



## Impact of the internet of things (IOT) on academic libraries and its users

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### Abstract

Due to rapid development in Information Technology Libraries have been affected to great extent and have benefited from Information Technology based tools including hardware, software applications, communication networks, and electronic information sources of information in order to provide better library services and wider access to the user community. Since libraries are sources of culture, they can create change in the user community's culture, specifically by shaping their information collections, improving resource availability, and helping users access the collection through communication and training efforts. In recent years, new Information Technology concepts have appeared, including digital transformation, cloud computing, and the Internet of Things (IoT). They have had an impact on the population, and therefore libraries can benefit from them too. Libraries may save a lot of their Information Technology budget by adopting these new approaches, because they provide technology in easy ways, often at lower costs, and to the benefit of users. There are large numbers of applications driven by Internet of things in libraries.

**Key Words:** internet of things (IoT), academic libraries

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### Introduction

Internet of things (IoT) is a new revolution of the Internet that is rapidly gathering momentum driven by the advancements in sensor networks, mobile devices, wireless communications, networking and cloud technologies (Bahga & Madiseti, 2014) <sup>[1]</sup>. They are interrelated networks that allow devices to receive and send data with each other via Internet. Internet of things (IoT) is defined as “a dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual ‘Things’ have identities, physical attributes, and virtual personalities and use intelligent interfaces, and are seamlessly integrated into the information network” (Kranenburg, 2008) <sup>[2]</sup>.

### Concept of Internet of Things (IoT)

The term Internet of things (IoT) was first coined by Kevin Ashton in 1999. Firstly, the term was introduced to describe how Internet of things (IoT) was created by adding RFID and other sensors to everyday objects (Simões, Filipe & Barbosa, 2019) <sup>[3]</sup>. In Internet of things (IoT) the things function like smart and living entities by sensing and communicating through embedded devices which interact with sensors. Internet of things (IoT) consists of the networks of physical objects, the traditional network of the Internet, and various devices (gateway, border router etc.) that connect these networks (Tkachenko & Brezhniev, 2019) <sup>[4]</sup>. Xu *et al.* (2014) <sup>[5]</sup> stated that RFID and WSN are the foundational technologies of Internet of things (IoT) and service-oriented architecture as a key technology in integrating heterogeneous systems or devices that can be applied to support Internet of things (IoT). The identification and tracking technologies, communication technologies, networking technologies and service management form the four-layer architecture of Internet of things (IoT) (Liang, 2019). The application of Internet of things (IoT) extends to a wide range of domains including homes, cities, environment, energy systems, retail, logistics, industry, agriculture, health etc. The researcher are concentrating on the application of Internet of things (IoT) in libraries. It is an area that can make drastic changes in services as well as management of libraries. The application of Internet of things (IoT) in libraries saves time of the patron and provides a digital view of physical items for finding location of things (Gupta and Singh, 2018) <sup>[7]</sup>.

### Information Technology and the Library Infrastructure for Internet of Things (IoT).

The Information Technology infrastructure in most libraries should consist of the following ten elements:

1. Hardware, specifically computers and accessories
2. Software, including all the programs and applications that are used in running the library and providing services to the users
3. LAN, including the library's internal communications network and its devices

4. WAN, which encompasses internet services, virtual private networks (VPNs), and other networks
5. ILS, which helps manage the collections, library services, and user accounts
6. Library websites and other electronic marketing tools, including social media
7. Databases
8. Paperless information resources (Electronic or Digital Media)
9. Training resources to help staffers and users develop technology skills
10. Administration, including IT department management and contract managers

When these ten elements are in place, libraries are in a position to develop an information culture for their community of users.

### **Internet of Things (IoT) Applications in Libraries**

There are many potential areas identified by different scholars for the application of Internet of things (IoT) in libraries. It can be used to track and trace library materials and promote self-check-outs. It can also be used for consulting and training, sharing of information, library marketing and promotion. The literature search also shows the infinite possibilities of Internet of things (IoT) application in libraries. Most prominent applications derived from the literature reviewed are listed below:

#### **1. Personalized Services**

With the help of Internet of things (IoT), libraries can provide a number of personalized services. Wojcik (2016) explained that IoT can be used to deliver contextual hints and information about resources connected with current user interest. Mobile applications can be integrated with existing library systems. Internet of things (IoT) would be able to communicate to a user about the commencement of new additions in his area of interest as well as related works. Users can receive notifications about their account status, about library events or search through catalogs.

