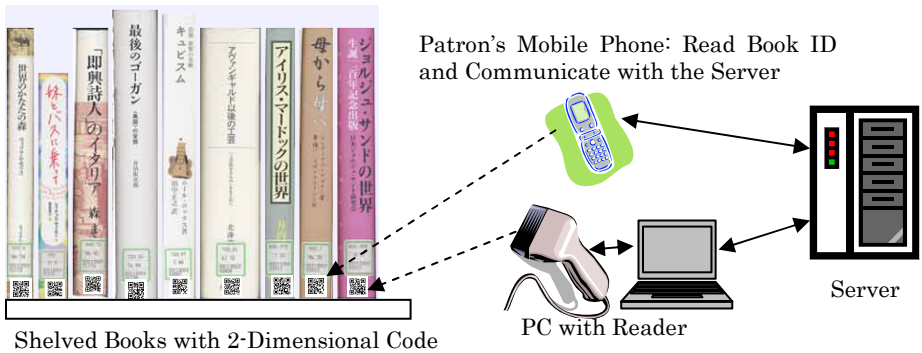http://<ServerIP>/bookinfo.cgi?bookid=<BookID>,patronid=<PatronID>

Fig. 9. Books with 2-Dimensional Code Label Together with Data Collection and Service

Whatever methods we choose, these actions will be recorded in the database of the server and will be used as a basic data for library marketing.

The combination of the PC and the reader in Figure 9 indicates the jobs by library staff. It will be used for inventory, search for misplaced books, and maybe more. Because of the very high cost for RFID system, some library may choose 2-dimensional code system as a substitute for the barcode system which they are using now. In such a case PC with 2-dimensional code is a good choice for such library works.

3.3 Library Marketing System with Combined Data

In the previous section we discussed from the viewpoint that 2-dimensional code is an alternative to RFID because it is an upgraded version of barcode and is cheaper than RFID.

In this section we would like to discuss from the viewpoint that it is a complementary system to RFID. The most important advantage of 2-dimensional code is its affinity for mobile phones. Here again, we would like to emphasize the advantages of mobile phones for our purpose such as:

(1) Quite a lot of mobile phones are quipped with cameras and are able to recognize the data printed in the form of 2-dimensional code attached, for example, on the books. Also almost all patrons have mobile phones these days and carry them all the time. Furthermore they have buttons for input and screens for output. Thus mobile phones are universal I/O devices for information, or PDAs, that support our ubiquitous life. This is the reason that 2-dimensional code is very convenient for recording and providing various kinds of information.

(2) Mobile phones are communication devices in nature. They can transmit and receive data to and from the servers in the Internet. Thus the essential information printed on the 2-dimensional code labels is their IDs, or keys, to the other information. We can get all information based on such key data.

(3) Each mobile phone will be used basically one person; i.e. its owner. So it is a good tool for individual authentication, thus it is very useful as a tool for providing personalized library services to patrons.

As we consider the current status of arts, RFID based IBS is the most appropriate tool for recognizing the book IDs and 2-dimensional code is the one for recognizing the patron IDs. By applying these two types of AIDC technologies the library marketing system can collect data about patrons' interest to the shelved books and the books that attract interest of each patron.

One possible patron service in this situation is a personalized recommendation of reading materials to a patron. First, the system recognizes the patron's interest type, or profile, by analyzing the interest data through 2-dimensional code label and from other methods. Then the system finds the books that are attractive to many people and will match to the patron's profile on interest. The attractiveness can be evaluated based on the access frequency data from the IBSs, from the circulation data, and from other sources. The matching criterion may vary. One possible one is to check the similarity of keywords based on the meaning and the classified field relating to the keywords.

Another combination candidate is with patrons' entrance and exit data of the target library. Even if the two frequency numbers of access are the same, the one should be considered more important than the other if the number of patrons staying in the library is smaller than the other. So the number of patrons staying in the library can be used for standardizing the frequency data from RFID and 2-dimensional code.

4   Concluding Remarks

The aim of this paper is to present two types of library marketing systems; with RFID and with 2-dimensional code. Firstly we describe the basic concept of library marketing, which consists of two important parts; data collection and data analysis, or data mining. RFID is an excellent tool for data collection. By installing the RFID readers to bookshelves, we can construct intelligent bookshelves (IBSs), with which we can collect usage data of library materials automatically. We presented three types of analysis methods for such usage data.

2-dimensional code has characteristics inbetween RFID and barcode in terms of data collection technology. The most important advantage of this technology is that quite a lot of mobile phones are equipped with cameras so that they can be used as readers for 2-dimensional code. Also mobile phones have screen and are able to communicate with application servers, thus they can be used as output devices for library services. For utilizing this advantage, we propose an idea of putting labels with 2-dimensional code to books so that patrons can get information about the books they are attached on.

One of the best candidates for library marketing may be a combination of these two types of technologies. The library system can collect usage data of library materials with RFID-based intelligent bookshelves and the patrons can get services that use the extracted information, knowledge, and know hows from these data.

Now we are preparing to realize a library marketing system based on the concept presented in this paper. Some of my students have started developing a system for 2-dimentional code. In collaboration with some librarians in Japan and Korea, we are planning to make an experiment for collecting usage data with intelligent bookshelves.

Our future plan includes:

(1) to develop a prototype library marketing system by combining RFID and 2-dimensional code technologies,
(2) to do experiment for automatic data collection,
(3) to develop useful analysis methods, and
(4) to prove the usefulness of the concept of library marketing so that it is installed in some libraries.

References

1. AIM Global: http://www.aimglobal.org/
2. City of Kita Library (in Japanese):
    http://www.library.city.kita.tokyo.jp/
3. Finkenzeller, K.: RFID Handbook, 2nd edn. John Wiley & Sons, Chichester (2003)
4. Kim, E.J.: A Study on the Space Organization by the User's Behavior in Public Library, Doctoral Theis, Gyeonggi University (in Korean) (2009)
5. Kyushu University Library: http://www.lib.kyushu-u.ac.jp/
6. Minami, T.: RFID Tag based Library Marketing for Improving Patron Services. In: Hoffmann, A., Kang, B.-h., Richards, D., Tsumoto, S. (eds.) PKAW 2006. LNCS (LNAI), vol. 4303, pp. 51–63. Springer, Heidelberg (2006)

7. Minami, T.: On-the-site Library Marketing for Patron Oriented Services. Bulletin of Kyushu Institute of Information Sciences 8(1), 15–33 (2006) (in Japnese)
8. Minami, T.: A Perspective to the Library in Network-Oriented Society – Ubiquitous Library Services through PDAs. Bulletin of Kyushu Institute of Information Sciences 10(1), 1–17 (2008) (in Japanese)
9. National Library Board Singapore: `http://www.nlb.gov.sg/`
10. Ranganathan, S.R.: The Five Laws of Library Science, Bombay. Asia Publishing House (1963)
11. Security QR Code (in Japanese):
    `http://www.denso-wave.com/ja/adcd/product/qrcode/sqrc/index.html`
12. University of Nevada, Las Vegas Libraries: `http://www.library.unlv.edu/`
13. Zhang, L., Minami, T.: Library Marketing that Boosts Education with RFID. In: Proc. 6th International Conference on Information Technology Based Higher Education and Training, ITHET 2007 (2007)