

Implementation and Impact of RFID in Library Management Systems

Joyson Mascarenhas^{1,*}, Bhausaheb Eknath Shinde²

Abstract

This system relies on UHF RFID scanners at the gate and transaction section, which are supported by antennas and RFID transceivers embedded in library cards. These devices allow information to be electronically stored and read/written using radio waves without the need for physical interaction. It does not require manual input and instantly sends information about books and library users to the library's management system. It has a record-keeping and search system as well. The recorded module will track every book that passes through the gates in real time, allowing librarians to simply track down and notify anyone who takes a book off the rack without authorization. With the use of an RFID reader, the search module will enable quick book searches. For identification purposes, students will be scanning their ID cards directly. Only those with valid identification are permitted entry into the library. If a librarian is not present, the user can issue or return books immediately after being identified. Information is recorded and transferred to a cloud database whenever a student issues or returns a book. Thus, if a student lends out a book, it is put to his account; if he returns a book, it gets taken out of his name. The library will profit immediately and over time from increased transaction flow, traceability, and security thanks to the library management system.

Keywords: Library Automation, RFID Technology, Automation system, Atmega 328P microcontroller, UHF RFID.

INTRODUCTION

The process of managing books in libraries is incredibly intricate and time-consuming. Anybody in the library, including teachers and students, has the ability to move books around. The librarian is responsible for database maintenance under this suggested approach. After presenting their ID, individuals can access their accounts. If the user does not display the book ID after taking the book, the user account will be prohibited in the primary databases. Information on books issued and their due dates is available to the user. The fine will be immediately updated in the databases if the return deadline is extended. A user's account may be blocked if they are losing books. Only blocked accounts can be released by the librarian. Only blocked accounts can be released by the librarian. The user doesn't need

the librarian's assistance to obtain the book. Issues of various kinds have arisen in the library system. The problem lies in the fact that the books were stolen and improperly replaced in the same location. Books are easily stolen, and it was more difficult to keep book details updated in the database. Additionally, the librarian finds it extremely difficult to replace the books in their right locations. Books are misplaced and may even become lost as a result of this. The librarian is unable to oversee the library as a result. These problems arose with the library administration system. The RFID technology offers an efficient means of gathering, organizing, and distributing the books. Selecting the

*Author for Correspondence

Joyson Mascarenhas

E-mail: mascarenhasjoyson@gmail.com

¹Student, Department of Electronics and Telecommunication Engineering, Dhole Patil College of Engineering, Pune, India

²Professor, Department of Electronics and Telecommunication Engineering, Dhole Patil College of Engineering, Pune, India

Received Date: October 17, 2023

Accepted Date: December 22, 2023

Published Date: February 10, 2024

Citation: Joyson Mascarenhas, Bhausaheb Eknath Shinde. Implementation and Impact of RFID in Library Management Systems. International Journal of Solid State Innovations & Research. 2023; 1(1): 20–25p.

kind of RFID reader and tag to be used for library automation is the first step. The signal must then be received by a tag, which must then alter it to match the information on the card and provide the updated response back to the reader. Secondly, the tags inside the book are bound with a unique ID.

Radio Frequency Identification

The wireless non-contact technology known as Radio Frequency Identification (RFID) transfers data from a tag affixed to an object for automatic identification and tracking using radio-frequency waves. Radio Frequency Identification (RFID) is a wireless non-contact system that tracks and identifies objects automatically. It works by using radiofrequency to transport data from a tag affixed to an object. Within the library, the Motorola MC9090 RFID reader is utilized for all procedures. Each and every user receives an RFID tag upon delivery. RFID technology is a new field that is gaining tremendous traction, offering convenience and productivity benefits. Without a doubt, it plays a crucial role in our daily lives because we use it for a variety of purposes in places like traffic, shopping centers, libraries, and industries. Thus far, this technique has been effectively deployed globally. However, due to a lack of awareness and financial constraints, India is still in the observation level, particularly with regard to university and educational institution library management. The administration of books in libraries is an extremely intricate and time-consuming process. The librarian, students, teachers, and everyone else in the library have the ability to move the books around. As a result, finding a book in a large library is not simple. An essential piece of technology for customer service and storage management is indoor positioning. RFID offers a reliable wireless platform that makes indoor positioning easier.

