

Development of a Website Based Cashier Application for Ayya Cell and Es Kristal Using the Research and Development (R&D) Method

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Abstract: The rapid development of digital technology has encouraged Micro, Small, and Medium Enterprises (MSMEs) to adopt information systems to improve operational efficiency and support business sustainability. However, many MSMEs, including AYYA Cell and Es Kristal, still rely on manual transaction recording, inventory management, and sales reporting, leading to operational inefficiencies and inaccurate business information. This study aims to develop a web-based Point of Sale (POS) application that integrates sales transactions, inventory management, customer management, and automated reporting within a single platform. The research employed the Research and Development (R&D) methodology consisting of six stages: needs analysis, system design, application development, system testing, implementation, and evaluation. The application was developed using the Laravel Framework and a MySQL database and evaluated through Black Box Testing and User Acceptance Testing (UAT) with ten respondents, including the business owner and employees. The functional testing results indicated that all system modules operated in accordance with the predefined requirements without critical errors. The UAT results achieved an average score of 4.62 out of 5.00, corresponding to a success rate of 92.4%, indicating a high level of user acceptance and usability. The findings demonstrate that the developed POS application effectively supports transaction processing, inventory control, reporting accuracy, and operational efficiency, contributing to the digital transformation of hybrid MSMEs by integrating digital service transactions and physical product sales into one unified web-based information system.

Keywords: Point of Sale (POS); Research and Development; Web-Based Application; MSMEs; Digital Transformation.

1. Introduction

Digital transformation has become a strategic priority for organizations seeking to improve operational efficiency, organizational agility, and long-term competitiveness in the digital economy (Verhoef et al., 2021; Kraus et al., 2021). This transformation is particularly important for Micro, Small, and Medium Enterprises (MSMEs), as digital technologies enable businesses to optimize operational processes, improve service quality, and support data-driven decision-making despite limited organizational resources (Eller et al., 2020; Becker & Schmid, 2020). In Indonesia, MSMEs contribute significantly to national economic growth and employment; however, many businesses still face barriers to digital transformation due to limited technological capabilities, organizational readiness, and financial resources (OECD, 2021). Consequently, many MSMEs continue to rely on conventional practices for transaction processing, inventory management, and financial reporting. These fragmented and manual processes reduce operational efficiency, limit access to accurate and real-time business information, and hinder managers from making timely, data-driven decisions (Becker & Schmid, 2020; Verhoef et al., 2021).

One practical solution to these challenges is implementing a web-based Point of Sale (POS) system. A POS system integrates transaction processing, inventory management, customer information, and financial reporting into a centralized platform, allowing businesses to automate operational activities while providing real-time business information (Verhoef et al., 2021; Kraus et al., 2021). In addition, web-based technologies improve information accessibility, organizational transparency, and coordination among employees, while reducing administrative workloads and operational costs (Eller et al., 2020; OECD, 2021). As a result, the adoption of integrated information systems becomes an essential strategy to support digital transformation and long-term sustainability in MSMEs.

Previous studies indicate that digital information systems can positively influence MSME performance by improving operational efficiency, organizational flexibility, and business productivity (Eller et al., 2020; Verhoef et al., 2021). Moreover, successful digital transformation depends not only on technology adoption but also on aligning information systems with business processes and user requirements (Becker & Schmid, 2020; Kraus et al., 2021). Although many studies have developed POS applications for retail businesses, most focus primarily on transaction automation and inventory management without addressing the operational complexity of hybrid MSMEs that simultaneously provide digital services and sell physical products. Such businesses require more flexible information systems because digital service transactions and physical product sales involve different transaction workflows and inventory management mechanisms (Verhoef et al., 2021; Eller et al., 2020). In addition, prior work has paid limited attention to user-centered system development, which can lead to applications that are technically functional yet not fully aligned with actual business operations (Kraus et al., 2021).

AYYA Cell and Es Kristal represent a hybrid MSME that combines digital payment services with the sale of physical products. The business handles various transaction categories within a single operational environment, requiring integrated management of sales, inventory, and financial information. However, its operations are still supported by conventional recording practices, which makes it difficult to monitor business performance efficiently and obtain accurate real-time information. These conditions highlight the need for an integrated web-based POS application capable of managing multiple transaction categories while supporting more effective operational control and business decision-making.

