

**SCHOOL MANAGEMENT SYSTEM 1: LIBRARY
WITH QR CODE INNOVATION AND BOOK
MONITORING: STUDENT INFORMATION
IN BESTLINK COLLEGE OF
THE PHILIPPINES**

A Capstone
Presented to the Faculty of
The College of Computer Studies
Bestlink College of the Philippines

In Partial Fulfillment
Of the Requirements for the Degree of
Bachelor of Science in Information Technology

**BAMBA, MISHA-EL LABAJA
GARGOLES, JERELYN AMANTE
OBELIDOR, IVAN DECIMO
PERIA, NELLY ROSE NAYRE
RICABLANCA, CARMINA**

October 2024

APPROVAL SHEET

This capstone entitled **SCHOOL MANAGEMENT SYSTEM 1: LIBRARY WITH QR CODE INNOVATION AND BOOK MONITORING: STUDENT INFORMATION IN BESTLINK COLLEGE OF THE PHILIPPINES**, prepared and submitted by **Misha-el L. Bamba, Jerelyn A. Gargoles, Ivan D. Obelidor, Nelly Rose N. Peria and Carmina Ricablanca**, in partial fulfillment of the requirements for the degree of Bachelor of Science in Information Technology, has been examined and is recommended for acceptance and approval Oral Defense.

RONALD G. ROLDAN JR.

Adviser

CAPSTONE REVIEW PANEL

Approved by the Committee on Oral Examination with a grade of

Member

Member

ROMMEL J. CONSTANTINO, MSIT

Chairperson

Accepted and approved in partial fulfillment of the requirements for the degree of Bachelor of Science in Information Technology.

ROSICAR E. ESCOBER, Ph. D

Dean, College of Computer Studies

Date of Final Defense:

DECLARATION

We hereby declare that the capstone project **School Management System 1: Library With QR Code Innovation And Book Monitoring: Student Information** submitted to Bestlink College of the Philippines is an original work completed by Cluster D under the guidance of the Research Adviser, Ronald Roldan Jr. This project has not been replicated in any form for submission to another institution. This is a project done in fulfillment of the requirements for a Bachelor of Science in Information Technology and will be submitted as a semester project.

Signature of Group/Individual:

Date: October 2024

Misha-el L. Bamba

Jerelyn A. Gargoles

Ivan D. Obelidor

Nelly Rose N. Peria

Carmina Ricablanca

Countersigned by:

Date: October 2024

Mr. Ronald Roldan Jr.

Research Adviser

ACKNOWLEDGMENT

The researchers would like to express their heartfelt thanks and gratitude to the following persons who, in one way or another, has contributed much, and extended willingness and support needed to make this research possible:

Dr. Maria M. Vicente, President/CEO, Bestlink College of the Philippines, for her generosity and kind heart in establishing this institution and giving opportunities to those less fortunate students to continue their studies and pursue their dreams;

Ms. Edith M. Vicente, Executive Vice President, for providing the needed information to complete this research;

Dr. Charlie I. Cariño, Vice President for Academic Affairs, for his support and encouragement to make this thesis writing possible;

Engr. Diosdado T. Llano, Vice President for Administration and Finance, for his words of encouragement and motivation;

Dr. Joy Evelyn A. Ignacio, Director, Center for Research and Development, for her good heart to extend her help needed by the researchers.

Dr. Rosicar E. Escobar, Dean, College of Computer Studies of Bestlink College of the Philippines, for providing a guideline documentation in capstone project.

Mr. Rommel J. Constantino, Program Head, Bachelor of Science in Information Technology, for the constant supervision as well as providing necessary information regarding the project and also for his support in completing this project

Mr. Ronald G. Roldan Jr., Research Coordinator, for helping us in improving our research and guiding us in completing this project. Capstone Adviser, for giving us suggestions and ideas to improve our research and guiding us in completing this project.

Panelists, who extended their effort and time to be able to constructively criticize this thesis and share their knowledge with them to deepen and widen their needed information.

Families and Friends, for all the financial and moral support that have enabled the researchers to triumph all the challenges, especially during the lowest time that served as their inspiration to complete this study; and

Above all, to the **Almighty God**, for the strength and knowledge that were used for the accomplishment of this research journey.

THE RESEARCHERS

ABSTRACT

**Title: SCHOOL MANAGEMENT SYSTEM 1: LIBRARY WITH
QR CODE INNOVATION AND BOOK MONITORING:
STUDENT INFORMATION**

**Authors: MISHA-EL L. BAMBA
JERELYN A. GARGOLES
IVAN D. OBELIDOR
NELLY ROSE N. PERIA
CARMINA RICABLANCA**

Degree: Bachelor of Science of Information Technology

**Major: Information Management, Information Security,
Network Administrative**

Date of Completion: March 2024

The system is an innovation in the management of school libraries designed to facilitate modern tracking of access to library resources and information. It will be the first time for the students to ever have a library management system to make their experience easier. Most schools are facing challenges such as poor organization of collections, as well as poor methods of checking whether books are available. These problems may create frustration for the students and librarians, which may hinder effective utilization of library resources.

Addressing such problems would positively improve the general educational experience while fostering a culture of reading and learning.

The project team has adopted Agile methodology to support the development of the SMS Library System. This approach allows the breakdown of a project into doable phases. This ensures a structured sequence of phases in the development process. Interviews were conducted on a regular basis with the stakeholders in providing feedback towards the enhancement of features for the system to ensure that it meets the needs of the users properly.

The SMS Library System addresses the needs of its users through its rapid identification of books available for borrowing by scanning QR codes. This indeed makes the organization of library resources much better and ensures proper tracking of overdue books with fewer errors, providing a very efficient library experience. For users, the system has increased their satisfaction and also made the process of finding and borrowing books more seamless.

This system has the potential to greatly enhance the library experience for both students and librarians. In addressing typical problems in managing a library, the SMS Library attempts to involve more students with library resources. Insights gained during the development process have shown that user feedback is crucial in creating a system that truly serves the needs of its community.

TABLE OF CONTENTS

	Page
Title Page	i
Approval Sheet	ii
Declaration	iii
Acknowledgement	iv
Abstract	vi
Table of Contents	viii
List of Tables	xi
List of Figures	xii
 CHAPTER I	
 1 INTRODUCTION	
1.1 Background of the Capstone Project	1
1.2 Context and Scope	4
1.3 Problem Statement	4
1.4 Objectives and Goals	6
1.5 Significance and Relevance	7
1.6 Structure of the Document	8
 CHAPTER II	
 2 RELATED STUDIES AND LITERATURE REVIEW	
2.1 Agile Scrum Methodology Overview	11
2.2 Enterprise Architecture Concepts	15
2.3 Microservices Architecture (Deep dive into	18

	microservices principles, benefits, and challenges)	
2.4	DevOps and CI/CD	19
2.5	Relevant Studies and Research	20
2.6	Integration of Information Systems in Enterprise Environments	29

CHAPTER III

3 METHODOLOGY

3.1	Agile Scrum Methodology in the Project	30
3.2	Roles and Responsibilities	32
3.3	Sprint Cycles	35
3.4	Scrum Artifacts	37
3.4.1	Product Backlog	37
3.4.2	Sprint Backlog	48
3.4.3	Scrum Board	59
3.4.4	Burndown Chart	60
3.5	Microservices Architecture (Detailed explanation of the adopted microservices architecture)	61
3.5.1	Microservices Diagram	62
3.5.2	Data Flow Diagram	63
3.6	DevOps Implementation	63
3.6.1	Infrastructure as Code	65
3.6.2	Monitoring and Alerting	66
3.7	Innovation Integration	68

3.8	Additional Considerations	71
3.8.1	Use Case Diagram	71
3.8.2	Sequence Diagram	72
3.8.3	Network Architecture	73

List of Tables

Table	Page
1 Objective and Goals	6
2 Roles	32
3 Sprint Cycles	35
4 Product Backlog	37
6 Sprint Backlog	48
7 Scrum Board	59
8 Monitoring and Alerting	66

List of Figures

Figure	Page
1 Agile Scrum Methodology Overview	14
2 Enterprise Architecture Concepts	18
3 Sprint Cycles	35
4 Burndown Chart	60
5 Microservices Architecture Diagram (Admin)	62
6 Microservices Architecture Diagram (Student)	62
7 Data Flow Diagram Level 1	63
8 DevOps Implementation	65
9 Infrastructure as Code	65
10 Business Process Architecture Level 1	69
11 Business Process Architecture Level 2	69
12 Data Flow Diagram Level 3	70
13 Use Case Diagram	71
14 Sequence Diagram (Admin)	72
15 Sequence Diagram (User)	72
16 Network Architecture	73

Chapter 1

Introduction

1.1 BACKGROUND OF THE CAPSTONE PROJECT

The School Management System (SMS) Library with QR Code came up with something new that can be very useful to everyone. The idea of a school library as a place with quiet conversations and stacks of old books is quickly changing. Libraries today are embracing technology and transforming into thriving areas of participation and learning. The researchers evaluate how these systems have changed the traditional library experience, providing students with more access to a larger range of resources, encouraging a love of reading, and streamlining library operations for librarians.

As the expanding of new technology trends, IT is widening to library platforms that generate an opportunity to leverage the way people access the right information. The preparations of our system represent the higher education of Bachelor of Science in Information Technology (BSIT). This research project seeks to identify the library's current obstacles and propose a library management system that improves performance and proper storage of various data types such as users, books, and transactions for the convenience of both the librarian and the user. We'll delve into the key features of these systems highlighting

their impact on both students and educators and the future of school libraries. This approach aims to empower students, streamline library operations, and foster a love of reading in addition to digitizing books. The proponents propose this system to make it efficient and possible with the researchers who spent their time and manifested their own capabilities in technical and management skills. This project aims to develop user-friendly, innovative, and data-driven SMS that empowers students and educators to fully leverage the potential of the school library as a vital learning resource. Increasing easy access and management of library resources is one way of hoping to fulfill this vision of fostering a supportive learning environment to adapt to the changing times. For the student, QR code can aid in easily finding the needed book; for the librarian, the hassle of tracing issued and returned materials may be brought about.