LITERATURE SURVEY

Fennani et al. [1] provided an economical and high-quality service solution for implementing RFID technology in academic libraries. Song Qiao et al. [2] combine L-GEM based RBFNN with image matching to improve the book finding system's resilience and accuracy. Srujana et al. [3] build an RFID-based library management system.

RFID technology was used with an internet-based concept to create an internet-based application for library management by Renold et al. [4] Polycarpou et al. [5] developed an intelligent Library Management System (LMS) based on Radio Frequency Identification (RFID). In order to meet user demands and accommodate all required library capabilities, a Graphical User Interface (GUI) was thoughtfully built. A variety of shelf antenna designs were created with the goal of providing library patrons with 100% tag readability in a low-SAR situation. Different kinds of near-field shelf antennas were used in the construction and testing of prototype smart cabinets to ensure limited coverage in the area surrounding the shelf and prevent undesired identification of books stored at adjoining shelves. Microsoft Visual Basic.Net was used by Abdullah et al. [6] to construct the system's graphical user interface. The GUI's job is to enter the book's specific data into the database. To evaluate the effectiveness of the RFID library system at a university library, Golding et al. [7] looked at several variables, including tag location, read rate, reading distance, reader orientation sensitivity, and metal and electromagnetic interference.

BLOCK DIAGRAM AND WORKING:

When a RFID reader detects a RFID card at the door, the door opens by the operation of stepper motor. Comparator compares the present value with predefined values and determines whether the lights and fans should be switched on. LDR senses the presence of a person and switches on the lights. Depending on the temperature condition the fans will be switched on. Wi-Fi Module is used to transmit and receive information to and from the rack side. The required information is displayed on the LCD [8, 9]. The required code words for books are given with the help of keypad. Buzzer is used as an alarm whenever somebody tries to take a magazine/reference book out of the library. The maximum operating voltage of microcontroller is 5V, since the operating voltages of stepper motor, buzzer, lights and fans are more, a driver IC in between these and the microcontroller.

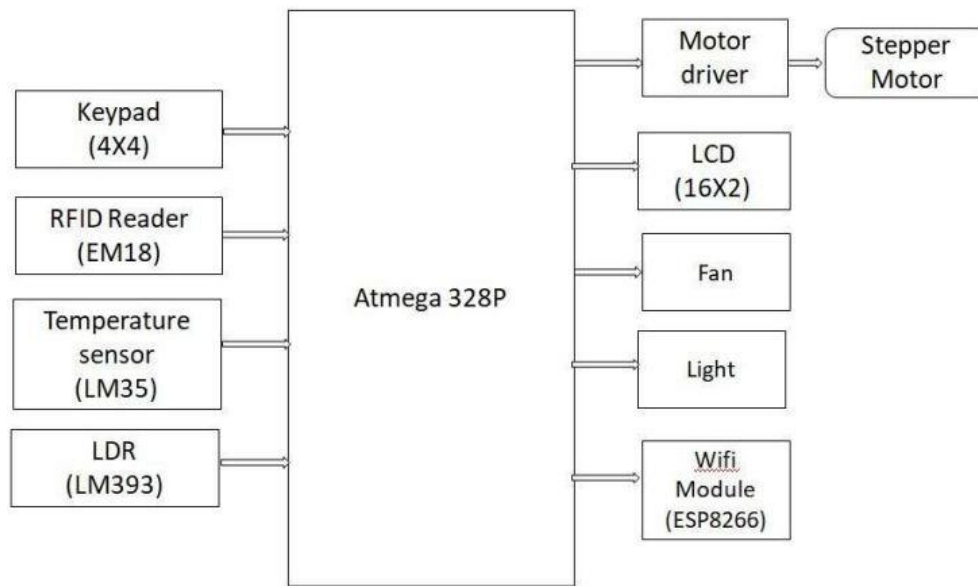


Figure 1. Block diagram of Entry Section.