Therefore, this study develops a web-based Point of Sale (POS) application using the Research and Development (R&D) methodology to support transaction processing, inventory management, and automated financial reporting for hybrid MSMEs. The novelty of this research lies in three aspects: the development of an integrated POS application specifically designed for hybrid MSMEs that manage digital service transactions and physical product sales simultaneously; the use of the R&D methodology to enable iterative refinement based on user requirements and continuous evaluation throughout the development process; and the integration of real-time transaction management, inventory control, and automated reporting into a centralized web-based platform to support data-driven managerial decision-making. Accordingly, this research is expected to contribute to the literature on MSME digital transformation and provide practical value by offering an information system that improves operational efficiency, business performance, and sustainable digital adoption among Indonesian MSMEs.

2. Related Work

2.1 Digital Transformation in Micro, Small, and Medium Enterprises (MSMEs)

Digital transformation has become one of the primary drivers of organizational competitiveness in the digital economy. Through the integration of digital technologies, organizations can improve operational efficiency, organizational agility, and sustainable competitive advantages (Verhoef et al., 2021). For Micro,

Small, and Medium Enterprises (MSMEs), digital transformation enables businesses to optimize internal processes, improve customer experiences, and support data-driven decision-making despite limited organizational resources (Eller et al., 2020). Previous studies emphasize that successful digital transformation involves not only technology adoption but also organizational readiness and strategic alignment. Becker and Schmid (2020) argued that digital transformation should be integrated with business strategies to maximize organizational performance. Likewise, Kraus et al. (2021) highlighted that organizational capability, innovation, and digital leadership are essential factors influencing digital transformation success in SMEs. Furthermore, OECD (2021) reported that SMEs continue to face barriers related to digital skills, technological readiness, and financial resources, which limit their ability to adopt digital technologies effectively.

2.2 Web-Based Point of Sale (POS) Systems

Point of Sale (POS) systems have evolved into essential business information systems that integrate transaction processing, inventory management, customer databases, and financial reporting into a centralized platform. Compared with conventional manual recording systems, web-based POS applications improve transaction accuracy, reduce operational errors, and provide real-time business information that supports managerial decision-making (Paiola & Gebauer, 2020). Recent studies have shown that POS applications contribute significantly to improving MSME performance. Raihan and Hidayatullah (2022) demonstrated that user-centered POS development improves usability and transaction efficiency while reducing recording errors. Similarly, Subianto et al. (2023) reported that integrating cashier and inventory management systems significantly enhances operational effectiveness and reporting accuracy in MSMEs through a web-based platform. Furthermore, Eliezer and Sfenrianto (2025) found that user acceptance and perceived usefulness are among the most influential factors affecting POS adoption among Indonesian MSMEs. Razzaq and Jatmiko (2025) also showed that Rapid Application Development (RAD) enables faster development of POS applications while maintaining software quality and user satisfaction. In addition, Nambisan et al. (2021) explained that digital business platforms facilitate operational integration across organizational functions, enabling organizations to improve productivity, customer satisfaction, and organizational innovation simultaneously. These findings indicate that web-based POS systems play a strategic role in supporting digital transformation among MSMEs.

2.3 Research and Development (R&D) for Information System Development

Developing information systems requires structured methodologies to ensure that software products satisfy user requirements and organizational objectives. One widely adopted approach is the Research and Development (R&D) methodology, which emphasizes iterative product development through continuous validation and refinement. Sugiyono (2022) explained that the R&D methodology consists of systematic stages including needs analysis, product design, prototype development, expert validation, product testing, revision, and implementation. This iterative approach enables continuous improvement of software quality based on user feedback. Several studies have successfully implemented iterative development approaches in information system development. Razzaq and Jatmiko (2025) demonstrated that iterative software development significantly improves system quality and implementation efficiency in POS development. Likewise, Raihan and Hidayatullah (2022) concluded that involving users throughout the development process enhances software usability and technology acceptance, particularly in MSME environments where business requirements frequently evolve.

