CHAPTER I
INTRODUCTION

1.1 Background

In the digital era, efficient asset and inventory management is a crucial factor for the operational sustainability of an organization, including Student Activity Units (UKM) within higher education institutions. The Unit Kegiatan Kerohanian Islam (UKKI) at UPN "Veteran" Jawa Timur possesses several vital assets, such as projectors, audio equipment, mats, and other religious outreach properties that support various internal and external activities. Organizational inventory management encompasses the recording, monitoring, and maintenance of these various items. Manual recording methods and conventional systems are susceptible to various issues, such as inconsistent data, difficulties in tracking item status, and an increased risk of asset loss due to weak monitoring systems. This is corroborated by [1], which states that the use of spreadsheets and manual databases frequently leads to data entry errors (human error) and hampers information coordination between departments.

Currently, the inventory rental system at UKKI UPN "Veteran" Jawa Timur is still operated conventionally through spreadsheet recording and short message confirmations. This method has critical security vulnerabilities, evidenced by an incident involving an attempted asset retrieval by an unauthorized party using manipulated borrowing credentials. This incident highlights the fundamental weaknesses in the current system, namely the absence of a centralized database that hinders real-time verification by officers, weak authentication mechanisms to ensure the authenticity of the borrower's identity, and a lack of recording structure that increases the risk of data errors and duplication.

Given the complexity and risks inherent in the manual system, the development of a web-based information system is an urgent necessity. According to [1], inventory management is a crucial aspect for an organization, and the implementation of a web-based information system allows for a more accurate and efficient provision of stock data and item activities. The system also serves to

replace error-prone, spreadsheet-based manual recording methods while facilitating integrated and transparent monitoring of inventory status.

This system is developed using the Rapid Application Development (RAD) method due to its participatory characteristics and its ability to provide concrete visualizations for UKKI administrators from the early stages of development. Through an iterative cycle comprising requirements planning, user design, construction, and cutover phases, developers can systematically yet rapidly build high-quality applications while minimizing the risk of requirement misinterpretation [2]. This approach facilitates the creation of prototypes or mockups that allow users to provide immediate feedback, thereby ensuring that the resulting rental system strictly aligns with operational workflows in the field [2]. With this method, system features can be promptly tested through mockups or prototypes by UKKI administrators to ensure the developed asset security solution genuinely matches the operational workflow.

Once the development framework is established, the next critical aspect is the validation feature to overcome manual verification issues and authentication system weaknesses, an automated technology-based solution is required. Research by [3] emphasizes that manual data extraction from employee identity cards (ID badges) is a repetitive, time-consuming process that is highly prone to human error. In the effort to automate this visual data extraction, Optical Character Recognition (OCR) technology was selected as the primary solution over alternative methods such as Template Matching. The selection of OCR is based on empirical evidence from study [4], which compared the performance of Template Matching and Pytesseract-based OCR for identity card reading. The study results indicated that the Template Matching method only achieved an average accuracy of 67.33% and was highly susceptible to failure under non-ideal lighting conditions. Conversely, OCR technology proved significantly superior, with an accuracy rate reaching 98.33% in recognizing text characters on identity cards. Based on this performance comparison, an OCR-based Student Identity Card (KTM) validation feature is designed within this system to ensure the borrower's data is extracted automatically, accurately, and validly.

Although OCR technology offers high accuracy, the raw output from image extraction often still contains character reading errors (noise), particularly if the KTM photograph is taken under uneven lighting conditions [5]. To mitigate this shortcoming, the system implements a post-processing stage. In this stage, Regular Expressions (Regex) are utilized as an initial filtering method to extract structured patterns, such as the Student Identification Number (NIM). Furthermore, to validate text data such as the borrower's name, a string matching algorithm utilizing the Levenshtein Distance is applied. As demonstrated in research [6], the Levenshtein Distance algorithm is highly effective in correcting OCR output text errors by calculating the minimum distance of character edits, thereby significantly increasing the success rate of document validation.