The purpose of this system is to seek a better way of managing books, raise the service level of users, and effectively monitor library resources. In order to turn the school library into a dynamic center of learning and engagement, this capstone project will build and implement a contemporary school management system that takes use of these advancements. Through the integration of advanced book monitoring, individualized student information, and QR code technology, this system will empower students, optimize library operations, and ultimately improve education for all. This proposed Library Management

System with QR Code technology thinks of a very new way of accessing and managing library resources, therefore overcoming all challenges. It benefits both students and librarians by simplifying the processes of searching for books and managing resources in busy learning environments with inefficient use of resources by many students, leading to frustrating experiences. It becomes easy for students to identify and access the needed resources quickly because of QR codes, which can make a more effective and interesting experience for the library. Such technology for librarians serves better by reducing the technicalities of loan and return tracking so that librarians can focus more on literacy initiative development and other academic support services. The capstone project will aim for the creation of an attractive and innovative Library Management System, which integrates the old library functions with modern demands of education. It helps transform school libraries into communication-intensive learning environments because advanced monitoring and personalization of the user experience features are found therein. Ultimately, this system empowers students and educators to use the school library as a source for learning and discovery in the fast-evolving digital landscape.

1.2 CONTEXT AND SCOPE

The system of the library in our campus faced so many challenges such as book monitoring because of the changing technology. The Context of this system aims to initiate and propose the QR code in the library management system, offering the comprehensive solution for the school campus, faculty members and also students. This system will form the base that organizes and manages library resources through streamlining different functions of book tracking, user interaction, and resource management. This will focus on addressing minor processes such as the availability of books, which can easily be found through assistance from QR code integration, tracking issued and returned items, and ensuring successful user experiences both by students and librarians.

1.3 PROBLEM STATEMENT

Many school library management systems have problems because they rely on manual processes to check book availability. These challenges include:

- **Lack of Organization:** There is often no clear organization in how books are managed and borrowed, making it hard for both students and librarians to find and manage resources effectively.

- **Manual Errors:** Dependence on manual operations leads to many incorrect inputs regarding book availability, thus creating confusion and increasing delays in fulfilling user requests.
- **Ineffective Tracking:** The system lacks effective tracking for overdue books and timely calculation of fines, hence, managing returns becomes problematic and problems occur while managing the returns by libraries, affecting both resource and user accountability.
- **Inefficient Resource Management:** Libraries face issues like delayed availability of materials, misplaced items, poor inventory control, and not having enough data to analyze borrowing trends. These problems make it hard for libraries to manage resources well.

Our proposed system aims to solve these problems by creating tools to automate book management and tracking using QR code technology.

1.4 OBJECTIVE AND GOALS

This table outlines our key objectives and goals:

Business Objectives/Goals	Description
Enhance Accessibility	Implement QR code technology to allow students to easily locate and access available books within the library.
Book Management	Develop a centralized system for tracking issued and returned books, reducing the manual workload for librarians.
Improve User Experience	Create a user-friendly interface that simplifies interactions for both students and librarians, facilitating efficient book transactions.
Real-Time Monitoring	Enable real-time updates on book availability and borrowing status, ensuring accurate resource management.

Implement Access Control	Role-based access control is implemented to limit access to sensitive data. Only authorized personnel, such as librarians, can access certain administrative functions and user data, minimizing the risk of internal breaches.
--------------------------	---

Table 1: Objective and Goals

1.5 SIGNIFICANCE AND RELEVANCE

The importance and relevance of our system in school libraries lie in its ability to enhance the user experience. Our system not only saves users time and effort in searching resources in a library, allows easy access to important information related to a resource, such as location and availability, borrowing details, etc.

On the other hand, this system will also make for a better, more systematic library environment both for students and librarians. By systematizing resource management, it reduces frustration and encourages more people to delve into library materials, thus making a culture of reading and learning.

The use of QR code technology ensures that the modern user of the library is provided with an interaction that is modern and user-friendly

as opposed to what prevailed in the past. It thus meets the current technological trends, making our system a means to improve the school libraries' effectiveness as a whole.

1.6 STRUCTURE OF THE DOCUMENT

Chapter 1: Introduction

1.1 Background of the Capstone Project: This section introduces the newly high-tech user-friendly School Management System: Library with QR Code innovation and book monitoring, student information. It also enhances the processing of the library system accurately.

1.2 Context and Scope: This section specifies the reason for designing the system, as well as the obstacles that currently encounter in the library.

1.3 Problem Statement: In this section state all the specific problems that may be encountered in the library system management that can be solved by the end of the project.

1.4 Objective and Goals: This section focuses on improving the system processing that can specify the objective and specific goals, including developing a centralized for tracking issued and returned book and improving the real-time processing.

1.5 Significance and Relevance: In this section will indicate all the Importance and in its potential impact on the library management system, to meet the expectations for the system improvement.

1.6 Structure of the Document: This section focuses on specific aspects of the library capstone project. The system will explore the project technical and architectural components, development process, testing and quality assurance, as well as the result, evaluation and insight gained.

Chapter 2: Literature Review

2.1 Overview of the Agile Scrum Methodology: This section provides an overview of the agile scrum process and its application to the project, including its principles, benefits, and important roles.

2.2 Enterprise Architecture Concepts: This section introduces Enterprise Architecture (EA) and its application to the School Management System discussing its fundamentals concepts and outlining the many areas of architecture under EA.

2.3 Microservices Architecture: This section introduces microservices Architecture and it is applied to the School Management System, addressing its benefits and presenting common administrative responsibilities.

2.4 DevOps CI/CD: This section discusses the principles and benefits of DevOps CI/CD (Continuous Integration and Continuous Deployment)

in the context of the School Management System focusing on the key principles, benefits and problems.

2.5 Relevant Studies and Research: This section presents a brief review of significant research and studies on School Management System Library with QR Code, emphasizing major findings and insights.

2.6 Integration of Information Systems in Enterprise Environment: This Section describes the integration of several information systems inside the School Management System, including the essential systems to be merged and their benefits.

Chapter 3: Methodology

3.1 Agile Scrum Method in Projects: In this section, the agile scrum technique will be used for the project. Its guiding principles essential Procedures, and ways to customize it to meet the project's unique Requirements are explained.

3.2 Roles and Responsibilities: This section provide on how the teams Makes the project unthinkable and improved the skills of in each their roles and responsibilities including Product Owner, Lead Programmer, Programmer, System Analyst, Document Analyst, Business Analyst, Security Analyst, Scrum Master, and Development Team.

3.3 Sprint Cycles: This section detailed all the planned sprint cycles for the Rest of the project, defining its goals with specific tasks for every sprint.

3.4 Scrum Artifacts: This part displayed the project Scrum artifacts such as The Product Backlog, User Stories and Sprint Backlog.

3.5 Microservices Architecture: This section will probably go into detail about how the library management system microservices architecture is specifically implemented, describing the main services, features and how they Work together.

3.6 DevOps Implementation: This section will probably address how the Project will apply DevOps CI/CD principles, describing the instruments and Procedures that will be utilized.

3.7 Integration Approach for Information Systems: This section outlines the strategies and methods used to integrate various information systems, ensuring seamless data flow and communication between components.

Chapter 2

Related Reviews and Literature Review

2.1 AGILE SCRUM METHODOLOGY OVERVIEW

The Agile Scrum methodology is a useful method in the management of complex software projects, focusing on teamwork and continuous improvement. Using this method, we can improve efficiency

in our Library Management System by providing for the needs of users such as librarians and students.

The whole project is divided into shorter phases, called sprints. Within every sprint we developed certain features and delivered a working version for feedback. That gives us the possibility to promptly adjust to new requirements and let the development of the system improve continuously through feedback from users.

The Scrum Master keeps the team on track and solves any problems that may come along, while the Product Owner prioritizes the features to make sure we focus on what adds the most value to the library. It encourages good communication among all members involved.

Using Agile Scrum makes it possible to create an efficient Library Management System, but also increases collaboration with continuous improvement between students and staff in the school.

1. Cameron & Smith (2023), "The Application of Agile Project Management Principles for Library IT." This paper investigates the use of agile project management principles in library information technology, emphasizing how these practices can enhance service delivery and improve user experience. Cameron and Smith discuss various agile methodologies and their applicability to library settings, demonstrating how flexibility and iterative development can address user needs more effectively. The study includes case studies that illustrate successful agile implementations in libraries, showcasing the positive impact on

project outcomes and stakeholder engagement. The findings suggest that adopting agile principles can lead to more responsive and efficient library services, ultimately benefiting both staff and patrons.

https://www.researchgate.net/publication/373103145_The_Application_of_Agile_Project_Management_Principles_for_Library_IT

2. IFLA (2020), "Agile Project Management for Libraries." This document explores the implementation of agile project management techniques within library environments, focusing on the principles of flexibility, collaboration, and user-centered service delivery. It highlights how agile practices can enhance project outcomes by fostering a responsive approach to changing user needs and preferences. The document provides insights into effective teamwork and communication strategies that are essential for successful agile implementation in libraries. By showcasing real-world examples, IFLA illustrates the potential benefits of adopting agile methodologies, including improved efficiency and increased user satisfaction. The findings advocate for a shift towards more adaptable and user-focused project management in library settings.

<https://repository.ifla.org/items/5e797538-2c1d-4bdf-a84e-8d6d214ebcb8>

3. Smith et al. (2020), "Adopting Agile Methodologies in Academic Libraries." This paper investigates the effective implementation of agile methodologies in academic libraries,

emphasizing their potential to enhance project management and improve user services. The authors discuss the benefits of agile practices, including increased collaboration among staff and the ability to respond swiftly to user needs. By examining case studies and providing practical recommendations, the research highlights how agile methodologies can lead to more efficient workflows and greater user satisfaction. The findings advocate for academic libraries to embrace agile approaches as a means to modernize their operations and better serve their communities.

