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Adoption of Smart Technologies in University Libraries of Pakistan: A Qualitative Review

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Abstract

Technological advancement has a deep influence over all the sectors of life including libraries. The libraries are coping with these developments accordingly but the pace of development is not the same around the globe. The Smart library concept emerges from the idea of smart cities, where all functions are controlled by the latest technology to minimize human involvement. This study aims to present a comprehensive model of smart library technologies and applications. The peer-reviewed literature published from 2016 to 2020 was reviewed to model eleven smart library technologies. The feedback from the selected, senior university librarians of Pakistan on the proposed model of smart libraries was collected. The experts appraised the smart library model as a good combination of related technologies and applications. The findings reveal that each participating library is using some of the smart library technologies. The problems faced by university librarians of Pakistan while adopting smart library technologies are discussed. The study also suggests a way forward to overcome barriers to adopting the proposed model.

Keywords: Smart libraries, Technology-supported libraries, Automated library operations, Self-service libraries, University libraries, Pakistan.

Introduction

The traditional format of libraries is changing with the advent of technology. The electronic formats are gradually replacing print versions of books, journals, newspapers, and so on through the use of information and storage technologies (Aithal, 2016). The need for multiple copies of print collections and physical space to store them brings about the usage of electronic resources. Despite and owing to many other reasons, libraries are adopting the systems based on Information and Communication Technologies (ICTs) to cope up with the varied information needs of their users in this digital age (Ao & Huang, 2020). In this era, technological revolutions have impacted all sectors of life. The application of technologies has reduced human efforts. The world has become a global village and the users can access and find their required information from anywhere with the help of technology (Freyberg, 2018).

Originated from the 'Smart City' concept, the 'Smart Library' has been used more frequently for tagging a new vision of libraries. The concept of Smart City addresses the incorporation of digital processes and loops of informational feedbacks in the community and claims to be a

desirable state, in which cities become efficiently organized, secure, resource-friendly, flexible, green, sustainable, and socially inclusive (Simeone, 2020).

According to Shah and Bano (2020), a “smart library is a hardware and software complex with a wide range of opportunities for searching and providing necessary information to virtual users according to their inquiries and requirements” (p. 2). Baryshev and Babina (2016) view a smart library as “a hardware and software complex with a wide range of opportunities for searching and providing necessary information to virtual users according to their inquiries and requirements” (p. 2). UK’s Leicestershire County Council (LCC, 2019) explains that a smart library “is accessible to the library users without being staffed. The technology enables control of remote library buildings, including automatic doors, lighting, self-service kiosks, dropbox, and public computers ... to significantly extend library opening hours so that more people can use the library at times that are convenient for them” (p. 2).

The smart library technologies and applications facilitate automatic patrons’ identification systems, individual verification for transactions via biometric fingerprints, facial patterns, voice, hand geometry, face recognition, or typing cadence. These technologies also facilitate searching through voice command, self-checked-in/out (Shafagat, 2016), Geographic Information System (GIS) for resource locating. Dropbox, Kiosks, Artificial Intelligence (AI), Radio Frequency Identification (RFID), and Closed Circuit Television (CCTV) systems (Nisha, 2018) for smooth library operations with the least staff involvement.

Objectives of the Study

The primary objective of this study is to propose a model of smart library technologies and their applications based on peer-reviewed literature. The secondary objective to obtain feedback from the university librarians of Pakistan on the status and adoption of these technologies.

Research Questions

The objectives of the study can best be interpreted in the following research questions.

1. How do the university librarians of Pakistan view the proposed model?
2. What is the adoption status of the listed technologies in the university libraries of Pakistan?
3. What are the problems/barriers for Pakistani university librarians to adopt smart library technologies?

Literature Review

Review of the relevant literature is an integral part of the research process. For this purpose, a comprehensive search of the literature was conducted using leading databases, e.g. Emerald, ProQuest, EBSCO-Host, Crossref, Directory of Open Access Journals (DOAJ), Elsevier, Higher Education Commission (HEC) Pakistan’s Summon search, and Google Scholar. The most relevant literature has been reviewed in the following paragraphs.

Basic Elements of a Smart Library

Cao et al. (2018) conceptualized the idea of a smart library into three basic elements, namely, technology, services, and human as shown in Figure 1. This conceptual study supported by an

extensive review of the literature provides direction and guidelines for libraries to become smarter.

