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REVOLUTIONIZING GYM MANAGEMENT: A QR-ENABLED CASHLESS SYSTEM FOR SMARTER PAYMENTS AND TRACKING

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ABSTRACT

Aim/Purpose	The aim of this study is to develop and evaluate the King's Way Cashless Payment and Product Monitoring System with QR Technology, specifically designed for the fitness industry. The system seeks to enhance operational efficiency, strengthen transaction security, and provide a seamless experience for gym members and administrators through digital transformation. Its novelty lies in the integration of QR-based transactions with automated membership and product monitoring features within a unified platform, a combination not yet widely adopted in small and medium-sized fitness enterprises.
Background	With the rapid rise of digital payment technologies, the shift toward cashless transactions has become indispensable for modern businesses. The fitness industry, characterized by frequent transactions and dynamic membership management, continues to struggle with inefficiencies caused by manual payment

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	and record-keeping systems. These traditional processes are prone to delays, errors, and data security vulnerabilities, underscoring the need for an integrated digital solution tailored to the operational structure of fitness centers.
Methodology	The system was developed using the Agile methodology, ensuring iterative development, integration of user feedback, and adaptability throughout the process. The testing phase involved 50 participants, including gym members and staff from King's Way Fitness Center in Nueva Ecija, Philippines. The prototype's core functionalities, QR-based payment processing, automated membership tracking, and real-time product sales monitoring were evaluated through controlled performance tests. Data were collected using the System Usability Scale (SUS) and time-efficiency measurements. The Technology Acceptance Model (TAM) was applied to assess perceived usefulness, ease of use, and user acceptance.
Contribution	This study provides a validated prototype that demonstrates the feasibility and effectiveness of integrating QR technology into gym operations. It distinguishes itself by combining cashless payment, membership management, and inventory tracking into a single, interactive system. The research also contributes empirical data on user acceptance and operational impact, offering a benchmark for future digitalization initiatives in the fitness sector.
Findings	Performance evaluation revealed significant efficiency and accuracy improvements over manual systems, including the following: 80% reduction in average transaction time, 95% accuracy rate in financial and inventory tracking, and 88/100 mean SUS usability score. Statistical analysis confirmed that the digital system significantly improved transaction speed, reduced administrative workload, and enhanced data security compared to traditional methods ($p < 0.05$).
Recommendations for Practitioners	Fitness centers and similar service-based enterprises are encouraged to adopt integrated digital systems combining payment, monitoring, and tracking features. Emphasizing real-time data visibility and user-friendly interfaces can lead to improved customer satisfaction, operational transparency, and streamlined business management.
Recommendations for Researchers	Future researchers should explore cross-industry applications of QR-based management systems and analyze how demographic factors influence user adoption. Longitudinal studies are also recommended to assess the sustained effects of system implementation on business performance, customer loyalty, and profitability.
Impact on Society	The study supports the broader shift toward cashless, contactless payment solutions, promoting digital inclusion and operational transparency. By minimizing human error and physical cash handling, the system contributes to both public health safety and the digital advancement of small to medium enterprises in developing regions.
Future Research	Subsequent system iterations will explore the integration of biometric authentication, AI-driven analytics for customer behavior insights, and multi-branch scalability. Further studies will assess user acceptance of these advanced features and their contribution to long-term business resilience and innovation in the fitness industry.

Keywords cashless transactions, QR technology, gym management system

INTRODUCTION

The digital revolution has transformed how businesses manage financial transactions and operations, with the fitness industry being no exception. Traditionally, fitness centers relied on manual processes for membership management, payments, and inventory tracking practices that often result in inefficiencies, inaccuracies, and poor service delivery. Recent research also highlights that technological change is reshaping operational models in the fitness sector, pushing organizations to innovate and adapt to digital transformation trends (Cecere & Bernardi, 2023). As consumers increasingly demand faster, more secure, and more convenient digital experiences, fitness centers face growing pressure to modernize their systems and adopt cashless solutions that ensure both operational efficiency and customer satisfaction (Putrevu & Mertzanis, 2024).

The COVID-19 pandemic further accelerated the adoption of cashless and contactless payment technologies, highlighting the urgent need for digital transformation in service-based industries (Mansour, 2022). Recent analyses also show that contactless payments have become a dominant post-pandemic trend, fundamentally reshaping consumer expectations for safety and convenience (Harshavarthini, 2024) Despite this shift, many fitness centers particularly small and medium-sized ones still operate through fragmented systems that handle payments, memberships, and inventory separately. This gap reveals an unmet need for an integrated platform that combines financial transactions and product monitoring within a single, user-friendly system.

In this study, Product Monitoring refers to the systematic digital tracking of fitness-related items (e.g., supplements, equipment, and apparel) sold or used within a gym facility. Such monitoring supports real-time inventory control, minimizes human error, and ensures transparency in both financial and product management. Barbosa et al. (2022) emphasize that fitness center apps can enhance operational efficiency and customer satisfaction by providing tailored digital solutions that address the specific needs of gym facilities. Similarly, Yakean (2020) notes that cashless systems can improve transaction accuracy and reduce administrative errors, highlighting the benefits of integrating financial and product monitoring digitally. Existing digital payment platforms are often too generalized and fail to cater to the unique operational demands of fitness centers.

