Graduation project 2022-2023

Computer engineering department

ALMS

(Automotive Library Management System)

Supervised by

Dr. Hadeer Ahmed

Presented by

Mustafa Mahmoud Abd-El-Moneim Mustafa

Esraa Ashraf Ibrahim Mohammed

Nada Ahmed Mostafa Ibrahim

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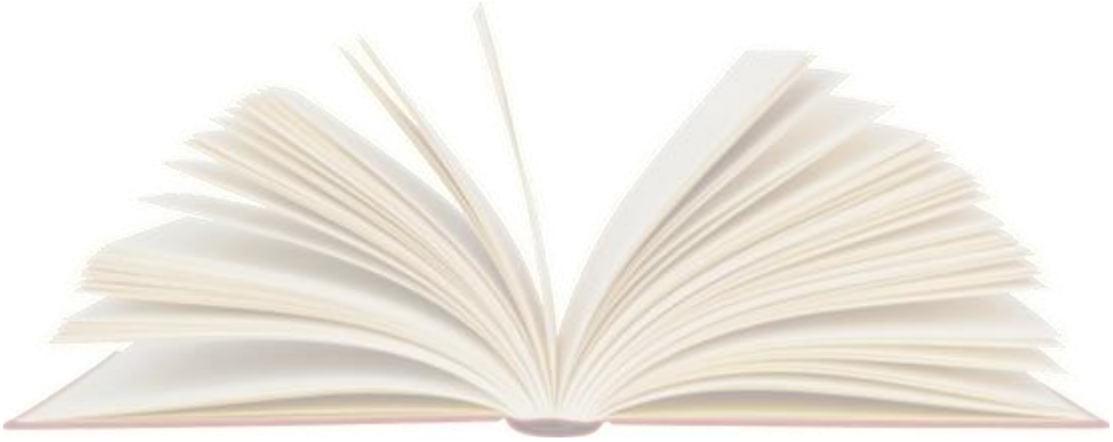
Individual Contributions

Name	Contributions
- Mustafa Mahmoud Abd-El-Moneim	1- Scanning QR code 2- Sequence diagram 3- Requirement analysis 4- Class diagram 5- Attendance with RFID wired 6- Biometric attendance using Finger print 7- Flyer design
- Esraa Ashraf Ibrahim Mohammed	1- Use case diagram 2- Generating QR code 3- Wireless connection between HW and website 4- ERD diagram 5- Poster design 6- Report generating and format 7- Contact us 8- Testing and Validation 9- Gathering information about the problems

- Nada Ahmed Mostafa Ibrahim	1- Front-End 2- Back-End 3- Scanning QR code 4- Report 5- ERD diagram 6- Gathering information about the problems 7- Data base creation 8- Mail Reminder

“R*eading alone is what gives one person more than one life, because it increases this life in depth, although it does not prolong it by the amount of reckoning*.”

Abbas Mahmoud Al-Akkad.



Abstract

Libraries are institutions designed to preserve records, written material, legends, and literature. They preserve the history of time and place as well as the intellectual activity, discoveries, and innovative ideas within a culture. The first libraries of the western world were collections of literature, commentaries, records, and speculations on the way the world worked. Many of these institutions also encouraged scientific investigation, new ideas, and innovative methods of understanding the world.

Libraries were inconceivable until writing was invented between 5,500 and 6,000 years ago in Mesopotamia and Egypt. Other scripts were invented by the Minoans on Crete 5,000 years ago, the Hittites in Anatolia (modern Turkey) about 4,000 years ago, and in China about 3,500 years ago.[1]

Libraries play a great part in enriching knowledge of people around the world, also it provides a good environment for those who seek to learn and study. So, it is a must to develop a technology in that sector which make it easier for readers and librarians to deal with all documentation problems, like borrowing and restoring books, also, storing and checking books manually is a hard mission for librarian to handle, especially with large number of books.

Acknowledgments

We would like to express our sincere gratitude for supporting us throughout our Graduate project. We wish to express our sincere gratitude to our supervisor **Dr. Hadeer Ahmed** for her enthusiasm, patience, insightful comments, helpful information, practical advice, and unceasing ideas that have always helped us tremendously in our project. Her immense knowledge, profound experience, and professional expertise have enabled us to complete this project successfully. Without her support and guidance, this project would not have been possible.

Esraa, Nada, Mustafa.

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Chapter 1: Introduction

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Before discussing library management systems, it might help to talk about systems. A system is something formed of parts, each of which interacts with the other parts to achieve some common purpose. In the case of a library management system, the parts work together to support the management of library information resources: their acquisition, representation and circulation. Each of these parts constitutes a subsystem which in turn comprises a set of interconnected parts. In other words, each of these subsystems can be broken down into yet smaller subsystems, for example, a subsystem to control the catalogue display options.

The collection should be orchestrated for superlative repossession of information and materials. Cataloguing and classification will mirror nationally rectified matters of forms in sync with other academic libraries. Cataloging and classification have been synthesized owing to the fact that these are twin processes that make the certain systematic design of the materials in a library. Conventionally classification guarantees the helpful marshaling of books and documents on the shelves of the library and cataloging, as Charles Ami Cutter" has put it in the following manner:
1. To enable a person to find a book of which either:

a. The author: When a person knows the name of the author of a book they are looking for, they can easily locate it in the library catalogue. The catalogue will list all the books written by that particular author, providing details such as title, edition, publication date, and call number to help the user locate the physical copy or access the electronic version.

b. The title: If the person is aware of the title of the book, they can search for it in the library catalog using the book's exact title or even partial words from the title. The catalog will then present the book's full record, including the author's name, publication details, and other relevant information.

c. The subject is known: When a person is interested in a particular topic or subject, they can search for related books or resources in the library catalog. The catalog will list books that cover the subject, offering various perspectives and materials on the topic of interest.

2. To show what the library has

a. By a given author: When a person wants to explore the works of a specific author, the library catalogue allows them to access a list of all the books written by that author that are available in the library's collection. This feature helps users discover the breadth of an author's works and locate specific titles they may be interested in.

b. On a given subject: If a person is researching a particular subject, the library catalogue enables them to search for books and resources related to that subject. By inputting the desired subject keyword or subject heading, the catalog will present a list of relevant materials available in the library's collection. This allows users to explore various perspectives and sources on the topic of interest.

c. In a given kind of literature: Libraries often have diverse collections that encompass different genres, literary forms, or types of literature, such as fiction, poetry, drama, or non-fiction. The catalogue can provide options to browse or search for specific kinds of literature, enabling users to discover books that align with their preferences or research needs within a particular genre or literary form.

3. To assist in the choice of a book

a. As to its edition (bibliographical): When multiple editions of a book exist, cataloguing provides bibliographic details about each edition. This includes information such as the publication year, publisher, edition number, and any significant variations or updates between editions. By having access to this information, users can determine which edition of a book aligns with their requirements, whether they need the most recent version or a specific edition for a particular purpose.

b. As to its character (literary or topical): Cataloguing also offers insights into the character or nature of a book, helping users assess its literary or topical qualities. This may include information about the genre, literary style, or thematic content of the book. For example, the catalog may indicate if a book is a work of fiction, non-fiction, poetry, biography, or falls into a specific genre such as mystery, science fiction, or history. This information allows users to select books that match their preferences or research interests, ensuring they choose resources that align with their desired reading experience or informational needs.

The conventional schemes of classification have been unreliable, known as “logical absurdly” as advocated by Trevons, and the same has been consented by Shera on the basis that classifications schemes intend to limit the multidimensional knowledge to a unidimensional order, thereby introducing the linear arrangement on the shelves of the library. This, per se, impairs the usage of classification as an efficient way for the arrangement of documents in a library. Thus, we have to rely on the library catalogue which has a better edge on classification, as we can embrace multiple entry systems for a single document and fulfill different and multidimensional modes of the user.

Materials should be cataloged and classified into planned fashion to make them ready as soon as possible after receipt. Materials to be cataloged envelop print, non-print and electronic resources, and remote data bases to which the library subscribes. In the modern era, throughout the globe, we have the following general schemes of classification.

1. Melvil Dewey's Decimal Classification: Dewey's Decimal Classification (DDC) is a widely used library classification system developed by Melvil Dewey in the late 19th century. It organizes library materials into a numerical hierarchy based on subject areas. The DDC system is based on the principle of dividing knowledge into ten main classes, each represented by a specific range of numbers. These classes cover a wide range of subjects, including general knowledge, philosophy, religion, social sciences, natural sciences, technology, arts, literature, history, and geography. Within each main class, further subdivisions are made using decimal notation, allowing for increasingly specific subject classifications. This hierarchical structure enables the efficient and logical arrangement of library materials on shelves, making it easier for users to locate books on specific topics. The DDC system continues to be widely used around the world, providing a standardized method for organizing library collections and facilitating effective information retrieval for library users.

2. Charles Ami Cutter's Expansive Classification: Charles Ami Cutter's Expansive Classification (EC) is a library classification system developed by Charles Ami Cutter, a prominent librarian and cataloguer. EC was designed as an alternative to the Dewey Decimal Classification (DDC) system, with a focus on providing greater flexibility and adaptability for cataloging library materials. Unlike the fixed hierarchical structure of DDC, EC allows for the expansion and modification of classification categories to accommodate new subjects and changing knowledge domains. Cutter emphasized the importance of detailed and specific subject headings to aid in the precise classification and retrieval of materials. EC incorporates a combination of alphabetic and numeric notations to represent subjects,

offering a more flexible approach to classifying diverse collections. Although not as widely adopted as DDC, Cutter's Expansive Classification has influenced subsequent cataloging practices and contributed to the development of more adaptable and user-focused classification systems.

3. Library of Congress Classification: The Library of Congress Classification (LCC) is a widely used library classification system developed by the Library of Congress. LCC provides a comprehensive framework for organizing library materials based on subject areas. It divides knowledge into 21 major classes, each represented by a single letter of the alphabet. These major classes cover a broad range of subjects, including social sciences, natural sciences, language and literature, history, and more. Within each major class, further divisions and subdivisions are made using alphanumeric notation, allowing for increasingly specific subject classifications. LCC incorporates a hierarchical structure that provides a logical arrangement of materials on library shelves, making it easier for users to locate books on particular topics. The system is continuously updated and expanded to accommodate new subjects and developments in knowledge. LCC is widely used in academic and research libraries, particularly in the United States, and is known for its detailed and extensive subject coverage.

4. J. D. Brown's Subject Classification: J.D. Brown's Subject Classification is a library classification system developed by J.D. Brown. It offers an alternative approach to organizing library materials based on subject areas. Brown's classification system focuses on a subject-centered approach, where subjects are assigned main classes and further divided into subclasses. Unlike some other classification systems, Brown's Subject Classification emphasizes the use of common vocabulary and natural language to describe subjects, making it more

user-friendly and accessible. The system aims to provide a more intuitive way for users to navigate and retrieve information from library collections. While not as widely adopted as other classification systems, Brown's Subject Classification offers a unique perspective on the subject organization and provides an alternative option for libraries seeking a different approach to classifying their materials.

5. Universal Decimal Classification: The Universal Decimal Classification (UDC) is a widely used library classification system that provides a comprehensive and flexible approach to organizing library materials. Developed by Paul Otlet and Henri La Fontaine in the late 19th century, the UDC combines decimal notation with a faceted structure. It covers a wide range of subjects and knowledge domains, allowing for precise classification and retrieval of materials. The UDC uses a systematic approach to classify subjects, enabling easy expansion and adaptation to accommodate new areas of knowledge. It incorporates a hierarchical structure with ten main classes, each represented by a numerical digit, followed by decimal subdivisions to provide finer levels of subject classification. The UDC is used in libraries worldwide, particularly in Europe, and offers a versatile system for organizing diverse collections and facilitating efficient information retrieval for library users.

6. S. R. Ranganathan's Colon Classification: S. R. Ranganathan's Colon Classification (CC) is a library classification system developed by the renowned Indian librarian S. R. Ranganathan. CC is based on the principles of facet analysis and aims to provide a flexible and comprehensive method of organizing knowledge. The system employs a combination of letters, numerals, and symbols to represent different facets or aspects of a subject. It uses a colon (:) to indicate the main classes and further divisions based on specific facets. CC emphasizes the use of

facets such as personality, matter, energy, space, and time to classify subjects, allowing for a multidimensional and granular approach to classification. The system provides a robust framework for organizing a wide range of materials, including books, documents, and other resources. Ranganathan’s Colon Classification has had a significant influence on library classification systems, particularly in India, and continues to be utilized in libraries seeking a sophisticated and adaptable classification system.

7. Henry Evelyn Bliss’s Bibliographic Classification: Henry Evelyn Bliss’s Bibliographic Classification (BC) is a library classification system developed by Henry Evelyn Bliss. BC is a systematic and analytical-synthetic classification system that focuses on the comprehensive organization of knowledge. It combines elements of alphabetical and numerical notation to represent subjects and their subdivisions. BC utilizes a combination of letters and numbers to create a hierarchical structure that allows for the precise classification of materials. The system emphasizes the importance of semantic relationships between subjects, enabling users to navigate related topics effectively. BC is known for its detailed and expansive coverage of subjects, making it suitable for large and diverse library collections. While not as widely adopted as some other classification systems, Bliss’s Bibliographic Classification offers a unique and comprehensive approach to knowledge organization and continues to be studied and appreciated by librarians and information professionals.

1.1 Motivation

We have made a survey to ask students if they prefer reading from books or pdf or e-books and most of them response with preferring reading from real books, but they need a system that ease borrowing process. And this is the result for the previous survey and students' response to the questions:

Books or Smartphone Statistics at figure [1]

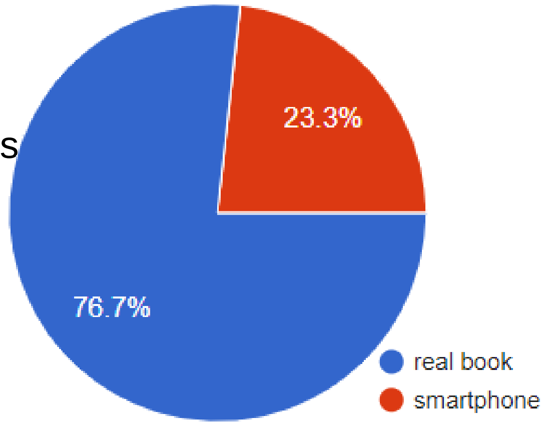


Figure 1:Books or smartphone survey's result

Students' who choose books said

- Feel more inspired while touching papers
- Focused while reading
- More comfortable for the eyes

Students' who choose smartphone said

- Reading anywhere
- can have many books in one smartphone
- Portable and Easy to use

Home or Library Statistics at figure [2]

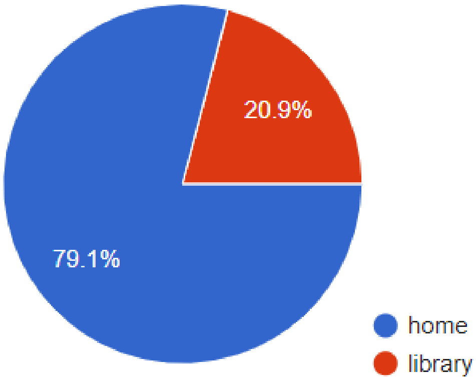


Figure 2: reading from home or library survey's result

Students' who choose Home said

- Feel more comfortable
- Library strict rules
- Scheduling
- Library is far away

Students' who choose Library said

- Quite place
- Feel comfortable with people with the same interests
- Focus on the book without interruption

then we have gone to the library and ask the librarians about the problems that faces them during work, they said that it’s difficult to check the books yearly as they have a large number of books , also recording a daily report about attendance is a bit difficult, and they prefer if these problems got handled automatically.

1.2 Problem statement

After doing the previous we managed to define the following problems that have faced:

1.2.1 Librarian

- **Scanning Books “El-Gard”.**

  Every year the librarians checking books as they compare their names or ISBN with those that have been recorded in the papers. This process takes a huge time and effort especially with the large number of books in the library and it’s not that precise as they maybe have read a wrong value which force them to recheck the book again.
- **Daily report.**

  Librarian must deliver an attendance and borrowing report, this process is a bit hard doing it manually.
- **Sending an alert.**

  Librarian is also responsible for alerting users about their due date to return the borrowed books, but this process is not accurate as the librarian herself may forget about the borrowed book.
- **Data recording:**

  Recording data manually is not precise as some data may be missed while recording it manually.
- **Finding a particular book:**

  Sometimes it’s hard to find a book between this huge number of books.

1.2.2User

- **Borrowing process.**

  Users find it a bit difficult to go to library and ask for a book while it’s not existed or already has been borrowed.
- **Forgetting book.**

  Sometimes when a user borrowed a book, he might forget about returning that book and this issue affect the scanning process and force other users to wait until they got that book.
- **Viewing books.**

  Users prefer to view all available books rather than go to library and ask for it.

1.3 Project Description

The project consists of two parts.

The first part “Web application”:

The website provides the following feature.

- Borrowing system.
- Viewing books.
- Rating and reviewing books.
- Searching for a particular book.
- Generating QR code.
- Scanning QR code.
- Making daily reports and download it in a pdf format.
- Authentication.
- Provide security for input fields.
- Sending E-mail for alerting and warning purposes.
- Contacting with the librarian.
- View for scanned and missed books.

The second part “Hardware implementation”.

- Implementing a scanning system to scan existing books in the library in order to detect missing books and view existing ones using RFID reader and tags in order to scan books, and ESP32 for wireless communication between the reader and the web site.
- All the details of the system will be discussed in the following chapters.

Chapter 2: Literature Review

Chapter 2: Literature Review

2.1 RFID Based Attendance system

The Radio Frequency Identification (RFID) technology is gaining momentum nowadays with its applications being seen in various fields such as industries, offices, transportation, agriculture, etc. The conventional method of manual attendance in educational institutions is often cumbersome and time consuming. However, this problem can be mitigated using the RFID technology. Radio Frequency Identification is an automatic identification technology used for retrieving from or storing data on to RFID Tags without making any physical contact [1]. As shown in Figure [3], The RFID system comprises an RFID reader, tags, a backend storage system and also an intermittent part that contains all the electrical elements. This RFID based attendance system has a storage that stores the unique identification number of the student/employee with the attendance system being user friendly for commercial purposes. The principal objective is to make a system that will take the attendance of authorized individuals, record the data along with time and date and store in an internal SD card file,

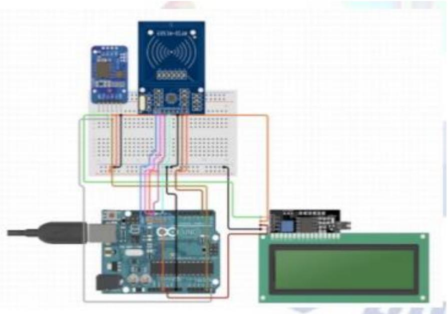


Figure 3:RFID Based Attendance system

and finally store the data inside the EEPROM.

Both hardware and software parts have been

synchronized in order to serve the aforementioned objective.

The RFID hardware has been relied upon to take the attendance of users. Each user would be provided with an individual RFID tag and its record will be maintained.

Disadvantages:

- Doesn’t support a web interface.
- Doesn't support a wireless connection.

2.2 Barcode attendance system

The barcode system is a common type of time and attendance system through which the efficiency of measuring and tracking students’ time could be increased to a great degree. With the automation through barcode technology, the errors previously made in the manual payroll or attendances are eliminated. Thus, the system provides high levels of accuracy and reliability in tracking of student’s attendance. In addition, the costs associated with the installation of the system are not too much relative to the cost of payroll or attendance errors. 16 The implementation of the barcode system is easy. Every student is issued a badge/card in which there is a barcode. To check into or out of the campus, the badge/card is swapped on the time clock, and the data is captured by the clock. This data from the clock can be downloaded by the manager or the administrator and then used for updating and maintaining time and attendance records. The Universal Product Code (UPC) is a unique 12-digit number assigned to retail merchandise that identifies a product and the vendor. The Universal Product Code (UPC) on a product typically appears adjacent to its barcode, the machine-readable representation of the Universal Product Code (UPC). The UPC for a product is always the same. The first six digits is the vendor unique identification number. All the products that the vendor sells will have the same first six digits in their UPCs. The next five digits identify the product. The last digit is called the check digit. This is used to verify that the UPC for that specific product is correct. Each time that UPC is read, typically by a scanner reading the barcode, a calculation is done. And, if the check digit is different compared from the one that is calculated, then the computer knows that there is something wrong with the UPC. Figure [4] is a pictorial diagram of a barcode with its universal product code (UPC).

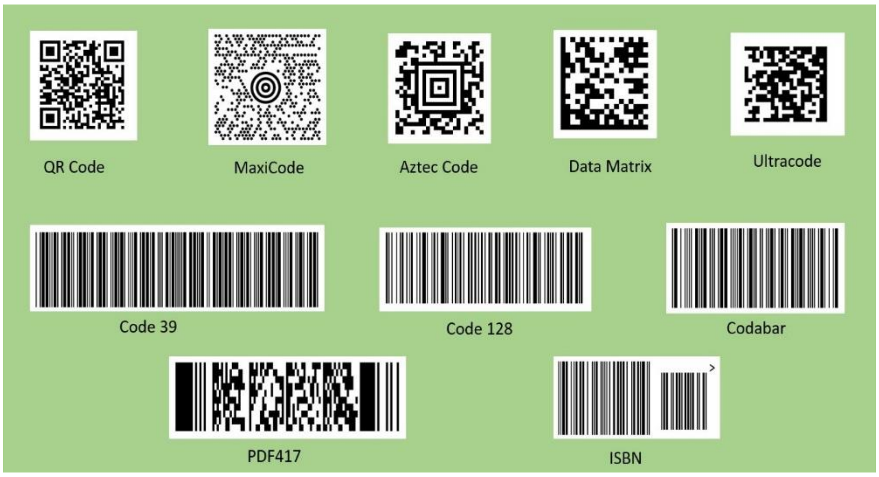


Figure 4:Barcode types

Disadvantages.

