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# Development of a Library Information System for Data Processing at SMK N 1 Pangkalpinang

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**ABSTRACT**

SMK N 1 Pangkalpinang is one of the schools in Pangkalpinang City that has a library playing an important role in supporting the learning process. However, the current library data processing system is still manual, relying on Microsoft Office applications, and lacks an integrated information system. This condition leads to various challenges in library management, such as difficulty in book searches, recording errors in borrowings and returns, and limitations in report generation. Therefore, this study aims to develop a more effective and efficient library data processing information system. Data collection methods used in this research include direct observation of library activities and interviews with related parties to identify system requirements. The system analysis and design were carried out using an object-oriented approach, with the Unified Modeling Language (UML) used as a modeling tool. Diagrams used include use case diagrams, class diagrams, sequence diagrams, and activity diagrams to illustrate business processes, data structures, and system logic to be built. The result of this research is a desktop-based library information system application featuring member and book data management, automated borrowing and returning transaction records, and computerized report generation. With this system, administrative processes become faster and more accurate, facilitating data management and search. The system also supports more systematic and real-time reporting, providing a positive impact on the overall quality of library services. Moreover, the use of object-oriented methodology and UML modeling allows the system to be more flexible and easily developed in the future.



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## 1. INTRODUCTION

The school library is one of the essential facilities that supports the teaching and learning process [1]. Its existence helps students and educators access various sources of information to improve the quality of learning. However, inefficient library management can hinder the optimal utilization of this facility. Currently, SMK N 1 Pangkalpinang does not yet implement an integrated information system and still uses a manual system for processing library data, aided by Microsoft Office applications such as Microsoft Excel and Microsoft Word. This system has various limitations, such as difficulties in searching for books, inaccuracies in recording borrowings and returns, and time-consuming report generation. These issues reduce the efficiency of library administrative processes and may decrease the quality of service for users.

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The use of a manual system in library management often results in recording errors, data duplication, and delays in managing borrowing and returning transactions. Additionally, data entry processes using Microsoft Office do not allow for optimal automation, thus requiring more time in data management. Therefore, a library information system is needed to improve efficiency and accuracy in data processing.

This study aims to develop a library data processing information system at SMK N 1 Pangkalpinang using an object-oriented methodology. The object-oriented approach was chosen because it enables a more structured, flexible, and scalable system model, using the Unified Modeling Language (UML). UML is used as a design tool to visualize various aspects of the system through diagrams such as use case diagrams, class diagrams, sequence diagrams, and activity diagrams. The object-oriented approach in software development allows for more accurate modeling of system requirements and increases efficiency in implementation and maintenance [2].

With the implementation of this information system, it is expected that library management at SMK N 1 Pangkalpinang will improve user satisfaction by accelerating services and reducing potential errors in data recording. This solution is intended to address the administrative challenges in the library and contribute to the development of a more modern and integrated school library information system.

## 2. RESEARCH METHOD

This study adopts a systematic approach encompassing two main methods: data collection methods and system engineering methods.

### 2.1 Data Collection Methods

To obtain accurate information regarding the requirements of the library data processing information system at SMK N 1 Pangkalpinang, this research employed two primary data collection techniques :

**a.** **Interview Method :** Conducted with librarians, teachers, and students as library users to understand the processes of book borrowing and returning, the challenges encountered in data management, and the required features in the information system to be developed.

**b.** **Observation Method :** Direct observation was carried out on administrative activities within the library, including manual recording of borrowing and returning transactions using Microsoft Office. This method aims to identify weaknesses in the manual system and the need for a more efficient one.

### 2.2 System Engineering Method

After collecting the data, the next step is system engineering using the waterfall methodology to develop a solution that meets user requirements. The stages of this method include:

a. Requirement Analysis : Based on data from interviews and observations, this stage identifies issues in the manual system and determines the functional and non-functional requirements needed for the new system.

b. Design : This stage follows requirement analysis and involves modeling the system using the Unified Modeling Language (UML), which serves as a visual notation to model and communicate the system through various diagrams and supporting texts. The modeling includes use case diagrams, activity diagrams, sequence diagrams, and class diagrams.

c. Development and Implementation : The system is developed by creating the user interface and coding based on the design. The application is built as a desktop-based program. Implementation includes installing the software, migrating data from the old system, and conducting initial trials to ensure the system operates properly.

d. Testing : The testing phase uses black-box testing, which focuses on evaluating the system's functionality without examining the source code. The results of this testing are used to assess whether the system performs according to specifications. If errors are found, corrections are made before the system is fully deployed.