To address this gap, the present study develops and evaluates the King's Way Cashless Payment and Product Monitoring System with QR Technology, a web-based solution designed to unify cashless transactions, membership tracking, and product inventory management in one platform. As noted by Ibrahim et al. (2024), the growing societal preference for cashless transactions highlights the importance of adopting digital payment solutions that are efficient, secure, and user-friendly. The system's novelty lies in its targeted application of QR-based technology to automate core gym processes, reducing administrative burden, improving data accuracy, and enhancing user experience.

The study is guided by a central research question that seeks to determine how a QR-based Cashless Payment and Product Monitoring System can improve operational efficiency, enhance transaction security, and elevate user satisfaction within a fitness center setting. This question directs the investigation toward assessing the system's ability to address the limitations of manual processes, optimize administrative tasks, and deliver a more seamless and secure experience for both gym members and administrators. This focus aligns with findings by Freitas and Lacerda (2019), who emphasize that efficiency, reliability, and service quality are among the most critical attributes influencing user satisfaction in fitness centers. Moreover, Mezoh and Zhou (2024) highlight that cashless payment systems contribute to faster transactions, improved financial security, and enhanced overall user experience, reinforcing the value of digital solutions in service-oriented environments.

Grounded in the Technology Acceptance Model (TAM) and implemented using the Agile Development Framework, the research emphasizes iterative testing, usability evaluation, and the integration

of continuous user feedback. The system's performance is assessed in terms of usability, transaction time, and accuracy, providing empirical evidence of its practical value.

By integrating cashless payment and real-time monitoring functions into a single, gym-specific system, this research makes both a theoretical and practical contribution. It extends current understanding of digital transformation in service industries by presenting a tailored technological solution for fitness management. The study also demonstrates how usability-driven system design and QR-based innovation can serve as a blueprint for other small to medium enterprises seeking to transition toward secure, efficient, and data-driven digital operations.

LITERATURE REVIEW

QR ADOPTION, BARRIERS, AND SCALABILITY

Adoption of QRIS as a Digital Payment Mode in the Culinary Subsector: A Conceptual Framework Study. This study examines the adoption of the Quick Response Code Indonesian Standard (QRIS) among micro, small, and medium enterprises (MSMEs) in the culinary sector. It identifies adoption factors, including performance expectancy, effort expectancy, relative advantage, perceived risk, and facilitating conditions. The authors report that infrastructure limitations, equipment costs, and inconsistent internet connectivity hinder successful implementation (Nurqamarani et al., 2023).

The findings highlight similar technological and operational barriers that may affect fitness centers, particularly smaller establishments. Addressing these constraints is crucial to ensure the reliability and scalability of the QR-based cashless payment and Product Monitoring System proposed in this study.

Determinants of QRIS Usage Decisions in Culinary MSMEs Using the TAM Model. Rachman et al. (2025) apply the Technology Acceptance Model (TAM) to analyze QRIS adoption among culinary MSMEs in Medan City, Indonesia. Results reveal that perceived usefulness and ease of use significantly influence the decision to adopt QR-based systems, while perceived security has a lesser effect in this context.

The results validate the use of TAM as a suitable theoretical framework for assessing user acceptance in the present study. However, in the fitness industry, additional factors such as product monitoring accuracy, transaction reliability, and system responsiveness must also be considered, expanding the TAM constructs to fit the gym management context.

FAILURES, RISKS, AND CHALLENGES IN QR AND DIGITAL PAYMENT SYSTEMS

QR code payment: challenges and barriers to adoption

This conceptual paper explores common challenges in implementing QR-based payment systems globally. It discusses issues such as fraudulent QR codes, inconsistent network infrastructure, lack of standardization, and limited user awareness, which collectively hinder system adoption and trust (Sabli et al., 2025).

The study underscores the importance of system reliability and user confidence, both of which are central to the QR-based cashless system being developed. The current study integrates enhanced data security protocols and real-time monitoring to mitigate the risk factors identified in earlier works.

Top 5 merchant pain points solved by Razorpay QR Stack

A white paper from Razorpay (2024) outlines the primary difficulties merchants encounter with QR transactions, including payment failures, settlement delays, reconciliation complexity, and limited scalability during high transaction volumes.

These insights inform the design of the present system's real-time financial tracking and product monitoring features. By ensuring seamless reconciliation and data accuracy, the system aims to address the scalability and transaction reliability concerns identified in prior research.

QR Applications in Gym and Fitness Center Contexts

Optimization of gym check-in and membership information system QR code scanner-based.

Badriah and Veri Shandy (2024) introduce a QR-based system that streamlines gym check-in procedures and membership administration. Their study demonstrates how QR scanners reduce manual log entries and improve attendance tracking and customer convenience.

While the cited system effectively optimizes membership processes, it lacks integration with sales and product tracking functions. The current study builds upon this foundation by extending QR functionality to include financial and inventory monitoring components, thereby creating a more comprehensive gym management solution.

Development of Olympic Fitness Gym management system with integrated QR code technology

Villanueva et al. (2025) designed a QR-integrated management system for a gym in Tacloban City, aiming to automate attendance, membership renewal, and sales tracking. Their results indicate improved efficiency and user satisfaction following the adoption of the system.

The study demonstrates the applicability of QR-based solutions in gym operations; however, it does not extensively address inventory management and system evaluation using usability metrics. The present research advances this line of inquiry by incorporating product monitoring and employing empirical evaluation through usability testing and performance assessment.

