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Development of Design Digital Application System for Laundry Partner Services: A Smart Village Initiative

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***Abstract*— The digital transformation of micro and small enterprises is an important component of smart village initiatives aimed at improving service efficiency and business sustainability. This study develops a mobile-based digital laundry application for Metro Laundry to address operational challenges associated with manual order recording, payment management, inventory tracking, and laundry status monitoring. The system was designed using object-oriented analysis and design techniques, including use case, class, activity, and sequence diagrams. The proposed application integrates customer management, order processing, digital payment, real-time laundry tracking, and administrative reporting into a unified platform. The resulting system provides a structured workflow that reduces dependence on manual processes, improves data accuracy, and enhances transparency between customers, laundry partners, and administrators. The developed design demonstrates how digital service platforms can support operational efficiency and contribute to the implementation of smart village concepts for local micro-businesses. Future work includes system implementation, user acceptance evaluation, and integration with emerging technologies such as artificial intelligence and Internet of Things (IoT).**

Keywords*— *smart village, laundry Information Systems, mobile application, digital transformation, uml, business process automation

I. INTRODUCTION

The rapid development of information and communication technologies has accelerated digital transformation across various sectors, including micro, small, and medium enterprises (MSMEs) [1]. In rural areas, this transformation is closely associated with the Smart Village concept, which promotes the utilization of digital technologies to improve public services, strengthen local economies, and enhance community welfare [2]. The implementation of Smart Village initiatives enables local businesses to adopt digital solutions that improve operational efficiency and competitiveness while supporting sustainable economic development [3], [4].

Traditional laundry businesses in rural and village settings operate predominantly through manual processes, leading to persistent operational inefficiencies that hinder scalability and service reliability. Interviews conducted with laundry manager Virna Indri Luthfia revealed specific pain points such as manual garment recording causes frequent mix-ups and losses; stock management for detergents, softeners, and packaging lacks organization, complicating needs assessment; payment processing and financial recording remain inefficient, delaying business cycles and risking errors; technical issues like network disruptions, machine malfunctions, and external factors (water/electricity shortages) exacerbate delays. These challenges underscore the urgent need for digital transformation aligned with smart village principles, which leverage technology to empower micro-businesses.

Based on previous literature within the laundry business context, the information systems development can provide an

effective way to improve the value proposition [5]. This system can improve the employee productivity from 66% to 100% [6]. There are several MSMEs, especially in laundry business adopt the information systems in their business [7], [8]

However, many MSMEs face several challenges in adopting the digital technology [9]. They often need to overcome limited digital literacy, inadequate infrastructure, and lack of strategies knowledge [10]. These problems can reduce the MSMEs ability to adopt the digital transformation. Therefore, they need a proper strategy to implement the digital technology in their business.

MSME require a systematic procedure to develop and implement an information system which align with their business needs and capabilities. The Software Development Lifecycle (SDLC) provides a structural process that guides the system development [11], [12]. One method can be used to develop a system is Object-Oriented Analysis and Design (OOAD). This method provides a systematic framework for translating business requirements into software models, enabling the development of robust and user-oriented information systems [13], [14]. In developing information systems for MSMEs, this method can facilitate the identification of business processes and their representation as interacting objects, resulting in more efficient and adaptable software solutions.

This study employed an OOAD approach to develop a digital laundry application system that supports operational efficiency and Smart Village initiatives. OOAD was selected because it provides a systematic framework for analyzing user requirements and translating them into structured system models that can support future implementation and scalability. The research consisted of four main stages: requirement analysis, system analysis, system design, and design validation.

This research gap highlights the need for a comprehensive digital platform that not only automates laundry operations but also supports the implementation of Smart Village initiatives through integrated digital services. Therefore, this study aims to design a mobile-based digital laundry application for Metro Laundry that integrates customer management, order processing, payment handling, real-time laundry tracking, and administrative reporting within a unified platform. By adopting object-oriented system design techniques, including use case, class, activity, and sequence diagrams, this study contributes a scalable digital service model that can improve operational efficiency, enhance service transparency, and support the digital transformation of MSMEs in rural communities.

