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Library Philosophy and Practice (e-journal)

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May 2023

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Mohapatra, Niranjan; Nayak, Satyajit; and Parida, Dillip Kumar, "Unleashing the Potential of the Internet of Things in Transforming Libraries into Intelligent Hubs of Digital Knowledge" (2023). *Library Philosophy and Practice (e-journal)*. 7659.

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# Unleashing the Potential of the Internet of Things in Transforming Libraries into Intelligent Hubs of Digital Knowledge

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## Abstract:

*Internet of Things (IoT) is a rapidly evolving technology that has the potential to transform the way libraries operate and provide services to their patrons. By connecting devices and systems to the internet, libraries can gain access to real-time data and automate many of their processes, leading to more efficient and effective operations. This paper explores the use of IoT in libraries, specifically focusing on how it can enable smart libraries in the digital era. The paper will discuss the benefits and challenges of implementing IoT in libraries and provide examples of how libraries are currently using IoT to improve their services. The paper will also explore the future possibilities of IoT in libraries and how it can be used to enhance the user experience and support the development of new services. Overall, this paper will provide an overview of the IoT technology and its potential to revolutionize the way libraries operate and provide services to their patrons in the digital era.*

**Keywords:** IoT, Smart Library, Emerging Technology, Internet, Internet of Things

## 1. INTRODUCTION:

The term 'Emerging Technology' refers to new technology or a continuing development of an existing technology. Its meaning slightly differs as used in different areas such as communication, business, science, education etc. Education technology, information technology, nanotechnology, biotechnology, robotics, and artificial intelligence are among the emerging technologies (Nag & Nikam, 2016; Chang, 2016). An IoT is a network of physical devices that communicate with other devices and exchange data, facilitating increased connectivity, machine learning, and artificial intelligence advances. The expression 'The internet of things' was begun by Kevin Ashton of Procter and Gamble, Later MIT's AutoID Center in 1999. India's first internet of things strategy comes at the most suitable time when the nation is moving towards digitization and the strategy will uphold the drives taken toward

this path (Liu & Sheng, 2011). Two significant endeavors taken by Govt. of India Smart urban communities project and Digital India Programme. The IoT makes a keen, Invisible organization texture that can be sensed, controlled and programmed. IoT empowered items utilize straightforwardly or by implication with one another or the internet. Most of them are considered to be interfaced on the web and using that connection gives some kind of remote monitoring or control.

### **1.1. About Internet**

The web is a worldwide arrangement between associated PC networks that utilizes the standard web convention suite to serve billions of clients around the world. The web is an organization of PCs crossing the whole globe. Web is the network of networks.

### **1.2. The History of Internet:**

In the 1950s, the development of electronic computers marked the beginning of the history of the Internet. Researchers in the United States, United Kingdom, and France began exploring the concept of wide area networking. Robert Taylor and Lawrence Roberts were responsible for leading and managing the ARPANET project in the 1960s. As early as 1969, computer labs at UCLA and Stanford Research Institute sent the first message over the ARPANET.

## **2. INTERNET OF THINGS (IoT):**

In the daily life of human beings, the Internet of Things (IoT) has a great role for making the possibility of anything, at any time, from anywhere, by anyone. The IoT depicts a state where huge quantities of items are interconnected over the web and can gather information and communicate and get data. The IoT makes a canny, invisible organization texture that can be sensed, controlled and programmed (Mineraud et. al., 2016). IoT empowered items utilize inserted innovation that permits them to convey directly or by implication with one another or the web. It is otherwise called a web of articles alludes to the arranged interconnection of each item which is made out of a wide range of data detecting devices. IoT is an overall organization of interconnected items exceptionally addressable. A concept of IoT that frames an organization by sharing data of every identified object has been highlighted in the world of late. It is a network of physical objects that can store and exchange data over the Internet Connect with the analog things around you in a digital way (Sun, Liu & Li, 2010; Xia et. al., 2012; Nastic et. al., 2013; Al-Fuqaha, 2015).

### **2.1. Definition:**

There are many definitions that come from time-to-time for the 'Internet of Things' (IoT). Out of them some definitions from few reference sources and IT or software companies are being mentioned here. Oxford Dictionary defines 'Internet of Things' as "A proposed development of the Internet in which everyday objects have network connectivity, allowing them to send and receive data". IBM defines IoT as "the concept of connecting any device to the Internet and to other connected devices. It is a giant network of connected things and people- all of which collect and share data about the way they are used and about the environment around them". ORACLE defines it as "the network of physical objects- "things"-that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet". It may be defined as "the network of physical objects that feature an Internet Protocol address for internet connectivity, where the communication occurs between these objects and other Internet-enabled devices".

## 2.2. IoT Applications in Library:

In the digital scenario where everything goes digitalized and the importance of digital objects became more popular than the physical objects i.e., digital certificate, digital photos/videos, digital printer, digital currency etc. (Hoy, 2015; Wojcik, 2016). All the transactions of digital objects are possible only for the Internet of Things (IoT). The IoT has been widely adopted in different sectors in the daily life of human-beings, but its applications in libraries convert the traditional library to smart digital library (Pujara & Satyanarayanab, 2015; Hahn, 2017; Berte, 2018). Here are some IoT applications being adopted in the Library.