As a solution to these problems, a web-based inventory rental management system was designed, integrating an automated identity validation feature utilizing Optical Character Recognition (OCR) technology on the Student Identity Card (KTM). To guarantee system accuracy against reading error constraints, the extraction process is supported by a post-processing algorithm that includes Regular Expressions (Regex) for identity pattern filtering and the Levenshtein Distance string matching algorithm to correct character discrepancies. The implementation of this intelligent system and centralized database is expected to minimize the risk of asset loss due to borrower data manipulation, improve administrative efficiency, and realize transparent and accountable inventory governance within the UKKI UPN "Veteran" Jawa Timur.

1.2 Problem Formulation

Based on the background described, the problems formulated in this study are as follows:

1. How to design and develop an inventory rental system for UKKI UPN "Veteran" Jawa Timur using the Rapid Application Development (RAD) method to overcome the constraints of manual recording?
2. How to implement Student Identity Card (KTM) validation based on Optical Character Recognition (OCR) supported by post-processing

algorithms, such as Regular Expressions (Regex) and the Levenshtein Distance, to automatically extract and verify borrower data?

3. What is the accuracy rate of the Optical Character Recognition (OCR) feature and its post-processing algorithms in recognizing, extracting, and validating text on the UPN "Veteran" Jawa Timur Student Identity Card (KTM)?

1.3 Problem Scoping

To ensure a focused study, the following problem limitations are established:

1. The system is focused on the inventory management of the Unit Kegiatan Kerohanian Islam (UKKI) at UPN "Veteran" Jawa Timur, which encompasses the rental, return, and stock reporting processes.
2. The validation of active student status is not conducted via direct (real-time) integration with the SIAMIK API due to the university's data access restriction policies. Validation is performed using the system's internal database, which is imported from student recapitulation data in Excel/CSV format.
3. The OCR implementation is strictly focused on extracting key attributes, namely NPM (Student Identification Number), Name, Study Program, and Faculty. The OCR accuracy rate is optimized for Student Identity Card (KTM) images captured under adequate lighting conditions and in a vertical orientation, and it does not encompass physical authenticity detection (liveness detection) features.
4. The system's payment feature utilizes the Midtrans gateway in development (sandbox) mode or is restricted to bank transfer methods, and the system explicitly excludes complex financial accounting modules.
5. System development employs the Rapid Application Development (RAD) method, prioritizing the rapid deployment of core functionalities without conducting in-depth performance comparisons with other development methodologies.

1.4 Research Objectives

The objective of this research is to design and develop an inventory rental information system for UKKI UPN "Veteran" Jawa Timur using the Rapid Application Development (RAD) method. This system integrates an automated identity validation feature based on Optical Character Recognition (OCR), supported by post-processing algorithms (Regular Expressions and the Levenshtein Distance), to enhance administrative efficiency and the security accuracy of organizational asset management.

1.5 Research Benefits

This research provides both theoretical and practical benefits, specifically:

1. Theoretical Benefits: Contributes to information systems literature regarding OCR-integrated web-based inventory management and serves as a reference for future research.
2. Practical Benefits:
    a. For UKKI UPN "Veteran" Jawa Timur: Enhances organizational asset security through automated identity validation mechanisms and digital transaction verification, thereby minimizing the risk of asset loss or theft by unauthorized parties. It also improves the operational efficiency of administrators by replacing spreadsheet-based manual recording with a real-time, centralized database system.
    b. For UPN "Veteran" Jawa Timur: Supports the digitalization program for student activities within the university environment. Furthermore, this system can serve as a prototype or model for other Student Activity Units (UKM) seeking to manage their inventories in a modern and secure manner.
    c. For Future Researchers: Acts as a foundational reference for subsequent studies concerning OCR implementation on Indonesian identity documents (KTM/KTP) or the development of asset management systems incorporating biometric security features or IoT.