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May 2019

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Chhetri, Monishankar and Thakur, Ranjan Sinha, "Implementation of RFID Technology in Libraries: A Case Study in UPES Library" (2019). *Library Philosophy and Practice (e-journal)*. 2344.  
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## **Implementation of RFID system in Libraries: A case study in UPES library**

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### **Abstract:**

Implementation of Radio Frequency Identification (RFID) in libraries has carried exceptional improvement like automated issue return, security of library materials, inventory control etc. RFID is the latest technology used in libraries for managing the automated library and also for theft detection. The paper highlights that the importance of Implementing RFID system in UPES library and emphasizing its advantages, disadvantages, different component of the system and their standards. The relevant cost of the different component and approximate total cost of implementing an RFID system for a library is given.

**Keywords:** RFID, Academic Library, Library Automation, RFID Components, Inventory management, Library Management

### **1. Introduction:**

Radio Frequency Identification (RFID) is the very important and advanced technology of the 21<sup>st</sup> century. Now it becomes one of the most controversial technologies in present ICT era. Libraries began using RFID system to replace their barcode system in the late 1990s. RFID help to secure library materials mobilize the circulation process and enhance the user service and reduce theft case. The budget for implementing RFID for an academic library or big Public library is an important issue today. But now the cost of different components of RFID reduces day by day. This study states different aspect of implementing of an RFID system in Library and give an idea of approximate budget for implementing an RFID system. UPES was established on the year 2003 at Dehradun, Uttarakhand. Now UPES have three library, one is Central Library, other two is School of Law Library and School of Business Library. All three libraries have total approximately 2 lakh documents consist of books, thesis, bound volume of journals etc. To securitize all these things RFID implementation is being very much important all these three libraries

### **2. Literature review:**

Galhotra and Galhotra<sup>1</sup> in their paper studied that application of RFID in libraries, its different components, benefits of RFID, disadvantages, RFID in the Indian scenario.

Kern and Nauer<sup>2</sup> opined that, by implementing RFID in 20 libraries in Switzerland, observed that more than 90% users towards RFID stations. They also studied that by implementing RFID two main things are happened, one is the development of prices and another is the availability of standard. They also state that due to the increase of RFID application in other sectors such as supply chain, personal identification etc. in 2003-2004 prices of RFID decrease more than 50%.

Kumar and Kaur<sup>3</sup> studied components, technical features, advantages, disadvantages of an RFID System in a library. They also suggest the relevant cost of implementing RFID system in a library and states the role of the librarian.

Nisha<sup>4</sup> in her paper entitled “implementation of RFID technology at Defence Science library, DESIDOC: a case study” discuss the different parts of RFID system, their standards, advantages, disadvantages, overall requirement. She also opined that RFID system improves stock taking and circulation process.

Rafiq<sup>5</sup> studied that when the tagged material between the range of an RFID reader, the reader will get the wireless signal from the activate tag and the information be redirected to a computer system for processing.

Boss<sup>6</sup> in his paper entitled “RFID technology for libraries” suggests the relevant cost of implementing RFID in a library. He also estimates the individual RFID components.

Pattnaik and Pattnaik<sup>7</sup> studied genesis, overview, barriers, and technology related to implementing RFID in the library. They also state that due to its features and continuous improvement the libraries in India get involved in their development using it.

### **3. Scope of the study:**

This study has includes the complete study of RFID system integrated with open source ILMS Koha of the three libraries of two campuses (Central Library, School of Business library, School of law library) at University of Petroleum & Energy studies.

### **4. Objectives:**

- To study the automated services presently offered by the UPES library.
- To study concepts, tools, and techniques related to RFID system.
- To know about the implementation of the RFID system integrated with ILMS KOHA.
- To know about the Radio Frequency Identifier security system and its various components like RFID workstation, self-circulation Kiosk, RFID tags and different parts, RFID Gate etc.
- To know about the different advantages and disadvantages of these systems.
- To know about the approximate budget allocation for implementing RFID in the library.

