ENHANCING LIBRARY SERVICES USING BARCODE, QR CODE AND RFID TECHNOLOGY: A CASE STUDY IN CENTRAL LIBRARY NATIONAL INSTITUTE OF TECHNOLOGY, ROURKELA

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Abstract

A library should try to keep up with the digital world through various technologies in this modern age. Users' of the present days especially the new generation students are having information in just one click. They became more used to retrieving information from the internet then a tradition library. As each generation becomes more in tune with the internet, their desire to retrieve information as quickly and easily as possible has increased. For them, finding information by simply searching the internet could be much easier and faster than reading an entire book. So libraries must update their techniques time to time accordingly and with the necessity of the future users'. In this article, three modern technology initiatives in the library i.e. Barcode, QR code and RFID were discussed. These are becoming very useful technology not only to serve the users' but for library security also. The overall technology, its uses, advantages, challenges of using these technologies were also discussed here. At the end, a case study has been done on Central Library, NIT, Rourkela about implement and uses of these technologies and accomplished their users' satisfaction.

KEYWORDS- Modern library, Technology initiatives, Barcode, QR code, RFID, NIT Rourkela.

1. INTRODUCTION

In the last two decades, libraries are facing tremendous changes as the modern tools and technologies have grown rapidly. Library materials are also changing quickly to the various digital formats from the traditional print formats. Information/knowledge has been creating and publishing from every sector of humankind. Document types are also not limited to books and periodicals. Various types of materials out there like- image, audio, video, painting, artefacts, three-dimensional, software, and much more. These materials are also available with various file formats so that, one information can be used in many ways. Lastly, the internet has opened the door to reach anything or anybody from anywhere with just a single click. So, managing this huge amount of resources becomes more challenging day by day.

Implementing various software is becoming a way to maintain these resources like- automation, digitisation, content management, e-resource management and much more. These software are handling as well as managing all types of housekeeping works in the library like- procuring materials, acquisition, cataloguing, circulation, controlling serials, digitising, archiving-retrieving, providing service to the users' and so on. Barcode, QR Code and RFID are some technology by which store and retrieval of resources got easier and also very important for security purpose of the resources.

Central Library of National Institute of Technology (NIT), Rourkela (http://library.nitrkl.ac.in/) is an almost digital library which starts functioning since 1965. It has 76000+ print books, 18000 back volume periodicals, more than 2000 online journals, 86 print journals. Apart from that, it has access to the consortium, ISI codes, online video courses, cassettes, CD-ROMs and many more resources. To maintain these resources library has almost all latest technology like- Barcode, QR Code, RFID with various library software like- Libsys, Koha, DSpace, EPrints and is planning to implement Coral and Subject-guide. So, I have taken this library as a sample for case study to have an overview of various ways that, NIT library is taking full advantages by using these technologies and satisfying their users.

1.1 Need for these Technologies

Libraries are going automated/digitised now a days. Users' have very less time to find out a piece of information from an entire content. So, these technologies are very important for providing quick and pinpointed services and-

- Keep up-to-date with the modern technical initiatives.
- To improve access more quickly from inside the library as well as from outside the library at any time.
- To improve the working efficiency
- More sharing and use of materials.
- Cost saving.
- Maintaining through software is very easy.
- Easy to reproduce.
- Can create hyperlinks for more similar materials (Alhaji 2009).

1.3 Objectives of the Study

The objectives of this study are as follows-

- To create awareness about the latest library technologies.
- To create awareness of using these technologies.
- To create awareness of their designing methods/process.
- To create awareness of the working mechanism of these technologies.
- To create awareness of the advantages and disadvantages of using these technologies and,
- Lastly to have an overview, of implementing these technologies and providing various services to their users' on Central Library, NIT Rourkela.

1.3 Coverage of the Study

To tied up into a fixed boundary, the discussion of this paper is limited to the key objectives, due to the lengthiness of the paper and wide speared off the technologies. Though these technologies are now used in many sectors, but this paper is limited to the library based use and services, as we are library professionals.

