

IOT and its Applications in Library Science

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Abstract: Libraries have continually embraced various forms of information technology, from content creation to management and delivery platforms, to maintaining long-term presentation tools. They are always quick to adopt and utilize the latest developments. Internet of Things (IoT) allows for the collection and transfer of data using the internet, sensors and RFID, without any human intervention. This paper investigates IoT's emergence in various fields, its historical roots and potential applications in libraries through creative solutions.

Keywords: IOT, Sensors, Internet of Things, RFID.

I. INTRODUCTION

The term Internet of Things (IoT) refers to the collective network of connected devices and technology that enables these devices to interact with each other and with the cloud. Nowadays, owing to the arrival of inexpensive computer chips and high bandwidth telecom technology, billions of everyday items such as toothbrushes, vacuums, cars, and machines are linked up to the internet. This consequently permits these devices to make use of sensors for gathering data and responding smartly in response to user input. In the Internet of Things, everyday objects are connected to the internet through sensors and processors. However, progress was initially slow due to the large size and bulk of the chips. In the 1990s, low power computer chips known as RFID tags were used to track expensive equipment. These chips also became smaller, faster, and smarter over time as computing devices shrank in size. [1]

The cost of integrating computing power into small objects has now decreased greatly. For instance, you can connect Alexa voice services capabilities to microcontroller units that have less than 1MB embedded RAM, like when it comes to light switches. A whole industry is dedicated to filling our homes, businesses and offices with IoT devices. These intelligent products can send data to and from the Internet automatically. All these "unseen computing devices" and the technology they use is referred to generally as the Internet of Things. [1]

The Internet of Things, or IoT, refers to the billions of physical devices now connected to the internet. Super-cheap computer chips and widespread wireless networks have made it possible to convert any item - from a pill to an aeroplane - into part of this vast network. By adding sensors, these machines become responsive and intelligent, with the ability to share data in real-time without any human intervention. The result is a merged digital-physical universe that is increasingly smarter and more responsive. [2]

Pretty much any physical object can be turned into an IoT device if it is able to establish an internet connection and be controlled or send information. For example, a lightbulb that can be switched on with a smartphone app, a motion sensor in the workplace or a connected streetlight. These devices span the spectrum from something as innocuous as a toy to something like an autonomous truck. Conversely, larger objects may contain multiple smaller IoT components - such as a jet engine where thousands of sensors collect and transmit data to guarantee its correct performance. Smart cities projects represent another scale altogether, where whole regions are equipped with sensors to monitor and control our environment. [2]

Internet of Things is primarily used to describe devices that are not normally expected to have an internet connection, and that are able to communicate with the network without human interference. As a result, a PC and a smartphone -- even though the latter is stuffed with sensors -- aren't generally considered IoT devices. Smartwatches, fitness bands, and other wearables might be considered IoT devices, however. [3]