II. RESEARCH METHOD

A. Requirement Analysis

The first stage focused on identifying the operational problems and business requirements of Metro Laundry. Data were collected through direct observation of existing business processes and interviews with the business owner to understand current challenges related to customer management, order processing, payment recording, inventory control, and laundry tracking. The collected information was then analyzed to identify both functional and non-functional system requirements.

B. System Analysis

Based on the identified requirements, system analysis was conducted to define the interactions between users and the proposed system. Three primary actors were identified: customers, laundry partners, and administrators. Each actor's activities, responsibilities, and information needs were analyzed to ensure that the proposed system could effectively support operational workflows and stakeholder collaboration. The output of this phase was a structured set of functional requirements that served as the foundation for system modeling.

C. System Design

The system design phase translated the identified requirements into object-oriented models using Unified Modeling Language (UML). Several UML diagrams were developed to represent different perspectives of the proposed system. The Use Case Diagram was utilized to describe interactions between actors and the system. The Class Diagram was designed to model system entities, attributes, methods, and relationships. The Activity Diagram illustrated the operational workflow of laundry services, while the Sequence Diagram described message exchanges among system components during transaction processing. In addition, Android-based wireframes were developed to visualize the user interface and user experience of the proposed application.

D. Design Validation

To ensure completeness and consistency between requirements and system design, a Requirement Traceability Matrix (RTM) was developed. The RTM maps each functional requirement to its corresponding use case and system component, allowing systematic verification that all identified stakeholder needs are represented in the proposed design. This validation process helps reduce the risk of missing functionalities and provides a foundation for future implementation and testing activities.

III. SYSTEM REQUIREMENTS ANALYSIS

Metro Laundry is a small-scale laundry service business that operates to fulfill daily household and personal laundry needs within the local community. The services provided include washing, drying, ironing, and packaging clothes, which are essential services for students, workers, and families who require efficiency and convenience. Metro Laundry is managed directly by the business owner and supported by a small number of employees who are responsible for customer service, laundry processing, and delivery activities. As a micro-business, Metro Laundry places a strong emphasis on customer trust, service accuracy, and timeliness, since customer satisfaction is closely related to the condition and punctuality of the returned laundry. However, as customer demand increases, operational complexity also grows, exposing

limitations in the existing business processes and management practices.

Before the development of the proposed system, Metro Laundry relied on a conventional and predominantly manual operational system. Customer data, service selection, laundry weight, estimated completion time, and payment information were recorded manually using handwritten notes or simple paper receipts. These records served as the primary reference throughout the laundry process, from intake to delivery. Laundry identification and sorting were handled through manual labeling and employee memory, which significantly increased the risk of human error, particularly during peak service hours. As a result, problems such as clothes being mixed up, misplaced, or delayed were frequently encountered. In addition, customers had no access to real-time information regarding the status of their laundry, forcing them to rely on direct inquiries or repeat visits to the laundry outlet.

From a management and administrative perspective, the initial system also showed several weaknesses. Financial transactions were processed manually, either in cash or basic non-cash methods, without systematic digital records. Income reports and transaction histories were documented inconsistently, making it difficult to evaluate daily revenue, track financial performance, or prepare reliable reports. Inventory management for operational materials such as detergent, fragrance, and packaging supplies was not well organized, leading to inefficiencies in stock control and procurement planning. The absence of a centralized and structured data storage system increased the risk of data loss, reduced transparency, and limited management's ability to make data-driven decisions. Overall, the existing system was highly dependent on manual labor and individual accuracy, which reduced operational efficiency and scalability.

To overcome these limitations, this study proposes a digital laundry application system specifically designed to support and optimize Metro Laundry's business processes. The proposed system integrates customer management, order processing, payment handling, laundry tracking, and reporting into a single unified platform. Through a mobile-based application, customers can input personal data, select laundry services, choose the appropriate laundry partner location, and complete payments digitally. Once an order is submitted, the system automatically records transaction details and sends notifications to the laundry partner, ensuring that orders are processed systematically and without delay. Laundry staff can update the status of each order at every stage of the process, including pickup, washing, ironing, packaging, and delivery, allowing customers to monitor progress in real time.