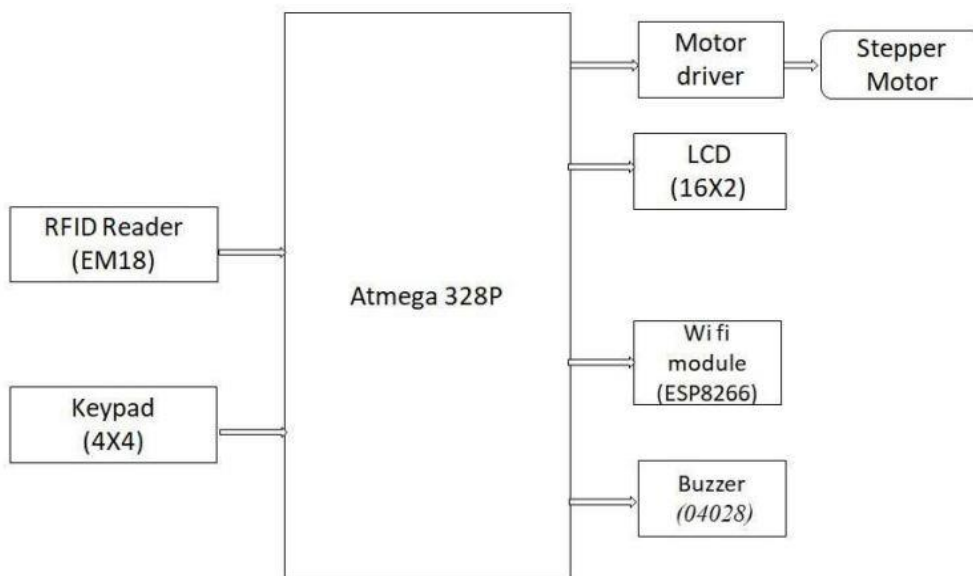


Figure 2. Block diagram of Library Section.

RFID reader is used to verify the user's while issuing and return of books. Stepper motor is attached to all the racks for automatic opening and closing of racks. Buzzer is used to alert when a wrong book is showed to the reader at the time of return. User enters the library(Block diagram of Entry Section and Library Section is shown in Figures 1 and 2 respectively).

Lights and fans will be switched on automatically depending on the surrounding conditions. A new method for integrating RFID technology is introduced in academic libraries by cost effectiveness and good quality of service is presented in this paper. Then, we check the hardware problems which includes optimization by minimizing the total number of used devices for avoiding collision between them and capturing all tags. Then the use of a modular and basic programming method that enables reusing some software parts in several applications and offering flexibility to a large extent by introducing new equipment's like readers and sensors allowing for the use of devices from changed suppliers are the main challenges for designing RFID [9, 11].

User has to press ENTER key to know the information about the books available. The information is displayed on the LCD and he/she is asked to press the code of required book. This information is transmitted to rack side using Wi-Fi. The corresponding rack door opens and the user takes the book. This information that the book is issued to the user is transmitted to door side using Wi-Fi. The LCD at the door side displays the updated information.

FLOWCHART

The Motorola MC9090 RFID reader is utilized for every step of the process inside the library. This reader is suitable and able to read tags with frequencies of all kinds, including low, high, and ultra-high. Each user is given an RFID tag, and each book has its own unique EPC (Electronic Product Code), which is generated in relation to the database for further information [10]. The Internet of Things architectural layer aids in the development of internet concepts. The notion of keeping an eye on and perceiving the library's surroundings from a distance, as well as recognizing the items books, CDs, and other materials that are housed within for convenient access was found to be the most prevalent problem. The Flowchart of Entry Section and Library Section is shown in Figures 3 and 4 respectively.

