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An overview of IoT (Internet of Things) and its applications for transforming traditional libraries to Smart libraries

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Abstract

Introduction*: Over the past decade, the advent of the internet (also known as the World Wide Web) has changed our life, work, and our leisure time. A number of new technologies including IoT (Internet of Things) have evolved as a result of the significant transformation of the internet. The network of physical items, or "things," that have sensors, software, and other technologies installed in them so they can interact with other devices and systems over the internet and exchange data. IoT may be considered as a transformative potential in libraries to improve User experiences, intelligent library management system, inventory tracking, and sensor-based environmental monitoring, for instance air quality, humidity, and temperature in library spaces.*

Purpose*: This article focuses on the concept of IOT, its applications in libraries, and how IoT-enabled technologies have the potential to transform traditional libraries into smart ones.*

Objectives*: There are basically three objectives for this study. Understanding about the Internet of Things is the first phase, then exploring its applications and, finally, its benefits and drawbacks in the library field.*

Methodology*: To identify the Internet of Things (IoT) tools and applications that might transform traditional libraries into smart libraries, a theoretical approach has been taken. A critical analysis and synthesis were performed on literature that was retrieved from Google Scholar.*

Findings*: It is find that, the application of IoT minimizes the time for various library operations like circulation, stock verification, identification of mis-shelved books, handling of library materials etc. IoT technology allows libraries to provide more efficient and personalized services to their patrons. IoT will likely to become an essential part of modern library services as the technology advances.*

Keywords*: Internet of Things, RFID, Library, Smart Library*

Introduction

Kevin Ashton introduced the term "internet of things" in 1999. He is widely regarded as the founder of IoT and believes that the IoT is an essential tool for understanding the real world. The concept was given to the Auto-ID Center, which was formed in 1999 at Massachusetts Institute of Technology. Its initial description is simple: connects any kind of items to the internet using radio frequency identification and other sensor equipment in order to achieve intelligent identification and management. The phrase "internet of things" was formally proposed by the International Telecommunication Union at the 2005 World Summit on the Information Society in Tunis.

The term "internet of things," also referred to as "the internet of objects," describes how every object is connected through network and is built up of multiple information-sensing devices, including radio frequency identification devices, Infrared sensors, laser scanners, global positioning systems, and other devices. Chips and sensors, when embedded, objects can think feel and talk with each other with together with the infrastructure of Internet and mobile network. These objects can communicate with human and enables to monitor and control anytime anywhere.

IoT technologies cover a wide range of hardware not just one type of hardware but many kinds of hardware that exist as unconnected devices. IoT devices will be integrated into an enhanced cloud architecture that has the ability to generate and gather data about its surroundings on its own. Internet of Things (IoT) is computing machines that are not conventional points of use; in other words, they are more similar to data-gathering probes than desktops or mobile devices.

RFID and WSN are the basis all technologies of IoT and service oriented architecture as a key technology in integrating heterogeneous system or devices that can be applied to support IoT (Xu et al., 2014). IoT as a video object facilitate with an appropriate sensor and network access that can communicate to fulfill particular tasks.

It's a technology that connects multiple items together without requiring human participation by using sensors and the internet (Wojcik, 2016).

It is a huge network of interconnected objects that gathers information about their usage and the surroundings. Sensors are incorporated in devices and objects, and they transmit data to various IoT platforms. IoT platforms are also used to collect targeted data and identify patterns. Thus, the above technique assists enterprises and institutions in lowering costs by improving process efficiency, asset utilization, and productivity.

Libraries were not exempt from the significant improvements brought about through the internet of things. Even though there are many advantages to IoT applications in libraries, it is important to take concerns about data security into consideration. Libraries may improve user experience and simplify operations with the help of IoT. Books with RFID tags embedded in them allow for automated check-in and check-out operations and efficient inventory control, which save time for both patrons and librarians. IoT-enabled environmental monitoring ensures ideal preservation conditions, protecting valuable library materials.

IoT converts the academic library into a living learning Lab that census and studies human dynamics, human computer interaction and human building interactions (Ju and Shen, 2015). According to an OCLC research it is revealed that several librarians are unaware of the Internet of Things and associated technologies. The survey also shows that librarians are unsure about whether IoT is hype or a reality. Additionally, their research shows that librarians intend to delay until the technology is more widely used before investing time, energy, and financial resources to building IoT services.