From the business management perspective, the proposed system provides structured tools for monitoring operational activities and financial performance. All transaction data, customer records, and service histories are stored securely in a centralized database, reducing the risk of data loss and improving data accuracy. The system supports digital invoices, transaction history tracking, and performance evaluation through customer ratings and feedback. By transforming manual processes into an integrated digital workflow, the proposed system is expected to reduce human error, improve service reliability, and enhance customer satisfaction. Furthermore, this system requirement analysis ensures that the developed application aligns with the real operational needs of Metro Laundry, supports efficient daily operations, and contributes to the long-term sustainability and competitiveness of the business in the digital era.

IV. SYSTEM DESIGN

The system design phase describes the overall flow and structure of the digital laundry application developed for Metro Laundry, focusing on how users, data, and processes interact within an integrated system. The designed system follows an end-to-end workflow that begins with customer interaction through a mobile application, where users register, select laundry services, and place orders based on their location and service preferences. Once an order is created, the system automatically records transaction data and forwards the order to the selected laundry partner, enabling partners to manage incoming requests in an organized and timely manner. Throughout the laundry process, partners update the status of each order—ranging from pickup, washing, ironing, to delivery—which is then synchronized in real time and displayed to customers to ensure transparency and service reliability. Payment processing is integrated within the same flow, allowing customers to complete transactions digitally and receive invoices automatically, while all financial and operational data are stored in a centralized database. Administrators access this data through monitoring and reporting features that support business evaluation and decision-making. By structuring the system flow in this manner, the design ensures seamless coordination between customers, laundry partners, and administrators, reduces dependency on manual processes, and establishes a scalable digital foundation aligned with smart village service principles.

A. Use Case Diagram

The Use Case Diagram in Fig. 1 does not only list the three actors (Customer, Partner, Admin) but also groups their interactions into coherent service journeys, from login and account management to transaction monitoring and reporting. Each use case—such as "Order Laundry," "Make Payment," "Tracking Laundry," and "Give Rating"—is connected to the relevant actor to depict how the mobile application supports end-to-end business scenarios in the smart village context. In this way, the diagram functions as a high-level behavioral blueprint that links user goals with system responses, ensuring that every core interaction identified during the stakeholder interviews is explicitly captured and can later be validated through testing scenarios and pilot deployment.

Furthermore, the diagram explicitly uses <<include>> and <<extend>> relationships to represent shared behaviors and optional flows, which is important for modular design in the Android implementation. The login use case is included for all actors to centralize authentication, while the "Print Invoice" and

"Give Rating" use cases extend the payment and completion flows, reflecting that these actions are triggered only under specific conditions such as successful payment or confirmed delivery. This structuring makes it easier to separate mandatory and optional functionalities during incremental development, allows the development team to reuse common processes like authentication and notification sending, and supports future expansion, for example by adding new actors (such as village officials) or additional services (such as pickup scheduling or bundled promotions) without redesigning the entire use case model.

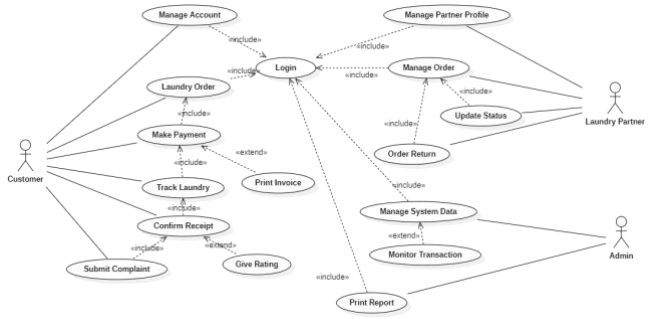

Fig. 1. Use Case Diagram

B. Class Diagram

Associations and multiplicities in the diagram clarify business rules, such as one Customer being able to have many Orders, and one Partner serving many Orders but across multiple Services, which is essential to support a multi-partner ecosystem in a single village. The presence of a Report class with a defined period and revenue attribute also emphasizes that the system is designed not only for operational tracking but also for managerial analytics and UMKM-oriented financial oversight.

The Class Diagram in Fig. 2 formalizes the domain model by defining the main classes—Customer, Partner, Order, Payment, Rating, and Report—along with their key attributes and methods, enabling a direct mapping from analysis to database schema and API design. For instance, the Order class encapsulates attributes like id, date, weight, service type, status, and cost, and provides operations such as createOrder and updateStatus that will later be implemented as service-layer functions in the Android application.