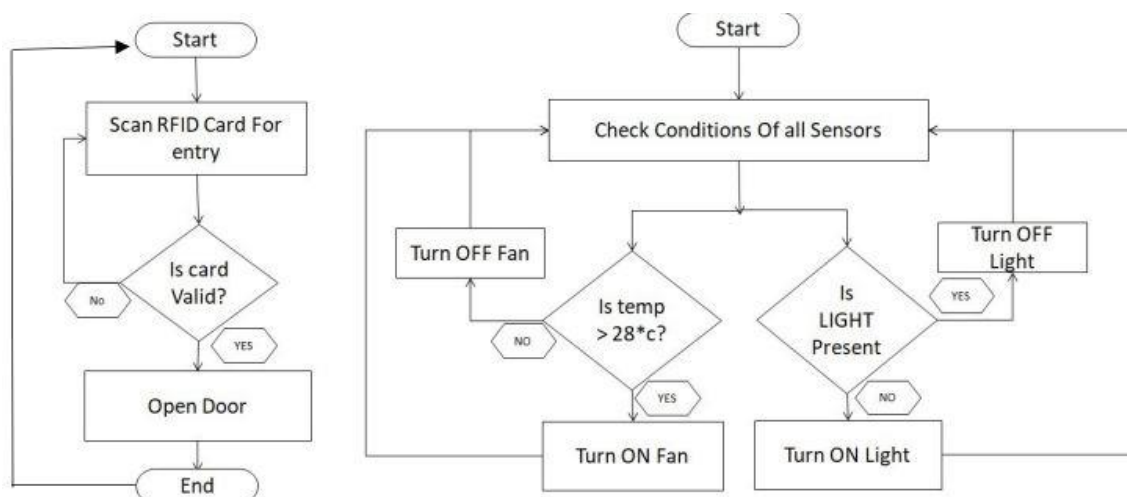


Figure 3. Flow chart of entry Section.

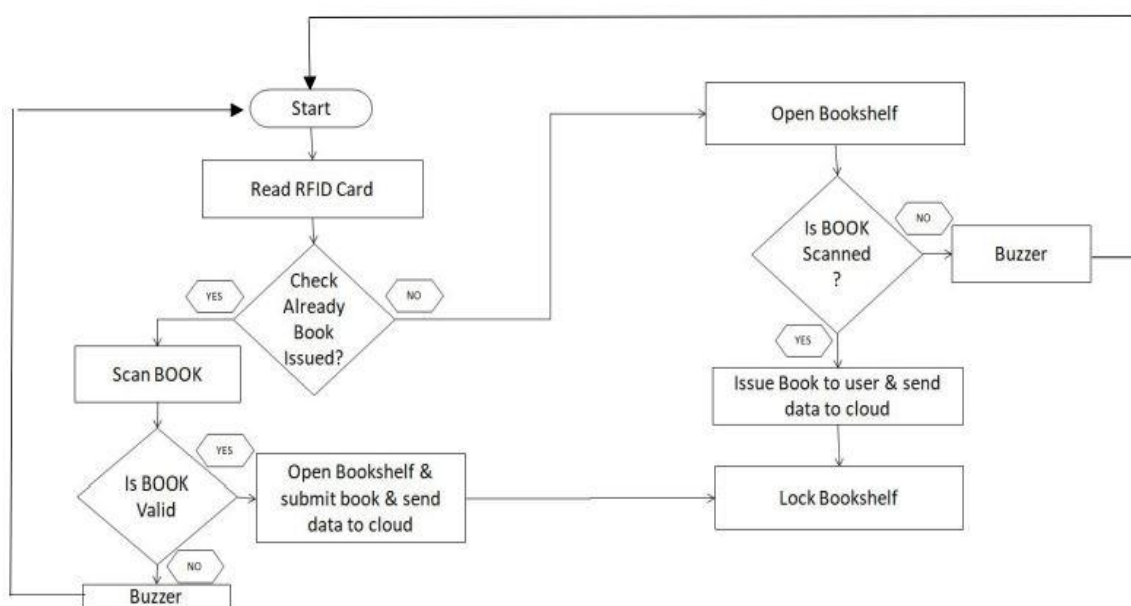


Figure 4. Flow Chart of Library Section.

COMPONENTS AND IT'S SPECIFICATIONS

Components required to build the library management systems with their specifications are shown in the Table 1.

Table 1. Components and its specification.

Components	Specifications
AT mega 328P Microcontroller	8-bit AVR RISC, 32KB, Operating Voltage: 1.8V to 5.5V, 28-pin DIP, QFN, or TQFP,
RFID Reader RS232	Read distance 10cm, Operating frequency 125 kHz, Operating Voltage 5v
LCD 16x2 Display	Display Size: 16 characters x 2 lines, Character Size: 5x8 pixels, Operating Temperature: Typically -20°C to +70°C
ESP 8266 Wi-Fi module	L106 32-bit RISC, 32 KiB, UART on dedicated pins
LM 35 Sensor	Temperature Range: -55°C to +150°C, Sensitivity: 10 mV/°C

ADVANTAGES AND APPLICATIONS

Advantages

1. Makes work simple.
2. Can lead to smart system development.
3. Save time and human work.

This article addressed the challenges and problems in the library environment, such as misplaced or incorrectly shelved books, by monitoring and sensing the library environment from a location to identify the materials, books, CDs, etc. As a result, less physical labor and comfortable book access are completed, and a strategy to address these issues through better, more productive work is devised. This article describes an intelligent Library Management System (LMS) that was created for the university library using Radio Frequency Identification (RFID), a Graphical User Interface (GUI) with support for library features as well. Different kinds of near-field shelf antennas were used to test prototype smart cabinets [8].

