INTERNET OF THINGS (IOT) AND ACADEMIC LIBRARIES

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Abstract: We are in a new era of smart world with smart technologies, smart mobile connections and smart services. Impact is that this technology changed the way of communication and dissemination of information of the whole world and the people around us. One of the most recent moves in technology was from Internet of Communication to Internet of Things. The aim of the current study is to examine the role of Internet of Things as a new technology in the libraries and academic institutions. IOT will be a new revolution in the field of library and information science and it will affect libraries and their services through building, collection management, instruction, data security, information literacy and so on. This smart and mobile communication technologies have increased user expectations from library services. So, librarians should aware of the various applications of IOT in libraries and services. Awareness of security issues of IOT in libraries is to be provide to the Librarians. The aim of this study is to make aware of new technologies applied to IOT that can help libraries to improve their services and increase users' satisfaction.

***IndexTerms* - Internet of Things, IoT, IoT and Libraries, IoT and Security, IoT and academics**

I. INTRODUCTION

The emergence of smart technology has completely changed the life style of people in the world. One of the most recent changes in technology was the shift from the 'Internet of Communication' to the 'Internet of Things' or IoT. This exciting and emerging technology makes it possible to connect anything with the internet based on a stipulated protocol by embedding sensors in them. In short, the IoT are simply network of objects or things where the infrastructure and technology involved are sensors, processors, cloud computing, and wireless connectivity. RFID is an accepted technology in libraries and it is some of the ways that the IoT is already utilized in libraries, that allows for item identification and item security. Self-check kiosks, automated materials handling machines, and semantic search technologies that include metadata and discovery tools are used by an automated library for their efficient service. IoT has a potential to deliver solutions that improve efficiency of library services and security of academic library.

II. METHODOLOGY

An extensive view of literature on "Internet of Things" was carried to find out emerging technologies in Internet of Things. Review of literature on application of Internet of Things in Academic libraries are done and made an attempt to identify the areas where IoT can be executed effectively. Literature was searched against various key words like Internet of Things, smart technologies and smart libraries retrieved by Sematic scholar and Google Scholar were selected.

III. INTERNET OF THINGS: DEFINITION

Internet of Things (IoT) is emerging as a wave in the development of internet. Kevin Ashton, a British technology Pioneer, introduced the term 'Internet of Things' are first used in 1999 to describe a system in which objects in the physical world could be connected to internet by sensors. Internet of Things has become an environment in which Internet connectivity and Wireless Sensor Networks are used to connect a variety of objects, devices, sensors, and everyday items.

According to Whatis (2015) the Internet of Things is a layout in which objects, animals or people are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. IoT has evolved from the convergence of wireless technologies, micro-electrochemical systems (MEMS) and the internet.

The Oxford Learners Dictionary (2021) define Internet of things (noun) as "the connection of devices within everyday objects via the internet, enabling them to share data".

According to Karen Rose, Scott Eldridge, Lyman Chapin (2015) the term Internet of Things generally refers to an integrated system where the network connectivity and computing capability extends to everyday objects which is not normally considered as computers, allowing these devices to generate, exchange and consume data with minimal human intervention. There is, however, no single, universal definition.

Pujar and Satyanarayana (2015) considers Internet of Things as a system that enables any natural or man-made object to communicate with each other and transfer data using assigned internet protocol (IP) address with or without human intervention.

In general, these definitions give a layout in which network connectivity and computing capability extends to an array of objects, devices, sensors, and everyday items. With the help of Internet of Things, the devices can generate, exchange, and consume data with or without human intervention. The aim of the Internet of Things is to enable things to be connected anytime,

anyplace with anything and any one ideally using any path / network and any services. It is an emerging structured network that will connect physical resources and actual users.