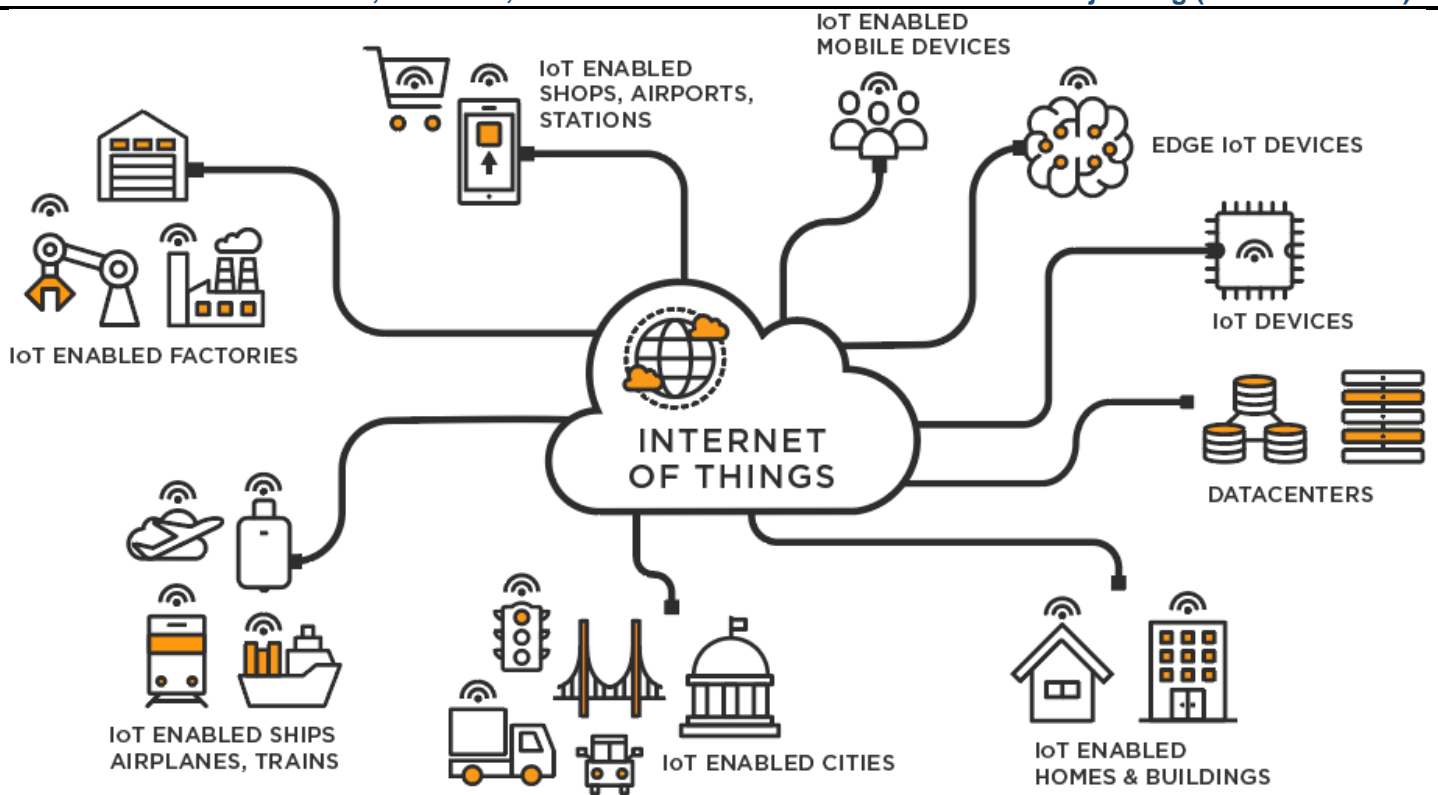


Fig 1. Internet of Things

The idea of adding sensors and intelligence to basic objects was discussed throughout the 1980s and 1990s (and there are arguably some much earlier ancestors), but progress was slow because the technology wasn't ready at the time, except for some early projects, such as an internet-connected vending machine. The chips were too large and bulky to communicate effectively with objects. [3] Cheap, power-frugal processors capable of being almost expendable made it economical to link up billions of devices. RFID tags - tiny chips with the ability to communicate wirelessly, together with the rising use of broadband internet and cellular and wireless networks - dealt with this challenge. IPv6 was also essential in order for IoT to develop; among other perks, it should furnish enough IP addresses for every machine on the planet (or beyond). [3]

In 1999, Kevin Ashton coined the phrase 'Internet of Things,' but technology took at least another decade to catch up. Adding RFID tags to expensive pieces of equipment to track their locations was one of the first IoT applications. Since then, the cost of adding sensors and an internet connection to objects has continued to drop, and experts predict that this basic functionality will one day cost just 10 cents, making it possible to connect almost everything. [4]

Initially, businesses and manufacturers were the most intrigued by the Internet of Things (IoT), where its use was labelled as machine-to-machine (M2M). However, the focus is now on using IoT to create clever technology that can be incorporated into our homes and offices. This has made it much more pertinent to everybody. Early ideas regarding connected devices consisted of 'blogjects' (products that share data with the web), ubicomp (ubiquitous computing), invisible computing, and pervasive computing. Eventually though, it was Internet of Things and IoT that stuck. [4]

