Journal of Artificial Intelligence and Engineering Applications

Website: https://ioinformatic.org/

15th June 2025. Vol. 4. No. 3; e-ISSN: 2808-4519

Design and Validation of a Web-Based E-CRM System for Baby Fashion Business: A Case Study of PT Rhinno Makmur Jaya Using Black Box and UAT Testing

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Abstract

This study aims to design and validate a web-based Electronic Customer Relationship Management (E-CRM) system tailored for the baby fashion business sector. The system was developed in response to operational limitations experienced by companies that rely on third-party marketplaces, particularly issues related to restricted access to customer data and the inability to implement loyalty programs. The development approach followed the Waterfall model, encompassing stages such as requirements analysis, system design, implementation, and testing. The system incorporates key features including user registration, product catalog management, coupon integration, payment confirmation, and reward point redemption. Validation was performed using Black Box Testing to assess functional accuracy and User Acceptance Testing (UAT) to evaluate usability and user satisfaction. The test results confirmed that all functions operated as intended, with UAT yielding a strong approval rating. The implementation of the E-CRM system is expected to enhance operational efficiency, provide better control over customer interactions, and support long-term engagement strategies. These improvements position the business for sustainable growth in the digital market landscape.

Keywords: *Baby Fashion; Black Box Testing; E-CRM; Loyalty Program; User Acceptance Testing*

1. Introduction

The baby fashion industry in Indonesia has experienced notable growth in recent years, driven by increasing birth rates and the adoption of digital platforms for consumer shopping. In 2023 alone, more than 4.6 million births were recorded, generating increased demand for baby-related products [1]. Digital-native young families are particularly inclined to purchase baby items through online platforms due to convenience and variety [2].

PT Rhinno Makmur Jaya, founded in 2022, is a local business specializing in baby fashion products such as shoes and clothing. Initially, the company relied on third-party marketplaces to access its market, but this approach introduced significant operational limitations. These platforms often mask customer data [3], restrict retargeting efforts [4], limit the implementation of loyalty features [5], and reduce profit margins through administrative fees and commission structures [6].

CRM (Customer Relationship Management) systems are essential for maintaining long-term customer relationships by facilitating data-driven communication and personalized experiences [7]. The emergence of Electronic CRM (E-CRM) systems has enhanced this capability through centralized customer databases, automation, and real-time interaction [8], [9]. These tools allow businesses to track customer behavior [10], execute reward strategies [11], and improve service responsiveness [12].

Numerous studies have confirmed the effectiveness of E-CRM in the fashion and retail industries. Oktaviani et al. reported improved order management and market expansion through E-CRM implementation [13], while Jumandika et al. emphasized enhanced operational efficiency and retention [14]. Husna highlighted the positive impact of reward-based features on customer loyalty [15].

However, many small businesses still face challenges in E-CRM deployment. Sutrisno and Pratama noted that systems lacking features such as coupon management and segmentation fail to build meaningful engagement [16]. Additionally, limited system integration with analytics and mobile platforms weakens the strategic value of CRM initiatives [17].

In response to these problems, this study aims to design and validate a web-based E-CRM system tailored to the operational needs of PT Rhinno Makmur Jaya. The proposed system includes core functions such as user registration, coupon and reward point features, personalized shopping, and admin-controlled transaction management. The development followed the Waterfall model and was validated using Black Box Testing and User Acceptance Testing (UAT) to ensure functionality and user satisfaction. This system is expected to increase operational efficiency, improve customer loyalty, and enable sustainable digital competitiveness.

2. Research Methodology

This research adopts a descriptive and system development approach using the Waterfall model. The Waterfall method provides a structured and sequential framework suitable for system development projects with clearly defined requirements. The development stages consist of: requirements analysis, system design, implementation, testing, deployment, and maintenance. Each phase must be completed before proceeding to the next stage, ensuring a controlled and well-documented process. The overview of the Waterfall development model is shown in Fig. 1.

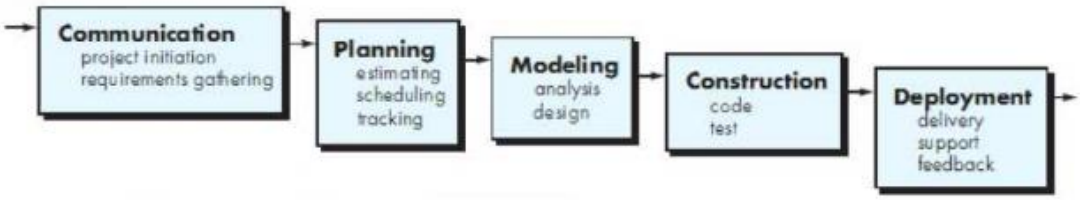

Fig. 1: The Waterfall development model used in this research.

The system was developed using PHP as the server-side scripting language, MySQL as the relational database management system, and XAMPP as the local testing environment. These tools were chosen due to their compatibility, scalability, and wide adoption in web-based system development.

