Implementation of Internet of Things (IoT) in Libraries: Challenges and Opportunities

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Abstract

Agriculture forms a significant part of our Indian economy. Agriculture and irrigation are the essential and foremost sectors in the current world. It is a mandatory need to apply information and communication technology in our agricultural industries to aid agriculturalists and farmers in improving all stages of crop cultivation and post-harvest activities. This paper highlights the modern technologies deployed to agriculture, and discusses the challenges and possible solutions and implementations. It proposes an implementation framework for using Internet of Things (IoT) to renovate the conventional library systems to become smart online library schemes. The IoT enables the connectivity of a physical object (such as a book or other text typologies) with real-time communication technology by using RFID tags and tiny sensors. The Internet of Things can also provide a global linking of a considerable number of libraries and universities in real-time, all the time. It is concluded that the IoT-based library management systems will be a good structure that can play a vital role in human data organization and knowledge access by helping researchers, farmers, agriculturalists more efficiently and smartly.

Keywords: Internet of Things (IoT), library Management System, Cloud System, Information and Communication Technology (ICT)

Introduction

The IoT is a prevalent phenomenon in which many smart objects can connect and plot a smart map of the devices deployed over a field. Based on the ISOC (Internet Society), the IoT refers to the scenarios of the advanced

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connectivity of the devices' physical objects without human intervention (ISOC, 2015). This extraordinary evolution was possible due to the progress in information science and technologies such as cloud systems, wireless communication, WSN, RDIFs that drive IoT (Höller et al., 2014; Bayani et al., 2010).

The librarians also face innovative challenges, concerns, and opportunities for development regarding the emergent technologies such as the IoT.

The Internet of Things will be overlaid with many IP-based objects that can connect physical and virtual embedded devices shortly. As an emergent technology, IoT uses the RFID to interconnect unique identifiable devices within the existing configuration, creating smart infrastructures.

Although the traditional library management systems have used the RFID barcodes in the various administrative processes, these systems are not considered smart systems. Nowadays, many systems need to provide connections between virtual and physical objects to make a detailed map related to the situations and decisions based on the obtained data. Furthermore, with the assistance of the IoT, the objects will become smart devices that can facilitate the supply administrating chain, the tracking, monitoring, and controls of the products in an efficient manner.

A library management system should incorporate the more innovative elements in its processes to cope with the efficiency limitations, converting it into an intelligent system. This paper contains a brief explanation of the Internet of Things and proposes a theoretical model design related to the IoT-based automation library system for providing a proper awareness to the library system designs to incorporate the IoT's innovative elements into the structure of this kind of system

Literature Review

Building the smart library and its related issues, such as monitoring, registering, establishing security, managing, tagging, tracking, self-servicing, and detecting users, is subject of interest and concern for the researchers.

While some issues remain, including privacy safeguards, data interoperability standards, and cybersecurity measures, we can say that the various technologies needed to support the IoT can and will be integrated to realize the IoT's full potential. Among the enabling technologies are some that should be familiar to librarians: Radio Frequency Identification (RFID), machine-to-machine (M2M) communications protocols, and semantic search capabilities, including metadata and discovery tools (Vermesan and Friess 2013).

A worldwide internet-connected library system makes the global research process possible for users: Locally, by employing the RFID, WSN, and cloud technologies in the IoT architecture, and by the process of identification checking of the users and books, object tracking, and self-checking in/ out, which create an innovative and secure library management platform. Connecting the physical objects to the Internet builds an effective structure named Web of Things (Guinard and Trifa, 2016). The Web of Things (WoT) provides an efficient interface to search and data mining to discover patterns and multiple-dimension categorizations of the books. With WoT, books or documents can be classified by many attributes such as the type, author, editor, subject, location, publishing place, weight, size, volume, price, ranking, history, e-copy, updated, etc. Creating a direct link between everything and multiple physical and virtual attributes was impossible before the release of IoT in our real world. The WoT (by using IoT) can generate both centralized and non-centralized networks of the books as living objects connected to an extensive database. This can facilitate collecting large volumes of data related to each element in a real-time mode.

Furthermore, the emergence of a prevalent technology, such as the Internet of Things, with lots of benefits, as it offers, has its limitations in the implementation phase at the initial point.

Discussion

Most of the libraries in the world, especially those in third world countries, are managed traditionally for many reasons, such as cost-benefit analysis

or because there are unknown related technologies for making decisions. One of the main advantages of the IoT library management implantation is the automation of the process. The benefits for an automated system are technically likely and expected; although, sometimes politically, it is not the concern of the people or administration system.