Iot transform libraries into smart connected spaces that improve user experience and smooth operation from monitoring environment and conditions to powering automated service. IoT technology holds tremendous potential for libraries to adapt to the digital age while preserving their primary objective of knowledge dissemination and community engagement.

Objectives

1. To find out the concept of IoT.
2. To explore potential areas in libraries where IoT may be used effectively.
3. To identify the opportunities and challenges in IoT applications in library.

Survey of related literature

Renold and Rani (2013) proposed a library management system based on RFID for automated tracking and identification. This study addresses the challenges encountered in a library setting, such as finding misplaced or mis-shelved books or materials, and facilitating book access. A solution is proposed to address these concerns and problems through improved work. Li (2014) discussed on RFID integration and Internet of Things applications in university library management. The internet can be used to establish resource sharing. The Internet of Things may perform a number of tasks, such as self-checkin, Check out and self-return, intelligent querying, smart inventory, and integration of information systems and books. Pujar and Satyanarayana (2015) define the term "Internet of Things," discuss the technology and its development, provide examples from the service sector, discuss potential effects on libraries, and identify specific library spaces where it can be successfully deployed. Ju and Shen (2015) proposed The "Internet of Knowledge (IoK)," an innovative approach put out by can be used to connect scatter resources online and arrange them into a valuable knowledge asset that can be used to accomplish any number of goals. Wojcik (2016) put forth a theoretical model of IoT that can be applied to provide contextual hints and information on resources related to the user's actual area of interest. Mobile apps can be integrated into current library systems. IoT technology can notify users about new additions to their related works. Notifications regarding events at the library, their account status, and catalog searches can all be delivered to the users. Hahn (2017) in Library technology reports discuss about the Google-Analytics-style dashboard for the library building. It will record the total number of footfalls, the browsing habits of users, and the sections of the library that users visited most frequently. This project uses sensors to collect data about how library spaces are being used. In turn, this will assist librarians in making important decisions about usage patterns and promote the delivery of efficient user services. Gupta and Singh (2018) proposed that the use of IoT in libraries saves the time of user and provide them a digital view of physical items for locating. Patel (2019) presented an energy-saving technology for libraries and other facilities, utilizing two sensors to detect human presence. The majority of research demonstrated that IoT can be successfully incorporated into the library's physical space. Sheeja (2019) describes potential areas where Internet of Things (IoT) can be implemented successfully. The paper evaluates the literature on IoT applications in libraries. The literature on IoT applications that could be found between 2010 and 2019 using a Google Scholar search was chosen. They conclude that, IoT technologies can benefit libraries in

a number of ways through their services. While employing new technology to improve services and facilities at their libraries and information centers, librarians must collaborate and plan strategically. Liang (2020) conducted a literature review on IoT from major databases such as Web of Science, IEEE Xplore, Scopus and Inspec for the period between 2010 and 2018 for identification of IoT potential impact on libraries, and its application in libraries from managerial perspective, especially focuses on library service innovation in IoT era. Natarajan (2022) provides definitions and an overview of the Internet of Things and characteristics like interconnectivity, heterogeneity, dynamic change, safety and connectivity. Information literacy, cloud computing for the e-resources stored and accessed from publishers' websites, circulation desk, book restoration, virtual libraries, book tracing, user entry, and fire detection and protection are some of the IoT applications in libraries that are covered. Library professionals should try implementing IoT as it is still in its early stages. Sashidhara (2023) indicates that the internet of things has currently projected that this technology will benefit librarians in their effort. This study shows that the IoT technology has not been widely adopted, especially in Indian libraries, and that only a small number of libraries in Western countries have adopted these applications. Ram, Kumar and Pal (2023) discuss that IoT is being used by libraries to improve user experiences and operations. Intelligent shelf management, self-checkout kiosks, and computerized inventory tracking are just a few examples of intelligent library management technologies that optimize resource use and streamline library operations. IoT-enabled environmental monitoring, which keeps an eye on temperature, humidity, and air quality in library areas, guarantees the protection of fragile materials.