Applications

RFID technology enables fast and efficient check-in and check-out processes in libraries. Library users can simply place their items on an RFID-enabled self-checkout station, and the system automatically scans and records the borrowed items without the need for manual barcode scanning.

RFID-based library automation systems allow for real-time inventory management. RFID tags on library materials can be quickly and accurately detected and recorded by RFID readers, providing instant updates on the availability and location of items. This streamlines the inventory process and reduces the time and effort required for shelf checks and item tracking.

RFID technology empowers library users with self-service options. They can independently browse and locate books using RFID-enabled search stations, check the availability of items, and locate them on the library shelves. Self-checkout kiosks with RFID technology enable users to borrow and return items without the assistance of library staff, reducing wait times and increasing user convenience.

RESULT AND CONCLUSION

In conclusion a better and more efficient library can be developed with the existing technology but that should be achieved without causing harm to human beings and the environment. Such a library system would not only be user friendly but also take care of the staff, i.e. with least number of human energy and recourses managing a library system. The effectiveness of the proposed approach will be evaluated by implementing the same.

Acknowledgment

We wish to state that the work embodied in this project titled “Library Automation Using RFID Technology” forms our own contribution to the work carried out under the guidance of Prof. Prachi

Deshpande, at the Dhole Patil College of Engineering. We declare that this written submission represents our ideas in our own words and where others ideas or words have been included, We have adequately cited and substantiated the original sources. We also declare that We've stuck to all principles of academic honesty and integrity and haven't misrepresented, fabricated, or falsified any idea/ data/ fact/ source in our submission.

REFERENCES

1. Fennani, A. and NB; Hamam, H., "An Optimized RFID Based Academic Library", IEEE Second International Conference on Sensor Technologies and Application, pages: 44-48, Aug 2008.
2. Ng, W.W.Y. ; Yi-Song Qiao ; Li Lin ; Hai-Lan Ding, "Intelligent book positioning for library using RFID and book spine matching", IEEE International Conference on Machine Learning and Cybernetics (ICMLC)(Volume:2),pp:465-470, July 2011.
3. C. Srujana, B. Rama Murthy, K.Tanveer Alam, U. Sunitha, Mahammad D.V, P.Thimmaiah, "Development of RFID Based Library Management System using MATLAB", International Journal of Engineering and Advanced Technology (IJEAT),Volume-2, Issue-5, pages:480-483, June 2013
4. A. P. Renold and R. J. Rani, "An internet based RFID library management system," *2013 IEEE Conference on Information & Communication Technologies*, Thuckalay, India, July 2013, pp. 932-936, doi: 10.1109/CICT.2013.6558229.
5. Polycarpou, A.C.; Samaras, T.; Sahalos, J.N., "An RFID based library management system using smart cabinets: A pilot project", IEEE European Conference on Antennas and Propagation (EuCAP), pp: 2954-2955, April 2014.
6. Bin Abdullah, A.T. ; MARA, Shah Alam, Malaysia ; Ismail, I.B. ; Ibrahim, A.B. ; Hakim Bin Noor, M.Z. , "Library shelf management system using RFID technology", IEEE International Conference on System Engineering and Technology (ICSET), pages:215-218, June 2011.
7. Golding, P.; Kingston; Tennant, V., "Work in Progress: Performance and Reliability of Radio Frequency Identification (RFID) Library System", IEEE International Conference on Multimedia and Ubiquitous Engineering (MUE), pages: 1143-1146, April 2007.
8. Narayanan A., Sanjay Singh and Somasekharan M., "Implementing RFID in Library: Methodologies, Advantages and Disadvantages", Scientific Information Resource Division, IGCAR, pp: 271-281.
9. Cheng Feng; Libr. "Research for application of RFID in library", IEEE International Conference on Computer and Communication Technologies in Agriculture Engineering (CCTAE), Volume: 1, pp: 262-264, June 2013.
10. Yusof MK, Saman MY. The adoption and implementation of RFID: a literature survey. LIBRES: Library and Information Science Research Electronic Journal. 2016 Jun 1;26(1):31.
11. Waykar S, Shelar A, Zanjure S, Vibhute S, Singh A. DSS for Library Management System Implementing RFID. International Journal of Scientific & Engineering Research. 2012;3(4).