AN IOT BASED SECURED SMART LIBRARY SYSTEM WITH NFC BASED BOOK TRACKING

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Abstract—**The Internet of Things (IoT) is a technology that has gained spotlight in the recent years. A "Smart Connected Environment" has drawn a lot of attention and the reason for all this buzz is due to the emergence of IoT. The Internet of Things has scope in all walks of life right from smart homes to critical medical examinations. Though RFID based library management system has emerged successfully in the recent past, it has its own limitations. A major difficulty in the present library system is that RFID technology finds its application only in the issuing and returning part of the library system. The present system does not provide any assistance to the user to track the book right to its rack. Hence, in this paper, we propose an IoT based Smart Library system which provides the luxury of fetching a book from its place with the assistance of an IoT based interconnected system using a Wi-Fi based Local Positioning System (LPS) and Near Field Communication (NFC) tags.**

Keywords- IoT, RFID, NFC, LPS.

I. INTRODUCTION

The world is drenched in the internet and now the Internet of Things is also gaining a lot of attention. But the application of the internet technology in library management is at its infancy. In a library, books are arranged in shelves based on their classification of subject. There is a lot of movement of these books in and out of the library and so there is every possibility that these books get misplaced. When such misplacement of books occurs, it becomes a tall order for both the librarian and the user to search for the books [1]. Though the OPAC gives the rack and the access number of the books, it is always an uphill task to even find the rack in huge libraries. The scenario becomes worse if the books are misplaced. So a system that could lead the user directly to the place where the book is placed would come in very handy and

it also saves a lot of time. It also helps in finding the misplaced books. Now that everyone has a smartphone and is connected to the internet, the doctrine of building a connected library system where the user can utilize his mobile phone to connect to the library system and also find the position of the book through a local positioning system would prove to be very useful. The aim of the concept in this paper is to build a "Smart Library System" with facilities to issue, return and even locate the book using an authenticated smart phoneThis paper is organized as follows. In section 2, we present the existing techniques for managing library available in the literature. Section 3 elaborates the proposed IoT based "Smart Library System" and its architecture. Section 4 presents the merits of the proposed system over the existing library management systems and finally Section 5 presents the conclusion and future work.

II LITERATURE SURVEY

The Internet of Things may be defined as interconnection of uniquely identifiable embedded computing devices within the existing infrastructure [Wikipedia]. In the near future the world will be overlaid with communication of embedded devices creating a "Smart World" [1]. Already many places have sensors sensing temperature, trying to save energy [2] and automating the traffic system and autopilot of vehicles and UAVs [3]. Many applications may be powered by IoT and its underlying technologies such as M2M communications, V2V communications, RFID, NFC, etc. [8] Thus the world is becoming smarter and in a smart world IoT will definitely play a pivotal role. With a large number of gadgets and things getting connected, IoT has a bright future. A work that served as a base to this work is [4] where the authors have provided a solution to the havocs in library management using Augmented Reality based Context Aware Library Management system. They have proposed a system

in which smartphones are used which captures the code markers set on the spine of the books arranged in the library. The major drawback of this system is that it is image dependent and without proper lighting and other such factors it would put a load on the users. Further the code markers can be set on the spines of the books only if the spines are broad enough. Thus there are no solutions to magazines and other such articles in a library that do not have broad spines. Also they use complex image processing segmentation techniques to first identify the ROI [4] and then search for the misplaced book. Also the work has dealt only with the searching and identification part of the library management and does not deal with the whole management issue. So such a method would only be an addition to the existing library system and not an alternative. Taking such things into account, we propose an "IoT based Smart Library System" which could prove to be a total alternative to the existing library system Also the present RFID based library management system does not provide any aid to locating the books. They only help in the issue and return of the books [4]. Priyanka et al. [5] have implemented an RFID based library management system wherein they use the user's RFID card and tag attached to a book for issuing, retuning and re-issuing a book to a user. In this system, when a user wants to get some books issued, he has to puts the books and his RFID card on the self-checking counter. The card reader in the self-checking counter reads the RFID card of the user for authentication and then reads the details of the books from the RFID tag attached to the books and updates the student's details in issue database. They also make use of LCD display to display details of issue. A similar procedure is followed for returning and reissuing of books. The major disadvantage of Priyanka et al.'s system is that the users have to be issued separate RFID cards. But in our proposed system, the user details can be got from the NFC in the user's smartphone. Another fact is that Priyanka et al.'s system does not provide the book position tracking facility. But our system offers complete guidance on the location of the book. RFID based library management systems have been proposed in [6], [7] and [9]. These systems employ RFID reader/writer and RFID tags. These systems assist the librarians in managing the books in a library. Like Priyanka et al.'s system these systems also do not provide any assistance to the user in tracking the location of books. Pravin et al. [8] have proposed an IoT based library management system that helps in issue and return of the books. But the major disadvantage of their system is that they need a separate handheld RFID reader the Motorola MC 9090 for the identifying the books. Also a very little work has been done in locating the book and they have listed it as future work. Our proposed system uses the user's own smartphone and so there is no need of a separate RFID reader. Also we provide solution to locating the book within the library using a triangulation Wi-Fi based local positioning system

III . PROPOSED SMART LIBRARY SYSTEM

Libraries are areas in which the application of IoT has not yet placed its footprint. In a library books are arranged in shelves based on their context. As these books are being

moved constantly monitoring of these books is a hectic task. The Figure 1 depicts the architecture of the proposed system. One of the major goals of this IoT based "Smart Library System" is simplifying the user's task of searching for the books..

