Towards Creating a Model of IoT to be used in Library Activities for Saudi Arabia's Taibah University

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Abstract: The library must create a replacement organisation system in instruction to swap the existing system with the new one. There are several details why library operates need to adopt a new scheme, including the following: I have lost a lot of info on library books. The lack of familiarity with the literature Difficulty deciphering the fine print of library operations because of a sluggish system Difficulty in maintaining current information. Apart from orientation, the user interfaces are pleasant, and retraining was required. The researcher suggests that this approach be used on an ongoing basis to ensure the continued provision of library services. Other management responsibilities include serials and magazines, as well as reservations book, e-mail notice, and automated reminder, as well as the use of bar codes, scanners, and labels, as well as the custom of regularity identification tags to reduce book theft. Additionally, it is suggested that the library system engage in online surfing to enable users to access books and courses through the internet. The proposed research project would contribute to the development of a model IoT application for library operations at TIBA University in Saudi Arabia. The new system will manage and regulate all library information, resolving the aforementioned issues while also providing numerous advantages to staff and students.

Keywords: Internet of Things (IoT); library management; RFID; service delivery; smart libraries

1 SERVICES PROVIDED BY MODERN LIBRARIES

The library is regarded as a repository of information for students in any field of study. Following the internet's creation, it became a primary source of information for education and research. The introduction of the internet as a product of Information and Communication Technology (ICT) facilitated the advancement of the traditional educational system, which has evolved into an online omnipresent educational system. In this shifting educational landscape, the notion of traditional information resources such as instructors, books, and even libraries is evolving as well. Teachers are rebranded as Learning Enablers, books become audio/video e-books, and libraries become Learning Resource Centers. Electronic and communication technology advancements are resulting in the miniaturization of equipment and an increase in the speed of transmission involving massive amounts of data [1].

Through a variety of uses, information technology (IT) has transformed and simplified life. Users attended libraries to examine a variety of info sources based on their specific requirements. The development of Internet technology, contemporary telecommunications, and related fields such as processing, management data systems, and information retrieval systems, among others, has had a profound effect on the operation and atmosphere of libraries during the past three decades. Libraries are always changing and developing in order to survive. They lack the need to settle on, to vary and develop, but they do require survival and the ability to retain their prominent position as data and learning hubs. There are many explanations for this societal phenomenon. Every aspect of life has been transformed by technology [2].

Users' information-seeking behaviors have changed. Libraries must evolve and adapt in order to meet the users' knowledge requirements. Libraries are allegedly tasked with the responsibility of providing information to users when and in whatever format they have it. The current generation, dubbed millennials or netizens, is more at ease working in virtual settings. The users' expectations and demands have multiplied. They are dissatisfied with location-based library services and need information offerings that extend beyond the actual library's four walls. The contemporary library's aim is to assist in increasing market share by making it very simple for consumers to utilize. Computer systems are raising consumer expectations and businesses who are not computerized will inevitably lose out owing to the strong rivalry and efficiency brought about by computers. It is prudent for libraries to remodel their services in accordance with the expectations and needs of their user community. Libraries may use new technology to provide novel information services in order to maintain and attract new patrons [3].

2 IOT SERVICE DESCRIPTIONS

The Internet of Things (IoT) is a prominent trend that is being utilized to create and manage smart libraries. The Internet of Things (IoT) is a term that refers to the usage of interconnected devices and frameworks to collect data gathered by implanted sensors and other monitoring. IoT makes use of interface media like as wireless networks and bodily substances to join devices to one another and hence to the internet, with little direct human interference obligatory to bolster public services. Several of the benefits of IoT include the ability to demand access to information from anywhere on any device; enhanced device connectivity; increased time and cost efficiency; and improved service quality. There are many Internet of Things (IoT) applications in a variety of fields, as shown in Fig. 1, and as a result, interest in IoT is growing yearly across the world, with numerous major companies investing resources in the innovation process [4].