- Barcode scanners need a direct line of sight to the barcode to be able to read.
- In order to read the barcode, the barcode scanner needs to be quite close; around no more than 15ft.
- Barcodes have no read/write capabilities; they do not contain any added information such as expiry date etc. They only contain the manufacturer and product.
- They are very labour intensive as they must be scanned individually.
- Barcodes have less security than RFID as they can be more easily reproduced or forged.

- Barcodes are more easily damaged; as the line of sight is needed to scan, the printed bar code has to be exposed on the outside of the product.
- If a barcode is ripped or damaged there is no way to scan the product.

2.3 Biometric attendance system

This is the study of measurable biological characteristics. In computer security, biometrics refers to authentication techniques that rely on measurable physical characteristics that can be automatically checked. There are several types of biometric identification schemes which include: retina, hand geometry, vein, voice etc. The computer uses any of these biometric identification schemes to determine who you are, and based your identity authorized your different level of access. Under this system, there is time and attendance software that is paired with a time clock for employees which uses biometric technology for authentication purposes. When these systems are in 17 use, the employees can use their finger prints for clocking in and clocking out. This method has the great benefit that the entire process is easy as well as quick.

Other advantages include elimination of

the cost previously incurred in getting the students cards.

In the other system that uses card

(magnetic stripe and barcode systems),

there is an ongoing expense associated with the damage, misplacement and stealing of cards and the continuous need for their restoration and maintenance.

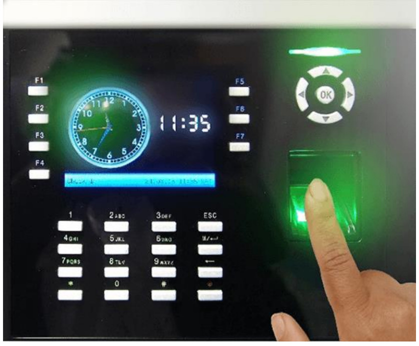


Figure 5:Biometric attendence system

2.4 Magnetic stripe attendance system

In the magnetic stripe attendance system, data is encoded in the magnetic stripe of the student card. When the card, is swiped through the student time clock, the information in the card’s magnetic stripe is recorded by the time clock. This system also read one card at a time and requires contact with the reader.

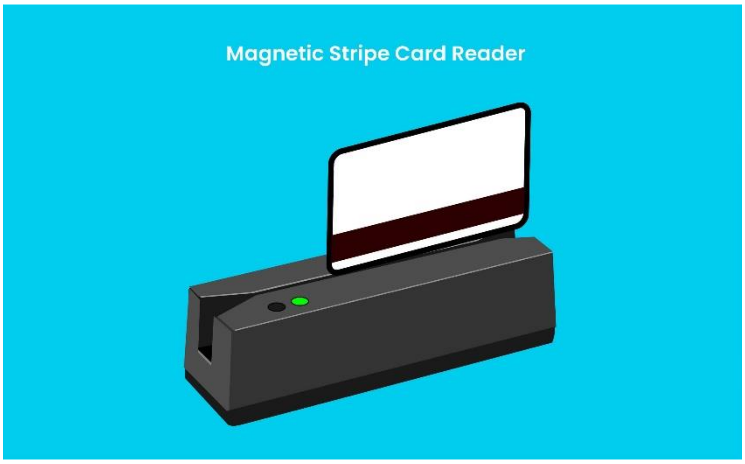


Figure 6: Magnetic stripe card

Chapter 3: Analysis and Requirement

Chapter 3: Analysis and Requirement

3.1 System Requirements.

Requirements can be divided into functional requirements and non-functional requirements

3.1.1 Enumerated Functional Requirements.

The type of requirement that specifies what a system or software application should do or how it should behave in response to certain inputs or events, as shown in table [1].

Table 1: Enumerated Functional Requirements.

Requirement Number	Requirement brief description
REQ-1	Register & Login: - All users are directed to this page when using the system - From this page users can login or register as a new user (first the user is an anonymous).
REQ-2	Allowing all registered users to view their heartbeat, Oxygen saturation and Temperature values in Mobile Application.
REQ-3	Search and browse: Users should be able to search and browse the library's catalog of books and other materials by title, author, subject, and other criteria.
REQ-4	Place holds and reservations: Users should be able to place holds and reservations on items that are currently checked out or on order.

REQ-5	Place holds and reservations: Users should be able to place holds and reservations on items that are currently checked out or on order.
REQ-6	View availability: Users should be able to view the availability of items in real-time, including whether they are currently checked out, on hold, or available for checkout.
REQ-7	Notifications: Users should be able to receive notifications for due dates, holds, and other important events, such as when an item they have placed on hold becomes available
REQ-8	Reading history: Users should be able to view their reading history, including the books they have checked out, returned, and renewed.
REQ-9	Integration with other systems: The system should be able to integrate with other library-related systems such as online catalogs, databases, and electronic resources.
REQ-10	Security: The system should implement appropriate security measures to protect user data and prevent unauthorized access to the system. This includes authentication, and authorization mechanisms.
REQ-11	admin management: The admin should be able to create and manage user accounts, including registration, login, and password management. It should also allow the admin to set user roles and permissions.

REQ-12	books management: The admin should be able to add, edit, and delete books. It should also allow the admin to search and filter the books by various criteria such as title, author, subject, and publication year.
REQ-13	Circulation management: The admin should be able to manage the circulation of library materials, including borrowing, renewing, and returning items
REQ-14	Reporting and analytics: The admin should be able to generate various reports and analytics on library usage and performance, including circulation statistics, overdue items, popular items, and attendance.
REQ-15	The admin can generate a QR code containing book information
REQ-16	Scan QR for issued: admin opens readers page and clicks on issue button and scan the QR code of the book

3.1.2 Enumerated Non-functional Requirements.

The type of requirement that specify how a system or software application should perform or behave in terms of its characteristics or qualities, rather than what it should do, as shown in table [2].

Table 2: Enumerated Non-functional Requirements.

Requirement Number	Requirement brief description
REQ-1	Performance: The library management system should be able to handle a large number of users

	and transactions without slowing down or crashing. Response times should be fast
REQ-2	Scalability: The library management system should be designed to scale up or down based on changing needs. It should be able to accommodate growth in the number of users, books, and other materials, as well as changes in the library's policies and procedures
REQ-3	Reliability: The library management system should be highly reliable and available, with minimal downtime or service interruptions. It should be able to recover quickly from any failures or errors, and should have backup and disaster recovery mechanisms in place
REQ-4	Security: The library management system should be secure, with strong access controls, and other security measures in place to protect user data and prevent unauthorized access or tampering
REQ-5	Usability: The library management system should be easy to use, with a user-friendly interface that is intuitive and easy to navigate. It should be accessible to users with different levels of technical expertise
REQ-6	Compatibility: The library management system should be compatible with different operating systems, hardware platforms, and software

	applications that the library uses. It should also be able to integrate with other library-related systems
REQ-7	Maintainability: The library management system should be easy to maintain and update,
REQ-8	Availability: The library management system should be highly available, with minimal downtime or service interruptions.

3.2 Functional Requirements Specification

Stakeholders.

Librarians, Readers and Library.

Actors and goals

Actors

Librarians: They are the primary actors in the system who manage the library's collection and handle circulation tasks and They are responsible for managing the library management system.

Library users: They are the secondary actors in the system who use the system to search and borrow books, renew items, and manage their accounts.

Goals

For librarians: To efficiently manage the library's collection of books and other materials, handle circulation tasks, and generate reports and analytics on library usage and performance.

For library users: To easily search and browse the library's catalog, borrow and renew books, and manage their accounts.

3.4 Use cases Description

Use case name

Borrow book

Actors

Library user, Librarian

Goal

Allow a library patron to borrow a book from the library.

Preconditions

The user must have been logged in to the library management system.

The book must be available for checkout and not currently on hold by another patron.

Basic flow of events

- The user searches for the book they want to borrow using the library management system.
- The system displays information about the book, including its availability status.
- The user selects the book they want to borrow and admin clicks the "Borrow" button.
- The system prompts the user to confirm the borrowing request.
- The user confirms the request.
- The system records the borrowing request and updates the availability status of the book to "Checked Out".
- The system displays the due date and other relevant information to the user.

- The user receives an email or other notification confirming the borrowing request.

Alternate flow

If the book is not available for checkout, the system displays an error message to the user and prompts them to place a hold on the book instead.

Postconditions

The book is checked out and no longer available for checkout by other users.

The user account is updated to reflect the borrowed item and the due date.

The librarian may need to retrieve and check out the book to the user in person, depending on the library's policies and procedures

Use case name

Search library home page

Actors

Library user

Goal

Allow a library user to search the library's catalog for books and other materials.

Preconditions

The user must be logged in to the library management system.

The library's catalog must be available and accessible through the system.

Basic flow of events

- The patron navigates to the "Search" page or section of the library management system.
- The system presents a search form with fields for the user to enter search terms, such as author, title, subject, or keyword.
- The user enters one or more search terms and clicks the "Search" button.
- The system queries the library's catalog and displays a list of results that match the search terms.
- The user can browse the search results and view detailed information about each item, such as its title, author, publication date, and availability status.
- The user can select an item and view additional information, such as a description, reviews, or other related items.
- The user can select the "Request" or "Place Hold" button to request the item if it is available, or place a hold on the item if it is currently checked out or on order.

Alternate flow

If the search returns no results, the system displays a message to the user indicating that no items were found.

Postconditions

The user can view and request items from the library's catalog through the system.

The system may send a notification to the user confirming their request or hold.

The librarian may need to review and approve requests made by users, depending on the library's policies and procedures

Use case name

Renew borrowed items

Actors

Library admin

Goal

Allow a library admin to renew items they have borrowed from the library.

Preconditions

The admin must be logged in to the library management system.

The item to be renewed must be eligible for renewal

Basic flow of events

- The admin navigates to their account page on the library management system.
- The system displays the admin's account information, including their borrowing history and any items currently checked out.
- The admin selects the item they want to renew and clicks the "Renew" button.
- The system checks the item's eligibility for renewal, such as whether the item has already been renewed, the item's due date, and any holds on the item.
- If the item is eligible for renewal, the system presents the new due date for the item.

Alternate flow

If the item is not eligible for renewal, such as if it has already been renewed or is on hold by another user, the system displays an error message to the admin and prompts them to return the item or place a hold on it instead.

Postconditions

The admin's account information is updated to reflect the renewal and the new due date for the item.

The librarian may need to review and approve renewals made by patrons, depending on the library's policies and procedures

Use case name

Submit book review

Actors

Library user

Goal

Allow a library user to submit a review for a book they have read and borrowed from the library.

Preconditions

The user must be logged in to the library management system.

The user must have borrowed and read a book from the library.

Basic flow of events

- The user navigates to the library's catalog on the library management system.
- The user searches for the book they want to review.
- The system displays information about the book, including its title, author, and a summary.
- The user selects the "Comment" button for the book.

- The system presents a form for the user to enter their review, including a rating and a written review.
- The user enters their review and clicks the "Submit" button.
- The system validates the review and adds it to the book's record in the library's catalog.
- The system may display the review on the catalog page for the book, allowing other users to read the review.

Alternate flow

If the user does not want to submit a review for the book, they can simply browse or search for other books in the page.

Postconditions

The user's review is added to the book's record in the library's catalog.

Other users can read the review and use it to select books to borrow.

The librarian may need to review and approve reviews made by patrons, depending on the library's policies and procedures.

Use case name

Generate library reports

Actors

Library administrator

Goal

Allow a library administrator to generate reports about the library's collection, borrowing history, and other data.

Preconditions

The administrator must be logged in to the library management system.

The administrator must have the necessary permissions to generate reports.

Basic flow of events

- The administrator navigates to the library's admin page on the library management system.
- The system displays a list of administrative tasks, including "Generate Reports".
- The administrator selects the "Generate Reports" task.
- The system presents a list of report options, such as "Borrowing History"
- The administrator selects the desired report option.
- The system generates the report and presents it to the administrator in a downloadable format, such as a spreadsheet or PDF.
- The administrator can download and save the report for future reference or analysis.

Alternate flow

If the selected report option requires additional input or parameters, such as a date range for borrowing history, the system prompts the administrator to enter the necessary information before generating the report.

Postconditions

The administrator can generate reports about the library's collection, borrowing history, and other data.

The administrator can use the reports to analyze trends, identify areas for improvement, and make informed decisions about library operations.

The librarian may need to review and approve certain report generation requests made by administrators, depending on the library's policies and procedures.

Use case name

Manage library users

Actors

Library administrator

Goal

Allow a library administrator to manage library users, including creating new user accounts, editing user information, and deleting user accounts.

Preconditions

The administrator must be logged in to the library management system.

The administrator must have the necessary permissions to manage library users.

Basic flow of events

- The administrator navigates to the library's admin page on the library management system.
- The system displays a list of administrative tasks, including "Manage Library Users".
- The administrator selects the "Manage Library Users" task.
- The system presents a list of options for managing library users, such as "Create New User Account", "Edit User Information", and "Delete User Account".
- The administrator selects the desired option.

- If creating a new user account, the system presents a form for the administrator to enter the new user's information, such as name, email, and contact information.
- If editing user information, the system displays a list of existing users and allows the administrator to select the user to edit and update their information.
- If deleting a user account, the system displays a list of existing users and allows the administrator to select the user to delete.
- The system validates the entered information and performs the selected action, such as creating a new user account, updating user information, or deleting a user account.
- The system updates the library's user database to reflect the changes.

Alternate flow

If the entered information is incomplete or invalid, the system displays an error message and prompts the administrator to correct the information.

Postconditions

The administrator can manage library users, including creating new user accounts, editing user information, and deleting user accounts.

The librarian may need to review and approve certain user management actions made by administrators, depending on the library's policies and procedures

Use case name

Manage library website

Actors

Library administrator

Goal

Allow a library administrator to manage the library's website, including editing website content, adding new pages, and managing website settings.

Preconditions

The administrator must be logged in to the library management system.

The administrator must have the necessary permissions to manage the library's website.

Basic flow of events

- The administrator navigates to the library's admin page on the library management system.
- The system displays a list of administrative tasks, including "Manage Library Website".
- The administrator selects the "Manage Library Website" task.
- The system presents a list of options for managing the library's website, such as "Edit Website Content", "Add New Pages", and "Manage Website Settings".
- The administrator selects the desired option.
- If editing website content, the system displays the website content and allows the administrator to make changes using a built-in editor.
- If adding new pages, the system presents a form for the administrator to enter the page title, content, and other information.
- If managing website settings, the system presents a list of settings options, such as "Website Title", "Logo", and "Navigation Menu", and allows the administrator to modify the settings.

- The system validates the entered information and performs the selected action.
- The system updates the library's website to reflect the changes.

Alternate flow

If the entered information is incomplete or invalid, the system displays an error message and prompts the administrator to correct the information.

Postconditions

The administrator can manage the library's website, including editing website content, adding new pages, and managing website settings.

The librarian may need to review and approve certain website management actions made by administrators, depending on the library's policies and procedures.

Chapter 4: software Design

Chapter 4: software Design

4.1. Use Case Diagram

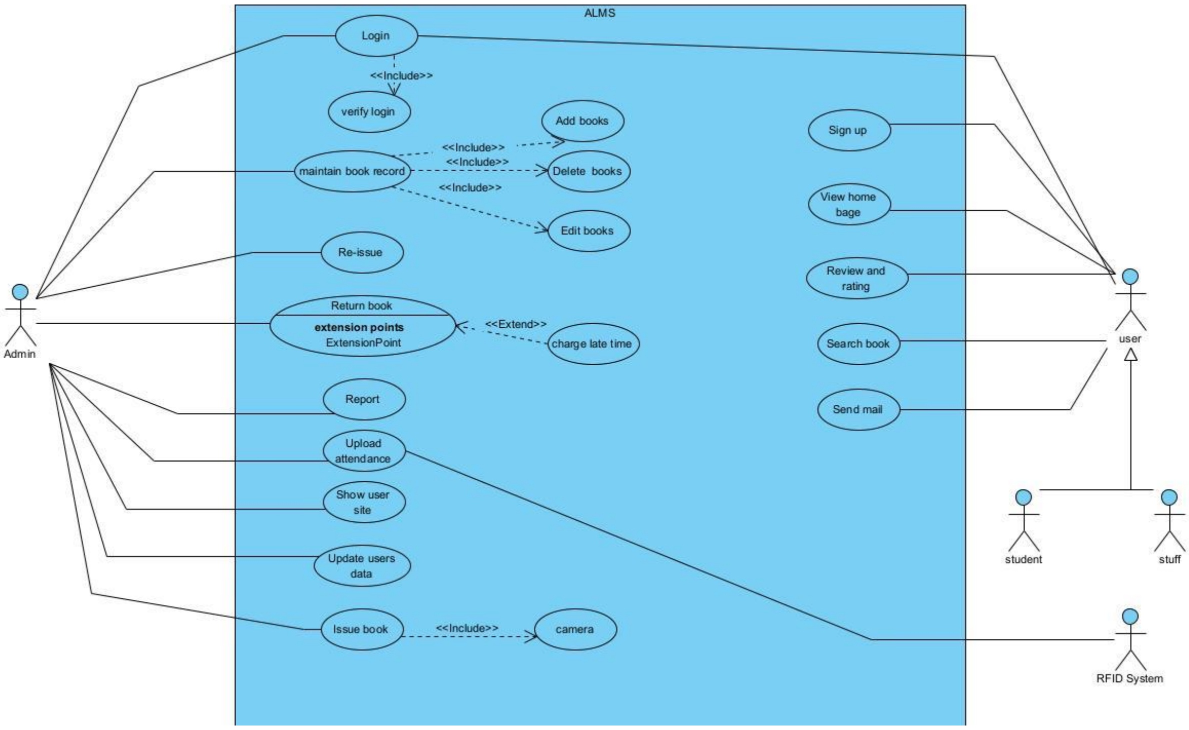


Figure 7:Use Case Diagram

In this sequence diagram as presented in figure [7], we can see the interactions between the user, the admin, the library system, and the database. Users can log in, search the catalog, check out, or return items, and view their account information. Admins can log in, add, renew, update, or delete items, issue or return items, and generate reports. The library system communicates with the database to authenticate logins, query the catalog, create, modify or remove item records, update item status, query user accounts, and generate reports. The database returns success or failure messages or report data to the library system

4.2 Sequence Diagram

A detailed description of the system's sequence diagram is presented in figure [8] and figure [9]

