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Development of a Class IIB Pati Prison Inmate Processing System Using Barcodes

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Abstract

Correctional facilities in Indonesia face significant challenges in inmate management due to reliance on manual, paper-based systems for room occupancy verification, leading to inefficiencies, prolonged verification times, high potential for data errors, and substantial workload for correctional officers during frequent room reshuffling activities. This study aims to develop a web-based information system leveraging barcode technology to streamline the inmate verification process at Lapas Kelas IIB Pati, minimizing human error, enhancing administrative efficiency, and accelerating data management processes. The research employed a Research and Development (R&D) approach with qualitative methodology using the Waterfall model for system development, incorporating data collection techniques including observation, semi-structured interviews with correctional officers, literature review, and document analysis. The study population comprised all data management processes for inmates and officers at Lapas Kelas IIB Pati, with purposive sampling selecting key informants, relevant documents, and existing manual systems. System validation was conducted through Blackbox Testing to verify functional specifications and User Acceptance Testing (UAT) using Likert scale questionnaires to evaluate user satisfaction. The developed system successfully automated inmate verification through QR/barcode scanning, implemented role-based access controls, and provided room transfer functionality, with all system functionalities achieving successful outcomes in testing, demonstrating operational viability and significant improvement in efficiency and data accuracy. The web-based inmate processing system effectively addresses operational challenges in correctional facility management, providing a practical solution for digital transformation in Indonesian correctional institutions.

Introduction

Correctional facilities, often referred to as Lapas in Indonesia, are government institutions tasked with the rehabilitation and management of individuals who have committed crimes and been legally convicted by court decisions (Irawan et al., 2019; Efendi & Hariansah, 2024). The legal foundation for correctional facilities in Indonesia is stipulated in Article 1, Paragraph 3 of Law Number 12 of 1995, which defines "Lembaga Pemasyarakatan (Correctional Facility) as a place for conducting the guidance of inmates and correctional students." Effective daily operations within these institutions, particularly concerning the guidance and management of inmates, are governed by specific rules and regulations

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established by law (Situmorang, 2019; Kadir et al., 2-24). Globally, the modernization of public services, including correctional systems, is a critical agenda to enhance accountability, transparency, and operational efficiency (Alshami et al., 2022; Kurniawan & Romzi, 2022).

The effective management of inmates within correctional facilities presents multifaceted challenges, primarily due to the diverse nature of criminal offenses and the varying placement requirements for each individual (Nurohmah, 2018; Awofẹsọ et al., 2024; Nafid et al., 2024). Inmates are typically categorized into general criminal offenses, which apply to all individuals regardless of their status or profession (e.g., kidnapping, theft, murder) (Fitria & Hadjon, 2017), and special criminal offenses, which pertain to specific individuals or circumstances (e.g., psychotropic offenses, narcotics, economic crimes) (Barama, 2015). This classification necessitates a meticulous and adaptable system for managing inmate data and room assignments. The increasing complexity of inmate populations and the need for personalized rehabilitation programs further underscore the importance of robust and efficient information systems to support prison administration (Smith & Jones, 2023; Garcia & Lopez, 2023).

Despite the critical need for efficient inmate management, Lapas Kelas IIB Pati continues to rely on a manual, paper-based system for checking room occupancy. This traditional method involves printing data for each inmate and physically attaching it to the front of the room doors. Such an approach inherently leads to significant inefficiencies, including prolonged verification times and a high potential for data errors, particularly when periodic room reshuffling occurs without a fixed schedule, sometimes weekly or even daily. The reliance on manual record-keeping in such dynamic environments is a well-documented source of operational bottlenecks and data integrity issues across public institutions (Brown & Davis, 2022; Setiawan & Pasha, 2020).

Furthermore, the manual process at Lapas Kelas IIB Pati imposes a substantial workload on correctional officers. Each reshuffling event necessitates the replacement of paper documents, consuming considerable time, energy, and financial resources (e.g., printing costs), often resulting in delays in updating inmate information. This high-intensity, repetitive task not only strains human resources but also detracts from other essential duties, potentially compromising overall facility security and administrative accuracy. The challenges associated with labor-intensive, outdated systems often manifest as reduced staff morale, increased operational costs, and diminished service quality in public sector organizations (Alshami et al., 2022; Chen & Wang, 2021; Abbas et al., 2024).

In response to these pervasive challenges, this study aims to develop a web-based information system leveraging barcode technology to streamline the inmate verification process at Lapas Kelas IIB Pati. The primary objective is to automate inmate checks through simple barcode scanning, thereby minimizing human error, enhancing administrative efficiency, and accelerating data management processes (Imandeka et al., 2024; . This research is highly urgent given the pressing need for digital transformation within correctional facilities to improve operational effectiveness and data integrity. The novelty of this study lies in its specific application of web-based barcode technology within the context of inmate room verification in a correctional facility, offering a practical solution to support the digitalization of Lapas services and elevate the quality of inmate data governance (Tua et al., 2025).

Methods

Type and Method of Research

This study adopts a Research and Development (R&D) approach, focusing on developing a web-based information system integrated with *barcode* technology for inmate data

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management at Lapas Kelas IIB Pati (Pati Class IIB Correctional Facility). A qualitative approach was employed to gain a deep understanding of existing processes, identify specific user requirements, and analyze issues arising from the manual system (Sugiyono, 2022; Emzir, 2021). The findings from this qualitative analysis serve as the foundation for designing a system aimed at enhancing efficiency and accuracy (Sudaryono, 2023).

