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Design of a Web-Based Computer Laboratory Management System at the Faculty of Computer Science

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Abstract

The computer laboratory is an essential facility that supports practicum activities, learning, and research at the Faculty of Computer Science, Santo Thomas Catholic University of Medan. However, the current management of the laboratory, which is still conducted manually, both in inventory recording and room scheduling, often leads to issues such as inefficiency, recording errors, and assistant laboratory attendance problems. To address these challenges, this study develops a web-based Computer Laboratory Management Information System designed to facilitate data recording of laboratory equipment, management of laboratory usage schedules, and recording of assistant laboratory attendance. Therefore, this information system is expected to optimize the management of computer laboratories and ensure the smooth implementation of academic activities at the Faculty of Computer Science, Santo Thomas Catholic University of Medan.

Keywords

Laboratory, information system, management, inventory, scheduling, web.

Introduction

Computer laboratories are vital facilities that support practical learning, research, and testing in the field of information technology. At the Faculty of Computer Science, St. Thomas Catholic University, there are seven computer laboratories that play a significant role in supporting both student and faculty academic activities. These laboratories provide students with hands-on experience in computer use, programming, networking, and other aspects of information technology that are essential for their learning process.

However, the current laboratory management system still relies on manual processes, particularly in inventory recording, room scheduling, and laboratory assistant attendance tracking. This manual approach often results in several challenges, such as inaccurate records, data loss, difficulties in monitoring equipment conditions, and inefficiencies in laboratory

utilization. Moreover, poorly managed scheduling can cause conflicts in room usage, which disrupts the smooth execution of academic activities.

To overcome these challenges, a web-based laboratory management system is required to assist administrators in recording inventory data, managing laboratory schedules, and tracking assistant attendance in a more structured, transparent, and efficient manner. The implementation of such a system is expected to minimize errors, improve monitoring and supervision of laboratory equipment, and provide easier access to information for all stakeholders.

Based on this background, this study aims to design and develop a web-based computer laboratory management system at the Faculty of Computer Science, St. Thomas Catholic University. The system is expected to improve the efficiency and transparency of laboratory management processes and to provide better support for practical and academic activities within the faculty.

Methodology

The research method applied in this study is the Waterfall method.

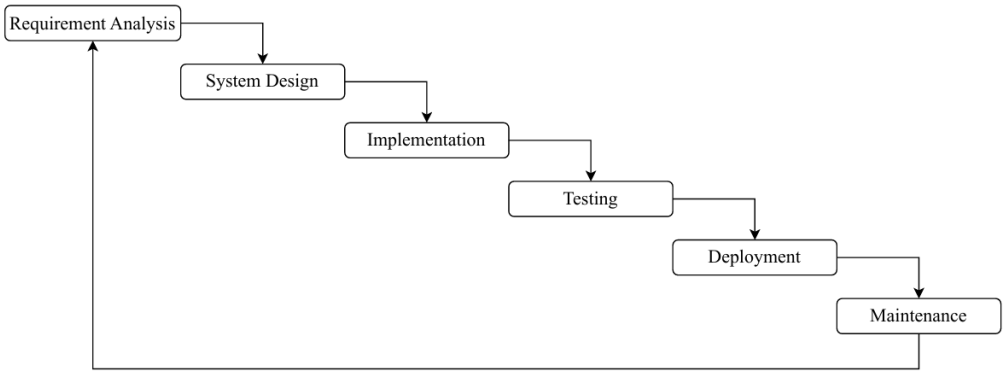

Figure 1. Waterfall

The methodology used in this study is the Waterfall method. The Waterfall method is a linear and sequential software development model in which each development phase begins only after the previous phase has been completed. This method is suitable for projects with clear and specific requirements, as it allows for a more structured and systematic development process.