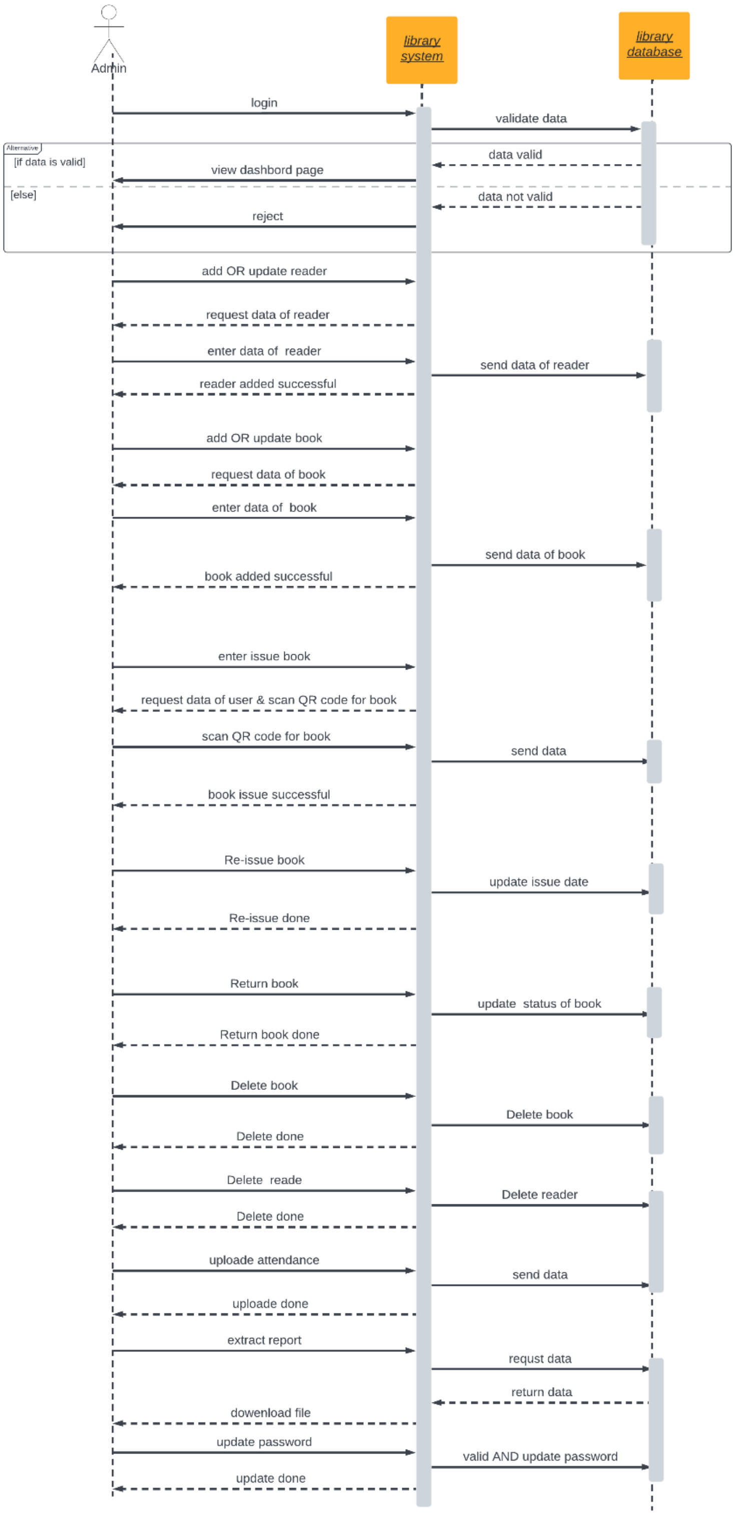


Figure 8: System Sequence Diagram1

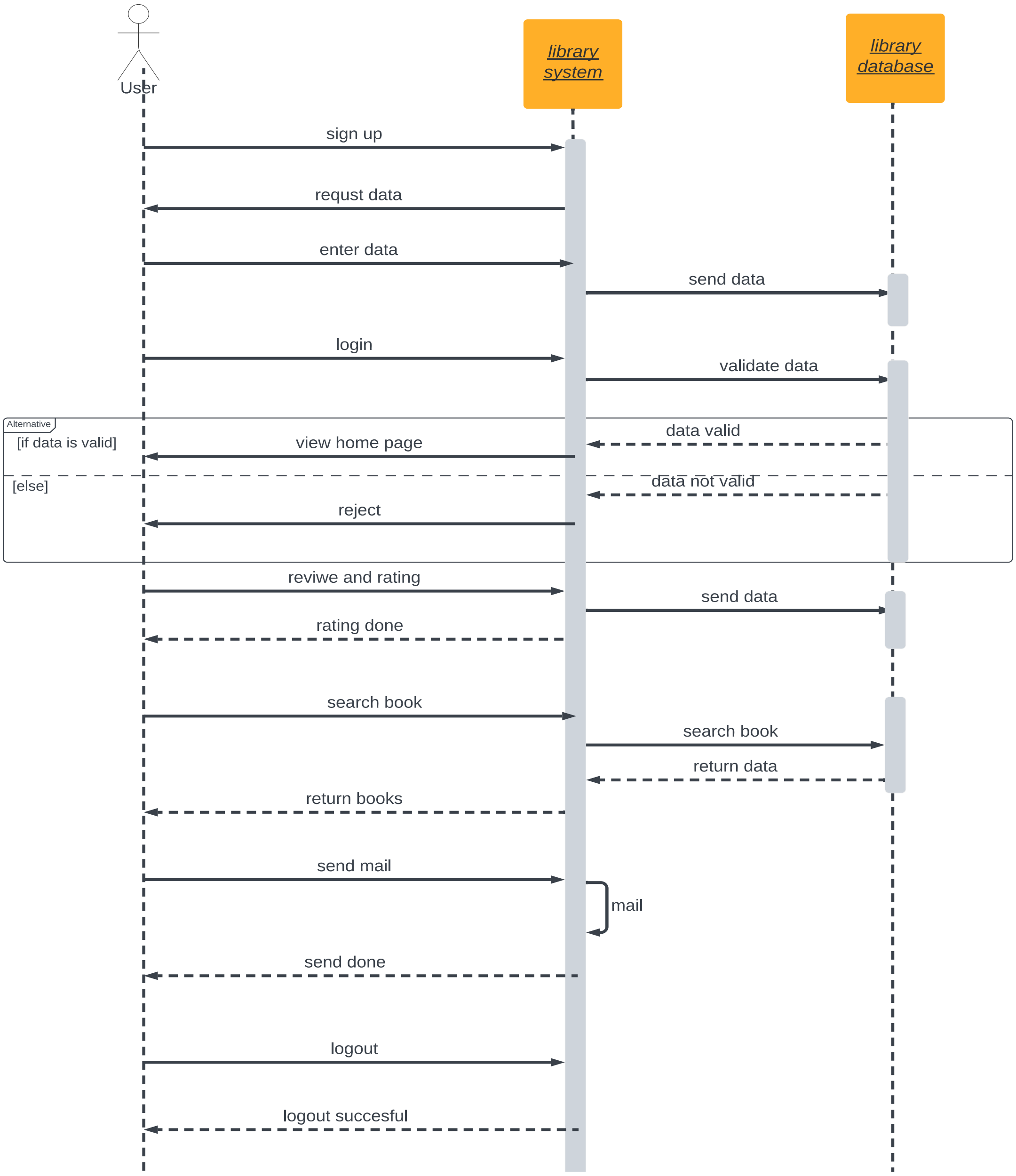


Figure 9: System Sequence Diagram 2

4.3 Class Diagram

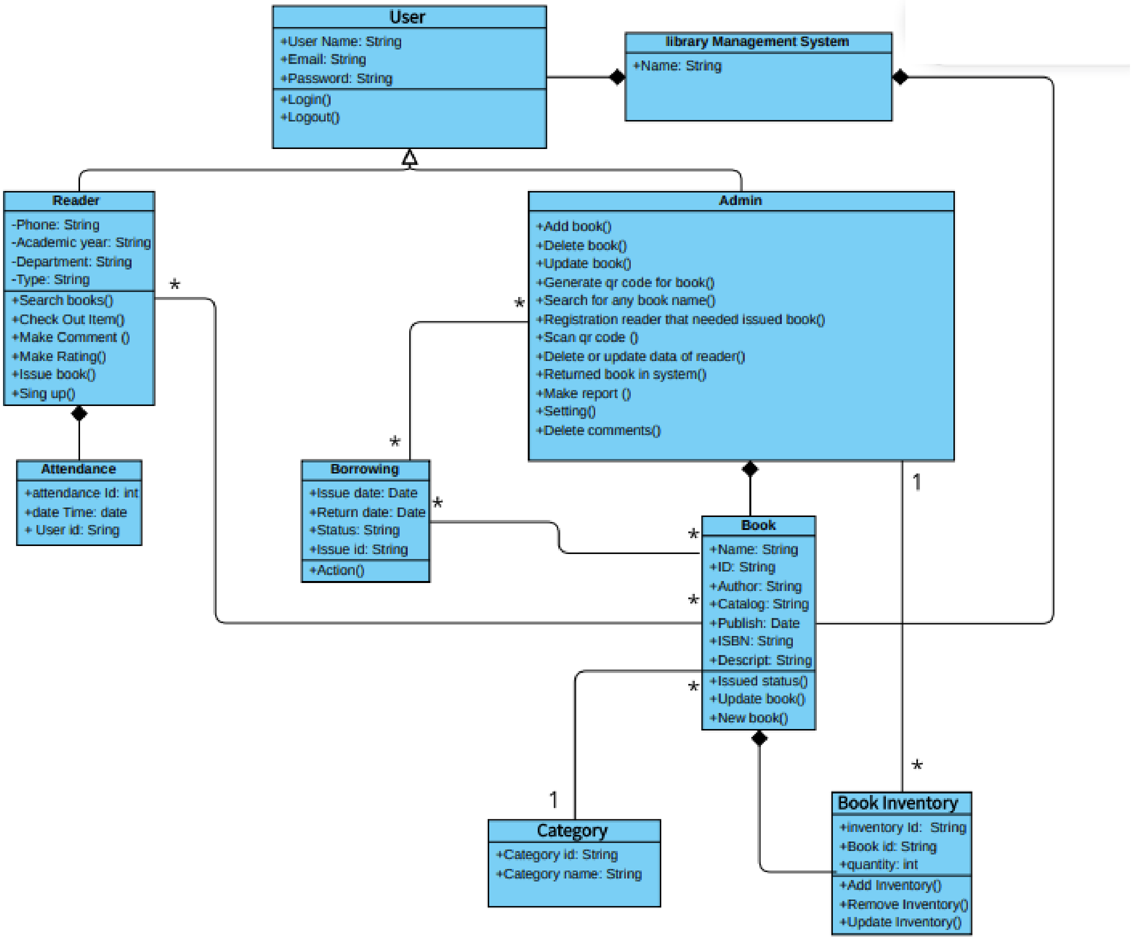


Figure 10: Class Diagram

In this class diagram in Figure [10], we have nine main classes: User, Reader, Admin, Book, Borrowing, Library management system, Category, and Attendance, Book inventory.

The class diagram shows the relationships between these classes. For example, Admin has a many-to-many association with Borrowing, indicating that a user can have multiple borrowing transactions, Book has a many-to-many association with Borrowing, indicating that a book can be borrowed by multiple users, Admin has a composition relationship with Book, Library has a dependency relationship with Book, indicating that the library system depends on the Book class.

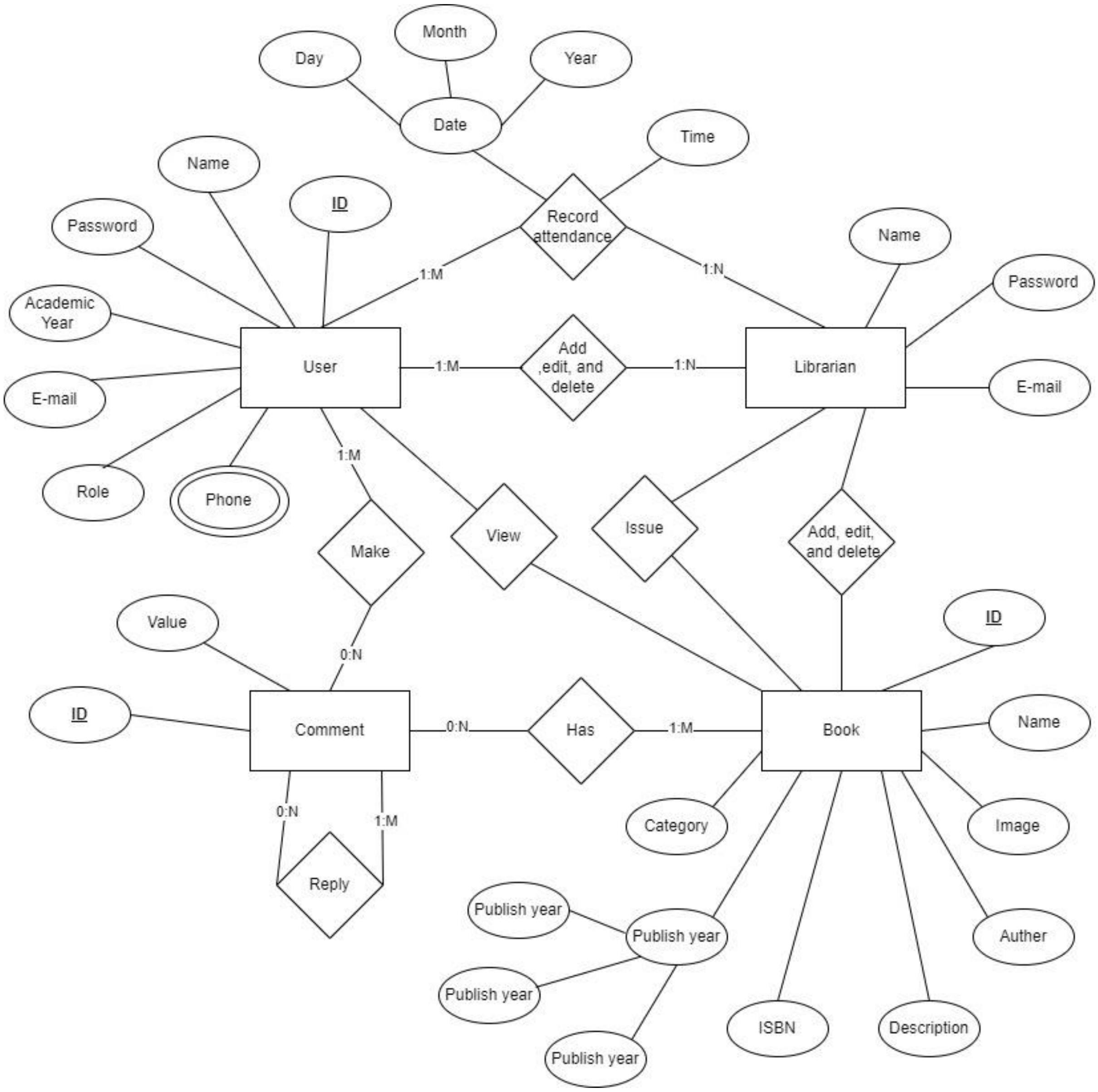


Figure 11: ERD Diagram

Figure [11] is a basic ERD diagram for a library management system, this diagram includes the following entities (User, Librarian, Book and Comment) and relationship between entities.

Chapter 5: Tools and technologies

Chapter 5: Tools and technologies

5.1 Used Technology

5.1.1 RFID

What is RFID (radio frequency identification)?

RFID (radio frequency identification) is a form of wireless communication that incorporates the use of electromagnetic or electrostatic coupling in the radio frequency portion of the electromagnetic spectrum to uniquely identify an object, animal or person.

How does RFID work?

Every RFID system consists of three components: a scanning antenna, a transceiver and a transponder. When the scanning antenna and transceiver are combined, they are referred to as an RFID reader or interrogator. There are two types of RFID readers -- fixed readers and mobile readers. The RFID reader is a network-connected device that can be portable or permanently attached. It uses radio waves to transmit signals that activate the tag. Once activated, the tag sends a wave back to the antenna, where it is translated into data.

The transponder is in the RFID tag itself. The read range for RFID tags varies based on factors including the type of tag, type of reader, RFID frequency and interference in the surrounding environment or from other RFID tags and readers. Tags that have a stronger power source also have a longer read range.

What are RFID tags and smart labels?

RFID tags are made up of an integrated circuit (IC), an antenna and a substrate. The part of an RFID tag that encodes identifying information is called the RFID inlay.

There are two main types of RFID tags:

- **Active RFID.** An active RFID tag has its own power source, often a battery.
- **Passive RFID.** A passive RFID tag receives its power from the reading antenna, whose electromagnetic wave induces a current in the RFID tag's antenna.

There are also semi-passive RFID tags, meaning a battery runs the circuitry while communication is powered by the RFID reader.

Low-power, embedded non-volatile memory plays an important role in every RFID system. RFID tags typically hold less than 2,000 KB of data, including a unique identifier/serial number. Tags can be read-only or read-write, where data can be added by the reader or existing data overwritten.

The read range for RFID tags varies based on factors including type of tag, type of reader, RFID frequency, and interference in the surrounding environment or from other RFID tags and readers. Active RFID tags have a longer read range than passive RFID tags due to the stronger power source.

smart labels are simple RFID tags. These labels have an RFID tag embedded into an adhesive label and feature a barcode. They can also be used by both RFID and barcode readers. Smart labels can be printed on-demand using desktop printers, where RFID tags require more advanced equipment.

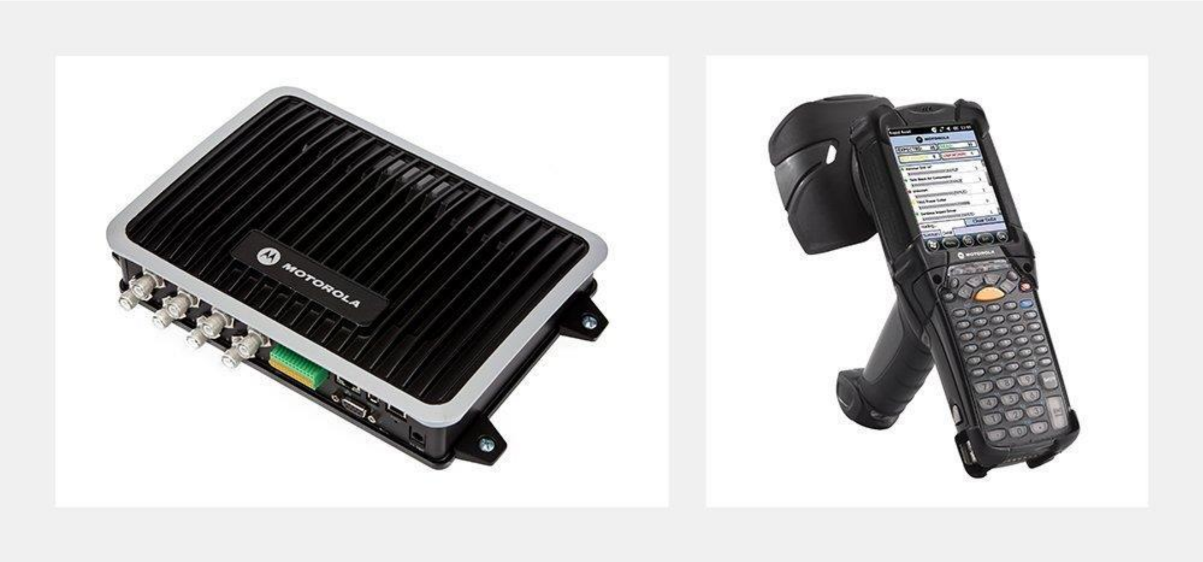


Figure 12: RFID reader

- **What are the types of RFID systems?**

There are three main types of RFID systems: low frequency (LF), high frequency (HF) and ultra-high frequency (UHF). Microwave RFID is also available. Frequencies vary greatly by country and region.

- **Low-frequency RFID systems.** These range from 30 KHz to 500 KHz, though the typical frequency is 125 KHz. LF RFID has short transmission ranges, generally anywhere from a few inches to less than six feet.

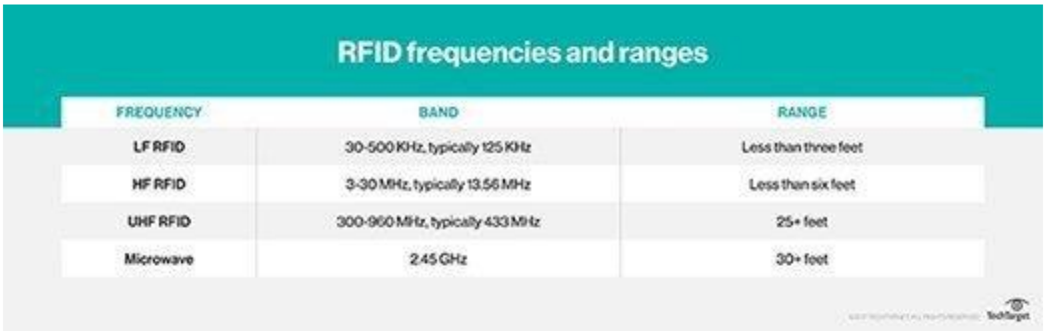
- **High-frequency RFID system** These range from 3 MHz to 30 MHz, with the typical HF frequency being 13.56 MHz. The standard range is anywhere from a few inches to several feet.

- **UHF RFID systems.** These range from 300 MHz to 960 MHz, with the typical frequency of 433 MHz and can generally be read from 25-plus feet away.

- **Microwave RFID systems.** These run at 2.45 GHz and can be read from 30-plus feet away.

The frequency used will depend on the RFID application, with actual obtained distances sometimes varying from what is expected. For example, when the U.S. State Department announced it would issue electronic passports enabled with an RFID chip, it said the chips would only be able to be read from approximately 4 inches away. However, the State Department soon received evidence that RFID readers could skim the information from the RFID tags from much farther than 4 inches -- sometimes upward of 33 feet away.

If longer read ranges are needed, using tags with additional power can boost read ranges to 300-plus feet.



RFID frequencies and ranges

FREQUENCY	BAND	RANGE
LF RFID	30-500 KHz, typically 125 KHz	Less than three feet
HF RFID	3-30 MHz, typically 13.56 MHz	Less than six feet
UHF RFID	300-960 MHz, typically 433 MHz	25+ feet
Microwave	2.45 GHz	30+ feet

Figure 13: RFID frequencies and ranges

- **RFID applications and use cases**

RFID dates back to the 1940s; however, it was used more frequently in the 1970s. For a long time, the high cost of the tags and readers prohibited widespread commercial use. As hardware costs have decreased, RFID adoption has also increased.

Some common uses for RFID applications include:

- pet and livestock tracking
- inventory management
- asset tracking and equipment tracking

- inventory control
- cargo and supply chain logistics
- vehicle tracking
- customer service and loss control
- improved visibility and distribution in the supply chain
- access control in security situations
- shipping
- healthcare
- manufacturing
- retail sales
- tap-and-go credit card payments

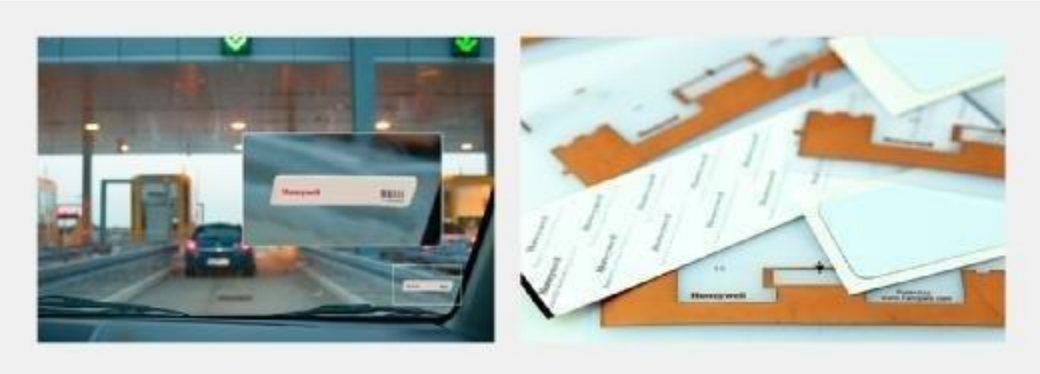


Figure 14: RFID passive tags

Passive RFID tags do not require batteries. In this example of passive RFID from Honeywell, battery-free tags in vehicles are used to collect tolls on highways.