- Locate items from my book list
- A self-guided virtual tour.
- An enriched special collection experience.
- Contact less fine payment.
- Availability of machines.
- More details of items
- Admittance to library and records assets.
- Assortment the executives
- Data education
- Suggestion administration
- Area based assistance
- Machines the executives Resources availability for both context and physical plant.
- Smart books
- Object based learning
- Self-help borrowing/returning books /RFID
- Chat, Mail, social media, Mobile application.
- Actually library service split into groups :-
  - The sharing of data as dates, names, facts and so on:
  - The arrangement of inventory and bibliographic data which helps clients with exploring through library assets and looking for applicable wellsprings of data.
  - The arrangement of admittance to conventional and online assortment as far as loaning materials and making them accessible on location or from a distance.

- Giving Education in the field of assessing the nature of data is one of the main library administrations

### **2.2.1. Required Skills & Knowledge of Library Professionals for IoT:**

In today's rapidly evolving digital age, libraries must integrate with the Internet of Things (IoT) to offer patrons the best possible experience. This requires library professionals to have a unique set of skills and knowledge in the field of IoT technology.

- Reference Skills
- Networks, metadata, Digital resources, information base administration, site advancement
- Insights/Analytics abilities
- Educating/Instructions
- Information on arising patterns/Technologies
- Digitization projects, Integrated library frameworks

### **2.2.2. Advantages of IoT:**

The integration of the Internet of Things (IoT) in libraries has opened up a new realm of possibilities, streamlining operations and improving the overall experience for patrons. With connected devices and sensors, libraries can gather data and insights that help optimize their services and make better use of their resources. From automating tasks and reducing manual labor, to providing real-time information and enhancing the user experience, the advantages of IoT in libraries are numerous and far-reaching. By embracing this technology, libraries can create a smarter and more efficient environment that better meets the needs and expectations of their users, making them a hub for innovation, learning, and community engagement. Some advantages are given below:

- Finding the mis-shelved and mismatched books and materials
- Stack upkeep
- Diminishing manual work
- Diminishing the time squandered in line and looking
- The section and exit of clients all through the library implement innovative ideas.

### **2.3. Libraries of the Future:**

Libraries have been a staple of society for centuries, serving as a source of knowledge, information, and community. As technology evolves and our needs change, libraries must also adapt and evolve to remain relevant and meet the demands of the future. The libraries of the future will be more than just a place to borrow books. They will be a hub for innovation, learning, and community engagement, offering access to cutting-edge technology, diverse learning opportunities, and a variety of services and resources. These libraries will leverage

cutting-edge technology such as AI, VR and AR, and the IoT to provide patrons with an engaging and interactive experience. They will also prioritize sustainability, accessibility, and inclusivity, becoming spaces that serve everyone, regardless of age, ability, or background. The libraries of the future will be more than just a building with books, they will be a cornerstone of a connected, knowledgeable, and thriving society.

- Multi-Dimensional Fiction
- Holographic Audio-books (Nano-books and Nano-libraries)
- Book pills
- Robot Librarians
- Sentiment books (I am overdue please take me back to the library)

#### 2.4. Tools, Sources and Initiative:

Innovations like the Internet of Things (IoT) are transforming our lifestyles by bringing smart technology that makes life easier. An array of components enables developers to extend applications, gather data remotely, ensure secure connections, and manage sensors on an IoT platform. In our daily life we have been used some IoT Tools which along with some open source IoT applications are mentioned in the following table no.1. The Government of India has taken some key initiatives on IoT i.e., Draft IoT Policy 2016, National Digital Communications Policy (NDCP) 2018, Smart Cities Mission (SCM) 2015, IoT Centre of Excellence (CoE) by NASSCOM, DEITY and ERNET (Rishi & Saluja, 2019). As a result of some initiative introduced by Govt. of India are given in the following table.

| Proprietary tools                         | Open source  | Introduced by Govt. of India                   |
|---|--------------|--|
| RFID                                      | Mnubo        | Visvesvaraya PhD scheme for electronics and IT |
| AI Grab and Go                            | Axeda        | SWAYAM   |
| Motion sensors                            | Echelon      | Sygamaya Pustakalya                            |
| Wearable- Fitbit charge 5                 | Everything   | Shaala Darpan                                  |
| Beacons- wireless senser                  | Sensor Cloud | Saransh  |
| Magic/Smart mirror                        | Xobxob       | Online Labs                                    |
| Pressure pad sensor                       | Libradio     | National Supercomputing Mission (NSM)          |
| Cloud computing                           | Node-RED     | National mission on education using ICT        |
| Wireless sensor notebook                  | OpenRemote   | National Knowledge Network                     |
| Smart Home- (Amazon Echo and Google Home) | Flutter      | Meghraj  |
|   | Arduino      | Learning management system                     |
|   | Kinoma       | Knowledge management system                    |
|   | ThingsBoard  | ePathasal                                      |
|   |              | eBasta   |
|   |              | eGrantahalaya                                  |
|   |              | Center for excellence for internet of things   |