<https://docs.lib.purdue.edu/cgi/viewcontent.cgi?referer=&httpsredir=1&article=2007&context=iatul>

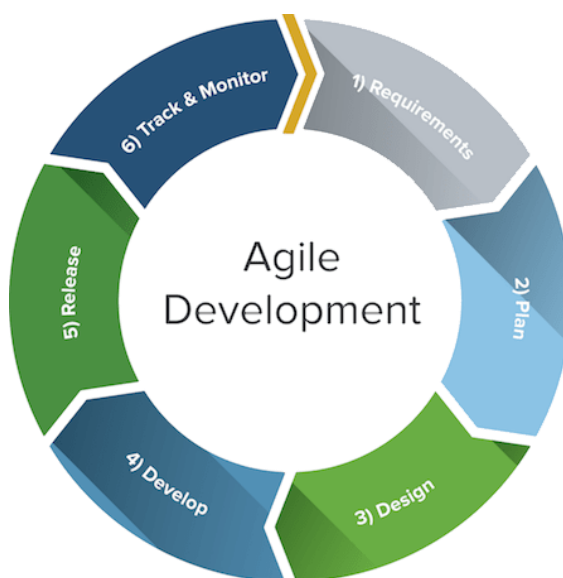


Figure 1: Agile Scrum Methodology Overview

2.2 ENTERPRISE ARCHITECTURE CONCEPTS

In our Library System, Enterprise Architecture (EA) aligns technology with our goals by organizing software, data, and infrastructure. Using the TOGAF framework, we break down our system into manageable components like business processes, application design, data handling, and technology. This approach enhances efficiency, flexibility, and alignment with library needs, leading to improved system performance.

What is TOGAF? An enterprise architecture methodology for business. The Open Group Architecture Framework (TOGAF) is probably one of the most used enterprise architecture frameworks in the world. It combines all the elements to design, plan, implement, and manage enterprise architecture. TOGAF is a vendor-neutral framework that is widely adopted by organizations worldwide. TOGAF is divided into four architecture domains. Every domain represents a different aspect of enterprise architecture. The architectural domains are:

Business Architecture refers to the plan and function that describes an organization structure, business processes, goals, or its organizational structure. It would help align business activities with an organization's strategic aims, increase its efficiency, and optimize resources utilized for their performance.

Data Architecture In the context of the organization, data architecture focuses more on the management and flow of data on issues of

consistency, availability, and security of data for the decision-maker. In other words, it means that data should be accurate, well-organized, and accessible.

Application Architecture looks into the make-up of software applications and their relationship within the organization. It therefore addresses the business need as it supports integration with the growth of the organization and scaling.

Technology Architecture centers upon the information technology infrastructure, which underpins the organization's operations and systems. This infrastructure consists of hardware, software, and networks. It forms an adaptable, secure, and reliable base for business applications and data that may meet today's technology needs and tomorrow's business requirements.

This Library System can be exceptionally well applied with the 'The Open Group Architecture Framework', because of its four architectural domains: defining business processes of borrowing and returning books, managing students' records and viewing book availability with QR codes, outlining software components for scanning and tracking QR codes, and specifying the technology stack to support the application-while still following ADM for design, implementation, and governance.

1. Searle (2021), "The Benefits of Enterprise Architecture for Library Management," This article discusses how enterprise architecture can enhance library management by improving resource allocation, fostering innovation, and aligning IT strategies with organizational goals.

<https://www.semanticscholar.org/paper/The-Benefits-of-Enterprise-Architecture-for-Library-Searle/dc12520045c21ff8e4997931c497f87bf74b8ae8>

2. Sharma & Bansal (2023), "A Study on the Adoption of Agile Methodology in Library Management," This paper explores the integration of Agile methodologies in library management practices, emphasizing improved efficiency, user satisfaction, and adaptability to changing needs.

<https://ital.corejournals.org/index.php/17tal./article/view/10437>

3. Searle (2018), "The Benefits of Enterprise Architecture for Library Technology Management: An Exploratory Case Study," This study examines how enterprise architecture can enhance technology management in libraries, focusing on improved alignment with organizational goals and better resource utilization.

https://www.researchgate.net/publication/329726300_The_Benefits_of_Enterprise_Architecture_for_Library_Technology_Management_An_Exploratory_Case_Study

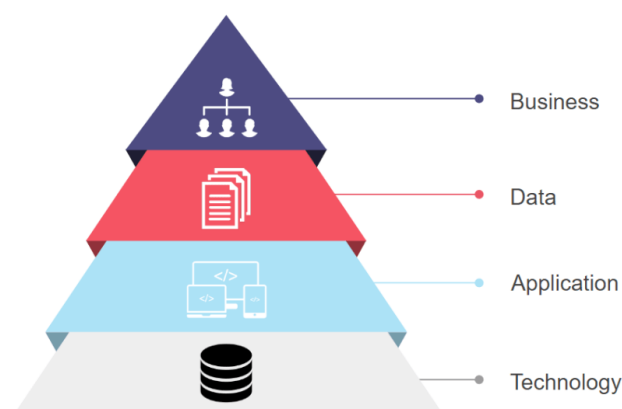


Figure 2: Enterprise Architecture Concepts

2.3 MICROSERVICES ARCHITECTURE

This library management system would be developed in a microservices architecture, strictly considering core data management principles, independent services with distinct APIs that enable them to communicate between services. This will allow functionalities such as displaying books available using QR codes and will track borrowings and returns of the books with reports to chase better oversight.

Additionally, we would send reset password codes from the Gmail API, which will also improve user experience so that account management security might be done smoothly.

This microservices approach brings forth many advantages such as ease of scalability, flexibility, and reliability-that is, it makes the system grow in size with respect to changing needs, and it is possible to monitor

the performance of a service independent of a team so that if there is a glitch in a certain service, it can be caught promptly.

However, this architecture comes with challenges as well. It is not easy to manage multiple services, and they may suffer issues while communicating with each other. Also, we will have to apply strict monitoring and security requirements so that all services may combine well and run at a very high level of performance and safety.

2.4 DEVOPS AND CI/CD

DevOps is a set of practices which aim at having development and operations teams collaborate better on processes of software development and deployment. This approach thus aims to automate workflows, improve communication, and deliver software more quickly and reliably.

Continuous Integration and Continuous Deployment are practices whereby changes to code are automatically integrated and deployed. In Continuous Integration, every time developers push their code, it automatically gets tested for problems through tests. Continuous Deployment ensures that provided the tests pass, any change is rolled into production automatically; thus, the software is always up to date.

We will implement DevOps for streamlining our development and deployment processes, and for engaging our development teams in

better collaboration with operations teams. All these measures will help control the code base more easily and automate workflows and roll out updates more rapidly.

By implementing both DevOps and CI/CD, we will deliver better-quality software, reduce system downtime, and accelerate the shipping of new functionalities and enhancements.

2.5 RELEVANT STUDIES AND RESEARCH

This includes important studies and research related to our system, including both local and foreign findings, to help improve understanding and support new ideas.

Local

Dela Cruz (2019), “The Impact of an Automated Library System on Library Services.” This study examines the transformative effects of automation in library systems, emphasizing its benefits for borrowing processes, material tracking, and reporting functions. Dela Cruz highlights how automated systems streamline operations, enabling librarians to manage inventory and track loans more efficiently. The research shows that automation reduces errors and enhances accuracy in reporting, leading to improved library service efficiency. By analyzing

user feedback and operational data, the study reveals that patrons enjoy a more seamless interaction with library resources, resulting in increased usage and satisfaction. The findings stress the importance of integrating technology into library management, positioning automation as essential for modernizing services and enhancing user experiences.

Santos (2020), “Developing an SMS Notification System for Library Borrowing.” This research explores the implementation of SMS notifications to facilitate the borrowing and returning of library books, highlighting user satisfaction as a primary outcome. Santos examines how timely notifications improve communication between the library and patrons, reducing overdue books and enhancing overall user engagement. The study analyzes user feedback, revealing that patrons value the convenience and reliability of receiving reminders. The findings indicate that the SMS system not only streamlines the borrowing process but also fosters a sense of responsibility among users, contributing to more efficient library operations. This research underscores the potential of SMS technology to enhance library services and improve the user experience.

Mendoza (2021), “Library Management and Reporting: A Review of Current Practices.” This paper reviews contemporary practices in library management and reporting, with a particular focus on the importance of monthly reports. Mendoza emphasizes that effective reporting is essential for assessing library performance,

tracking usage statistics, and identifying trends in resource allocation. The study analyzes various reporting methods and their influence on decision-making within libraries. It discusses how regular reporting fosters accountability and transparency, allowing administrators to make informed decisions that enhance services. By synthesizing current practices, the paper highlights the necessity of robust reporting systems to improve library management, ultimately leading to better resource utilization and user satisfaction. The findings encourage libraries to adopt standardized reporting practices for continuous evaluation and improvement.

Reyes (2022), "Monitoring and Evaluation of Library Resources: A Philippine Perspective." This study discusses effective strategies for monitoring library resources, focusing on the integration of digital tools to enhance evaluation processes. Reyes examines various techniques used in the Philippines to track the usage and availability of library materials, highlighting the importance of accurate data collection in resource management. The research explores how digital tools facilitate real-time monitoring, improve inventory accuracy, and enable better decision-making for library administrators. By analyzing case studies and user feedback, the study demonstrates that implementing these strategies increases operational efficiency and enhances user access to resources. The findings suggest that adopting modern monitoring techniques is essential for libraries to effectively respond to the evolving

needs of their communities, ensuring optimal resource utilization and improved service delivery.

Torres (2023), “Enhancing Library Services through Mobile Technologies.” This article highlights the integration of mobile technologies in libraries, focusing on the use of SMS and other notification systems to enhance user engagement. Torres explores how these technologies facilitate real-time communication between libraries and patrons, simplifying access to information about services, events, and available resources. The article discusses various mobile applications and systems that improve library interactions, emphasizing their role in increasing user satisfaction and participation. By analyzing case studies, the research demonstrates that mobile technologies not only streamline library operations but also foster a more connected community. The findings suggest that embracing these innovations is essential for libraries seeking to adapt to the digital age and enhance overall service delivery.

