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RFID Technology in Libraries: A Review of Literature of Indian Perspective

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ABSTRACT

Implementation of Radio Frequency IDentification technology in libraries in a developing country like India has brought remarkable improvements in the services such as shelf charging-discharging, automated handling of materials, security, high-speed inventory and moved beyond security to become tracking systems that combine security with more efficient tracking of materials throughout the library, reduced the data entry errors, enhanced customer service, and records updates. This article is an attempt to assess the potential of these aspects after the implementation of RFID technology and factors responsible for the slow influx of the technology, as revealed in the reported literature covering the concerned libraries of India. It is hoped that the present study will help Librarians and Library professionals in improving the return on investment and proving the long-term security of the library.

Keywords: RFID technology, implementation, information extraction, libraries, India

1. INTRODUCTION

The term Radio Frequency IDentification (RFID) technology has come a long way both in terms of the multitude of applications and their potential uses. Despite the involvement of RFID in a variety of areas such as logistics, inventory control, aviation security, road, and rail rolling, the potential implementation and use of the technology in libraries is still in its budding stage, particularly in the case of countries with developing economies like India.

As inferred from the fifth law of library science that 'library is a growing organism', librarians are always found interested in adopting latest technologies to provide better and efficient services to the patrons. Indeed, RFID technology has redefined various library related services and made every patron's job easier and efficient, from the patrons to the library professionals, as compared to conventional technologies like barcode, but in a developing country like India, the high cost of implementation and maintenance is still the major barrier in the proliferation of such auspicious technology.

After the perusal of literature based on RFID, it is found that most of the work was carried out on different aspects of RFID technology and none of them systematically covered them keeping focus the availability of technology in libraries.

The aim of the paper is to present the descriptive literature reviews (the abstract section of the source papers) and integrative literature reviews (reference the conclusion) on different facets of RFID technology with emphasis on select libraries of India as revealed in the literature available online.

2. REVIEW OF RELATED LITERATURE

There are many articles existing on various facets of paper reviewed articles related to the implementation of RFID technology in Indian Libraries. The scope of this study is limited to the articles published during 2010 to 2016 in various journals both Indian and Foreign by the Indian authors and on Indian libraries. The present review focuses on the comprehensive reports published in India keeping in view of the seminal results coming out of the relationship between RFID technology and Indian Libraries.

Kumar & Kaur[1] discussed the advantages, disadvantages, components, and technical features of a RFID library system to provide guidelines for the evaluation of different systems. They also briefed about the tentative cost of implementing RFID system in a library and how it functions and describes the role of librarians.

Madhusudhan[2] opined that the RFID technology could be the future of services provided by libraries, but the involvement of high cost in the working and implementation has been encountered as the primary challenge in its proliferation. Nevertheless, the author forecasted a decrease in the cost of the technology with its adoption, if carried out in large numbers in libraries all over India. The author concluded that the adoption of the technology couldn't be given a blind eye in an era of constrained funding, because in spite of its limitations, it has provided serious considerable advantages and benefits by curbing many time consuming, monotonous, tedious and complex problems in an efficient manner.

Sarasvathy, Jagadish, & Giddaiah[3] highlighted the essential role of RFID in the management and security of the pool of resources in a library and found it to be

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efficient in the identification of multiple objects.

Grover & Ahuja[4] found that the efficiency of the RFID-LMS system depends upon the information written in tags and to yield better performance, good quality of RFID readers and RFID tags should be used.

Pandey & Mahajan[5] concentrated on the application of RFID technology in libraries and opined that the technology is not only emerging but also more effective, convenient and cost efficient in providing library security. It can also act as a security device, taking the place of the traditional electromagnetic security strip. The authors found that the RFID tag contains all required identifying information's without being pointed to a specific position to be read by an RFID reader.

Nagalakshmi[6] outlined the deployment, issues and best practice of RFID technology in libraries. The author opined that the deployment of the RFID in library should come after the checking privacy policy to protect issues and benefits related to the patrons and standards since most of the Indian institutions have started implementing RFID for tracking the library materials.