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## 3. RESULTS AND DISCUSSION

The development of this library information system was carried out through several main stages to ensure that the data processing at the SMK N 1 Pangkalpinang library could be developed systematically.

### 3.1 Data Collection

In developing the library information system, data collection was conducted to understand the system requirements and ensure that the proposed solution addresses the identified issues. Interviews were conducted with librarians, teachers, and students as library users to gather information regarding the procedures of borrowing and returning books, the challenges in recording and managing book data, expected features of the new system, and the required access control and security. Observations were made by directly monitoring library activities to gain a real understanding of the manual system workflow. Observed aspects included how librarians recorded borrowings and returns, the use of Microsoft Office or other tools in data management, and the time required for book searching and logging. The data collected was used as the basis for the requirement analysis and system design to ensure that the developed information system would improve the library's efficiency.

### 3.2 Requirement Analysis

Requirement analysis is a crucial stage in developing the library information system, aiming to identify problems in the current manual system and determine the necessary features and functionalities for the new system.

a. Identified Issues in the Manual System

Based on interviews and direct observations, several problems were identified in the manual library system that relies on Microsoft Office tools. One of the main issues is the manual process of recording borrowings and returns, which increases the risk of errors and data loss.Moreover, the book search process in the library catalog takes a long time due to the absence of a structured and automated search system.Report generation related to borrowing and returning activities is also still performed manually, which makes it inefficient and time-consuming. Additionally, the absence of an automatic reminder system for due dates causes users to return books late, potentially disrupting the circulation of collections in the library.

b. Functional Requirements

Functional requirements are the core features the system must provide to replace the current manual processes. Key functional requirements include:

1. Book data processing: allows librarians to add, edit, delete, and view book information.
2. Borrowing and returning management: enables automated recording of book transactions.
3. Book search: allows users to search for books by title, author, or category.
4. Library member data management: stores member data and their borrowing history.
5. Report generation: produces automated reports on borrowing, returns, and book inventories.

c. Non-Functional Requirements

In addition to the core features, the system must fulfill several non-functional aspects, such as:

1. Data security: ensuring access control based on user roles.
2. System performance: the ability to handle large datasets with fast response times.
3. Usability: the interface should be user-friendly and easy to use.

### 3.3 Design

This design phase creates a technical blueprint based on the requirement analysis to describe how the library information system will function before implementation.

a. Conceptual Design

This initial design phase defines the system’s structure and workflow using an object-oriented approach with Unified Modeling Language (UML). The diagrams used include:

1. Use Case Diagram : illustrates interactions between users and the system, showing the main functions.

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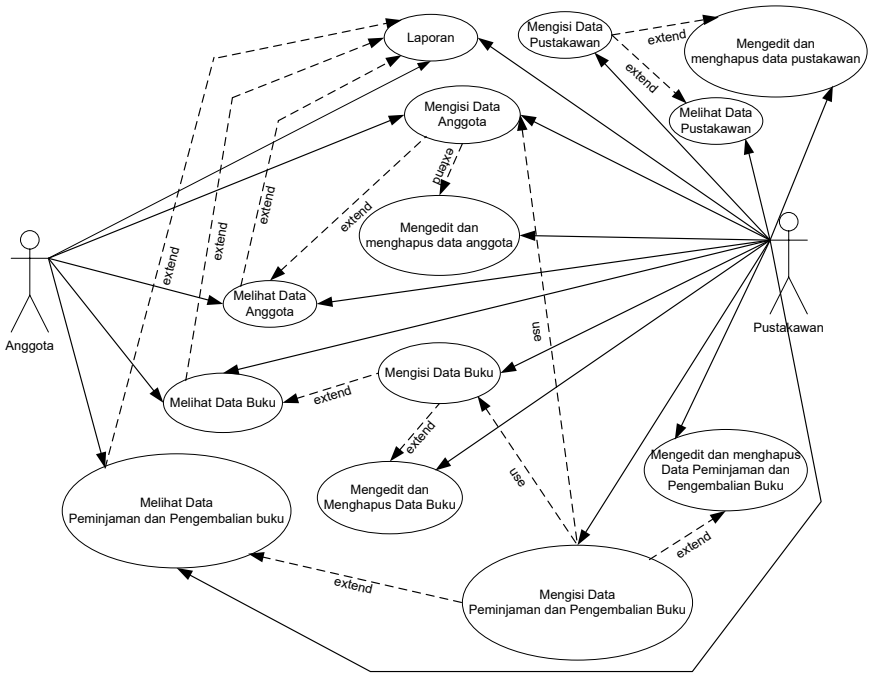