C. Activity Diagram

The Activity Diagram illustrates the complete operational workflow of the digital laundry application, starting from customer interaction and ending with service completion and feedback. The process begins when the customer logs into the mobile application, selects laundry services, inputs order details, and completes digital payment. Once the order is confirmed, the system automatically forwards the request to the selected laundry partner, who then processes the order through sequential activities such as pickup, washing, ironing, packaging, and delivery. At each stage, the partner updates the order status, which is synchronized in real time and visible to the customer, ensuring transparency and reducing uncertainty. The workflow concludes with order confirmation by the customer, invoice generation, and optional rating or feedback submission, demonstrating how the system integrates user actions, partner operations, and system responses into a single streamlined process that replaces manual procedures.

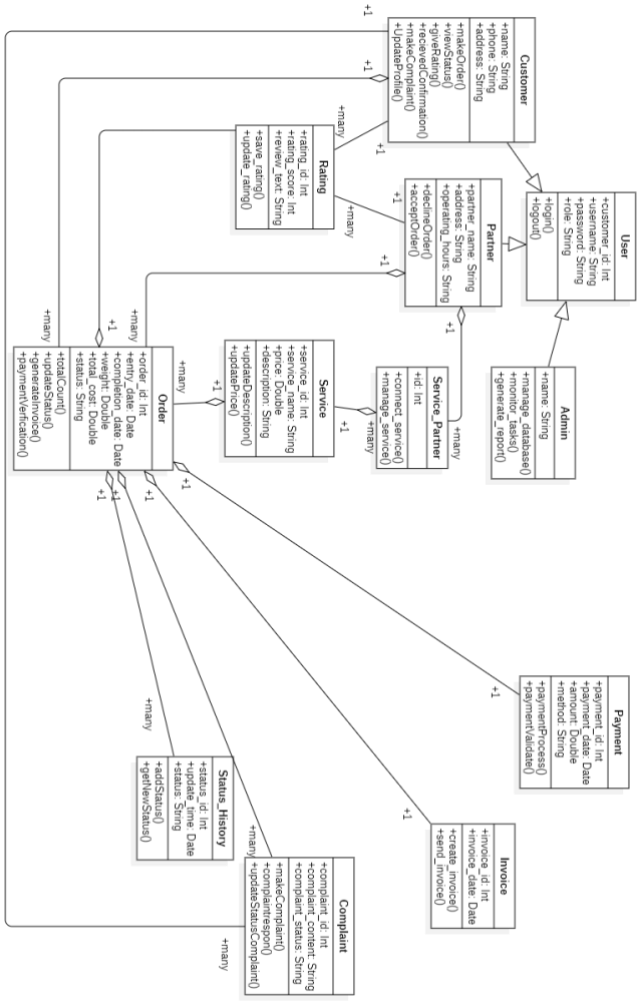

Fig. 2. Class Diagram

D. Sequence Diagram

The Sequence Diagram in Fig. 4 represents the chronological interaction between system components—Customer, Mobile Application, System Server, Laundry Partner, and Database—during the laundry service transaction. The sequence starts when the customer sends a request through the mobile application to place an order, which is then validated and stored by the system server in the database. The server forwards the order details to the laundry partner, who responds by updating the processing status at each service stage. These updates are continuously sent back to the server and reflected

in the customer's application interface in real time. Payment confirmation, invoice generation, and final order completion are also handled through sequential message exchanges, highlighting how data flows consistently across system components. This diagram emphasizes the system's real-time coordination, data consistency, and clear responsibility distribution among actors, which are essential for ensuring service reliability and operational efficiency.