II. IOT APPLICATIONS IN LIBRARY SCIENCE

Technically, the IoT has three basic functions: identification, sensing, and communication. The first step in the IoT architecture is identification at the primary level using a 'transponder' placed on whatever item is to be identified. This is like the RFID tags which are typically used to track books in libraries; an electronic chip containing a coil and microwave antenna. Secondly, sensing takes place, where the sensor reads the low power radio signal sent out by the transponder. Finally, communication allows interaction between devices and serves as an interface for mobile-to-mobile communication. Furthermore, there are many other technologies at play within IoT systems, such as middleware software providing a bridge between technology and application layers. [5]

Unlike other organizations, libraries are complex organizations with embedded constituents that are linked together and a large number of interactions take place. The interaction between humans, machines, and IoT objects has a great deal of potential for the future. Libraries can have some futuristic applications. These applications are probable, but with the support of IoT technologies, these applications may be implemented. Some potential libraries applications include: [5]

- **Control of inventory:** Apart from books, journals, magazines and various other library sources such as microfiche, video and audio - which can all be monitored using sensors - IoT provides the opportunity to track each item in real time. While RFID offers similar features for books, the added benefit of IoT with its internet capability ensures better inventory control through mobile data access for librarians or managers. Ultimately this reduces the amount of staff required to carry out stock verification. [6]

- **Management of thefts:** With tags on each item of the library inventory (scanners, printers, hard disks, CDs, etc.), a kind of tracking can be made at all times. The library gate can be equipped with high-end sensors and transponders, which not only notify the authorities via mobile or loud alarms, but can also block the theft by automatically closing the door. The library staff can use the system to remotely view their homes, send a warning when something is wrong, and contact emergency services. [6]
- **The circulation desk:** The circulation desk in libraries is involved with processes such as issuing and returning books and other library materials, keeping records, generating and updating library cards, overdue reminders, etc. RFID technology has made some of these activities easier to manage, such as issuing and returning books. With IoT however, mobile apps can offer users online connectivity which can further automate the rest of the jobs associated with circulation desk - from maintaining records to creating/updating library cards and overdue reminders. Thanks to IoT, users now won't have to stand in queues at the circulation desk; they can simply check for any overdue books on their mobile. Plus, when a book that someone has requested is returned, an automated message will be sent to them via IoT. For eBooks it's even simpler: required ones will be issued automatically. In essence, IoT not only promises relief for staff members but also saves time for users. A library user who requires assistance can be detected by the sensors at the circulation desk even if there is no library staff present at the desk. Computers at the desk are able to provide options based on a client's preferences/needs and take appropriate action.
- **Identification of users:** Using sensors at the library gate, all visitors can be recognized and their faces matched with the available databases, and only authorized users will be able to access the library. Alternatively, an electronic message will be sent to the librarian in charge, who can be anywhere and anytime. The librarian in charge can decide whether to open the door for the unknown person or not from a distance. [7]
- **Book reservations:** The Internet of Things could create a potentially powerful use case for libraries. Instead of searching for a book through the OPAC using their smartphone, patrons would be able to reserve it with the same device. The book that is available on the shelf would then recognise its presence by emitting a sound or an illuminated light. This eliminates the need to physically search for the desired item, and librarians can identify and issue books more rapidly and efficiently, saving manpower and time all round. [7]
- **Detection and prevention of fires:** If there is a fire in a library and nobody notices it, the fire detection devices may automatically alert the Fire Department and sensors in the library with the associated networks will automatically send the message. The library's concerned person (for example, the Fire Officer), who can be anywhere and is responsible for taking action, can also receive the message. As a result, IoT will help prevent further damage by taking action automatically at an early stage. [8]
- **References for mobile devices:** With IoT, all activities of the library are connected to the internet, so one can refer to the library without even physically being there, using a mobile app. [8]
- **Monitoring the movement of resources and inventory:** As some libraries offer different access rights for faculties, students, staff, regular and non-regular students, etc., IoT can be used to categorize users according to their criteria for accessing library resources. IoT allows librarians to track where the library resource is physically present (inside or outside) on their mobile device. For example, suppose an incorrectly issued book/magazine has been issued to an unauthorised user. [9]