Surulinathi & Chudamani[7] opined that RFID technology as a unique application of Automatic Identification and Data Capture (AIDC) technology. The authors concluded that more libraries are gearing to use RFID technology because it has provided efficiency in terms of security, convenience, and increase patron satisfaction of the user community.

Mamdapur & Rajgoli[8] discussed in detail about the various applications of RFID technology with possible benefits and disadvantages of RFID system. The authors were optimistic that when the technology becomes more sophisticated with the competition among the related industries, the related components and accessories such as tags will become cheaper in the near future.

Baidwan, Adarsh & Harvinder[9] attempted to study the functional barriers and challenges faced while implementing the RFID technology. The authors opined that the application of this technology has come out in the betterment of services of the library. Although the technology is dearer in some respect, but the pro has outweighed the cons, thus making it cost effective.

Somvir & Kaushik[10] provided the overview, basic structure, function, major standards, advantages & disadvantages of RFID technology and suggested that RFID technology that could bring strong security and automatic identification surveillance system in the libraries.

Imran, Dar & Mushtaq[11] opined that with the advancement in RFID technology with larger memory capacities, wider reading ranges, and faster processing, more and more libraries are considering its adoption as a solution to increase the efficiency in the tracking of materials at an enhanced speed.

Venkatesh[12] suggested the development of an automatic RFID-based system for library material search. The author also found that RFID system could be used to reduce operating costs by reducing the labor costs, improving automation, refining tracking and tracing, and inhibiting the loss of resources. The author concluded that due to the technology enhanced organisation of books and resources, security of resources and timely service has become possible.

Pawar & Rodge[13] discussed National Information Standards Organisation Circulation Interchange Protocol (NCIP) standards related to development and practical issues of RFID systems working in a library environment, in addition to the basic issues concerning equipment maintenance, support, software compatibility, privacy, and standardisation. The authors attempted to touch basis of all the areas relating to use of RFID in libraries that could be used as a ready reference for librarians for implementation of RFID in their libraries.

Singh[14] proposed the phased implementation of RFID technology as the best approach because it was not possible to commit the whole library to RFID services at the same time. In initial implementation might include the circulation process, security, the self check-in and checkout, stock taking and task like sorting units. In the meantime, the library could be used to monitor, contemplate and assess the returns on investments, assess its benefits, patrons' acceptance, and the education or training needs of the staff. The author concluded that RFID is an advantageous technology that made library management operations more convenient and facilitate optimum services for the patrons, but comes at a cost for which libraries have to be prepared.

Patel[15] showed a vivid picture of application of RFID technology in libraries such as improvement in self-check-in, check-out, monitoring, shelf charging-discharging, reliability, fast inventory, and automatic handling of materials. The author also outlined the challenges and their possible solutions encountered while implementing RFID systems with an aim to cover detail insight for other academic libraries that are willing to deploy RFID system.

Chavan[16] opined that library choose to implement RFID technology should take extra precautions to follow best practice guidelines according to well-established privacy principles. The author asserted that libraries are one of many industries that could increase their efficiency by preventing loss of control over our personal information from the safe implementation of RFID systems.

Hasan[17] enumerated merits of RFID over barcode and electromagnetic tapes. The author also discussed the scope of the hybrid technology and listed some important RFID vendors with special reference to the Indian environment while keeping in mind the limitations. RFID technology could become the future of libraries because of the advantages it offers that supports not compete in the present system.

Saravankumar[18] opined that automated identification procedures have become the order of the day in many library services that provide information. The author

also discussed RFID system and traced its usefulness with regards to library services in an improved manner to staff and student community. The author forecasted that the utilisation of library facilities might increase with the introduction of this RFID technology and found that the technology can help in stock verification to get processed quicker and reduction in the theft of books to a greater extent.

Jain & Sharma[19] introduced the criteria for adoption, and pros and cons of RFID technology. The authors opined that the synergy of RFID in library systems is advantageous because of its novel communication ability using radio waves that is contactless and improved automated check-in or check-out, detection of thefts, fast verification of stocks.