Synthesize

Existing literature reveals several critical gaps. First, limited studies address product monitoring and inventory integration within fitness centers, as most QR applications focus primarily on check-in or membership renewal. Second, the scalability and reliability of such systems under high transaction volumes remain underexplored. Third, failure cases and security vulnerabilities in gym-related QR systems are seldom documented.

Fourth, while the Technology Acceptance Model provides a foundational lens for examining user perception, additional determinants such as technological infrastructure, risk perception, and system responsiveness warrant investigation. Lastly, empirical studies focusing on small to medium-sized fitness enterprises, particularly in developing regions, are scarce.

The current study responds to these gaps by developing and evaluating a QR-based Cashless Payment and Product Monitoring System specifically designed for gym management. Through the integration of usability-driven system design, real-time monitoring, and secure transaction processing, the study offers both a practical solution and a theoretical contribution to digital transformation research within the service industry.

METHODOLOGY

The study employed a Descriptive Developmental Research Design, aiming to systematically design, develop, and evaluate a QR-based Cashless Payment and Product Monitoring System for King's Way Fitness Gym in General Tinio, Nueva Ecija. This approach enabled both the descriptive assessment of current gym management practices and the development of the system creation and testing process. The research was guided by the Agile Scrum framework to ensure iterative progress, flexibility, and user-centered feedback throughout system implementation.

Sampling and Respondents

A purposive sampling technique was used to select participants who were directly involved in gym operations and system use. The sample consisted of 50 respondents, including the gym owner, administrative staff, and active members. This sample size was deemed sufficient for usability and performance testing, as recommended in small-scale system evaluations (Sauro & Lewis, 2016). Demographic data, including age, gender, membership type, and digital payment experience, were collected to understand better the user profile and its potential influence on technology acceptance.

Data Collection and Instruments

Data collection combined both quantitative and qualitative approaches. The primary instrument was the System Usability Scale (SUS), a standardized 10-item questionnaire used to assess system usability and perceived ease of use. In parallel, the Technology Acceptance Model (TAM) constructs Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) were operationalized through a structured survey containing five-point Likert-scale items adapted from validated TAM instruments (Davis, 1989; Venkatesh & Bala, 2008).

Complementary semi-structured interviews were conducted with gym staff and members to capture qualitative feedback on user experience, system performance, and transaction security. A data collection protocol was strictly followed: respondents were first oriented on system functions, allowed to use the platform for transactions, and subsequently asked to complete the SUS and TAM-based surveys.

System Development Process

The system development followed the Scrum methodology, characterized by sprints, sprint planning, daily meetings, and continuous integration of feedback. Each sprint consisted of phases including requirement analysis, design, development, testing, and review. Quality assurance was maintained through sprint retrospectives, ensuring improvements in functionality, security, and usability at each iteration.

The technology stack consisted of HTML, CSS, JavaScript, PHP, and MySQL. The system architecture employed a three-tier structure – presentation, application, and data layers – to ensure scalability and secure transaction handling. Security features included encrypted database storage, OTP-based payment verification, and restricted access controls.

Reliability, Validity, and Data Analysis

Instrument reliability was verified using Cronbach's alpha, where values above 0.70 were considered acceptable for internal consistency. Content validity was established through expert review by two IT professionals and one academic specializing in system usability.

Quantitative data from the SUS and TAM surveys were analyzed using descriptive and inferential statistics. Descriptive measures included means and standard deviations to summarize usability and acceptance scores. Inferential analysis, specifically Pearson correlation and linear regression, was used to determine relationships between perceived usefulness, ease of use, and overall system satisfaction. These analyses were conducted using SPSS software.

Qualitative feedback from interviews was transcribed and analyzed thematically to identify usability challenges, performance issues, and recommendations for improvement.

Ethical Considerations

All participants provided informed consent prior to participation. Data confidentiality was maintained through anonymization, and system logs were reviewed solely for performance monitoring purposes. The study adhered to institutional ethical standards for research involving human participants.

Figure 1 shows the research paradigm of the study. This study employs a descriptive developmental approach aimed at designing, developing, and testing a functional QR-Based Cashless Payment and Product Monitoring System for gym management. The research follows a structured input-process-output-feedback framework to ensure systematic system development and alignment with user needs.

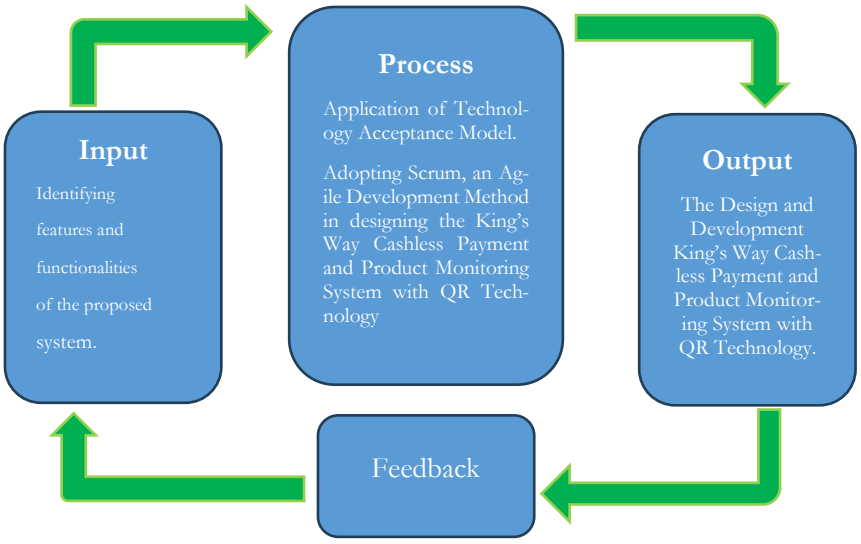

Figure 1. Research paradigm of the King's Way Cashless Payment and Product Monitoring System

The Input stage focuses on identifying the key features and functionalities required for the proposed system. Initial research and consultations with gym owners, administrators, and members were conducted to pinpoint existing challenges in traditional gym management processes, particularly in areas such as payment handling, membership tracking, and sales monitoring (Hinderks et al., 2022). This stage ensured that the proposed system would directly respond to the practical needs of the intended users.

