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Optimising Financial Transparency in the Oregon Cluster through the Development of a Web-Based System and Intelligent AI Chatbot

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Abstract: *Managing finances within neighborhood associations frequently encounters persistent hurdles regarding transparency and the speed of information delivery. This study develops a web-based financial platform for the Oregon Cluster, uniquely integrated with a Gemini-powered virtual assistant to enable real-time data inquiries. The novelty of this research lies in the integrated service model that pairs an automated payment gateway with conversational AI, effectively removing traditional bottlenecks in community reporting. Performance evaluation showed significant improvements compared to manual processes payment verification latency dropped by over 99.9% (from 24–48 hours to less than 10 seconds), and the time required for residents to access specific balance information was reduced by approximately 95% (from 5–10 minutes to near-instantaneous retrieval). Functional validation via Black Box Testing achieved a 100% success rate across 15 core modules. Furthermore, a System Usability Scale (SUS) evaluation with 21 respondents yielded an average score of 85.36, placing the system in the "Good" to "Excellent" category. While highly effective, feedback indicates a need to further simplify the administrative interface to reduce the treasurer's cognitive load. Overall, this integrated system markedly strengthens local financial accountability and empowers residents to monitor cash reports independently and efficiently*

Keywords: *Cash Information System, Financial Transparency, Virtual Assistant, Chatbot, System Usability Scale, Website.*

1. INTRODUCTION

The landscape of financial and administrative management has been fundamentally reshaped by the swift evolution of digital technology. Today, organizations across various sectors increasingly turn to structured information systems to secure higher levels of precision, openness, and operational efficiency [1]. In the Indonesian context, the ICT Development Index's rise to 5.90 in 2023 up from 5.85 the year prior signals a society that is becoming more adept at integrating digital tools into daily life [2]. This strategic shift toward IT is no longer exclusive to major corporations; it has become vital for grassroots community units, such as neighborhood associations (RT) [3]. However, achieving true financial transparency at the local level remains a struggle, particularly when community groups still depend on fragmented, manual processes that lack full integration [4]. In the Oregon Cluster, specifically, neighborhood cash management has historically operated on a semi-digital basis, using basic spreadsheets for records and conventional bank transfers for payments. Our preliminary observations revealed a significant bottleneck: the treasurer's manual verification process typically lags by 24 to 48 hours after a resident submits a payment receipt. This delay not only hinders real-time updates but also increases the risk of data inconsistency. Beyond payment issues, residents lose roughly 5 to 10 minutes digging through shared folders just to find a specific monthly balance a clear sign that current information retrieval methods are failing to meet the community's needs.

While financial reports are technically prepared, they remain difficult to access from a user experience (UX) standpoint. Residents are often presented with static, numerical documents that are hard to interpret without assistance, which ultimately stifles community engagement. Security is another pressing concern; handling sensitive data like National Identification Numbers (NIK) and contribution logs requires much tighter authentication than what current manual setups provide. Currently, data privacy is frequently overlooked, creating unnecessary risks of unauthorized access. Consequently, there is an urgent need for a more secure and interactive platform that goes beyond simple recording to offer instant, protected information access [5]. Earlier research has demonstrated that web-based systems can bolster accountability, with some studies reporting efficiency gains in data processing as high as 94% [6] or productivity boosts of 78% [7]. Yet, a critical gap persists: most existing solutions rely on static dashboards that still impose a high "cognitive load" on non-technical users. There is a notable lack of research on how to integrate automated payment gateways with Conversational AI to offer a more intuitive, natural language interface [8]. The core novelty of this study lies in developing a model that bridges this gap, combining a payment gateway for instant verification with a Gemini-powered AI chatbot to eliminate the need for tedious manual document navigation.