RFID vs. barcodes

Using RFID as an alternative for barcodes is increasing in use. RFID and barcode technologies are used in similar ways to track inventory, but there are some important differences between them.

Table 3: Comparison of RFID tags and Barcodes

RFID tags	Barcodes
Can identify individual objects without direct line of sight.	Direct line of sight required for scanning.
Can scan items from inches to feet away, depending on type of tag and reader.	Require closer proximity for scanning.
Data can be updated in real time.	Data is read-only and can't be changed.
Require a power source.	No power source needed.
Read time is less than 100 milliseconds per tag.	Read time is half a second or more per tag.
Contain a sensor attached to an antenna, often contained in a plastic cover and more costly than barcodes.	Printed on the outside of an object and more subject to wear.

RFID vs. NFC

Near-field communication (NFC) enables data to be exchanged between devices by using short-range, high-frequency wireless communication technology. NFC combines the interface of a smart card and reader into a single device.

Table 4: Comparison of Radio frequency ID and Near-field communication

Radio frequency ID	Near-field communication
Uni-directional	Bi-directional
Range up to 100 m	Range less than 0.2 m
LF/HF/UHF/Microwave	13.56 MHz
Continuous sampling	No continuous sampling
Bit rate varies with frequency	Up to 424 Kbps
Power rate varies with frequency	<15 mille amperes

RFID challenges

RFID is prone to two main issues:

Reader collision

Reader collision, when a signal from one RFID reader interferes with a second reader, can be prevented by using an anti-collision protocol to make RFID tags take turns transmitting to their appropriate reader.

Tag collision

Tag collision occurs when too many tags confuse an RFID reader by transmitting data at the same time. Choosing a reader that gathers tag info one at a time will prevent this issue.

RFID security and privacy

A common RFID security or privacy concern is that RFID tag data can be read by anyone with a compatible reader. Tags can often be read after an item leaves a store or supply chain. They can also be read without a user's knowledge using unauthorized readers, and if a tag has a unique serial number, it can be associated to a consumer. While a privacy concern for individuals, in military or medical settings this can be a national security concern or life-or-death matter.

Because RFID tags do not have a lot of compute power, they are unable to accommodate encryption, such as might be used in a challenge-response authentication system. One exception to this, however, is specific to RFID tags used in passports -- basic access control (BAC). Here, the chip has sufficient compute power to decode an encrypted token from the reader, thus proving the validity of the reader.

At the reader, information printed on the passport is machine-scanned and used to derive a key for the passport. There are three pieces of information used -- the passport number, the passport holder's birth date and the passport's expiration date along with a checksum digit for each of the three.

Researchers say this means passports are protected by a password with considerably less entropy than is normally used in e-commerce. They key is also static for the life of the passport, so once an entity has had one-time access to the printed key information, the passport is readable with or without the consent of the passport bearer until the passport expires.

The U.S. State Department, which adopted the BAC system in 2007, has added an anti-skimming material to electronic passports to mitigate the threat of undetected attempts to steal users' personal information.

RFID standards

There are several guidelines and specifications for RFID technology, but the main standards organizations are:

International Organization for Standardization (ISO), Electronics Product Code Global Incorporated (EPC global) and International Electro-Technical Commission (IEC).

Each radio frequency has associated standards, including ISO 14223 and ISO/IEC 18000-2 for LF RFID, ISO 15693 and ISO/IEC 14443 for HF RFID, and ISO 18000-6C for UHF RFID.

The use technology Next-generation RFID

RFID systems are becoming increasingly used to support internet of things deployments. Combining the technology with smart sensors and/or GPS technology enables sensor data including temperature, movement and location to be wirelessly transmitted.

A web application (web app) is an application program that is stored on a remote server and delivered over the internet through a browser interface. Web services are web apps by definition and many, although not all, websites contain web apps.

5.1.2 IOT

The internet of things (IOT) in figure [14], is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. A thing in the internet of things can be a person with a heart monitor implant, a farm animal with a biochip transponder, an automobile that has built-in sensors to alert the driver when tire pressure is low or any other natural or man-made object that can be assigned an Internet Protocol (IP) address and is able to transfer data over a network. Increasingly, organizations in a variety of industries are using IoT to operate more efficiently, better understand customers to deliver enhanced customer service, improve decision-making and increase the value of the business.

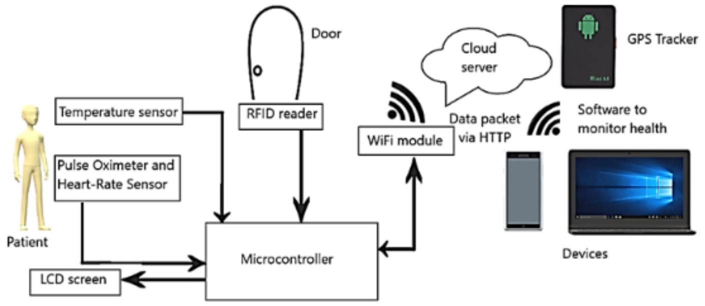


Figure 15: Example of IOT system

How does IoT work?

An IoT ecosystem consists of web-enabled smart devices that use embedded systems, such as processors, sensors and communication hardware, to collect, send and act on data they acquire from their environments. IoT devices share the sensor data they collect by connecting to an IoT gateway or other edge device where data is either sent to the cloud to be analyzed or analyzed locally. Sometimes, these devices communicate with other related devices and act on the information they get from one another. The devices do most of the work without human intervention, although people can interact with the devices -- for instance, to set them up, give them instructions or access the data.

IoT standards: There are several emerging IoT standards, including the following:

IPv6 over Low-Power Wireless Personal Area Networks (*6LoWPAN)* is an open standard defined by the Internet Engineering Task Force (IETF). The 6LoWPAN standard enables any low-power radio to communicate to the internet, including 804.15.4, Bluetooth Low Energy (BLE) and Z-Wave (for home automation).

ZigBee is a low-power, low-data rate wireless network used mainly in industrial settings. ZigBee is based on the Institute of Electrical and Electronics Engineers (IEEE) 802.15.4 standard. The ZigBee Alliance created Dotdot, the universal language for IoT that enables smart objects to work securely on any network and understand each other.

LiteOS is a Unix-like operating system (OS) for wireless sensor networks. LiteOS supports smartphones, wearables, intelligent manufacturing applications, smart homes and the internet of vehicles (IoV). The OS also serves as a smart device development platform.

OneM2M is a machine-to-machine service layer that can be embedded in software and hardware to connect devices. The global standardization body, OneM2M, was created to develop reusable standards to enable IoT applications across different verticals to communicate.

Data Distribution Service (DDS) was developed by the Object Management Group (OMG) and is an IoT standard for real-time, scalable and high-performance M2M communication.

Advanced Message Queuing Protocol (AMQP) is an open source published standard for asynchronous messaging by wire. AMQP enables encrypted and interoperable messaging between organizations and applications. The protocol is used in client-server messaging and in IoT device management.

Constrained Application Protocol (CoAP) is a protocol designed by the IETF that specifies how low-power, compute-constrained devices can operate in the internet of things.

Long Range Wide Area Network (LoRaWAN) is a protocol for WANs designed to support huge networks, such as smart cities, with millions of low-power devices.

5.1.3 SPI Protocols

Introduction to SPI communication

SPI is a common communication protocol used by many different devices. For example, SD card reader modules, RFID card reader modules, and 2.4 GHz wireless transmitter/receivers all use SPI to communicate with microcontrollers. One unique benefit of SPI is the fact that data can be transferred without interruption. Any number of bits can be sent or received in a continuous stream. With I2C and UART, data is sent in packets, limited to a specific number of bits. Start and stop conditions define the beginning and end of each packet, so the data is interrupted during transmission. Devices communicating via SPI are in a master-slave relationship. The master is the controlling device (usually a microcontroller), while the slave (usually a sensor, display, or memory chip) takes instruction from the master. The simplest configuration of SPI is a single master, single slave system, but one master can control more than one slave (more on this below).

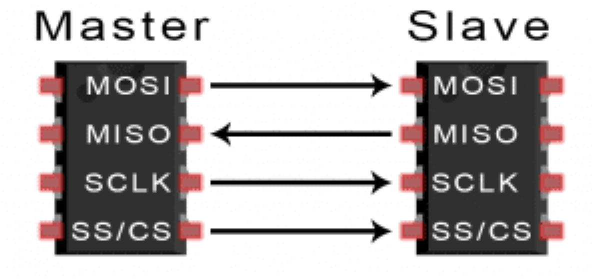


Figure 16: SPI master to slave connection

MOSI (Master Output/Slave Input) – Line for the master to send data to the slave.

MISO (Master Input/Slave Output) – Line for the slave to send data to the master.

SCLK (Clock) – Line for the clock signal.

SS/CS (Slave Select/Chip Select) – Line for the master to select which slave to send data to.

In our project the serial peripheral interface (SPI compatible) is supported to enable high-speed communication to the host. The interface can handle data speeds up to 10 Mbit/s. When communicating with a host, the MFRC522 acts as a slave, receiving data from the external host for register settings, sending and receiving data relevant for RF interface communication. an interface compatible with SPI enables high-speed serial communication between the MFRC522 and a microcontroller. The implemented interface is in accordance with the SPI standard.

Advantages

No start and stop bits, so the data can be streamed continuously without interruption

No complicated slave addressing system like I2C

Higher data transfer rate than I2C (almost twice as fast)

Separate MISO and MOSI lines, so data can be sent and received at the same time

Disadvantages

Uses four wires (I2C and UARTs use two)

No acknowledgement that the data has been successfully received (I2C has this)

No form of error checking like the parity bit in UART

Only allows for a single master

5.2 Used Tools

5.2.1 Used IDE's and frameworks

Arduino IDE:

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.

VS code IDE:

Visual Studio Code is a lightweight but powerful source code editor which runs on your desktop and is available for Windows,

macOS and Linux. It comes with built-in support for JavaScript, Typescript and Node.js and has a rich ecosystem of extensions for other languages and runtimes (such as C++, C#, Java, Python, PHP, Go, .NET).

Laravel Framework:

Laravel is a web application framework with expressive, elegant syntax.

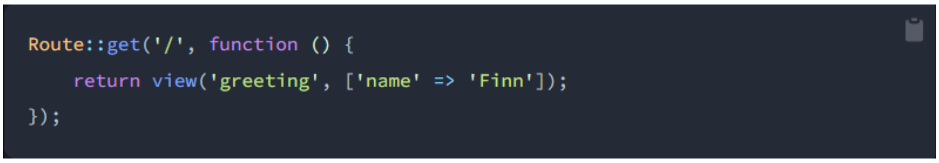
A web framework provides a structure and starting point for creating your

application, allowing you to focus on creating something amazing while we sweat the details.

Blade Template

Blade is the simple, yet powerful templating engine that is included with Laravel. Unlike some PHP templating engines, Blade does not restrict you from using plain PHP code in your templates. In fact, all Blade templates are compiled into plain PHP code and cached until they are modified, meaning Blade adds essentially zero overhead to your application. Blade template files use the.blade.php file extension and are typically stored in the resources/views directory.

Blade views may be returned from routes or controllers using the global view helper. Of course, as mentioned in the documentation on views, data may be passed to the Blade view using the view helper's second argument:



```
Route::get('/', function () {
    return view('greeting', ['name' => 'Finn']);
});
```

Blade Directives

In addition to template inheritance and displaying data, Blade also provides convenient shortcuts for common PHP control structures, such as conditional statements and loops. These shortcuts provide a very clean, terse way of working with PHP control structures while also remaining familiar to their PHP counterparts.

Routes

All Laravel routes are defined in your route files, which are located in the routes directory. These files are automatically loaded by your application's App\Providers\RouteServiceProvider. The routes/web.php file defines routes that are for your web interface. These routes are assigned the web middleware group, which provides features like session state and CSRF protection. The routes in routes/api.php are stateless and are assigned the api middleware group.

For most applications, you will begin by defining routes in your routes/web.php file. The routes defined in routes/web.php may be accessed by entering the defined route's URL in your browser. For example, you may access the following route by navigating to http://example.com/user in your browser.

Routes defined in the routes/api.php file are nested within a route group by the RouteServiceProvider. Within this group, the /api URI prefix is automatically applied so you do not need to manually apply it to every route in the file. You may modify the prefix and other route group options by modifying your RouteServiceProvider class.

Migration

Migrations are like version control for your database, allowing your team to define and share the application's database schema definition. If you have ever had to tell a teammate to manually add a column to their local database schema after pulling in your changes from source control, you've faced the problem that database migrations solve.

The Laravel Schema facade provides database agnostic support for creating and manipulating tables across all of Laravel's supported database systems. Typically, migrations will use this facade to create and modify database tables and columns.

Models

The Model corresponds to the letter ‘M’ in the MVC framework. The motive of Models in any Model view controller framework web application is to manage business logic. A Model is nothing but a class in the Laravel framework. This class is responsible to interact with underlying database tables. Laravel with Eloquent ORM is capable of handling the database more efficiently. ORM stands for ‘Object Relational Mapper’ and it is responsible for your swift interaction with the database. These Models provide you with an easy way to update, insert or retrieve data from the tables.

Controllers

Instead of defining all of your request handling logic as closures in your route files, you may wish to organize this behavior using "controller" classes. Controllers can group related request handling logic into a single class. For example, a UserController class might handle all incoming requests related to users, including showing, creating, updating, and deleting users. By default, controllers are stored in the app/Http/Controllers directory.

Security

- Authentication:

  Many web applications provide a way for their users to authenticate with the application and "login". Implementing this feature in web applications can be a complex and potentially risky endeavor. For this reason, Laravel strives to give you the tools you need to implement authentication quickly, securely, and easily.

  At its core, Laravel's authentication facilities are made up of "guards" and "providers". Guards define how users are authenticated for each request. For example, Laravel ships with a session guard which maintains state using session storage and cookies.

  Providers define how users are retrieved from your persistent storage. Laravel ships with support for retrieving users using Eloquent and the database query builder. However, you are free to define additional providers as needed for your application.

  Your application's authentication configuration file is located at config/auth.php. This file contains several well-documented options for tweaking the behavior of Laravel's authentication services.

- Authorization:

  In addition to providing built-in authentication services, Laravel also provides a simple way to authorize user actions against a given resource. For example, even though a user is authenticated, they may not be authorized to update or delete certain Eloquent models or database records managed by your application. Laravel's authorization features provide an easy, organized way of managing these types of authorization checks.

Laravel provides two primary ways of authorizing actions: gates and policies. Think of gates and policies like routes and controllers. Gates provide a simple, closure-based approach to authorization while policies, like controllers, group logic around a particular model or resource. In this documentation, we'll explore gates first and then examine policies.

You do not need to choose between exclusively using gates or exclusively using policies when building an application. Most applications will most likely contain some mixture of gates and policies, and that is perfectly fine! Gates are most applicable to actions that are not related to any model or resource, such as viewing an administrator dashboard. In contrast, policies should be used when you wish to authorize an action for a particular model or resource.

5.2.2 Hardware tools

Arduino UNO

Arduino in figure [16], is an open-source platform used for building electronics projects, Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not

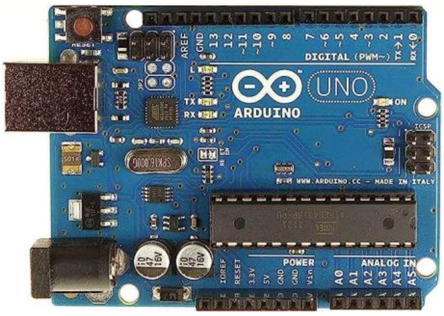


Figure 17: Arduino uno

need a separate piece of hardware (called a programmer) in order to load new code onto the board -- you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program.

Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

ESP32 Dev-Kit

ESP32 in figure [17] is a series of low-cost, low-power system on a chip microcontroller with integrated Wi-Fi and dual-mode Bluetooth. The ESP32 series employs either a Tensilica Xtensa LX6 microprocessor in both dual-core and single-core variations, Xtensa LX7 dual-core microprocessor or a single-core RISC-V microprocessor and includes built-in antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power-management modules. ESP32 is created and developed by Espressif Systems, a Shanghai-based Chinese company, and is manufactured by TSMC using their 40 nm process. [2] It is a successor to the ESP8266 Microcontroller.

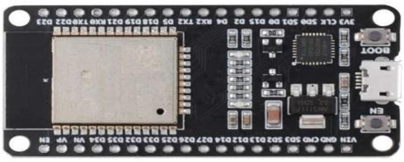


Figure 18: Esp32 Devkit

RC522

The MFRC522 is a highly integrated reader/writer IC for contactless communication at 13.56 MHz. The MFRC522 reader supports ISO/IEC 14443 A/MIFARE and NTAG. The MFRC522's internal transmitter is able to drive a reader/writer antenna designed to communicate with ISO/IEC 14443 A/MIFARE cards and transponders without additional active circuitry. The receiver module provides a robust and efficient implementation for demodulating and decoding signals from ISO/IEC 14443 A/MIFARE compatible cards and transponders. The digital module manages the complete ISO/IEC 14443 A framing and error detection (parity and CRC) functionality. The MFRC522 supports MF1xxS20, MF1xxS70 and MF1xxS50 products. The MFRC522 supports contactless communication and uses MIFARE higher transfer speeds up to 848 kBd in both directions.

The RC522 module has a total of 8 pins that connect it to the outside world. The connections are as follows:

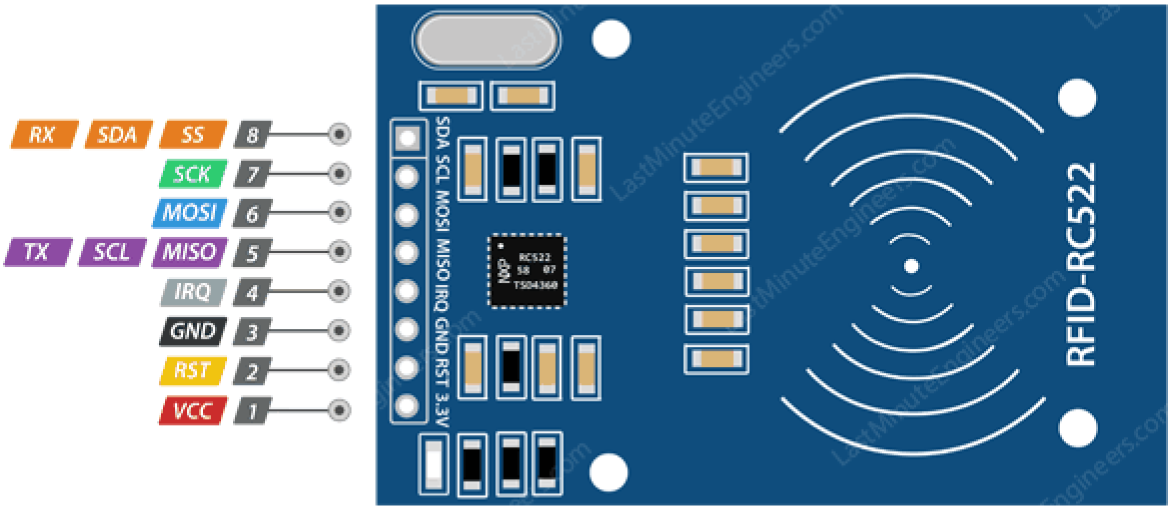


Figure 19:RC522

VCC supplies power to the module. This can be anywhere from 2.5 to 3.3 volts. You can connect it to the 3.3V output from your Arduino. But remember that connecting it to the 5V pin will probably destroy your module!

RST is an input for reset and power-down. When this pin goes low the module enters power-down mode. In which the oscillator is turned off and the input pins are disconnected from the outside world. Whereas the module is reset on the rising edge of the signal.

GND is the ground pin and needs to be connected to the GND pin on the Arduino.

IRQ is an interrupt pin that alerts the microcontroller when an RFID tag is in the vicinity.

MISO / SCL / Tx pin acts as master-in-slave-out when SPI interface is enabled, as serial clock when I2C interface is enabled and as serial data output when the UART interface is enabled.

MOSI (Master Out Slave In) is the SPI input to the RC522 module.

SCK (Serial Clock) accepts the clock pulses provided by the SPI bus master i.e. Arduino.

SS / SDA / Rx pin acts as a signal input when the SPI interface is enabled, as serial data when the I2C interface is enabled and as a serial data input when the UART interface is enabled. This pin is usually marked by encasing the pin in a square so that it can be used as a reference to identify other pins.

5.2.3 Front-End

For designing the previous pages, we have used the following tools:

Html

The Hyper Text Markup Language or HTML is the standard markup language for documents designed to be displayed in a web browser. It is often assisted by technologies such as Cascading Style Sheets and scripting languages such as

JavaScript.

CSS

Cascading Style Sheets is a style sheet language used for describing the presentation of a document written in a markup language such as HTML or XML. CSS is a cornerstone technology of the World Wide Web, alongside HTML and JavaScript.