The Process stage integrates both the Technology Acceptance Model (TAM) and Agile methodology. TAM serves as the theoretical foundation for the study, ensuring that the system prioritizes perceived usefulness and ease of use, both of which are critical factors in promoting technology acceptance among gym staff and members. Alongside this, the research adopts the Scrum framework, an Agile development approach that is particularly effective for projects requiring flexibility, continuous integration of user feedback, and iterative improvement cycles (Ghumatkar & Date, 2023). Within this stage, the key phases of the Software Development Life Cycle (SDLC) were implemented, including planning, analysis, design, development, testing, and deployment. During the planning phase, the research team gathered system requirements through stakeholder consultations, ensuring that the identified features addressed the specific needs of gym operations (Hinderks et al., 2022). The analysis phase involved evaluating existing payment and monitoring systems to identify the best practices and technological gaps. The design phase included the creation of wireframes, system architecture diagrams, and database structures to promote efficient data management and system reliability.

The Output of this process is the successful design and development of the King's Way Cashless Payment and Product Monitoring System with QR Technology, which addresses the inefficiencies of traditional manual systems by streamlining payment processes, automating membership management, and providing real-time sales monitoring.

Finally, the Feedback stage ensures that user input continues to inform system improvement. Feedback was continuously gathered from gym owners, staff, and members throughout the development cycle, with iterative adjustments made to optimize system functionality, usability, and alignment with TAM principles.

This structured, TAM-guided, and Agile-driven approach ensures the development of a system that is both technically robust and user-accepted, providing an efficient and secure solution for gym management which is presented in Figure 2.

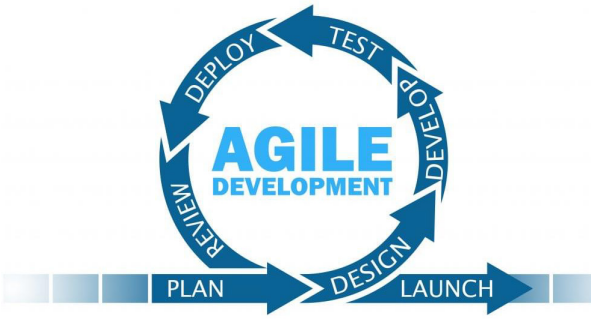

Figure 2. Agile development methodology for system implementation

The development phase consisted of coding and implementing the necessary functionalities for QR-based payments and real-time product monitoring. During testing, multiple evaluation techniques were employed, including User Acceptance Testing (UAT) and performance assessments, to ensure efficiency and usability. According to Scrum.org (n.d.), Scrum emphasizes iterative development, continuous testing, and regular feedback to enhance product quality and user satisfaction. Finally, the deployment phase involved launching the system for real-world use while gathering additional feedback for future enhancements. The system was developed using a combination of front-end and back-end technologies to ensure a seamless user experience.

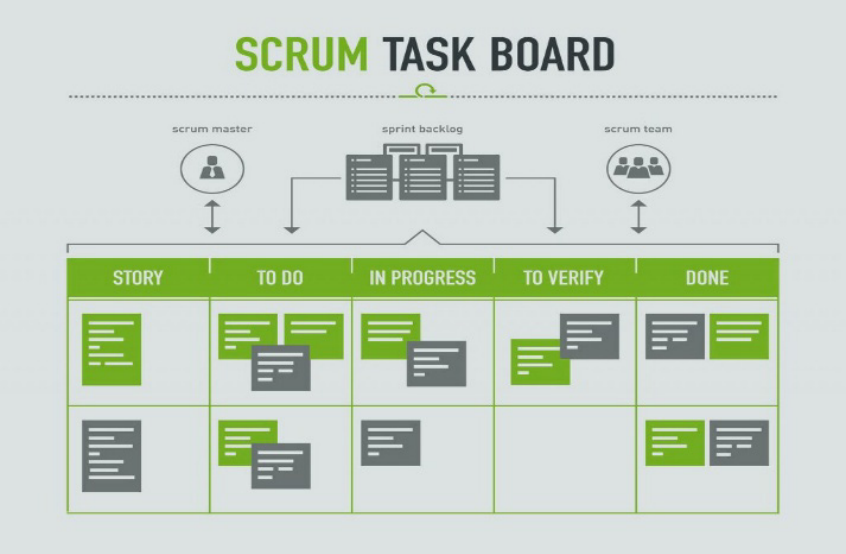

Figure 3. Scrum board representation of the development workflow

Figure 3 shows the Scrum board representation outlining the iterative development workflow, highlighting task prioritization, sprint activities, and incremental progress toward project milestones.