The Internet of Things has made it easier to maintain control in the retail and supply chain industries. Due to

the distant nature of agricultural operations and the large number of farmed animals that must be monitored, the network of Things has the potential to change the way agricultural processes operate and make farming simpler for farmers.
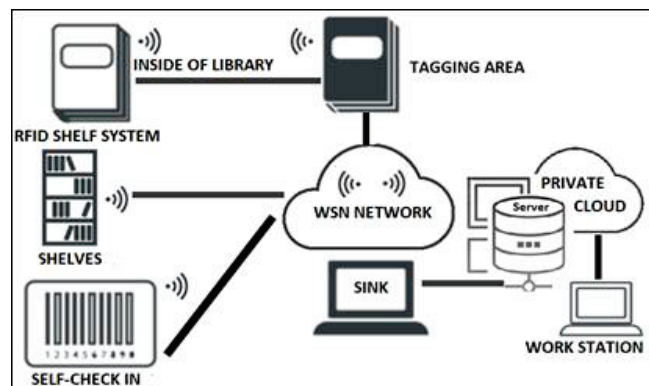

Figure 1 IoT Applications in Library [9, 11]

Issues such as disrupted shelving, library thefts, and so on are addressed by implementing an Internet of Things-based system across the library. RFID technology, scanners and monitors, as well as alarms, are widely implemented. Scholars may quickly find books by using their smart phones or library computers to search the library's Online Catalogue (OPAC) and, as a result of the automated network, they are sent straight to the shelves. Additionally, it supports user authentication and generates unique profiles for easy borrowing and return. Users are informed immediately when it is time to return given material. Additionally, the library management system supports fine computation, easing the load on personnel. By using online data storage, portable and digital libraries, you may eliminate paper-based processes and associated maintenance costs, increase efficiency, reduce activity costs, and save time. Additionally, it assists customers by giving a virtual tour of the library. As a result, much research and development effort has been directed into automating public and academic libraries during the past two decades. It facilitated enhanced management and service delivery. Numerous other technologies, like as blockchain and machine learning, are utilized to suggest books to consumers through their devices. Numerous software programs are created, with some including specific changes to improve administration in a variety of library types. Cloud storage has eliminated security risks while facilitating access. Recently, public library use has decreased as a result of a lack of current books and inadequate upkeep. The primary goal of giving students with high-quality education and training is impossible without first learning about their evaluations and needs. Thus, use statistics may assist staff in determining the users' interests. Additionally, in academic libraries, proper analysis of student use of books, periodicals, and other materials may result in increased collaboration between instructors and students throughout the learning

and research process. Faculty members may see how students study and refer to write notes. Through this study, library personnel may serve as a liaison between academics and instructors, as well as update the collection with more important resources. As a result, our proposed study will focus on fully automating IoT in library administration and will use predictive analytics to help in improving the entire automation process and upgrading the library [5].

3 THE INTERNET OF THINGS IN RELATION TO COMMERCIAL SERVICES

(a) Library information literacy services
The library collection's RFID-tagged items allow the creation of a virtual representation of the items, which can be recognized by means of computers and RFID readers. By incorporating RFID tags into member cards, it is often possible to simplify the circulation of goods and fine collection. The IoT will be able to inform users of unpaid books and the amount of fine they owe the library, allowing them to reappearance late paid books and pay the fine online without having to wait at the circulation desk16. Additionally, keen numeral shelves may be prepared to push material that is backed by customers' borrowing records and online search histories. Additionally, IoT will aid in improved inventory management by making it easier to find lost books [6].

(b) Library-based IoT services
The Internet of Things might make it possible for libraries to provide location-based services to its patrons. Using an IoT-enabled mobile device, a user who creates a results have suggested in the digital library from his or her homes and offices will be able to obtain instructions to the stacks where his or her favorite novels are postponed, as well as guidance in recognizing impressive titles relevant to the topic and the position of checked out books, when that user walks into the library [7].