The development model used in this research is the Waterfall model, which consists of requirements analysis, system design, implementation, testing, deployment, and maintenance. The stages of the waterfalSl model can be explained as follows:

1. Requirement Analysis
   At this stage, the problems in the computer laboratories of the Faculty of Computer Science, St. Thomas Catholic University, are identified. This phase also includes the analysis of components needed for system development, such as how the system will function and the features that must be included, such as access rights management, report generation, and other necessary functionalities.
2. System Design
   In this stage, the design of the system interface for input, output, and processes is carried out. It involves creating several designs, such as input-output flow diagrams, context diagrams, and determining the roles of actors in the system. This stage also includes the design of the database to be used.

3. Implementation
   At this stage, the program code is developed based on the previously created design and implemented into the software. The result of this phase is the development of a computer program that matches the predetermined design. In this study, coding was conducted using PHP as the programming language and MySQLi for database management.
4. Testing
   System testing is a crucial step to ensure software quality and verify the consistency between the specifications, design, and code. In this system, testing was carried out using the black-box testing method to verify whether the implemented features aligned with the design. If errors are found, the development process returns to the coding stage for corrections.
5. Deployment
   After the system has successfully passed the testing phase, the next step is deployment into a real environment. The system is installed on user devices and used by administrators, laboratory staff, and other relevant stakeholders. At this stage, user training and initial data input may also be carried out to ensure the system is ready for daily operational use.
6. Maintenance
   The maintenance phase involves ensuring that the system continues to run properly after deployment. This includes regular updates, routine maintenance, and improvements to maintain system performance and to address potential issues that may arise over time.

Findings

1.1 System Requirements

The system was designed to address both functional and non-functional requirements:

1.1.1 Functional Requirements:

1. Manage user accounts (administrators, assistants, lecturers).
2. Record and manage laboratory inventory data.
3. Schedule laboratory usage and prevent overlapping bookings.
4. Track assistant attendance and generate reports.
5. Provide notifications for laboratory activities.

1.1.2 Non-Functional Requirements:

1. Web-based accessibility.
2. User-friendly interface.
3. Secure login and data access.
4. Efficient response time and reliability.

1.2 Use Case Diagram

The use case diagram helps simplify the workflow of the system to be developed, where actors can perform specific activities. The design includes 4 actors interacting with the system and 4 use cases, as follows:

1. Head of Lab Use Case Diagram
   This diagram illustrates the activities of the Head of Lab. The Head of Lab logs in to manage their profile, view assistant attendance data, lab inventory, room usage schedules, and submissions.

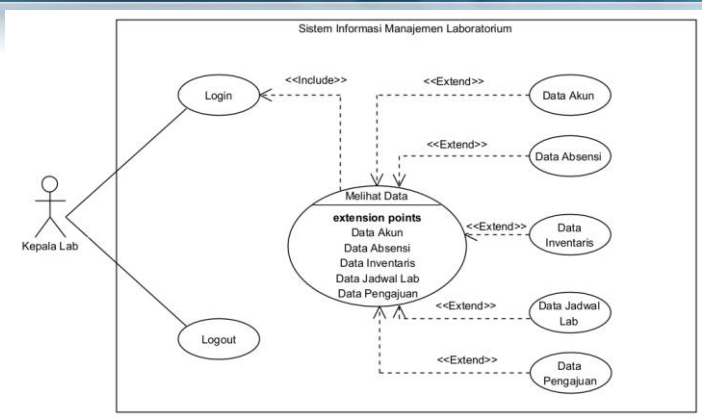

Figure 2 Head of Lab Use case Diagram

2. Admin Use Case Diagram
   This diagram shows the Admin's activities. The Admin logs in to manage their profile, account data, and access assistant attendance, lab inventory, and room schedules.