III. CHALLENGES OF IOT IN LIBRARY SCIENCE

As technology has evolved, one of the most recent changes is the transition from the 'Internet of Communication' to the 'Internet of Things'. By embedding sensors in everyday objects that aren't computers, this exciting and emerging technology makes it possible to connect them. Thus, the Internet of Things can encompass factories, cars, appliances, toothbrushes, pacemakers, and even light bulbs. [10]

In addition to being able to communicate with one another, access Internet services, and interact with people, these sensors provide data that can then be transmitted over a network without human interaction. The Internet of Things consists of sensors, processors, cloud computing, and wireless connectivity as the infrastructure and technology involved with objects or things. The new paradigm will impact library models, patron experiences, and our everyday lives. Most importantly, it will affect the way libraries connect with their patrons and communicate with them. It is already possible for libraries to use IoT technologies such as RFID (radio frequency identification) to identify and secure items, machine 2 machine (M2M) communication, such as self-check kiosks or automated materials handling machines, and semantic search technologies, such as metadata and discovery tools, to identify items and secure them. [10]

Some of the challenges related to IOT in Library Science are,

- **Security and privacy:** A user may need to enable mobile data always in order to fully utilize the IoT. This enabling may track its location, as well as intrude its privacy by having access control on the device as well as content available on phones such as photographs, documents, etc. As a result, individuals' privacy may be compromised.

- **Understanding accuracy:** In order for the IoT to be successful, it must be highly accurate, and the system must be able to understand the semantics clearly. It must know the user's requirements without any ambiguity; otherwise, the whole system could fail. [11]
- **The transactions:** It is very common for people these days to use their phones for transactions. They can sync their credit/debit cards with Google wallet (for Android) and purchase things by simply touching a sensor with their phone. It is possible to pay for library services and overdue charges in the same way. [11]
- **Invasion of privacy:** Mobile apps can have full control over users' data and personal information, so they can track and hack sensitive information and make it available to unauthorized parties.
- **Expenditure:** The library budget may have to be increased as a result of IoT tagging of its inventory. In addition to sensors, actuators, communication devices, and internet connectivity, additional expenditures could be required. This could pose a challenge for the IoT. [12]
- **Development of systems:** Different applications will require different inputs from librarians and staff. Libraries must understand and identify how to use the Internet of Things. For a system to be highly reliable and accurate, all requirements must be given in a highly accurate manner and librarians and staff need to be deeply involved.
- **The standardization process:** It is vitally important to the development of the Internet of Things. Among its objectives are lowering entry barriers, improving interoperability, and enabling products or services to compete for better outcomes. Because of its rapid growth, IoT is difficult to standardize. IoT standardization faces a number of challenges, including interoperability, radio access level, semantic interoperability, security and privacy concerns.
- **Training for users:** In order to facilitate the smooth implementation of IoT in libraries, basic training must be provided to the staff. In the beginning, library staff may not be comfortable using the system, so demonstration tools must be developed to automate the assistance to users. [12]

IV. CONCLUSION

Library professionals are known to be ahead of the curve when it comes to embracing modern technologies. They are highly adept at using them to improve their workflows, such as by employing library automation software, library management tools, digitization technology, search and access tools and preservation solutions. Additionally, they are quick to utilize the internet and its various services like social media and mobile applications as well as favored communication methods such as SMS and e-mail for the benefit of their customers. Nothing is beyond the scope of their resourcefulness in leveraging technological advances to serve their patrons. IoT has emerged now, and there are definitely some libraries that can benefit from it, as has been mentioned in this article. IoT will help libraries and their users in a big way. There are certain issues that need to be addressed, but surely with time as technology has advanced, solutions will also emerge. Library professionals have to anticipate the future, which they are certainly doing.

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