Smart Library Using IoT And LPS

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***Abstract*—With the development of the new generation of internet and with millions of devices getting connected to the internet every day, the IoT (Internet of Things) is definitely a promising technology for the future. The major goal of this proposed work is to reduce the burden of the library user in tracking a book and tracing it to its location. Here we have used LPS (Local Positioning System) technology and RFID (Radio Frequency Identification) tags to communicate with system. With great ease, the user can interact with the library server to check whether the book is available and if so, to locate it. The aim and objective of this proposed work is to change the traditional library system into a smart library using IoT and LPS, so that it will be more efficient, and it would be easier for a user to borrow a book and return it to the library. Libraries are areas in which the application of IoT has not yet made its mark. Our motive is to develop "Smart library using IoT" which would prove to be a good replacement to the existing library system since it possesses facilities to issue, return and even locate the book. This work differs from its predecessors in the 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 for borrowing and returning books.**

***Keywords*— IoT, LPS, RFID.**

I. INTRODUCTION

As the world becomes more connected through the communication devices we use, as well as the common household items and systems that theoretically make our lives less stressful, there is an increased acknowledgement that this interconnected environment has entered the next phase of potential unlimited possibilities through what is commonly referred to as the Internet of Things (IoT). In the existing library system the manual labour required while issuing a book from library and the hassle it takes to search for the required book is the major drawback. In a library, books are arranged in shelves based on their classification of subject. Still it is time consuming to search for the required book. Sometimes we might spend hours searching for it and in the end it turns out that the particular book we've been searching for is unavailable. This results in loss of time and energy. There is a lot of movement of these books in and out of the library and so there is possibility that these books might 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. The traditional library comprises of librarians who issue user the book when a user needs it ,And this process has many loop holes as the librarian can make faults while issuing, its time consuming to wait, and since all the exchanging information is written on paper it might get torn, lost or tampered. And there is no backup about these transactions. Hence, it is not a reliable process, near about similar problems are recorded while returning the book. Managing the collection of dues is also a mess as the librarian use coupons to collect dues so it becomes difficult to manage and keep the track of the overall due collected. The aim and objective of this project is to level up the traditional library system into a smart library using IoT (Internet of Things) and LPS (Local Positioning System). So including this advancement in our traditional system it will make it more efficient and easy for a user to locate the book, issue the book and return it back. Since, the technology is so advanced, alerting, notifications, shortest distance to reach the book and additional features can also be added to our proposed system to make it more user friendly and easy to use.

This paper is organized as follows. In section 2, we present the existing system for managing library available in the literature [1]. Section 3 elaborates the proposed System which is IoT and LPS based "Smart Library System" and its architecture. Section 4 presents the flowchart of the proposed system over the existing library management systems. Section 5 presents how the implementation of the proposed system. Section 6 presents the merits of the proposed system.

II. LITERATURE REVIEW

The term Internet of Things (IOT) has been around for quite a few years. In this scenario, it is gaining ground with the evolution of advanced wireless technology. The basic idea of this concept is the presence of a variety of objects – such as RFID, NFC, sensors, actuators, mobile phones. Different technologies in market like RFID, machine to machine communication, vehicle to vehicle communication etc are implemented using IOT [5].

NFC is an acronym for "Near Field Communication". Near-field communication is a short range, high frequency, wireless technology that enables two electronic devices, one of which is usually a portable device such as a Smartphone, to establish communication by bringing them within 10 cm of each other. NFC is used for sharing contacts, photos, videos or files. NFC-enabled devices can act as electronic identity, documents and key cards [Wikipedia]. Although it is readily available in many of the smart phone devices, Applying NFC tags to all the books in the library will be an expensive affair. The proposed system in paper [6] is based on the NFC technology where NFC tags are embedded on the books and on the user cards and NFC readers are used to read these tags for proper, efficient and theft controlled operation of libraries. The use of NFC tags in library is such, where every student will be given a library card which will have an embedded NFC tag in it. This card will contain all the information of the card holder. A major difficulty in the present NFC based library system is that NFC technology finds its application only in the issuing and returning part of the library system. Hence to get over the drawbacks of using NFC technology RFID based library system has been proposed in paper [2].