### **5. Advantages of RFID in Library:**

- It improves material handling. RFID technology is automated material handling system.
- RFID helps to minimize the time and simplify the circulation of library documents, more than one item can be checked out or in at a time.
- It saves the times of library staff rather than barcode system.
- It's very helpful for stock verification of library materials.
- One of the main advantages of RFID system is theft detection. It helps to detect unissued materials.
- Long tag life.
- Helps to re-shelving of misplaced books.
- Less staff handling of each item. Protects staff from many materials handling related problems.

## 6. Disadvantages of RFID in library:

- High cost is the major barrier to implementing RFID system in the library.
- Lack of standard of the RFID tags. Many of the library RFID vendors did not supply standard RFID tags.
- The security system may be failed by placing the magnetic device, magnetic tape, aluminum foil over the tags.
- Gate sensor problem. Sometimes due to electricity problem gate sensors are not able to detect tags.
- Maintenance problem of the total system.

## 7. Components of RFID technology:

**7.1. RFID Tags:** RFID tags are one type of microchips. It consists of two main components one is a silicon chip which contains information about item and other is an antenna which receives and sends signals. Tags are of two types; one is active tags which have their own power source with an internal battery and possesses longer range than passive tags. Active tags are of two types, transponders and beacons with frequency 433MHz and 915 MHz respectively. Another is passive tags; it has no internal power source. Passive tags are of three types available in the markets in respect to their frequency.

- **Low frequency (LF):** The frequency range of these type of tag is from 125KHz to 134KHz and it provides very short read range (0cm-10cm).
- **High Frequency(HF):** Hf tags operate at 13.56 MHz approximately and a longer read range of about 1 meter and it is less costly than LF tags. These tags mainly used for the library system.
- **Ultra High Frequency(UHF):** UHF tags operate at 300MHz to 3GHz. Its read range is 3-5 meter. These type of tags mainly used in IT asset tracking, File tracking etc.



➤ **Figure 1: RFID Tag**

### 7.1.1. Specification of RFID tag uses in UPES library:

Standard	ISO 18000-3 mode1( Mainly used for item-level tag), ISO 15693, ISO 28560
Operating Frequency	13.56 MHz
Maximum Thickness	0.4mm
Memory	0.5k-2.5k bit
Data Retention	50 yr
Standard Format	Aluminum Antenna
Operating Temperature	-40°C – 85°C

**7.2: RFID WorkStation:** RFID workstation is a fast and efficient component of an RFID system to programme and verify RFID tags without the ILMS software. It also helps to the issue, return and renew of the multiple documents at a time with the help of ILMS integrated with it. RFID workstation is of three types, they are mobile (Portable and Small), shielded, and USB.

### 7.2.1. Specification of RFID Workstation at UPES Library:

Standard	ISO 15693
Operating Frequency	13.56 MHz
Dimension	350mm x 280mm x 15mm
Weight	1.5kg.
Power & Connectivity	110v-240v ac/50-60Hz & Connect to PC via USB
Shield	Fully Shielded
Software Required	Yes (staffConnect™)



➤ **Figure 2: RFID Workstation**

**7.3. RFID EAS Gate:** RFID gate mainly used for security purpose. It protects and secure library collection. It also analyses the library traffic patterns with visible user counters. When anyone takes books without issue and went between this gates it gives the alarm and sends the information to the local administrator through the server. It also acts as an antenna.

**7.3.1. Specification of RFID gate at UPES Library:**

Standard	ISO 15693, ISO 18000-3
Operating Frequency	13.56 MHz
Dimension	73mm (at base) x 680mm x 1,780 (± 3)mm
Weight	28kg.
Power	24 V ac
Materials	Transparent glass panel, aluminum like RAL9006" ABS with light texture base
Data	Ethernet TCP/IP
Performance	Read 8 tags per second, Coverage up to 47 inches / 1,200 mm can be achieved with certain tags
Alarm	Multicolor, selectable
Software	No software required for theft detection, software required for user statistics and reporting



➤ **Figure 3: RFID Gate**

#### **7.4. Self-Circulation Kiosk:**

This component of an RFID system used for the self-issue /return, renew of the documents. It has connected with the ILMS and server. A printer is also attached with it where the user can take a slip of his/her circulation status. From here, we also get the statistics of circulation status of the library.