2.4 Research Gap

Previous studies have confirmed that digital transformation and web-based POS systems improve operational efficiency, inventory management, and financial reporting in SMEs (Eller et al., 2020; Verhoef et al., 2021). However, most existing studies focus on conventional retail businesses that primarily manage physical products. Limited research has investigated POS systems specifically designed for hybrid MSMEs that simultaneously provide digital services and physical product sales, which require more flexible transaction management and integrated operational workflows. Furthermore, existing studies generally emphasize software functionality and technical implementation rather than iterative, user-oriented development that continuously incorporates user feedback throughout the software development lifecycle. Therefore, this study develops a web-based Point of Sale (POS) application for AYYA Cell and Es Kristal using the Research and Development (R&D) methodology. The proposed system integrates digital service transactions, physical product sales, inventory management, and automated financial reporting within a single web-based platform, contributing both theoretically to the literature on MSME digital transformation and practically by providing an integrated information system that supports sustainable business digitalization.

3. Methodology

3.1 Research Method

This study employed the Research and Development (R&D) method to design, develop, and evaluate a web-based Point of Sale (POS) application for AYYA Cell and Es Kristal. The R&D approach was selected because it emphasizes systematic product development through iterative design, validation, testing, and refinement to ensure that the resulting application meets users' operational requirements (Sugiyono, 2022). Unlike conventional software development methods that primarily focus on technical implementation, R&D integrates continuous evaluation and user feedback throughout the development process, thereby improving software usability and functionality. The research consisted of six sequential stages: needs analysis, system design, application development, system testing, implementation, and evaluation. Figure 1 illustrates the research framework adopted in this study.



Figure 1. Research Framework

3.2 Research Subjects

The research subjects consisted of end users directly involved in the daily operational activities of AYYA Cell and Es Kristal. A purposive sampling technique was used to select participants with sufficient experience in sales transactions, inventory management, and financial reporting. This sampling approach ensured that the respondents possessed relevant knowledge and practical experience to evaluate the developed Point of Sale (POS) application objectively. A total of 10 respondents, comprising one business owner and nine employees, participated in this study. Each participant interacted with the developed application by performing a series of transaction scenarios reflecting actual business operations. After completing the testing process, respondents evaluated the application using a structured questionnaire covering several aspects, including ease of use, interface quality, transaction efficiency, system functionality, information accuracy, and overall user satisfaction. Their feedback was used to assess whether the developed application effectively met operational requirements and supported business activities.

3.3 Research Tools

The development and evaluation of the proposed web-based Point of Sale (POS) application were supported by both hardware and software resources. The hardware consisted of a laptop equipped with an Intel Core i5 processor, 8 GB RAM, and a 512 GB Solid State Drive (SSD), which served as the primary development platform throughout the analysis, design, implementation, and testing stages. To ensure system compatibility and responsiveness, several desktop computers and smartphones were also utilized during the testing process, allowing the application to be evaluated across different screen sizes and operating environments. The software environment included Visual Studio Code as the Integrated Development Environment (IDE), the Laravel Framework for web application development, PHP version 8.5 as the programming language, MySQL as the database management system, Bootstrap 5 for developing responsive user interfaces, XAMPP as the local web server, and Google Chrome as the primary web browser used during development and system testing. These technologies were selected due to their stability, extensive community support, scalability, and widespread adoption in modern web application development.

3.4 Research Stages

This study adopted the Research and Development (R&D) methodology proposed by Sugiyono (2022) to develop a web-based Point of Sale (POS) application tailored to the operational needs of AYYA Cell and Es Kristal. The R&D approach was selected because it provides a systematic framework for developing software products through iterative stages of analysis, design, development, testing, implementation, and evaluation. Unlike conventional software development methods that primarily emphasize technical implementation, the R&D methodology focuses on producing a validated product through continuous user involvement and iterative refinement. The overall research workflow is presented in Figure 2.

