

Abstract

This study addresses the inefficiencies of the manual locker reservation system currently used by numerous educational institutions, including the partner school in this research, iACADEMY. The existing paper-based process involves multiple physical steps that are prone to delays, miscommunication and unnecessary waste of resources, making it a burden for both students and administrators. To resolve these issues, the study proposes and develops LockR, a centralized web application designed to digitize the locker reservation and management workflow. The system allows students to view locker availability in real-time, reserve slots through an intuitive interface, and automatically generate digital referral slips. The system also notifies administrators upon reservation and payment that provides a quick and easy locker reservation experience through a user-friendly dashboard. By moving the reservation process to a web application, this platform reduces administrative workload and enhances user experience. LockR demonstrates the potential of digital solutions to modernize campus operations and optimize resource management in institutions.

Keywords: *digital locker reservation system, school resource management, web application, workflow optimization, real-time availability*

Chapter I: Introduction

1.1 Background of the Study

In educational institutions, lockers are an essential resource, providing students secure storage for their personal belongings. Despite their importance, the management

and reservation of these lockers often rely on outdated, manual procedures. These procedures can be inefficient and hasslesome for both students and school administrators.

At present, the locker reservation process in iACADEMY is entirely paper-based and involves multiple in-person steps: A student must first visit the Office of Student Affairs and Services (OSAS) to check for available locker slots. If a student eyes an open slot, the student receives a payment advice slip which must then be brought to the finance department for processing. After the payment is completed, the student must return the payment advice slip to OSAS for final approval. The OSAS staff then manually marks the assigned locker as taken on their paper grid (see Figures 1.1.3 and 1.1.4).

This process is not only time-consuming but also vulnerable to common issues such as double bookings and difficulty in tracking locker availability in real time. The use of a physical paper grid to manage locker occupancy (as illustrated in Figures 1.1.3 and 1.1.4) presents significant limitations in terms of accessibility, accuracy, and long-term record keeping.

To address these issues, the proponents propose the development of LockR, a web application designed to digitize the entire locker reservation and management workflow. Through this platform, students can log in with their school email to view available lockers, select a preferred slot, and generate a digital payment advice slip. After making the necessary payment at the finance department, the system notifies OSAS of the payment, allowing administrators to confirm and assign the locker using LockR. This new

process simplifies tasks for both students and administrators while also providing real-time updates on locker availability.

By integrating modern digital practices into a long-standing manual system, LockR seeks to improve efficiency and campus experience. The inclusion of real-life examples, such as the paper-based system currently in use, underscores the necessity for such an upgrade. This platform represents a big step towards a smarter and modern campus experience.

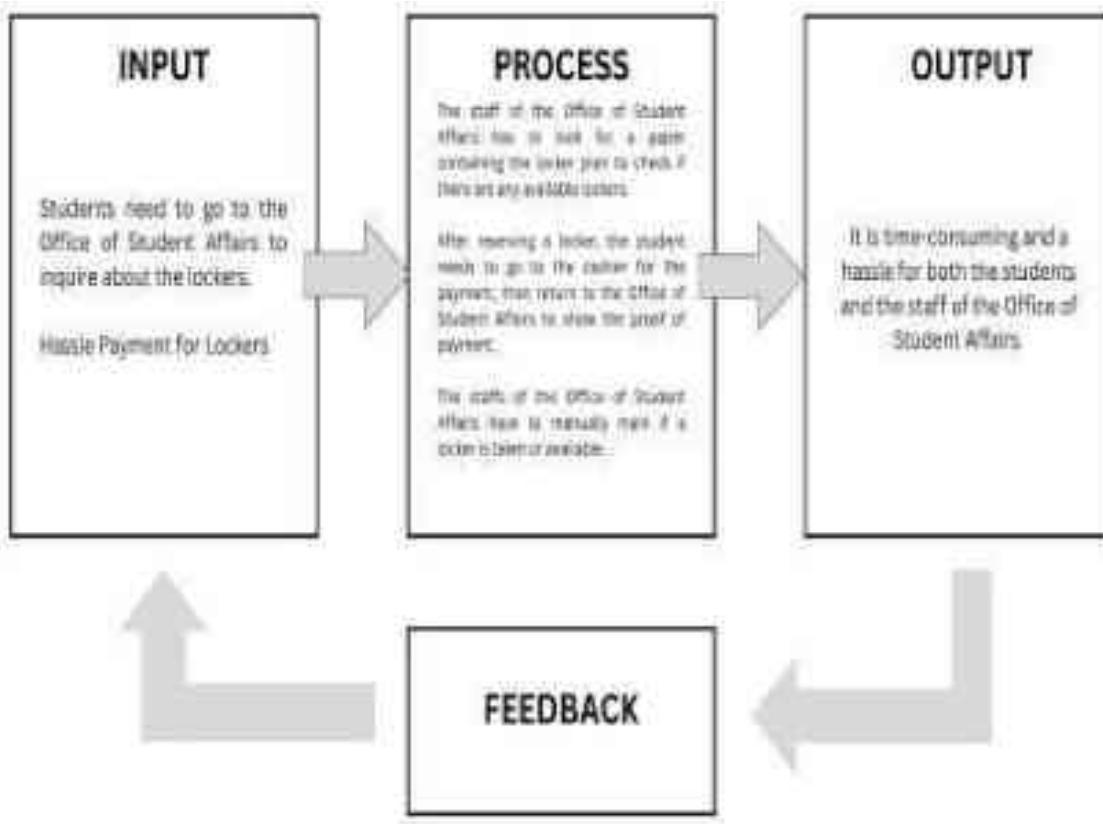
Flowchart of the Current Manual Locker Assignment Process.

Figure 1.1.1 Input Process Output of the Current Manual Locker Assignment Process.

Input Process Output of the Proposed Digital Locker Reservation Workflow using LockR.

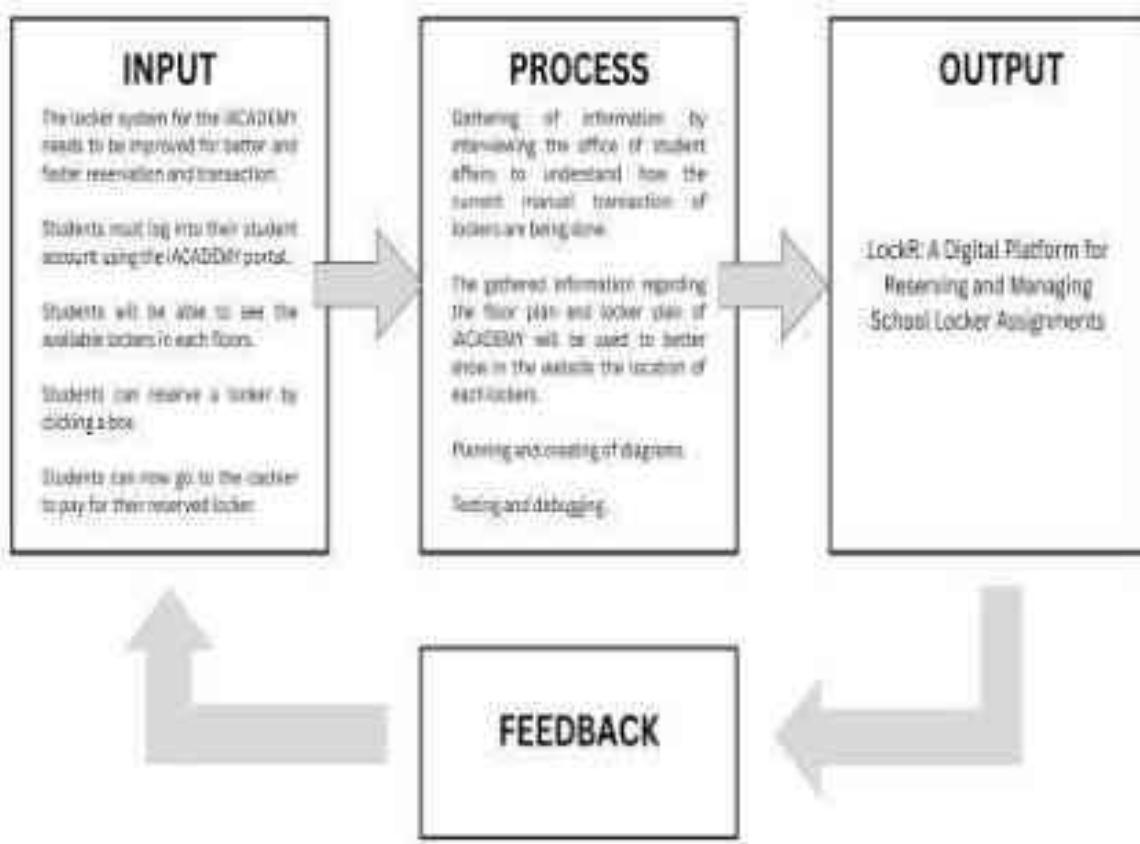


Figure 1.1.2 Input Process Output of the Proposed Digital Locker Reservation Workflow using LockR.

Photo of OSAS's paper-based locker grid used for manual locker assignments.

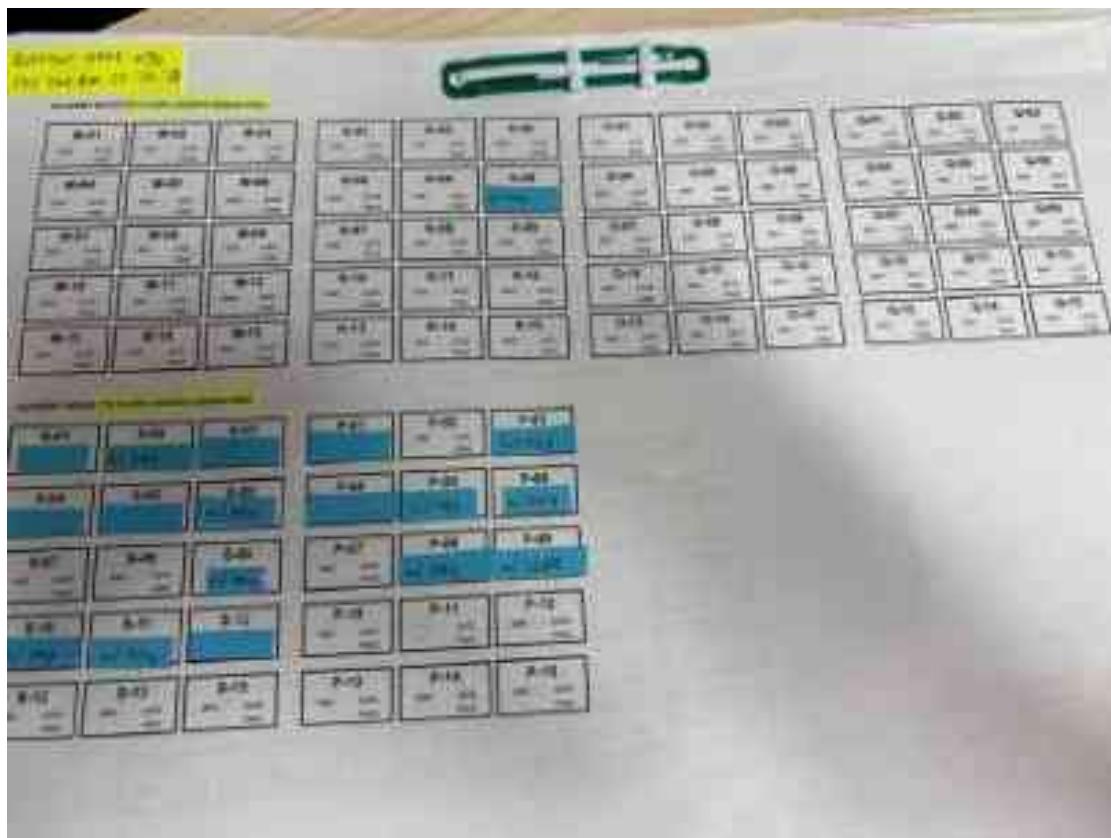


Figure 1.1.3 Photo of OSAS's paper-based locker grid used for manual locker assignments.