The Waterfall model was selected as the system development methodology due to its structured and sequential nature (Wijaya & Astuti, 2019). This model facilitates a systematic progression through software development phases, beginning with requirements analysis, followed by system design, implementation, testing (verification), and finally, maintenance. The Waterfall approach ensures that each phase is completed thoroughly before proceeding to the next, thereby yielding detailed and systematic documentation (Pressman & Maxim, 2021; Sommerville, 2021).

Instruments and Data Collection Techniques

Data collection in this research was carried out using several techniques to gather comprehensive information. The data collection techniques employed include:

Observation

The authors conducted direct observation of the workflow and issues encountered at Lapas Kelas IIB Pati, specifically concerning inmate room occupancy checks and data evaluation on the correctional facility's server. Observation sheets were used as an instrument for systematic recording of findings (Hasibuan et al., 2023). This participatory observation was essential for understanding the actual operational context and requirements (Creswell & Creswell, 2022).

Interviews

In-depth interviews were conducted with a key informant, Mr. Nyaman Hadi Sasmito, a correctional officer at Lapas Kelas IIB Pati. The interviews were semi-structured, utilizing an interview guide to focus on the inmate room checking process, inmate classification based on case types (General Criminal Offenses and Special Criminal Offenses), and challenges faced with the manual system. This interpersonal interview technique was crucial for extracting detailed information that might not be evident through observation alone (Heni Widiastuti et al., 2018; Bogdan & Biklen, 2022).

Literature Review

Data collection also involved a comprehensive literature review from various relevant sources such as scientific journals, books, and other academic works. This study aimed to build a strong theoretical foundation related to information systems, *barcode* technology, software development methodologies (particularly Waterfall), and system testing (Blackbox Testing and UAT). A comprehensive literature review ensures that the research is grounded in solid theoretical principles and aligned with current developments (Sani & Suwandi, 2021; Nurjanah & Purwanto, 2022).

Document Analysis

Document analysis served as a complementary method to observation and interviews. The collected data included official information regarding the correctional facility's server, inmate *datasets* at Lapas Kelas IIB Pati, and regulations about inmate management. Document analysis aided in validating information obtained from other sources and understanding the applicable procedural context (Emzir, 2021; Guba & Lincoln, 2023).

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Population and Sample

The population for this study comprises all data management processes for inmates and officers at Lapas Kelas IIB Pati. Given the nature of this research as system development with a qualitative approach, purposive sampling was employed. The research sample consisted of:

Key Informant

A correctional officer at Lapas Kelas IIB Pati, directly involved in the process of checking and managing inmate room data, specifically Mr. Nyaman Hadi Sasmito, selected for his in-depth understanding of daily operations and system needs.

Documents

Relevant documents concerning inmate data, workflows, and the correctional facility's server pertinent to system development.

Existing System

The current paper-based manual process is implemented at Lapas Kelas IIB Pati. Purposive sampling allows researchers to select the most relevant and informative cases for the research objectives, ensuring the collected data is rich and in-depth (Sugiyono, 2022; Patton, 2021).

Research Procedures

The research procedures followed the systematic stages of the Waterfall model, as illustrated in Figure 1.

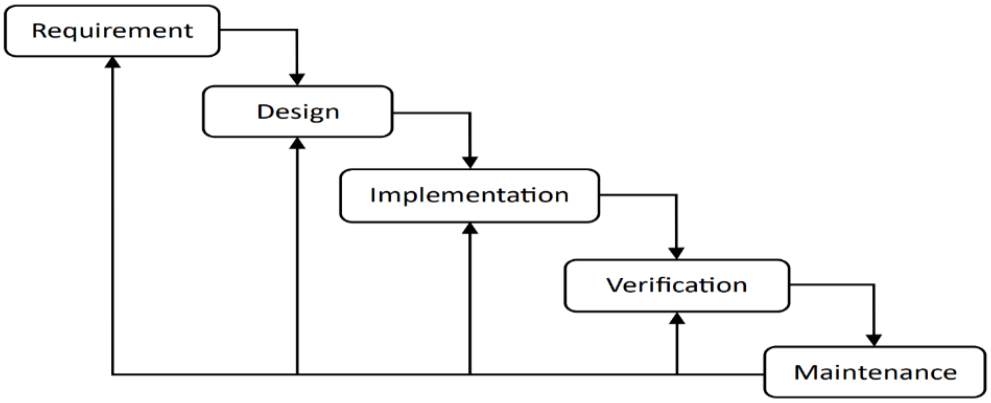

Figure 1. Waterfall Method

Requirement Phase

In this phase, problem identification and the elicitation of functional and non-functional system requirements were conducted through literature review, observation, and interviews. Key functional requirements identified include: 1) The system must provide a *QR/barcode Scan* feature for checking occupants in each cell of the Correctional Facility; 2) The system must have distinct access rights: only administrators can add, edit, and delete data, while officers can only view data and perform *QR scans*; 3) The system must include a room transfer feature to facilitate inmate reshuffling, ensuring that the *QR Code* remains unchanged. A thorough understanding of these requirements is crucial to ensure that the developed system is relevant and capable of resolving existing problems (Wahyuni et al., 2022).