The proposed system comprises of the following modules.

- Authentication
- Query and Reply
- Locating the book
- Issue and Return

A. Authentication

The main issue with many of the automated library systems is security. One aspect of security is authenticating the library user.

Authentication is more important for our proposed smart library system as anyone with a NFC enabled smartphone should not sneak into the library

Hence, we propose a strong authentication mechanism which authenticates both the user ID through his smartphone and also his finger print through a biometric finger print reader. Once the user enters the library main door, he utilizes his smartphone which contains the NFC chip and also he uses his fingerprint to authenticate himself to get into the library

The user places his NFC enabled phone over the NFC reader placed at the entrance of the library. This relays the user's information to the library database. If the user ID and the fingerprint match, the user is granted permission to the library's local area network. Now the user can access the library's OPAC and also his personal account which contains information about the user's transactions.
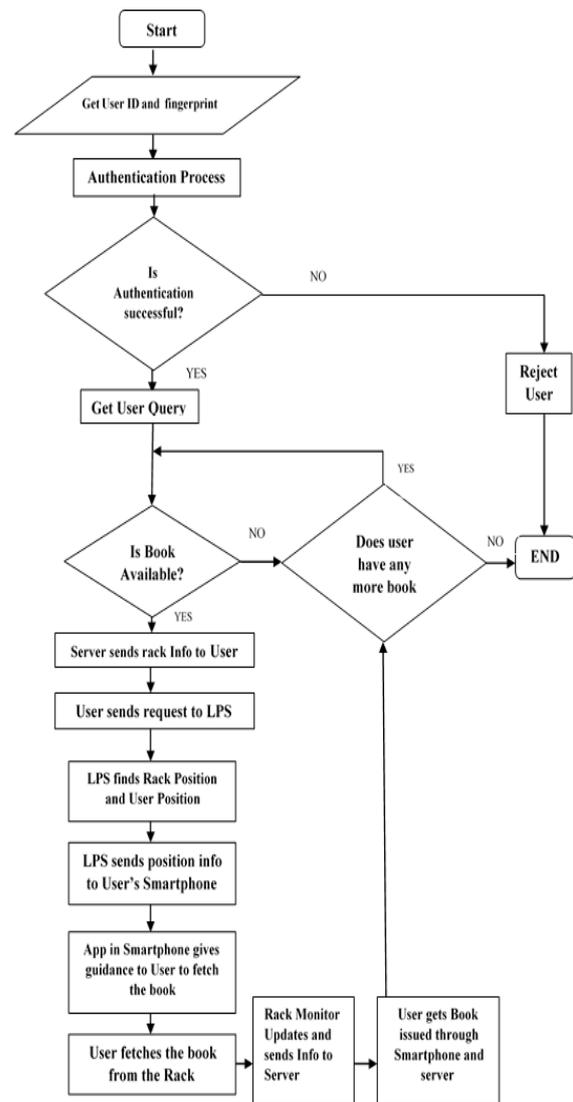

Figure 1. Proposed IoT based Smart Library System

The following steps represent the method to show how the user can get the rack position using IoT in SLS.

- Biometric finger print authentication for user physical entry into the Library.

- User device authentication is done by using user credentials like username, password and device IMEI (International Mobile Equipment Identity) number.

- User queries for a particular book to the library server.

- Server checks whether the requested book is available or not.

- If the book is available, then server sends reply with rack details of the book to the user. If the book is not available, then it asks the user to query for some other book.

- User sends the request with rack details of the book to LPS to get the location details of the rack in the library and his own position.

- LPS sends location details to the user about the current location of the user and the rack position in the library. Current location of the user is identified from signals from the user's smartphone.

- The user follows the instructions provided by an application and reaches the rack.

- Rack monitors send the book location updates to the library server when the book is removed from the rack.

LPS updates the library server about the rack location. It happens when the rack is migrated from one place to other; rack is removed from the library or a new rack is added to the library

The flow diagram shown in Figure 2 explains the functioning of the proposed smart library system.book that he is searching for, in his smartphone. Once the user queries for the book, the smartphone communicates with the library's database and searches for the book. If the book is present a reply is sent to the user with the coordinates of the book's current position which is explained in the following section. If the book is not present a negative reply is relayed to the user.