**Figure 1.** Use Case Diagram

2. Class Diagram : shows the data structure within the system, including classes, attributes, and object relationships, and supports database design with entities like Book, Member, and Transaction.

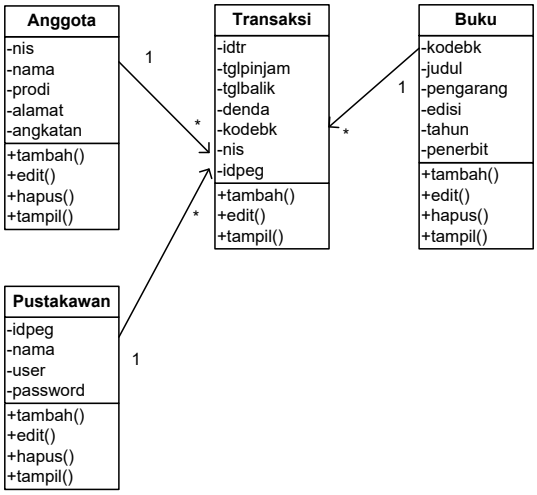


**Figure 2.** Class Diagram

3. Sequence Diagram : describes the sequence of interactions between system objects over time and ensures proper communication between users and the system.

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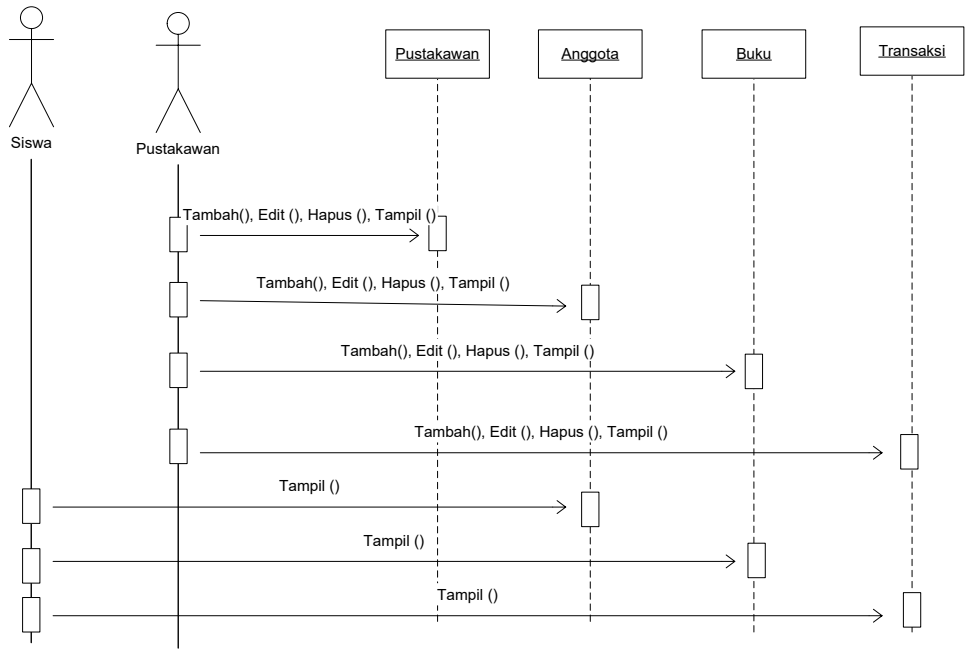


**Figure 2.** Sequence Diagram

4. Activity Diagram : visualizes workflows such as borrowing and returning processes, helping to understand each step of the operations.