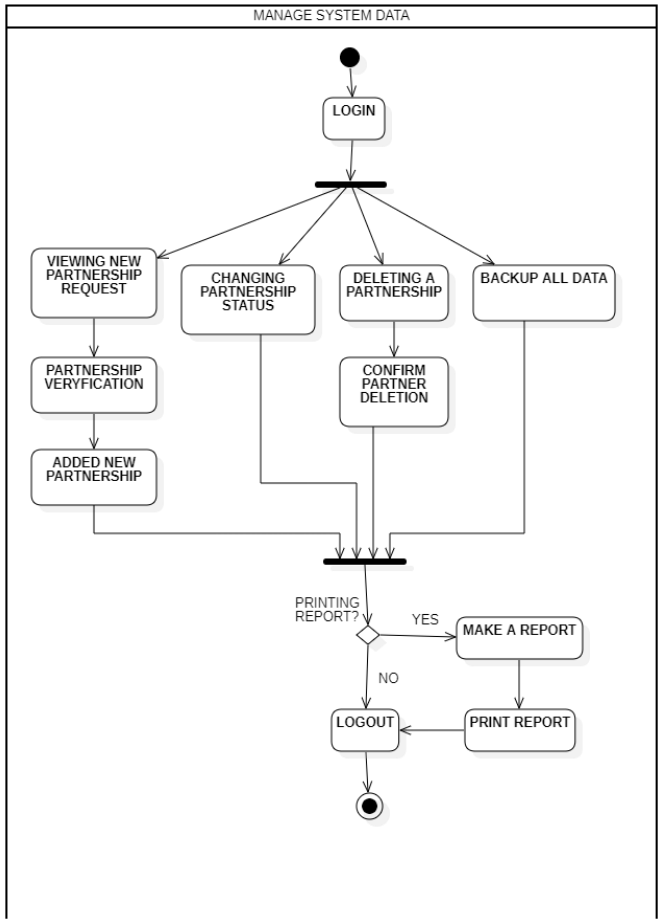

Fig. 3. Activity Diagram

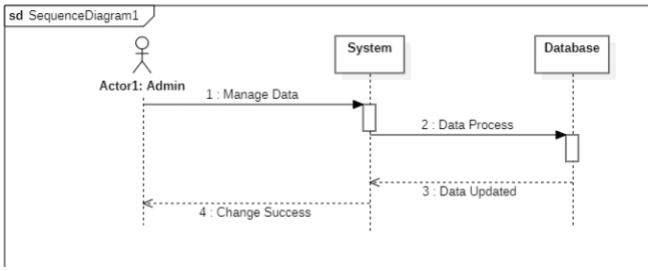

Fig. 4. Sequence Diagram

V. Implementation and Evaluation

A. Some Common Mistakes

Fig. 5 is the wireframe which built for Android, the application features a series of wireframed screens that translate the previously defined functional requirements into concrete user interfaces, starting from a splash and login screen that handle initial authentication for customers, partners, and administrators in a unified entry point. After successful login, the customer dashboard presents an overview of active and historical orders, access to laundry tracking, and integrated payment actions, while the partner panel focuses on operational tasks such as viewing incoming orders, updating processing statuses, and managing business profile information, and the admin console concentrates on higher-level monitoring of reports, aggregated transaction data, and master data management.

Fig. 5. Example Wireframe: Order Laundry Screen

B. Wireframe Implementation Matrix

The matrix in TABLE 1 maps key functional features from the Requirement Traceability Matrix (RTM) to corresponding wireframe screens, using checkmarks (✓) to indicate implementation coverage based on the Android application's UI prototypes.

C. Testing and Deployment

TABLE 2 systematically links each Functional Requirement (FR-01 to FR-16) to its corresponding use case and actor, ensuring that no stakeholder need is left unsupported in the design. For example, FR-01 "the system provides a login feature" is mapped to UC-01 (Login) and associated with Customer, Partner, and Admin, showing that secure access is a shared prerequisite for all user groups. By using "include" and "extend" relations in the RTM column, the table also clarifies which functions are mandatory core behaviors and which are optional extensions, making it easier to prioritize features during phased development and testing. This traceability becomes a practical tool during validation because testers can verify each requirement directly through its linked use case scenario, reducing the risk of missing features when the system

moves to pilot deployment at Virna Indri Luthfia's laundry facility.