Application of IoT in libraries

Iot has revolutionized the way libraries operate by providing a variety of innovative applications to improve patron services and increase efficiency. Various studies have highlighted a wide range of possible applications for IoT in libraries. Most prominent IoT applications are:

1. Smart library management using RFID technology

RFID stands for Radio frequency identification, RFID, is a technique that automatically identifies individual items using radio waves. Any RFID system's aim is to store data in appropriate transponders, frequently referred to as tags, and retrieve it using machine-readable methods at the appropriate time and location in order to meet the demands of certain applications. Special software must be installed in order to use this system.

RFID components for Smart library management

- RFID tags are attached to books for the purpose of identification. Only the RFID readers are able to read this tag. These are rewriteable tags.
- RFID Cards: These serve as an alternative for the library cards that are given to users. This card is compulsory for issue books. .The cards are rewriteable.
- RFID reader for a library staffs: The library staff uses this for book tagging. The staff members working at the circulation desk also use this for book lending. This also acts as a smart RFID desk.
- RFID gate antenna: This system reads tags in all three orientations and is a walk-through gate antenna. It has the ability to log every object that passes through the gates. In compliance with the configuration settings or whenever undesirable things are passed, it also generates a buzzer.

2. Smart Circulation management

With the help of IoT based technology in libraries not only saves staff time, but it also saves patrons' time by streamlining self-check-in and self-check-out procedures.

Components of Smart circulation

- Self-Touch Kiosk: This self-touch kiosk is primarily used in libraries for book issue and return services. Patrons are self-dependent for lending of books. The built-in slip printer will automatically produce an issue slip for the borrower of the book after it is checked out.
- Library Book drop box: The main purpose of this independent book return station is to return library books. Its integrated high-speed thermal printer and touch screen functionality enable users to view and print transaction-related information.

3. Smart inventory management:

IoT enabled sensors can monitor book stocks using hand held reader. The reader's user interface is similar with Android platform and has a big touch screen. This is capable of reading book tags to confirm stock.

4. Interactive Library space:

Digital signage is an electronic display that can show text, animated, or video messages for advertising, information, entertainment for targeted patrons. Digital signage can provide interactive activities and real-time information.

5. Smart Book tracking:

IoT, through mobile app, allow virtual tour of the library to its patron for tracking and monitoring of the availability of books on their specific shelves.

6. Environmental monitoring:

IoT sensors monitor environmental parameters in libraries, including temperature, humidity, and air quality. This information aids libraries in keeping the best possible circumstances for protecting and maintaining sensitive items.

7. Smart security and Fire protection

IoT-based security devices keep surveillance on restricted areas, entrances, and exits to improve library security. Unauthorized access is detected by surveillance cameras and sensors, ensuring the security of library materials and users. If a fire breaks out in the library, the fire detection devices may sound an alarm and activate.

Advantages and disadvantages of IoT applications in library

In the context of libraries, the Internet of Things provides a number of advantages. The application IoT minimizes the time needed to do tasks like circulation, stock verification, identification of mis-shelved books, handling of library materials etc. IoT technology allows libraries to provide more efficient and personalized services to their patrons. This simplifies processes and enhances the library experience as a whole. It helps librarians to make well-informed decisions about collection development policies, space utilization and enhancing their services.

IoT has many benefits for libraries, but it's important to have strong data privacy policies in order. Securing patron information must be a top priority for libraries.

While implementing IoT, libraries need to give priority to data security and privacy. They must conduct privacy impact assessments, adopt privacy-by-design principles, and communicate transparently to its patron about data collection and usage practices. To reduce the drawbacks of IoT in libraries and protect data privacy, cooperation with privacy specialists and compliance with relevant regulations are essential.

Conclusion

To summarize, Internet of Things applications in libraries have the potential to significantly improve library services and operations. IoT technologies can benefit libraries in a number of ways through their services. There are not many challenges associated with the internet of things, especially when it comes to data security. Libraries may take use of the internet of things while protecting patron data and maintaining confidence in the ecosystem of libraries by effectively handling data privacy concerns. When using new technology to improve services and facilities at their libraries and information centers, librarians must collaborate and plan strategically.

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