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Application of IoT in Academic Libraries

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ABSTRACT

There is no denying that libraries are evolving. Libraries of today resemble community centres with lots of activity, advancement, and creativity. The explanation for these changes is simple. Libraries have had to make adjustments to be relevant in our society and to embrace a lot of technological innovation. The transition from the "Internet of Communication" to the "Internet of Things," or IoT, is one of the most significant recent shifts in innovation. By adding sensors, this fascinating and evolving technology opens the possibility of using common objects that aren't computers at all. This paper discuss the unique perspectives of IoT in libraries in brief.

The Internet of Things (IoT): what is it?

A network of physical objects is called the Internet of Things, or IoT. These gadgets are capable of exchanging data without the need for human involvement. Aside from machines and computers, there are other types of Internet of Things devices. Everything with a sensor and a unique identification (UID) can be a part of the Internet of Things. Real-time communication between self-reporting devices and people is made possible by the Internet of Things. IoT use is rising quickly in India as the nation rolls

out 5G networks nationwide. Professionals who understand how the Internet of Things operates will likely be in more demand as its use grows.

IOT's History

With each explanation, you will discover more about IOT's role in these developments and how it advances them!

• 1982: Vending machine: When a Carnegie Mellon University vending machine was connected to the internet in order to report its stock and status, it was the first example of the Internet of Things and allowed for remote monitoring.

• Toaster: A prototype for the user-friendliness of smart home appliances was a 1990s internet-connected toaster that allowed remote operation.

• 1999 saw the invention of the term "Internet of Things" by Kevin Ashton to describe a network of networked devices that exchanged data and talked with one another, bringing in a new era of connectivity.

• 2000 - LG Smart Fridge: This innovative product, which allowed users to remotely monitor and control refrigerator contents, showcased the possibilities of IoT in daily life.
• 2004 – Smart Watch: IoT entered the wearable tech space with the launch of smart watches, which offer fitness tracking and notifications while on the road.
• 2007 - Smart iPhone: Apple's iPhone revolutionised the mobile industry by merging Internet of Things (IoT) capabilities with applications that connected users to an array of services and gadgets.
• 2009 saw the entry of the Internet of Things (IoT) into the automotive industry, bringing sensors to vehicles for real-time diagnostics, performance monitoring, and remote testing.
• The Internet of Things was first launched in 2011 with the advent of Smart TVs, which enabled internet connectivity for streaming, app use, and interactive content in the living room.
• In 2013, Google Lens was released, showcasing the potential of the Internet of Things in image recognition by allowing smartphones to provide information on actual objects.

• 2014: Echo: Featuring Amazon's virtual assistant, Alexa, the device demonstrated the potential of voice-activated Internet of Things, improving smart home responsiveness and intuitiveness.
• 2015: Tesla Autopilot: One of the best examples of the Internet of Things in automotive technology, Tesla's Autopilot system enabled semi-autonomous driving capabilities through the use of networked sensors and software.

Three crucial technologies enable the Internet of Things

• Sensors: Sensors are apparatuses that gather information about the external environment. They have the ability to measure sound, motion, light, humidity, and temperature.

• Networks: The internet is connected to the sensors through networks. Both wired and wireless networks are possible.

• Software: The data that the sensors gather is gathered, stored, and analysed using software. The devices can also be controlled with it.

How does the Internet of Things operate?

The Internet of Things, or IoT, is a network of network-connected devices that have sensors, software, and network connectivity installed. As a result, these devices may collect and share data. Thanks to the Internet of Things, these objects may be operated remotely and communicate with one another online.

The Internet of Things functions by utilising many technologies, including cellular networks, Bluetooth, and Wi-Fi, to link items to the internet. Devices can send and receive data once they are connected to the internet. The devices' behaviour can be managed, their performance tracked, and their tracking data monitored.

The following elements are necessary for the Internet of Things to function:

• An IoT platform: This type of platform controls the networking of devices. It might be a software programme or a cloud service. An IoT platform's goal is to control and keep an eye on the processing power, hardware, software, and application layers.

•Sensor technologies, also referred to as smart sensors, are components of the Internet of Things (IoT) that translate physical variables into data that can be understood and shared by devices. There are a wide variety of sensor kinds. Temperature sensors, for instance, monitor temperature variations and identify heat. Motion sensors use ultrasonic wave monitoring to identify movement, and when those waves are interrupted, they initiate a desired response.

• Unique identifiers: The core concept of the Internet of Things is interaction between users and devices. Unique identifiers, or UIDs, are used to identify a device's context inside a wider network in order to facilitate this communication. Identifiers are patterns, like numeric or alphanumeric strings. One type of UID that you might be aware with is an internet protocol (IP) address. They have the ability to identify a particular device (instance identification) or the class (type identifier) that it belongs to.

• Connectivity: Sensors can connect to other devices and cloud platforms via a range of Internet network protocols.

• Artificial intelligence (AI) and machine learning: Information entry and user interaction are facilitated by natural language processing, or NLP, in Internet of Things (IoT) devices. Furthermore, machine learning enhances their capacity for analysis.

Applications of IoT

•Data is being collected and disseminated by the billions of devices connected to the internet. They include everything from military-grade surveillance gear to smart household appliances and smoke alarms. The following is a list of some of the most well-liked Internet of Things application categories.

•Consumer IoT: This category includes wearable and personal internet-connected devices. These devices are frequently referred to as "smart devices."

• Industrial Internet of Things (IIoT): A network of connected devices in the industrial sector. It involves the manufacturing of machinery and apparatus for energy management.