Design Phase

Following requirement identification, the next stage involved system design. This design aimed to identify hardware and system requirements and determine the overall system

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architecture. The system design was visualized using Unified Modeling Language (UML) for clarity and structured representation (Putra & Andriani, 2019). The UML diagrams created include:

Use Case Diagram (Figure 2): Depicting system functionalities from the perspective of users (administrators and officers).

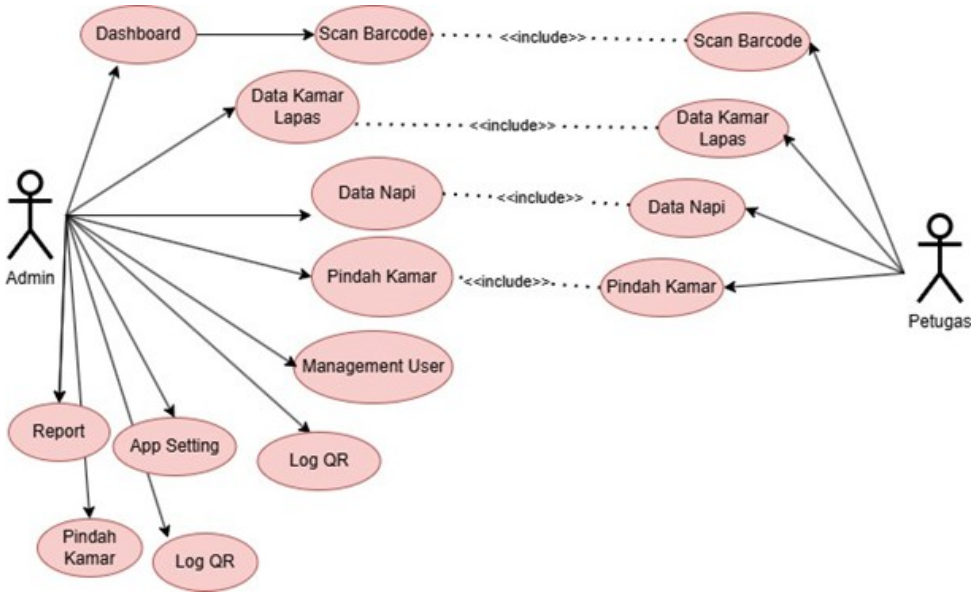

Figure 2. Use Case Diagram

Activity Diagram (Figure 2): Explaining the sequence of activities within the system, such as login flow, room data management, and *barcode scan* process.

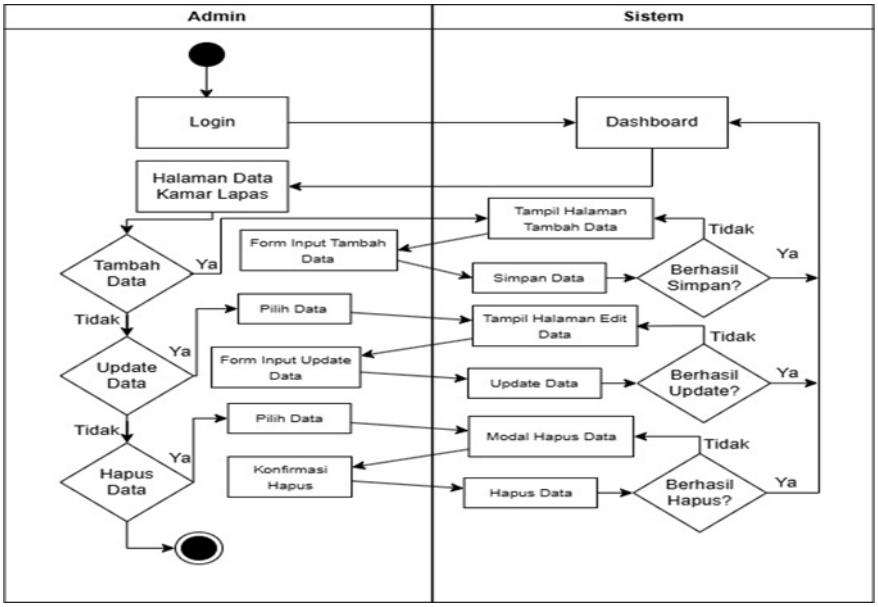

Figure 3. Activity Diagram

Class Diagram (Figure 3): Visualizing the structure of objects, attributes, and relationships between classes in the system's database (*db_lapas*). Additionally, a system framework was developed to outline the main tasks within the application (Figure 5), encompassing *input* (login), processes (data management), and *output* (CRUD operations, *barcode scan* results).

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This design was discussed with users to ensure alignment with their expectations and needs (Purwanto et al., 2023).