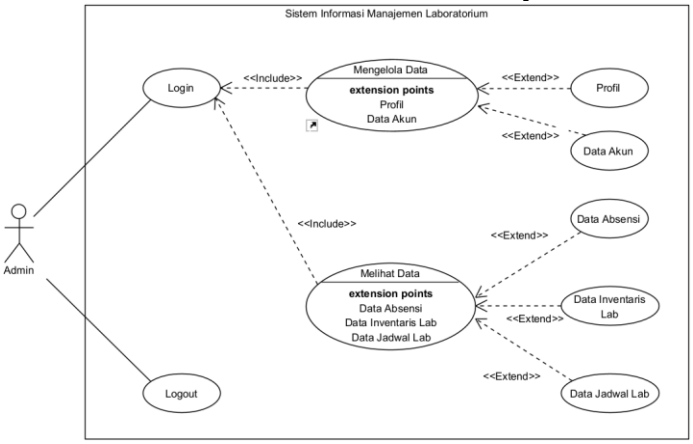

Figure 3 Admin Use case Diagram

3. Laboratory Assistant Use Case Diagram
   This diagram illustrates the Laboratory Assistant's activities. The Assistant logs in to manage their profile, attendance, lab equipment data, room schedules, and submissions.

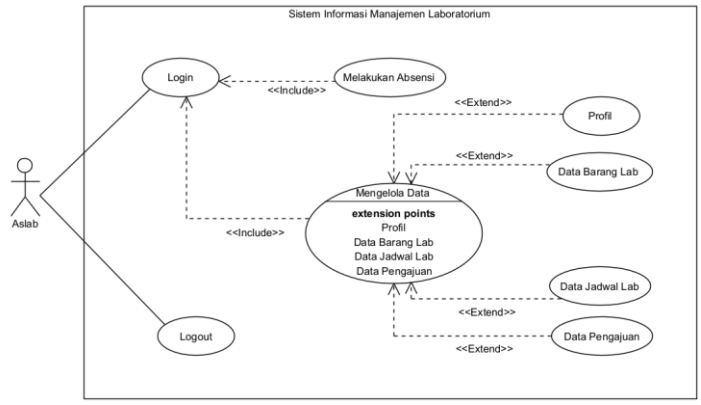

Figure 4 Laboratory Assistant Use case Diagram

4. Lecturer Use Case Diagram
   This diagram shows the Lecturer's activities. The Lecturer can view lab usage schedules (available or occupied) and submit requests for lab room usage.

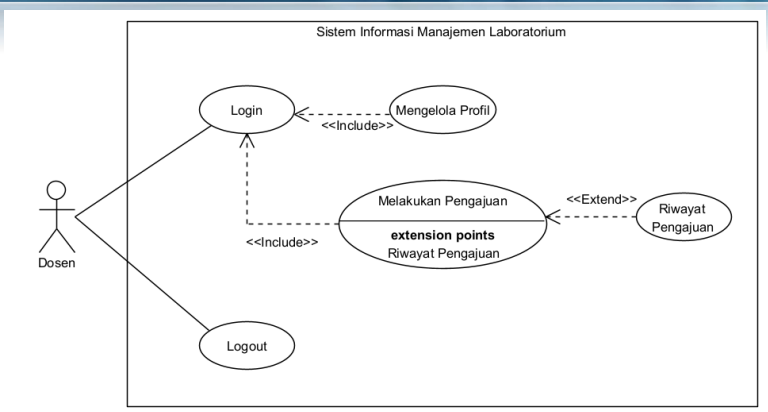

Figure 5 Lecturer Use case Diagram

Results and Discussion

System Implementation

Implementation presents the website interface for the laboratory management system at the Faculty of Computer Science, Catholic University of Santo Thomas.

Figure 6 Homepage

The main page provides menus that allow users to access other pages related to the system. The Homepage serves as the central interface, acting as the main control and information hub of the application or system.

Figure 8 The Usage Schedule of Each Computer Lab

This page displays the usage schedule of each computer lab at the Faculty of Computer Science, Catholic University of Santo Thomas. At the top, it shows the title "Computer Laboratory Room" and the selected date. Users can choose a specific day and time to view schedules, presented in cards containing the lab name, day, start time, and end time.

Figure 9 Login Page

The login page is an interface used to authenticate users before accessing the system. Users must enter a username and password, which the system verifies against the database. If the credentials match, access is granted. This page ensures secure authentication before users can access the application's features and information.