Foreign

Smith (2020), “Agile Development in Library Systems: A Case Study.” This study analyzes the application of agile methodologies in developing library management systems, focusing on functionalities related to borrowing and reporting. Smith explores how agile principles facilitate iterative development, enabling continuous feedback and

adaptation throughout the project lifecycle. The case study highlights the benefits of using Agile in library settings, including enhanced collaboration among stakeholders and a swift response to changing user needs. By examining real-world implementations, the research demonstrates that agile methodologies improve the effectiveness and efficiency of library systems, leading to streamlined borrowing processes and more accurate reporting. The findings suggest that adopting agile practices can significantly enhance the development and deployment of library management solutions, ultimately benefiting both library staff and patrons.

Johnson (2021), "User-Centered Design in Library Services: Implementing Agile Methods." This paper discusses how agile methods enhance user-centered design in library services, specifically in book borrowing systems. Johnson highlights the significance of understanding user needs in developing effective solutions. By applying agile methodologies, libraries can gather continuous feedback, allowing for iterative improvements that make borrowing systems more intuitive and accessible. The findings show that integrating user-centered design with Agile practices leads to higher user satisfaction and a more responsive library environment. The paper advocates for the adoption of agile methods to create better library services tailored to users' needs.

Wang (2022), "The Role of SMS Alerts in Library Services." This research examines the impact of SMS alerts on user engagement and book borrowing practices in public libraries. Wang investigates how SMS notifications enhance communication between libraries and patrons, leading to increased awareness of available resources and timely reminders for due dates. The study highlights that SMS alerts significantly improve user engagement by making library services more accessible and convenient. By analyzing user feedback and borrowing data, the findings reveal that patrons are more likely to borrow books and utilize library services when they receive SMS notifications. This research underscores the importance of integrating SMS technology into library services to foster greater interaction and improve overall user satisfaction.

Lee (2023), "Monthly Reporting in Libraries: Challenges and Solutions." This article addresses common challenges faced by libraries in their monthly reporting processes and proposes solutions through the implementation of Agile practices. Lee identifies key issues such as data accuracy, time constraints, and inadequate reporting tools that hinder effective library management. The article suggests that adopting agile methodologies can streamline reporting by promoting iterative development and continuous feedback. By incorporating regular check-ins and user input, libraries can enhance their reporting accuracy and responsiveness to changing needs. The findings highlight that agile

practices not only improve the efficiency of monthly reporting but also foster a culture of collaboration among library staff, ultimately leading to better decision-making and service delivery.

Kim (2024), “Borrowing Patterns in Digital Libraries: A Quantitative Analysis.” This study conducts a quantitative analysis of borrowing patterns in digital libraries, emphasizing the significance of effective monitoring systems for enhancing service delivery. Kim examines various metrics, such as borrowing frequency, user demographics, and material types, to identify trends and behaviors among library users. The research highlights the critical role of monitoring systems in providing insights into user preferences and resource utilization. By analyzing data collected over time, the study demonstrates that understanding these patterns can lead to better collection management, targeted outreach efforts, and improved user experience. The findings underscore the necessity of implementing robust monitoring tools to optimize library services in the digital landscape.

Indarkshi and Digbijoy (2021), “QR Code and Its Effectiveness in Library Services,” examines the role of QR codes in enhancing library services. The research details the structure of QR codes, emphasizing their data encoding and error correction features. The study highlights the advantages of QR codes, including improved accessibility, user engagement, and streamlined library processes. During the COVID-19

pandemic, QR codes facilitated contactless access to resources, enabling safe information retrieval. The authors also discuss applications such as linking to digital collections, online catalogs, and library events, showcasing QR codes' potential to modernize library services in response to evolving user needs.

Asare (2020), "The Effective Use of Quick Response (QR) Code as a Marketing Tool," investigates the advantages of QR codes in marketing. The research identifies key factors that contribute to successful QR code campaigns, drawing on observations and interviews with marketers and consumers. The study highlights benefits such as enhanced customer engagement, easy access to information, and the ability to track campaign effectiveness. By analyzing real-world applications, the authors provide insights into how QR codes can optimize marketing strategies and improve consumer interactions.

Paul and Naikar (2024), "Innovative Uses of QR Codes in Academic Libraries," examines the benefits and challenges of implementing QR codes in academic settings. The study emphasizes how QR codes can enhance user engagement by providing easy access to digital resources and facilitating interactive experiences. The authors discuss various applications of QR codes, such as linking to e-books, online databases, and library events, while also addressing potential challenges like user awareness and technical limitations.

Overall, the paper highlights QR codes as a valuable tool for improving accessibility and engagement in academic libraries.

Stephen G. (2023), “QR Code and Their Application in Academic Libraries: A Case Study from St. Xavier’s University, Kolkata,” explores the fundamental concept and structure of QR codes. The study highlights their advantages, such as ease of use and quick access to information. Focusing on the Fr. Arrupe Central Library, the paper discusses various potential applications of QR codes in enhancing library services, including facilitating access to digital resources, promoting library events, and improving user engagement. Overall, it emphasizes the role of QR codes in modernizing library services at academic institutions.

Das and Kumbar (2020), “Adoption of QR Code Technology in Libraries: A Case Study of IIT Gandhinagar,” offers an overview of QR codes and their early adoption in library settings. The study focuses on the implementation of QR codes at IIT Gandhinagar Library, detailing how they enhance access to resources and services.

The authors discuss specific applications, such as linking to digital catalogs and providing information on library events, illustrating the positive impact of QR codes on user experience. Overall, the paper highlights QR codes as an effective tool for improving resource accessibility in academic libraries.

2.6 INTEGRATION OF INFORMATION SYSTEM IN ENTERPRISE ENVIRONMENT

Integration of information systems to library management means combining various technologies and systems in the exercise with the aim of formulating a framework with the objective of improving operational effectiveness. Problems affecting such libraries include cases where book management is disorganized, relying on manual processes that lead to incorrect records of book availability, poor monitoring of books whose status is overdue, and the associated fines. Libraries can prove themselves to be truly great places by improving operational efficiency through automation, enhancing data consistency, and easy access of user information with the aid of accurate and timely information.

A good example of a successful integration is the integration of student information systems with learning management systems, such as Cloud Assess. Designed for Registered Training Organizations (RTOs) and Vocational Education and Training (VET) providers, the cloud-based platform of Cloud Assess is essentially a convergence of both – the learning management system and an assessment tool – which simplifies the process of managing students to help create a more engaging learning environment. Structuring an approach to integrating the systems in this manner would not only result in the streamlining of operations but also make librarians more responsive to users' needs.

The smooth flow of data will help better resource allocation and decision-making and move the focus of library staff toward superior user services. Thus, through the implementation of information systems in library management, productivity improves, cost factors of operation decrease, and reaction to changes concerning user demand and operational requirements becomes more dynamic-about indispensable aspects for maintaining effective libraries in digitalized global environments.

Chapter 3 Methodology

3.1 AGILE SCRUM METHODOLOGY IN THE PROJECT

To achieve flexibility and adaptability in our project, we have chosen to implement the agile methodology. This framework is designed to promote collaboration and iteration, enabling us to communicate regularly and respond to changing requirements. Agile is particularly ideal for software development projects in higher education due to the dynamic nature of academic institutions and their evolving needs.

How Agile Scrum Works

Sprints: Our team should divide the project into several task, time limited versions known as sprints. The sprint usually lasts for 3-4 weeks. The team should focus on a particular set and its functionalities and capabilities.

Backlog: We will need the Product backlog that's why we provide an ordered list for all our tasks. It is also to monitor our work if the project is effective when we improve the sprints.

Sprint Planning: We need to do the task that is in the list of the product backlog to keep to the necessary list of tasks.

Daily Scrum: Our team needs a weekly meeting that lasts for just 15 minutes. This is our way to monitor the team if the progress is still going.

Sprint Review: we must present the completed work to the stakeholders at the conclusion of each sprint and solicit their feedback. Also we need to measure our progress and make necessary adjustments to our plan.

Sprint Retrospective: After each sprint, we need to spend some time evaluating what performed well and how we could enhance processes continuing on.

3.2. ROLES AND RESPONSIBILITIES

ROLES	RESPONSIBILITIES
Product Owner	It makes sure the development of our team creates a product and offers an efficient value to users and stakeholders.
Programmer	Create the code and give an assurance to enhance the system accurately and transparency.
Lead Programmer	Guides and supports development of the team. It also gives the task and has a deadline to do the team. It also fosters knowledge sharing and continuous improvement with our team.
System Analyst	Analyze and review the data of the system, It makes sure that the system is designed, implemented and maintained to meet the needs for the library management system and its users.
Document Analyst	Contribute significantly to the assurance of accuracy, effectiveness and well –informed

	decision-making by offering insightful examination of the massive amount of data found in documents.
Business Analyst	Compile and evaluate the company needs pertaining to transportation services. Serve as a point of contact for technical teams and stakeholders. Find ways to make operations more efficient and to improve processes. Create business cases and offer project planning assistance.
Security Analyst	Assess and improve library management system security. It keeps an eye out for weaknesses in our system. Implement security policies and processes to protect sensitive data and conduct checks on safety and risk analysis.
Scrum Master	Conduct the scrum ceremonies for sprint planning, daily stand-ups, sprint reviews, and retrospectives. It also helps the team adhere to the principles and practices of scrum.

Development Team	Translating the ideas and requirements into functional and reliable software of the library management system. It also enhances the skills for innovation and improvement in the library management system.
Web Designer	Responsible for creating the design in the library management system that makes it a visually appealing, functional and user-friendly system. Create the design, visuals, layout and interactive elements like buttons and menus. Learn to maintain the new trend of technology to the user for better experience.