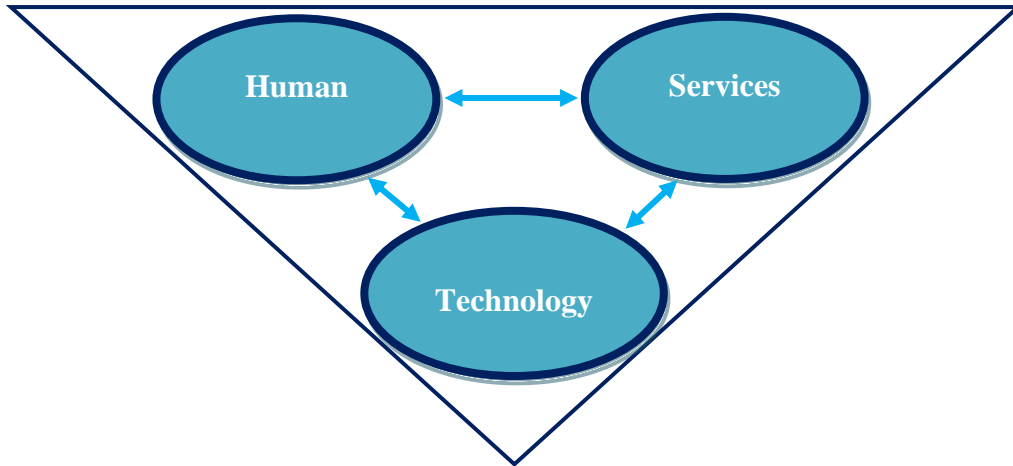


Figure 1. Three basic elements of a smart library (Cao et al., 2018)

Smart Library Technologies

The major findings from the peer-reviewed literature confirm that libraries are becoming smarter with the use of emerging technologies thereby enhancing the working capabilities that satisfy the users associated with them. The description of smart library technologies is summarized below.

Data mining. Data mining is a method used to convert raw data into useful information with the help of computer programs to look for patterns and big batches of the data. The organization can learn more about their patrons to develop more effective marketing and service strategies to increase the use and satisfaction level of library users (Cao et al., 2018). Data mining helps the libraries to plan as per the need of their users and to identify the potential library users by analyzing system logs, circulation history, and reading habits (Jadhav & Shenoy, 2020; Liu, 2018).

The traditional libraries worldwide are shifting to integrate technological library systems because the cutting-edge technologies bring revaluation in the day-to-day operations of libraries. Such technologies are artificial intelligence; the internet of things, data mining, and voice-based searching for transforming themselves into smart libraries. This study was based on the review of the literature and a fuzzy-based model for library smartness that was developed and applied to university libraries to measure the smartness of university libraries (Jadhav & Shenoy, 2020).

The research was planned to find out the hidden valuable information or association rules for a large amount of data in library books management system in the university libraries is of great significance to the management of library and its services. A collaborative filtering mining design was developed for university libraries. Data mining was based on a collaborative filtering algorithm and a books recommendation model was generated. The test results revealed that the precision ratio of books based on a collaborative filtering algorithm was greater than the traditional process. This paper has achieved its goal and can be used for data mining algorithms in academic library management (Liu, 2018).

Geographical Information System (GIS). A Geographical Information System (GIS) is a computer-based system for capturing; checking, storing, and displaying data related to library items and users to locate the position on the surface. The GIS is used to analyze in-library use data and possession of library space by mapping the location of users and library materials. It also provides facilities at sample times to access the library services. The GIS has also the potential of searching, displaying, and presenting several reports considering the extent of the loan for each specific shelf on the map of the building and several halls of the library. The ArcGIS software is also useful in this regard (Nisha, 2018; Pournaghi, 2017).

Integrated Library System (ILS). An ILS (Integrated Library System) is computer-based software that is integrated with a database and indexing software having two graphical user interfaces, one for library staff and another for library users. ILS has many modules comprising acquisition, cataloging, circulation, serials management, budget control, serials maintenance, patrons, reporting, and an online public access catalog for users. The ILS can be in-house developed or outsourced to vendors. Currently, there are two types of ILS systems available in the market; open-source and paid software (Yeh & Walter, 2016).