Based on these conditions, this study aims to optimize financial transparency in the Oregon Cluster by developing a web-based management system integrated with conversational AI. The research focus encompasses evaluating the extent to which this integrated system can significantly reduce payment verification time compared to traditional manual processes, while simultaneously assessing how the AI chatbot improves the ease of access to specific financial information for residents. Furthermore, this study seeks to determine the overall level of user acceptance of the proposed technology to ensure its long-term viability. To achieve these objectives, the System Development Life Cycle (SDLC) method with a prototype approach is adopted [9]. The system's performance is rigorously evaluated by comparing the legacy process with the proposed digital framework and by measuring usability using the System Usability Scale (SUS). Through this comprehensive approach, the study demonstrates that integrating conversational AI into neighborhood financial systems can significantly optimize transparency, accessibility, and administrative efficiency.

2. METHODS

This study utilizes primary data sourced from the internal administrative and financial records of the Oregon Cluster residential management for the 2023-2024 period. The dataset encompasses resident identities linked to National Identification Numbers (NIK), routine contribution logs, and environmental operational expenditure records. The dynamic and relational characteristics of this data serve as the primary basis for supporting the validity of financial reports presented interactively, testing the hypothesis that information transparency can be significantly improved through integrated data synchronization [10]. Given the sensitivity of NIK data, the research incorporates secure authentication principles to ensure data privacy while maintaining record accuracy. The study was conducted in the Oregon Cluster, a residential area transitioning from conventional manual cash management to a digital ecosystem. This setting provides a relevant context for identifying challenges such as high resident mobility and the urgent need for instant transaction validation [7].

The technical implementation is realized through a system architecture that connects a Laravel-based web server with various external services, as illustrated in Figure 1. This architecture integrates the Midtrans API for automated payment processing and the Gemini API for natural language processing within the AI Chatbot feature [11], allowing the server to manage complex data communication between clients and the database efficiently [12]. The system development follows the Prototype model of the System Development Life Cycle (SDLC), chosen for its

iterative nature which facilitates continuous feedback between developers and residents to ensure accurate functional results [13], [14].

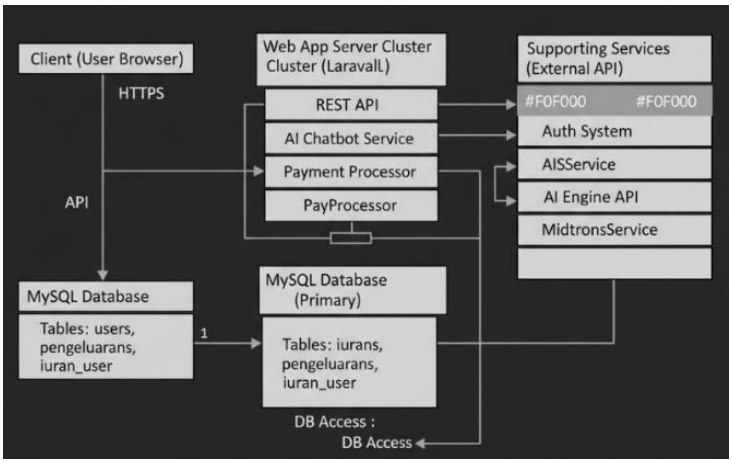


Figure 1. Architecture Diagram

The transaction validation process is executed through real-time synchronization, ensuring that every payment is recorded directly via a webhook mechanism to minimize manual input errors [15]. Residents interact with the system starting from a landing page equipped with an AI Chatbot and a secure NIK-based account registration process. To assess the effectiveness of the proposed system in improving operational efficiency, this study conducts a comparative analysis between conventional methods and the digital system, focusing on parameters such as payment verification rates and information access response times and administrative data accuracy [1]. Functional validation was strictly conducted through Black-box testing across 15 core modules, all of which achieved a "Success" status. Finally, the system's usability was evaluated by 21 targeted respondents, consisting of 18 residents and 3 neighborhood administrators, using the System Usability Scale (SUS) to convert qualitative user experiences into standardized scientific scores. The inclusion of both residents and administrators as respondents is crucial to validate the system's impact on both ends the citizen's ease of access and the administrator's operational capacity.