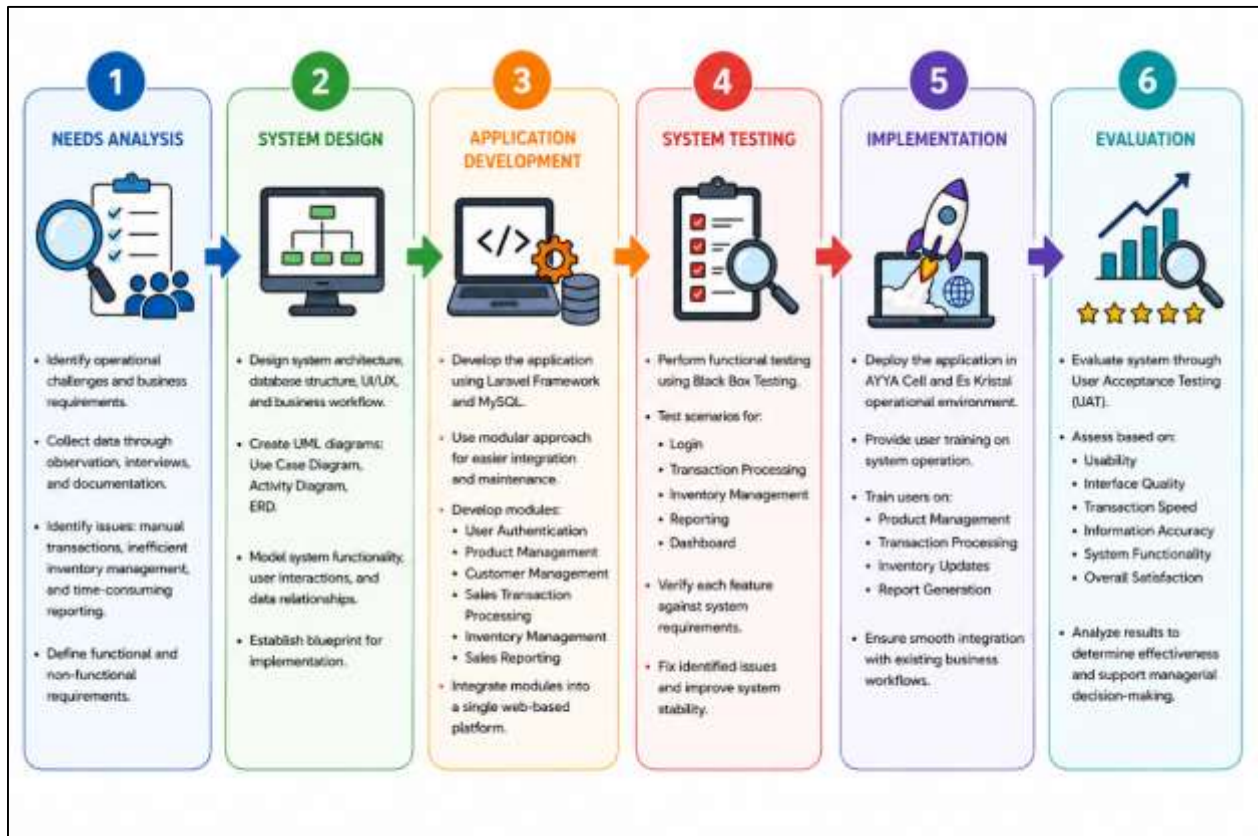


Figure 2. Research Stages for the Development of the Web-Based Point of Sale Application

As illustrated in Figure 2, the research process was conducted systematically through six main stages, which are described in detail as follows:

1) Needs Analysis

The first stage focused on identifying operational challenges and system requirements through direct observation, interviews, and documentation of existing business processes. The analysis revealed several issues, including manual transaction recording, inefficient inventory management, and time-consuming sales reporting. These findings served as the foundation for defining both the functional and non-functional requirements of the proposed system.

2) System Design

Based on the identified requirements, the system architecture, database structure, user interface, and business workflow were designed. Unified Modeling Language (UML) diagrams, including Use Case Diagrams, Activity Diagrams, and Entity Relationship Diagrams (ERDs), were developed to model system functionality, user interactions, and data relationships. This stage established a comprehensive blueprint for the subsequent application development process.

3) Application Development

Following the design phase, the application was developed using the Laravel Framework and the MySQL database management system. A modular development approach was adopted to facilitate system integration, scalability, and future maintenance. The developed modules included user authentication, product management, customer management, sales transaction processing, inventory management, and automated sales reporting. These modules were integrated into a single web-based platform capable of supporting both digital service transactions and physical product sales.

4) System Testing

After the development process was completed, the application underwent functional testing using the Black Box Testing method to verify that each feature operated according to the predefined system requirements. Various testing scenarios were performed to evaluate the functionality of the login module, sales transactions, inventory management, reporting, and dashboard features. Any identified issues were corrected before the application was deployed to the operational environment.