Internet of Things (IoT). The Internet of Things (IoT) utilized in libraries are technologies such as RFID technology that allows for item identification and item security, machine to machine (M2M) communication, devices such as self-check-in/out, dropbox, kiosks/automated materials handling machines, automatic doors, semantic searching, metadata, and discovery system in smart libraries (Cao et al., 2018; Gul & Bano, 2019).

Artificial Intelligence (AI). Artificial Intelligence (AI) technology is used in smart libraries for the integration of smart users. Such technologies that use AI are Personal Digital Assistants (PDA), RFID, IoT, Internet+, speech and image recognition (Cao et al., 2018; Gul & Bano, 2019; Yu, Gong, Sun, & Jiang, 2019).

Ambient intelligence (sensor technology). Ambient Intelligence abbreviated as “AmI” is an emerging technology used in smart libraries that brings intelligence to our day-to-day sensitivity requirements. *AmI* is based on the research of sensors and their integration, artificial intelligence (AI), and pervasive computing (Gul & Bano, 2019).

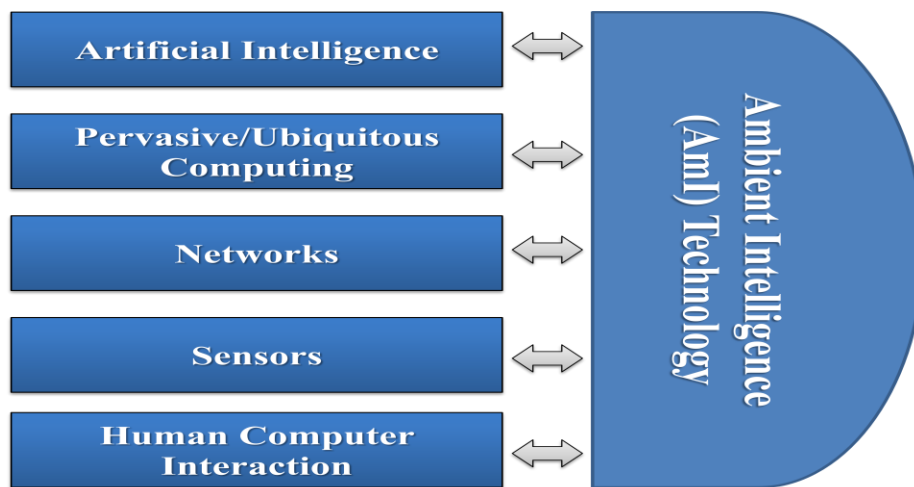


Figure 2. Ambient intelligence technology in smart libraries

Augmented Reality (AR). Augmented Reality (AR) is an emerging technology that is used for presenting a real-world environment where the objects that reside in the real world are enhanced by computer-generated perceptual information. AR is sometimes used for multiple sensory modalities such as visual and auditory (Gul & Bano, 2019; Shen, 2019).

Blockchain technology. Blockchain technology is a system of recording information in a manner that makes it difficult or impossible to be hacked, changed, or cheated the records in a blockchain system. Digital currency and online banking systems mostly use this technology. The blockchain is essentially a digital ledger of transactions that is duplicated and distributed across the entire network of computer systems on the blockchain for securing and preventing it from hacking (Coghill, 2018). This is an emerging technology in smart libraries to protect data and records.

Radio Frequency Identification (RFID). The Radio Frequency Identification (RFID) is an electromagnetic wireless system of communication that is used in libraries for identification and security purposes. Each RFID tag is attached to all items of a particular library and instantly responds with its unique item ID number which is the same as the accession or stock number used by many libraries. The RFID system helps library staff in security, stock-taking/verification, and patrons self-service such as auto door, dropbox self-check-in/out, and many more (Sungkur, Ozeer, & Nagowah, 2021).

Closed Circuit Television (CCTV). The CCTV camera is a system that sends signals to a limited number of screens, and stored on the hard disk, and often used in public places like stores and libraries for the security of materials to prevent crime. CCTV cameras installed in libraries for surveillance help keep the public secure while using the library for research, reading, referencing, or browsing. This surveillance system can help in preventing library theft, supervise and control library activity from one place (Gupta & Margam, 2020; Lavanya, 2017).