RFID is an acronym for "Radio-Frequency Identification" and refers to a technology whereby digital data encoded in RFID tags or smart labels are captured by a reader via radio waves. RFID is similar to bar-coding in that data from a tag or label are captured by a device that stores the data in a database. In IoT technology the RFID is the most important concept and it is necessary for internet of things. Before RFID technology entered this domain barcode based system was used where each book had a unique barcode. The barcode was used to uniquely identify the book and contained very limited information about the book also it gave very limited functionalities with respect to the set up it required. Irrespective of its limitations it is still used in few libraries. A new advancement had been implemented in paper [2] where RFID has been used to automate the library system and has many advantages over a traditional library system or the system which uses barcode for recognition of individual book. It was difficult for librarian to manage the trading of books in these systems. Introduction of RFID has improved the processes involved in issuing and returning of books. The present system does not provide any assistance to the user to track the book right to its rack. RFID can be used in library anti-theft systems. Though barcode or RFID based library management system has emerged successfully in the recent past, it has its own limitations. The privileges can be enhanced and that is our proposed work. After finding the book, user needs to scan his/her ID and they will be able to issue the book on their card. Therefore, there is no need to stand in long queue for issuing a book and librarian's work gets saved. This system helps in identifying the right book and for issuing and returning purpose. Advancement can be made to locate the book right to the shelf using a triangulation Wi-Fi based local positioning system as mentioned in the paper [2].

Wireless Fidelity (Wi-Fi) is a networking technology that allows computers and other devices to communicate over a wireless signal. Wi-Fi or WiFi is a technology for wireless local area networking with devices based on the IEEE 802.11 standards [5]. In their system, authentication is done using biometric fingerprints which increases the security and is also a reliable technology to validate the users. 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 [2].

In our proposed system the database is stored on GCP cloud. The Navizon Indoor Triangulation System (ITS) [7] is one such positioning system that can identify the position of wireless devices such as smart phones 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.

In one of paper [8] their work, a beacon is linked with a book in the library which provides the basic information of the book to a reader/library user without even picking up the book. An app is developed which enables user to get information about the book using their devices. Estimote Bluetooth beacons and Android phones are used for their experimentations. we will be using similar technology for our work, not on books but for indoor positioning and locating the rack where the required book is placed. In paper [4], augmented Reality is used to guide the user to the specified location of the book. This update of using augmented reality helps lost users to navigate to the required book. Our proposed system will use some fragments of all the mentioned technologies to make a customized smart library for our new smart generation. The process flow of the system is shown in Figure 1 with the help of an activity diagram.