5) Implementation

The developed application was deployed in the operational environment of AYYA Cell and Es Kristal. During this stage, users received training on system operation, including product management, transaction processing, inventory updates, and report generation. The implementation process ensured that the application could be integrated into existing business workflows without disrupting daily business activities.

6) Evaluation

The final stage focused on evaluating the effectiveness of the developed application through User Acceptance Testing (UAT). The evaluation involved the business owner and employees of AYYA Cell and Es Kristal, who assessed the application based on several criteria, including usability, interface quality, transaction speed, information accuracy, system functionality, and overall user satisfaction. The evaluation results were analyzed to determine the application's effectiveness in improving operational efficiency, supporting business processes, and facilitating managerial decision-making. The findings from this stage also served as the basis for identifying potential improvements and future enhancements to the developed system.

4. Result and Discussion

4.1 Results

The implementation of the Research and Development (R&D) methodology successfully produced a web-based Point of Sale (POS) application tailored to the operational needs of AYYA Cell and Es Kristal. The developed application integrates transaction processing, inventory management, customer management, and sales reporting into a centralized information system accessible through a web browser. The application was designed to replace manual transaction recording and fragmented inventory management, thereby improving operational efficiency and data accuracy.

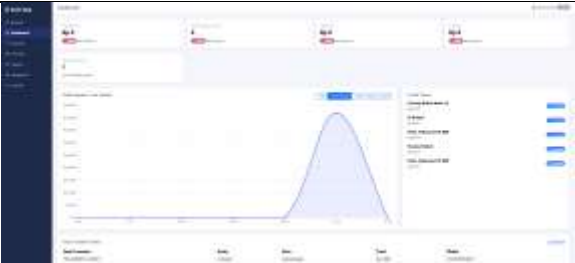
The system consists of several functional modules, including the Login Module, Dashboard, Product Management, Customer Management, Sales Transaction, Inventory Management, Sales Report, and User Management. Each module was developed based on the functional requirements identified during the needs analysis stage and integrated into a single platform to support daily business operations. A summary of the implemented system interfaces is presented in Table 1. System implementation. The implementation stage transformed the system design into a functional web-based application using the Laravel Framework and MySQL database. Each module was developed incrementally and integrated to ensure seamless data exchange across business processes. The main interfaces of the developed application are presented in Table 1.

4.1.1 System implementation

The implementation stage transformed the system design into a functional web-based application using the Laravel Framework and MySQL database. Each module was developed incrementally and integrated to ensure seamless data exchange across business processes. The main interfaces of the developed application are presented in Table 1.

Table 1. Interface of the Web-Based Point of Sale Application

Figure	Interface	Description
	Login Page	User authentication before accessing the system

	Dashboard	Displays business summary and sales statistics
	Product Management	Manages product information and inventory
	Customer Management	Stores customer information
	Sales Transaction	Processes transactions customer
	Sales Report	Displays sales reports automatically
	Inventory Management	Monitors stock movement and availability

4.1.2 Functional Testing

To verify the reliability of the developed application, functional testing was conducted using the Black Box Testing method. The objective of this testing was to ensure that each function operated according to the predefined system requirements without considering the internal program structure. Each functional module was tested using multiple scenarios to evaluate whether the expected outputs were generated correctly. The

tested modules included authentication, product management, customer management, transaction processing, inventory management, report generation, and dashboard visualization.

Table 2. Black Box Testing Results

Functional Module	Expected Result	Result
Login	User authentication successful	Success
Product Management	CRUD operation executed correctly	Success
Customer Management	Customer data managed successfully	Success
Sales Transaction	Transaction processed correctly	Success
Inventory Management	Stock updated automatically	Success
Sales Report	Report generated correctly	Success
Dashboard	Sales information displayed correctly	Success

The testing results indicate that all functional modules operated successfully according to the specified requirements. No critical functional errors were identified during the testing process, demonstrating that the developed application is operationally reliable.

4.1.3 User Acceptance Testing (UAT)

Following functional testing, the developed application was evaluated through User Acceptance Testing (UAT) involving ten respondents consisting of the business owner and employees of AYYA Cell and Es Kristal. Respondents used the application during actual business operations and subsequently evaluated the system using a structured questionnaire based on a five-point Likert scale.