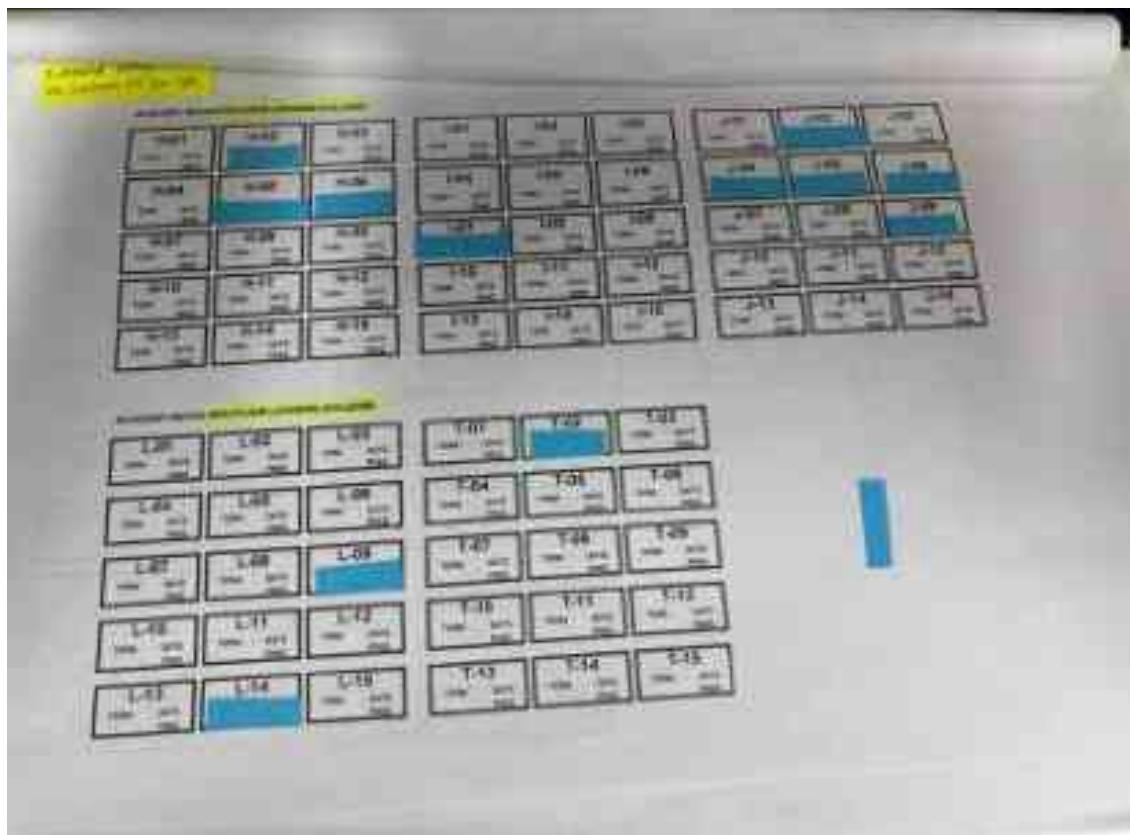


Figure 1.1.4 Photo of OSAS's paper-based locker grid used for manual locker assignments.

1.2 Statement of the Problem

The current locker management system in iACADEMY is viewed as inefficient and dependent on manual processes. This can often result in miscommunication, delays, and a lack of accessibility. Students are required to go through multiple in-person steps to reserve a locker, while administrators rely on physical paper grids that are prone to errors and a hassle to update in real time.

This study aims to address these issues through the development of LockR, a digital platform designed to ease locker reservation and management. The following questions are raised:

1. How can the current locker reservation process be transferred to a digital space to minimize administrative workload and bolster student accessibility?
2. What system features can be implemented to allow accurate real-time locker availability checking and selection?
3. How can the platform ensure proper coordination between students, OSAS, and the finance department?
4. What measures can be taken to enhance accurate record keeping in the locker reservation process?

1.3 Purpose of the Study

The purpose of this study is to improve the efficiency, accuracy, and accessibility of the locker assignment process in educational institutions. By automating the workflow, the system aims to reduce administrative workload, eliminate redundant manual steps, and provide students with an accessible and user-friendly experience.

Specifically, the study intends to:

- Digitize the locker reservation process to address the inefficiencies of the current manual system
- Enable real-time checking and selection of available lockers through the school portal
- Enhance coordination between students, OSAS, and the finance office;
- Improve data security, record accuracy, and system transparency through centralized digital records.

The implementation of LockR is expected to modernize locker management practices and contribute to iACADEMY's vision of being a digital and tech savvy institution.

1.4 Objectives

General Objective

The general objective of this study is to develop a locker reservation and management web application, LockR, that will modernize the process of assigning school lockers, thereby improving operational efficiency, accuracy, and accessibility for both students and administrative staff.

Specific Objectives

- Develop a web application where students can log in and access locker reservation features.
- Implement a digital interface that displays all available locker slots in real time.
- Enable students to select and reserve locker slots through an intuitive, user-friendly interface.
- Integrate a system that generates digital referral slips to be forwarded to the finance department.
- Design a tracking feature that notifies OSAS of student intent and verifies reservation status post-payment.
- Coordinate with the finance department to reflect payment confirmation and OSAS locker assignment updates.
- Ensure secure storage and retrieval of locker data using a centralized and reliable database.
- Evaluate system usability, performance, and effectiveness through user testing and feedback collection.

1.5 Scopes and Limitations

Scopes

The scope of this study covers the development and implementation of a web application for locker reservation and management, LockR, for use by students, the Office of Student Affairs and Services (OSAS) and the finance department at the partner educational institution, iACADEMY. The system will allow students to view available lockers, select a preferred locker, and receive a digital payment advice slip. The web application will also provide OSAS with an administrative dashboard to manage reservations, add or remove locations of lockers, as well as a screen for the finance department to confirm payments.

The platform will include the following core features:

- Student authentication through the school email;
- Real-time locker availability viewing and selection;
- Payment advice slip generation and status tracking;
- Administrative interface for OSAS locker management;
- Integration with payment validation workflows;
- Secure, centralized database for storing locker and user information.

Limitations

- The system is designed specifically for the internal locker management processes of the partner institution, iACADEMY and may not support different workflows in other schools without modification.

- Integration with the finance department's payment system will initially rely on manual confirmation unless full system access is granted.
- The platform is a web application and may require future adaptation for offline use.
- User acceptance testing will be limited to selected participants from the institution due to time and resource constraints.

Chapter II: Review of Related Literature and Studies

Review of Related Literature

This section discusses the different studies, literature, systems, and technologies in retail automation, encompassing advancements in both booking/reservation systems and IoT. It explores how these advancements are transforming traditional retail operations, enhancing efficiency, customer experience, and operation management.

2.1 Web Based Locker Booking System with Multifactor Authentication for Wajasakti Sdn Bhd

Locker management systems have evolved significantly with the integration of modern web technologies and security measures. Radin Nur Haziqah and Khairul Amin (2024) developed a **Web-Based Locker Booking System with Multifactor Authentication** tailored for Wajasakti Sdn Bhd to overcome challenges of manual logbook entries, missing records, and inefficient locker utilization. Their system featured nine key modules, including booking management, user and admin control, and an activity log to ensure security and traceability of operations.

A distinctive element of their system is the adoption of **Multifactor Authentication (MFA)**, employing One-Time Passwords (OTPs) sent via email, thereby mitigating risks associated with static passwords and unauthorized access. Additionally, security features like session timeouts, encryption using salted hashing, and reCAPTCHA integration further strengthen system resilience against common cyber threats.

Compared to similar systems such as E-Locker Book Secure Shared Bicycle Parking and Radical Storage, the Wajasakti system offers enhanced features like dual

authentication, detailed reporting, and damage locker tracking, which were absent in other implementations. This aligns with current trends emphasizing not only operational efficiency but also robust security protocols for data protection and privacy compliance (Radin Nur Haziqah & Khairul Amin, 2024).

The authors concluded that adopting a web-based, secure locker booking system facilitates efficient locker utilization, prevents conflicts or double bookings, and improves the user experience for both administrators and staff. Nevertheless, they acknowledge certain limitations, such as dependence on internet connectivity and the absence of integrated online payment, suggesting future improvements through IoT integration and expanded digital functionalities.

2.2 Locker Management System

Several studies have explored the digitalization of institutional processes to enhance efficiency and reduce manual workload. Walia and Gill (2014) designed a web-based platform to comprehensively track student information—from attendance and academic progress to financial records. This centralized system, developed using PHP and a XAMPP server, allows users to securely access and manage student data online, thereby simplifying reporting and administrative tasks.

Similarly, Alibraheemi and Alkhefaji (2015) developed a digital solution for managing university staff records and financial details. Their system incorporates user authentication, ensuring that only authorized individuals can view relevant information. This approach replaced paper-based processes, streamlining administrative functions and improving data security.

Bista et al. (2018) proposed a web application focused on hostel management. Their system automated various processes such as room allocation, mess bill payments, complaint registration, and out-pass generation. The computerized platform facilitated quick searches for vacant rooms and maintained comprehensive records, significantly reducing the manual workload for hostel staff.

Lal et al. (2018) introduced a web-based attendance management system that stores student and faculty data—including personal details and course-specific attendance—in a MySQL database. Their solution ensures secure record-keeping and simplifies the retrieval of attendance data across departments, thereby enhancing institutional oversight.

Goel et al. (2017) developed a college monitoring system that enables institutions to manage admissions, fees, and other academic operations through a centralized digital platform. The system features multi-level user access controls and generates comprehensive reports, promoting data-driven decision-making and administrative efficiency.

The research by Shrimai et al. (2020) addressed similar challenges faced in managing lockers for students in academic institutions. Previously, the process of assigning and returning lockers at Universal College of Engineering was entirely manual, leading to significant delays and cumbersome record-keeping. Students had to fill out forms that were stored physically, consuming time and storage space. Additionally, issues arose when students misplaced keys or forgot locker numbers, necessitating time-consuming searches through paper files.