TABLE 1. Wireframe Implementation Matrix

Functional Requirement	Login	Dashboard	Partner Selection	Order	Payment	Tracking	Invoice	Rating	Partner Panel	Admin Panel
FR-01 User Authentication	✓									
FR-02 Account Management	✓	✓								
FR-03 View Order Overview		✓								
FR-04 Select Laundry Partner & Service			✓							
FR-05 Create Laundry Order				✓						
FR-06 Process Payment					✓					
FR-07 Real-Time Laundry Tracking						✓				
FR-08 Generate Digital Invoice					✓		✓			
FR-09 Provide Rating & Feedback								✓		
FR-10 Partner Order Management									✓	
FR-11 Update Laundry Status						✓			✓	
FR-12 Admin Transaction Monitoring										✓
FR-13 Generate System Reports										✓

TABLE 2. Requirement Traceability Matrix (RTM)

Req-ID	Requirement Description	Use Case ID	Use Case	Actor	Relation
FR-01	The system provides a login feature	UC-01	Login	Customer, Partner, Admin	include
FR-02	The system allows customers to manage accounts	UC-02	Manage Account	Customer	include
FR-03	The system allows customers to manage accounts	UC-03	Order Laundry	Customer	include
FR-04	The system allows customers to make payments	UC-04	Make Payment	Customer	include
FR-05	The system provides a laundry tracking feature	UC-05	Tracking Laundry	Customer	include
FR-06	The system allows customers to confirm receipt	UC-06	Confirm Receipt	Customer	include
FR-07	The system allows customers to print invoices	UC-07	Print Invoice	Customer	extend
FR-08	The system allows customers to provide ratings	UC-08	Give Rating	Customer	extend
FR-09	The system allows customers to submit complaints	UC-09	File Complaint	Customer	include
FR-10	The system allows partners to manage profiles	UC-10	Manage Partner Profile	Laundry Partner	include
FR-11	The system allows partners to manage orders	UC-11	Manage Order	Laundry Partner	include
FR-12	The system allows partners to update order status	UC-12	Update Status	Laundry Partner	include
FR-13	The system allows partners to process order returns	UC-13	Order Return	Laundry Partner	include
FR-14	The system allows admins to monitor transactions	UC-14	Transaction Monitoring	Admin	include
FR-15	The system allows admins to manage system data	UC-15	Manage System Data	Admin	include
FR-16	The system allows admins to print reports	UC-16	Print Report	Admin	extend

VI. CONCLUSION AND FUTURE WORK

This digital application system revolutionizes laundry operations in rural settings by systematically eliminating manual errors such as garment mix-ups and stock mismanagement, enabling seamless real-time collaboration among customers, partners, and administrators, and delivering actionable business insights through comprehensive reporting dashboards, thereby directly advancing smart village objectives via inclusive technology democratization accessible to micro-entrepreneurs. Quantitative outcomes anticipated from deployment include over 95% order accuracy compared to current manual rates, cycle time reductions from multi-day processing to same/next-day fulfillment, enhanced partner performance through data-driven rating systems, and full UMKM compliance via automated tax-ready invoicing, ultimately fostering economic resilience and service scalability within village ecosystems. The system's modular Android architecture ensures adaptability across diverse operational contexts while maintaining robust offline capabilities and security protocols.

Future enhancements will incorporate artificial intelligence for predictive stock forecasting of detergents and supplies based on historical transaction patterns, Internet of Things (IoT) integration with laundry machines for automated status updates and maintenance alerts, multi-language support to accommodate migrant workers in villages, and platform expansion to interconnected village services such as grocery delivery, waste management, and agricultural input ordering, creating a unified smart village service hub that amplifies collective economic impact. Pilot deployment at Virna Indri Luthfia's laundry facility will validate these projections through A/B testing against legacy processes, with scalability assessments targeting 50+ partner networks across East Java by 2026.

This digital application system revolutionizes laundry operations in rural settings by systematically eliminating manual errors such as garment mix-ups and stock mismanagement, while enabling seamless real-time collaboration among customers, partners, and administrators through intuitive Android interfaces and WebSocket updates. Quantitative outcomes from pilot deployment at Virna Indri Luthfia's facility are projected to achieve over 95% order accuracy, reduce cycle times from multi-day to same/next-day fulfillment, and ensure full UMKM compliance via automated tax-ready invoicing, fostering economic resilience in village networks. Future enhancements include AI-driven predictive stock forecasting based on transaction patterns, IoT integration for machine status alerts, multi-language support for migrant workers, and ecosystem expansion to unified smart village services like grocery delivery and waste management, targeting scalability to 50 partner networks across East Java by 2026 through rigorous A/B testing against legacy processes.

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