Requirements were gathered through direct observation, stakeholder interviews, and analysis of existing documentation. Functional requirements were modeled using Unified Modeling Language (UML) diagrams, such as use case, activity, class, and sequence diagrams, to provide a comprehensive visualization of the system structure and behavior.

The validation process involved two testing techniques. First, Black Box Testing was used to verify that the system's functionalities aligned with specified requirements, focusing on user login, product management, checkout, reward points, and transaction verification. Second, User Acceptance Testing (UAT) was conducted using a Likert scale questionnaire to assess usability, efficiency, reliability, and user satisfaction. The UAT resulted in an overall acceptance score of 81.83%, indicating the system is considered ready for use.

3. Result and Discussion

3.1. System Overview

The E-CRM system developed for PT Rhinno Makmur Jaya integrates loyalty and personalization features to enhance customer engagement and increase direct transactions through the official website. One of the key features is a point-based reward system, where users receive points for every successful transaction. These points can be accumulated and redeemed for baby products offered in the reward catalog. This mechanism incentivizes repeat purchases and reduces dependency on third-party marketplaces. The reward points are displayed on the user dashboard along with a record of point usage, as illustrated in Fig. 2. In addition, the system includes a product personalization feature that enables customers to preview their baby's name directly on selected products, such as prewalker shoes. This visual customization increases emotional value and contributes to purchase decisions, as shown in Fig. 3.

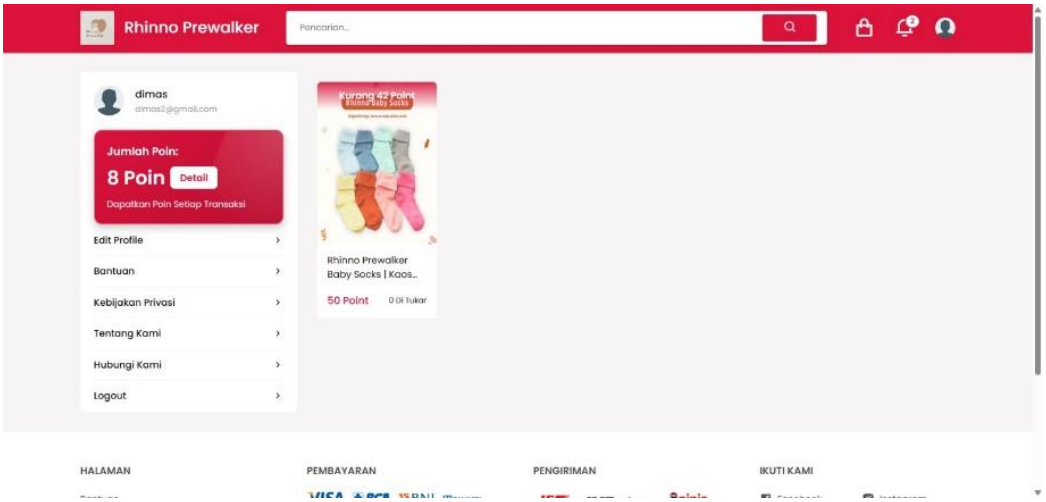

Fig. 2: Reward point interface for customer loyalty

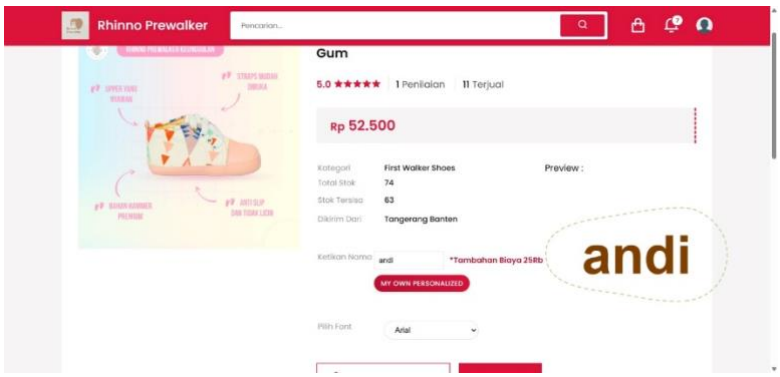

Fig. 3: Personalized name preview on baby shoes product page

3.2 Use Case Diagram

The system was designed based on functional requirements gathered during analysis. The interactions between actors and system functionalities are presented in the use case diagram shown in Fig. 4.

Fig. 4: Use case diagram of the proposed E-CRM system.

The diagram illustrates two primary actors: User and Admin. The User can perform functions such as registration, login, product browsing, voucher usage, checkout, payment upload, and reward redemption. Meanwhile, the Admin is responsible for managing product data, order verification, shipment tracking, promotional banners, flash sale setup, voucher generation, and reward item configuration. Each feature was designed to reflect core CRM functions including acquisition, retention, and personalization.

3.2 Class Diagram

To provide a clear structural representation of the system's core components, a class diagram was developed to define the entities, attributes, and relationships that form the foundation of the E-CRM platform. The diagram serves as a blueprint for the system's backend logic and database schema.