To overcome these obstacles, the authors developed a Locker Management System using technologies such as HTML, CSS, PHP, JavaScript, and MySQL. The

proposed system automates locker assignment, searching, availability checks, and returns, while generating reports for administrative use. Staff can efficiently manage locker data and instantly retrieve records, saving time and reducing physical storage needs. The digital system improves security and accessibility, as it can be accessed from any location within the campus by authorized personnel. By transitioning from manual to digital operations, the system significantly boosts operational efficiency and ensures accurate record-keeping.

Collectively, these studies highlight the importance and effectiveness of digital systems in transforming manual administrative tasks into streamlined, secure, and efficient processes, which directly supports the development and implementation of locker management solutions in educational institutions.

2.3 Design and Development of an Integrated Room Reservation System for Higher Education Institutions

The increasing demand for automation across industries has significantly transformed traditional processes, leading to improved efficiency and productivity (Bai et al., 2020; Frohm et al., 2006). Among these innovations, Information Systems (IS) have emerged as crucial tools for enhancing organizational management, data handling, and decision-making processes (Arifin & Tajudeen, 2020). In educational institutions, IS has been instrumental in alleviating administrative burdens, optimizing workflow, and simplifying document processing (Razak et al., 2018; Demir, 2006).

Higher Education Institutions (HEIs) have increasingly adopted IS to improve academic and administrative functions such as student admission, enrollment, grading, and facility management (Koyluoglu et al., 2015; Puchol et al., 2017). Automated

systems enable faster service delivery, better resource allocation, and enhanced user satisfaction (Martins et al., 2019). Specifically, room and facility reservation systems play a vital role in ensuring smooth academic operations by preventing scheduling conflicts and reducing manual paperwork (Castillo et al., 2011).

German et al. (2021) analyzed the existing manual room reservation process in a Philippine HEI, identifying eight categories of process waste based on lean management principles: transportation, waiting, motion, overprocessing, unused talent, inventory, overproduction, and defects. Transportation and waiting wastes ranked highest, indicating excessive physical movement and delays in approval processes. Such inefficiencies are consistent with earlier findings on the benefits of digital process integration in eliminating non-value-adding activities (Samaranayake, 2009).

To address these issues, the study developed e-Reserba Cardinal, a web-based integrated room reservation system built with Booked Scheduler, PHP, and SQL. The system facilitates real-time information exchange, paperless transactions, and centralized approval processes. Similar to findings by Arts et al. (2015), the adoption of digital technologies reduces operational costs, minimizes errors, and supports environmental sustainability by reducing paper usage.

The correlation analysis conducted by German et al. (2021) revealed that the identified wastes were interrelated; for instance, transportation waste positively correlated with waiting and overprocessing wastes. This aligns with the lean principle that process inefficiencies are often interconnected, necessitating a holistic approach to system improvement.

In conclusion, the literature strongly supports the use of IS in educational facility management. The development of integrated reservation systems, such as e-Reserba

Cardinal, not only optimizes resource utilization but also enhances user convenience and institutional efficiency.

2.4 Integration of Web-based and Mobile Application with QR Code

Implementation for the Library Management System

In response to the growing need for improved library management and user accessibility, this research introduces a comprehensive system that integrates QR code technology with both web-based and mobile applications to enhance library operations in a Malaysian private university. Traditional methods of locating and borrowing materials—often reliant on the Library of Congress Classification (LCC) system and manual procedures—have proven time-consuming and inefficient, especially for users unfamiliar with classification schemes.

To address these issues, the proposed system enables quick and accurate identification, reservation, and borrowing of library resources by allowing users to scan QR codes directly attached to the materials using their smartphones. This process not only facilitates real-time data retrieval but also eliminates unnecessary delays caused by physical searches.

Furthermore, the mobile and web platforms support automated user interactions such as material search, account management, and status tracking, streamlining the entire user experience. Administrators also benefit from improved inventory control, simplified data management, and timely notifications of overdue or uncollected items. By leveraging the low-cost, high-capacity, and easy-to-implement features of QR code technology, the system presents a practical, scalable solution that enhances both the efficiency of library

services and user satisfaction, while maintaining compatibility with existing institutional workflows (Md Din & Fazla, 2021).

2.5 Digital Divide, Adaptability and Transformation Among Faculty Member and administrators of Private Schools in Dasmariñas City, Cavite

The integration of digital platforms in educational institutions continues to evolve, especially in response to growing demands for efficiency and modernization. A study conducted among private school faculty and administrators in Dasmariñas City highlighted the role of digital transformation in administrative processes. It revealed that while technology has become indispensable, disparities in access and adaptability—commonly referred to as the digital divide—still pose significant challenges. This indicates that for any new digital tool to be effectively adopted in a school setting, it must not only be functional but also accessible and user-friendly for all stakeholders involved.

One of the key findings of the study emphasized the varying degrees of adaptability among school personnel when using new technologies. Many educators and administrators expressed a willingness to embrace digital systems, but their readiness was often hindered by gaps in technical skills and institutional support. This insight is critical for platforms like LockR, as it underscores the importance of developing a system that includes user education and support mechanisms to facilitate seamless adaptation. By ensuring that users can quickly understand and navigate the system, LockR can address potential barriers related to technology use in school environments.

The research also pointed out the importance of digital transformation as a means of enhancing organizational efficiency. Schools that had begun digitizing their

administrative tasks reported improvements in task management, time-saving, and accuracy of records. This reinforces the relevance of LockR as a solution, as it offers a structured and automated approach to locker reservations—a process that is traditionally manual and time-consuming. LockR aligns with this need by simplifying locker allocation, reducing clerical workloads, and minimizing scheduling conflicts among students and faculty.

Finally, the study advocated for institutional commitment to technological upgrades, including policy formulation and investment in digital tools. This finding supports the broader adoption of platforms like LockR, which not only streamline specific school functions but also contribute to the school's overall digital transformation strategy. As educational institutions become more reliant on technology, systems such as LockR serve as stepping stones toward smarter campus management and demonstrate how targeted, well-designed tools can support broader institutional goals

2.6 A case study of cinema management system

Modern cinema operations increasingly rely on Information Management Systems (IMS) to enhance efficiency and decision-making. IMS integrates technology, people, and data, creating tools that support organizational processes and strategies. Unlike traditional systems, IMS offers analytical capabilities, enabling businesses to monitor operations, generate insightful reports, and adapt to dynamic environments. For cinema management, these systems facilitate tracking sales, scheduling, and managing customer interactions, forming a critical backbone for operational success (Dweiri, 2005; Wikipedia, 2012).

Implementing computerized systems transforms cinema operations by centralizing data and improving communication. Revenue tracking, customer feedback analysis, and

performance reports empower management to align services with audience preferences. Moreover, computerized systems reduce manual errors, streamline transactions, and enhance customer service. Such systems enable predictive insights into audience behaviors, allowing cinemas to tailor marketing and operational strategies effectively (Dweiri, 2005).

Online reservation systems have revolutionized how cinemas manage ticketing and seat allocation. These systems allow patrons to search for films based on location, time, or title and select preferred seats visually via graphical interfaces. Users receive a booking reference which they can present to print tickets, improving convenience and reducing wait times at cinemas. Additionally, these systems manage cancellations and refunds efficiently by linking transactions to unique booking identifiers (Steward, 2011). This evolution enhances customer autonomy while providing cinema operators with valuable data for strategic planning.

Effective cinema management systems are underpinned by robust database structures. Such databases store details about customers, employees, movies, seating arrangements, and financial transactions. Each entity—including movies, customers, employees, showrooms, and producers—has defined attributes that facilitate operations like seat reservations, sales tracking, and inventory management. Database designs must support scalability and security, ensuring data integrity and facilitating complex queries, such as sales analytics and customer behavior reports (Acharya, 2023).

Security remains paramount in cinema management systems, particularly regarding payment processing. Online payment solutions enable seamless transactions but demand robust security protocols to protect user data. While electronic payment systems, such as credit card integrations, offer convenience, they also pose risks of cyber threats.

An alternative method employed in some cinema systems involves scratch cards containing pre-generated serial numbers and PINs. Customers purchase these cards and use the codes to reserve seats online. This approach reduces online transaction exposure but introduces logistical considerations in card distribution and management (Jing, 2011; Acharya, 2023).

Cinema management systems provide significant benefits, including automated ticketing, reduced operational costs, improved customer service, and enhanced data-driven decision-making. They enable cinemas to offer online services, catering to consumer preferences for convenience and speed. However, challenges include the costs of developing and maintaining such systems, ensuring data security, and managing the integration of new technologies. Moreover, systems dependent on scratch cards may face scalability issues and limitations in user experience compared to fully online payment platforms (Acharya, 2023).

2.7 Learner Record Management application of SHS in San Nicholas III, Bacoor City

The development of a learner record management system in San Nicholas III Senior High School demonstrates how educational institutions can benefit from customized digital solutions tailored to their operational needs. The system aimed to resolve the inefficiencies of manual documentation by automating student data storage and retrieval. This shift not only streamlined administrative workflows but also reduced the chances of data loss and human error. Similarly, LockR proposes to digitize the traditionally manual locker assignment process; minimizing paperwork, reducing mismanagement, and making the entire system more secure and organized.

The learner record system highlighted the value of accessibility, enabling both administrators and students to interact with data quickly and accurately. Such accessibility is a fundamental design principle for LockR as well. By integrating a centralized platform where locker information is managed digitally, LockR ensures that users can easily view, reserve, or modify their assignments with minimal supervision, reducing unnecessary physical interaction and improving the overall user experience within school environments.

Another key takeaway from the record management initiative was the importance of user-oriented design and usability. The developers prioritized ease of use, recognizing that both students and faculty members have varying levels of technical proficiency. LockR adopts the same approach by focusing on intuitive navigation, minimal learning curve, and responsive features—ensuring that its adoption will not be hindered by technological unfamiliarity among users.

Moreover, the success of the learner management system was attributed to its ability to adapt to the institution's specific needs, rather than following a one-size-fits-all model. LockR follows this principle by being designed specifically for locker management in school settings, integrating policies, locker availability, and student preferences into a flexible digital workflow. This reinforces the idea that effective digital platforms in schools should not only automate tasks but also align with the school's unique administrative processes and student behaviors.

2.8 Development of Framework for Integrated Car Rental Management System.

The increasing demand for automated reservation systems has led to the development of integrated car rental management systems designed to streamline operations and enhance customer experience. Prior research on rental and reservation systems emphasizes the significance of automation in reducing manual processes, minimizing errors, and improving service efficiency. Similar to other booking platforms, car rental systems have adopted features such as real-time availability display, secure login authentication, and digital payment gateways to ensure convenience and reliability for customers. These technologies are also found in other service industries, such as hotel and transport reservations, indicating a common trend toward user-centered design and operational efficiency.

The integration of mobile applications and web-based management systems has been a key advancement in car rental services. Studies highlight that mobile platforms allow customers to browse vehicles, book rentals, and make payments from any location, which aligns with the system described in this study. Moreover, cloud-based platforms such as Google Firebase are widely used for real-time database synchronization and secure user authentication, demonstrating the importance of scalability and data security in modern rental services. The inclusion of Google Maps API and GPS tracking reflects an industry trend of improving fleet monitoring, enhancing transparency, and building customer trust by enabling live vehicle location tracking.