Khanna[20] observed that RFID technology has numerous applications in various areas of the library. The efficiency obtained in the control of accession and management with available facilities of touch screen and drop box systems enabled users to save energy and time. The author opined that despite being expensive in nature, the RFID technology has yielded numerous benefits, advantages, and excellent results by making the library management processes efficient and saved users time and workload.

Madhusudhan & Gupta[21] analysed the behaviour with the opinions of the users towards RFID technology. The authors also found many intriguing results, for example, the majority of users were familiar with the RFID system and its components, but most of the users were not using smart cards because of the lack of information despite the conduction of several literary programs. The findings of the study suggested the quality of related services, patterns of usage, and satisfaction of the users towards RFID technology that enabled an improvement in the attitude and satisfaction of users and service-provider. The authors concluded that the article forms the basis and provides a fundamental understanding of factors such as user-satisfaction that can affect the proper handling of the RFID system for efficient use by users.

Kumar, Singh & Manglam[22] outlined various components, working process of the RFID technology, operational RFID solution to reduce operating costs, improving automation, refining tracking and inhibiting the loss of the resources under any conditions and also briefed its future in Indian libraries.

Baba & Tripuram[23] explained the electromagnetic system technology with a focus on its implementation as RFID technology. The authors concluded that the future development of library sector can only be realised with RFID technology.

Sinha[24] opined that although the RFID Technology is quite expensive, but the technology is set to become more popular in India with more deployment in the coming time in different sectors because it has yielded excellent results by reducing the labor, costs and providing better results, which lead to precise security and control on access. The author forecasted the barrier in its journey as the high cost which is expected to come down further in the future with the adoption of this technology on a large scale in libraries in India and across the world.

Muthukrishnan & Sivaraman[25] opined that deployment of RFID technology in a library requires dedicated research, careful planning, and training. The authors assist that the need of the library users for information can be fulfilled by adopting the new gadgets of information technology that would significantly increase the impact on libraries with a focus on RFID technology and its impacts on its application, features and suitable guidelines.

Verma & Meenakshi[26] provided an overview of RFID technology, its limitations and future outlook with a purpose to assist educators in considering new course topics into the curriculum, while involving some teaching resources, objectives and suggestions.

Anuragi[27] overviewed importance, components, operations, merits, demerits, and essential requirements of RFID technology in the library system. The author opined that the RFID technology is not only emerging but also more effective, convenient and cost efficient technology in library security.

Singh[28] opined that the RFID technology has helped the libraries in numerous many ways and moved beyond security services to become tracking systems that combine security with more efficient tracking of materials throughout the library and also reduced the data entry errors, records updates to enhance customer service. The author concluded that the RFID systems are more expensive if they are operated on higher frequencies and there is a need to standardise the system for its full utilisation in this global world.

Gogoi[29] investigated the privacy risks of the use of RFID technology in the libraries and the methods for reducing such risks, while covering issues about reliability, interference and attacks on privacy and security.

Nahak & Patra[30] opined that RFID is going to be the next wave of automation in the library industry because of its robust, reliable, efficient, and safe operations in comparison to other systems surveillance. The authors also asserted that if guidelines for the implementation of RFID are practiced religiously than the technology could serve in an auspicious manner and the returns can be judiciously utilised in the library.

Nagalakshmi & Trivedi[31] elucidated the deployment of RFID systems that can bring many benefits in library services. The authors concluded that users, libraries and the concerned librarians must have an awareness to come forward to carry out effort related to public education of RFID technology for the benefit of patrons and possible loss of control over personal information.

Hasan[32] compared the traditional technologies such as, barcode with RFID technology and electromagnetic (EM) strips and other related hybrid technologies. The

author also listed RFID Vendors and the concerned libraries using RFID. This article helps in providing an insight for libraries and librarians wishing to implement the RFID system in Library environment.

Addepalli & Addepali[33] proposed RFID LMS for fast transactions with additional properties of traceability and security. The authors concluded that the technology can lead to significant improvements such as savings in labor costs, enhancement of customer services, lower book theft and provide a constant record update of new collections of books.

Jain & Krishna[34] in their book discussed the RFID applications that speeds up book borrowing, returning and monitoring, and thus frees staff from doing manual work so that they could be used to enhance user service tasks.