JS

JavaScript, often abbreviated as JS, is a programming language that is one of the core technologies of the World Wide Web, alongside HTML and CSS.

As of 2023, 98.7% of websites use JavaScript on the client side for webpage behavior, often incorporating third-party libraries.

Bootstrap

Bootstrap is a free and open-source CSS framework directed at responsive, mobile-first front-end web development. It contains HTML,

CSS and JavaScript-based design templates for typography, forms,

buttons, navigation, and other interface components.

5.2.4 Back-End

In order to implement the functionality of the system we used the following:

Xampp

XAMPP is a free and open-source cross-platform web server solution stack package developed by Apache Friends, consisting mainly of the Apache HTTP Server, MariaDB database, and interpreters for scripts written in the PHP and Perl programming languages.

PHP

PHP is a general-purpose scripting language geared toward web development. It was originally created by Danish-Canadian programmer Rasmus Lerdorf in 1994. The PHP reference implementation is now produced by The PHP Group. PHP originally stood for Personal Home Page, but it now stands for the recursive initialization PHP: Hypertext Preprocessor.

PHP code is usually processed on a web server by a PHP interpreter implemented as a module, a daemon or as a Common Gateway Interface (CGI) executable. On a web server, the result of the interpreted and executed PHP code – which may be any type of data, such as generated HTML or binary image data – would form the whole or part of an HTTP response. Various web template systems, web content management systems, and web frameworks exist which can be employed to orchestrate or facilitate the generation of that response. Additionally, PHP can be used for many programming tasks outside the web context, such as standalone graphical applications and robotic drone control. PHP code can also be directly executed from the command line.

The standard PHP interpreter, powered by the Zend Engine, is free software released under the PHP License. PHP has been widely ported and can be deployed on most web servers on a variety of operating systems and platforms.

The PHP language evolved without a written formal specification or standard until 2014, with the original implementation acting as the de facto standard which other implementations aimed to follow. Since 2014, work has gone on to create a formal PHP specification.

Chapter 6: System Implementation

Chapter 6: System Implementation

6.1Hardware Implementation

Finger print sensor interfacing with Arduino

A fingerprint scanner is an electronic security device that employs biometric authentication to provide users access to information or authorize transactions. Fingerprint scanners used to be something you only saw in movies and TV shows or read about in science fiction novels. However, the days of human engineering skill surpassing imagination are long gone—fingerprint scanners have been in use for decades! Fingerprint scanners are not only becoming increasingly widespread in the latest mobile gadgets, but they're also making inroads into everyday life. What you need to know about fingerprint scanners and how they function is outlined here.

Fingerprint scanners capture the ridges and valleys on a finger's pattern. The information is then compared to a list of registered fingerprints on file by the device's pattern analysis/matching software. A successful match indicates that an identity has been validated and hence access has been granted. The process for obtaining fingerprint data varies depending on the scanner used.

Work method for optical scanner

The principle of Total Internal Reflection governs the operation of an optical fingerprint scanner (TIR). A glass prism is utilized to permit TIR in such a scanner. For TIR to occur, light from an LED is permitted to penetrate through one face of the prism at a certain angle. The reflected light passes through the prism's opposite face, which houses a lens and an image sensor.

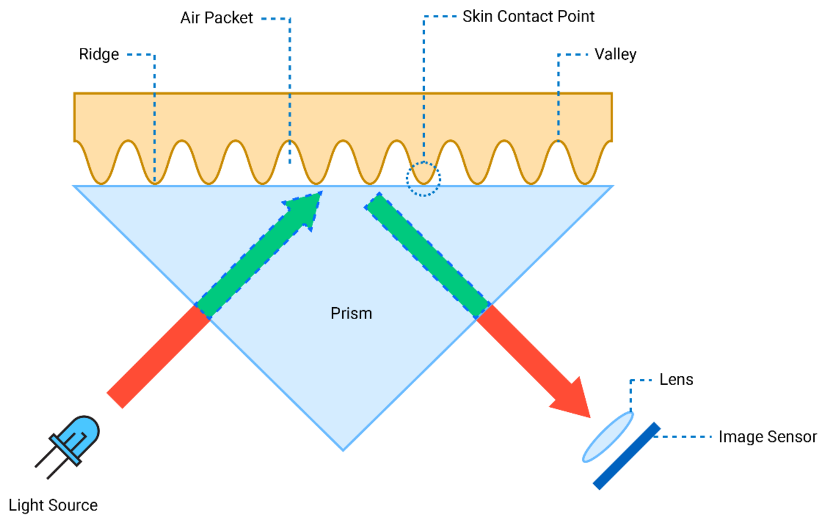


Figure 20 Optical fingerprint scanner working Principle

When there is no finger on the prism, the light is entirely reflected off the surface, leaving the image sensor with a plain image. The Evanescent Wave arises when TIR occurs and a tiny quantity of light is spilled to the external medium. The evanescent wave interacts differently with materials with various refractive indices (RI). Only the ridges make excellent contact with a glass surface when we touch it. Air packets keep the valleys isolated from the surface. Our skin and air have distinct RIs, hence they have differing effects on the evanescent field.

In our project we use SM12 scanner

SM12 is a standalone fingerprint module equipped with Optical Sensor, CMOS Image Sensor, CPU and Flash Memory. Via UART interface, SM12 Fingerprint Module is readily applicable to time & attendance applications. SM12 Fingerprint Module offers comprehensive functions to be integrated into middle & high biometric fingerprint end products.

Processing steps:

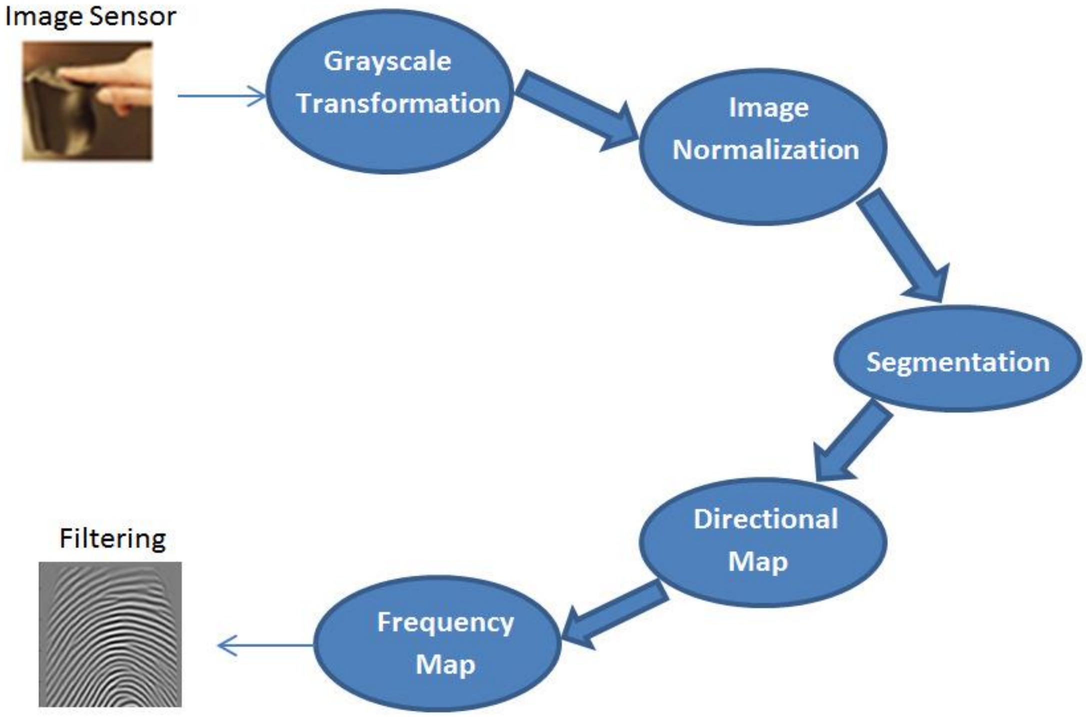


Figure 21 processing steps

- Gray scale transformation: The image becomes smaller because each pixel will be represented on 8 bits (from 0 to 255 grey levels) instead of 24 bits for the color image (RGB).
- Image normalization: Normalization is used to standardize the intensity values in an image by adjusting the range of grey level values, the structure of the image does not change, and the variation in grey levels is standardized.
- Segmentation: The segmentation makes it possible to eliminate the edges of the image as well as the too noisy zones.

.3.3 $g(x,y) = \begin{cases} 0, & f(x,y) < T \\ 1, & f(x,y) \geq T \end{cases}$

- Directional map: The directional map makes it possible to specify the local direction of the constituent elements for each pixel (or block of pixel).
- Frequency map: The frequency map of the image consists of estimating the local frequency of the elements in each pixel.

Fingerprint sensor interfacing with Arduino

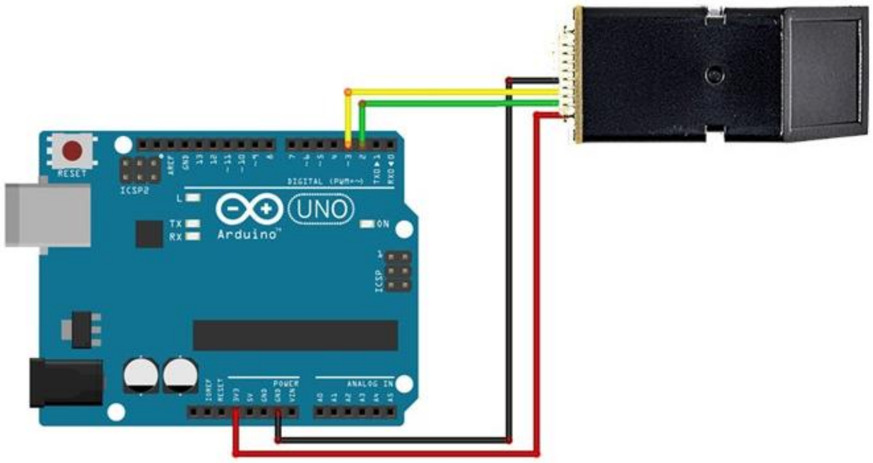


Figure 22 connection Arduino with fingerprint

Fingerprint recognition technology can be used to store attendance information in a library management system

- Hardware setup: The first step is to set up the hardware components. This includes connecting a fingerprint scanner to an Arduino board and connecting the Arduino board to a computer.
- Fingerprint enrollment: The next step is to enroll users into the system by capturing their fingerprints and storing them in the fingerprint scanner. This can be done using the fingerprint scanner's software or by using an Arduino library that supports fingerprint enrollment.

- Fingerprint authentication: When a user enters the library, they can authenticate themselves by placing their finger on the fingerprint scanner. The scanner will compare the user's fingerprint to the stored fingerprints in the system to identify the user.
- Attendance recording: Once the user has been authenticated, the Arduino board can use the Serial.print() function to send a signal to the computer's serial monitor to record the user's attendance, along with the date and time. This information can be stored in a text file or directly in an Excel sheet.
- The Excel file is uploaded by the system administrator to the database, and this data is used to generate reports

Here are some additional considerations when using fingerprint recognition for attendance tracking:

- System Security: It is important to ensure that the fingerprint recognition system is secure and protected from unauthorized access. The system should use encryption and other security measures to protect user data.
- User Privacy: It is important to obtain user consent and follow best practices for data privacy when using fingerprint recognition technology. Users should be informed about how their data will be used and have the option to opt out of the system if they prefer.
- System Maintenance: The fingerprint recognition system should be regularly maintained and calibrated to ensure accurate readings. The system should also be tested and monitored for any errors or malfunctions.

By using fingerprint recognition to store attendance information, libraries can improve the accuracy and efficiency of attendance tracking, while also providing a convenient and secure way for users to authenticate themselves

RC522 interfacing with Arduino uno

With this technology, each library member can be issued a unique RFID card that contains their personal information. When they enter the library, they can scan their card using the RC522 reader connected to an Arduino board. The Arduino board can then process this information and store it in a Excel sheet database or send it to a central server.

This system provides an efficient way to manage attendance in libraries and can be used to automatically keep track of which members are using the library and when. It can also be used to generate reports on library usage patterns and help librarians make informed decisions about resource allocation and library policies.

Overall, the combination of RC522 recognition technology and Arduino boards can be a powerful tool for creating attendance systems and other applications in library management

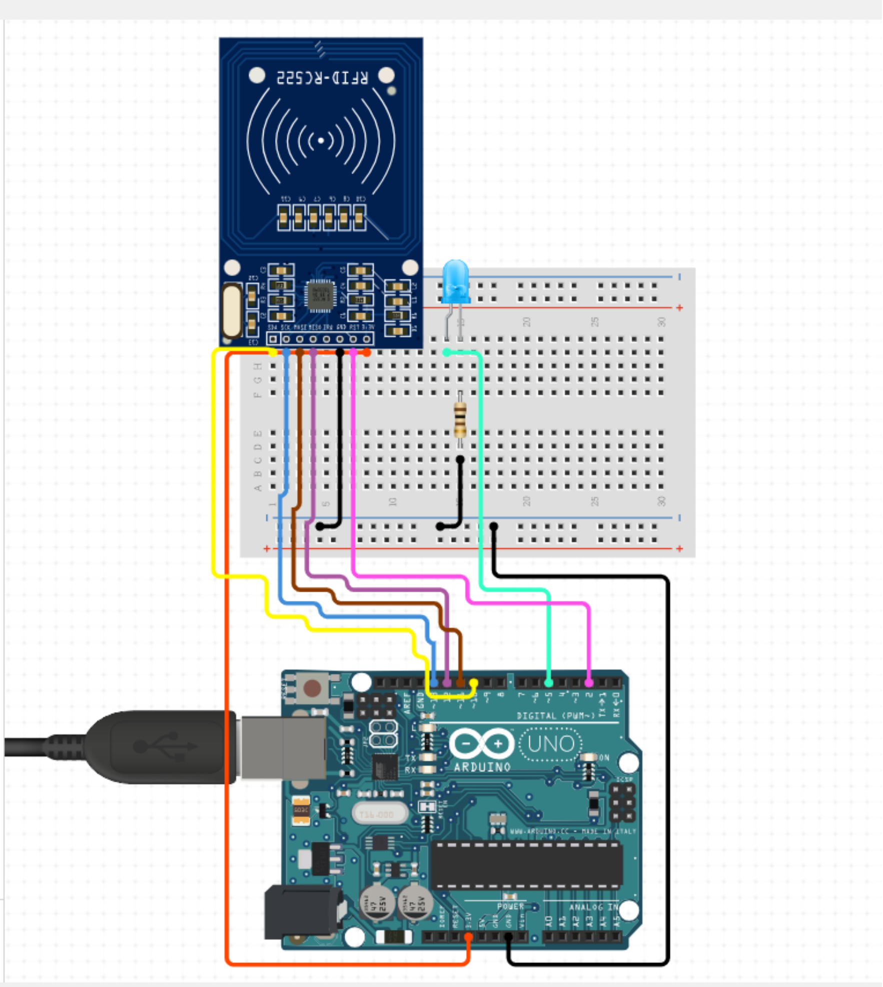


Figure 23: RFID interfacing with Arduino

RC522 interfacing with ESP32 and Laravel "Scanner system"

Used components

- RC522 reader
- 13.56MHZ tag
- ESP32 devkit v1
- LED
- Battery
- USB Type B

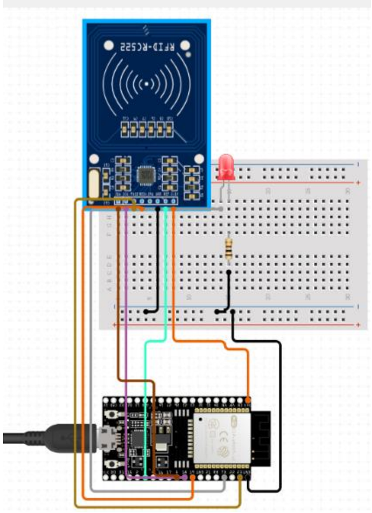


Figure 24: RC522 interfacing with ESP32

As we stated previously the problem of checking all library books every year is a burden for the librarians so, we decide to make this system to make this process faster and more accurate, the scenario for the applied system goes as:

first the librarian will start scan each book and wait for the led to turn off "this process take seconds" then continue to do the same for the remaining books, the scanner transmits the data to the system data base and change the state of the book from 0 to 1 after we scan all the book the librarian will check the website to view all unscanned books which means that they aren't in the library he also can check all scanned books, check all scanned books.

Table 5: RC522 interfacing with ESP32

Sr No	**RFID RC522 Pins**	**ESP32 Pins**
1	VCC	+3.3V
2	RST	D0
3	GND	GND
4	MISO	19
5	MOSI	23
6	SCK	18
7	SS/SDA	5

6.2 Software Implementation

Login and Registration

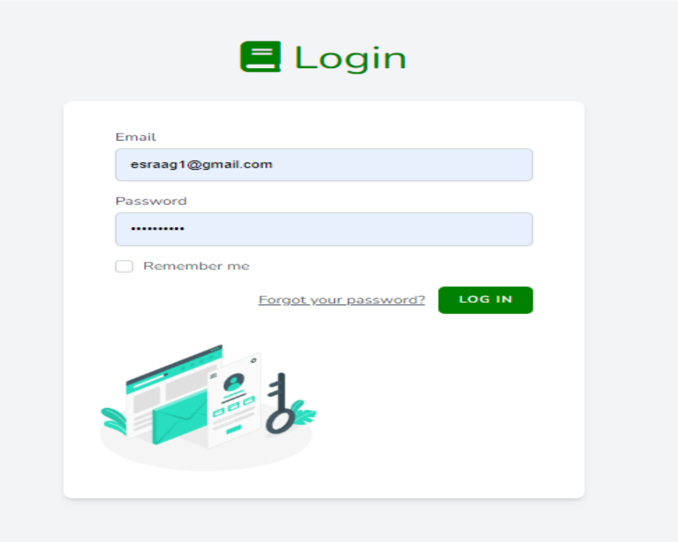
The Login at figure [25] and Registration at figure [26] pages are key components of a library management system's user interface, as they allow users to access the system and manage their accounts. Here's a description of each page:

Login Page

The Login page is the first page that a user will see when they try to access the library management system. The page typically includes a form where the user can enter their username/email and password to access their account.

Registration Page

The Registration page is where a new user can create an account for the library management system. The page typically includes a form where the user can enter their personal information, such as name, email, address, and phone number, and choose a username and password.



Login

Email

esraag1@gmail.com

Password

••••••••••

□ Remember me

Figure 25: Login page

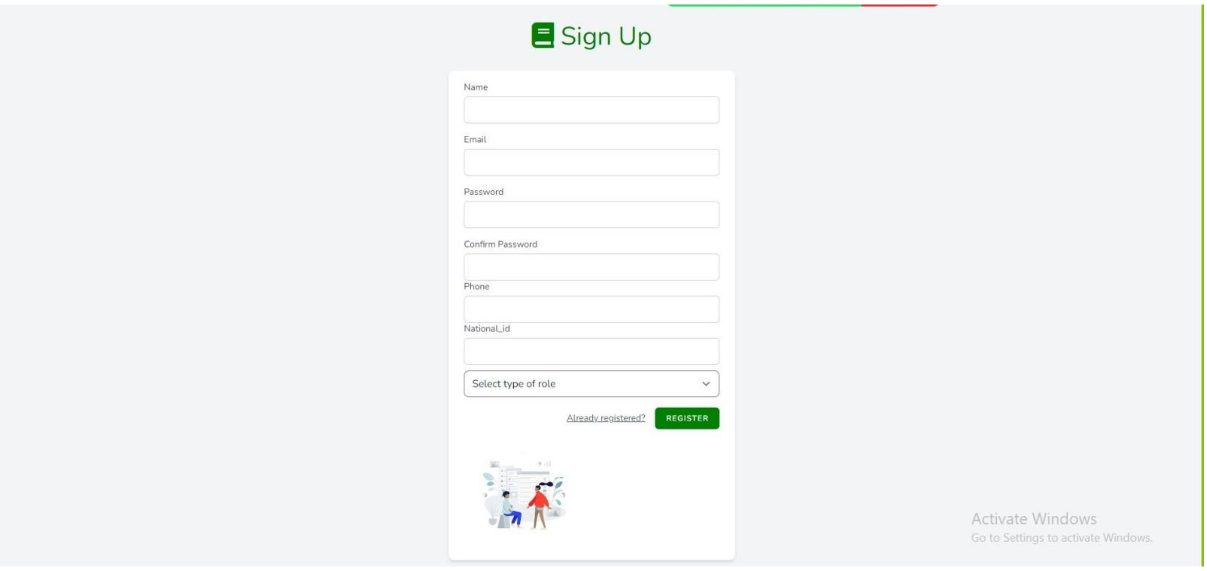
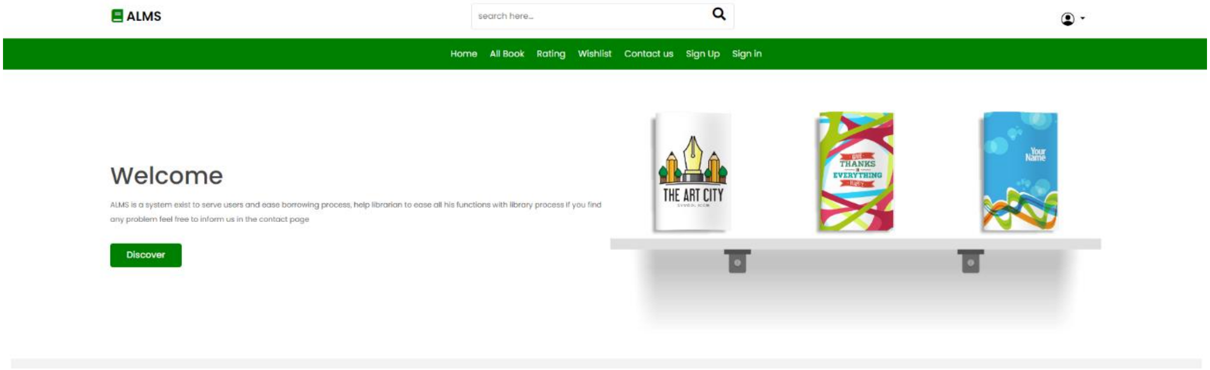


Figure 26: Registration page

User Home page

The User Home page is the primary landing page for users when they log in to a library management system. It provides users with a summary of their account information, as well as quick access to key features and functions of the system



ALMS is a system exist to serve users and ease borrowing process, help librarian to ease all his functions with library process if you find any problem feel free to inform us in the contact page

Figure 27: Home page

Rate and View books

The ability to rate and view books as shown in figure [28], is a key feature of many library management systems that allows users to provide feedback on the books they've read and help other users discover new books that they might enjoy.