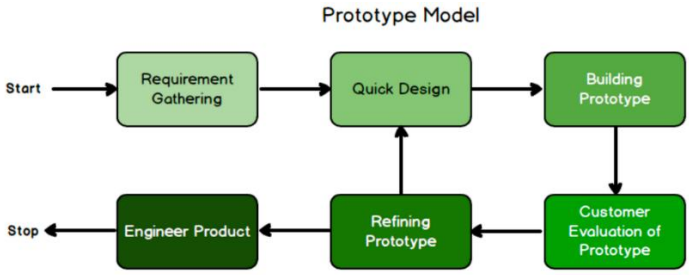


Figure 2. Prototype SDLC stages.

The system success was measured using the System Usability Scale (SUS) instrument to convert qualitative user perceptions into standardized scientific scores [16]. Based on the testing results, the system obtained a score of 85.36, which falls into the "Good" to "Excellent" category, proving that the integration of digital technology and artificial intelligence is highly reliable in improving administrative transparency [17]. The entire system workflow is documented through Activity Diagrams to ensure that each stage of development can be reproduced and scientifically validated for future studies.

3. RESULTS AND DISCUSSION

A. Needs Analysis

Before designing the system, a comprehensive problem identification process was conducted through in-depth observation of the administrative dynamics in the Oregon Cluster. This approach ensured that users and developers collaborated effectively to formulate software designs and determine the system's core functionalities [18]. The observations revealed significant barriers in the existing manual process, primarily centered on the difficulty of accessing financial information. Residents were forced to manually search for report documents within fragmented digital messaging archives, leading to information asymmetry. Furthermore, the payment process was identified as highly inefficient, requiring residents to manually send photos of transfer receipts for treasurer verification. Security concerns regarding sensitive financial data also emerged as a priority; residents expressed the need for a restricted-access system where account activation is strictly controlled by administrators through National Identification Number (NIK) validation to ensure data privacy.These identified challenges were then transformed into system requirements specifications designed to provide a comprehensive digital solution. To address accessibility, an Intelligent AI Chatbot was integrated to allow instant retrieval of financial data using natural language inquiries. Additionally, an automated digital payment module was developed to eliminate manual confirmation procedures. Security requirements were accommodated through a pre-registered account method, positioning administrators as the sole authority to register resident NIKs in the database before citizens can activate their accounts. The detailed software requirements for administrators and citizens are structured and presented in Table I and Table II.

TABLE 1. ADMINISTRATIVE MODULE SPECIFICATIONS

No	Key Features	Features ID	Software Description
1	Administrator Authentication	R-ADM-01	Provides restricted and secure access control for Oregon Cluster administrators to manage the financial system.
2	Master Data Authory	R-ADM-02	Centralized management of the Head of Household's NIK database as the primary credential for resident account activation.
3	Main Admin Dashboard	R-ADM-03	Real-time visualization of cash asset summaries and monthly contribution statistics through interactive graphs.
4	Cash Flow Management	R-ADM-04	Systematic recording of environmental operational expenses, including digital transaction evidence attachments.
5	Knowledge Synchronization	R-ADM-05	Integration of the latest financial reports into the AI database to ensure the Chatbot provides accurate, real-time data.

TABLE 2. CITIZEN SERVICE INTERACTION REQUIREMENTS

No	Key Features	Features ID	Software Description
1	User Activation	R-CIT-01	Self-registration process with NIK verification that has been recorded in the system.
2	NIK-Based Login	R-CIT-02	Access the portal using your NIK as your unique identity
3	Natural Language Chatbot	R-CIT-03	Interactive solution for accessing balance information without manual document searches
4	Digital Payment Module	R-CIT-04	Automatic contribution facility through Midtrans to eliminate the need to send proof of receipt.
5	Transparency Visualization	R-CIT-05	*Dashboard* for monitoring personal contribution history and real-time public cash recapitulation.

B. System Design

The architectural design process is a crucial phase in transforming user requirements into software logic. This stage aims to ensure that every component of the system, from identity data management to payment automation, can operate in harmony.