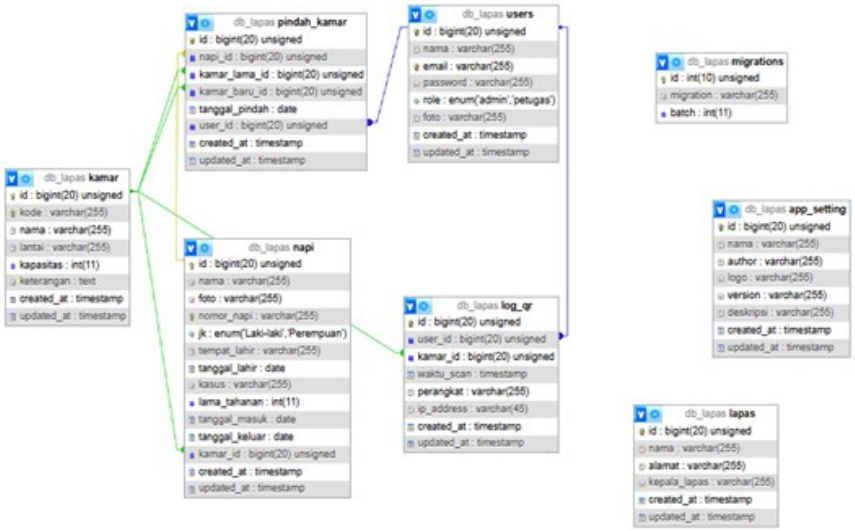

Figure 4. Class Diagram

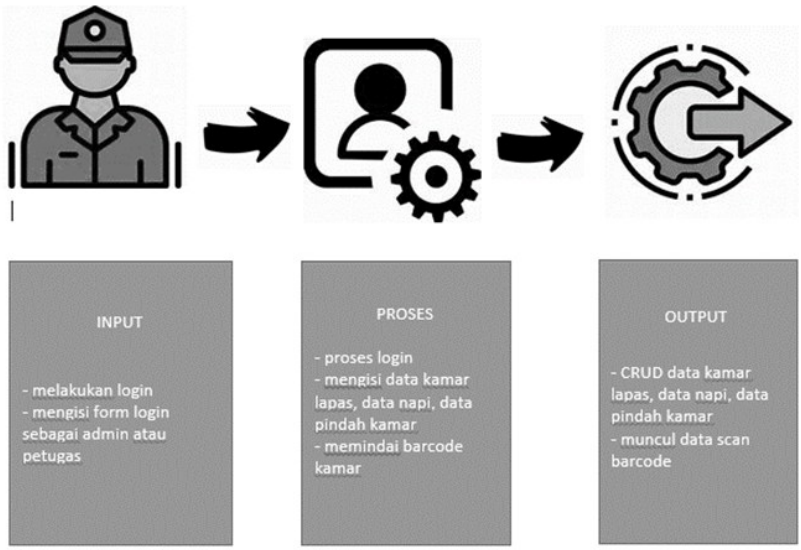

Figure 5. System Framework

Implementation Phase

The implementation phase involved developing the system based on the established design. The system was developed using the PHP programming language with the Laravel *framework* (Purnama Sari & Wijanarko, 2020), and Visual Studio Code was utilized as the *code editor*. Development was carried out in small units that were subsequently integrated. Each unit was developed and tested to ensure its functionality (unit testing) before being assembled into a complete system.

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Verification Phase

In this phase, the implemented system was validated and tested to ensure that all functional and non-functional requirements were met. The testing methods employed were: 1) Blackbox Testing: This testing focused on the functional specifications of the software, where *testers* defined *input* conditions and tested the program's functionality without examining its internal code structure. This testing was conducted to verify that each system feature (such as login, data management, and *barcode scanning*) functioned according to defined requirements (Shadiq et al., 2021; Santosa et al., 2022); 2) User Acceptance Test (UAT): UAT was conducted to evaluate user responses to the developed system, ensuring that the system was acceptable and met user expectations. A Likert scale questionnaire was used to collect user feedback regarding their experience with the application (Erlangga et al., 2023; Putri & Wahyuni, 2022).

Maintenance Phase

The maintenance phase is an ongoing stage after the system has been implemented and is operational. During this phase, data updates and refreshes are performed regularly, and data re-checks are conducted to prevent errors in data *input*. System maintenance also includes addressing any *bugs* that may emerge and enhancing features in the future to ensure optimal system performance and relevance (Setiawan et al., 2021).

Results and Discussion

Build the system

Dashboard Page

Before entering the dashboard page, users must first log in. There are two users to log in, namely admin and officer. In the view that users get for admins as shown below, if the officer can only see the Prison Room Data page, the Prisoner Data Page, the Room Moving Page, and can scan QR codes.