Figure 10 Dashboard

The laboratory assistant homepage contains menus that provide access to other system-related pages.

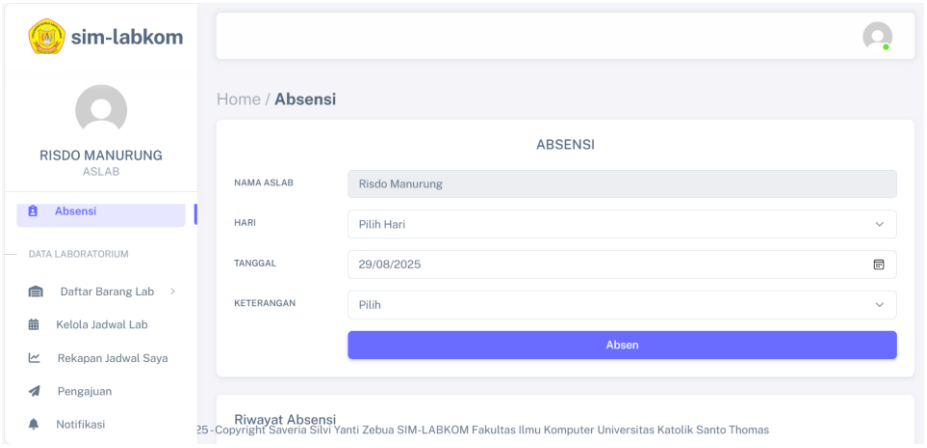

Figure 11 Attendance Page

The Attendance page is used to record assistant attendance by filling out a form with name, day, date, and notes, then clicking the *Attend* button. Below, an Attendance History table displays previous records with a search feature.

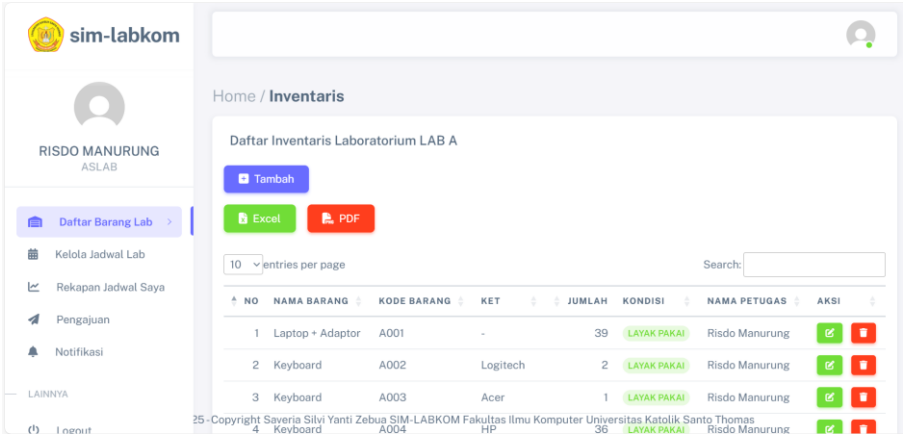

Figure 12 Lab Inventory Page

The Lab Inventory page displays complete laboratory inventory data. It includes an *Add* button for new items and options to export data to Excel or PDF. The inventory table lists item number, name, code, condition, description, quantity, room, and staff name, along with a search bar for easy data retrieval.