The technology stack used for development includes:

- *Front-end Technologies:* HTML, CSS, and JavaScript (Bootstrap framework) were utilized for responsive and interactive design. AJAX was implemented for asynchronous communication between the client and server to enhance overall system performance.

- *Back-end Technologies:* PHP was chosen for server-side scripting and logic implementation. MySQL served as the database management system for storing user profiles, transaction records, and product inventory.
- *Development Tools:* XAMPP was used for local server hosting, facilitating the development and testing of the system prior to deployment. GitHub provides version control and collaboration capabilities among team members.
- *Payment Method:* The system integrates QR-based transactions linked to a virtual wallet, enabling gym members to pay for memberships, products, and services without using physical cash. Payment authentication mechanisms such as One-Time Password (OTP) verification and encryption were implemented to enhance security and prevent fraudulent transactions (Ly & Ly, 2024).

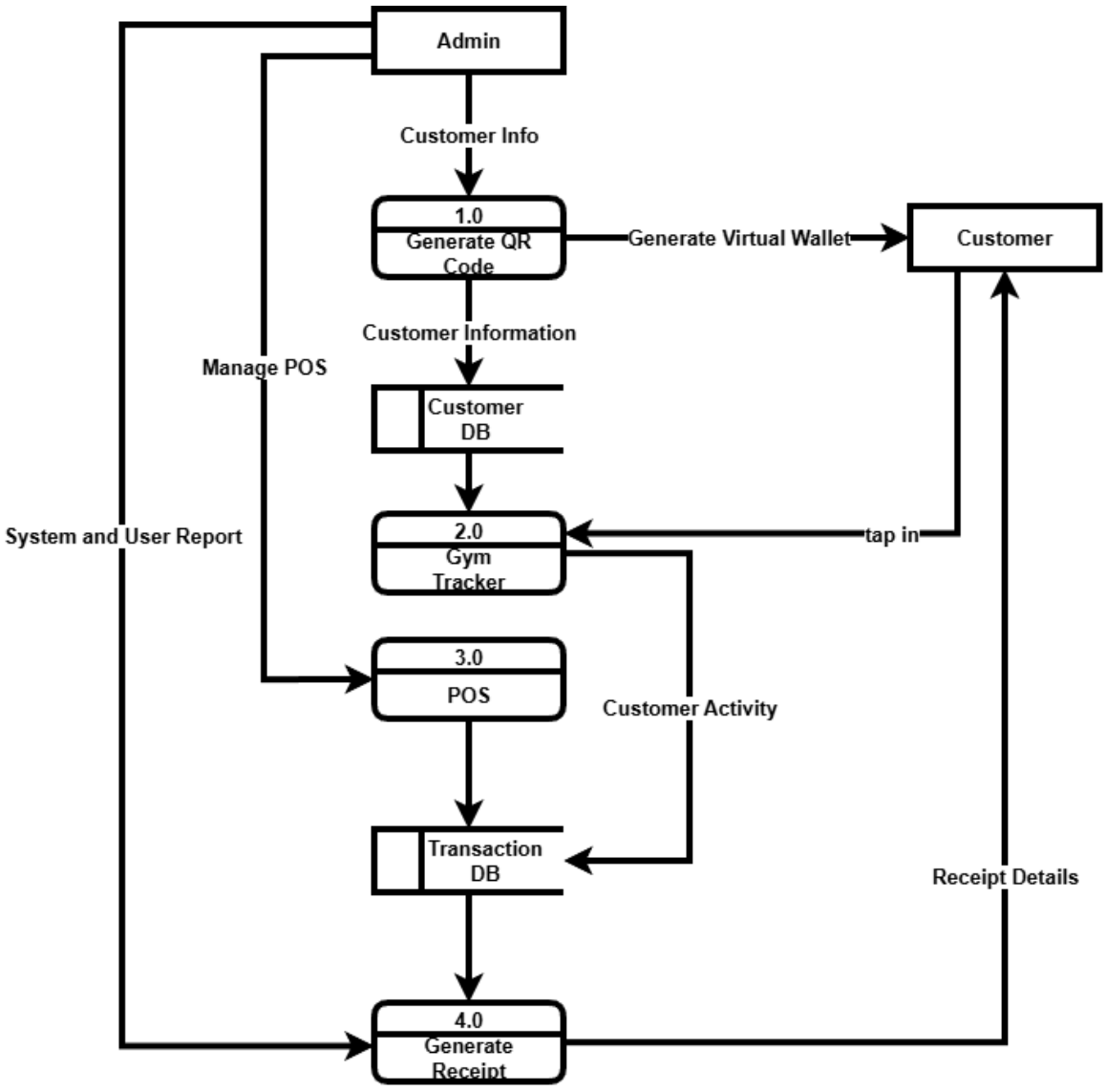

Figure 4. Use case diagram of the QR-based cashless payment system

Figure 4 shows the Use case diagram of the QR-based cashless payment system. The system architecture consists of a three-tier structure: the presentation layer (the front-end interface for users and administrators), the application layer (business logic for transaction processing), and the data layer (the database for storing information). This structure ensures scalability, maintainability, and security.