1. Use Case Diagram

The implementation of *use case* diagrams in this study serves to map the functional boundaries and interactions between actors and the system. Through this approach, developers can harmonize the system workflow with specific user needs in a more structured manner [19]. In the Oregon Cluster cash system, the administrator actor has full control over NIK master data authority and expenditure validation, while citizen actors have special access to the independent payment module and virtual assistant. This separation of roles is very important to maintain financial data integrity while providing transparency for citizens.

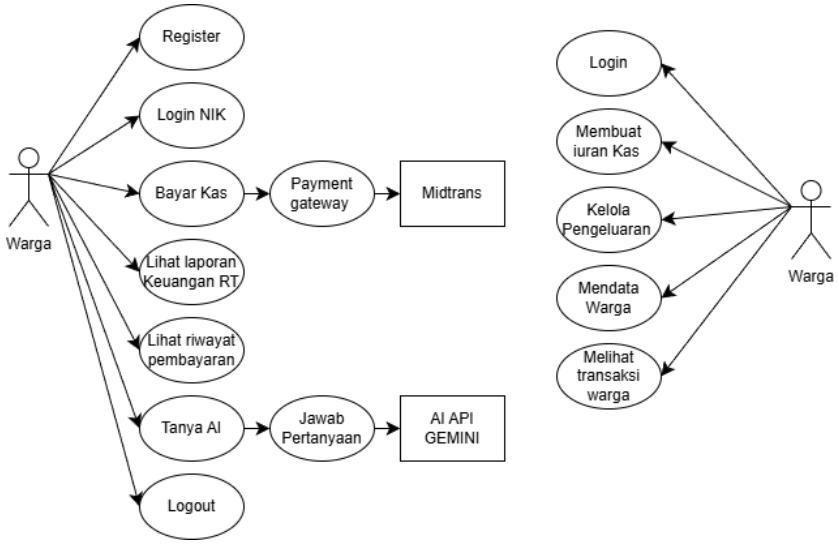


Figure 3. Use Case Diagram.

2. Activity Diagram

After mapping the relationships between actors, the system workflow is described in more detail through *an Activity Diagram*. This diagram provides a visual representation of the transition of data from one action to the next, especially in the registration and payment flows. The system is designed to automatically validate the NIK entered by residents by matching it with the database that has been previously registered by the administrator. In addition, this diagram shows the *real-time* mechanism of the payment gateway, where the status of residents' contributions will change automatically as soon as the system receives notification of a successful transaction from the bank.