Moreover, the speed to access the information and objects (books), low energy consumption, decrease in latency, cheaper maintenance cost, and smart automated system implementations are advantages of robotizing the processes.

Using the prevalent technology such as the Internet of Things pervades the intelligence into the structure and processes (Hamm, 2013), making the system more efficient. Therefore, using a technology such as IoT converts a library management structure from a traditional to a smart system that can inherit all attributes of an intelligent infrastructure, such as linking many objects.

Because there are different time zones, many people are always active, and others are slept or inactive. The IoT can provide a global linking between the huge number of Universities, people, and research centers' libraries in real-time 24/7 (Bayani & Vilchez, 2017). Building such a long connection provides a big opportunity for researchers worldwide or inside a country (local linking), to access the online resources and projects.

Besides, establishing local and global links is possible through the Internet, facilitating access to the unknown valuable historic and scientific resources around the world. Furthermore, creating a global library link among other collections leads to building an open online global library that enables global access to the big treasure of knowledge in human history. Thus, a novel phenomenon called "the IoT-based World Library Network" is formed. Libraries have been affected by all developments in IT. They have benefited from IT tools-including hardware, software applications, communication networks, and electronic sources of information-to provide better library services and broader access to the user community. Since libraries are

sources of culture, they can create change in the user community's culture, specifically by shaping their information collections, improving resource availability, and helping users access the collection through communication and training efforts.

New IT concepts have appeared in recent years, including digital transformation, cloud computing, Artificial Intelligence, Big Data, Machine Learning, and the Internet of Things (IoT). They have impacted the population, and therefore libraries can benefit from them too. Libraries may save a lot of their IT budget by adopting these new approaches because they provide technology in accessible ways, often at lower costs, and to the benefit of users. This paper will cover the IoT and its applications in libraries.

The IoT Concept

In recent years, several new IT concepts have emerged around the IoT.

- The IoT refers to physical devices connected to and exists as internet entities. The devices may be in appliances or security systems in cars, trucks, and construction or farming equipment and the sensors in traffic signals and street lighting, the smart tags on items in stores; and the mobile devices that many users wear or carry with them at all times. The data streaming over internet connections may serve various business purposes, including equipment performance monitoring, system updating, and inventory control.
- The Internet of Things (IoT) is a scenario in which objects, animals or people are provided with unique identifiers and the ability to transfer data over a network without requiring human interaction (TechTarget 2018).
- The importance of the IoT is evident in that it allows the connection of things anytime, anywhere, with everyone and everything connected to the network. The potential of the IoT is best shown in smart cities where continuously monitoring the data generated from sensors can result inefficiencies in managing resources.

The first existing constraint is related to the hardware design for the particular purpose of a global or local library system. It is required to create a customized design to adapt to the overall conditions of the library systems. Producing the colossal small-size and low-cost number of WSN sensors and the exact numbers of the RFID tags is needed to paste them to the library objects such as books or other kinds of documents. On the other side, the objects (books) should possess the appropriate physical conditions to take the sensors or tags.

The internal communication system is another issue that the project managers or designers will confront because of technical, administrative, or financial limitations. One of the main elements in an IoT infrastructure is the storage capacity.

Another type of preparation is needed to connect the local libraries: A well-designed telecommunication and Internet system and a public cloud system can guarantee the interconnection between the libraries in a country or region. The employed devices in this infrastructure should perceive the IoT signal and messages by using the IoT applications. As mentioned before, the applications of the IoT in many areas such as the library management system are still in progress. The IoT comprises a wide range of devices and is driving a particular market segment in application development. In addition to the popular operating desktop systems hosting the IoT interfaces, using mobile applications is a trend.

People are spending high percentages of their time using their smartphones and mobile apps, then applying a library mobile application can increase the users' library usage rate. It is ubiquitous to use smartphones to connect to the Internet, buy a product, pay for a service, watch a video, and get access to numerous online services. One of the advantages related to the library service management that the IoT can offer is that once the users download and install the library application, they can access all online services prepared by the system.

The IoT is considered a complex environment, and many times the implementation of an innovative process and even the development of an application is a big challenge. As a library system provides specific services to the users, customized IoT mobile applications in the library field are facing a lot of unavoidable challenges; such as the IoT's hardware compatibility with the different operating systems like Android, iPhone OS (iOS), and Windows, the application's licensing costs and the speed of technology changing.