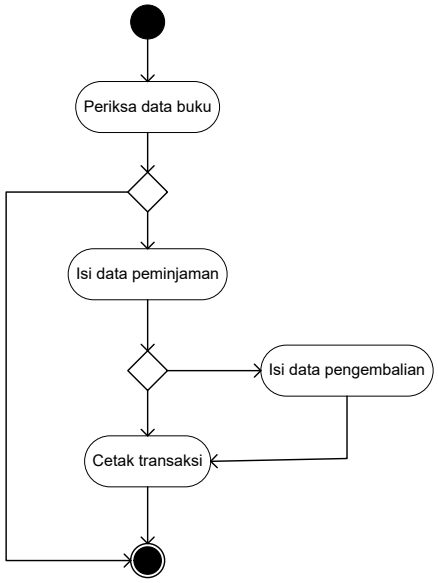


**Figure 3.** Activity diagram of book borrowing and returning data entry

b. Interface Design

The interface design aims to create a user-friendly system interface that allows users to interact with the system efficiently. Key elements include forms for book data input.

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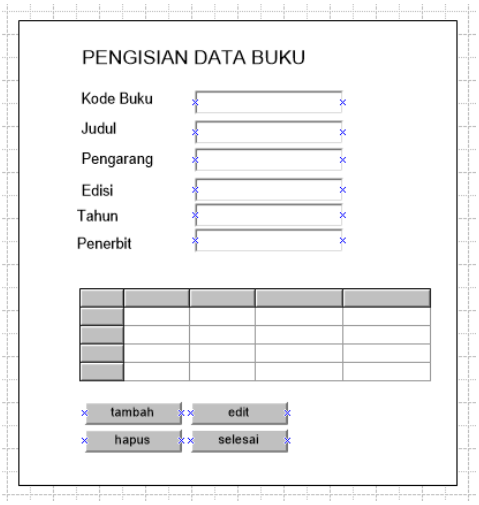


**Figure 4.** Book data entry interface

c. Development and Implementation

System development involved creating the user interface and programming based on the design. The application was built as a desktop-based system. Implementation included software installation, data migration from the old system, and initial trials to ensure functionality.

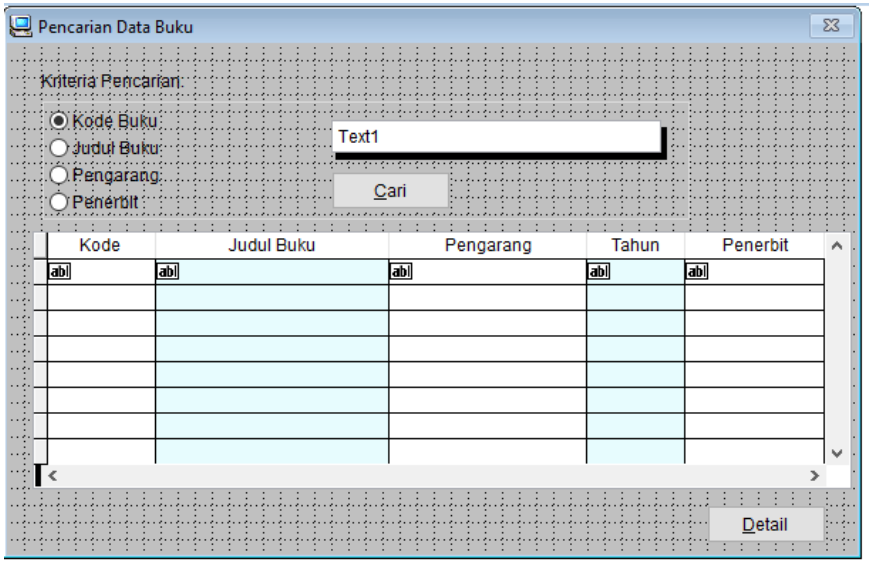


**Figure 5.** Book data search display

d. Testing and User Response Evaluation

Testing was performed using black-box testing, which focuses on system functionality without inspecting the source code. The tests involved librarians and prospective users (teachers and students). The results helped determine whether the system met the expected specifications. Any identified bugs were fixed before full deployment.