Sequeira[35] found the significant advantages of LibRFID systems which are non-contact and non-line-of-sight nature that could be tag encrypted ID and then sends it to the reader that eliminated the capturing of the tag IDs and hence the cloning of the tags. The author concluded that the LibRFID although work for low-frequency range tags, but range can be extended after implementing a reader with high frequency ranges.

Singh & Mahajan[36] reviewed and highlighted the importance of RFID system in libraries. The authors concluded that comprehensive studies need to be conducted on the status, actual use and the perception of users, as well as librarians in India about the RFID technology, because not many empirical studies were carried out about the actual usage of RFID technology in libraries either in India or abroad.

Rabari[37] found out the technology aspects of the RFID/EM technology and the process of implementation in the library. The article also shows an overview of the implementation of RFID/EM hybrid system and reviewed the results of the project.

Sevukan & Vijyakumar[38] evaluated the implementation of RFID system. The authors concluded that the personnel working in library perceived that the implementation of RFID system in libraries minimised a number of barriers such as the lack of speed, accuracy, reliability, and time consumption, manpower, besides preventing mutilation, misuse and theft of library documents.

Sahoo & Sharma[39] opined that application of RFID system has yielded efficient results such as a marked cut in the cost of the staffs, regular updating of library materials in real-time services in addition to the enhanced security using memories with enhanced capacities, broader range of readers, and quicker processing. They also noted that RFID technology brought remarkable changes in libraries all over the world because of the user-friendly processes in various management processes.

Warrier, *et al*.,[40] explained the advancement of RFID technology to reduce human intervention and errors, issue and reissuing of the books to enhance user services task. The authors found that the efficiency of the system depends on upon the quality of RFID readers and RFID tags.

Makhija & Chugan[41] discussed RFID-LMS, with its various benefits and challenges and stressed it as one of the latest technologies being used by libraries in the management and maintenance of a library which are usually very crucial and time consuming tasks. The authors opined that RFID technology involves direct systems to detect the target and hence made detection of documents (digital or print) easier and quicker, although the cost was still a big challenge in its adoption.

Thakre & Khaterker[42] asserted that RFID technology is not only cost-effective but also more efficient, reliable and secure in the library and replaced the conventional strips that use the electromagnetic waves.

Kolhe, *et al.,*[43] compared the application of barcode and RFID technologies in libraries. The authors concluded that the latest technology will replace the traditional tracking systems such as barcode in the near future because of its unmatched advantages over them.

Pawar, Shegaonkar & Udane[44] discussed RFID-LMS that allowed fast transaction flow with additional properties of traceability and security. The authors opined that the technology could lead to significant savings in labor costs, enhance customer service, lower book theft and provide a constant record update of new collections of books. It also speed up book borrowing, returning and monitoring, and thus freed staff from doing manual work to do any other user services task.

Sharma & Sharma[45] reviewed the design of a campus-based tracking system, with its possible up-gradation with some new tools and components, to make a check on every student individually based on RFID and ZigBee wireless network. The authors found that the system reads data from RFID tags through RFID reader as each RFID tag that is transferred to the PC node or any mobile device using custom wireless protocol ZigBee and GSM module. The authors concluded that RFID and ZigBee Technology implies low-cost implementation, easy installation, and secure network technologies, so it would be easy for an institution to apply and keep track of their students.

3. CONCLUSIONS

The article presents the reviews mainly on the different theoretical and practical aspects of the implementation and use of RFID technology in libraries, including the benefits, pros, cons, challenges, and problems related to RFID application. In conclusion, a common feature that reappears is the improvement in the library service after its implementation vis a vis shortage of funds for its implementation. The future of the library can be improved many times if generous funding is done to perpetuate the technology in all the potentially active libraries of

India. There will be no exaggeration in saying that RFID is right technology investments for all stakeholders, for long-term security of the library.

The reviews of this paper will not only guide the librarians in effective implementation of RFID technology in their libraries, but also abreast the knowledge of RFID technology and its advantages. The major limitation of the study related to many libraries in India is using RFID technology, but not reported in the form of an article. Although, there exist many related studies that are covered in foreign studies, but these are excluded due to Geographical limitation.

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