(c) IoT-enabled appliances and services in libraries
The Internet of Things may assist libraries and their patrons in better managing accessible equipment, thus reducing energy expenditures. While some of these measures are already in place in certain libraries, they may expand control beyond library personnel to users. Consider that a person entering a library, sitting in a cubicle or reading table, using their IoT-enabled mobile phone, might manage the lights, air conditioning, and Wi-Fi, among other things [8].

(e) IoT-enabled library services
Whenever a researcher looks for materials on a certain topic in a database, it is feasible for the database to suggest other materials which may be of interest to them. No matter how many times a user returns to the library or is on the brink of returning, IoT will be ready to inform him or her of recent comers during his or her

field of work or of the availability of a loaned book which he or she was looking for during a prior visit [9].

(f) Impact of IoT on library services

In order to enhance the value of the service and offer a great library experience for consumers, libraries will be ready to boost their worth. The Internet of Objects is all about connecting things online based on their unique identifiers, which is what it is called. Because of the use of radio frequency identification (RFID), which performs the same function of conversing with machineries, tagging and updating the library system with entries of library books to a user, librarians are already familiar with this concept. The only difference between RFID and IoT, however, is that the web is interfacing with something physical, such as a book. Libraries include books, journals, and CDs/DVDs; these, as well as many other tangible things, as well as the Internet of Things (IoT), are often a gift in disguise for addressing a variety of recurrent library problems [10].

4 TAIBAH UNIVERSITY LIBRARY DESCRIPTIONS

Research libraries are those that are solely devoted to research. Studies that analyze library websites in order to assess researchers-targeted programs are typical of this kind of study [7-11]. The assessments of the requirements of researchers presented in the former part mark the substantial importance of having broad accessibility to the latest materials, electronic as well as print. Van Zijl's investigation of the policies and procedures for research collection at two universities of technology, one in South Africa and another in New Zealand and, discovered that the institution in South African, for instance, fell short of international standards in many areas. The two recent comprehensive assessments of library research services conducted by the Research Information Network (RIN) are especially useful. Respondents were given the option of selecting from a menu of thirteen options. Academics' answers reveal seven categories of library competence that are critical duties: dataset manager, repository manager, operations manager of data management, custodian of collections, subject-based knowledge expert, technology specialist, and teacher of data managerial skills, to name a few. The answers from librarians prove those issues. Nevertheless, they include others, including intellectual property counselling, information literacy education, and metadata management, to the list of recommendations. Researchers seem to put a greater value on their roles as instructors of comprehension skills and propagandists of research findings than do researchers, according to this study. Using mostly qualitative methods, this study investigates the connection between specific library features and the academic standing of a university's research program. In addition to boosting the income of research, taking on skilled researchers, and encouraging them, eleven library characteristics have been shown to be essential. Information and organizational abilities, proactive

information specialists, outstanding research collections, a strong service culture, subject expertise, and leadership in institutional repository administration are just a few of the library qualities that have been recognized as important. It is possible that the most important, and yet intangible, feature for the future of university libraries is the common idea between a research institution's faculty members that the academic library is a necessary component of their research. The creation of specialized research units aiming to "embed" the library in research operations, is one example of a library initiative that seeks to join the world of researchers proactively [11].

For instance, at Curtin University of Technology, the mission is to "proactively support research activities through offering appropriate information and resources, improving research procedure, enabling scholarly interaction, and enhancing research output" (Garner 2006) [12]. Several of the operations carried out by these units include the following:

- supervising the submission of electronic theses:
- Institutional repository management Collecting research materials Instruction in database search
- Providing reading areas for scholars apart from the undergraduate classroom. Developing connections between the research communities of institutions, for instance, among research and development offices, as well as postgraduate study committees:
- establishing communication and collaboration platforms, such as wikis, for research communities;
- placing librarian offices inside faculties to maximize interaction with researchers; students pursuing advanced degrees; and
- creating online research portals that provide great accessibility to a wide variety of electronic resources.
- Accessibility to extended and updated print and electronic collections
- Access to archives and special collections - facilitated over the last years by libraries digitalization-related projects
- Effective communication and information technologies
- Rapid document delivery services
- Assistance and advice in finding resources from experts.