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**Table 1.** Black Box testing results

| No. | Tested Feature | Test Scenario | Input | Expected Output | Test Result | Notes |
|---|---|---|---|---|---|---|
| 1 | Member Data Entry Form | Admin inputs new member data completely | Name, Student ID (NIS), class, address, etc. | Member data is successfully saved and displayed in the member list | Passed | Validation and saving work well |
| 2 | Member Data Entry Form | Admin inputs member data with missing/incomplete fields | Empty fields | Error message appears and data is not saved | Passed | Input validation is active |
| 3 | Book Data Entry Form | Admin adds a new book with complete information | Title, author, publisher, year, quantity, etc. | Book data is successfully added to the system | Passed | Data saved correctly |
| 4 | Borrowing and Returning Transaction Entry Form | Admin fills in transaction form with member ID and book ID | Member ID, Book ID, borrow date, return date | Transaction is saved; book stock decreases on borrow and increases on return | Passed | Borrowing flow functions properly |
| 5 | Book Search Form | User searches for a book by title | Title keyword | Relevant books appear in the search results | Passed | Accurate search results |
| 6 | Member Search Form | Admin searches member data by name or Student ID (NIS) | Name/NIS keyword | Matching members are displayed | Passed | Search function is active |
| 7 | Transaction Search Form | Admin searches transactions by member name or date | Name/NIS or transaction date | Relevant transaction data appears | Passed | Search meets criteria |
| 8 | Member Report | Admin prints or views a report of all members | - | Report appears in table or PDF format | Passed | Neat report format |
| 9 | Book Report | Admin views a report of available books | - | Complete book report displayed according to existing data | Passed | Output matches the data content |
| 10 | Borrowing and Returning Transaction Report | Admin prints a report of transactions based on a specific date range | Date range | Transactions for the selected period are displayed completely | Passed | Date filter functions properly |

User testing was conducted at SMK N 1 Pangkalpinang's library for one week, involving 2 staff and 10 students. Overall average score = 4.48 (Effective category). Based on observation and interviews, the average score was as follows:

**Table 2**. User response evaluation

| No | Evaluated Aspect | Average Score (1–5) | Description |
|---|---|---|---|
| 1 | Ease of Use | 4.6 | Very Good |
| 2 | Data Access Speed | 4.5 | Very Good |
| 3 | Recording Accuracy | 4.4 | Good |
| 4 | Interface Appearance | 4.2 | Good |
| 5 | Report Generation | 4.7 | Very Good |

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## 4. CONCLUSION

Based on the research and development that have been carried out, the developed library information system has been successfully implemented and tested. This system is designed to replace the previous manual method that relied on Microsoft Office applications, which tended to be inefficient and prone to human error. With the new system, the processes of recording book data, library members, as well as borrowing and returning transactions can now be done automatically. This automation not only improves data accuracy but also accelerates workflows and reduces the administrative burden that was previously performed manually.

The implemented features in the system provide various practical benefits. The book search process becomes faster and more structured, making it easier for users to find the information they need. In addition, the system is capable of systematically recording borrowing and returning transactions, supported by a due-date reminder feature that helps prevent late returns. Librarians can also manage transaction histories more easily and efficiently, and generate reports on borrowing, returns, and book stock automatically. This greatly saves time and effort, especially in routine reporting and documentation tasks.

From a software development perspective, the use of object-oriented methodology and modeling with Unified Modeling Language (UML) makes the system more structured and easier to understand. This approach assists the development team in designing and building the system, while also providing opportunities for future expansion. The system is designed to be flexible and adaptable, allowing for adjustments in response to policy changes or improvements in library services. Thus, the system not only meets current needs but is also ready to face future library management challenges.

The main contributions of this development lie in increasing operational efficiency, reducing errors in manual recording, and providing easier access to and retrieval of data. Furthermore, the system supports more systematic and professional data management, and provides a strong foundation for future development if needed. The implementation of this information system is expected not only to assist librarians in their daily tasks but also to serve as a digital library solution model for other schools with similar needs.

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