(Table-1: Some IoT tools, Open source and Some evidence of introduced by Govt. of India)

## **2.5. Factors Affecting Adoption of technology:**

The adoption of technology in libraries has the potential to greatly enhance the services and resources offered to patrons. However, the success of these implementations is heavily dependent on various factors that can either facilitate or hinder the process. Some of the key factors affecting the adoption of technology in libraries include funding, staff training and support, user acceptance, infrastructure and connectivity, privacy and security concerns, and vendor support. Understanding these factors is crucial in ensuring that libraries can effectively adopt and integrate technology, while balancing the need for innovation with the realities of budget and resources. By taking a comprehensive approach and considering these factors, libraries can ensure that their technology investments are well-placed, delivering the greatest benefit to patrons and the community.

- Unwavering quality of the innovation
- Information on the most proficient method to utilize innovation
- Accepting innovation improves or upgrades learning.
- Troublesome in utilizing the innovation
- Institutional help for utilizing the innovation now.
- Institutional help for involving innovation in the future.
- Trouble in figuring out how to utilize the innovation.
- The innovation assist me with thinking and arranging
- I anticipate that the technology should save personal time over the long haul.

## **2.6. Problems of IOT:**

The Internet of Things (IoT) has brought about a wave of connected devices and endless possibilities for automation and optimization. However, with this increased interconnectedness come a range of challenges and problems that must be addressed. Some of the most significant problems of IoT include security and privacy concerns, interoperability issues, reliability and durability of devices, scalability, and data management. Addressing these problems is crucial in ensuring the continued growth and success of IoT, as well as protecting users and their data from potential harm. Some problems are given below:

- Hardware disappointment or breakdown
- Time to learn new innovation
- Grounds support weak
- Programming outdated
- Takes too long to even think about learning given worth to learning
- Programming is contrary to the study hall/office/understudy's framework.
- Presently where to learn; need to learn.
- Area excessively sluggish.
- Programming glitch.

## **2.7. Suggested solutions to Problems:**

The problems of the Internet of Things (IoT) can greatly impact its growth and success if left unaddressed. However, there are several suggested solutions that can help mitigate these challenges and ensure the responsible development and implementation of IoT technology. These solutions include implementing strong security measures, promoting interoperability and standardization, improving device reliability and durability, and implementing effective data management strategies. Additionally, involving all stakeholders, including government, industry, and consumers, in the development and implementation of IoT can help ensure that these solutions are comprehensive and effective. By taking a proactive and collaborative approach, we can overcome the problems of IoT and fully realize its potential to transform our lives and the world around us. Some suggestions are given below:

- Increment data about hardware
- Gear ought to be checked consistently
- Make the classroom practically the same.
- Make a framework for fast reaction.
- Increment client commonality.
- Have tech accessibility in the start.
- Keep a long over issues.
- Decentralize direction.

## **2.8. Copyright:**

Copyright has been known as the Single most vexing obstruction to computerized advancement. Digital objects are less fixed, effortlessly duplicated and somewhat available by different clients at the same time. The issues for libraries are that not normal for personal business are the majority of the part. Basically, overseers of data they don't claim the copyright of the materials they hold. It is improbable that libraries can at any point unreservedly digitize and give admittance to copyright materials in their assortment. Rather they should foster instruments for overseeing copyrights, systems that permits them to give data without abusing copyright called freedoms the executives. Some rights management functions could include: -

- Usage tracking
- Identifying and authenticate users
- Providing the copyright status of each digital objects and the restrictions on its use or the fees associated with it.

## **3. Conclusions:**

Information is the power and demonstration of learning is engaging. Admittance to information offers students a chance to find the inspiration and motivation essential to making a positive commitment in their own lives as well as the remainder of the world. Libraries and custodians



as cutting edge fighters in the conflict against ignorance and the absence of creative mind. The Internet of Things (IoT) is an emerging technology that has the potential to transform the way libraries operate and provide services to their patrons. By connecting devices and systems to the internet, libraries can gain access to real-time data and automate many of their processes, leading to more efficient and effective operations. The implementation of IoT in libraries can also enhance the user experience and support the development of new services. However, it is important to note that the implementation of IoT in libraries also comes with challenges such as data privacy and security, and cost.

In the future, libraries can benefit from IoT by using it for tracking and managing library resources, automating library processes, and for providing new services such as virtual reality and augmented reality. Furthermore, IoT can also be used to enhance the user experience by providing personalized recommendations and real-time information about library resources and services.

Overall, the Internet of Things has the potential to revolutionize the way libraries operate and provide services to their patrons in the digital era, but it is important for libraries to carefully consider the challenges and opportunities that come with implementing IoT before doing so. With the right approach, IoT can be a powerful tool for libraries to improve their services and stay relevant in the digital age. IoT can Transforming Libraries into Intelligent Hubs of Digital Knowledge in future.

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