Electronic Resource Management (ERM). An ERM system is the technique used by library professionals to trace the selection, acquisition, access, licensing, usage, evaluation, retention, and de-selection of library’s electronic information resources (Breeding, 2018; Gul & Bano, 2019).

Table 1. Summary of Smart Library Technologies and Their Applications

#	Technology	Application
1	Internet of Things (IoT)	IoT technology is used with the identification of items and their security i.e. RFID/Bio-Metrics.
2	Artificial Intelligence (AI)	AI technology is used to achieve the natural integration of smart users and libraries.
3	Ambient Intelligence (AmI)	Ambient Intelligence technology is for sensors and sensor integration in smart libraries.
4	Augmented Reality (AR)	Augmented Reality is a technology that superimposes a computer-generated image on a user's view of the real world.
5	Blockchain technology	Blockchain is a system of recording information in a manner to makes it difficult or impossible to hack, change or cheat and works as a digital ledger of transactions that is duplicated and distributed across the entire network systems.
6	Radio Frequency Identification (RFID)	RFID is an electromagnetic wireless communication system used in libraries for the identification and security purposes of library materials and patrons.
7	Closed Circuit	CCTV Cameras installed in libraries are for surveillance keeping the

	Television (CCTV)	public safe while using the library for research, reading, referencing, or browsing.
8	Electronic Resource Management (ERM)	The ERM is the practice/technique used by librarians for electronic information resources management.
9	Data mining	Data mining is a method used to convert raw data into useful information with the help of computer programs to look for patterns and big batches of the data.
10	Integrated Library System (ILS)	An ILS is a resource system planned for the library to trace library materials owned, orders placed, items received, bills paid, and borrowed items record by library users.
11	Geographic Information System (GIS)	GIS is used to analyze in-library use data and possession of library study space by mapping the location of users and library materials.

Based on the literature review, a model of smart library technologies is proposed in Figure 3 below.