Applications for Libraries

It is difficult to imagine all possible IoT applications in the future, but all IoT applications depend on communication tools, including the internet, Wi-Fi, and RFID.

Here are some practical use cases for libraries:

- You could discover the smartphones located in a particular library area via Wi-Fi or Bluetooth and send targeted communications (such as announcing an event currently taking place inside the library).
- Alternatively, you could track Wi-Fi devices to show traffic patterns and identify popular shelves to make better-informed space-usage decisions.
- Many libraries already tag the items in their collections with RFID tags to help check out and check-in materials. Libraries can also benefit from smart tagging in other ways: finding lost or misplaced items in the collection or tracking items as they move through the library and possibly deciding to relocate underused resources to increase their visibility.

Just imagine the improvements that could result from adopting smart city technologies:

- You might install smart lighting inside and outside your library. The library could then use the internet to monitor and control the lighting

(and its costs) via the library's Wi-Fi network to turn the lighting on and off.

- The same goes for installing a smart energy system in which energy consumption can be controlled according to need-and not just made available all the time-thus saving a lot on expenses.
- Using fire sensors connected to the internet, the advent and progress of a potentially disastrous fire could be followed and dealt with safely from outside the library, pinpointing the danger areas and remotely dealing with them.

As we have witnessed book-based libraries' evolution into electronic, digital, and virtual libraries, we will no doubt soon see smart libraries.

Challenges

While the IoT promises to make an extraordinary change in our entire way of life and work-not just for libraries and librarians-realizing the IoT's potential presents challenges to IT leadership inside and outside libraries. In some cases, there needs to be a change in business culture, the structure of projects, and leadership strategy to focus on innovation, cooperation, and integration.

The Current Scenarios

The most important reasons for not adopting technology are as follows:

- Not all librarians have the skills to deal with new technology.
- Administrative and bureaucratic procedures in the libraries have negatively affected the development of technology infrastructure; therefore, the technology in place is often obsolete and possibly not even being used.
- Users are not playing their part in demanding that the libraries provide a distinguished service. Users should urge libraries to pay more attention to services based on IT.

However, the following is clear:

- The IoT, digital transformation, and cloud computing are three concepts that should be of interest to those serving in the library field and governments worldwide. These concepts depend on three key elements: the technology itself and its components, the central importance of data, and the imperative for community awareness.
- IoT advantages include cost savings and increased work efficiency. But realizing these goals depends on reliable infrastructure, including the existence and persistence of good internet connections. In the era of the IoT, ISPs have become VIPs.
- IoT applications can and will be applied and adapted by libraries, even as the IoT expands to what some have called the Internet of Everything.

Recommendations

- The Ministry of Communications and Information ought to advance participation among libraries, setting a genuine model by further developing the IT framework inside the public authority libraries it manages. A reasonable approach to exhibiting its significance is to update PCs and programming in those libraries.
- The Ministry of Culture should consider fostering libraries, simultaneously advancing client consciousness of the job and significance of IT.
- Libraries need to comprehend and apply the new ideas, giving specific consideration to offering the best types of assistance by further developing the IT foundation, particularly the speed of their web associations.

If we genuinely care about the user community, libraries will provide the best current services to them by applying the concepts of IoT, digital transformation, and cloud computing. The goal will be achieved when all

libraries and library associations do their best to advocate for change and work together to implement solutions.

Conclusion

At present, information technology and related topics such as the Internet, communication technology, smart mobiles' connections, and online services significantly impact all aspects of human beings' lives. The libraries are also affected directly, facing growth, advancement, and challenges for development. The library atmosphere is a complicated environment in terms of the high volume of the elements, customer attending quickness, continuous growing of the objects and demands, and a good supply chain management system. The IoT enables the connectivity of a physical item like a book to real-time communication technology. This characteristic of connecting all things to the Internet allows implementing an online library supply chain, integrating it with diverse technologies such as wireless and Internet technology, database, data acquisition, and cloud systems. By integrating the mentioned systems, many online services can be generated. Connecting similar IoT library systems makes possible the biggest online supply chains and services in the world, a massive number of the objects, including books and users, and a huge number of the data depository research universally will be connected through the Internet.

In rundown, one might say that applying the IoT's innovation in the library, the board frameworks' execution is promising for the forthcoming future. It can assume a critical part in the human's worldwide information access and information engendering in a quick, more effective, and brilliant way.

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