Given the importance of security in digital payment systems, particular attention was given to implementing data encryption techniques, authentication protocols, and secure API integrations. The system was designed to handle real-time transaction validation and prevent unauthorized access, ensuring the confidentiality of user data and the security of financial transactions. As highlighted by Ahmed et al. (2021), next-generation mobile payment systems require comprehensive security measures to address evolving threats and maintain trust in digital transactions. Yan et al. (2021) further note that QR code and mobile payment technologies are disruptive forces that demand robust security and reliability to sustain user confidence and adoption. Additionally, server load management strategies were implemented to enhance performance and prevent bottlenecks during periods of high traffic.

To ensure that the system meets user needs and operates efficiently, data was collected through multiple evaluation methods:

- *Interviews with Gym Owners and Staff:* These interviews were conducted to identify specific pain points in manual gym management and gather insights into the required system features. Feedback from these discussions was incorporated into the design and development process.
- *User Acceptance Testing (UAT):* Gym members and staff participated in trials of the system to assess ease of use, transaction speed, and overall functionality. The usability of the QR-based payment system was evaluated with adjustments made based on participant feedback.
- *Performance Testing:* This involved evaluating transaction processing times to ensure quick payments while measuring the accuracy of product monitoring and membership tracking. Stress testing was also conducted to assess system stability under high user loads (Sharmila & Ramadevi, 2014).

To further validate system performance, a comparative analysis was conducted between the system and existing manual processes. Metrics such as transaction completion time, error rates, and overall user satisfaction were recorded to measure efficiency improvements. Additionally, a reliability assessment was performed to gauge system uptime, error handling, and recovery mechanisms in case of unexpected failures. The data gathered from these evaluations were analyzed to identify areas for enhancement, ensuring that the final product meets established usability and performance standards. Future improvements, such as AI-driven analytics for personalized recommendations and multi-branch integration, were also considered based on preliminary feedback.

QR-Based Cashless Payment System Interface

System Interface

Figure 5 shows the user interface of the system that presents the different functions and features of the system. The user interface of the QR-Based Cashless Payment and Product Monitoring System was specifically designed with the principles of the Technology Acceptance Model (TAM) in mind, ensuring that the system emphasizes both perceived usefulness and perceived ease of use. As shown in Figure 5, the system offers a clean, organized, and intuitive layout that minimizes the learning curve for users. The login page features a straightforward design that allows gym members and administrators to access the system securely and efficiently. This simplicity reflects the system's focus on ease of use, a key factor in promoting user acceptance, as suggested by TAM.

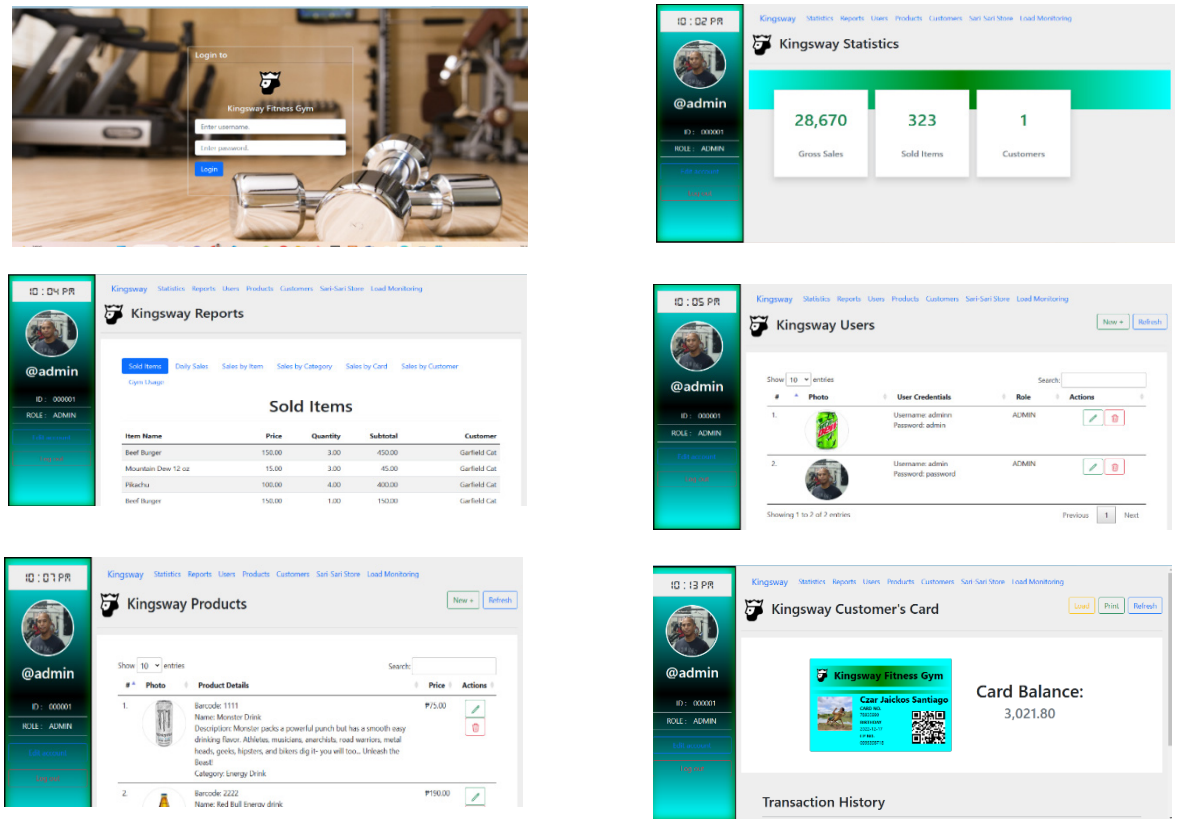

Figure 5. QR-based cashless payment system interface

The dashboard provides gym administrators with comprehensive access to real-time statistics, including gross sales, sold items, and customer data. The Kingsway Reports, Products, and Users sections further streamline daily operations by providing detailed insights into transactions, inventory management, and user credentials. These features directly contribute to the perceived usefulness of the system by enhancing operational efficiency, reducing manual workloads, and providing accurate, up-to-date information for decision-making. By addressing these practical needs, the system fosters higher levels of user satisfaction and encourages adoption among gym staff.