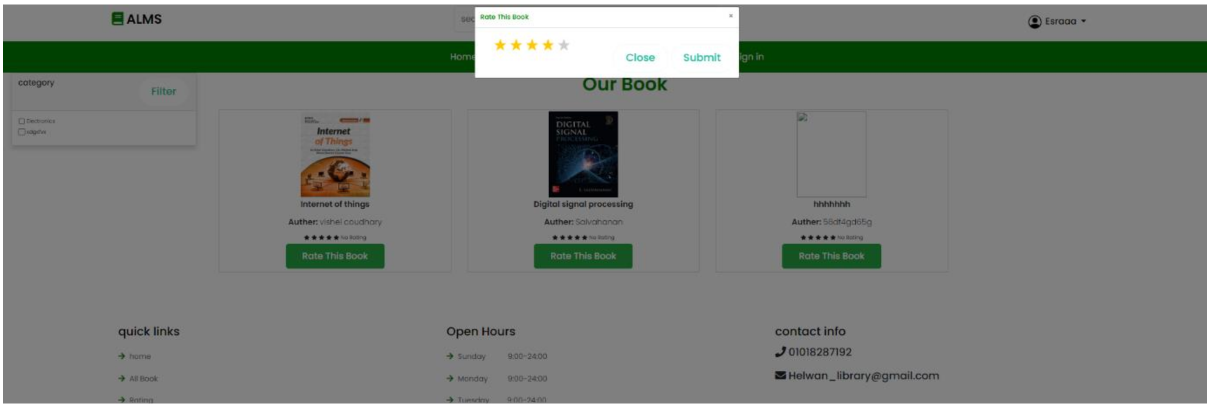


Figure 28: Rate and view book

High rating books

View the highest rated books at figure [29], high rating books are books that have received consistently positive ratings and reviews from users of a library management system. These books are often popular among readers and may be widely recommended by the library or its users.

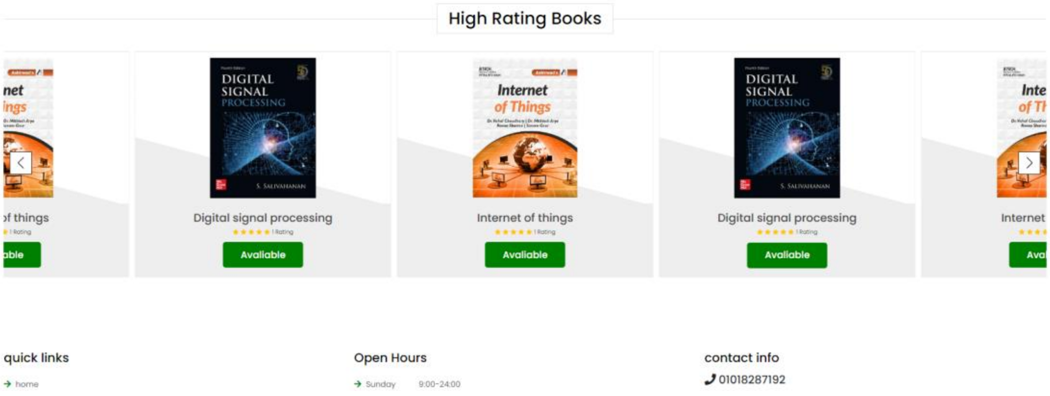
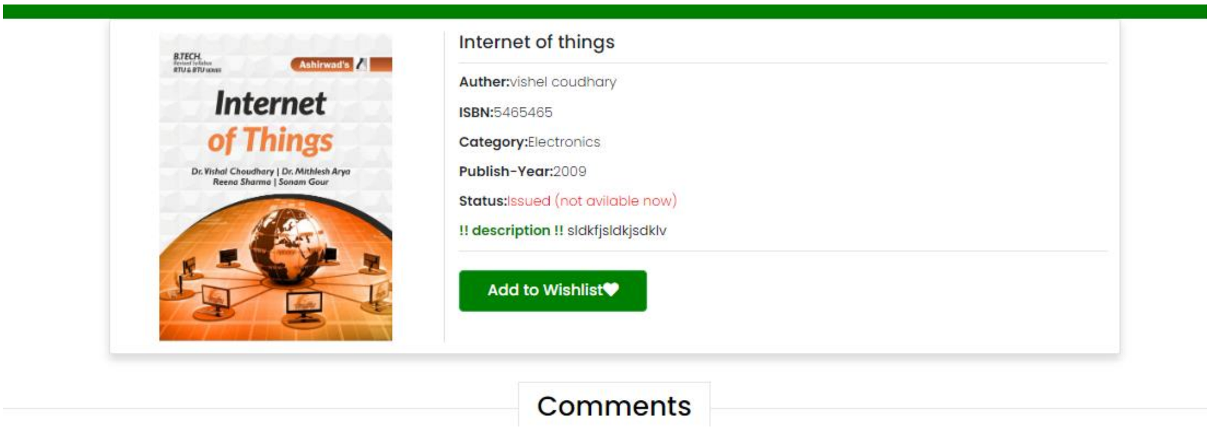


Figure 29: High rating books

View book info

Viewing book info is a key feature of library management systems that allows users to access detailed information about a book, such as its title, author, publication date, and summary.



Internet of things

Auther:vishel coudhary

ISBN:5465465

Category: Electronics

Publish-Year:2009

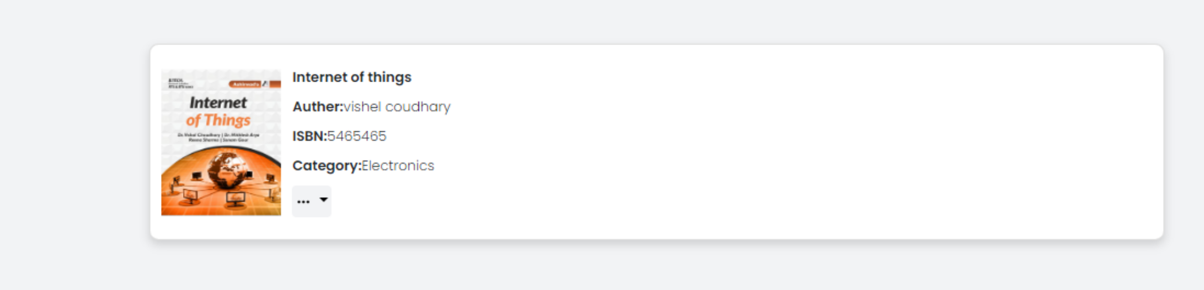
Status: Issued (not avilable now)

!! description !! sldkfjsldkjsdklv

Figure 30: Book info

Wishlist

The Wishlist is a feature of many library management systems that allows users to create a personalized list of books that they are interested in reading or checking out in the future.



Internet of things

Auther:vishel coudhary

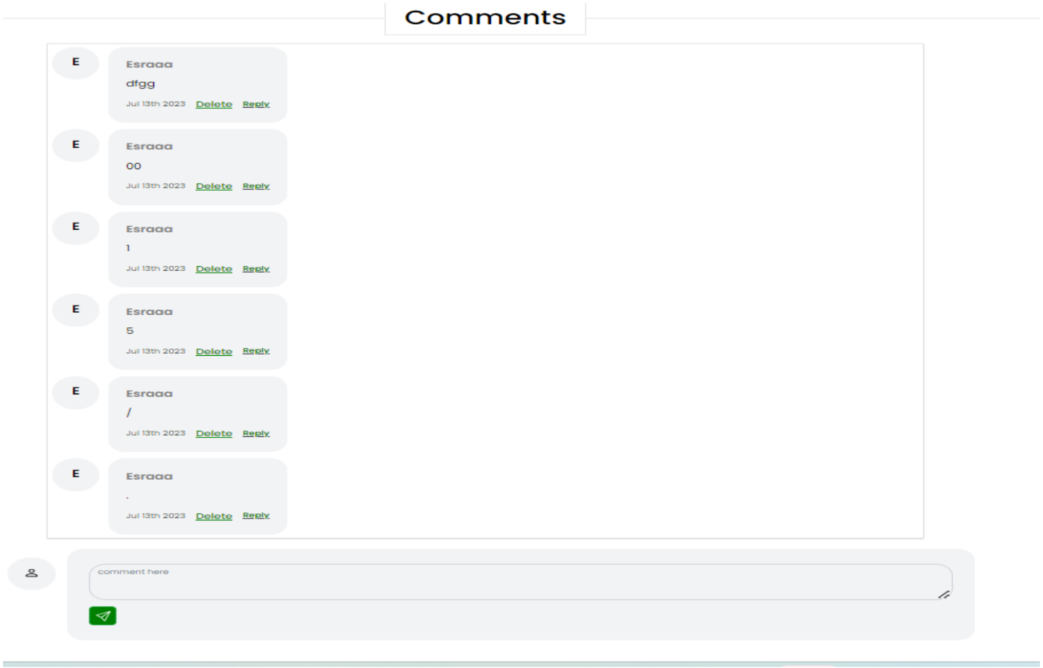
ISBN:5465465

Category: Electronics

Figure 31: Wish list section

View Comments section

The View Comments section is a feature in the library management systems that allows users to read and post comments on books, as well as engage with other users who have read the same book.



Comments

E Esraaa
dfgg
Jul 13th 2023 Delete Reply

E Esraaa
00
Jul 13th 2023 Delete Reply

E Esraaa
1
Jul 13th 2023 Delete Reply

E Esraaa
5
Jul 13th 2023 Delete Reply

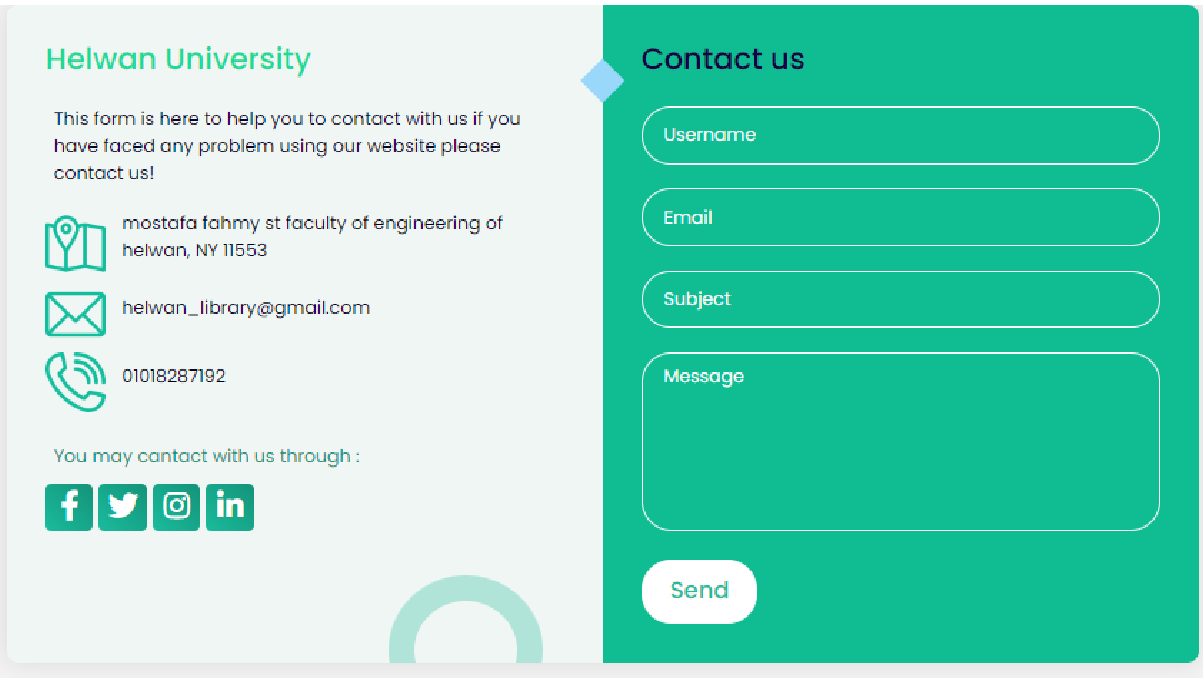
E Esraaa
/
Jul 13th 2023 Delete Reply

E Esraaa
.
Jul 13th 2023 Delete Reply

Figure 32: cooment section

Contact form

A contact form is a feature of many library management systems that allows users to communicate with the library's staff, ask questions, report issues, or provide feedback.



Helwan University

This form is here to help you to contact with us if you have faced any problem using our website please contact us!

mostafa fahmy st faculty of engineering of helwan, NY 11553

helwan_library@gmail.com

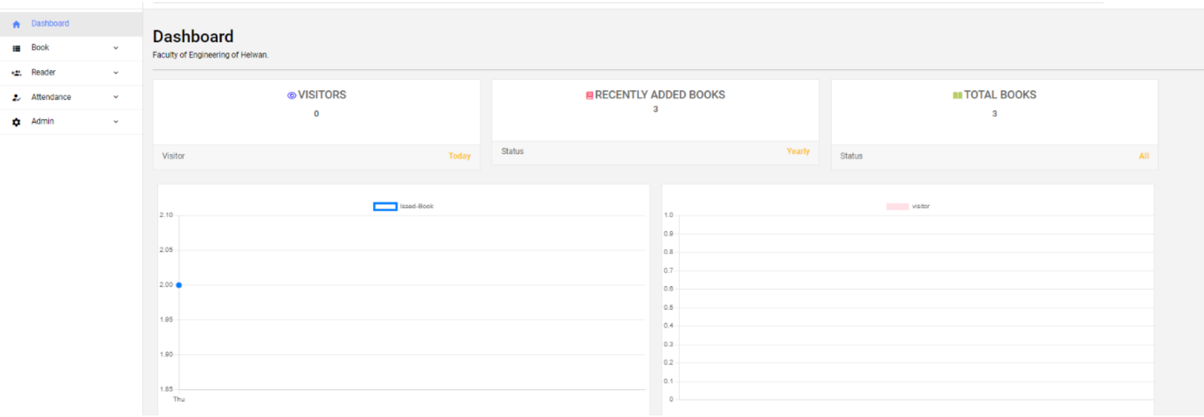
01018287192

You may cantact with us through :

Contact us

Admin dashboard

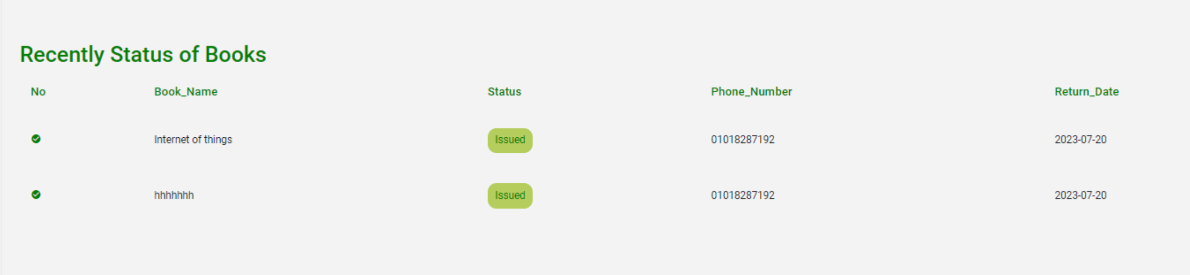
An admin dashboard is a feature of library management systems that provides library staff with a centralized interface for managing the library's collection, users, and service.



Dashboard

Faculty of Engineering of Helwan.

Figure 34: Dashboard



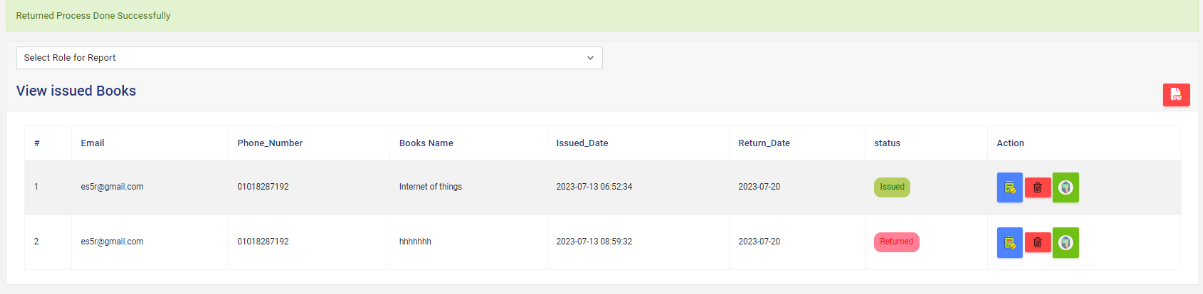
Recently Status of Books

No	Book_Name	Status	Phone_Number	Return_Date
✓	Internet of things	Issued	01018287192	2023-07-20
✓	hhhhhhh	Issued	01018287192	2023-07-20

Figure 35: Recently issued books

Add and view books and issued books

Adding and viewing books, as well as tracking issued books, are important features of library management systems.



Returned Process Done Successfully

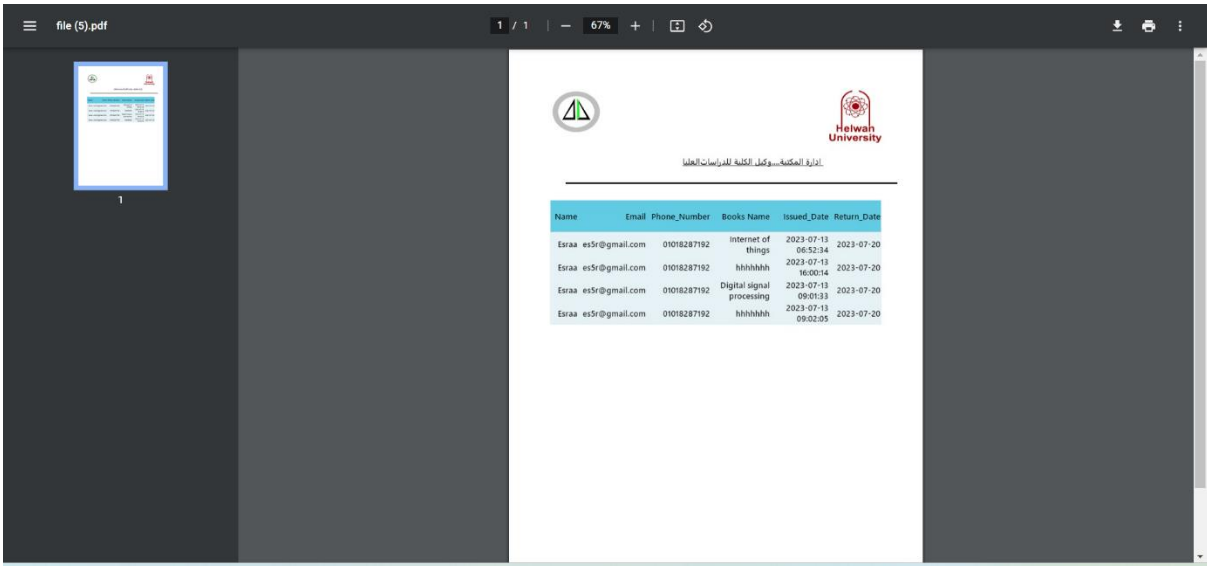
Select Role for Report

View issued Books

#	Email	Phone_Number	Books Name	Issued_Date	Return_Date	status	Action
1	es5r@gmail.com	01018287192	Internet of things	2023-07-13 06:52:34	2023-07-20	Issued	
2	es5r@gmail.com	01018287192	hhhhhhh	2023-07-13 08:59:32	2023-07-20	Returned	

Figure 36: view issued books

You can download issued books



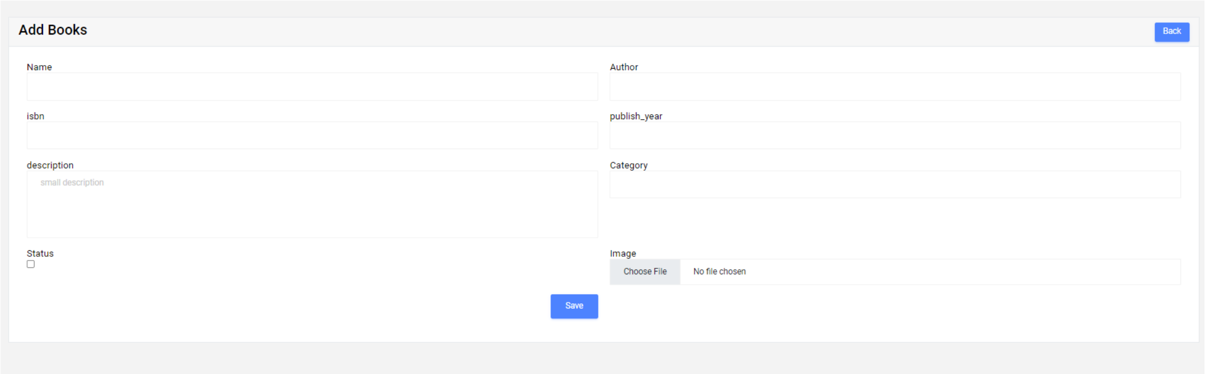
ادارة المكتبة...وكيل الكلية للدراسات العليا

Name	Email	Phone_Number	Books Name	Issued_Date	Return_Date
Esraa	es5r@gmail.com	01018287192	Internet of things	2023-07-13 06:52:34	2023-07-20
Esraa	es5r@gmail.com	01018287192	hhhhhhh	2023-07-13 16:00:14	2023-07-20
Esraa	es5r@gmail.com	01018287192	Digital signal processing	2023-07-13 09:01:33	2023-07-20
Esraa	es5r@gmail.com	01018287192	hhhhhhh	2023-07-13 09:02:05	2023-07-20

Figure 37: Report

Add book

Adding a book to a library's collection is an important task in library management, the addition process is as shown in the figure [38].