##### **7.4.1. Overall Specification of RFID kiosk:**

Standard	ISO 15693, ISO 18000-3
Operating Frequency	13.56 MHz
Dimension	Desktop: w: 610mm / 24.0"   d: 550mm / 21.7"   h: 759mm / 29.9" Tray : w: 290mm / 11.4" Total Height 1041 mm approx.
Weight	120kg approximate
Power	240 vAC input, 130 watts, 50Hz, 5AMP fuse
Data	10/100 Ethernet
Touchscreen	22" portrait or landscape touchscreen 1920x1080p resolution
Standard PC	Windows 10 IoT enterprise or windows 7 embedded, 4GB RAM, 128GB SSD
Software	Software required for issue, return view account, renew etc.
Log In Types	Barcodes, Smartcards, Manual Typing



➤ **Figure 4: RFID Self Issue / Return Kiosk**

### 7.5. RFID Handheld Reader:

It is a cordless handheld device mainly used for stocktaking, re-shelving and findings of library documents. It is compact and easy to use. It reads RFID tags of library document simultaneously and quickly. It identifies items, which not check in or out properly and instantly detect materials caused by an alarm.

#### 7.5.1. Specification of Handheld Reader:

Standard	ISO 15693, ISO 18000-3
Operating Frequency	13.56 MHz
Dimension	Handheld unit: 240mm x180mm x100mm ; Antenna: 240mm x100 x 12.5mm
Weight	650gms approx
Power	7.4 v rechargeable battery
Data	10/100 Ethernet
Touchscreen	Yes
Certification	CE, FCC, IC, ANATEL, ETL, RCM, DDA, ADA



➤ **Figure 5: RFID Handheld Reader**



**7.6 RFID Book Drop (Return Station):** RFID book drop allows patrons to automatically return the library documents. A reader installed in a book drop allows reading of RFID tags as patron drops of the documents. It eliminates the labour intensive stapes of check in and deactivation of security protection by the library staff. It automatically check in the document, takes them off the patron’s library account and reactivates the security function.

**7.6.1 Specification of Book Drop at UPES Library:**

Standard	ISO 15693, ISO 18000-3
Operating Frequency	13.56 MHz
Dimension	Bookdrop: 16.5" d x 20.5" h x 16.25" w • Printer: 6.25" x 8.5" x 5.9"
Weight	50kg approx
Power	100–120 or 200–240 v AC
Data	10/100 Ethernet
Touchscreen	Yes
Certification	CE, FCC, IC, ANATEL, ETL, RCM, DDA, ADA

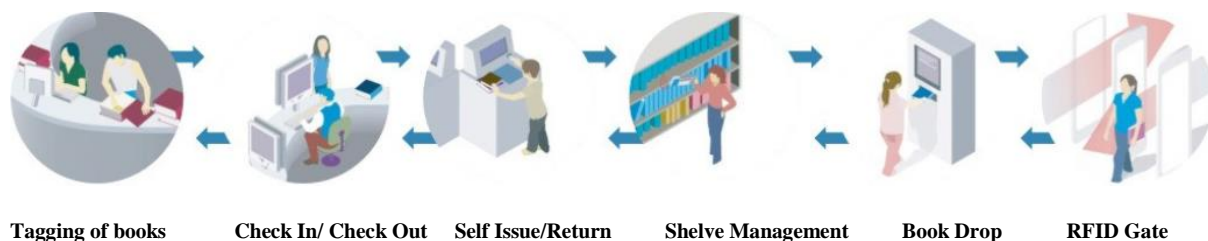


➤ **Figure 6: RFID Book Drop Station**

**7.6. RFID Server:**

The server is the heart of the RFID system. It is a communication gateway among the various components of the system. It receives the information from readers and exchange information to the ILMS.