Table 2: Roles

3.3 SPRINT CYCLES

This will include our weekly stand-ups and planning meetings to showcase system updates on system progress.

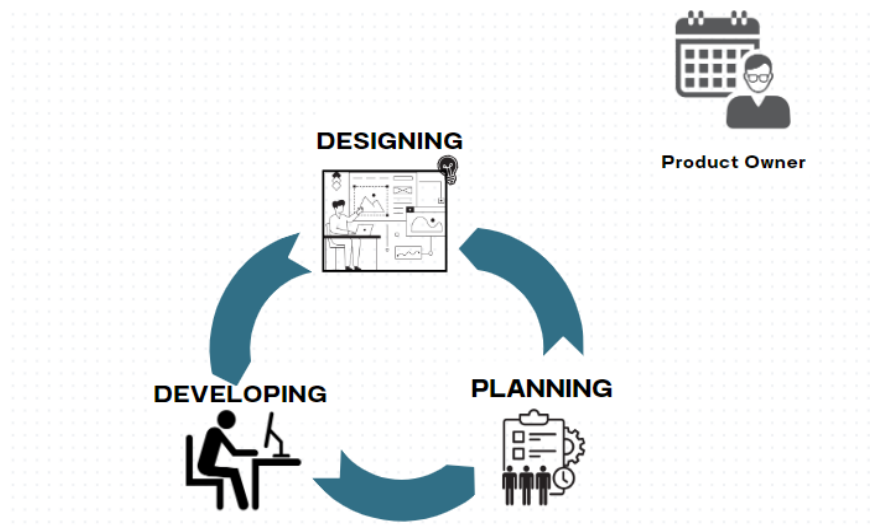


Figure 3: Sprint Cycles

SPRINT PLANNING	<p>In Sprint Planning, the development team collaborates with stakeholders to identify and prioritize tasks associated with document management, data visualization, and reporting. The team establishes sprint goals and agrees with a functional, ensuring that development efforts are aligned with the needs of users and system requirements.</p>
------------------------	--

DAILY STAND-UPS (SCRUM MEETINGS)	<p>Daily Stand-up meetings are designed to enhance communication within the development team. During these meetings, team members share updates on their progress, discuss ongoing work related to search and retrieval, data visualization, and reporting features, and highlight any challenges or obstacles they encounter. These brief meetings help keep everyone aligned and facilitate the quick resolution of issues.</p>
SPRINT REVIEW	<p>In this review, the team showcases the newly developed features and functionalities, such as document management and performance analytics. Stakeholders offer feedback, which is subsequently used to guide future improvements.</p>

Table 3: Sprint Cycles

3.4 SCRUM ARTIFACTS

3.4.1 Product Backlog

User Story No.	User Stories	Description	User Story Priority	Revision Priority	Status
Admin/Librarian					
1	As an Administrator, I want to login to my account securely so that I can access my library resources.	Enables administrators to securely access library resources, ensuring data protection and privacy.	High	Medium	Done
2	As an Administrator, I want to logout of my account so that I can ensure my session is securely closed.	Ensures that sessions are properly terminated, enhancing security for user accounts.	High	Medium	Done

3	As an Administrator, I want to manage the student information so that I can maintain accurate records.	Allows administrators to update and manage student records, ensuring information accuracy.	High	Medium	Done
4	As an Administrator, I want to monitor all the borrowed books so that I can manage inventory effectively.	Facilitates tracking of borrowed books, helping to maintain proper inventory levels.	High	Medium	Done
5	As an Administrator, I want to monitor all the returned books.	Enables oversight of returned books to ensure inventory is updated promptly.	High	Medium	Done

6	As an Administrator, I want to see and modify the list of books.	Allows for easy updates and management of the book catalog, ensuring it reflects current offerings.	High	Medium	Done
7	As an administrator, I want to generate reports for users, as well as for the listing, issuing, and returning of books.	Provides data insights through report generation, enhancing decision-making for library management.	High	Medium	To Do
8	As an Administrator, I want to manage the book catalog so that I can keep	Enables efficient management of the book catalog, helping to track available resources.	High	Medium	In Progress

	track of all available books.				
9	As an Administrator, I want to see user feedback and reviews to improve library services.	Gather user insights to enhance library offerings and service quality.	Medium	Low	To Do
10	As an Administrator, I want to manage overdue book notifications so that I can remind users to return items on time.	Automates notifications to users, improving book return rates and inventory management.	Medium	Low	To Do
11	As an Administrator, I want to receive notifications for	Ensures administrators are alerted to overdue items, facilitating	Medium	Low	To Do

	overdue books so that I can follow up promptly.	timely follow-ups.			
12	As an Administrator, I want to generate usage statistics for library resources to evaluate performance.	Provides insights into resource usage, helping assess and improve library performance.	Medium	Low	To Do
13	As an Administrator, I want to manage user roles and permissions to control access to library resources.	Allows administrators to configure user access levels, enhancing security and resource management.	High	Medium	To Do
14	As an Administrator, I	Provides users with self-service options,	Low	Low	To Do

	want to create a knowledge base or FAQ section for common user queries to reduce support requests.	decreasing the volume of support requests and improving user satisfaction.			
15	As an Administrator, I want to create a backup system for library data to prevent loss.	Ensures that critical data is backed up, reducing the risk of data loss and enhancing recovery capabilities.	High	Medium	In Progress
16	As an Administrator, I want to view a dashboard with key metrics (e.g., total users, borrowed books) for quick insights.	Provides a visual summary of library metrics, enabling quick assessment and decision-making.	High	Medium	Done

17	As an Administrator, I want to create a mobile-friendly version of the library system to improve accessibility.	Enhances user experience by ensuring the library system is accessible on mobile devices.	High	Medium	Done
User/Student					
18	As a User, I want to login to my account securely so that I can access my library resources.	Enables users to securely access their accounts and library resources.	High	Medium	Done
19	As a User, I want to logout of my account so that I can ensure my session securely closed	Ensures user sessions are securely closed to protect account information.	High	Medium	Done

20	As a User, I want to receive notifications for due dates so that I can manage my borrowing schedule effectively.	Helps users keep track of due dates, reducing late returns and associated fees.	High	Medium	To Do
21	As a User, I want to view my borrowed books so that I can keep track of what I have checked out.	Provides users with a record of their borrowed items for easy tracking.	High	Medium	Done
22	As a User, I want to see the books that I've returned.	Enables users to review their return history, helping them track their borrowing activity.	High	Medium	Done

23	As a user, I need a system that allows me to change my password.	Enhances security by allowing users to update their passwords easily.	High	Medium	In Progress
24	As a User, I want to scan QR codes to check book availability so that I can quickly find books.	Provides a quick and efficient way for users to check book availability in the library.	High	Medium	Done
25	As a User, I want to search for books by title, author, or subject so that I can find resources quickly.	Facilitates efficient book searches, improving user experience in finding relevant resources.	High	Medium	Done
26	As a User, I want to provide feedback or reviews on books	Allows users to share their thoughts on books, enhancing	Medium	Low	To Do

	so that I can share my opinions with others.	community engagement and resource quality.			
27	As a User, I want to change my personal information (e.g., email, phone number) so that my account is up to date.	Ensures users can maintain current contact information for communication and updates.	Medium	Low	In Progress
28	As a User, I want to filter book search results by genre or publication date to find relevant resources quickly.	Enhances search functionality, allowing users to find books that meet specific criteria easily.	Medium	Low	To Do
29	As a User, I want to report issues	Provides a simple way for users to	Medium	Low	To Do

	with a book (e.g., damage, missing pages) to the library staff easily.	communicate issues, ensuring timely resolution and maintenance of library resources.			
30	As a User, I want to have a mobile-friendly version of the library system for easy access on my phone.	Enhances accessibility and user experience on mobile devices.	High	Medium	Done
31	As a User, I want to access my borrowing history to track what I've read over time.	Enables users to review their borrowing history, promoting a better understanding of their reading habits.	Medium	Low	Done

Table 4: Product Backlog

3.4.2 Sprint Backlog

User Story No.	User Stories	Estimated Effort (Story Points)	Tasks	Responsible Team Member
1	As an Administrator, I want to login to my account securely so that I can access my library resources.	4	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
2	As an Administrator, I want to logout of my account so that I can ensure my session is securely closed.	4	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
3		7	Planning	Nelly Rose N. Peria

	As an Administrator, I want to manage the student information so that I can maintain accurate records.		Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
4	As an Administrator, I want to monitor all the borrowed books so that I can manage inventory effectively.	8	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
5	As an Administrator, I want to monitor all the returned books.	8	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
6		7	Planning	Nelly Rose N. Peria

	As an Administrator, I want to see and modify the list of books.		Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
7	As an Administrator, I want to generate reports for users, as well as for the listing, issuing, and returning of books.	8	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
8	As an Administrator, I want to manage the book catalog so that I can keep track of all available books.	8	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			UI Design	Jerelyn A. Gargoles
			QA/Testing	Misha-el L. Bamba Carmina Ricablanca
9		7	Planning	Nelly Rose N. Peria

	As an Administrator, I want to see user feedback and reviews to improve library services.		Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
10	As an Administrator, I want to manage overdue book notifications so that I can remind users to return items on time.	9	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
11	As an Administrator, I want to receive notifications for overdue books so that I can follow up promptly.	9	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
12		10	Planning	Nelly Rose N. Peria

	As an Administrator, I want to generate usage statistics for library resources to evaluate performance.		Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
13	As an Administrator, I want to manage user roles and permissions to control access to library resources.	5	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
14	As an Administrator, I want to create a knowledge base or FAQ section for common user queries to reduce support requests.	10	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
15		10		Nelly Rose N. Peria

	As an Administrator, I want to create a backup system for library data to prevent loss.		Planning	
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
16	As an Administrator, I want to view a dashboard with key metrics (e.g., total users, borrowed books) for quick insights.	8	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
17	As an Administrator, I want to create a mobile-friendly version of the library system to improve accessibility.	8	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca

18	As a User, I want to login to my account securely so that I can access my library resources.	4	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
19	As a User, I want to logout of my account so that I can ensure my session is securely closed.	4	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
20	As a User, I want to receive notifications for due dates so that I can manage my borrowing schedule effectively.	8	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca

21	As a User, I want to view my borrowed books so that I can keep track of what I have checked out.	5	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
22	As a User, I want to see the books that I've returned.	5	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
23	As a user, I need a system that allows me to change my password.	5	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca

24	As a User, I want to scan QR codes to check book availability so that I can quickly find books.	8	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
25	As a User, I want to search for books by title, author, or subject so that I can find resources quickly.	8	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
26	As a User, I want to provide feedback or reviews on books so that I can share my opinions with others.	5	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
27		5	Planning	Nelly Rose N. Peria

	As a User, I want to change my personal information (e.g., email, phone number) so that my account is up to date.		Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
28	As a User, I want to filter book search results by genre or publication date to find relevant resources quickly.	6	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
29	As a User, I want to report issues with a book (e.g., damage, missing pages) to the library staff easily.	8	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
30		5	Planning	Nelly Rose N. Peria

	As a User, I want to have a mobile-friendly version of the library system for easy access on my phone.		Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca
31	As a User, I want to access my borrowing history to track what I've read over time.	5	Planning	Nelly Rose N. Peria
			Coding	Ivan D. Obelidor
			QA/Testing	Jerelyn A. Gargoles Misha-el L. Bamba Carmina Ricablanca

Table 5: Sprint Backlog

3.4.3 SCRUM BOARD

To Do	In Progress	Done
Generate reports or usage statistics for library resources	Create a page to manage the book catalog.	Develop admin and user login functionality.
Setup notification for overdue books for admin and user.	Implement user feedback management.	Create dashboard that shows total users, borrowed books, returned books, and list of books.
Create a FAQ section for users.	Create a backup system.	Enable profile management.
	Create a mobile-friendly version of the system.	Add search functionality for available books.
	Manage profile settings for admin and user.	Create a page for the list of books.

	Develop “forgot or reset password” functionality	
	Create a page for borrowed books.	
	Create a page for returned books	

Table 6: Scrum Board

3.4.4 BURNDOWN CHART

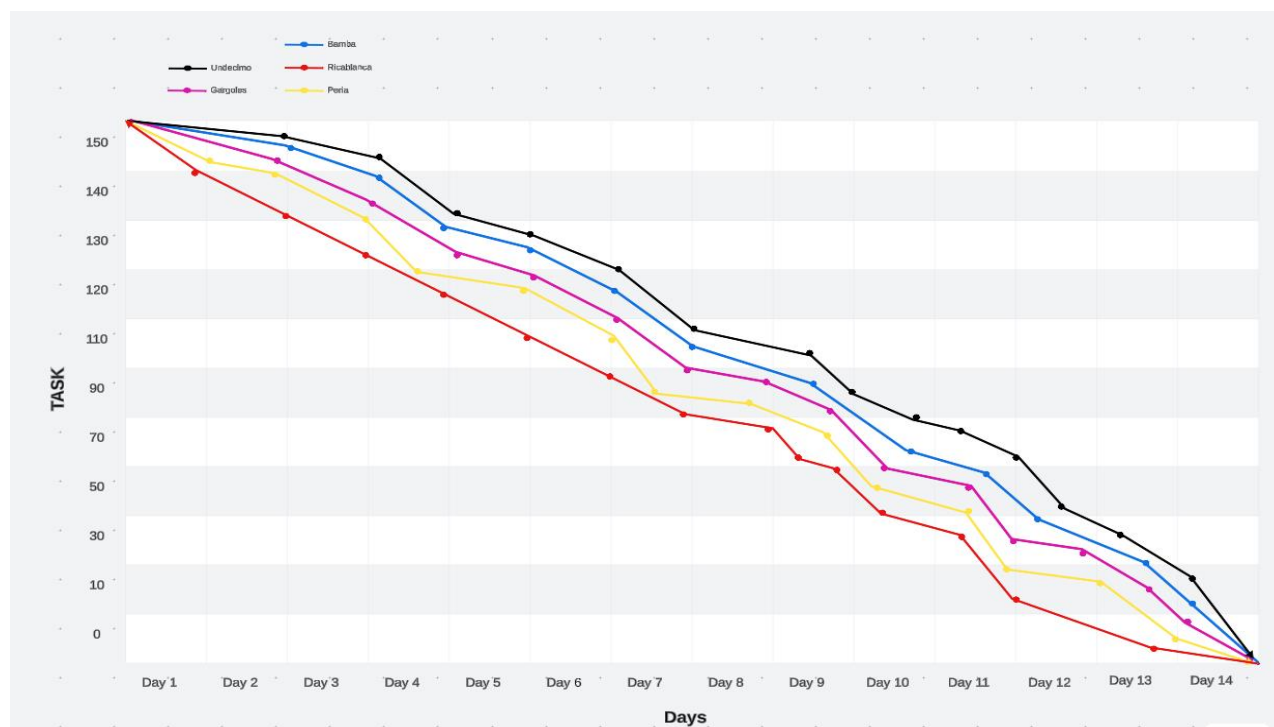


Figure 4: Burndown Chart

3.5 MICROSERVICES ARCHITECTURE

In our library management system, the microservices architecture consists of key components.

The account management and authentication service will ensure that the user sign-up and login are both secure. The catalog service will display a list of books available and use QR codes for easy tracking. The tracking service will keep records of books borrowed and returned. Thus it will help manage the overdue items effectively. Also, the reporting service will generate usage-based report which will make decisions accordingly.

We will include the Gmail API to facilitate resetting passwords via password reset codes, improve account management, and the Google Forms API to collect user experience with each service for further improvement.

All services are communicated through well-defined APIs via the API Gateway, which ensures they are routed correctly, securely, and monitored. This architecture allows every component to be independent while providing a seamless library management experience that adapts to whatever is required in the future.

3.5.1 MICROSERVICES DIAGRAM

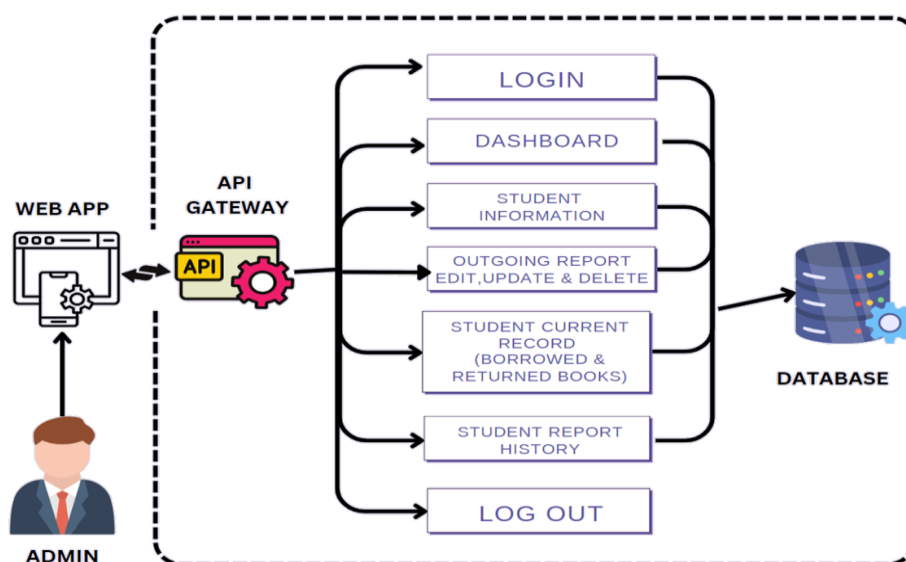


Figure 5: Microservices Architecture Diagram (Admin)

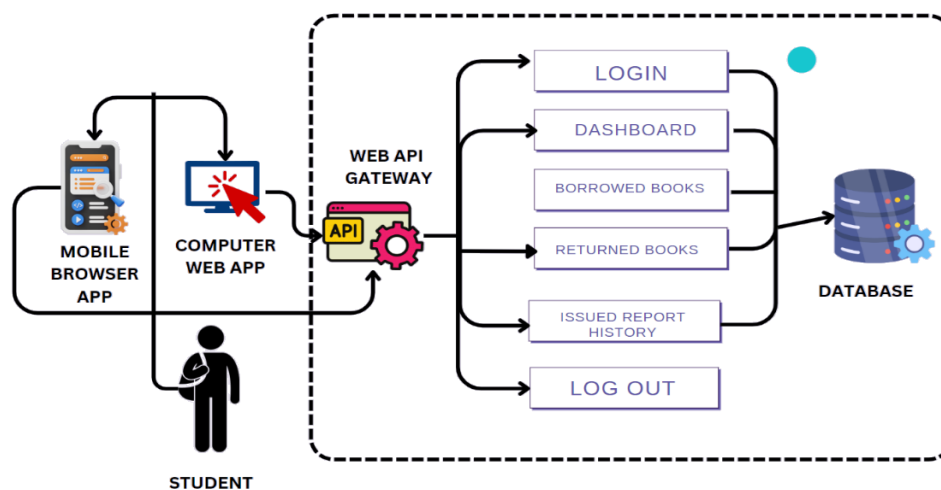


Figure 6: Microservices Architecture Diagram (Student)