Add Books

Name

Author

isbn

publish_year

description

small description

Category

Status

□

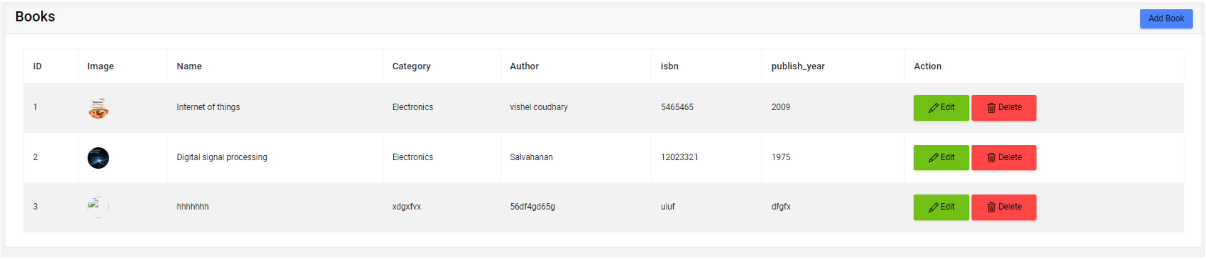
Image

No file chosen

Figure 38: Add book

Viewed books in librarian view

In a library management system, the librarian view provides staff members with a centralized interface for managing all aspects of the library's operations.



Books

ID	Image	Name	Category	Author	isbn	publish_year	Action
1		Internet of things	Electronics	vishel coudhary	5465465	2009	Edit Delete
2		Digital signal processing	Electronics	Salvahanan	12023321	1975	Edit Delete
3		hhhhhhh	xdgxfvx	56df4gd65g	uiuf	dfgfx	Edit Delete

Figure 39: Viewed books in librarian view

View and add user data

Viewing and adding user data are important tasks in library management. Here's a figure [40], [41] of how the process of viewing and adding user data typically works using a library management system.

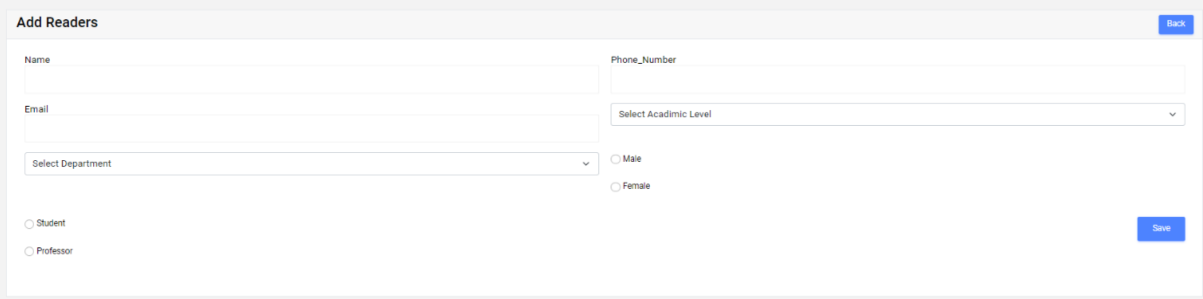
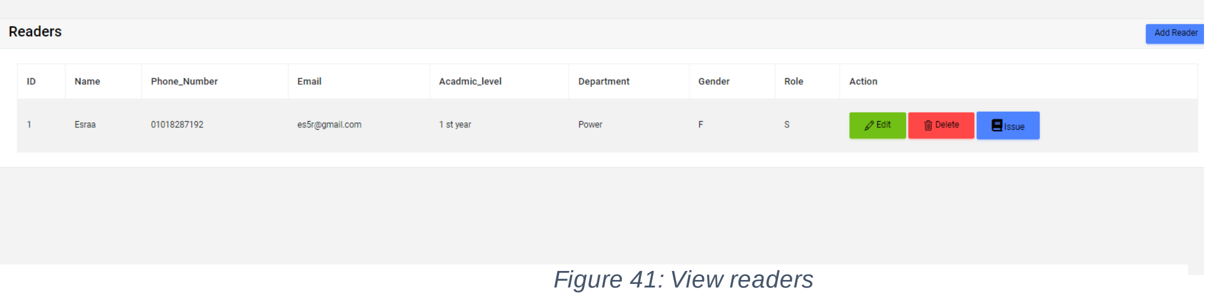


Figure 40: Add reader

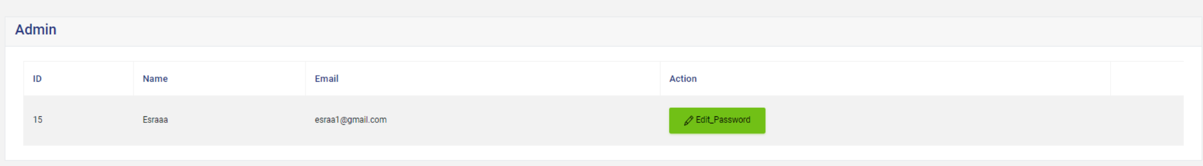


ID	Name	Phone_Number	Email	Acadmic_level	Department	Gender	Role	Action
1	Esraa	01018287192	es5r@gmail.com	1 st year	Power	F	S	Edit Delete Issue

Figure 41: View readers

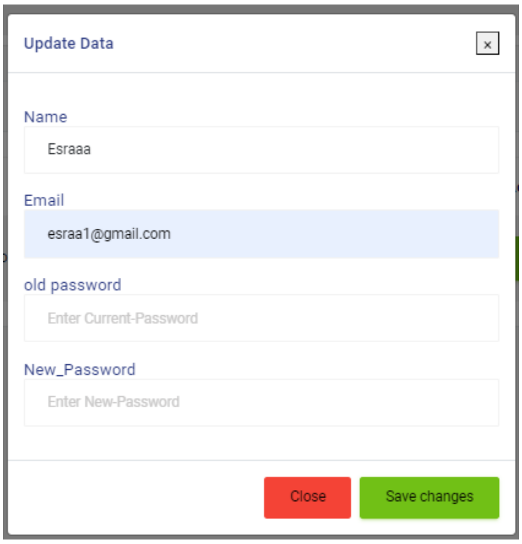
View and edit librarian data

in library management systems, librarian data typically includes information about library staff members who have access to the system's administrative features. Here's a figure [42],[43] of how the process of viewing and editing librarian data typically works.



ID	Name	Email	Action
15	Esraaa	esraa1@gmail.com	Edit_Password

Figure 42: View Admin info



Update Data

Name

Esraaa

Email

esraa1@gmail.com

old password

Enter Current-Password

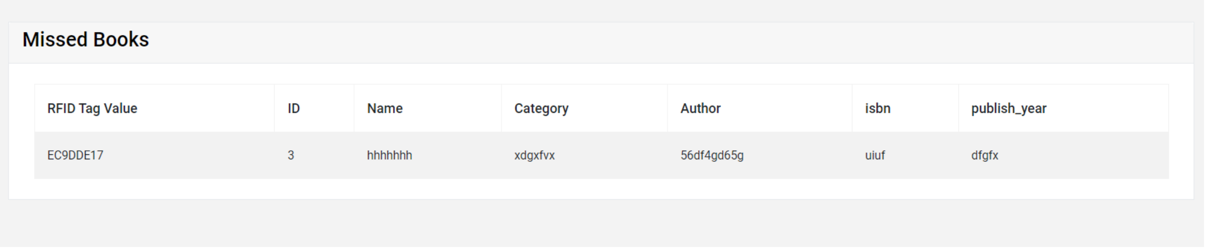
New_Password

Enter New-Password

Figure 43: Edit Admin data

Scanner pages

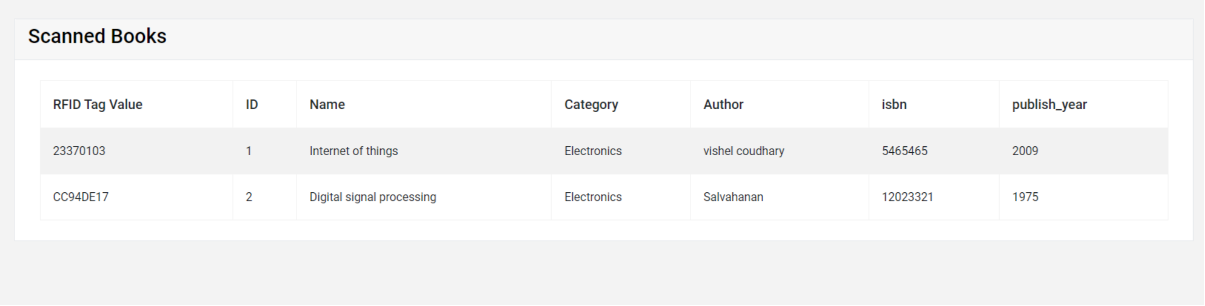
These pages represent the interfacing of the website with the scanner used to scan books



Missed Books

RFID Tag Value	ID	Name	Category	Author	isbn	publish_year
EC9DDE17	3	hhhhhhh	xdgxfvx	56df4gd65g	uiuf	dfgfx

Figure 44: Unscanned books



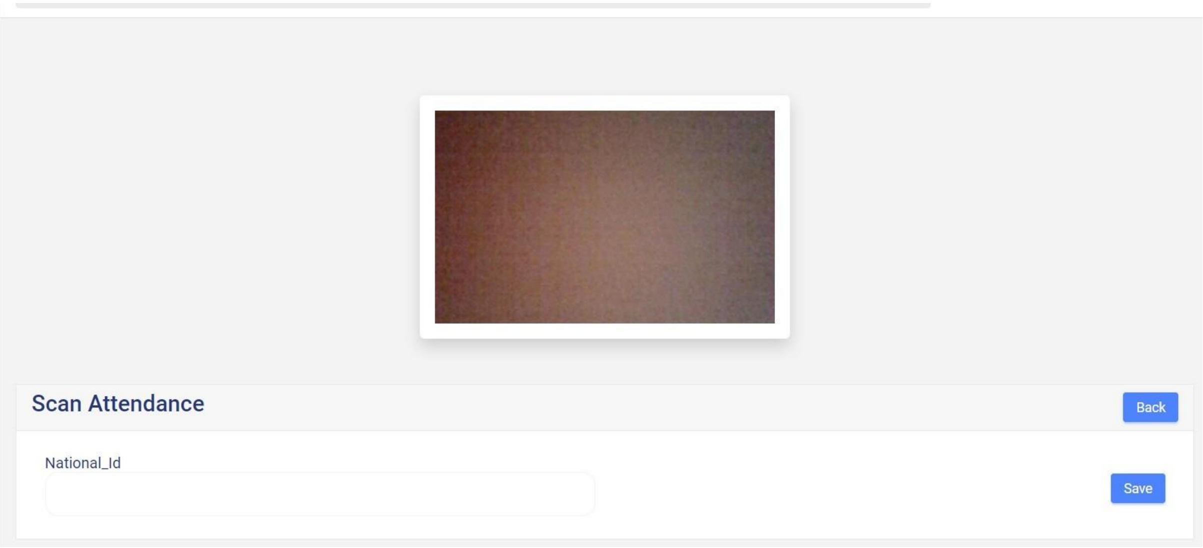
Scanned Books

RFID Tag Value	ID	Name	Category	Author	isbn	publish_year
23370103	1	Internet of things	Electronics	vishel coudhary	5465465	2009
CC94DE17	2	Digital signal processing	Electronics	Salvahanan	12023321	1975

Figure 45:Scanned books

Scanning and view attendance

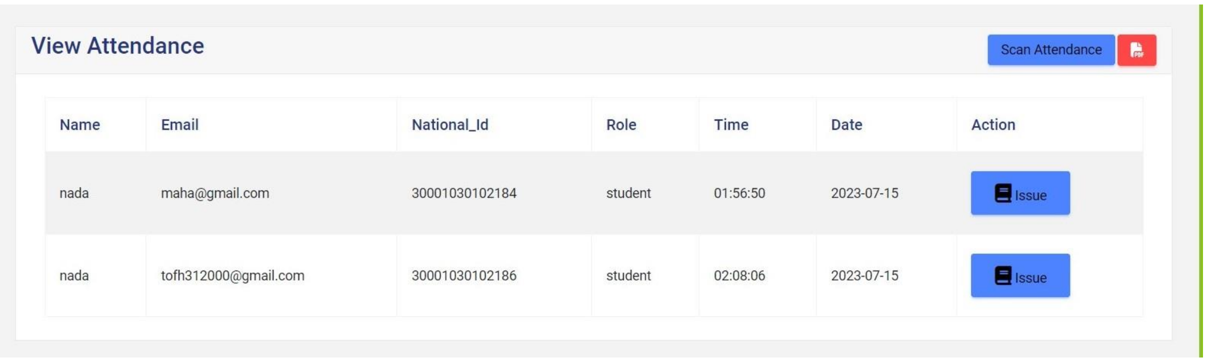
Tracking attendance is an important function in library management systems, particularly for events, workshops, and other programs. Here's a figure [46],[47] of how the process of scanning and viewing attendance typically works.



Scan Attendance

National_Id

Figure 46: scan attendance



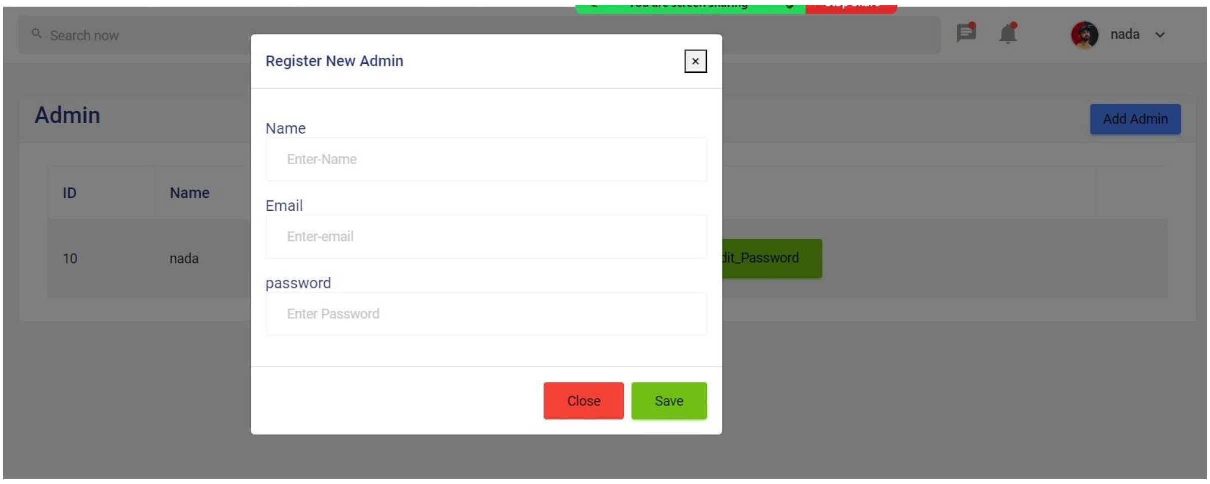
View Attendance

Name	Email	National_Id	Role	Time	Date	Action
nada	maha@gmail.com	30001030102184	student	01:56:50	2023-07-15	Issue
nada	tofh312000@gmail.com	30001030102186	student	02:08:06	2023-07-15	Issue

Figure 47: View attendance

Register new admin

In library management systems, registering a new admin involves creating a new account for a staff member who will have access to the system's administrative features. Figure [48] is a description of how the process of registering a new admin typically works.



Register New Admin

Name

Enter-Name

Email

Enter-email

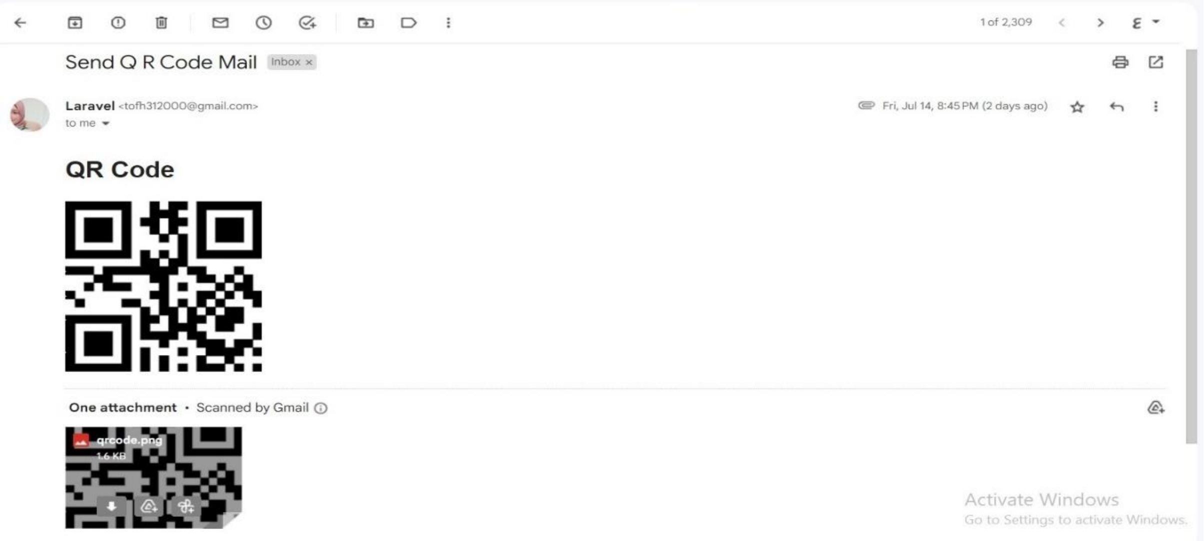
password

Enter Password

Figure 48: Register new admin

Send QR code email

Sending a QR code via email can be a convenient way to provide users with a quick and easy way to access library services or resources.



Send Q R Code Mail

Laravel <tofh312000@gmail.com>

to me

Fri, Jul 14, 8:45 PM (2 days ago)

QR Code

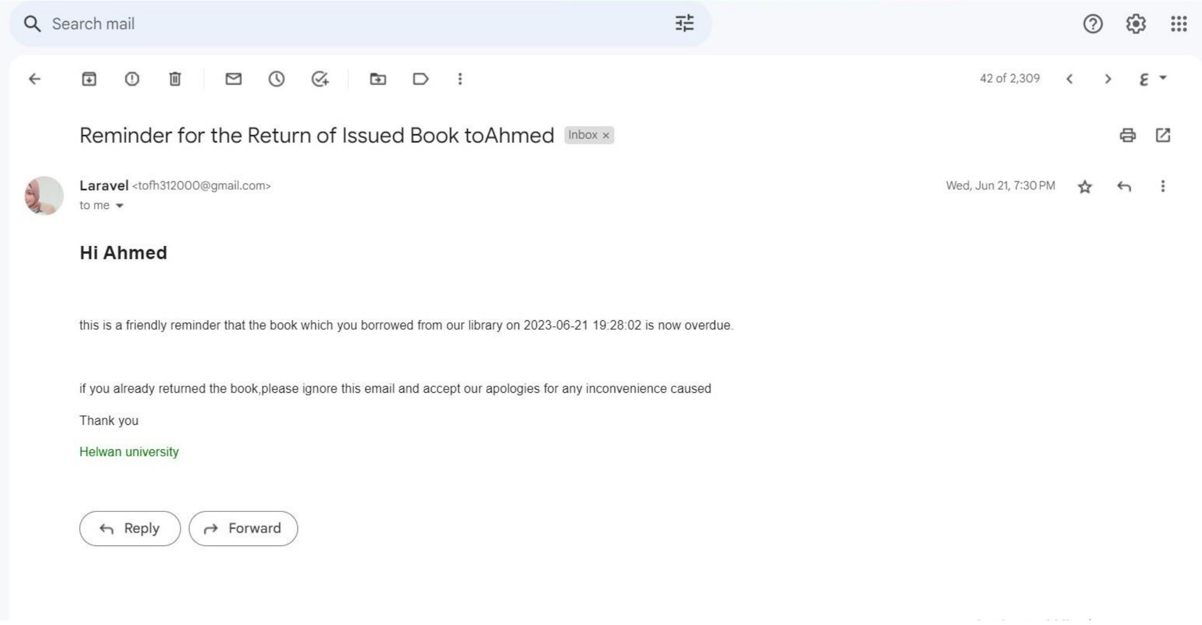
One attachment • Scanned by Gmail

qrcode.png 1.6 KB

Figure 49: Send QR code email

Reminder for the return of issued book

Send a reminder email to return a released book to remind the user.