5 THEORETICAL MODEL RELATED TO IoT LIBRARIES

IoT in libraries seems to be a strong industry, based on recent advances in this area. Once fully developed, the Internet of Things has the potential to fundamentally alter how libraries operate and offer services to their users. It has the potential to transform library buildings into smart buildings, where patrons may interact with different objects in the library and get practically any kind of information via communication-enabled devices. Apart from the areas of implementation mentioned previously, IoT may penetrate deeper into various areas of libraries over time, providing statistics on library resource usage, maps indicating the most heavily used areas of the library, user satisfaction levels, and when students become frustrated with library resources and resort to Google.

Libraries must examine a variety of factors before jumping on the IoT bandwagon [13]. The first concern is the privacy and security of patron data, since there is a possibility of exchanging this information with other parties, which may result in hacking. Secondly, the financial, personnel, and time costs associated with investing in IoT technology. Thirdly, staff training is necessary, and the most critical factor is the decrease in physical library usage. The library management system combined collection and acquisition, and therefore classified physical loading, cataloging, circulation, and information and retrieval for reference service series. When these computerized library services are implemented, the process is referred to as library automation. Automation and technologies that are involved with the planning & design processes, as well as systems that reduce the amount of human participation needed in their operations, are characterized as being part of the planning and development process. Library automation is a wide term that refers to the use of information and communication technologies (ICTs) to replace human library activities in a variety of settings. In light of the following considerations, is it acceptable to automate the library?

a) The growth rate of the information they offer is very fast, especially for the majority of material in libraries. It has become more difficult to manage and organize data using conventional methods [14].

b) It is difficult to update knowledge as a result of the significant rise in the number of specifications and the increase in the degree of specification concerned.

c) When it comes to sharing resources between libraries and users, automation can make things much easier. Automation provides a high speed, extra accurate, and extensive increased storage library automation, which improves the effectiveness of our work by providing uniformity and appreciation for our control. It also minimizes repetitious labor by automating it, and it makes bibliographic controls, checking, and other features possible. Computers are utilized to perform library tasks in the context of library automation [15].

Computers are increasingly being used by college students as both exercise books and textbooks. This implies that pupils who did not advocate for new technology would fall far behind, since current knowledge is often accessible simply via the usage of computers. This demonstrates unequivocally that library service administration is doomed to failure if new technologies are not used to organize these offerings. Only by digitizing and storing library material on small, accessible, and secured electronic media will future generations be able to benefit from their efforts to preserve the past. Since a result of the widespread use of computers in society and education, it is no longer necessary to visit libraries or book stores to get books, as many people increasingly rely on electronic books and other soft copies. Instead of carrying about a stack of books, a flash drive, CD, or laptop must be transported. Soft copies are less in size than textbooks and are easier to look through. Additionally, the writer observed that soft copies are more cost efficient than textbooks, and that many of us often access soft copies. Additionally, copies can do delicate animations, which are not feasible with text, and are rarely destroyed [16].

Table 1 TAIBAH University "Wish list" of library research support services

Ranking	"Wish list" of library research support services
1	Updates on new information resources are provided on an ongoing basis.
2	Keeping research repositories up to date is important.
3	Getting Started with a Database
4	offering suggestions for reading material on my subject and advising me on my literature review
5	Advice on how to properly reference a source in a bibliography
6	Suggestions for my research subject
7	Writing a study proposal: some pointers