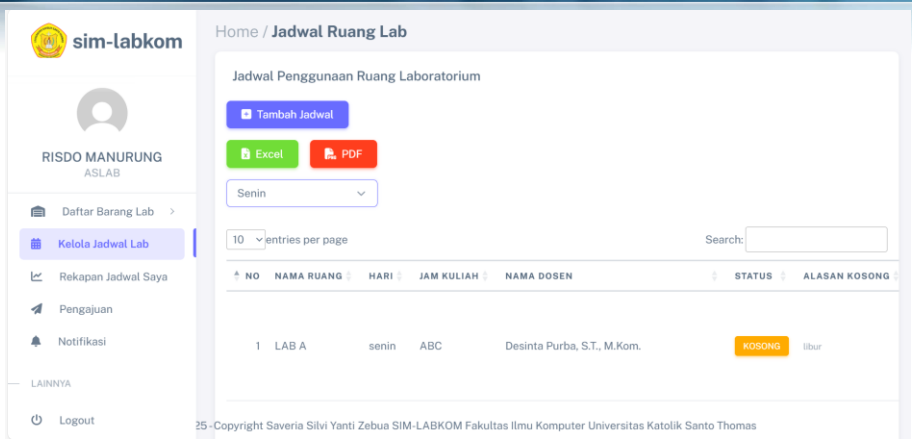

Figure 13 Lab Schedule Management Page

The Lab Schedule Management page is used to organize lab room usage. It provides an *Add Schedule* button to create new entries, export options to Excel and PDF, and a search bar to simplify schedule lookup.

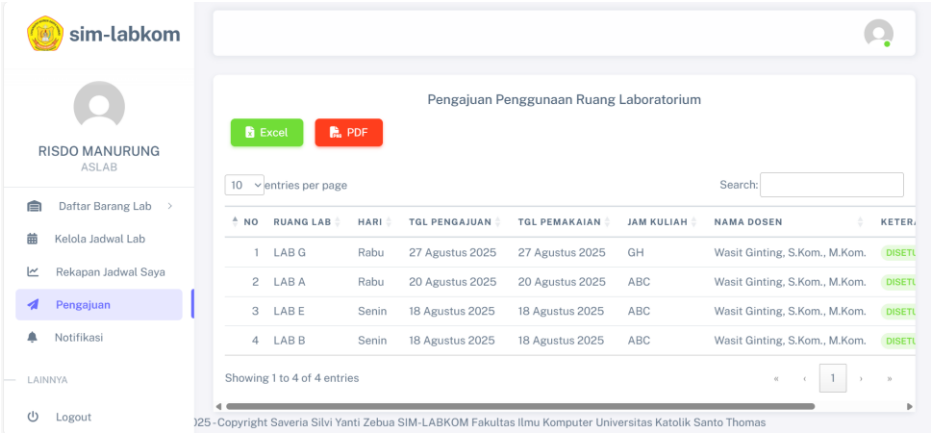

Figure 14 Submission Page

The Submission page displays requests for laboratory room usage. It includes export options to Excel and PDF. The submission table shows entry number, lab room name, day, submission date, usage date, start time, end time, and lecturer's name.

Conclusion

This study developed a Web-Based Computer Laboratory Management Information System (CLMIS) for the Faculty of Computer Science, Santo Thomas Catholic University. The main objective of the system is to improve the management of laboratory resources, which previously relied on manual processes that were often inefficient, error-prone, and time-consuming.

The system was designed and implemented using the waterfall methodology, which consists of six main stages: requirement analysis, system design, implementation, testing, deployment, and maintenance. During the requirement analysis phase, functional and non-functional

requirements were gathered to ensure that the system addresses the actual needs of laboratory management. The design phase focused on structuring the system architecture, database schema, and user interface to support usability and scalability. In the implementation phase, the system was developed using web-based technologies to allow easy access for different users, including the Head of Lab, Admin, Laboratory Assistants, and Lecturers.

The testing phase applied Black Box Testing to validate the system. Black Box Testing is a software testing method that evaluates whether system functionalities work according to predefined specifications without examining the internal structure or source code. This approach was used to check all critical features, including login authentication, inventory management, scheduling, attendance recording, and submission handling. The results confirmed that each feature performed correctly and met the stated requirements.

After successful testing, the system was deployed for use within the Faculty of Computer Science. The deployment demonstrated that the CLMIS can effectively handle laboratory-related activities such as inventory management, schedule management, and assistant attendance tracking. Additionally, the system provides options for generating reports in various formats, supporting transparency and accountability. The maintenance phase ensures that the system can be continuously updated and improved in response to user feedback and evolving needs.

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