Reminder for the Return of Issued Book toAhmed

Laravel <tofh312000@gmail.com>
to me

Wed, Jun 21, 7:30 PM

Hi Ahmed

this is a friendly reminder that the book which you borrowed from our library on 2023-06-21 19:28:02 is now overdue.

if you already returned the book,please ignore this email and accept our apologies for any inconvenience caused

Thank you

Helwan university

Figure 50: Reminder for the return of issued book

Chapter 7: Testing and Validation

Chapter 7: Testing and Validation

Software testing is the process of evaluating and verifying that a software product or application does what it is supposed to do. The benefits of testing include preventing bugs, reducing development costs and improving performance.

How does software testing work?

Software testing is the process of evaluating and verifying that a software product or application does what it is supposed to do. The benefits of testing include preventing bugs, reducing development costs and improving performance.

Types of software testing

There are many different types of software tests, each with specific objectives and strategies:

- Acceptance testing: Verifying whether the whole system works as intended.
- Integration testing: Ensuring that software components or functions operate together.
- Unit testing: Validating that each software unit performs as expected. A unit is the smallest testable component of an application.
- Functional testing: Checking functions by emulating business scenarios, based on functional requirements. Black-box testing is a common way to verify functions.
- Performance testing: Testing how the software performs under different workloads. Load testing, for example, is used to evaluate performance under real-life load conditions.

- Regression testing: Checking whether new features break or degrade functionality. Sanity testing can be used to verify menus, functions and commands at the surface level, when there is no time for a full regression test.
- Stress testing: Testing how much strain the system can take before it fails. Considered to be a type of non-functional testing.
- Usability testing: Validating how well a customer can use a system or web application to complete a task.

In each case, validating base requirements is a critical assessment. Just as important, exploratory testing helps a tester or testing team uncover hard-to-predict scenarios and situations that can lead to software errors.

Even a simple application can be subject to a large number and variety of tests. A test management plan helps to prioritize which types of testing provide the most value – given available time and resources. Testing effectiveness is optimized by running the fewest number of tests to find the largest number of defects.

7.1 Black Box Testing

Registration

Table 6: Registration black box testing

Input value	Expected output	Actual output
No input data	Error alert	Error alert
Enter password less than 8 characters	Error alert	Error alert
Enter ID less than 14 characters	Error alert	Error alert
Enter email without @gmail.com	Error alert	Error alert
No email entered	Error alert	Error alert
No password entered	Error alert	Error alert
No name entered	Error alert	Error alert

Enter unmatched password in confirm matched field	Error alert	Error alert
No password confirmation entered	Error alert	Error alert
Enter valid data and fill all field	Success message	Success message

Login

Table 7: Login black box testing

Input value	Expected output	Actual output
No input data	Error alert	Error alert
No email entered	Error alert	Error alert
No password entered	Error alert	Error alert
Enter valid data and fill all field	Success message	Success message
Enter unauthorized data	Error	Error
Enter data of admin	Redirected to admin dashboard	Redirected to admin dashboard
Enter data of normal user	Redirected to user home page	Redirected to user home page

Search field

Table 8: Search field black box testing

Input value	Expected output	Actual output
No input data	Return all books	Return all books
Enter character	Return all books which contains this character	Return all books which contains this character
Enter multiple characters	Return all books which contains these characters sequentially	Return all books which contains these characters sequentially
Enter invalid name	Return nothing	Return nothing

Comments and replies

Table 9: Comment and replies black box testing

Input value	Expected output	Actual output
No input data	No comment	No comment
Enter 0	No comment	No comment
Enter multiple characters	Displaying the written comment	Displaying the written comment
Enter single character	Displaying the written comment	Displaying the written comment
Write reply to comment	Displaying reply	Displaying reply

Add book

Table 10: Add book black box testing

Input value	Expected output	Actual output
No input data	Error alert	Error alert
No ISBN entered	Error alert	Error alert
No id entered	Error alert	Error alert
No name entered	Error alert	Error alert
No description entered	Error alert	Error alert
No author name entered	Error alert	Error alert
No category entered	Error alert	Error alert
No book's image chosen	Nothing	Nothing
Fill all fields	Success message	Success message
Fill all fields without choosing image	Success message	Success message
Fill the same data	Error	Error
Fill the same id twice	Error	Error

Register reader

Table 11: Register reader black box testing

Input value	Expected output	Actual output
No input data	Error alert	Error alert
No email entered	Error alert	Error alert
No phone number entered	Error alert	Error alert
No name entered	Error alert	Error alert
No gender selected	Error alert	Error alert
No role selected	Error alert	Error alert
No academic year chosen	Nothing	Nothing
Fill all fields	Success message	Success message
Fill all fields without choose academic year and department	Success message	Success message
Fill the same data	Error	Error
No department selected	Nothing	Nothing

Librarian setting

Table 12: Librarian setting black box testing

Input value	Expected output	Actual output
No password entered	Error alert	Error alert
No new password entered	Error alert	Error alert
No email entered	Error alert	Error alert
No name entered	Error alert	Error alert
Enter wrong password	Nothing	Nothing
Entered the same old password	Password changed	Password changed
Change email	Nothing	Nothing
Fill all fields	Success message	Success message
Change name	Name changed	Name changed

Reader editing

Table 13: Reader editing black box testing

Input value	Expected output	Actual output
No input entered	Error alert	Error alert
No new password entered	Error alert	Error alert
No email entered	Error alert	Error alert
No name entered	Error alert	Error alert
Change department	Department changed	Department changed
Change email	Email changed	Email changed
Fill all fields	Success message	Success message
Change name	Name changed	Name changed
Change gender	Gender changed	Gender changed
Change role	Role changed	Role changed

Esp32 scanning

Table 14: Esp32 scanning black box testing

Input value	Expected output	Actual output
Scan existing tag id	Change state of book to scanned one	Change state of book to scanned one
Scan non existing tag id	Nothing	Nothing

QR scanning

Table 15: QR scanning black box testing

Input value	Expected output	Actual output
Scan existing user QR code	Success	Success
Scan non existing QR code	Error alert	Error alert

7.2 Testing with Laravel

Laravel is built with testing in mind. In fact, support for testing with PHPUnit is included out of the box and a phpunit.xml file is already set up for your application. The framework also ships with convenient helper methods that allow you to expressively test your applications.

By default, your application's tests directory contains two directories: Feature and Unit. Unit tests are tests that focus on a very small, isolated portion of your code. In fact, most unit tests probably focus on a single method. Tests within your "Unit" test directory do not boot your Laravel application and therefore are unable to access your application's database or other framework services.

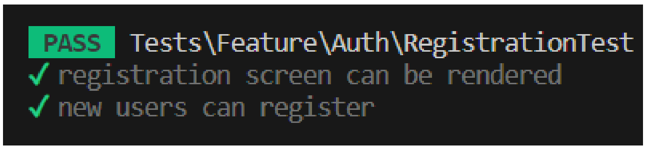
Feature tests may test a larger portion of your code, including how several objects interact with each other or even a full HTTP request to a JSON endpoint. Generally, most of your tests should be feature tests. These types of tests provide the most confidence that your system as a whole is functioning as intended.

An ExampleTest.php file is provided in both the Feature and Unit test directories. After installing a new Laravel application, execute the vendor/bin/phpunit or php artisan test commands to run your tests.

Registration Test

```
<?php

namespace Tests\Feature\Auth;

use App\Providers\RouteServiceProvider;
use Illuminate\Foundation\Testing\RefreshDatabase;
use Tests\TestCase;

class RegistrationTest extends TestCase
{
    use RefreshDatabase;

    public function test_registration_screen_can_be_rendered()
    {
        $response = $this->get('/register');

        $response->assertStatus(200);
    }

    public function test_new_users_can_register()
    {
        $response = $this->post('/register', [
            'name' => 'Test User',
            'email' => 'test@example.com',
            'password' => 'password',
            'password_confirmation' => 'password',
        ]);

        $this->assertAuthenticated();
        $response->assertRedirect(RouteServiceProvider::HOME);
    }
}
```

Results



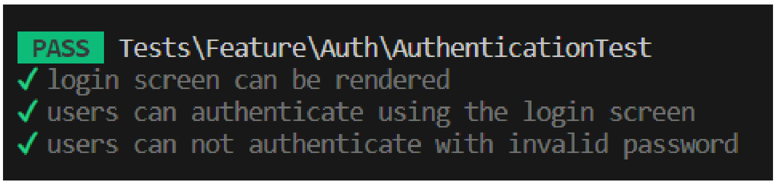
```
 PASS  Tests\Feature\Auth\RegistrationTest
✓ registration screen can be rendered
✓ new users can register
```

Figure 51:Registration test

Authentication Test

```
<?php

namespace Tests\Feature\Auth;

use App\Models\User;
use App\Providers\RouteServiceProvider;
use Illuminate\Foundation\Testing\RefreshDatabase;
use Tests\TestCase;

class AuthenticationTest extends TestCase
{
    use RefreshDatabase;

    public function test_login_screen_can_be_rendered()
    {
        $response = $this->get('/login');

        $response->assertStatus(200);
    }

    public function test_users_can_authenticate_using_the_login_screen()
    {
        $user = User::factory()->create();
        $response = $this->post('/login', [
            'email' => $user->email,
            'password' => 'password',
        ]);

        $this->assertAuthenticated();
        $response->assertRedirect(RouteServiceProvider::HOME);
    }

    public function test_users_can_not_authenticate_with_invalid_password()
    {
        $user = User::factory()->create();

        $this->post('/login', [
            'email' => $user->email,
            'password' => 'wrong-password',
        ]);

        $this->assertGuest();
    }
}
```

Results



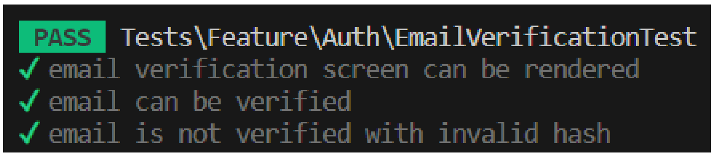
```
PASS  Tests\Feature\Auth\AuthenticationTest
✓ login screen can be rendered
✓ users can authenticate using the login screen
✓ users can not authenticate with invalid password
```

Figure 52: Authentication Test

Email verification Test

```
<?php

namespace Tests\Feature\Auth;

use App\Models\User;
use App\Providers\RouteServiceProvider;
use Illuminate\Auth\Events\Verified;
use Illuminate\Foundation\Testing\RefreshDatabase;
use Illuminate\Support\Facades\Event;
use Illuminate\Support\Facades\URL;
use Tests\TestCase;

class EmailVerificationTest extends TestCase
{
    use RefreshDatabase;
    public function test_email_verification_screen_can_be_rendered()
    {
        $user = User::factory()->create([
            'email_verified_at' => null,
        ]);

        $response = $this->actingAs($user)->get('/verify-email');

        $response->assertStatus(200);
    }

    public function test_email_can_be_verified()
    {
        $user = User::factory()->create([
            'email_verified_at' => null,
        ]);

        Event::fake();

        $verificationUrl = URL::temporarySignedRoute(
            'verification.verify',
            now()->addMinutes(60),
            ['id' => $user->id, 'hash' => sha1($user->email)]
        );

        $response = $this->actingAs($user)->get($verificationUrl);

        Event::assertDispatched(Verified::class);
        $this->assertTrue($user->fresh()->hasVerifiedEmail());
        $response->assertRedirect(RouteServiceProvider::HOME.'?verified=1');
    }

    public function test_email_is_not_verified_with_invalid_hash()
    {
        $user = User::factory()->create([
            'email_verified_at' => null,
        ]);

        $verificationUrl = URL::temporarySignedRoute(
            'verification.verify',
            now()->addMinutes(60),
            ['id' => $user->id, 'hash' => sha1('wrong-email')]
        );

        $this->actingAs($user)->get($verificationUrl);

        $this->assertFalse($user->fresh()->hasVerifiedEmail());
    }
}
```

Results



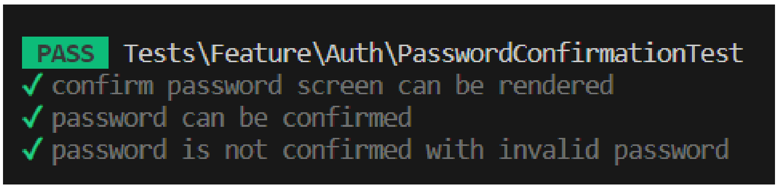
```
 PASS  Tests\Feature\Auth\EmailVerificationTest
✓ email verification screen can be rendered
✓ email can be verified
✓ email is not verified with invalid hash
```

Figure 53: EmailVerfication Test

Password Confirmation Test

```
<?php

namespace Tests\Feature\Auth;

use App\Models\User;
use Illuminate\Foundation\Testing\RefreshDatabase;
use Tests\TestCase;

class PasswordConfirmationTest extends TestCase
{
    use RefreshDatabase;

    public function test_confirm_password_screen_can_be_rendered()
    {
        $user = User::factory()->create();

        $response = $this->actingAs($user)->get('/confirm-password');

        $response->assertStatus(200);
    }

    public function test_password_can_be_confirmed()
    {
        $user = User::factory()->create();

        $response = $this->actingAs($user)->post('/confirm-password', [
            'password' => 'password',
        ]);

        $response->assertRedirect();
        $response->assertSessionHasNoErrors();
    }
    public function test_password_is_not_confirmed_with_invalid_password()
    {
        $user = User::factory()->create();
        $response = $this->actingAs($user)->post('/confirm-password', [
            'password' => 'wrong-password',
        ]);
        $response->assertSessionHasErrors();
    }
}
```

Results



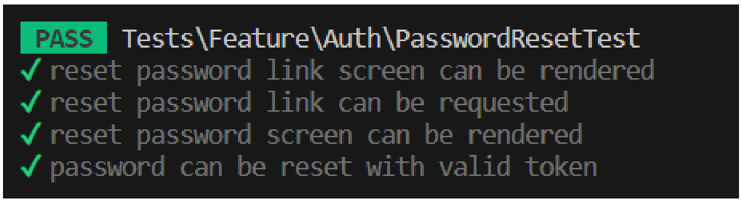
```
PASS  Tests\Feature\Auth\PasswordConfirmationTest
✓ confirm password screen can be rendered
✓ password can be confirmed
✓ password is not confirmed with invalid password
```

Figure 54: Password Confirmation Test results

Password Reset Test

```
<?php
namespace Tests\Feature\Auth;
use App\Models\User;
use Illuminate\Auth\Notifications\ResetPassword;
use Illuminate\Foundation\Testing\RefreshDatabase;
use Illuminate\Support\Facades\Notification;
use Tests\TestCase;
class PasswordResetTest extends TestCase
{
    use RefreshDatabase;
    public function test_reset_password_link_screen_can_be_rendered()
    {
        $response = $this->get('/forgot-password');
        $response->assertStatus(200);
    }
    public function test_reset_password_link_can_be_requested()
    {
        Notification::fake();
        $user = User::factory()->create();
        $this->post('/forgot-password', ['email' => $user->email]);
        Notification::assertSentTo($user, ResetPassword::class);
    }
    public function test_reset_password_screen_can_be_rendered()
    {
        Notification::fake();
        $user = User::factory()->create();
        $this->post('/forgot-password', ['email' => $user->email]);
        Notification::assertSentTo($user, ResetPassword::class, function ($notification) {
            $response = $this->get('/reset-password/'.$notification->token);
            $response->assertStatus(200);
            return true;
        });
    }
    public function test_password_can_be_reset_with_valid_token()
    {
        Notification::fake();
        $user = User::factory()->create();
        $this->post('/forgot-password', ['email' => $user->email]);
        Notification::assertSentTo($user, ResetPassword::class, function ($notification)
use ($user) {
            $response = $this->post('/reset-password', [
                'token' => $notification->token,
                'email' => $user->email,
                'password' => 'password',
                'password_confirmation' => 'password',
            ]);
            $response->assertSessionHasNoErrors();
            return true;
        });
    }
}
```

Results



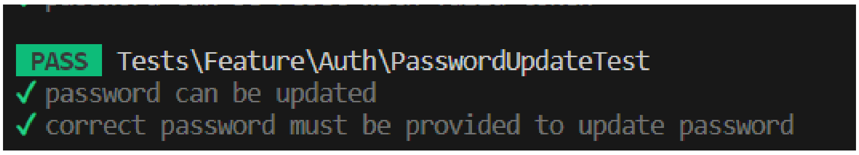
```
PASS Tests\Feature\Auth\PasswordResetTest
✓ reset password link screen can be rendered
✓ reset password link can be requested
✓ reset password screen can be rendered
✓ password can be reset with valid token
```

Figure 55: Password Reset Test Result

Password Update Test

```
<?php
namespace Tests\Feature\Auth;
use App\Models\User;
use Illuminate\Foundation\Testing\RefreshDatabase;
use Illuminate\Support\Facades\Hash;
use Tests\TestCase;
class PasswordUpdateTest extends TestCase
{
    use RefreshDatabase;
    public function test_password_can_be_updated()
    {
        $user = User::factory()->create();
        $response = $this
            ->actingAs($user)
            ->from('/profile')
            ->put('/password', [
                'current_password' => 'password',
                'password' => 'new-password',
                'password_confirmation' => 'new-password',
            ]);
        $response
            ->assertSessionHasNoErrors()
            ->assertRedirect('/profile');
        $this->assertTrue(Hash::check('new-password', $user->refresh()->password));
    }
    public function test_correct_password_must_be_provided_to_update_password()
    {
        $user = User::factory()->create();
        $response = $this
            ->actingAs($user)
            ->from('/profile')
            ->put('/password', [
                'current_password' => 'wrong-password',
                'password' => 'new-password',
                'password_confirmation' => 'new-password',
            ]);

        $response
            ->assertSessionHasErrorsIn('updatePassword', 'current_password')
            ->assertRedirect('/profile');
    }
}
```

Results



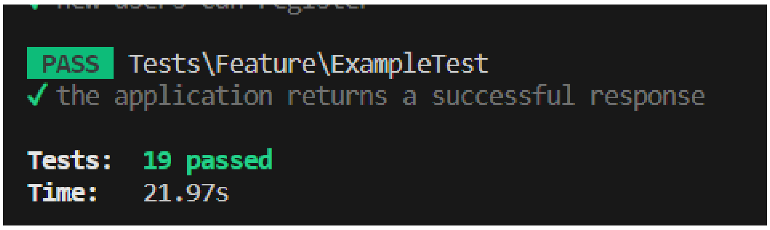
```
PASS  Tests\Feature\Auth\PasswordUpdateTest
✓ password can be updated
✓ correct password must be provided to update password
```

Figure 56: Password Update Test Result

Basic Test

```
<?php

namespace Tests\Feature;

// use Illuminate\Foundation\Testing\RefreshDatabase;
use Tests\TestCase;

class ExampleTest extends TestCase
{
    /**
     * A basic test example.
     *
     * @return void
     */
    public function test_the_application_returns_a_successful_response()
    {
        $response = $this->get('/');

        $response->assertStatus(200);
    }
}
```

Results and final result



```
PASS  Tests\Feature\ExampleTest
✓ the application returns a successful response

Tests:  19 passed
Time:   21.97s
```

Figure 57: Results and final result

Chapter 8: Conclusion and future Work

Chapter 8: Conclusion and future Work

8.1 Conclusion

Conclusion of our project is a library management system is a crucial tool for libraries to efficiently manage their collections, patrons, and circulation activities. The benefits of implementing a library management system include improved organization, increased efficiency, and enhanced user services.

The system allows for easy cataloging and tracking of library materials, simplifies the circulation process, and provides timely and accurate information to library staff and users. It also helps libraries to better understand their collections and patron behavior, which can inform collection development and service improvements.

However, there are also potential challenges associated with implementing a library management system, such as the cost of the system, the need for staff training, and the need to ensure that the system is accessible and user-friendly for all users.

Overall, a library management system is a valuable investment for libraries looking to improve their operations and services. With continuous updates and enhancements, libraries can continue to meet the changing needs of their patrons and provide access to resources and services that support lifelong learning and personal growth.

The RFID inventory system, can help administrators to better manage the library's collections and ensure that items are properly tracked and accounted for. It can also help to streamline the circulation process, allowing for faster check-in and check-out of library materials.

8.2 Future Work

- Mobile access: As more library users use mobile devices, a library management system could be enhanced to provide a mobile-friendly interface that allows users to search the library catalog, place holds, and renew items using their smartphones or tablets.
- Improved user experience: A library management system could be enhanced to improve the user experience for both users and library staff, such as by streamlining workflows, simplifying checkout and return procedures, and providing personalized recommendations.
- Integration with other library systems: A library management system could be enhanced to integrate with other library systems, such as interlibrary loan systems or academic research databases, to provide a more comprehensive and seamless library experience for users.
- Integration with emerging technologies: As new technologies emerge, a library management system could be enhanced to leverage these technologies to improve operations and services. For example, the system could use artificial intelligence and machine learning to provide personalized recommendations to patrons, automate administrative tasks, and improve search functionality.

Chapter 9: References

Chapter 9: References

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