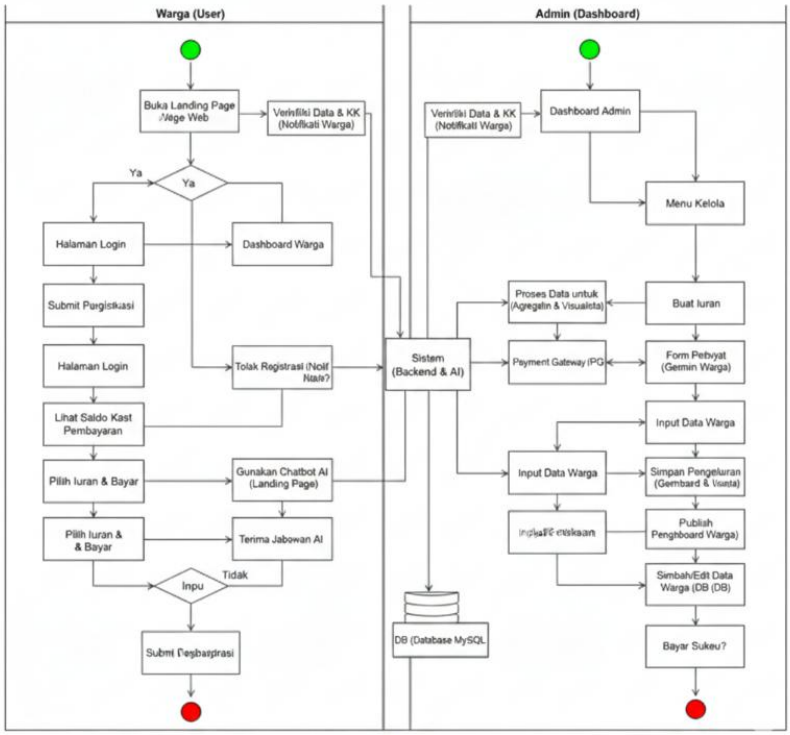
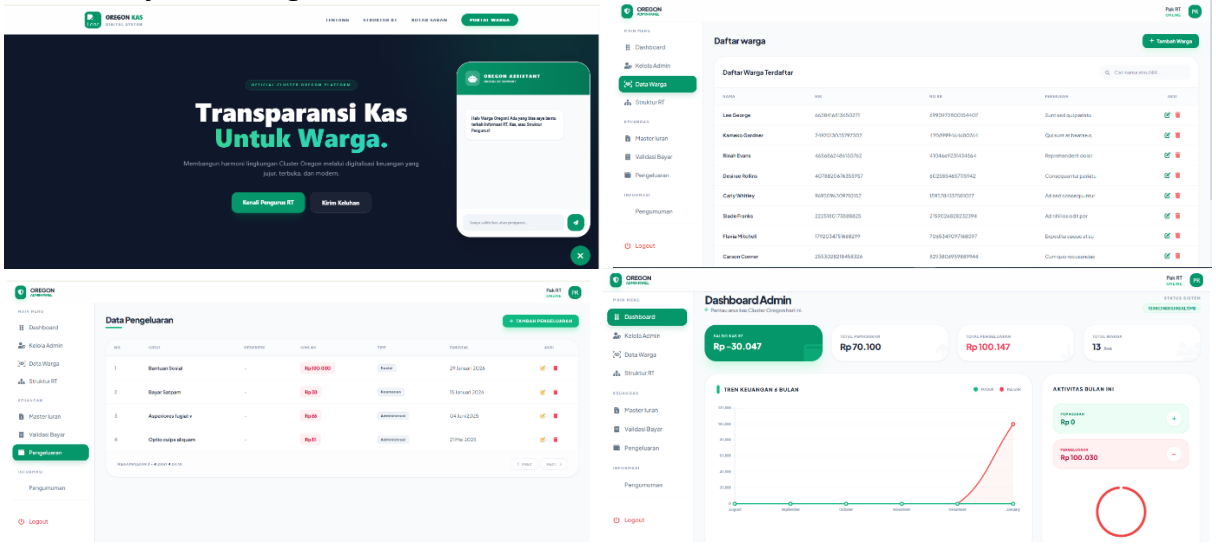


Figure 4. Activity Diagram.

C. System Display

The interface implementation stage in this study presents a visualization of the main features that have been successfully developed to support cash transparency in the Oregon Cluster. Figure 5 shows a series of system displays starting from the *landing* page (a), where a virtual assistant or *chatbot* is placed to facilitate residents in conducting interactive financial consultations. On the managerial side, administrators are equipped with a resident data management module (b) to register NIKs as the main database and a cash expenditure recording module (c) to document every use of neighborhood operational funds. A comprehensive overview of financial statistics can be monitored through *the* administrator *dashboard* (d), while residents have special access to *the* user *dashboard* (e) to view a summary of their contribution profiles. Collective data transparency is accommodated through the RT cash report page (f), which presents details of cash inflows and outflows in chronological order. To maintain data security, access to these internal features is protected by an authentication system consisting of a login page and a registration button (g) that can only be activated if the user's NIK has been validated by the management beforehand.