6 IMPLEMENTATION OF IOT IN LIBRARIES

At TAIBAH University, libraries are locations where students come to access and utilize the information they libraries in order to provide information and services to patrons [17]. ICT is increasingly playing a significant role in the library environment, both in terms of delivering services need to complete their assigned duties. As an institution, the library collects both print books and publications and digital and electronic versions of many kinds of information resources. Additionally, it includes the provision of various user-oriented services that assist users in meeting their informational requirements. Librarians are also required to undertake certain administrative functions inside to customers and administering other library operations:

a) Creating master plans for collection storage;

b) Standardization of storage;

c) Organizing the purchase of storage systems and their installation;

d) Keeping an eye on collection growth in relation to available storage space and layout;

e) Arranging for collection relocations;

f) Arranging for storage equipment maintenance and replacement;

g) Managing the physical preparation of goods to ensure they will last a long time;

h) Delivering and reshelving goods ordered from storage, whether on-site or off-site, including in public places;

i) Keeping track of the position of collection objects when they are removed from and replaced on the shelf;

j) Keeping the shelf order and sequencing consistent.

Radio Frequency Identification is an acronym for Radio Frequency Identification. RFID technology makes use of wireless radio communications to create unique identifiers for people or assets. It is a technology that enables the tracking and communication of an object,

such as a library book, through radio waves. This technology is conceptually similar to a telephone. RFID is a term that refers to the combination of radio frequency and microchip. RFID technology has the potential to significantly improve library operations by enhancing the efficiency of library transactions and providing better

service to library customers [18]. Libraries are benefiting from the usage of small Radio Frequency Identification (RFID) tags to monitor their assets, which aids in inventory management of hundreds of thousands of objects (Fig. 2).
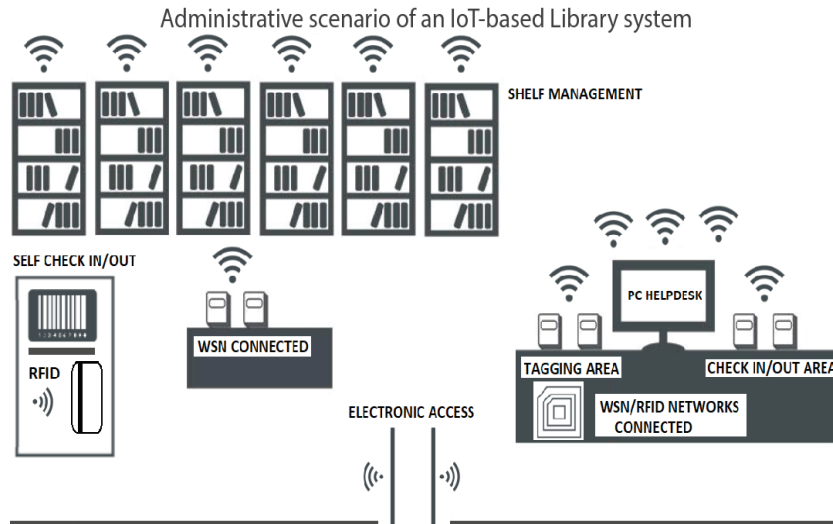

Administrative scenario of an IoT-based Library system

Figure 2 Implementation of IoT in Libraries [17]

This may be accomplished in a single day, rather than over the course of many months. Numerous libraries have used or are considering using RFID technology to automate circulation, inventory management, and security control. RFID technology enables automated check-out and return of library items at any time of day or night. It streamlines checkouts and maintains a more organized collection. Apart from facilitating checkouts and maintaining a more organized collection, RFID promises to improve a library's control over theft, non-returns, and incorrect filling of assets.

6.1 Radio Frequency Identification Tags

A programmable chip and an antenna are included with this tag. Each paper-thin tag is equipped with an etched antenna and a microchip with a minimum capacity of 64 bits. Three types of tags exist: "read only," "WORM," and "read/write". Tags are considered "read only" if the identifier is encoded during manufacturing and is not rewritable. The employing organization programs the Write-Once-Read-Many tags, but without the ability to modify them afterwards. The "read/write tags", which are preferred by the majority of libraries, allow for the modification or addition of data. It is typical for libraries that employ RFID to have a portion of the read/write tag protected from rewriting, such as the item's number [19, 20].