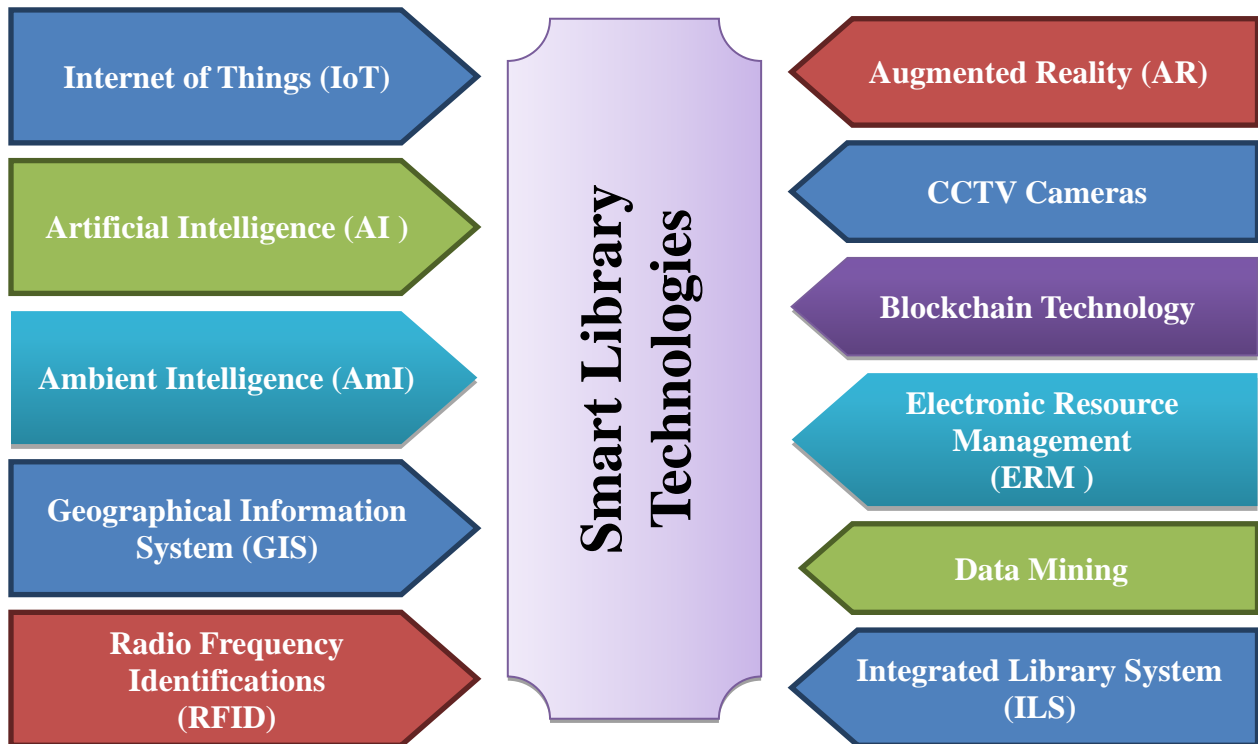


Figure 3. Smart library technologies' conceptual framework/model

Study Methodology and Limitations

The qualitative method was adopted for this research study. Firstly, a review of accessible literature was conducted to model smart library technologies and their applications. Secondly, a purposive sample of three university librarians was drawn for seeking their feedback with their prior consent. However, only two of them responded. Owing to time constraints, the sample was

limited to Islamabad, the capital of Pakistan, only. However, the librarians selected were the most senior and experienced ones. The selection of university libraries was because of their better standing than other types of libraries in terms of collection, physical and human resources, space, budget, infrastructure, users, and so on. Data collected from librarians through open-ended, written interviews via email were analyzed thematically.

Data Analysis and Interpretation

The data collected from university librarians through interviews are interpreted below against each research question.

RQ1. How do the university librarians of Pakistan view the proposed model?

The librarians are of the view that the proposed model covers almost all aspects of smart technologies that are used in university libraries. They consider the model as a sound blend of technologies for university libraries of Pakistan. To adopt this model in the Pakistani setup, the librarians suggest including services management, information literacy instructions, and social networking among all the stakeholders in this model.

RQ2. What is the adoption status of the listed technologies in the university libraries of Pakistan?

One of the librarians provides the following list of smart technologies they have implemented in their library.

- ✓ Integrated Library System (ILS)
- ✓ Closed Circuit Television (CCTV) cameras
- ✓ Radio Frequency Identifications (RFID)
- ✓ Self-service kiosks
- ✓ Digital repositions of e-books, theses, and archival records
- ✓ Library websites
- ✓ Online resources/databases (free and subscribed)
- ✓ Information Literacy (IL) instruction

The other librarian claims that they have installed and used only ILS & CCTV cameras in their library.

RQ3. What are the problems/barriers for Pakistani university librarians to adopt smart library technologies?

The librarians believe that the libraries in Pakistan need rebranding in terms of knowledge centers instead of information resource centers. One of the librarians provides the following list of problems/barriers they face to adopt smart technologies in their library.

- Budget constraints
- Lack of technological knowledge/specialties
- The absence of in-service training regularly
- Insufficient library human resources

The other librarian provides the following list of barriers and problems associated with adopting smart library technologies.

- The outdated curriculum of LIS schools that produces unskilled manpower
- Non-use of social media as a tool for marketing of library services
- Deficiency of management skills
- Lack of professional communication skills
- Lack of decision-making skills
- Lack of problem-solving skills
- Non-existence of national council on library and information sciences
- Lack of skills for negotiation with authorities to convince them
- Lack of coordination between library administration and university authorities
- Non-involvement of the librarians in university's policy/decision-making process
- Lack of regular, local training on modern information management techniques
- Lack of coordination between library administration and IT professionals
- Lack of foreign advanced training opportunities for LIS professionals
- The non-proactive role of professional associations
- Lack of coordination between library administration and university academia

Conclusion

The findings reveal that none of the participating libraries has implemented all the technologies presented in the model. One of the participating libraries has adopted four such technologies. Being a developing country, there are certain barriers to adopting smart library technologies as indicated by the participating librarians. These barriers include the poor financial position of libraries, no specific budget under the technology head, lack of required skills and knowledge in librarians, and non-cooperation from the university authorities. The absence of library and information science council and country-level policy are also unfavorable factors in this regard.