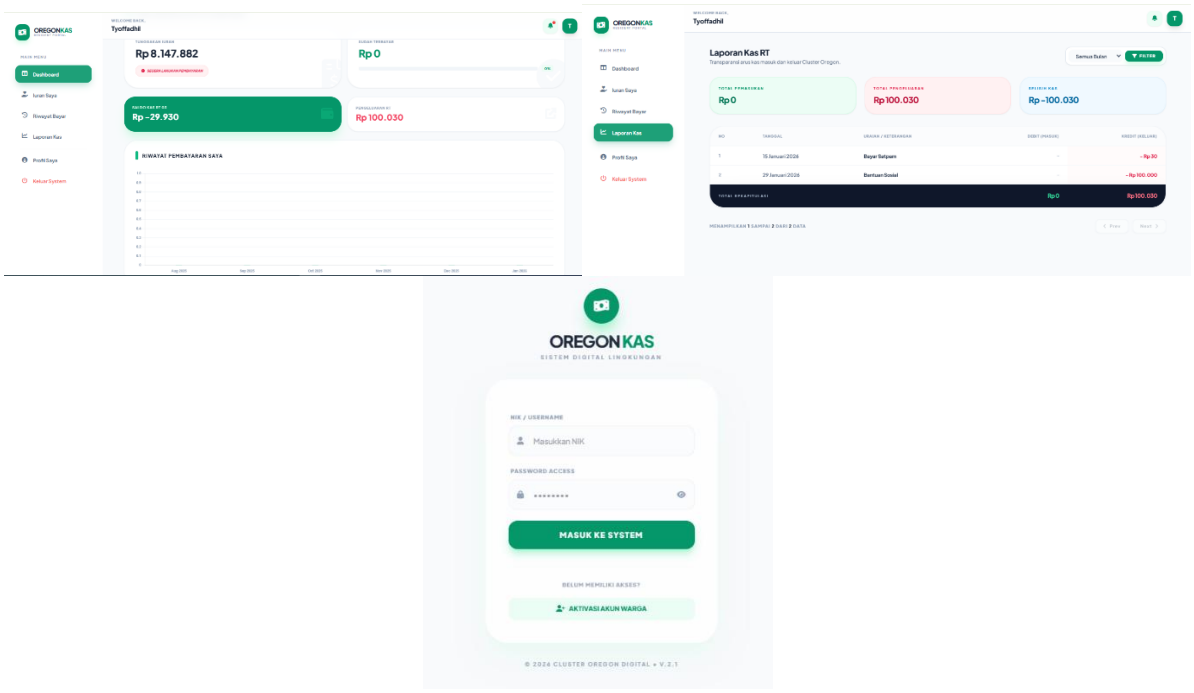


Figure 5. Interface Implementation: (a) *Landing* & *Chatbot*, (b) Resident Data, (c) Cash Expenditures, (d) Admin *Dashboard*, (e) Resident *Dashboard*, (f) Cash report, (g) Login & Register.

D. Comparative Analysis of System Efficiency

Performance evaluation was conducted by comparing the operational metrics of the Oregon Cluster's financial management before and after the implementation of the integrated digital system. This analysis focuses on measuring the extent to which the new system improves efficiency, reduces verification latency, and enhances data accessibility through quantitative observation.

In the manual condition, residents performed contributions by sending transfer receipts to the treasurer for manual reconciliation. This created significant bottlenecks and high verification times, as shown in Table III.

TABLE 3. MANUAL SERVICE CONDITIONS

No	Operational Metric	Observation Value	Analysis
1	Average Verification Time	24 – 48 Hours	Treasurer must manually verify bank statements against chat archives.
2	Info Retrieval Speed	5 Minutes	Residents manually search through PDF/Excel files in messaging groups.
3	Data Recording Accuracy	75 – 80%	High risk of duplicate entries or typos during manual spreadsheet input.
4	Transparency Level	Periodic	Access is limited to when the administrator publishes static reports.

After the implementation of the new system, transactions and information retrieval are handled automatically through API-based synchronization and AI processing. The operational metrics are presented in Table IV.

TABLE 4. DIGITAL SYSTEM PERFORMANCE CONDITIONS

No	Operational Metric	Observation Value	Analysis
1	Average Verification Time	< 10 Seconds	99.9% reduction via real-time automated API notification..
2	Info Retrieval Speed	< 15 Seconds	**95%** reduction via Gemini-powered Natural Language Processing
3	Data Recording Accuracy	99%	Elimination of manual input errors through direct DB synchronization.
4	Transparency Level	Real Time (24/7)	Continuous accessibility through interactive dashboards and AI.