Software development methodologies also play a crucial role in the success of integrated management systems. Research supports the use of Agile and Rapid Application Development (RAD) in rental system development, as these methodologies

allow iterative prototyping and faster implementation based on user feedback. This aligns with the current study, which used Agile to ensure flexibility in modifying system functions such as booking management, vehicle tracking, and reporting. The use of PHP, Java, JavaScript, and SQL for system development is consistent with technologies employed in similar studies, proving their reliability and suitability for building responsive and secure web and mobile applications.

Studies on management information systems stress the importance of comprehensive reporting features for operational analysis and decision-making. The system in this research incorporates car, booking, customer, payment, and system-user reporting modules, which mirrors trends in other integrated management systems where real-time analytics are used to optimize operations and improve customer satisfaction. The convergence of these technologies and methodologies demonstrates the growing emphasis on fully integrated, user-friendly, and secure rental service platforms.

2.9 Development of a web-based alumni Information System (AIS) with mobile application support for the Technological University of the Philippines.

The implementation of a web-based Alumni Information System (AIS) for the Technological University of the Philippines highlighted the growing need for educational institutions to establish centralized and accessible digital services. The AIS aimed to simplify alumni tracking, engagement, and data updating processes through an integrated platform supported by both web and mobile interfaces. LockR adopts a similar approach, emphasizing centralized locker data management, real-time updates, and mobile accessibility to ensure that locker reservations and assignments are efficient, transparent, and accessible to both administrators and students.

A notable feature of the AIS was its ability to serve multiple user roles: administrators, alumni, and support personnel through role-based access control. This functionality ensured that each user type could access only the features relevant to their tasks. Inspired by this, LockR incorporates a user-type logic that grants different levels of system access to students, administrators, and maintenance staff. By doing so, LockR secures its operations while maintaining usability, aligning with the goal of safe and streamlined locker management within school environments.

The AIS project also emphasized mobile compatibility to extend the system's usability beyond desktop interfaces. This element proved particularly beneficial in improving user engagement, as alumni could access features remotely and conveniently. Likewise, LockR's inclusion of mobile support is designed to maximize student convenience, allowing reservations to be made on-the-go—whether from a mobile phone or tablet—thereby enhancing user experience and encouraging consistent system use throughout the academic year.

The alumni system underscored the importance of sustainable data management, offering search functionalities and database synchronization for efficient record-keeping. LockR echoes this design principle by maintaining organized locker usage history, allowing administrators to track assignments, monitor maintenance issues, and generate reports on locker utilization. This parallel demonstrates that even systems built for distinct institutional needs share a foundational logic when designed to enhance operational efficiency through digital transformation

2.10 Online student record management for Paliparan III Senior High School

The development of the Online Student Record Management System at Paliparan III Senior High School reflects a broader movement toward the digitization of school operations to improve efficiency and data handling. This system aimed to replace manual processes with a centralized digital platform for storing and accessing student records. The shift significantly reduced delays, human error, and document loss, issues that are also commonly observed in manual locker assignment processes. LockR mirrors this initiative by offering a similar centralized, secure, and automated platform that eliminates the traditional inefficiencies in locker reservations.

An essential strength of the student record system was its ability to provide quick and reliable access to information for both students and administrative staff. The system enabled users to retrieve academic records without the need for physical visits or paperwork, enhancing the accessibility of vital student data. In a parallel approach, LockR ensures that locker reservations and assignments are equally accessible. Students can independently reserve lockers through the platform, while administrators can oversee availability and usage remotely, improving convenience and promoting a self-service model.

The success of the online record system was also attributed to its emphasis on security and accuracy in managing student data. Protecting confidential academic information was a core feature, and such security considerations are equally important in LockR's design. Although locker systems may not handle sensitive academic data, managing user identity, locker assignment history, and maintenance logs still demands secure handling. LockR addresses this by implementing user-specific access, transaction logs, and proper validation protocols.

The adaptability of the student record system to the school's operational needs highlighted the value of custom-built digital solutions over generic software. The system was designed to match the school's workflow and administrative structure, ensuring smooth integration. In the same vein, LockR is tailored specifically for locker management within school environments. It considers local locker policies, user roles, and student behavior, offering a solution that not only digitizes but also elevates traditional school locker operations

Chapter III: Methodology

3.1 Requirement Analysis

3.1.1 Functional Requirements

User-based Functionalities

Administrator:

- Must be able to login and log out securely.
- Must be able to view all lockers across different floors and their current statuses (available, reserved, occupied, and unavailable).
- Must be able to view and accept locker reservations and update availability statuses accordingly.
- Must be able to validate student payment and approve/refuse reservation requests.
- Must be able to generate reports for locker usage and reservation history.
- Must be able to view current locker reservations.

Student:

- Must be able to access LockR automatically if already authenticated via the school email.
- Must be able to select any floors that have lockers.
- Must be able to view locker availability and status.
- Must be able to reserve a locker and receive confirmation via the system.

- Must receive notifications for important actions (e.g., reservation approved, payment verified, reservation expired).

System-based Functionalities

LockR

- Must be able to provide real-time locker availability information to all users.
- Must be able to log and track every reservation action (who reserved, when, status, etc.).
- Must store user and locker data securely in a cloud-based database.
- Must automatically update locker status after reservation finalization or expiration and manually by OSAS if the locker is Unavailable.
- Must support OSAS notification triggers for new reservations, payments, and changes in locker data.
- Must prevent double-booking or unauthorized access to reserved lockers.

Web Application

- Must enable students to view available lockers on each floor.
- Must allow students to pick and select preferred slots.
- Must show OSAS rules and regulations before proceeding.
- Must notify and guide students regarding their reservation status.

Inventory and User Management (Administrator)

- Must allow students to browse locker listings and view visual locker maps per floor.
- Must provide reservation history and current reservation status in the student dashboard.
- Must allow OSAS to manage lockers via a dashboard: add/update locker data, approve requests, and view history.
- Must send automated email or in-system notifications for reservation actions and system updates.
- Must be responsive and accessible on both desktop and mobile browsers.

Software Specifications

Development and Maintenance

- Machine for development
 - CPU: Ryzen 5 3600
 - Memory: 16 GB
 - Graphics Card: Nvidia GeForce GTX 1660
 - Storage: 500 GB
 - Operating System: Windows 11
- Development tools
 - Visual Studio Code 1.101
 - Postman
 - Firebase

- Figma

Web Application

- PHP/MySQL
- Node.js
- Excel.js
- HTML5/CSS
- Express.js
- Vue.js
- Sheets.js

3.2 Methodology

3.2.1 Design Methodology

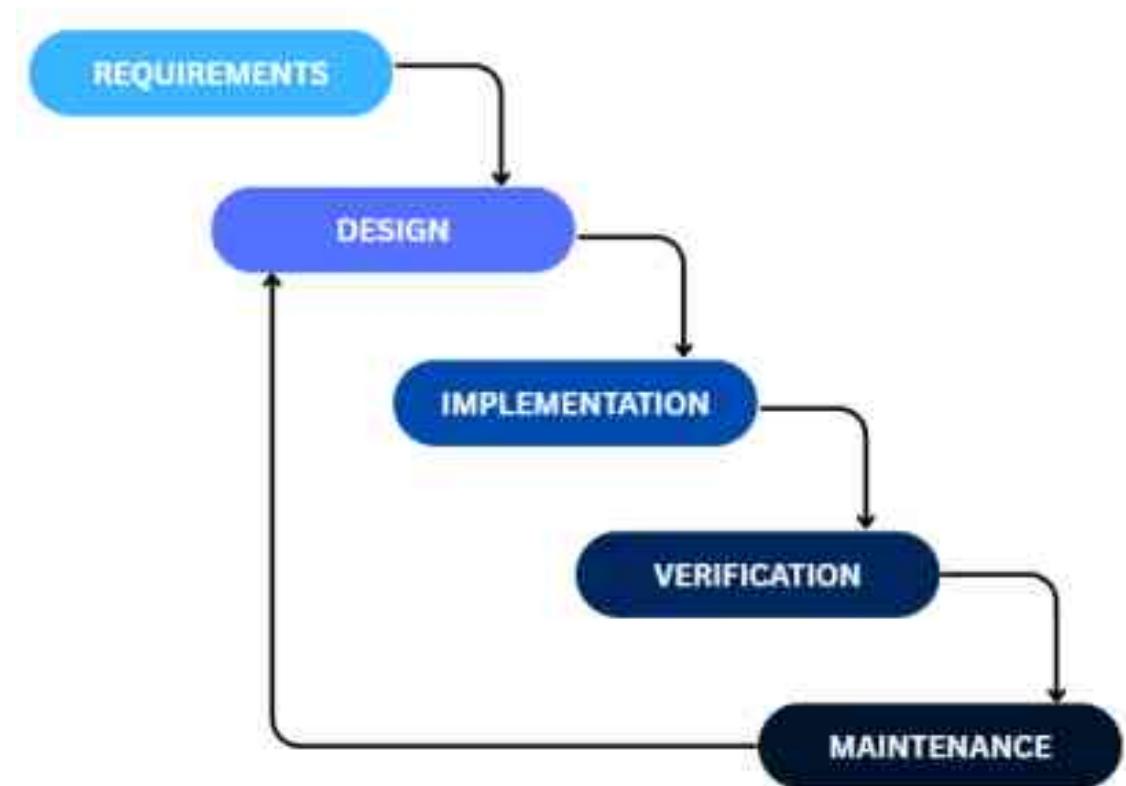


Figure 3.2.1.1 Waterfall Model

The Waterfall Model is a structured software development approach that follows a linear and sequential progression through distinct phases, emphasizing thorough planning and documentation before moving to the next stage. This model requires developers to complete each phase, such as requirements gathering, system design, implementation, testing, deployment, and maintenance in order, ensuring that all aspects of the project are clearly defined and approved before proceeding.

For LockR, this methodology enables the development team to fully document and design the system's functionalities; such as student login utilizing the iACADEMY school email, locker reservation processes, colored indicators for locker availability, and integration with school departments; before beginning implementation. The Waterfall Model helps ensure that the LockR system is developed according to well-established requirements and reduces the risk of significant changes later in the project, promoting stability and predictability throughout the development lifecycle.

3.2.1.1 Advantages and Disadvantages

Advantages

- **Clear Structure & Documentation:** The LockR project benefits from the Waterfall Model's clear structure and emphasis on comprehensive documentation, ensuring that all requirements—such as portal login and locker status definitions—are thoroughly captured from the outset.
- **Suitable for Fixed Requirements:** Since processes like locker reservations and payment workflows in the LockR system are unlikely to change frequently, the Waterfall Model proves suitable for managing these stable requirements.

- **Easier Progress Tracking:** The sequential phases of the Waterfall Model make it easier for school management and IT administrators to monitor progress and ensure that the LockR project stays on schedule.
- **Discipline & Predictability:** The Waterfall Model provides the discipline and predictability required in academic or institutional projects, where thorough reviews and approvals are often necessary before moving to the next phase.
- **Better Resource Planning:** By defining requirements and designs upfront, the Waterfall Model allows for efficient allocation of resources, helping developers, testers, and deployment teams work effectively on the LockR system.