❖ **Working in RFID System in Library:**



## 8. Need of RFID for UPES library:

The three libraries (Central Library, School of Business library, School of law library) of two campuses of UPES has a very rich collection of more than 1.5 lacks books and 300 CDs in the fields of Engineering , Design, Management and Law. Earlier library of UPES was use LIBSYS software. In the year 2013 it was migrated to open source ILMS KOHA. All library items were barcoded with accession number as identifier and scanner are used for circulation of library materials. Stock verification of library documents is done by barcode scanners and laptop computers. To enhance stock taking and circulation process and security of documents it was decided to implement RFID system along with Koha at UPES library. Implementation of RFID system was done at three libraries at two campuses of UPES in the year 2017 to improve the services provided by the library.

## 9. System requirement of implementing RFID system at UPES Library:

Implementation of RFID consist of the following steps it involves requirement analysis, Technical assessment, process analysis, budget analysis, technical selection, and evaluation. At first a team was formed which consist of subject experts, communication engineers, application developer and professional staff and the team was work together in all stages. Table 1 shows the overall system component requirement

**Table 1:**

Description	Required
Webcentric ILMS	KOHA
RFID kiosk	3 (for three Library)
RFID tags	150000 approx
RFID workstation	5
RFID gate	7(Central 3, SOL 2, SOB 2)
Handheld Reader	1
Smartcards	3500
Training	12 Person

## 10. Budget Allocation for Implementing RFID:

The most important aspect of any RFID system is the cost. Now for any library in India budgets are limited and in this situation implementation of RFID system is quite expensive. In table 2 we give the approximate cost for different components of RFID system for the library.

**Table 2: Approximate cost of RFID components**

Sl. No.	Description	Unit price(in Rs.) (Approx)
1	RFID Book Tag	14 - 20
2	RFID CD/DVD tag	17-25
3	Anti-Theft Labels	2

4	Staff stations	55000-65000
5	Security Gate	500000-550000
6	Handheld Reader	200000-250000
7	Self-Service kiosk	600000-650000
8	Book Drop Station	500000-550000

### **11. Benefits after implementing RFID:**

After implementing RFID in three libraries of UPES, users can easily and quickly issue and return their books through self-issue return kiosk and users are very comfortable with this. Different task of library staff such as finding of library document, re-shelving of books that are shelf management made better. Inventory of library materials get faster and accurate than before, Anti-theft detection made more easily using this system. The RFID gates keep track of all the movement of documents and users. It has made the daily task of library easier.

**12. Some Issues after implementation:** This is some issue faced by UPES library after implementing RFID.

- Shelf Checkout: Though the shelf issue return kiosk allows simultaneous multiple items checkout or check in at a time, it was often found that some items were not read.
- Sensor Gates: The gates reads accuracy has never been 100 percent. Sometimes if anyone take a document without issue and keep it on laptop, Tablet or smart phones and passing the gates, sometimes gates does not able to read the items.
- Inventory Taking: Since the bookshelves are metal, mainly the sides of the shelves and book stoppers, readers did not identify some tags.

### **13. Roles of Librarians:**

RFID technology founds an ethical problem for librarians. RFID technology allows for greatly improved services for users, mainly in the area of circulation and theft detection. It also allows for more efficient use of professionally trained staff and may reduce the labour of library workers. So librarians have taken extra steps to implementing this type of system for development of the library service.

### **14. Conclusion:**

RFID technology has become an important part of every modern library in the digital age. It has the capability of making our work lives in the library more suitable. However every new technology comes at cost. To rectify this, efforts must be undertaken for its development and implementation. In this paper we gave approximate budget for implementing RFID in library. Libraries should work to confirm that RFID components are manufactured and used according to well established privacy policies. Library should refuse the unsafe RFID components because they are not suitable. Though it is a quite expensive technology rather

than barcode, RFID has become essential for a broad range of information collection and identification of data.

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