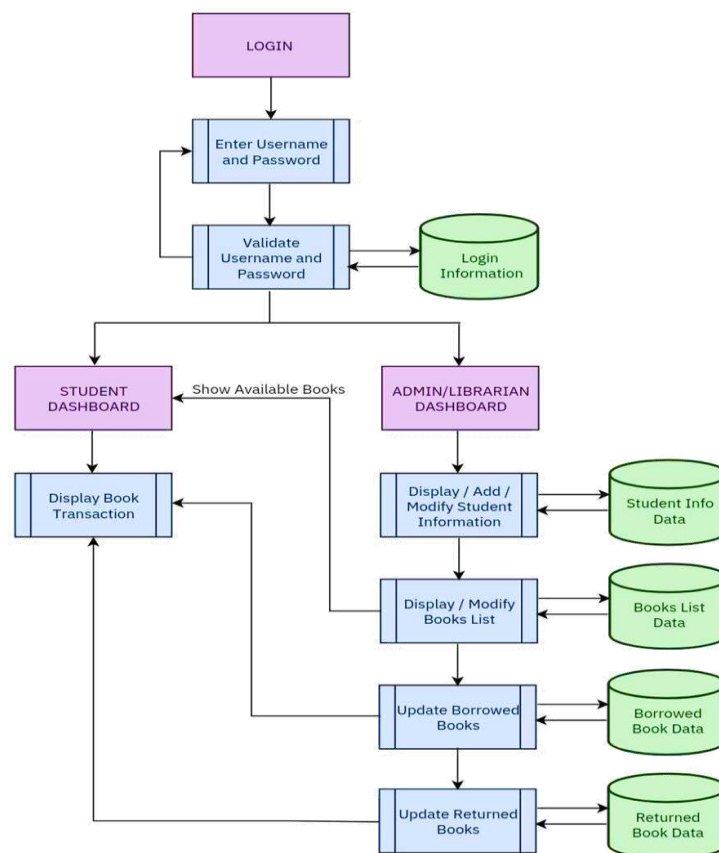


Figure 7: Data Flow Diagram Level 1

3.6 DEVOPS IMPLEMENTATION

We will apply DevOps to our system of library management: moving developers and operations teams closer together to expedite software development processes and make them more reliable. It will imply setting up a CI/CD pipeline using Git and GitHub, automating the testing and deployment processes for our code.

We would first evaluate the processes we currently use in order to know where we need improvement so that we may have a better understanding of our strengths and weaknesses. Then, upon conducting this assessment, we will decide on the proper tools that fit the best for our project needs and goals.

Next, we create a CI/CD pipeline that ensures every code change is automatically tested and deployed with a smooth path to the production environment. This would help catch problems earlier and lessen errors in the live system.

Our infrastructure will also be automated to maintain consistency and efficiency, even guaranteeing that the development environments match the production setup. We will further train our team to enhance collaboration, ensure all team members feel at ease with the new processes and the tools, and hence build a well-united team to enforce new changes.

This approach helps us have a very robust library management system that not only meets the needs of the users but can be readily adapted for future challenges, and, therefore, it is easier for the software to readily adapt to changes in technology and user expectations. Overall, it will help ensure more efficient workflow, of higher quality software, and a much better experience for users of the library.

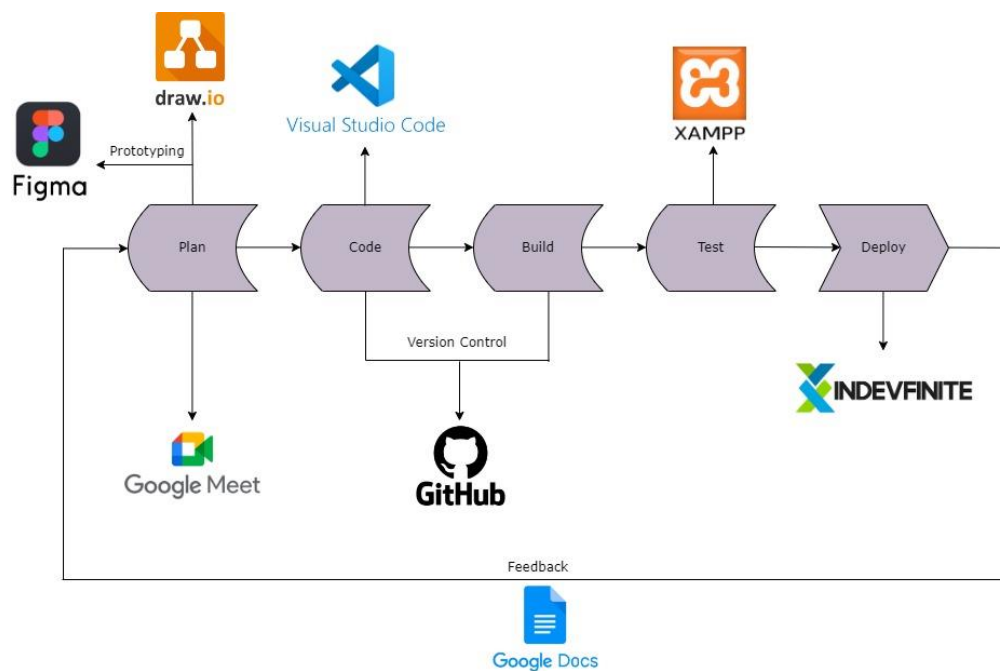


Figure 8: DevOps Implementation

3.6.1 INFRASTRUCTURE AS CODE

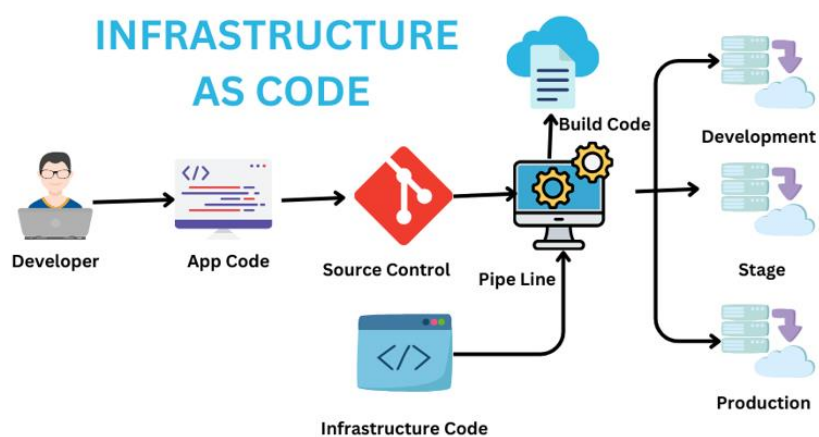




Figure 9: Infrastructure as Code

3.6.2 MONITORING AND ALERTING

No	Icon and Name	Description
1	 <p data-bbox="485 869 764 902">User Authentication</p>	<p data-bbox="839 555 1313 1323">User authentication confirms user identities when accessing a system by having them sign up with a username and password, which are securely stored. When logging in, the system checks these credentials to ensure only authorized users can access certain areas, often including options for password resets and added security measures.</p>
2	 <p data-bbox="438 1760 810 1872">Role Base Access Control (RBAC)</p>	<p data-bbox="839 1395 1302 1872">Role-Based Access Control is a system that manages who can access different parts of a program based on their job role. Each user is assigned a specific role, such as librarian, or student, which defines what</p>

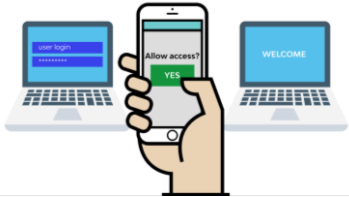

		actions they can take and what information they can see.
3	 <p>Multi-Factor Authentication</p>	<p>Multi-Factor Authentication (MFA) enhances security by requiring users to provide two or more verification factors to access their accounts. For instance, during a password reset, a user enters their username and receives a verification code via email, which they must input to confirm their identity.</p>
4	 <p>Inventory Reports</p>	<p>Inventory reports provide detailed insights into the status of library materials by tracking stock levels, circulation trends, and usage patterns, helping staff identify popular items, low stock, and underused resources for better collection management.</p>

Table 8: Monitoring and Altering

3.7 INNOVATION INTEGRATION

The integration of various innovations in our library management system has a significant impact on its overall effectiveness. One such innovation is the use of QR code where it helps check if the book is available or not. It enables users to view rapidly how the status of the book could be borrowed or not in this process. Thus, this technology offers access to the library's collection, and hence, it enhances the user experience. We'll use the Gmail API for safe password reset hence we can manage our users' accounts well. We will use the Google Forms API to collect feedback from our users. That feedback will help us improve our services to serve our users as best we can. Integration of these technologies is going to make the library run efficiently. Automated systems can send reminders relating to overdue books and track stock in real time; it will, therefore, ensure effective resource management. Personalized user profiles are going to make a difference in the librarian experience, promote teamwork, and contribute to support on digital skills. This will make our library management system efficient and more user-engaging by the modern tool set we would apply. It would make the library significant in education with this modern approach.

The diagram illustrates the interactions within a Library System. It features a central **LIBRARY SYSTEM** (SYSTEM) connected to several **MODULES** and **SUB-SYSTEMS**.

Legend:

- SYSTEM:** Pink box
- SUB-SYSTEM:** Grey box
- MODULE:** Blue box
- Send:** Solid arrow
- Receive:** Dashed arrow

Key Interactions:

- LIBRARY SYSTEM** (SYSTEM) sends **Book Checkout** to **AVAILABLE BOOKS** (MODULE) and receives **Return Process** from **BORROWED BOOKS** (MODULE).
- LIBRARY SYSTEM** (SYSTEM) sends **Availability Updates** to **AVAILABLE BOOKS** (MODULE) and receives updates from **RETURNED BOOKS** (MODULE).
- LIBRARY SYSTEM** (SYSTEM) sends **Send Records** to **REGISTRAR** (SUB-SYSTEM) and receives records from **HR** (SUB-SYSTEM).
- LIBRARY SYSTEM** (SYSTEM) interacts with **STUDENT INFORMATION** (MODULE) and **ADMIN INFORMATION** (MODULE) via dashed arrows, indicating bidirectional communication.

Figure 11: Business Process Architecture Level 2

Data Flow Diagram (Level 3) shows in detail how data moves in the system. It illustrates how information flows between different processes, data storage, and external sources. This level highlights specific interactions, making it easier to see how data is managed. It helps in designing and improving the system by clarifying data connections and identifying areas for improvement.