Disadvantages

- **Inflexible to Changes:** If users such as students or OSAS request changes—like introducing new locker statuses—adjusting the LockR project mid-process can be challenging under the Waterfall Model.
- **Late User Feedback:** In the Waterfall Model, user feedback often arrives late in the development process, increasing the risk that usability issues in the LockR system may only become evident during testing, potentially requiring significant rework.
- **High Risk if Requirements Are Missed:** Missing critical details during the initial requirements phase can lead to substantial changes later in the project, posing risks for the LockR system's timeline and budget.
- **Slow for Evolving Features:** If new features, such as mobile integration, are desired for the LockR system, the Waterfall Model would necessitate revisiting earlier stages, slowing the process of delivering updates.

- **No Early Working Software:** Users may have to wait until the later stages of development to see a working version of the LockR system, limiting opportunities for early evaluation and adjustments.

The Waterfall Model has been chosen for its structured and methodical approach, which is well-suited to projects with clearly defined and stable requirements. Its sequential process ensures that each phase of development is thoroughly completed and reviewed before moving forward, promoting clarity and reducing uncertainty. For the LockR project, this methodology enables the team to carefully analyze and document all system requirements, from student login through the iACADEMY Portal to locker reservation workflows and status indicators—before proceeding to design and implementation. By emphasizing detailed planning and documentation, the Waterfall Model helps minimize changes during later stages and contributes to delivering a system that aligns precisely with the established objectives and institutional processes.

3.2.2 Research Methodology

The team would utilize a descriptive research methodology to thoroughly understand the tools and technologies that are required for the development of their project, which incorporates concepts such as computer vision, machine learning, and internet of things. This methodology will involve gathering and analyzing information on various AI frameworks, different sensor options, and relevant software tools to ensure that the team gains a good understanding of the different capabilities, and limitations, and best practices associated with these technologies.

3.3 System Design

3.3.1 Use Case Diagram: Student - Locker Reservation System

Table 3.3.1.1 Use Case Diagram: Student - Locker Reservation System

Use Case Diagram	Reference Number: UCD-001
	Version Number: Version 1.0
System Name: Student LockR Reservation System	

3.3.2 Use Case Diagram: OSAS - Locker Status Update

Table 3.3.2.1 Use Case Diagram: OSAS - Locker Status Update

Use Case Diagram	Reference Number: UCD-002
Version Number: Version 1.0	
System Name: OSAS - Locker Status Update	

3.3.3 Use Case Diagram: OSAS - Add New Lockers

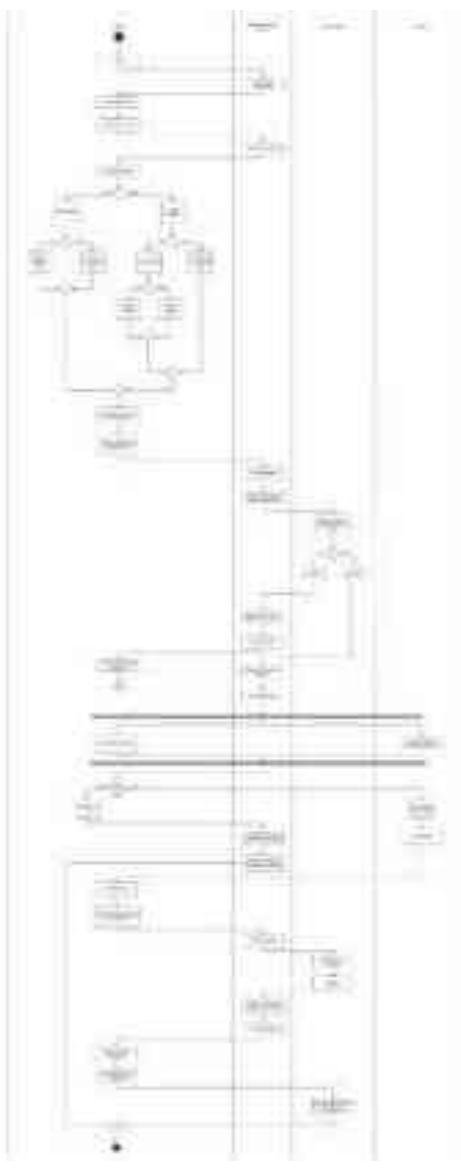
Table 3.3.3.1 Use Case Diagram: OSAS - Add New Lockers

Use Case Diagram	Reference Number: UCD-003
	Version Number: Version 1.0
System Name: OSAS - Add New Lockers	
<p>The diagram illustrates the process flow for adding new lockers in the OSAS system. It begins with a user (OSAS Admin) interacting with the system. The process starts at the 'Login' step, followed by 'LockR HomeScreen', 'View LockR Home Screen', and 'View Admin LockR Modify'. From 'View Admin LockR Modify', the flow leads to 'Select Floor Level', which then leads to 'Click the "+" icon to add new lockers'. This step is annotated with 'INCLUDES' and 'INTERACTS WITH'. Finally, the process ends at 'Update Locker Locations and Status', also annotated with 'INCLUDES' and 'INTERACTS WITH'. A System actor is shown interacting with the final step.</p> <pre> graph TD Admin((OSAS Admin)) --> Login([Login]) Login --> LockRHome[LockR HomeScreen] LockRHome --> ViewHome[View LockR Home Screen] ViewHome --> AdminModify[View Admin LockR Modify] AdminModify --> SelectFloor[Select Floor Level] SelectFloor --> ClickPlus[Click the "+" icon to add new lockers] ClickPlus -- INCLUDES --> UpdateStatus[Update Locker Locations and Status] ClickPlus -- INTERACTS WITH --> System((System)) UpdateStatus -- INCLUDES --> System </pre>	

3.3.4 Activity Diagram

A. Activity Diagram: Locker Reservation System

Table 3.3.4.1 Activity Diagram: Locker Reservation System

Activity Diagram: Locker Reservation System	Reference Number: AD-001
	Version Number: 1.1
System Name: <i>Locker Reservation System</i>	
 The diagram is an Activity Diagram (UML) illustrating the workflow of a Locker Reservation System. It features a central boundary object (represented by a rounded rectangle) containing several regions. One region at the top contains a start event (solid dot) connected to a gateway (diamond). This leads into a sequence of regions representing different steps in the reservation process, such as 'User Requests' and 'System Processes'. There are also regions for 'Lockers Available' and 'Reservation Confirmed'. The diagram uses various symbols like events, gateways, and transitions to show the flow between these steps. A large boundary object surrounds the entire process.	

3.3.5 Activity Diagram

B. Activity Diagram: Locker Reservation System

Table 3.3.4.1 Activity Diagram: Admin Side (Modify Locker Placement)

Activity Diagram: Locker Reservation System	Reference Number: AD-001
	Version Number: 1.1
System Name: Admin Side (Modify Locker Placement)	
<pre> graph TD Start((Start)) --> LogIn[Log In] LogIn --> CheckIn[Check-in Locker Status] CheckIn --> CheckInSave[Check-in Save] CheckInSave --> MultiLockerSelection[Multi-Locker Selection] MultiLockerSelection --> CreateOrDelete{Create or Delete} CreateOrDelete -- Create New Locker --> CreateNewLocker[Create New Locker] CreateOrDelete -- Delete Existing Locker --> DeleteExistingLocker[Delete Existing Locker] CreateNewLocker --> UpdateStatus[Update current locker and status] DeleteExistingLocker --> UpdateStatus UpdateStatus --> End((End)) </pre> <p>The activity diagram illustrates the process flow for modifying locker placement. It begins with a start node, followed by a log-in step. This leads to a check-in step, which then triggers a check-in save. Subsequently, a multi-locker selection step is performed. A decision point follows, offering two options: creating a new locker or deleting an existing one. Both paths lead to an update status step, which finally concludes with an end node.</p>	