• Commercial IoT: This category includes devices and systems used for purposes other than residential ones. Businesses and healthcare groups employ commercial IoT for auditable data trails and customer management.

The Internet of Things has many modern applications::

- energy-saving and smart grids;
- smart cities;
- smart homes and home automation;
- healthcare;
- radiation and harmful gas detection;
- smartphone detection;
- water flow monitoring;
- earthquake detection;
- surveillance of traffic;
- wearables
- Robots and drones,
- medical facilities and healthcare systems,
- telemedicine applications,
- security, and smart door lock protection systems
- Agriculture,
- Industry,
- Farm Animal Biochip Transponders;
- Implants for heart monitoring (pacemaker, real-time ECG tracking, etc.)

IoT Implementation in Libraries

IoT applications can be utilised in libraries in an effort to inform and motivate librarians to adopt these applications. It appears that some efforts have been made to assess the significance of IoT technology for the library system, particularly in the categories listed below.

Collection administration: Development of collections, access to traditional and online collections, and RFID-enabled collection administration.

Infrastructure management includes keeping track of equipment such as printers, scanners, and photocopiers to show their availability; keeping track of room usage to show seating availability;

monitoring humidity and temperature for special collections; keeping an eye on the proper operation of appliances like fire alarms, lights, and fans; and keeping an eye on user behaviour to prevent theft.

Facilities: Including things like a virtual tour, self-check-in and self-check-out document systems, library guides, catalogues, and shelve guides; storing and exchanging information with peers; adaptable learning environments; and safety features like fire alarms and evacuation systems.

Services: delivering comprehensive information in a highly interactive manner to OPAC; providing location-based services; consulting and training services; alerting and notifying services. **Additional uses** include user feedback gathering, online fine payment, information storage, analysis, and administration, as well as marketing and promotion of library resources and services.With the help of all these possible Internet of Things applications, libraries can become smarter places to be and smarter buildings.

Benefits of Internet of Things

1. Incidents like fire accidents, mishaps brought on by ageing infrastructure, natural disasters, and resource theft can all be addressed by implementing effective IoT.
2. Apps that help users use scarce resources like electricity and water appropriately can also be developed using the Internet of Things.

3. It helps libraries make the best use of their space, improve user experience, protect priceless treasures with smart room management, and offer self-guided virtual tours. Librarians can better control their equipment and facilities through IoT.

4. IoT lessens the need for staff to perform ad hoc tasks because most tasks would be completed by machines. This frees up staff time to devote themselves fully to resolving user issues and to encouraging other staff members to use the service, which allows them to take advantage of the new capabilities provided by the system and improves resource management.

5. Automating the library management system allows librarians to effectively manage resources and provide services like alert messages and full information on resources that are available.
6. It helps save time, controls and monitors the systems for better outcomes, and offers the chance to

review the processes, which enhances the system's performance.

Additionally, it aids in user on boarding, back office process simplification, and promotion of library resources and services. it helps libraries provide information literacy and location-based services.

The drawbacks of IoT

Although the Internet of Things (IoT) has many advantages for libraries, there are also several possible drawbacks and difficulties :

1.Risks to Data Security: There are higher chances for security breakdowns when Internet of Things (IoT) devices are used in libraries. If these devices are not properly protected, they could be vulnerable to hacking or illegal access, which could jeopardise user privacy and library resources.

2. Lack of requirements and Interoperability: Standardised security and privacy requirements may not be present because IoT systems and devices in libraries typically come from multiple manufacturers. This could cause interoperability problems and increase the difficulty of ensuring consistent and effective data privacy protocols across the library's IoT ecosystem.

3. Excessive Data Collection: Internet of Things (IoT) devices have the capacity to gather enormous volumes of data, including personally identifiable information (PII), seemingly for no apparent reason or aim. Over-collection of data can lead to privacy problems and expose people to unnecessary tracking and profiling.

4. Difficulties with Agreement and Openness: It might be difficult to get library patrons' meaningful and informed consent for the collection and use of personal data. Customers might not completely comprehend the ramifications or have clear visibility into what data is being gathered and how it is being utilised, even though Internet of Things devices may automatically collect data.

5. Data Ownership and Control: Libraries and their patrons may no longer have ownership or control over personal data as a result of IoT devices and services in libraries. There are worries over data ownership and usage beyond the library's jurisdiction when third-party providers gather and store data on the library's behalf.

6. Legal and Regulatory Compliance: When it comes to data protection, libraries have to supervise intricate legal and regulatory frameworks like the General Data Protection Regulation (GDPR) or local privacy laws. It can be difficult to ensure adherence to these standards while using IoT technology, especially if libraries lack the required resources and know-how.

Libraries must give data security and privacy a priority while using IoT in order to address these drawbacks. They must to carry thorough evaluations of the privacy impact, embrace privacy-by-design, put strong security measures in place, and communicate openly with customers regarding data collection and usage policies. To lessen the drawbacks of IoT in libraries and protect data privacy, cooperation with privacy specialists and respect to pertinent laws are essential.

Conclusion

The Internet of Things (IoT) has applications that could significantly improve library operations and services. IoT technologies facilitate data-driven decision-making, streamline processes, and enhance resource management. Setting data security and privacy as a top priority is essential when deploying IoT in libraries. Strong data privacy policies, such as those pertaining to safe data transmission, user control and consent, anonymization, and privacy by design, must be established by libraries. Libraries can profit from the Internet of Things (IoT) while guaranteeing the security of user data and preserving trust in the library ecosystem by skillfully handling data privacy issues.

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