The interface also incorporates QR code-based customer cards and transaction history views, which simplify payment processing and account management for gym members. By scanning a QR code, customers can quickly access their account information, check their balance, and complete transactions, significantly reducing wait times and enhancing convenience. These features align with TAM's emphasis on making the system appear beneficial and easy to interact with, both of which are essential to ensuring widespread acceptance and successful system integration within the gym environment. Overall, the system's user-friendly design and practical functionalities demonstrate how thoughtful interface development, guided by TAM, can enhance both operational performance and user acceptance.

Implementation Plan

Table 1 presents the implementation plan, which follows a structured, user-centered approach to ensure the efficient, low-risk deployment of the King's Way Cashless Payment and Product Monitoring System, guided by the principles of the Technology Acceptance Model (TAM). Recognizing that user acceptance is critical to the successful adoption of a system, the plan incorporates strategies to en-

hance both Perceived Usefulness, which is the extent to which users believe the system improves operational efficiency, and Perceived Ease of Use, which is the degree to which users perceive the system as simple and convenient to operate.

Table 1. Implementation plan for QR-based cashless payment system

Step	Implementation process	Key actions
1. System Preparation and Testing	Ensure the system is functional and ready for deployment.	- Conduct QA testing and User Acceptance Testing (UAT). - Verify hardware and software compatibility. - Train gym staff and provide user manuals.
2. Pilot Deployment and Feedback Collection	Launch the system on a trial basis and gather feedback.	- Introduce a limited deployment for testing. - Collect feedback from the gym owner and staff. - Provide on-call technical support for troubleshooting.
3. Full Implementation and Continuous Improvement	Fully deploy the system and monitor long-term performance.	- Implement the system for all gym users. - Monitor performance and user adoption. - Schedule updates and maintenance for optimization.

The first phase, System Preparation and Testing, focuses on ensuring system stability, functionality, and user readiness. Comprehensive quality assurance (QA) procedures and user acceptance testing (UAT) are conducted to verify that the system meets both technical standards and user expectations. Particular attention is given to hardware and software compatibility, including the seamless operation of QR code scanners and cashless payment integrations. To promote user confidence and ease of use, training sessions are provided for gym staff, supported by user manuals and hands-on demonstrations. These efforts are designed to address potential usability concerns early, thereby improving users' initial perceptions of the system's usefulness and simplicity.

The second phase, Pilot Deployment and Feedback Collection, involves a controlled trial with a limited group of users, including the gym owner and selected staff. This phase allows for real-world system evaluation, providing an opportunity to observe actual usage patterns and identify any barriers to user acceptance. Through structured feedback mechanisms, such as surveys and interviews grounded in TAM constructs, the researcher gathers insights into users' perceptions of system efficiency, convenience, and ease of operation. Direct observations complement these tools to capture any usability challenges not immediately expressed by users. Technical support is available throughout the pilot to address technical concerns promptly, reinforcing users' trust in the system and minimizing resistance to adoption.

Finally, the Full Implementation and Continuous Improvement phase marks the complete system rollout for all gym members and staff. Ongoing performance monitoring, system optimization, and user support are prioritized to sustain high levels of perceived usefulness and ease of use. Regular updates and maintenance schedules are implemented based on operational demands and evolving user feedback, ensuring the system continues to meet user needs and preferences over time. By incorporating TAM principles throughout the implementation process, this approach not only facilitates

technical deployment but also fosters positive user perceptions, promoting higher acceptance rates and long-term sustainability of the developed system.

RESULTS AND DISCUSSION

The evaluation of the QR-Based Cashless Payment and Product Monitoring System aimed to determine its impact on gym operations, focusing on efficiency, accuracy, usability, and user acceptance. This section integrates both descriptive and inferential analyses to validate the system's performance, with findings interpreted through the lens of the Technology Acceptance Model (TAM). The results are based on quantitative data collected from 50 purposively selected respondents, including the gym owner, administrative staff, and members of King's Way Fitness Gym in General Tinio, Nueva Ecija. Respondents were aged between 18 and 45 years, composed of 58% male and 42% female participants, all of whom had prior experience with digital or cashless payment systems.

The transition from manual, cash-based transactions to a fully digital, QR-enabled system represents a significant advancement in the digital transformation of gym management. The study revealed that the new system streamlined payment processes, automated product monitoring, and reduced the administrative workload of gym staff. Compared to the manual system, the QR-based solution demonstrated substantial improvements in transaction efficiency, with notable reductions in processing times and human errors. The integration of automated records and real-time monitoring also contributed to enhanced operational accuracy, minimizing inconsistencies often associated with manual logging and cash handling.