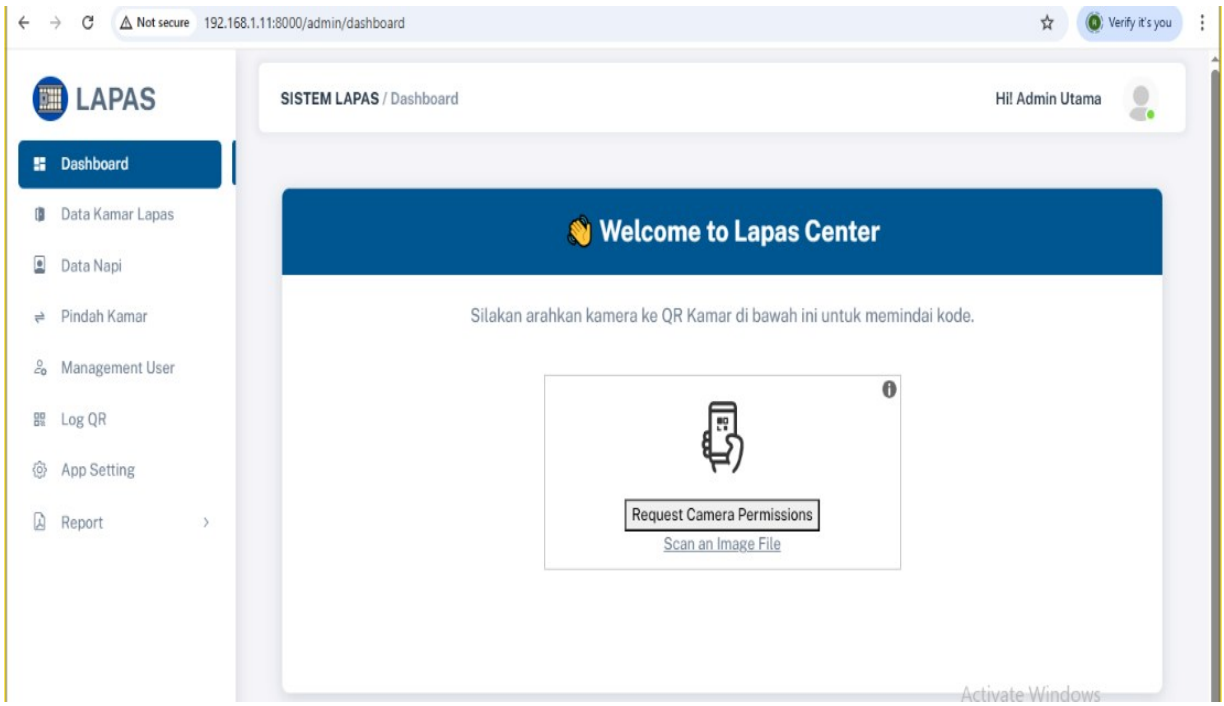

Figure 6. Dashboard Page

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Prisoner Room Data Page

This page displays the number of prison rooms, residents in each room, barcode in each room. Just click the barcode icon. On the page, only admins can add data, edit data, and delete data.

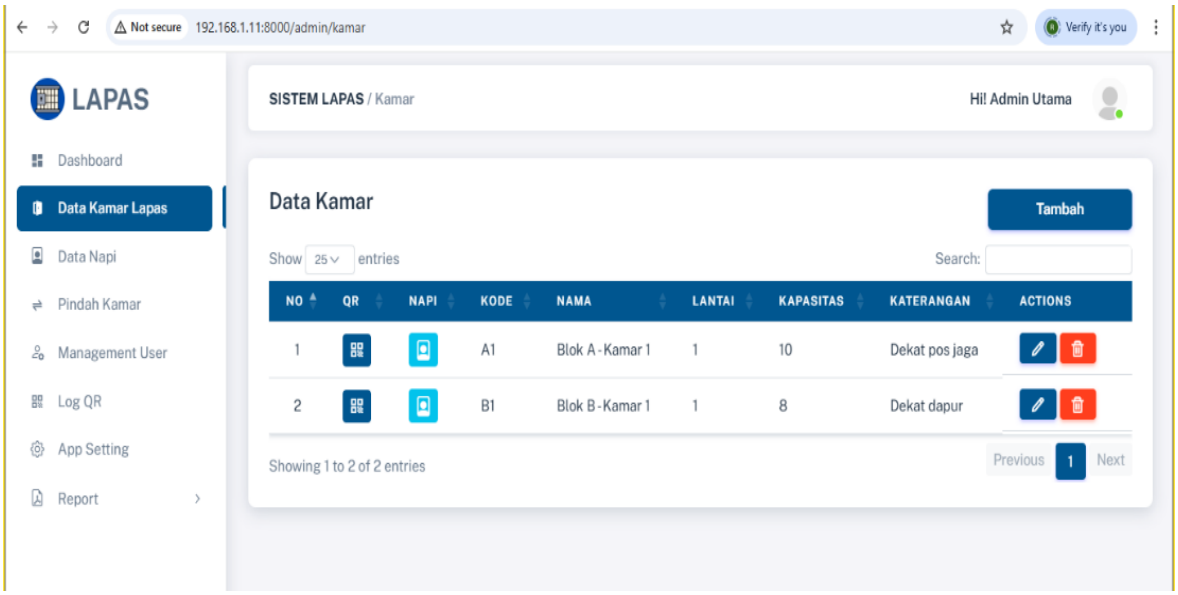

Figure 7. Prison Room Data Page

Prisoner Data Page

The Prisoner Data page contains information about Room Occupants in Class II B Pati Prison, which has a table about the inmates' biodata, the type of room used, entry and exit rates, and cases. The page below is a room-moving page, which can be operated by the admin. The yard is used for any time the occupants of the room are moved to another room easily.