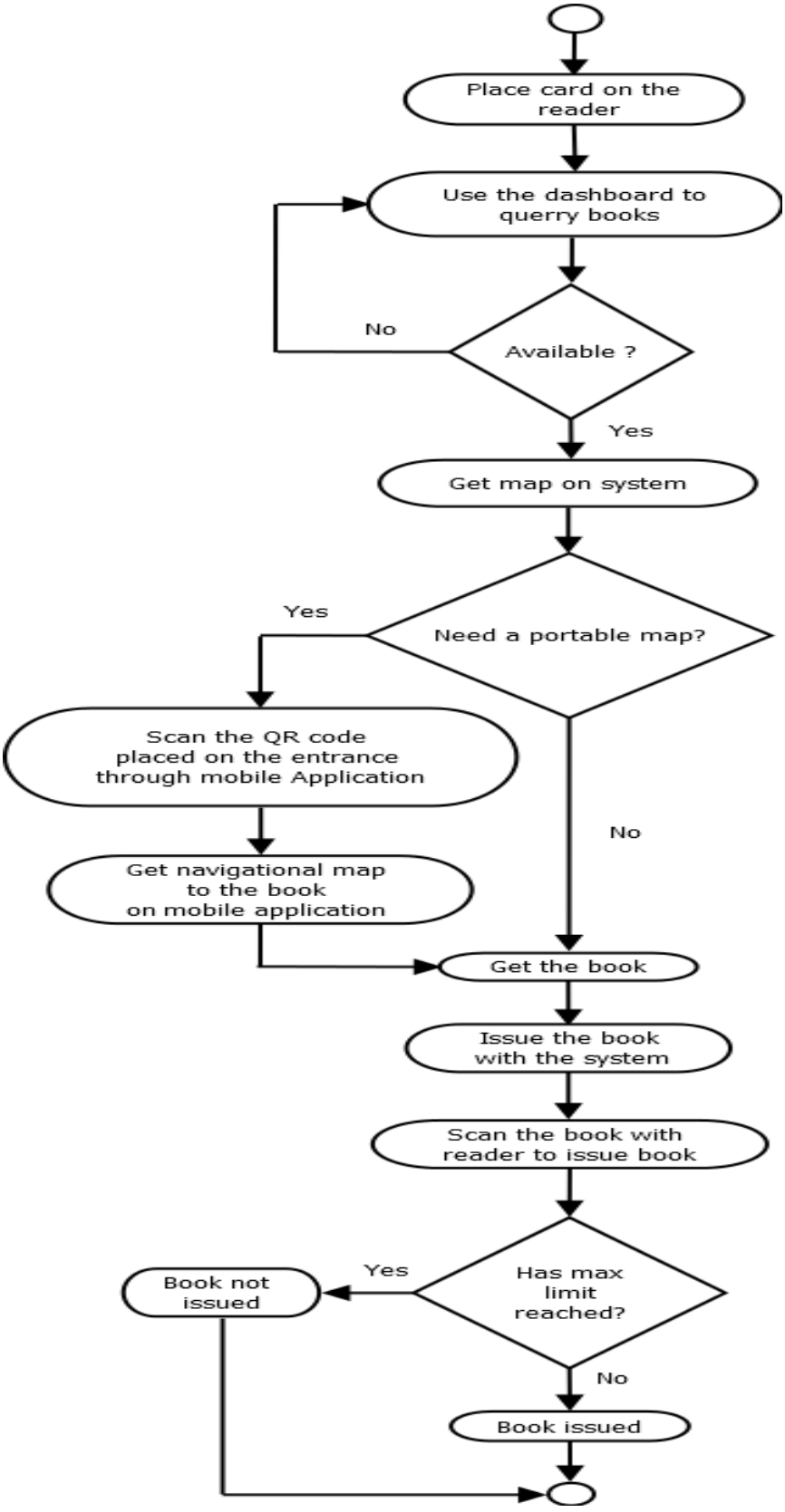

Figure. 1: Activity Diagram.

III. DESIGN AND IMPLEMENTATION

A. Selection of Component

1) *HARDWARE REQUIREMENTS:*

1. Intel processor IV and above 2.
2. 2 GB RAM
3. 160 GB hard disk
4. RFID tag
5. RFID card
6. RFID reader
7. Android Smart phone

2) *SOFTWARE REQUIREMENTS:*

1. Windows XP, Windows 7(ultimate & enterprise) Windows Enterprise
2. Visual studio 2017
3. SQL Server2014
4. Android studio
5. Mapwize SDK
6. Navisens "motionDNA" SDK

B. Methodology

1) Authentication:

The user places his RFID card over the card reader placed at the entrance of the library. This displays the user's information from the library database. It is not required for the user to put his credentials and password for verification. The user can access his personal account which contains information about the transactions. On successful authentication the user's information will be appeared on the dashboard. The dashboard will have different tabs such as personal information, search books, issue and return book. As shown in Figure 2.

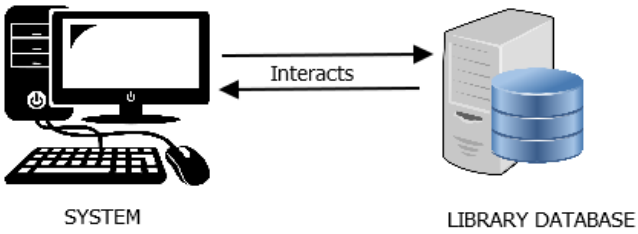

Figure. 1 : Dashboard after authentication.