3.3.5 Sequence Diagram

a. Sequence Diagram: Student - Accessing and Reserving

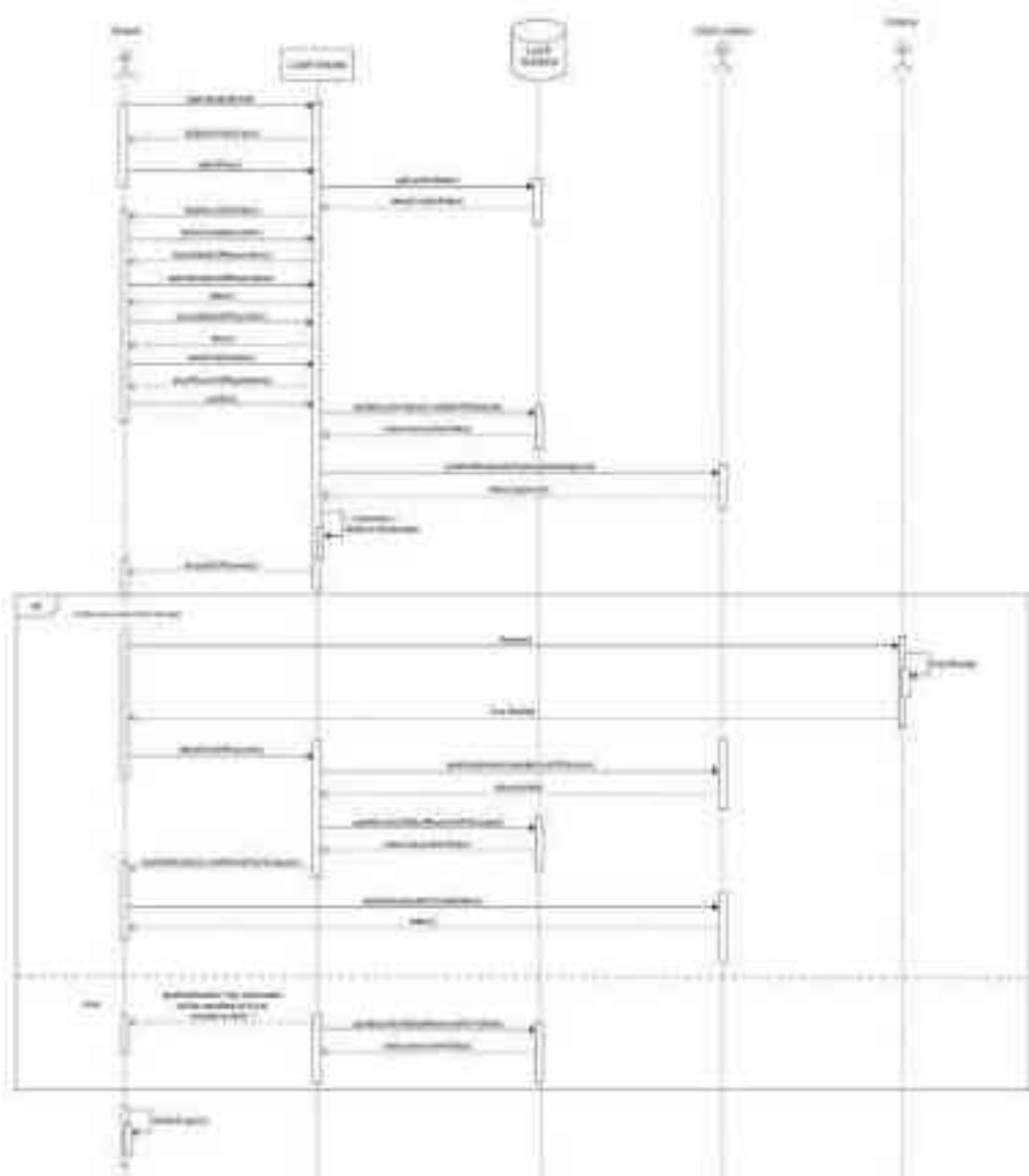


Figure 3.3.5.1 Sequence Diagram: Student - Accessing and Reserving

3.3.6 Sequence Diagram

b. Sequence Diagram: Admin - Handling of Student's Reservation Request

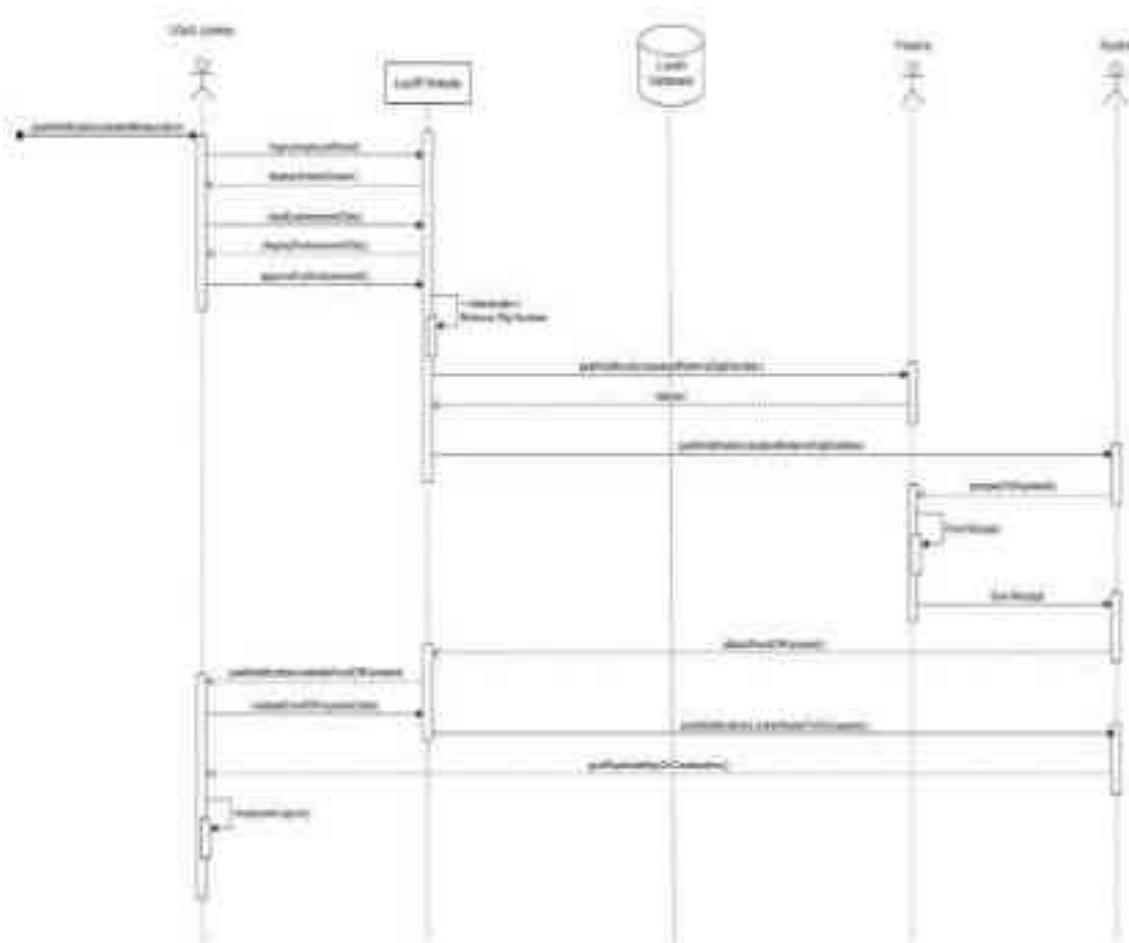


Figure 3.3.6.1 Sequence Diagram: Admin - Handling of Student's Reservation Request

3.3.7 Sequence Diagram

c. Sequence Diagram: Admin - Edit Locker Placement

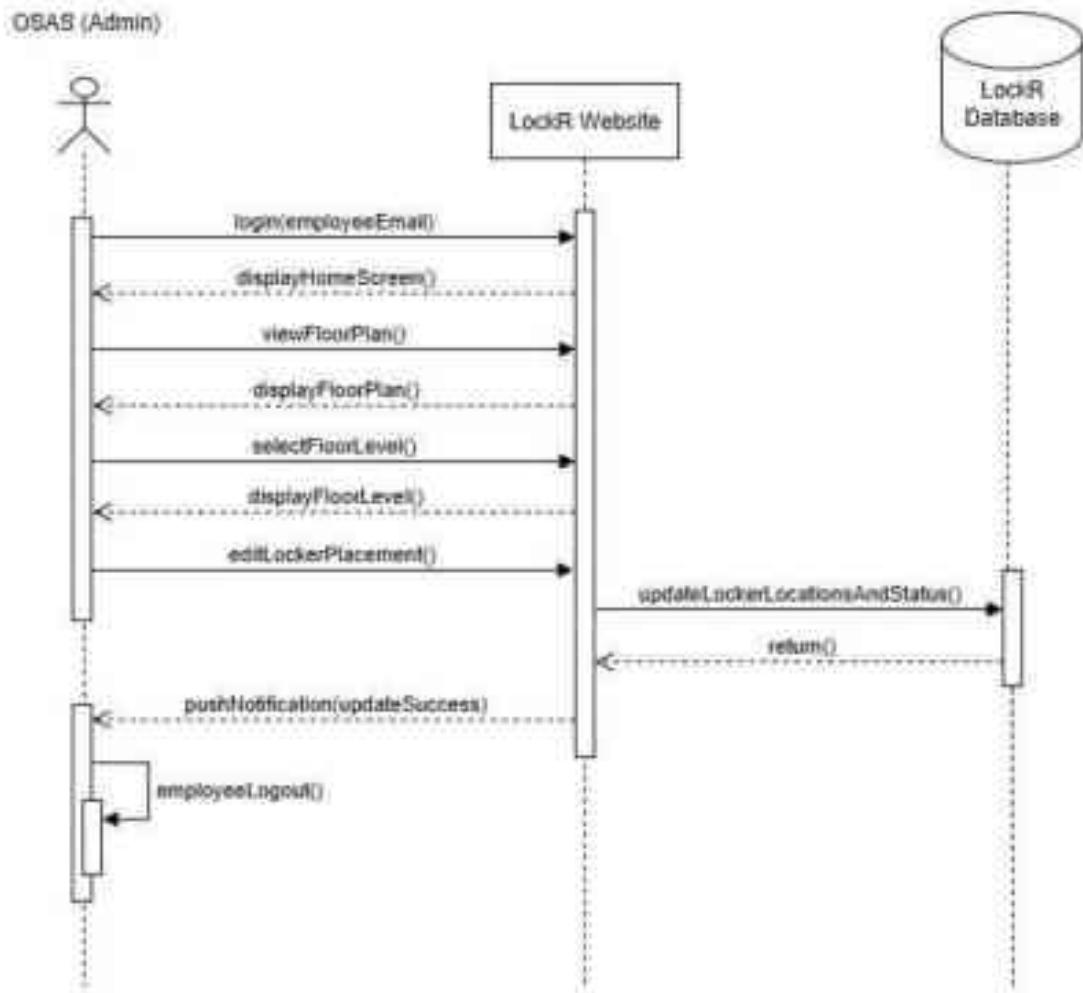


Figure 3.3.7.1 Sequence Diagram: Admin - Edit Locker Placement

3.3.8 Entity Relationship Diagram

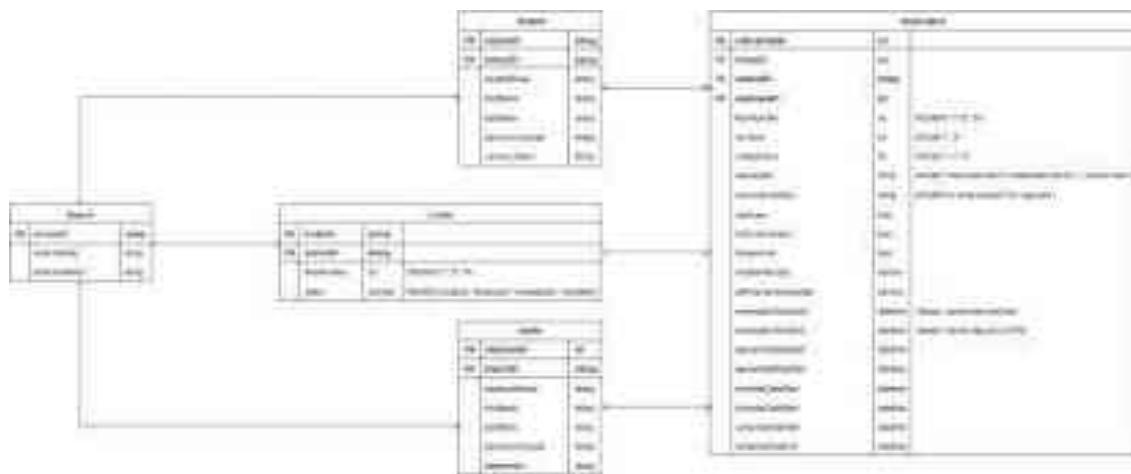


Figure 3.3.8.1 Entity Relationship Diagram

3.3.9 Data Dictionary

Table 3.3.9.1 Data Dictionary: Student

Data Dictionary	Reference Number:
	Version Number: 1.0
System Name: LockR Reservation System	
Subject: Student	

Key	Field Name	Data Type	Length	Nullable	Default Value	Description
PK	student_id	string			EMPTY STRING	Student ID assigned by the school since they were enrolled
FK	studentEmail	string			EMPTY STRING	The school email of the student
	first_name	string			EMPTY STRING	Student's First Name
	last_name	string			EMPTY STRING	Student's Last Name
	password	string			EMPTY STRING	Student's Password (stored as a bcrypt hash for security)
	course_strand	string			EMPTY STRING	Student's Course/Strand

Table 3.3.9.2 Data Dictionary: Login

Data Dictionary	Reference Number:
	Version Number: 1.0
System Name: LockR Reservation System	
Subject: Login	

Key	Field Name	Data Type	Length	Nullable	Default Value	Description
PK	email	string			EMPTY STRING	User's Email assigned by the school since they started in iACADEMY
	password	string			EMPTY STRING	User's Password (stored as a bcrypt hash for security)

Table 3.3.9.3 Data Dictionary: lockrReservationSystem

Data Dictionary	Reference Number:
	Version Number: 1.0
System Name: LockR Reservation System	
Subject: lockrReservationSystem	