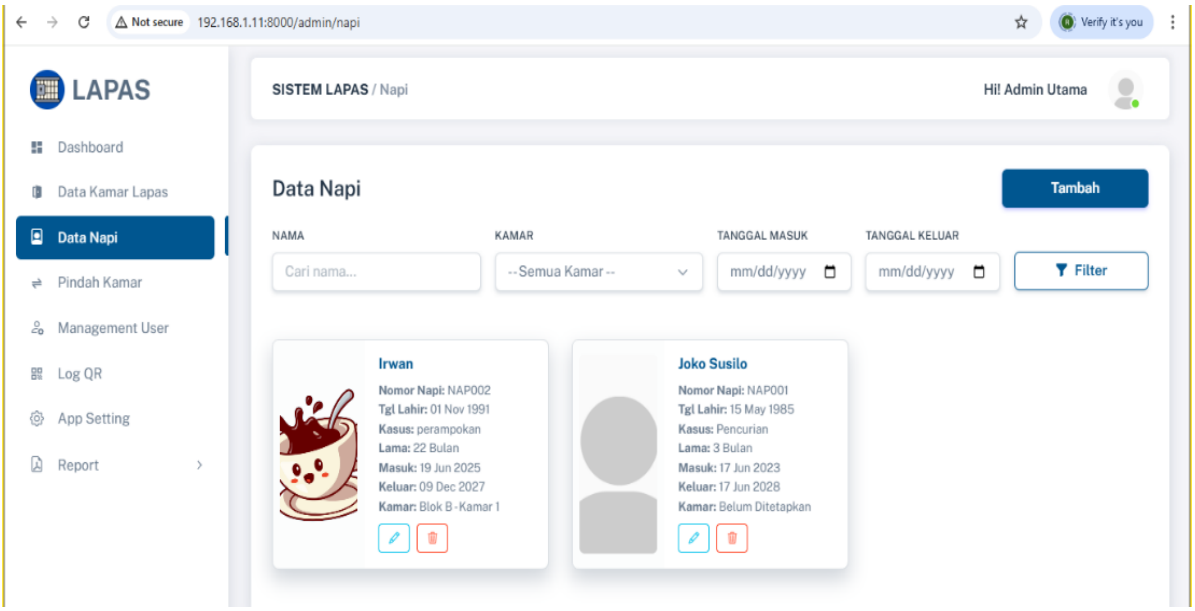

Figure 8. Prisoner Data Page

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Barcode Scan Results Page

On the dashboard page, officers and admins can scan the Barcode with each user's smartphone camera. For the results obtained after scanning the barcode, as shown in Figure 9 below.

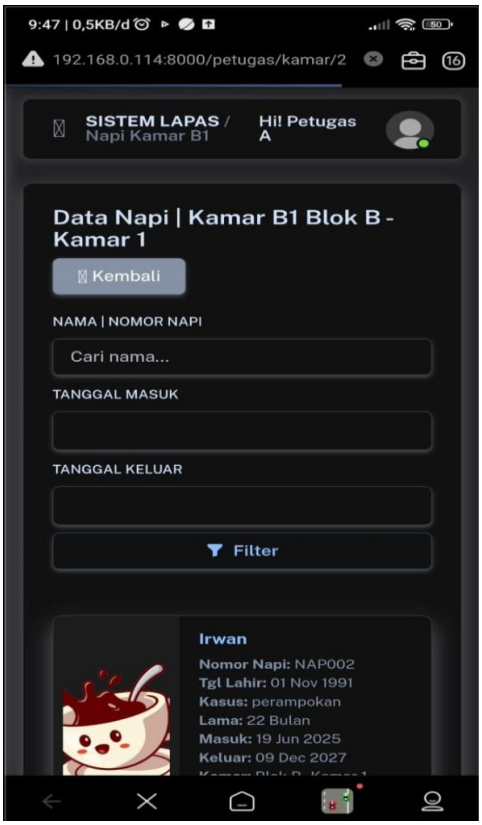

Figure 9. Barcode Scan Results Page

Implementation

The final stage in the application implementation process is testing and handover of the completed application. Testing is performed on each functional area using blackbox testing. This testing is performed to identify bugs or issues in the application developed using the Waterfall method. The following displays the results of the application testing using blackbox testing.

Tabel 1 Blackbox Testing

No	System Functionality	Case	Results
1	Login (Admin, Officer)	- View the login page - Enter your username and password - Pressing the login button - If the username or password is wrong, then the alert tone will appear on the page. - If true, log in to the dashboard page according to the access rights	Successful
2	Dashboard (Admin, Officer)	- Display dashboard page - There is an icon in the middle to go to the camera for QR Scans	Successful

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3	Prison Room Data (Admin)	- Displaying the Prison Room Data page - There is a table containing no, QR Code, napi, room code, room name, floor, capacity, description, and actions. - Can add data, edit data, and delete data	Successful
4	Prison Room Data (Officers)	- Displaying the Prison Room Data page - Only be able to view the tables on the page	Successful
5	Prisoner Data (Admin)	- Displaying the Prisoner Data page - View existing prisoner data - Can add data, edit data, and delete data	Successful
6	Prisoner Data (Officer)	- Displaying the Prisoner Data page - Can only display existing prisoner data	Successful
7	Moving Room (Admin)	- Showing the Moving Rooms page - Display data of prisoners who have moved rooms - Displays a table in it consisting of numbers, prisons, old rooms, new rooms, handles, and inputs by - Can add, edit, and delete data	Successful
8	Moving Room (officer)	- Showing the Moving Rooms page - Display data of prisoners who have moved rooms	Successful
9	User Management (Admin)	- Display the User Management page - View users that have already been created - Can add, edit, and remove users	Successful
10	Log QR (Admin)	- Displaying the QR Log page - The page contains about users who have done a QR scan, to monitor who has done the QR Scan	Successful
11	App Setting (Admin)	- Displays the App Settings page - To specify our application from name, author, version, description, and logo	Successful
12	Report (Admin)	- Report has two sidebars below it, namely, moving rooms and QR Logs - The purpose is to track our activities from the data entry and exit that the application does	Successful