The universities of the country need financial support to fulfill the technological need of their libraries. Additionally, communication skills, regular in-service training, country-level policy, knowledge of the latest technologies, and current trends in university libraries are the areas to focus on to convert conventional libraries to smart libraries in developing countries like Pakistan. Coordination with the IT department and academia is also essential in this regard. Higher Education Commission (HEC), Pakistan, a government funding agency for the public sector universities of the country, can play an important role in inviting proposals for the technological development of university libraries. They are already supporting the libraries for the development of collections. HEC can also play a pivotal role in library legislation and policy from the government and the establishment of the library and information council. Finally, the library schools in Pakistan should revise their curriculum keeping in view the latest trends in the field. They should particularly focus on practical aspects of the curriculum through compulsory practicum and internship. They should also take the employers onboard especially university librarians to produce the graduates aligned with job market requirements.

References

- Aithal, P. (2016). Smart library model for future generations. *International Journal of Engineering Research and Modern Education (IJERME)*, 1(1), 693-703.
- Ao, S. H., & Huang, Q. S. (2020). A systematic review on the application of dialogue in public relations to information communication technology-based platforms: Comparing English and Chinese contexts. *Public relations review*, 46(1), 101814.
- Baryshev, R., & Babina, O. (2016). Smart library concept in Siberian federal university. *International Journal of Applied and Fundamental Research*(1), 1-7.
- Breeding, M. (2018). ERM strategies in academic libraries: Historical evolution and current context. *Computers in Libraries*, 38(3), 17-21.
- Cao, G., Liang, M., & Li, X. (2018). How to make the library smart? The conceptualization of the smart library. *The Electronic Library*, 36(5), 811-825.
- Coghill, J. G. (2018). Blockchain and its implications for libraries. *Journal of Electronic Resources in Medical Libraries*, 15(2), 66-70.
- Freyberg, L. (2018). Smart Libraries—buzz word or tautology. *Elephant in the Lab*, 1-12. doi: <https://doi.org/10.5281/zenodo.1302988>
- Gul, S., & Bano, S. (2019). Smart libraries: an emerging and innovative technological habitat of 21st century. *The Electronic Library*, 37(5), 764-783.
- Gupta, P., & Margam, M. (2020). CCTV as an efficient surveillance system? An assessment from 24 academic libraries of India. *Global Knowledge, Memory and Communication*, 2020(1), 1-22.
- Jadhav, D., & Shenoy, D. (2020). Measuring the smartness of a library. *Library & Information Science Research*, 42(3), 101036.
- Lavanya, P. (2017). Security systems in libraries: An overview. *International Journal of Library and Information Studies*, 7(1), 225-229.
- LCC [Leicestershire County Council]. (2019). What is a smart library? *Answers to frequently asked questions about the changes taking place in your library* (pp. 1-7). England: LCC.
- Liu, Y. (2018). Data mining of university library management based on improved collaborative filtering association rules algorithm. *Wireless Personal Communications*, 102(4), 3781-3790.
- Nisha, F. (2018). Implementation of RFID technology at defence science library, DESIDOC: A case study. *DESIDOC Journal of Library & Information Technology*, 38(1), 27-33.
- Pournaghi, R. (2017). GIS as a supporting instrument for making decisions about the library sources collection management. *Collection Building*, 36(1), 11-19.
- Shafagat, M. (2016). Application opportunities of biometric technology in electron libraries. *Communications*, 4(2), 8-11.
- Shah, A., & Bano, R. (2020). Smart library: Need of 21 st century. *Library of Progress-Library Science, Information Technology & Computer*, 40(1), 1-11.
- Shen, Y. (2019). Intelligent infrastructure, ubiquitous mobility, and smart libraries—Innovate for the future. *Data Science Journal*, 18(1), 1-14.
- Simeone, M. (2020). The Smart City as a Library. *portal: Libraries and the Academy*, 20(2), 233-236.
- Sungkur, Y. G., Ozeer, A. M., & Nagowah, S. D. (2021). Development of an IoT-enabled smart library system for a university campus. *Journal of Telecommunication, Electronic and Computer Engineering (JTEC)*, 13(1), 27-36.

- Yeh, S. T., & Walter, Z. (2016). Critical success factors for integrated library system implementation in academic libraries: A qualitative study. *Information Technology and Libraries*, 35(3), 27-42.
- Yu, K., Gong, R., Sun, L., & Jiang, C. (2019). *The application of artificial intelligence in smart library*. Paper presented at the 2019 International Conference on Organizational Innovation (ICOI 2019).