2) Locating the book:

User queries for a particular book to the library server. Server checks whether the requested book is available or not. If the book is not available, then it asks the user to query for some other book. If the book is available, then it is shown on the screen of computer. When user wants to locate the book he/she can click on the "Get Map" button on the dashboard which will generate the QR code. As shown in figure 3. Mapwize SDK is used to develop an android portable application for getting the indoor map of library and tracing its live location while traversing. On scanning the QR code on their mobile application, the application will register its current position with respect to the destination and will guide along the path to reach its destination. The user follows the instructions provided by an application and reaches the rack.

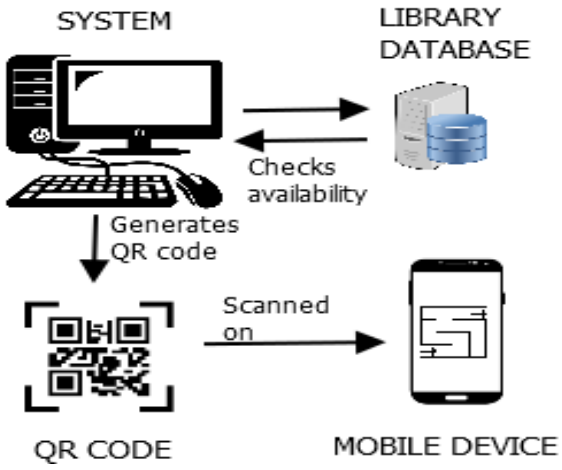

Figure 3 : Locating the book on mobile device.

3) Issuing and Returning of book

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 user's transactions are maintained in the library database. While issuing the required book the user has to place the book on the RFID reader with its own RFID card to register the book on its card. As shown in figure 4. A user can at the most borrow two books. While returning the book similar process is followed which ultimately removes the book from his list of borrowed books and there is no need of a librarian to monitor the process. The fines and dues are automatically calculated by the system and the user is prompted of the same. Once the book is issued, it can be taken out of the library. RFID scanners are present at the entrance and exit of the library. If an unissued book is taken out an alarm is raised.

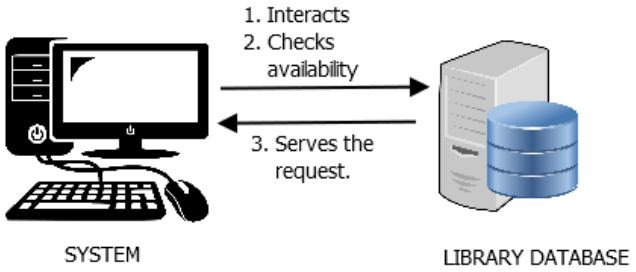

Figure 4 : Issuing and returning of book

C. Implementation

The implementation starts with the creation of database. We created a relational database using MySQL 2014. Here we have used the LPS (Local Positioning System) and RFID tags on the book to communicate with each other and with the system. Every user will be provided with a RFID card. A RFID Card is a device integrated with a RFID tag and also having memory capacity in it. A card reader is needed to read the information from card on having a physical contact with the card. In our proposed system, the card is used as authentication for users. With great ease, the user is validated as they do not need to put their ID and Password in order to login. When the card reader successfully reads the card the computer will display a dashboard. We have used visual studio 2017 to develop the desktop application using C# language. The dashboard will have different tabs in it. The different tabs in dashboard will be personal Information, search Books, issue book and return book. In the Personal information tab, user's personal information such as branch, semester and year will be displayed. User can search the book he wants in the "search books" tab on the dashboard. User can search for book either with the books name or author's name. When a user searches for a book and if it is

available, it will be shown on the dashboard. A triangulated network will be available to trace the location of book with respect to the user's location. It will be connected to an android app which will be deployed to the users. The android application has been developed on android studio using SDK (Software development kit) of Mapwize and Navisens. SDK of Navisens helps in live navigation without GPS, by using the accelerometer and gyroscope data in a unique way which is a built-in sensor on user's phone. The mapwize SDK is the platform to deploy our library map and get the direction from the entrance to the shelf of the book. Each user can communicate with the application to find the location of their book using LPS (Local Positioning System). To get the position of the book in the library the user has to open the application and scan the QR code which is generated on screen through the application. The application will navigate the user through the library to reach its desired destination. While borrowing the book user has to put their RFID card on the reader and scan the book on the same reader, the book will be issued immediately. Similar process is adopted while returning the book. Our aim is to use these highly advanced technologies in all possible manners to give an innovative experience to users.