B. Locating the Book

An NFC tag is embedded in each of the library books. Each rack in the library is provided with a device known as the Rack Monitor. This contains a NFC reader and is connected to the library's WLAN. The Rack Monitor is capable of communicating with the library's WLAN. When a book is placed in a rack it is tapped on the rack, monitor before it is placed on the rack. When such an action is done, the rack monitor reads the information about the book through the NFC tag embedded in the book. Once it reads the book's information, it updates details about the book in the library's database. The database has separate tables for each of the Rack Monitors. Thus, when a book is placed in a particular rack, the information gets updated in the concerned table.

When the user queries for a book, the database identifies the rack as each rack has a separate table. Once the rack is found, the rack information is communicated to the user. Also by using a triangulation based local positioning system, the user's coordinates and the rack's coordinates are found and an application guides the user to the absolute position of the book. The Navizon Indoor Triangulation System (ITS) [9] is one such positioning system that can identify the position of wireless devices such as smartphones with high accuracy. Thus when the position of the user is found using a Local Positioning System, it can be used to calculate the user's proximity to the rack. This information is utilized by an application in his smartphone which guides the user to the rack. The above procedure is provided in steps in the section 3.1 along with the pictorial representation shown in figure 1.

C. Issue and Return

After the book is found, it is issued after checking for the eligibility of the user to borrow books. Each user has a separate profile and all the information regarding the users' transactions are maintained in the library server. Once the book is issued, it can be taken out of the library. NFC scanners are present at the entrance and exit of the library. If an unissued book is taken out an alarm is raised. The return of the books is similar to the return procedure in the previous systems except that the user drops the book in the return box which has an NFC reader and thus the book is automatically removed from his list of borrowed books and there is no need of a librarian to monitor the return of the books. The fines and dues are automatically calculated and the payment can be paid from the smartphone itself.

IV. MERITS OF THE PROPOSED SYSTEM

The main focus of this work is to efficiently aid the user and the librarian. This work differs from its predecessors in a way that it helps the user to locate the books through a local positioning system. Also it provides the user an easier access to the library catalogue and the issue and return of books through his smartphone. The augmented reality based library system proposed in [4] employs complex image processing algorithms like segmentation and is also time consuming. Though our system takes a little toil for the initial setup, once established it would be a great experience for every library user especially in locating books in very large library systems and would save a lot of time. No matter whatever location and position in which the book is placed, the proposed system would successfully locate the book without taxing the patience of the user.

V. CONCLUSION AND FUTURE DIRECTIONS

With the development of the new generations of internet and with millions of devices getting connected to the internet every day, the IoT is definitely a promising technology for the future. In this paper, we have exploited IoT and mobile technologies for easy and efficient library management. The major goal of this proposed work is to reduce the burden of the library user to track a book and to fetch it from its location. Here we have used the local positioning system and embedded tags on the book to communicate with each other and with the user's smartphone. With much ease, the user can

interact with the library server to check whether the book is available and if available to locate it right to its position.

Future work might correspond to locating the book more accurately. For example, the proposed work leads the user only to the rack where the book is present. Work can be carried out in locating the book within the rack. This might use techniques like NFC reader based book identification and so on. Also there is scope for progress in the security aspects of the above proposed system. More complex and efficient security measures can be implemented to ensure safe transactions in the library.

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We develop a prototype system with different types of Android-based mobile phones and comprehensively experiment with the NTU campus shuttle buses as well as Singapore public buses over a 7-week period. The evaluation results suggest that the proposed system achieves outstanding prediction accuracy compared with those bus operator initiated and GPS supported solutions. AN IOT BASED SECURED SMART LIBRARY Management system. They have proposed a system AN IOT BASED SECURED SMART LIBRARY SYSTEM WITH NFC BASED BOOK TRACKING A.Documents. IoT SMART BUS WITH LoRaTechnology. Iot based livestock herd movement tracking systemPresentations & Public Speaking. With IoT based systems, the data will be well organized and easier to sort making it easier for decision making. Knowing who came in late and who worked overtime, you will have everything organized and will not have anything running out of time. 4. Increased security and confidentiality. Although many speak about the disadvantages of using an IoT based attendance system, the advantages it offers by saving your time and energy cannot be ignored. The concept of IoT revolves around connecting devices and physical objects to the internet so they can communicate with other similar objects without human intervention. The smartphone cannot be called smart if it isn't connected to the internet. NFC (Near Field Communication). - Communication technology based on radio waves at 13.56 MHz frequency. - Short range (<= 10 cm theoretical, 1-4 cm typical). - Low speed (106 / 216 / 414 kbps) => 13-50KBytes per sec. NFC Security Locks Android application; application can only be started if a NFC tag with the key is read in. TabPats Real-Time information for Stanford Marguerite bus departures, simply place the phone against the TapPATS badge at the bus stop. (C) Hochschule für Technik Fachhochschule Nordwestschweiz. - Read NFC Book. § Anwendungen und Technik von NFC Josef Langer & Michael Roland Springer, ISBN: 978-3-642-05496-9. (C) Hochschule für Technik Fachhochschule Nordwestschweiz.