The successful development and implementation of the web-based inmate processing system at Lapas Kelas IIB Pati mark a significant step towards modernizing correctional facility management, directly addressing the inefficiencies and inaccuracies inherent in previous manual, paper-based methods. As detailed in the Implementation Phase of the Research Methods, the system's core functionalities, including inmate data management, room transfer capabilities, and QR/barcode scanning for verification, was rigorously tested using Blackbox Testing, yielding universally successful outcomes (Table 1). This confirms the system's operational viability and its ability to fulfill the critical functional requirements outlined in the Requirement Phase, thus achieving the study's primary objective of streamlining inmate verification processes (Wahyuni et al., 2022).

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A key contribution of this system lies in its ability to substantially enhance operational efficiency and data accuracy within the correctional facility. The transition from manual record-keeping to an automated barcode-based verification system drastically reduces the time and labor required for inmate checks, especially during periodic room reshuffling. This automation minimizes the potential for human error, which was a significant challenge in the traditional system, as highlighted in the introduction. Such technological interventions are crucial in public administration, where digital solutions like this have consistently shown to improve service delivery and reduce administrative burden by automating repetitive tasks (Alshami et al., 2022; Kurniawan & Romzi, 2022).

Furthermore, the system's design, guided by the structured Waterfall methodology, has yielded a robust and secure application tailored to the sensitive environment of a correctional facility. The implementation of distinct access rights—allowing administrators comprehensive data management capabilities while limiting officers to viewing and scanning—reinforces security protocols and role-based accountability. The seamless integration of features like the inmate room transfer function, which retains QR Code integrity, demonstrates thoughtful consideration for real-world operational complexities. This structured approach to development is particularly beneficial for critical systems, ensuring all phases, from requirements to Verification, are meticulously completed, thereby minimizing post-deployment issues and enhancing system reliability (Pressman & Maxim, 2021; Santosa et al., 2022).

The implementation of this barcode-integrated system at Lapas Kelas IIB Pati aligns with the broader global trend of digital transformation and e-governance initiatives in public services. By leveraging web-based technology, the system not only improves internal administrative processes but also sets a precedent for enhanced transparency and data integrity within the Indonesian correctional system. Modernizing such critical infrastructure through information technology plays a pivotal role in improving public service delivery, fostering efficiency, and ensuring accountability in complex organizational settings (Chen & Wang, 2021; Purwanto et al., 2023). This project serves as a practical example of how targeted technological interventions can address specific operational bottlenecks in government institutions.

Despite its demonstrated effectiveness, this study has certain limitations that warrant consideration for future research. The system's current scope is primarily focused on inmate room verification within a single correctional facility (Lapas Kelas IIB Pati). Future work could explore the scalability and adaptability of this system to other correctional facilities, potentially integrating with a centralized national correctional database for broader impact. Additionally, enhancements could include incorporating advanced analytics for trend identification in inmate movements, exploring biometric verification methods for heightened security, or developing mobile applications with offline capabilities to ensure uninterrupted service in areas with limited connectivity (Azmi et al., 2023; Smith & Jones, 2023).

In conclusion, the developed web-based inmate processing system, integrating barcode technology, stands as a practical and effective solution for the challenges faced by Lapas Kelas IIB Pati in managing inmate occupancy. Through its successful Implementation and Verification phases, the system has proven its capacity to significantly improve efficiency, minimize errors, and reduce the workload for correctional officers. This research not only provides a tangible tool for administrative improvement but also contributes to the discourse on digital transformation within correctional facilities, offering a replicable model for other institutions striving for enhanced data management and operational excellence in the digital era.

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User Acceptance Testing

Although functional testing proved that the system was functional as intended, this type of validation is only one part of the story. The system can be technically correct and fail to become practical in the real world, or it can be technically correct and fail to be accepted by those who use it unless it meets their needs, habits, and expectations. This is the reason that once the Blackbox Testing stage was over, the research team proceeded to perform a User Acceptance Test (UAT) with the correctional officers, who would be using the application in their day-to-day operations. Ten Lapas Kelas IIB Pati officers were introduced to the system in simulated but realistic situations like checking the occupancy of cells, the movement of inmates in and out of rooms, and the QR code scanning exercise during a reshuffling exercise. When these tasks were completed, they were requested to give feedback based on a Likert-scale questionnaire with six dimensions of usability, namely ease of logging in, the speed of barcode scanning, navigability of the inmate data menu, the quality of the room transfer feature, the clarity of the interface and overall satisfaction. This direct use and reflective evaluation gave a more detailed view of the system reception, which is summarized in Table 2.