Key	Field Name	Data Type	Length	Nullable	Default Value	Description
PK	referralSlipNo	int			NONE	A unique sequence of numbers and/or letters, specifically to the student's reservation
FK	studentID	string			EMPTY STRING	Student ID assigned by the school since they were enrolled
FK	lockerID	int			NONE	A unique sequence of numbers and/or letters, specifically to the locker number
FK	employeeID	int			NONE	A unique sequence of numbers specifically to the employees' id.
FK	branchID	string			NONE	A unique sequence of

					numbers and/or letters, specifically to the id of the school's branch.
	reservationTimeStart	timestamp		NONE	The time wherein the student reserved the locker. Used to track the duration of the reservation.
	reservationTimeEnd	timestamp		current date at 16:30	The time wherein the student's reservation ends. Used to track the duration of the reservation.
FK	floorNumber	int		NONE	Floor's Number. Used for which floor is the locker.
	shsTerm	int		NONE	Indicates the term for SHS. It is used to set the start and end of the academic term for specific term numbers.
	collegeTerm	int		NONE	Indicates the term for SHS. It is used to set the start and end of the academic term for specific term numbers.
	agreement	string		EMPTY STRING	This is used for selection

					on how long the user is going to reserve the locker.
	reservationStatus	string		ENUM('For Endorsement', 'For Approval')	This is used to display a student's current status of reservation.
	duplicate	bool		NONE	It is to identify if a student gave a duplicate key/padlock combination to the OSAS.
	forEndorsement	bool		NONE	If a user requests to reserve a locker, their request will be displayed under the "For Endorsement" tab in the admin dashboard.
	forApproval	bool		NONE	If the user has been validated for the endorsement by OSAS, their request will be displayed under the "For Approval" tab in the admin dashboard.
	dropboxReceipt	varchar		NONE	This will serve as the file paths for each receipt that students will

					be uploading.
	pdfPaymentAdvice Slip	varchar		NONE	This will serve as the file paths for each auto generated Payment Advice Slip.
	agreementDateStart	datetime			When students' reservation has finally been approved by OSAS, it will store the Date and Time when the OSAS approved it.
	agreementDateEnd	datetime			The date and time when the reservation officially ends or expires based on the agreement and the academic year.
	trimesterDateStart	datetime			It is used by OSAS to set the start of a specific trimester of college students.
	trimesterDateEnd	datetime			It is used by OSAS to set the end of a specific trimester of college students.
	semesterDateStart	datetime			It is used by OSAS to set the start of a

						specific semester of shs students.
	semesterDateEnd	datetime				It is used by OSAS to set the end of a specific semester of shs students.

Table 3.3.9.4 Data Dictionary: locker

Data Dictionary	Reference Number:
	Version Number: 1.0
System Name: LockR Reservation System	
Subject: locker	

Key	Field Name	Data Type	Length	Nullable	Default Value	Description
PK	lockerID	int			NONE	A unique sequence of numbers and/or letters, specifically to the locker
FK	floorNumber	int			NONE	A unique sequence of numbers and/or letters, specifically to each floor with a locker
FK	branchID	string			NONE	A unique sequence of numbers and/or letters,

						specifically to the id of the school's branch.
	status	string			ENUM('Occupied', 'Reserved', 'Unavailable', 'Available')	Locker's Status

Table 3.3.9.5 Data Dictionary: floorPlan

Data Dictionary	Reference Number:
	Version Number: 1.0
System Name: LockR Reservation System	
Subject: floorPlan	

Key	Field Name	Data Type	Length	Nullable	Default Value	Description
PK	floorNumber	int			NONE	A unique sequence of numbers and/or letters, specifically to each floor with a locker
	floorName	string			EMPTY	Floor number of

					STRING	the iACADEMY building
--	--	--	--	--	--------	-----------------------

Table 3.3.9.6 Data Dictionary: OSAS

Data Dictionary	Reference Number:
	Version Number: 1.0
System Name: LockR Reservation System	
Subject: Admin (OSAS/FINANCE)	

Key	Field Name	Data Type	Length	Nullable	Default Value	Description
PK	employeeID	int			NONE	A unique sequence of numbers and/or letters, specifically to the OSAS and Finance

FK	branchID	string			NONE	A unique sequence of numbers and/or letters, specifically to the id of the school's branch.
	employeeEmail	string			EMPTY STRING	The name of the staff that handled the locker reservation
	firstName	string				
	lastName	string				
	password	string				
	department_name	string			NONE	Under what department was it approved