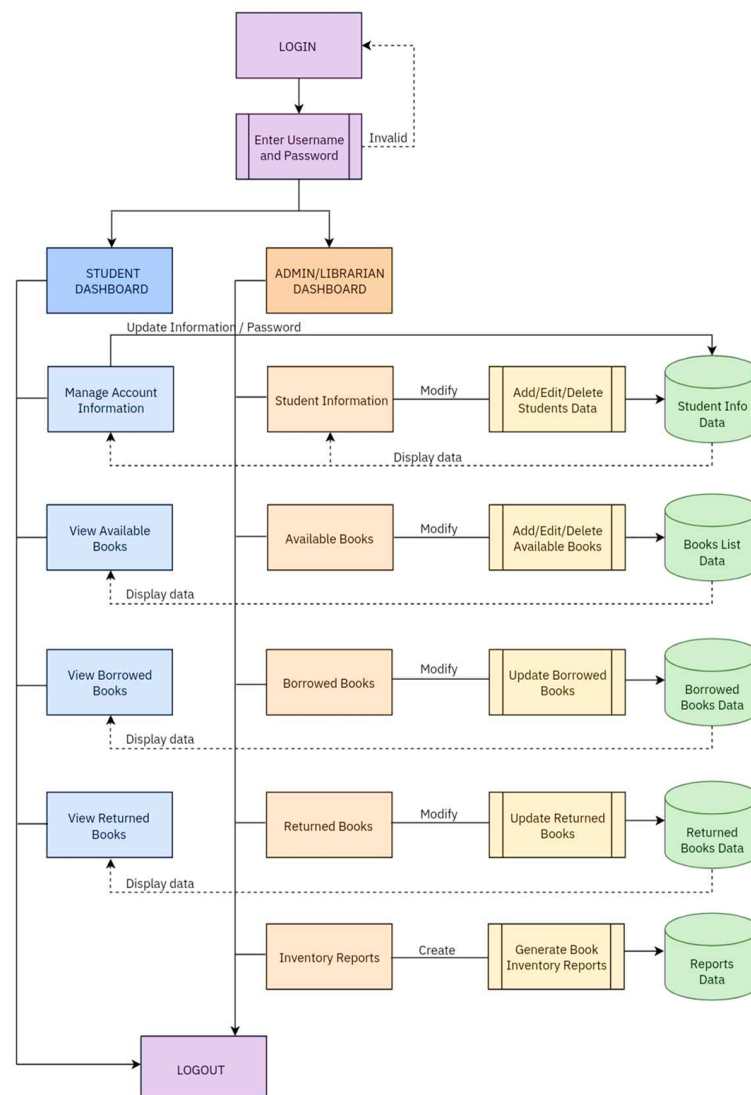


Figure 12: Data Flow Diagram Level 3

3.8 ADDITIONAL CONSIDERATIONS

3.8.1 USE CASE DIAGRAM

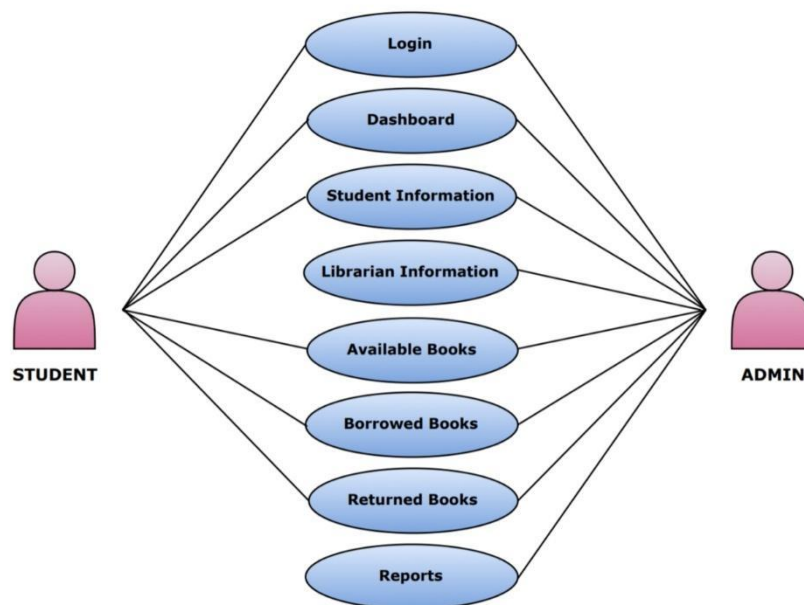


Figure 13: Use Case Diagram

A use case diagram shows how users interact with the system, highlighting important features for each user type. It clarifies who does what, making it easier to understand user and admin tasks. This diagram helps improve communication among all parties and is useful for identifying system needs and possible improvements.

3.8.2 SEQUENCE DIAGRAM

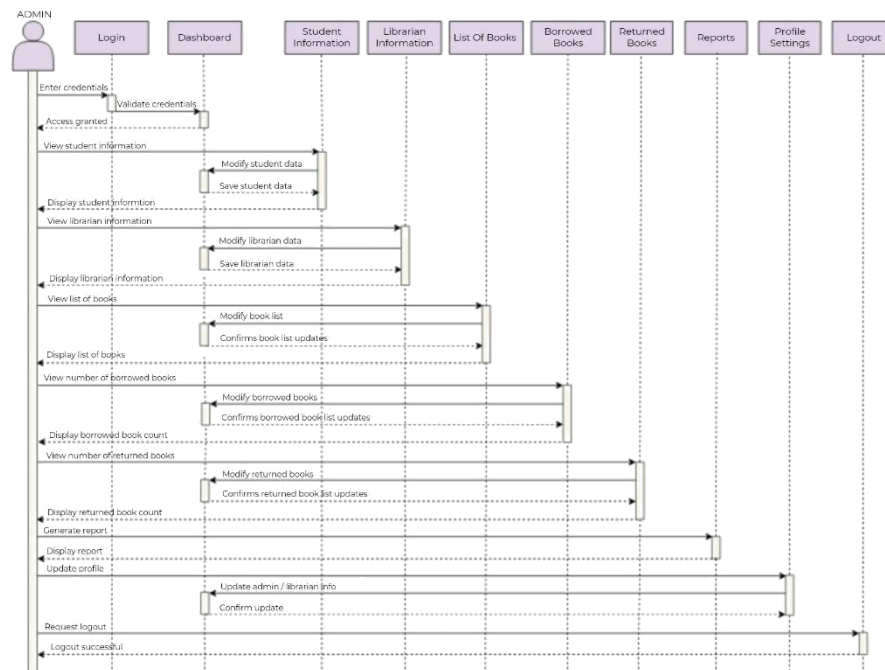


Figure 14: Sequence Diagram (Admin)

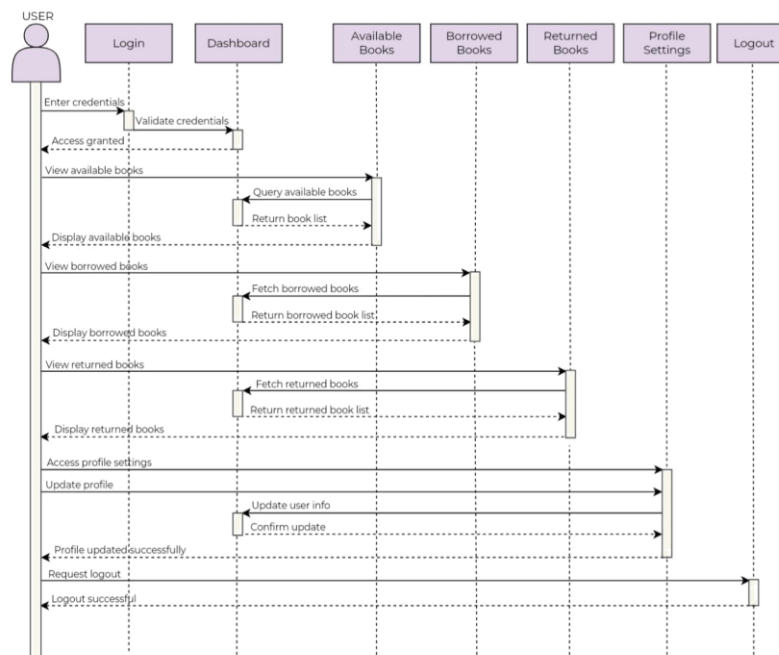


Figure 15: Sequence Diagram (User)

A sequence diagram shows how different parts of the system interact, outlining the flow of messages and actions over time. It clarifies how processes work, checks system requirements, and quickly spots potential issues, improving understanding and communication among everyone involved.

3.8.3 NETWORK ARCHITECTURE

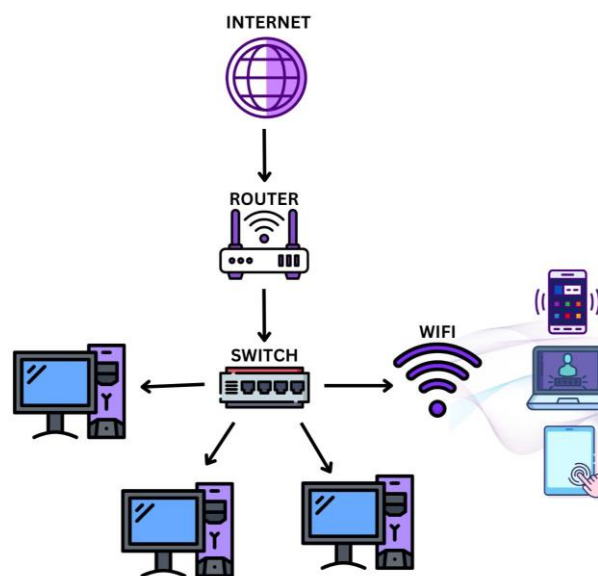


Figure 16: Network Architecture

Our network architecture uses a star topology, which shows how devices connect to a central switch. This design helps with efficient data transfer and central management while isolating connection problems for better fault tolerance and troubleshooting. Overall, it clarifies the network setup and aids in managing traffic for optimal performance.