6.2 Radio Frequency Authentication

In order to communicate with one another, RFID scanners and tags need a wireless channel, which implies

that the signals they send may be susceptible to listening or interception. Additionally, tags react to a reader's inquiry without their carriers being aware of what is going on around them. The use of encryption to protect the components of sent information may be an excellent method of ensuring that even if an unknown individual spills the beans on the linkage, the cipher text will not reveal critical information unless the key has also been stolen; however, encryption is not always effective. There is a requirement for a secure, safe system that will allow management to monitor the communication of their employees at all times. In this study, we utilized two different encryption techniques to protect the data stored in the system: the triple coding standards (3-DES) and the Message Digest 5 (MD5) (MD5) [20]. Throughout the authentication process, RFID tags are utilized to validate an individual's identity by scanning the tag (Fig. 3).
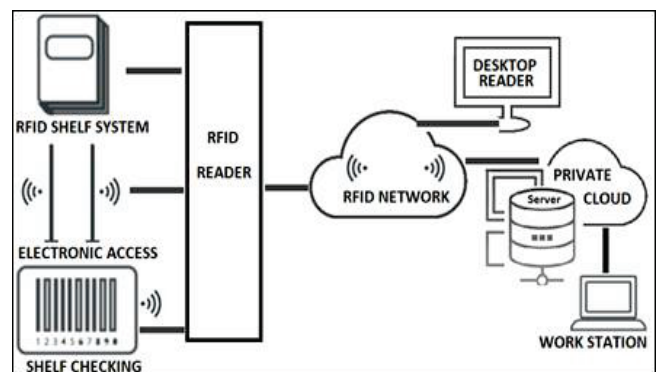

Figure 3 IoT Based Library Monitoring System [19]

(a) One of the most significant advantages of RFID technology is that it is non-contact and line-of-sight. Tags are often read through a variety of materials, including book covers, plastic products in any orientation, and other visually or environmentally challenging situations in which barcodes and other optically read technologies would be useless, such as in dangerous areas. RFID tags may also be read at rapid speeds even under challenging circumstances, with responses often taking less than 100 seconds.

(b) Reading and writing capabilities of a passive RFID system are also a significant advantage in multimedia applications such as work-in-process tracking and inventory management [21]. While RFID is costlier than barcode (in contrast to barcode), it may become indispensable for a broad range of automated data collecting and identifying purposes that would otherwise be difficult to implement without it.

(c) Libraries are being subjected to severe budget cutbacks. The reduction in financing from the state and local governments has made it difficult for libraries to keep their doors open around the clock, seven days a week. RFID is seen as a way of solving the lack of skilled workers [22].

(d) The self-service component of the RFID system enables members to check out goods without the need for assistance from staff employees. Self-service systems have the potential to become very popular with both members and staff. Members may check in or check out several books at the same time using RFID self-check systems, rather of just one book as in the past [20]. With self-check devices, there is no longer a need for people at the circulation counter.

7 CONCLUSION

Advances in information communication technology have created a fresh window of opportunity for innovation within established library paradigms. The Internet of Things offers enormous promise for libraries. If done properly, it has the potential to produce desired outcomes and add value to library resources and services. It is still in its infancy, therefore it is prudent for librarians to learn about and wait for this new technology to gain wider acceptance, adoption, and availability for better application in libraries. Simultaneously, it would be fascinating to learn from early adopters and develop more effective strategies for maximizing the benefits of IoT adoption in libraries. Because smart IoT technology in libraries is still in its infancy and is still developing, librarians must be educated in this technology until it is more widely recognized, used, and accessible. RFID technology is used to track the position of references, store data, and retrieve it quickly. RFID deployment in libraries has been explored. All operations, including issuing, reissuing, returning references, searching for references, and locating a lost reference location, may be completed efficiently using RFID in a library.

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