2. LITERATURE REVIEW

Barcode and QR code are a type of coding system that turns any information into a black & white rectangle or square bars or dots. Through scanners or readers, we can scan those and retrieve the information much faster than regular processes. On the other hand, RFID is a coded cheap, something more than a simple barcode and with linked to an LM software by which issue-return of a document can be done by self and also used for security purpose to avoid stealing materials. Lots of studies have been done on these technologies, I have mentioned some of them below.

Jeevan explained the application of barcode in IIT Kharagpur library as well as highlights its future applications (Jeevan 2000). Zebra Technologies shows the print technologies with the application of Zebra Printing (Zebra Technologies n.d.). Islam and Shuva explores a survey of overall barcode technology, its uses, applications, merits, demerits in the 8 libraries in Dhaka (Islam & Shuva 2010). Singh shows from the implement to present status of barcode technology in Central Library, GNDEC, Ludhiana (Singh 2014). Farashbandi highlights on the history, structure, benefit, challenges and application of QR codes in libraries (Farashbandi & Najafi 2014). Pones and others describe how to promote QR code for using library resources, website, links etc. to both user and librarians (Pones & et. Al. 2011). Association of the Nova Society Museums explores that how to create contents and use different devices through QR code (ANSM 2011). Coleman shows the various use and application in various devices through QR codes (Coleman 2011). Singh and Mahajan illustrated the present status of RFID and implementing it in various libraries in India and also some suggestion for implementing RFID (Singh & Mahajan 2014). Yu defines the purpose, design, methodology and approach of RFID (Yu 2007). Kaur and others stated the principles, advantages, limitations and applications of RFID (Kaur & et. al. 2011). Pandey and Mahajan describe the role of librarians in RFID libraries (Pandey & Mahajan 2010).

3. METHODOLOGY

Qualitative research methods have applied here due to this is a case study of some technology initiative through some modern software. It is also a case study of the implement, applies and issues of the same technologies in a particular library. The paper starts with an introduction, objectives, area coverage and some literature reviewing of the similar types of study. Later it elaborates about the technologies, a short history, designing methods with some prescribed formats, system requirements for initiatives, its advantages and disadvantages and the initiative and implications of these technologies in Central Library, NIT, Rourkela.

4. BARCODE TECHNOLOGY

Barcode is a coding technology of Automatic Identification and Data Collection (AIDC) or Auto ID method that stores real time data. Barcode is a collection of vertical or graphical bar patterns coloured in black with white spacing, generally started using in the grocery stores in the early 70'. By the development of new technologies, business organisations and industries have adopted barcode technology for collecting their information. After that, a variety of organisations has started using this zebra technology like- manufacturing, hospitality, education, travel, retail, security, healthcare etc. where the main job is repetitive. Among the above centres, the library is a perfect example for repetitive works; especially at the circulation counter, sometimes the stuff has to retype several times the same thing due to typing mistakes. Barcode is the typical solution here. It reads information 3 times faster and 0.03% errorless than a skilled personnel (Zebra Technologies n.d.).

4.1 Designing of Barcode

Normally two types of barcodes are there, one is the linear barcode and second one id 2-D symbology. Linear barcode (Figure 1) is made by black vertical lines with white space. The height and width may vary but it specified and represents fixed information. This type of barcodes stores normally numerical data, and contains limited data.

Figure 1: Linear Barcode

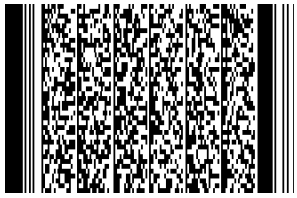

Figure 2: 2D Barcode

2-D barcodes (Figure 2) are made by either stacked linear bars or matrix symbol shaped in black and white cells. Any type of data can be stored in this barcode and contains a huge amount of information.

Various formats are available out there to generate barcodes like- Universal Product Code (UPC-A and UPC-E), European Article Number (EAN-8 and EAN-13), Interleaved 2 of 5 (ITF), Code-39, Code-128, Codabar etc. where UPC, EAN, ITF are used to encode numerals Code-39, Code-128, Codabar are used to encode all types characters (Jeevan 2000).

4.2 System Requirements for Barcoding

To generate and run the barcoding system we need some hardware as well as software materials according to library perspective. These are-

A Computer- it may be a laptop or a PC with all basic application software.

LMS- an integrated library management software is required with a proper database of patrons and materials to encode the information.