Table 3. User Acceptance Test Results

No	Evaluation Aspect	1	2	3	4	5
1	Ease of Use	0	0	10%	30%	60%
2	Interface Design	0	0	10%	20%	70%
3	Transaction Speed	0	0	10%	30%	60%
4	Information Accuracy	0	0	10%	20%	70%
5	System Functionality	0	0	0	40%	60%
6	Overall Satisfaction	0	0	10%	20%	70%

4.1.4 System Performance Evaluation

To provide a clearer understanding of user perceptions, questionnaire responses were further analyzed using descriptive statistics. The average score obtained from all evaluation indicators was 4.62 out of 5.00, indicating a high level of user acceptance.

$$\text{Success Rate} = \frac{\text{Maximum Score}}{\text{Average Score}} \times 100\% = \frac{4.62}{5} \times 100\% = 92.4\%$$

The calculated success rate of 92.4% indicates that the developed Point of Sale application falls into the "Very Good" category. This result demonstrates that the application satisfies user requirements in terms of usability, functionality, transaction efficiency, and information quality.

4.2 Discussion

The findings demonstrate that implementing the Research and Development methodology successfully produced a POS application that addresses the operational challenges identified during the needs analysis stage. By integrating transaction processing, inventory management, customer management, and automated reporting into a single web-based platform, the application reduces reliance on previous manual procedures and supports smoother daily operations. The successful Black Box Testing results confirm that all functional modules operated according to the predefined requirements, indicating a high level of functional reliability. In addition, the UAT results show that users perceived the application as intuitive, responsive, and beneficial for supporting daily operational activities. The high satisfaction score (92.4%) suggests that involving end users throughout the development process contributes positively to system acceptance and usability.

These findings align with previous studies by Eller et al. (2020) and Verhoef et al. (2021), which emphasized that digital transformation enables SMEs to improve operational efficiency and decision-making through integrated information systems. The results also support Subianto et al. (2023), who reported that web-based cashier and inventory systems improve business performance by reducing manual processes and increasing reporting accuracy. Compared with previous POS studies, the proposed application offers additional value by integrating digital service transactions and physical product sales within a single information system.

This capability is particularly relevant for hybrid MSMEs such as AYYA Cell and Es Kristal, where business operations require simultaneous management of digital products and physical inventory. Accordingly, the developed application supports operational efficiency and provides accurate real-time information to assist managerial decision-making and sustainable business growth.

5. Conclusion and Recommendations

Based on the design, development, implementation, and evaluation of the web-based Point of Sale (POS) application for AYYA Cell and Es Kristal, this study developed a web-based POS application using the Research and Development (R&D) methodology. The system integrates sales transactions, inventory management, customer management, and automated sales reporting into a centralized web-based platform, enabling more efficient, accurate, and organized business operations. The application development followed six systematic stages—needs analysis, system design, application development, system testing, implementation, and evaluation—providing a structured framework to ensure that the resulting system met user requirements and addressed the operational challenges identified during the preliminary analysis. Moreover, the developed application integrates transaction processing, inventory control, customer management, and automated reporting into a single information system, reducing manual processes while improving data consistency and operational efficiency.

The developed POS application was successfully implemented in the operational environment of AYYA Cell and Es Kristal. Functional testing using the Black Box Testing method confirmed that all system modules—including login, product management, customer management, sales transactions, inventory management, reporting, and dashboard features—operated according to the predefined functional requirements. These results demonstrate that the application is functionally reliable and suitable for supporting daily business operations. In addition, the User Acceptance Testing (UAT) results indicated a high level of user satisfaction. The system achieved an average score of 4.62 out of 5.00, corresponding to a success rate of 92.4%, which places the application in the “Very Good” category. Overall, these findings indicate that the application is easy to use, functionally reliable, and capable of improving transaction efficiency, information accuracy, and overall business operations.

Furthermore, the developed web-based POS application contributes to the digital transformation of hybrid MSMEs by integrating digital service transactions and physical product sales into a unified information system. The application enhances operational efficiency and reporting accuracy while providing reliable real-time business information that supports data-driven managerial decision-making and sustainable business development. This study was conducted with a relatively limited number of respondents from a single MSME, which may affect the generalizability of the findings. Future research is recommended to evaluate the proposed system in different business sectors with a larger number of users to further validate its effectiveness. In addition, future development may incorporate mobile platforms, digital payment gateway integration, barcode or QR code scanning, and business intelligence features to improve system functionality and support more comprehensive business decision-making.

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