As illustrated in Fig. 3, the system includes several primary classes: User, Product, Coupon, Invoice, Reward, and Category. Each class contains attributes that correspond to operational data, such as user identity, product specifications, voucher information, and transactional records. The relationships between classes—such as one-to-many links between User and Invoice, or between Product and

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Category—ensure data consistency and allow scalable feature integration. This modular design supports key system functionalities including reward point accumulation, personalized shopping, coupon application, and administrative control.

The use of class diagram modeling ensures that data flows and system logic are structured, maintainable, and aligned with object-oriented programming principles, contributing to the robustness and clarity of the system architecture.

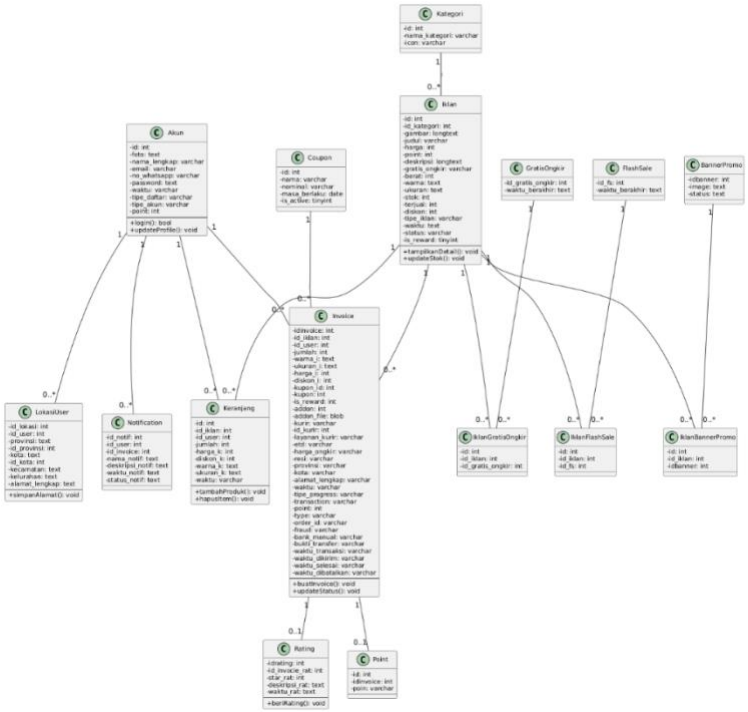

Fig. 5: Class diagram of the proposed E-CRM system.

The use of class diagram modeling ensures that data flows and system logic are structured, maintainable, and aligned with object-oriented programming principles, contributing to the robustness and clarity of the system architecture.

3.3 Black Box Testing

Black Box Testing was conducted to validate the functional behavior of the system based on user interactions. Each module was tested using valid and invalid inputs to determine whether the outputs matched expected behavior without inspecting the underlying code. The features tested included user login, product selection, checkout process, voucher validation, upload of payment proof, and point redemption. All tested scenarios passed successfully, indicating that the system components function as intended under both normal and error conditions. This testing confirmed that user-facing functions and system responses aligned with the defined requirements.

3.4. User Acceptance Testing

User Acceptance Testing (UAT) was performed to assess the system's usability, functionality, reliability, efficiency, and overall user satisfaction. A total of six users participated in the evaluation by completing a structured questionnaire consisting of 20 items rated on a 5-point Likert scale. The responses were analyzed to calculate a composite score representing system acceptability.

The final UAT score achieved was 81.67%, which falls within the category of 'Eligible to Use'. This result indicates strong approval from users and demonstrates that the developed system meets practical usability standards. The evaluation also provided qualitative feedback for future enhancements, including potential mobile app integration and interface refinement.

Tabel 1: Summary of User Acceptance Testing (UAT)

Answer Type	Score Weight	Number of Responses	Total Score
Strongly Agree (SS)	5	44	220
Agree (S)	4	42	168
Neutral (R)	3	34	102
Disagree (TS)	2	0	0
Strongly Disagree (STS)	1	0	0

4. Conclusion

This research successfully designed and validated a web-based Electronic Customer Relationship Management (E-CRM) system tailored for the baby fashion industry. The proposed system was developed in response to operational limitations commonly faced by businesses relying on third-party marketplaces, particularly the lack of access to customer data and the inability to implement loyalty programs. By centralizing customer interactions and integrating key features such as personalized shopping, coupon management, reward points, and admin-side transaction control, the system addresses these issues directly.

The results from Black Box Testing demonstrated that all functional modules operated in accordance with their specifications, while User Acceptance Testing (UAT) yielded a final score of 81.67%, placing the system in the "Eligible to Use" category. These outcomes validate the system's readiness for real-world deployment and highlight its potential to improve customer engagement, operational efficiency, and digital competitiveness. Future enhancements may include mobile application integration, automated campaign tools, and advanced analytics to further strengthen customer retention strategies.

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