Table 2. UAT Results of the Inmate Processing System

No	Evaluation Aspect	Average Score (1–5)	Satisfaction (%)	Notes
1	Ease of Login & System Access	4.6	92%	Officers reported login was smooth
2	Speed of Barcode Scanning	4.8	96%	Fast scanning via smartphone camera
3	Ease of Using Inmate Data Menu	4.5	90%	Menu considered intuitive
4	Room Transfer Feature	4.4	88%	Function works well, saves time
5	Clarity of Interface & Layout	4.3	86%	Some noted room for visual clarity
6	Overall Satisfaction	4.6	92%	Majority found the system effective

The information provided in Table 2 indicates that there is a trend of high acceptance in all areas of evaluation. It was the speed of barcode scanning that impressed the officers the most as it had the highest average of 4.8 out of 5. This should not be a big surprise, as among the most urgent objections to the old manual system, the time wasted on reshuffling of the cells could be named. Being able to scan a smart phone at a code and immediately be able to tell whether the room is occupied or not spoke directly to their everyday workload. The ease of login and overall satisfaction ratings, which stood at 4.6 each, were also encouraging, as they

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indicate that the officers found the system not only usable but comfortable to incorporate into their routine.

Interestingly, the area that scored the lowest, but still respectable, was the interface clarity 4.3. This fact is telling: speed and reliability were in the first place the values of the officers, but they also understood that even the look and the usability of the system could be improved. Not as a criticism that invalidates the system, this feedback is positive, pointing to the possibility of making iterative improvements as the application evolves. Collectively, the UAT findings support that the system is no longer a prototype that can theoretically be applied; it is a solution that is considered by correctional staff to be of real value, reliable, and worthy of implementation.

Comparison of Verification Efficiency

User satisfaction is essential, but the ultimate test of such a system is whether or not it can give an actual efficiency and accuracy lift over the manual process that it is supposed to replace. The paper-based system at Lapas Kelas IIB Pati meant that the officers had to cross-check the documents manually and change the sheet each time inmates were reshuffled. This also took a lot of time and was prone to errors, particularly in situations where the reshuffling was done on a weekly or even daily basis. A simple comparison of the manual system and the new barcode system was made to measure improvement. Each method of checking a single room was timed by the officers and the rate of mismatch or error of data noted. The findings of this comparison condensed into average times and error rates are given in Table 3.

Table 3. Comparison of Verification Time and Accuracy

Method	Avg. Verification Time per Room	Data Error Rate (%)	Remarks
Manual (Paper-Based)	4–5 minutes	12%	Slow due to manual cross-checking, errors from reshuffling
Barcode System	25–30 seconds	2%	Quick scan with smartphone, minimal error
Difference (Δ)	~4 minutes faster	10% more accurate	Significant efficiency improvement

The variations presented in Table 3 are dramatic. In the manual system, crosschecking a single room might take as long as five minutes, and mistakes were no exception, happening in about one in ten crosschecks. Conversely, the barcode system reduced the time taken to verify the data to less than 30 seconds and reduced the error to a mere 2 percent. When you multiply this with dozens of rooms and hundreds of inmates, this time savings is staggering, as officers can spend more of their energy on security and rehabilitative tasks instead of clerical checks. It is also important that the number of errors is reduced: it is not only a question of efficiency but also an institutional safety as wrongly registered room assignments can be dangerous in a corrections setting. These results show that the system is valued by the people who use it, but it is also provable that it is better than the paper-based system that it is replacing.

Number of Test Participants

The credibility of these results also needs to consider who was on the testing side. Balance must exist in system development between technical validation and in-the-field usability

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testing. On the one hand, developers are the best people to make the code behave in specifications. Conversely, end users who have to work with the system on an everyday basis have a different point of view that cannot be acquired through technical tests. These complementary views were presented in this project by two groups, the development team that did the Blackbox Testing, and the correctional officers who did the UAT. Table 4 sums their contributions.

Table 4. Number of Test Participants

Test Type	Participants Involved	Description
Blackbox Testing	Development team (3 persons)	Tested 12 functional features, all successful
User Acceptance Test (UAT)	10 correctional officers	Provided feedback via Likert scale questionnaire

The sampling of the participants highlights the strength of evaluation process. The developers made sure that all the features, including the login protocols, the reporting modules, etc. worked properly in a controlled environment. In the meantime, the officers evaluated how those features did solve the problems that they had on the ground. Engaging ten officers might not be a huge number when looking at it in absolute terms, but in the context of a single facility it constitutes a proportion of the staff that is directly involved in the inmate verification. The fact that they are all supported in this argument goes to say that it is not only technically feasible, but also practically useful. The testing process brought these two views together, and resulted in a complete validation, whereby the system was not only functionally reliable, but also operationally relevant.

Conclusion

This study successfully developed and implemented a web-based inmate processing system utilizing barcode technology for Lapas Kelas IIB Pati, demonstrably improving the efficiency, accuracy, and security of inmate data management and room verification processes, thus fulfilling its primary objective. The system's core functionalities, rigorously validated through Blackbox Testing, consistently yielded successful outcomes, highlighting its operational viability in mitigating the inherent inefficiencies of previous manual methods. Despite these significant advancements, the current system's scope is confined to a single correctional facility, presenting a clear limitation for broader applicability. Therefore, future research should explore the system's scalability and adaptability for integration across multiple correctional facilities, potentially linking with a centralized national inmate database for enhanced comprehensive management. Additionally, incorporating advanced features such as predictive analytics for inmate movements, biometric verification for heightened security, or developing robust mobile applications with offline capabilities could further optimize its functionality and reach.

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