Printer- a printer is required to print the barcodes generated by the LMS.

Paper and pasting materials- to print the barcodes we need papers. Many shops make these type of page which are looks like labels and pasting materials are required for pasting the labels.

Scanners- barcode scanner or reader is required to decode the information.

Skilled staff- skilled staff is required to maintain these mechanisms, to handle the LMS, generate barcode, print and paste properly.

4.3 Advantage of barcode

Here are some advantages of barcode-

- Gives accurate data;
- Easy job;
- Almost no error;
- Less human effort and labour cost;
- Ease of use;
- Uniform;
- Improving workflow;
- Improve staff efficiency;
- Increased customer satisfaction, and lastly
- Fulfill Ranganathan's fourth law i.e. 'save the time of the reader'.

4.4 Disadvantage of barcode

There are some disadvantages too for using barcodes-

- Maintaining is costly sometimes;
- Not possible without proper machinery;
- Not possible without skilled staff;
- Power-cut problems;
- Systems fall down problems.

Figure 3: Barcode label and Reader in NITR

4.5 Barcode initiative and applications in Central Library, NIT, Rourkela

After being transformed into a nationalised institute from an engineering college in 2003, the library developed very fast. The library initiated the Libsys LMS in the middle of 2006. The barcode technology was also initiated with LMS. The barcode is used then for storing bibliographic details of documents for issue/ return purpose as the library has turned into an automated library system. But after some time when RFID system was installed in the library, the barcode system was removed partially from the circulation desk, and some changes were made. From then to till today, the barcode is used for

storing the accession no of the book instated of full bibliographic details. It is also used at the time of stock verification in the library.

4.5.1 Use and Workflow of Barcodes in Central Library

The library uses barcode inside the books (Figure 3) for presenting the accession number. Two barcodes are generated for each book, one is for pasting on the title page and the other one is for pasting on the last written page of the book. The barcodes are generated through the LMS (Libsys) and printed on labels. After pasting those labels inside the book, a sellotape is also pasted on the label for its longevity. This process is done in the Acquisition and Technical Processing section of the library. After that, a barcode reader (Figure 3) is used to decode the information and serve to the users' from the circulation desk.

5. QUICK RESPONSE (QR) CODE TECHNOLOGY

QR code is the type of barcode used to hold and provide additional information. It can hold a large amount of data and can be used anywhere. QR code is much faster coding method than other barcodes. At first, it is developed in 1994 by Denso Wave Corporation, one of the Toyota Company's branch in Japan (Walsh 2009). Basically this coding system is developed for tracking of shipping, but later on, it is used from industrial assembly lines to marketing and also installed on the label, exhibits, business cards, flyers and so on in the countries like Japan, Korea, middle-east. But, this technology goes viral when Western and European countries adopted it and started using in every sector like, news, media, public announcement, Govt. activities and so on. Likewise, libraries are also using this technology so far in this present age to represent their websites, advertisements, seminars, workshops, meetings and mostly for URLs.


Figure 4: QR Code

5.1 Designing of QR Code

QR codes are 2-dimensional image sensor which is worked by some programmed processor. The three squares located in three corners using a smaller square are used to maintain the size, orientation, angle of viewing etc. of QR codes. The dots are used to represent the data by using binary digits through an error-correcting algorithm (Figure 4).

There are two types of QR codes; 0ne is static QR code, which is a one-time job. Once this type of code is generated then, we can't change the code again. The second one is dynamic QR codes, which is editable. We can change the information according to the change of time and need. A QR code can hold 7089 characters of numeric data, 4296 characters of alphanumeric data, 2953 character of binary data and 1817 Kanji (Chinese letter) character (Farashbandi 2014).

There are various standards used for encoding data in QR code. Some of them are- Association for Automatic Identification and Mobility (AIM, 1997), Japanese Electronic Industry Development Association (JEIDA, 1998), Japanese Industrial Standards (JIS X

0590, 1999), Chinese National Standards (CNS, 2000) Korean National Standards (KNS, 2002), ISO IEC 18004:2000, 2006 and 2015 (Gupta, 2016). Several organisations like NTT DoCoMo or open source ZXing project has been maintaining a list of encoding data types.