#### **2. Smart Library Buildings**

In Internet of things (IoT) based library building concept sensors will be deployed into building so as to monitor the building operations. It can optimize the control of lighting, cooling and heating. It is also helpful for fire protection. Sun (2014)<sup>[9]</sup> proposed that Internet of things (IoT) based buildings provide a clean and comfortable learning environment for readers. The intelligent fire and security systems can ensure the safety of personnel and buildings (Nie, 2016). The automatically adjusting temperature and lighting improve energy efficiency. Internet of things (IoT) technology can be used for collecting data regarding the usage of printed and electronic resources, suitability of the building, the cleanliness of the restrooms and the movement of furniture in the most used areas of the library for study and research. It enables the users to know the current user denseness and accessibility of reader's cubicles, desktops and for printers. Internet of things (IoT) enables librarians to know busy as well as less used space of the library. This will help the authorities to make strategic decisions regarding space management.

#### **3. Locating Books and Other Materials**

The misplacement of books is a burden for professionals. Internet of things (IoT) book tracking facility is very helpful for searching books on the shelf and locating misplaced books. Brian, Arockiam & Malarchelvi (2014)<sup>[11]</sup> proposed an Internet of things (IoT) based Smart Library system, which provides the luxury of fetching a book from its place with the assistance of an Internet of things (IoT) based interconnected system using a Wi-Fi based Local Positioning System and Near Field Communication tags. Near Field Communication enabled smart phone authenticates a user along with his biometric fingerprint. LPS enables a user to trace a book and its exact location from OPAC and to get the information on his smart phone. Near Field Communication scanners located at the library doors are triggered if an unissued book is taken out. This system is helpful for the users and librarians to easily locate and issue books in large libraries.

#### **4. Inventory Control**

The Library resources can be controlled by applying sensors on them. Internet of things (IoT) enabled libraries can easily trace the resources. Li *et al* (2016)<sup>[13]</sup> reviewed that Internet of things (IoT) enables searching and finding mis-shelved/ misplaced materials within no time. Using UHF RFID tags on library materials shelf, Android mobile readers read the tags' serial numbers, which are keys to the library database. A detailed list of materials available on the shelf is shown on the user interface of Android mobile reader. The misplaced books are highlighted and it will help reduce the amount of work involved in stock verification.

#### **5. Library Orientation**

Library orientation programme ensures the familiarization of library resources, services and facilities to new members. Internet of things (IoT) applications enhance the power of librarians in teaching users about library services using mobile applications, making virtual tours and exploring video contents. When users visit particular sections of a library, wireless devices recognize the users and play audio or video guiding the users on

the various services in the library. Internet of things (IoT) could be used for obtaining data on users by which library can customize several services.

## 6. Smart Circulation Control

Internet of things (IoT) can give alert to users about their current holdings and overdue dates and fine details. Patrons can pay fine by online. Li *et al* (2016) <sup>[13]</sup> designed an Internet of things (IoT) system for library materials management using Android based UHF mobile reader. It can be installed with library application software at the entrance of Internet of things (IoT) System for efficiently managing Library collections. It enables searching, self-help borrowing, returning and renewing library materials with Android mobile readers anytime and anywhere. Users are authenticated with an ID and password to log in to the system. The user interactive interface of the Android mobile reader helps the users to borrow and return books on their own.

## 7. Catalogue Search

In an automated Library, catalogue search is done through OPAC terminal or Web-OPAC. Library is using the RFID technology is accepted by libraries long back. RFID tag, which will be inserted inside the book will store the information about that book. In this era of Internet of things (IoT), Wireless Sensor Networks can be connected with RFID tag, which will help to search the books on shelf with the help of mobile application. Identifying the location and availability of the books are possible with this technology.

### Challenges for Internet of Things (IoT) Implementation in Libraries

There are infinite possibilities in the libraries using Internet of Things. Librarians need to take into consideration before implementing new of Internet of things (IoT) technologies.

- Privacy and security of user's data is to be assured because there is a possibility of sharing this data with third parties which may cause hacking.
- A huge financial investment is required for acquiring, implementing and maintaining Internet of things (IoT) equipment and technologies in libraries.
- Updating the staff with new technology is a challenging task for the librarians.

## Conclusion

The library professionals are always at the forefront in adapting the new technologies. Innovation of Internet of Things (IoT) and associated technologies provide practical aspects of attaining sustainable information development practices in the contemporary knowledge society. The application of Internet of Things (IoT) is an emerging concept in library and information science. In application level, there are many challenges. Along with security and privacy, standardization is also a great dispute for the adoption of Internet of Things (IoT) in libraries. Libraries can take advantage of Internet of Things (IoT) technologies for providing various library services.

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