The comparative results demonstrate a significant optimization in the administrative workflow as explained below:

1. Reduction in Verification Latency and Confirmation Waiting Time: In the manual baseline condition, the transaction verification process required a 24–48 hour window. Following the implementation of the online system integrated with a payment gateway, verification time was drastically reduced to less than 10 seconds. This represents a latency reduction of >99.9%. This significant decline occurred due to the elimination of manual reconciliation by the treasurer, which was replaced by an automated webhook mechanism that processes data in real-time immediately upon receiving successful confirmation from the bank.
2. Acceleration of Information Access via AI Chatbot: Manual data retrieval from static documents previously required approximately 5 minutes (300 seconds). With the integration of the AI Chatbot, the information access time was shortened to an average of 15 seconds, signifying a 95% increase in access speed. The AI eliminates information bottlenecks by removing resident dependency on administrator availability to obtain financial reports; instead, residents can execute direct database queries using natural language.
3. Enhancement of Administrative Accuracy and Capacity: The implementation of automated API synchronization increased data accuracy from an estimated 75% in the manual method to 99% in the digital system. This indicates a 24% improvement in accuracy along with the elimination of human error risks during data recording. Consequently, this enhances overall administrative capacity, as the system can manage hundreds of simultaneous transactions without additional manual workload, shifting the treasurer's role from a data recorder to a financial supervisor.

E. System Testing and System Evaluation

The system was evaluated to ensure that all implemented features were running according to plan and providing an optimal user experience. The first test was conducted using the *Black Box Testing* method, which focuses on validating the functionality of each module without regard to the internal structure of the code. The test results showed that all key features, from the NIK authentication process and citizen data management to virtual assistant interactions, were functioning at a 100% success rate. Details of the functionality test results are presented in Table V.

TABLE 5. BLACK BOX TESTING RESULT

No	Module	Test Scenario	Test Input	Expected Results	Status
1	Authentication	Login with wrong password	Valid NIK + Invalid Pass	System reject access with allert	Success
2	Authentication	Unauthorized page access	Bypass login via direct URL	Redirected to Login page	Success
3	Registration	NIK Master Data	NIK not in Admin List	System rejects:“not found”	Success
4	Registration	Duplicate account creation	Already registered NIK	System Reject:”Invalid length”	Success
5	Input	NIK digit Length Check	NIK > 16 Digit	Invalid Error:	Success
6	Payment	Closing Payment	Terminate Snap window	Invoice remains “unpaid” in DB	Success
7	Payment	Successful Transaction	Real VA/QRIS payment	Status updated to “paid” via API	Success
8	Finance	Expense recording logic	Expense > Currend Balance	Warning: “Insufficient balanace”	Success
9	Finance	Invalid file Upload	Uploading non-image file	System rejects invalid format	Success
10	Chatbot	Specific balance inquiry	“What is the total balance?”	AI retrieves real-time from DB	Success
11	Chatbot	Historical data inquiry	“Total expenses in 2024”	AI Calculates yearly data from DB	Success
12	Chatbot	API connectivity fallback	Simulate Gemini Timeout	System runs static fallback info	Success
13	Admin	Managing resident Master	Update NIK	Data reflected in login module	Success
14	Report	Date Range filtering	Filter: 01/2024 - 05/2024	Displays correct chonological logs	Success
15	System	UI Responsiveness	Access via mobile Browser	Interface adapts to screen size	Success

After functional testing was declared valid, usability was measured using *the System Usability Scale* (SUS) method through a questionnaire distributed to 21 respondents, consisting of 18 residents and 3 neighborhood association administrators. The SUS instrument included ten questions assessing the aspects of efficiency, consistency, and comfort of interaction. Each item was rated using a 1–5 Likert scale, which was then calculated using a standard average formula to obtain a final score in the range of 0–100.

$$\text{Rata - Rata SUS} = \frac{\text{S1+S2S3.....S4+5/N}}{\text{N}} = \text{Rata - Rata} = \frac{\text{1792,5/21=85,36}}{\text{36}}$$

Figure 6. Average SUS Formula Score.