5.2 System Requirements for QR Code

Here we also need some hardware and software materials to run the QR code. These are-

A Computer- where we can open QR code generator websites to generate the code. It may be a PC or a laptop.

A LAN or Network Connection- is required to connect to the network for accessing the internet.

Creating Websites- we must aware of the various websites who transmits the simple information into a coded information.

Data- to generate the code we need the data/ information which we want to encode into the QR code.

Scanner/ Decoder- a scanner or a decoder is required for decoding the coded information in QR code. An android mobile phone is the best example of a decoder.

Decoding Apps- to decode the information we have to install an app in a camera facility android phone to read and decode the information.

I have given some name of websites below through these we can generate QR code, and some mobile apps through these decoding of information can be done.

Websites	Mobile Apps
QR Code Generator – www.goqr.me/	Barcode Scanner (Android)
BeeTagg - www.beetagg.com/	i-Nigma (iPhone)
BeQRious- www.beqrious.com/qr-code-generator/	Norton Snap (iOS or Android)
Google Chart - www.createqrcode.appspot.com/	QR Droid (Android)
Kaywa- www.qrcode.kaywa.com/	QR Reader (iPhone)
Neoreader - www.neoreader.com/	QRafter (iPad)
Nokia Barcode Reader - http://mobilecodes.nokia.com/	QRky (Android)
	RedLaser (iPhone)

QR Stuff- www.qrstuff.com/ QRlicious- https://www.qrlicious.com/	ZBar (iPhone)

Figure 5: List of QR Code Generating Sites and Mobile Apps for Decoding

5.3 Advantage of QR Code

Here are some of the advantages of using QR code

- It's fast;
- Can store huge amount of data;
- Can use anywhere;
- No specific skill is required
- No additional technology is required;
- Can use the information later;
- Anyone can generate it;
- Increased customer satisfaction etc.

5.4 Disadvantage of QR Code

There are some disadvantages too for using QR codes-

- It's not working without the decoder like android phones;
- Sometimes need internet connection;
- Still users' are not fully aware of this technology;
- Human errors happen sometimes at the time of coding;
- Codes are not working sometimes due to the compatibility of the decoder.

Figure 6: QR uses in NITR

5.5 QR Code initiative and applications in Central Library, NIT, Rourkela

Barcode and RFID initiated in NIT library a long time ago, but QR code came to use in the library very recent. It is being used in the library from 2014. In the beginning, it is used in the web advertisements only. But later, the library started using QR code for many purposes like, in the banners of the workshop, training, seminar, conference, induction programmes; advertisement; notices; websites; URLs etc. not only in the webs but also in the printed forms too.

5.5.1 Use and workflow of QR Codes in Central Library

Now a days NIT library is using QR codes in many places to promote its services. Through QR code, anything can be converted into coded information and present it for quick and access for later. Many websites facilitate to generate QR code and many mobile apps are there to decode the information. Here is an example of using QR code in an advertisement banner for training in NITR library (Figure 6). The library didn't follow

any protocol for generating the code. Just put the data/ information in any QR code generating a website, copy the QR code image and paste it to websites, hooding, banners, ID cards, notices, for more services.

6. RFID TECHNOLOGY

Radio Frequency Identifier or simply say RFID is an extended technology of barcodes. It is a combined technology of radio-wave and microchip (Yu 2007). Due to low storage space in barcodes, IC chip like smart cards or memory cards is being used to store and retrieval of information. As a drawback of IC cards for power supply and reader based data transformation, contactless IC cards were implemented i.e. RFID. The data transmitted and power supplied were done through radio wave technology. RFID was started using many years back in the 1940s for replicated communication system only. In 1980s many business organisations started using it for managing their commercial products. Later on places like- supermarkets, retailers, malls started using RFID for quick identify and also for security purpose (Sumi & Kumar 2007). Now a days RFID is using many organisations including libraries.