D. GRAPHICAL USER INTERFACE (GUI)

The snapshots of GUI have been divided in 3 categories:

1) User Interface

Figure 5: Logged in for User.

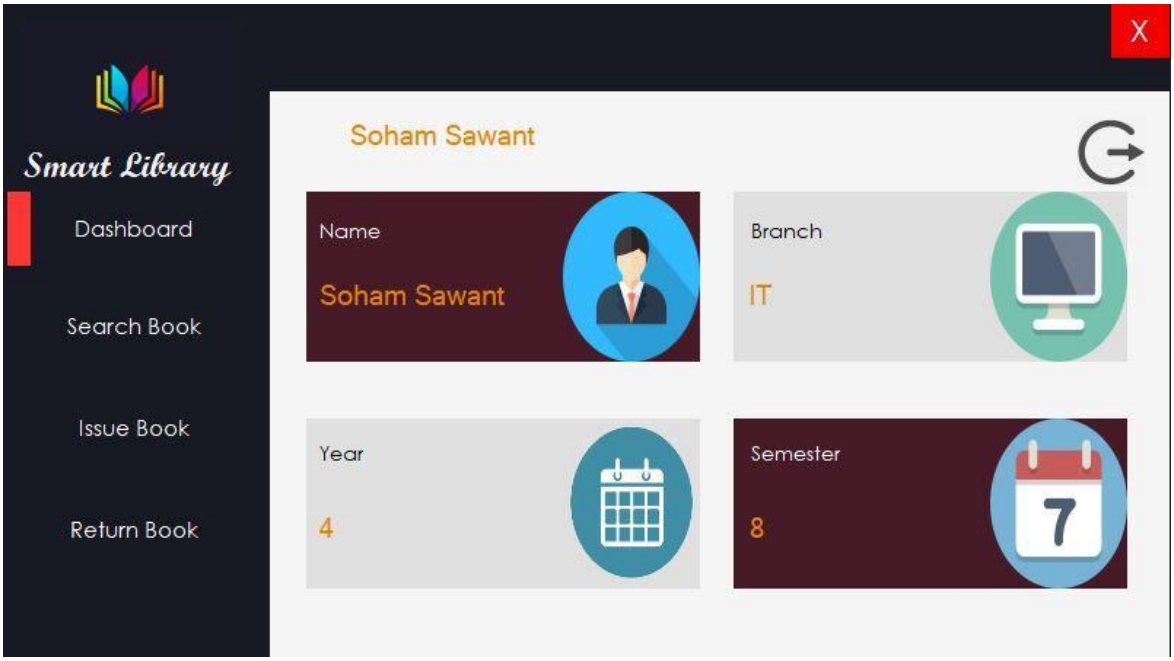

Figure 6: Dashboard for user.

Figure 7: QR Code for map after searching.

2) Map Interface

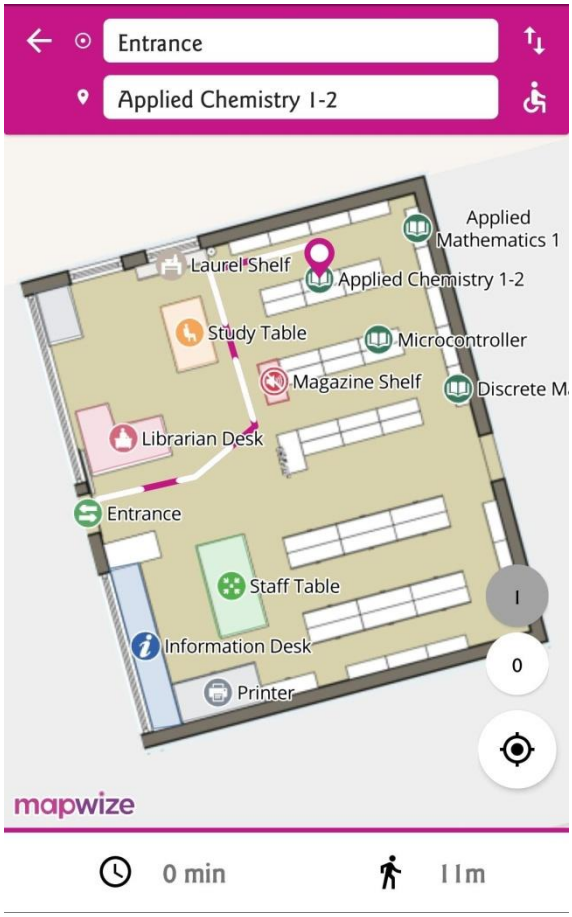

Figure. 8: Map developed from entrance to destination on Android application.