IV. Literature Review

Jian Fang (2011) discussed the concept of Internet of Things and methods of usage of the Internet of Things in the Library of Nationalities and enumerates the advantage of applying IoT in the University libraries. Libraries can add more value addition to their activities and give rich library experience to their users through usage of IoT, Bansal et al.(2018). Pujar and Satyanarayana (2015) projected the various applications of IoT in libraries viz energy management, virtual library card, smart digital shelves, real time data of patron's requests, IoT enabled mobile devices to locate favourite books etc. In an OCLC survey it was found that many librarians were familiar with IoT technologies (Hoy, 2015) and listed different methods of integrating IoT tools to library activities. These included inventory control, mobile reference, resource availability etc. Nag and Nikam (2016) proposed some technologies like cloud computing, magic mirror and pressure sensor pads, which will improve the efficiency of libraries in the near future. Ju and Shen (2015) proposed a novel solution called "Internet of Knowledge (IoK)", which can be used to organize scattered resources into a value-added knowledge asset for serving any specific objective through internet connection. Mohammadi and Yagane (2018) explained that libraries could be changed by IoT technology to the modern buildings as well as smart building.

V. Internet of Things and Academic Libraries

Library is a complex system consists of a number of components interacting with each other according to the policies and procedures that constitute learning. Due to the globalization of information and World Wide Web numerous changes are reflected in libraries also. Physical spaces of the library became learning spaces and physical resources are replacing by digital resources. Circulation section of the library is replaced by smart access. Because of its complexity in nature and changing environment, Internet of Things will play a huge role in Library Management. Researchers identified many potentials for application of IoT in Libraries. Literature shows that limitless application are possible with this technology connecting buildings, users, resources, services, and so on. Technology that supports IoT which can be used in the library are advanced Internet Protocol (IPV6), Wireless Communication Networks, RFID, Wireless Sensor Networks (WSNs) and the cloud computing. Some of the uses derived from the review of the literature are as follows.

1. User Orientation

Main purpose of user orientation is to educate the user in effective use of library resources. This will help the users to develop information seeking skills. Many methods are used for user orientation. IoT has enabled libraries to provide self-guided virtual tours inside the library. With the help of Wireless Network of Sensors and mobile application, libraries can provide self-help online guide in each sections of the library.

2. Catalogue Search

In an automated Library, catalogue search is done though 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 IoT, WSN 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.

3. Collection Management

Virtual representation of catalogue can be enabled in the libraries with the help of RFID tags inserted inside the books and connecting with IoT. These RFID tagged documents cane be identified by computers and RFID readers. By integrating these documents with the library membership card, circulation section can be managed. Connecting this system with IoT, automatic message can be sent to the users about the overdue, amount of fine to be paid, reserved items, new arrivals for issue etc. Connecting the inventories are possible through IoT and it will help to setup smart shelves and will help the users to identify whether the books or resources are available in the library, issued items are returned or reserved and also location of the books. Attaching sensors with the documents and using WSNs, there will be no possibility of missing of the library documents. Date collected by the devices can be analysed and user satisfaction survey can be done for improvement of library services and for improving the infrastructure facility of the libray.

4. Smart Library Building

Energy efficient eco-friendly building construction is possible with new building technology. Modern facilities can adjust lighting, automatic temperature control, provide better physical security, and provide detailed report of the building. Internet-connected fire sensors can be installed for fire safety of the library building. Intelligent gate system can be installed and with the help of RFID technology, theft from the library can be avoided. Self-check machines ca be installed to avoid ques or rush in the library counter. In this digital world, traditional library is transformed as a learning resource centre and digital space. By connecting the sensors and integrate this with the seating arrangements using the network, users can check the availability of space in the library with their mobile app.

VI. Challenges for IoT Implementation in Libraries

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

1. 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.

2. A huge financial investment is required for acquiring, implementing and maintaining IoT equipment and technologies in libraries.

3. Updating the staff with new technology is a challenging task for the librarians.

VI. Conclusion

The library professionals are always at the forefront in adapting the new technologies. They always try to implement and get the benefits of the new technology to serve their patrons. IoT has a potential to deliver solutions that improve efficiency of the library user service and security of the academic library. IoT promises to users a fully inter connected smart world, with relationship between objects and their environment using sensors and internet. In a world of smart things of technology innovations, Librarians want to move towards creating next generation smart libraries. The domain of the internet of Things is growing so fast as the number of objects connecting to the internet are increasing. This new wave will definitely help the libraries to connect its users with different forms of resources such as physical, digitized as well as born digital information.

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