3.4 Development Plan

3.4.1 LockR Display Screen Mockup

Splash Screen and LogIn Screen



Figure 3.4.1.1 LockR - Splash Screen



Figure 3.4.1.2 LockR - Login Screen

Home Screen

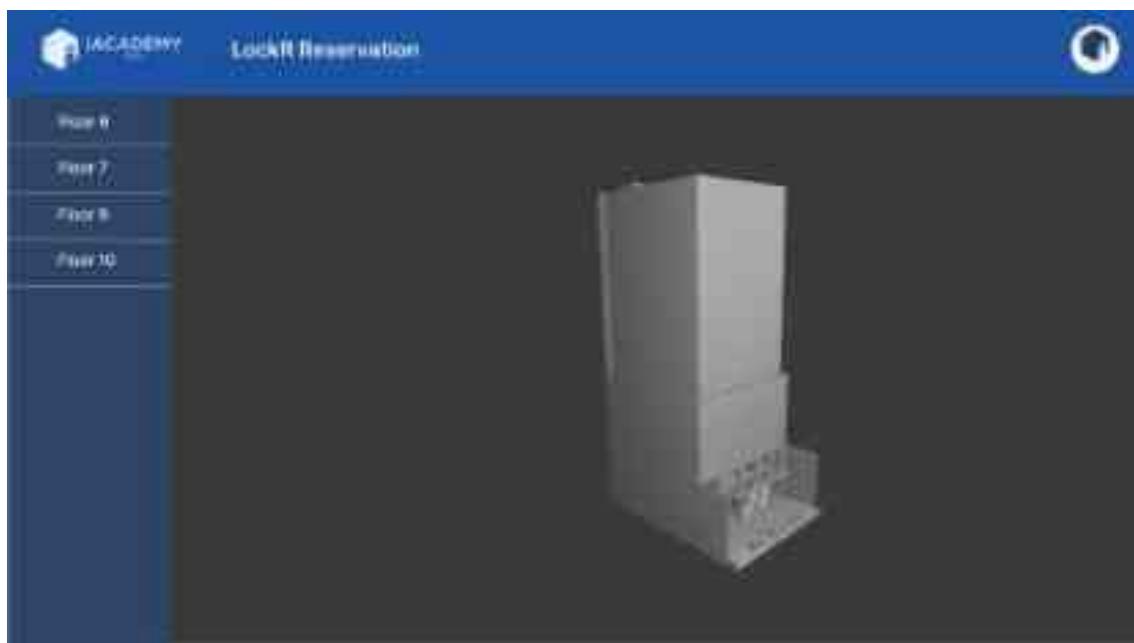


Figure 3.4.1.3 LockR - Home Screen

Floor Screen

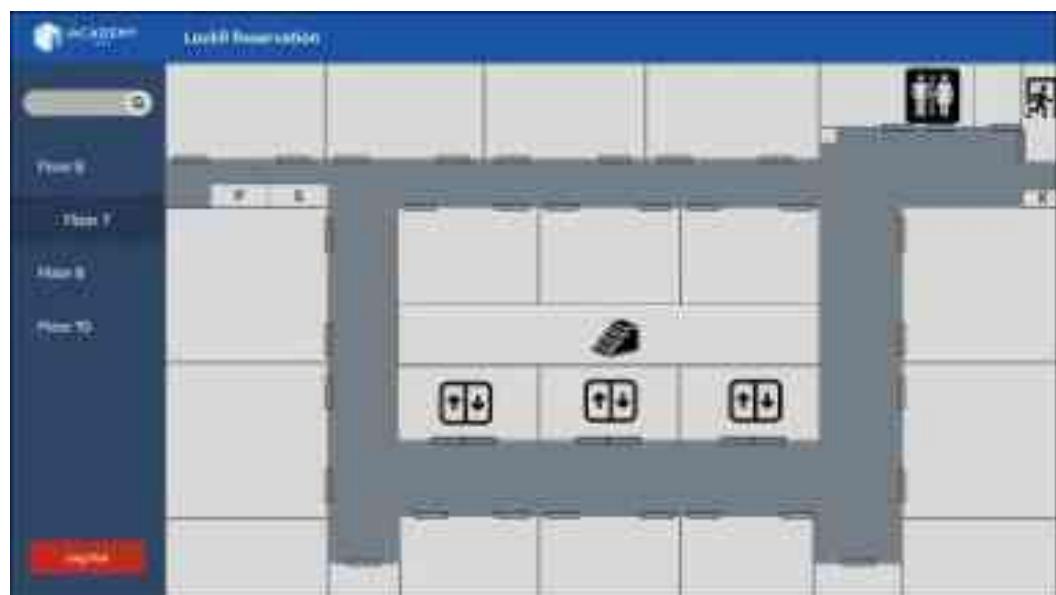


Figure 3.4.1.4 LockR - Floor Screen

LockerGrid Screen



Figure 3.4.1.5 LockR - LockerGrid Screen

Reservation Screen

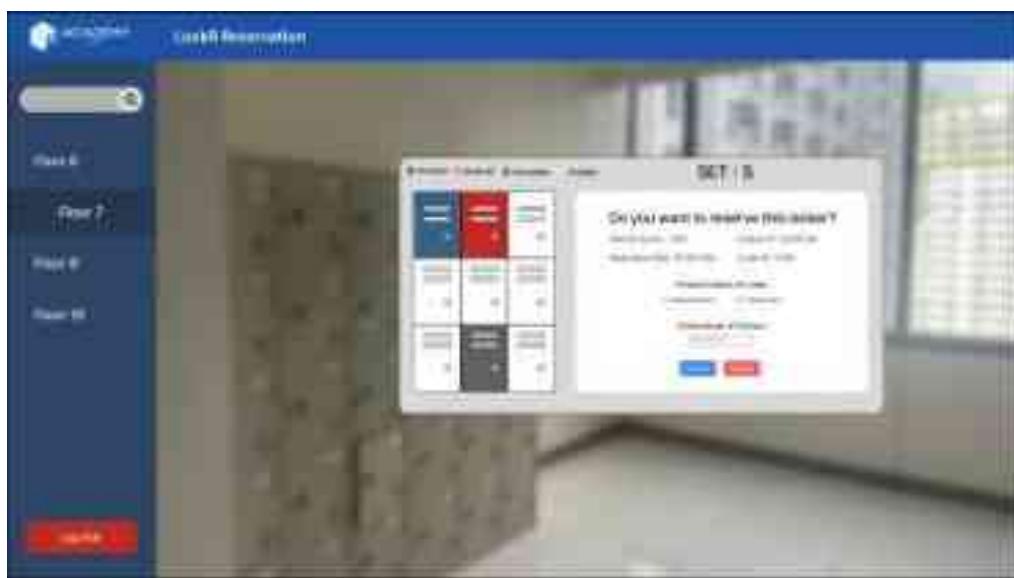


Figure 3.4.1.6 LockR - Reservation Screen

Rules and Regulation Screen



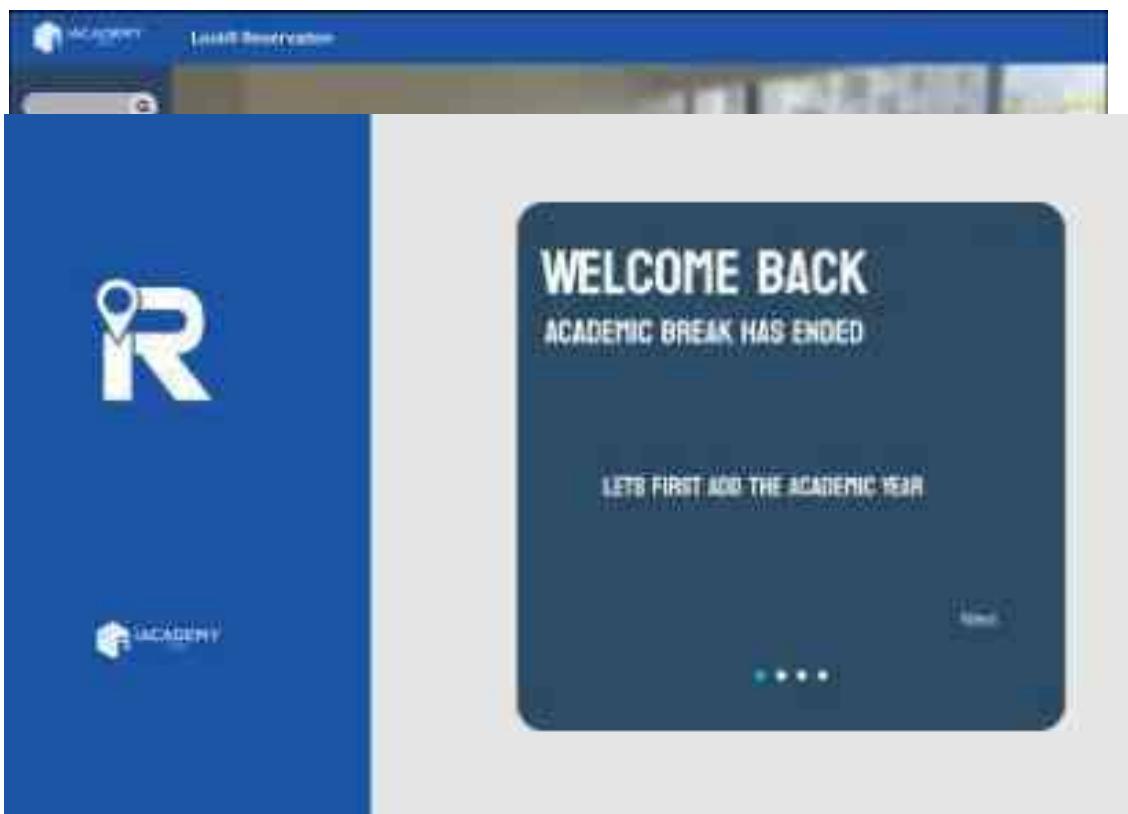
Figure 3.4.1.7 LockR - Rules and Regulations Screen

Receipt Upload Screen



Figure 3.4.1.8 LockR - Receipt Upload Screen

Verified Screen



3.4.3 LockR's - Administrator Web Application Mockup

New Academic Year Screen

Figure 3.4.3.1 New Academic Year Screen

New Academic Year Screen

Figure 3.4.3.1 New Academic Year Screen

Main Screen

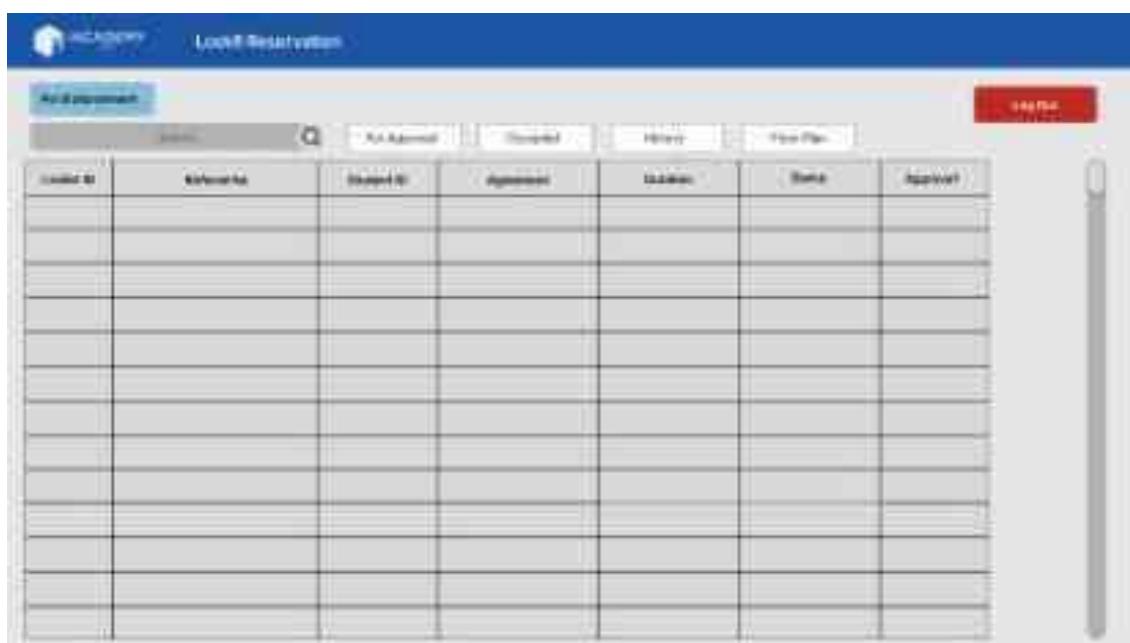


Figure 3.4.3.2 Main Screen

Add and Delete Locker Screen

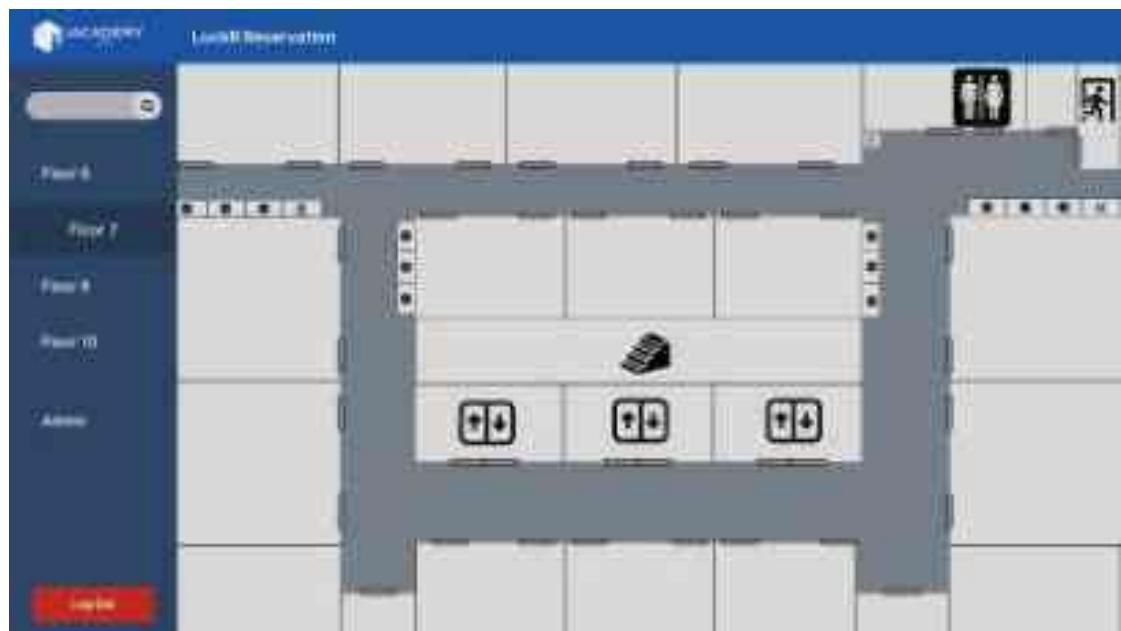


Figure 3.4.3.3 Add and Delete Locker Screen

Update Locker Screen

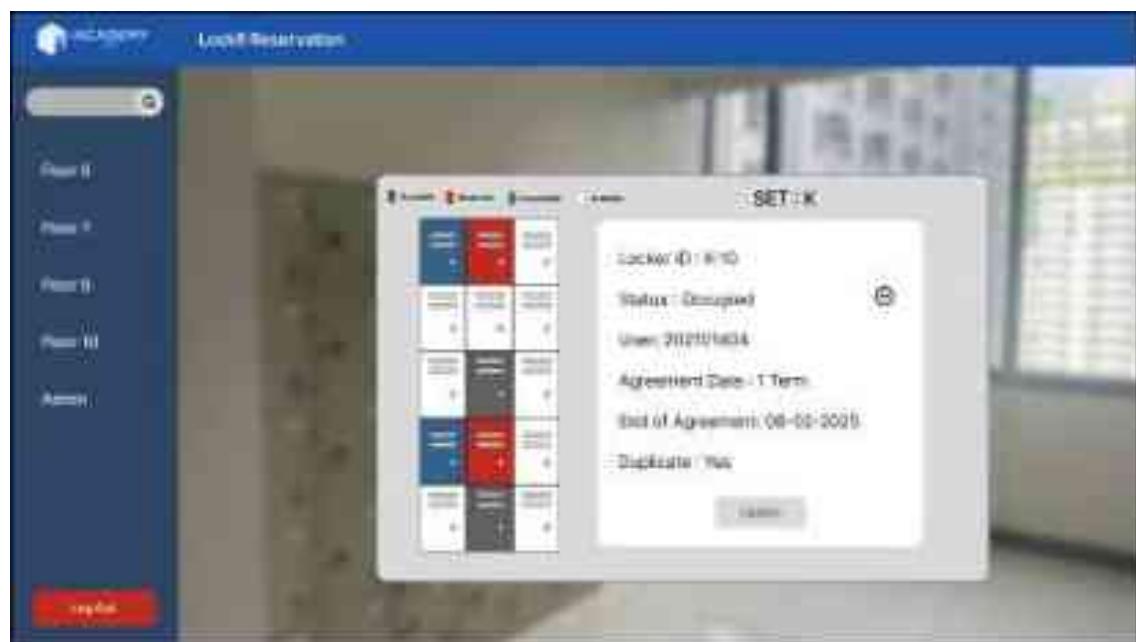


Figure 3.4.3.4 Update Locker Screen

3.5 Implementation Plan

The development of the LockR system will follow the Waterfall methodology, ensuring a structured and sequential development process. The implementation will be carried out through iterative phases, focusing on 3 key components: *Web Application Development (Vue.js, JavaScript, HTML5/CSS)*, *Database & Authentication Management (Firebase)*, *Testing (Postman)*.

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