3) Database

Host: 35.185.187.39 | Database: smartlibrary | Table: user | Data | Query

smartlibrary.user: 6 rows total (approximately) Next Show all

user_id	user_sem	user_name	user_year	user_branch	user_book1	user_book2	user_fine
0010700598	8	Siddhesh	4	IT	0	0	(NULL)
0007875599	8	Sana Syed	4	IT	0	0	(NULL)
0010677872	8	Soham Sawant	4	IT	0	0	(NULL)
0000000011	8	Ganesh Walavalkar	4	IT	0	0	(NULL)
0009698511	8	Nidhi Nayak	4	IT	0	0	(NULL)
0009710896	8	Shreedhar Prabhu	4	Comps	0	0	(NULL)

Figure. 9: User Table in Database.

Host: 35.185.187.39 | Database: smartlibrary | Table: books | Data | Query

smartlibrary.books: 14 rows total (approximately) — Next | Show all | Sorting (1) | Columns (11/11) | Filter

book_name	book_id	book_author	book_sem	book_year	book_available	dept_id	user_id	issue_date	return_date	qrcode
Engineering Drawing	001	M. D. Dayal	1	4	0	(NULL)	0	(NULL)	(NULL)	(NULL)
C Programming	004	Unknown	1	3	0	3	0	(NULL)	(NULL)	(NULL)
Applied Mathematics 2	002	G. V. Kumbojkar	2	2	0	(NULL)	0	(NULL)	(NULL)	(NULL)
Applied Mathematics 3	003	G. V. Kumbojka	3	3	0	(NULL)	0	(NULL)	(NULL)	(NULL)
Applied Mathematics 4	006	G. V. Kumbojka	4	4	0	(NULL)	0	(NULL)	(NULL)	(NULL)
Engineering Chemistry	009	S.S Dara	2	2	0	6	0	(NULL)	(NULL)	(NULL)
Wireless Commuinication	110	Unknown	7	3	0	(NULL)	0	(NULL)	(NULL)	(NULL)
Microprocessors	112	xyz	3	3	0	(NULL)	0	(NULL)	(NULL)	(NULL)
EVS	0001551006	pqr	1	1	0	13	0	(NULL)	(NULL)	(NULL)
Computer Organisation	115	lmn	2	2	0	(NULL)	0	(NULL)	(NULL)	(NULL)
Engineering Mechanics	0001522674	M. D. Dayaal	1	4	0	1	0	0	(NULL)	(NULL)
Applied Mathematics 1	0001502840	G. V. Kumbojkar	1	1	0	8	0	0	(NULL)	(NULL)
Applied Physics 1-2	0001512848	S.L Arora	2	2	0	4	0	0	0	(NULL)
Applied Chemistry 1-2	0003925717	S.S Dara	2	2	0	5	0	0	0	(NULL)

Figure. 10: Books Table in Database.

IV. FUTURE WORK AND CONCLUSION

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. Proposed system gives the ability to locate the book and it provides ease for issuing and returning of the books. In time, improvements could be made in the system to locate books more easily. For example, the proposed work leads the user only to the rack where the book is present. The improvement would enable a person to also find the exact place of the book on the shelf. Also, suppose the book is placed in the wrong location the new system can help to locate that book in the whole library. There is also scope for progress in the security aspects of the above proposed system. More complex and efficient security measures can be implemented to ensure safe procedures in the library. Also easier payment of dues and notifications for returning of books can be included in the advanced system. Many technologies such as Augmented Reality, Virtual Reality, Machine learning, and Artificial Intelligence can find its application in library domain.

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