Based on the data processing results of the 21 respondents, a minimum score of 37.5 and a maximum score of 97.5 were obtained, with an overall average score of 85.36. Referring to the SUS assessment category parameters, this score places the system in the GOOD category, approaching EXCELLENT. This indicates that the Oregon Cluster cash information system has met user expectations and is well received by residents.

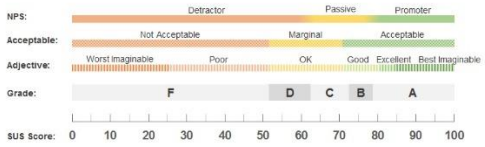


Figure 7. SUS Score.

TABLE 6. RESPONDENT DATA TABULATION

Respondents	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Total Score	SUS Score
1	4	4	4	4	4	4	3	3	4	4	38	95
2	4	3	4	4	4	3	4	4	3	2	35	87,5
3	3	4	3	4	4	4	3	4	0	4	33	82,5
4	3	3	3	4	3	4	4	4	3	3	34	85
5	4	4	3	4	4	4	3	3	4	4	37	92,5
6	3	4	4	4	4	4	4	3	3	3	36	90
7	3	4	4	4	4	4	2	4	4	3	36	90
8	4	3	3	3	4	3	3	4	3	4	34	85
9	4	4	3	4	4	3	4	4	4	4	38	95
10	4	4	4	4	4	4	3	3	0	4	34	85
11	3	3	3	4	3	4	4	4	3	3	34	85
12	4	3	3	4	4	4	3	4	4	4	37	92,5
13	4	4	4	4	4	4	3	4	4	3	38	95
14	4	4	4	3	4	4	3	3	4	2	35	87,5
15	4	4	4	4	4	4	4	4	3	4	39	97,5
16	3	3	3	3	4	4	3	4	3	3	33	82,5
17	4	4	3	3	3	3	3	2	3	2	30	75
18	4	3	3	4	3	3	2	2	4	4	32	80
19	4	3	3	3	3	4	2	4	4	4	34	85
20	4	2	1	1	3	3	1	0	0	0	15	37,5
21	4	3	3	3	3	3	4	4	4	4	35	87,5

Based on the data tabulation in Table IV, the analysis results show that low scores are mainly influenced by negative items related to the perception of system complexity and the amount of time required for users to learn the interface before being able to operate it smoothly. This indicates that although the system has functionally succeeded in automating cash management and increasing fund transparency, the *user interface* (UI) aspect still needs improvement to be more intuitive for ordinary users. The difference in perception found between residents and RT

administrators shows that residents tend to give higher scores due to simple feature interactions, while administrators face a higher cognitive load in complex data management modules.

Inconsistent icon placement and uninformative error messages hinder users' understanding of the system when input errors occur. Overall, improvements to the UI/UX are still needed to increase usability in the future in accordance with the *System Usability Scale* [20] evaluation standards. Key recommendations include simplifying *the* administrative *dashboard* display, providing *onboarding* guidance for new users, and improving interface consistency to provide a more optimal user experience.

4. CONCLUSION

This study successfully implemented a web-based financial management system for the Oregon Cluster, integrating a payment gateway and a Gemini-powered AI chatbot to enhance transparency and operational efficiency. The comparative analysis demonstrates that the system achieved significant optimization, reducing payment verification latency by over 99.9% (from 48 hours to <10 seconds) and accelerating information access by 95% via natural language inquiries. Functional validation through Black Box Testing confirmed a 100% success rate across all core modules. Furthermore, the usability evaluation yielded an average SUS score of 85.36, which falls into the "Good" to "Excellent" category, proving that the integration of digital technology and artificial intelligence is highly reliable in improving administrative transparency. Despite these achievements, the study identifies a need to further simplify admin dashboard navigation to minimize cognitive load during complex data management. Future development should focus on enhancing UI consistency and providing interactive onboarding guidance to ensure a more inclusive and optimal experience for all residents.

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