6.1 Designing of RFID

There are broadly two types of RFID system exits; active RFID and passive RFID. Both consists of a tag and a reader. A tag is consists of a coupling element and an electronic chip and the reader consists of an RF module, a control module and a coupling element (Kaur & et. al. 2011). The active tags may connect to the infrastructure or use a battery for continuing power supply. But the passive tags don't need a power supply or battery. Active tags are more powerful and cover more distance for induction than passive tags, but their life is short for this effort. The control module of the reader holds the database and connected to the chip of the tags. The RL module transmits/received data through radio wave technology. The distance for induction are divided into three frequency level mainly; low frequency (30-300 KHz), high frequency (3-30 MHz), ultra-high frequency (300 MHz-3 GHz)(Yu 2007). According to the memory structure, RFID can be divided into four parts i.e. read only (record objects id no), read/write (like memory card, uses EEPROM/ WORM process), built-in-process chip (like smart cards) and built-in-sensor (as sensible like pressure/temperature).

6.2 System Requirements for RFID

The following hardware and software are required for RFID technology-

Tag- contains a silicon chip which holds a unique identification no and connected to the database for data transmit/receiving.

Reader- holds the database and connected to the chip and transmit/receive data through radio wave technology.

A Computer- is required for interface and deal with the users'. It may be connected to a server for maintaining the bigger amount of data.

LMS- is required for maintaining the databases of materials as well as users'.

6.3 Advantage of RFID Technology

Here are some of the advantages of RFID technology

- It's very fast;
- Nobody is required for issue/return process;
- We can get the data less than a second;
- Increases the security level;
- Setting up the system is one-time job;
- Handling is very easy;
- Maintenance is fully automated and easy.

6.4 Disadvantage of RFID Technology

Some disadvantages are also there while using this technology-

- It's very costly to implement as well as maintain;
- If someone removes the tag then it becomes very big security problem;
- Systems fall down problem;
- Less skilled staff for maintenance;
- Invalid/damage tag problem.

Figure 7: RFID Tags and Self Issue Return Kiosk in NITR

6.5 RFID initiative and applications in Central Library, NIT, Rourkela

The RFID technology implemented in NIT library in the year 2006. Before some time of the implement of RFID, barcode was used in the library for issue/ return of books in the circulation integrated with Libsys. But after RFID initiative with the same LMS for self-issue/ return purpose, barcode was removed partially. The tags are pasted inside the book and a NIT sticker is also pasted over the tags in such a way that, it can't be seen by the outsider. It is done for the security check of the books. Because if any tag is removed by anybody, the book becomes insecure, anybody can steal it from the library. Though these words sound very cheap, but it is true, we still have such types of user. So, this is very important so that, nobody couldn't harm both the tag and the book.

6.5.1 Use and workflow of RFID in Central Library

The RFID is used in the library in the circulation counter (Figure 7). To work in RFID environment we have to set some parameter so that it can perform automatically. Firstly, we have to install an LMS and set according to the library needs like; administration rules, manage resources, manage databases etc. It may be processed by one single computer or may be hosted on a server just like NIT library. Then active both the tags of book and patron and connect them to the LMS by sending the unique identification no to both of them. At the time of issuing book, the system detects both the tags and coupled it to each other and record an entry in the system database. At the time of returning, system

release both the tags, the book goes back to its own place on the shelf and the patron id returned to its owner. The whole process is done very quickly and by users' himself.

7. FINDINGS

Modern technologies are transforming very quickly. Today's latest technology may be obsolete tomorrow or maybe the day after tomorrow. So, it is very difficult to decide whether we should go for the new technology initiatives or not, if so, which is/are better for my library? Because there are a lot of things to think of before taking the decision, for example, is there any need for these technologies, is budget permits, purchased or open source, types of users', types of resources', is/are skilled staff available etc. But in my opinion, we should go for these modern initiatives. We should know how to resolve these problems, how to make such decisions because we belong from such type of service sector where we get trained for all these, likewise, NITR library has become one of the most developed library in India within a decade. Before that, it was just a typical library under a college named Regional College of Engineering, but after becoming NIT, it developed very fast. Though these libraries are having a huge amount of budget but still the credit goes to the decision makers of the libraries because, to utilise a huge amount, is also a heavy responsibility.

Developing countries like India where libraries are still given very less important and where the budget is one of the most obstacles for development, library professionals should take care of every bit and utilise every single opportunity. Today's users' are very specific and want information very pinpointed as fast as possible. So, kept these things in mind, time has come to think of the above modern technologies to fulfil the one and only motto- 'satisfy users' through services with a smile'.

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