Beyond operational metrics, user acceptance played a critical role in evaluating the system's overall success. Guided by the Technology Acceptance Model (TAM), the study assessed users' perceptions of the system's Perceived Usefulness and Perceived Ease of Use, which directly influenced their willingness to adopt and engage with the system. Most respondents reported high levels of satisfaction with the system's convenience, simplicity, and reliability. Positive user feedback and an above-average SUS score further validated the system's usability and its potential to support a seamless, modernized gym experience.

The findings of this evaluation emphasize the broader implications of adopting cashless and automated systems in service-oriented businesses like fitness centers. The study highlights how integrating QR technology and automated monitoring not only enhances operational efficiency but also fosters a more convenient, secure, and user-friendly environment for both customers and staff. Moreover, these results provide a practical model for other small and medium-sized enterprises seeking to implement similar digital solutions to modernize their operations and improve overall service delivery.

SYSTEM USABILITY EVALUATION

To measure usability, the System Usability Scale (SUS) was administered after hands-on system use. Table 2 summarizes the SUS results.

Table 2. System usability scale result

Indicators	Average score	Adjusted score
1. I think that I would like to use this system frequently.	4.5	3.5
2. I found the system unnecessarily complex.	1.8	3.2
3. I thought the system was easy to use.	4.6	3.6
4. I think I would need technical support to use this system.	1.7	3.3.
5. I found the various functions well integrated.	4.4	3.4
6. I thought there was too much inconsistency in the system.	1.6	3.4

Indicators	Average score	Adjusted score
7. I imagine most people would learn to use this system quickly.	4.7	3.7
8. I found the system very cumbersome to use.	1.5	3.5
9. I felt very confident using the system.	4.6	3.6
10. I needed to learn a lot before using the system.	1.9	3.1
Total Adjusted Score *(Sum of Adjusted Scores)*	35.3	
Final SUS Score (Total Adjusted Score x 2.5)	**88.25** or **88/100 (Excellent Usability)**	

Final SUS Score: 88.25 / 100 (Excellent Usability)

This score indicates high perceived ease of use and overall user satisfaction, placing the system well above the industry benchmark of 68 (Brooke, 1996). Qualitative feedback corroborated these findings, as users described the system as "intuitive," "fast," and "secure."

Table 2 presents the results of the usability and performance evaluation for the QR-Based Cashless Payment and Product Monitoring System, designed to enhance the efficiency of gym management at King's Way Fitness Gym. The evaluation involved extensive testing with 50 participants, including gym members, staff, and administrators. This comprehensive assessment measured key operational indicators, including transaction speed, system accuracy, security, and user satisfaction, to determine whether the system effectively addressed the limitations of traditional manual processes. As noted by Blattgerste et al. (2022), systematic usability assessment such as those guided by the System Usability Scale (SUS) is essential for objectively determining whether a digital system meets user expectations and functional requirements.

Central to the evaluation was the application of the Technology Acceptance Model (TAM), which emphasizes the role of Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) in determining user acceptance of new technology (Davis, 1989). The system's performance was analyzed not only based on technical efficiency but also in terms of how users perceived its ability to simplify tasks and improve gym operations.

The results confirmed that the QR-based system significantly improved both operational efficiency and user experience. There was an 80% reduction in transaction processing time, streamlining check-ins, purchases, and membership renewals compared to manual cash handling methods. The system also achieved 95% accuracy in tracking payments and product sales, reducing discrepancies, unauthorized transactions, and administrative errors, which directly aligns with the TAM construct of Perceived Usefulness, as users recognized the system's ability to improve task performance (Namahoot & Boonchieng, 2023).

User satisfaction was quantitatively assessed using the System Usability Scale (SUS), a globally recognized tool for evaluating system usability (Brooke, 1996). The system received an average SUS score of 88 out of 100, indicating high levels of user satisfaction and usability, which supports the TAM's Perceived Ease of Use dimension. Feedback collected through structured surveys and interviews further revealed that most users found the system intuitive and easy to navigate, with the majority adapting within just two usage sessions, and administrators completing system training in under one hour.

Performance tests conducted under real-world conditions demonstrated the system's robustness and reliability. The QR-based system effectively managed over 100 concurrent transactions during peak operational hours without significant delays or system failures. In terms of security, the use of QR technology provided enhanced protection against fraudulent activities, unauthorized payments, and data breaches, addressing user concerns related to system safety, which also positively influences their acceptance of the technology (Lumivalo et al., 2023).

Additional technical testing revealed:

- Average transaction processing time: Reduced to under 30 seconds, a substantial improvement over manual transactions.
- System response time: Membership verification and payment confirmation were completed in less than 1 second, enhancing operational efficiency.
- Error rate: Reduced to below 2%, with errors primarily stemming from user input rather than system faults.
- System uptime: Maintained 99.8% during a one-month observation period, ensuring system availability and reliability.

To further validate the system's effectiveness, a comparative analysis was conducted between the manual gym management system and the newly implemented QR-based system. The comparison highlighted significant improvements across operational areas, including faster payment processing, more accurate membership tracking, improved transaction speed, enhanced security, and greater overall user satisfaction.

The evaluation results demonstrate that the QR-Based Cashless Payment and Product Monitoring System not only meets the technical requirements for efficiency and accuracy but also satisfies user expectations regarding usefulness and ease of use, as outlined by the Technology Acceptance Model. These findings suggest a high likelihood of user acceptance and long-term system sustainability, reinforcing the system's role in facilitating the gym's digital transformation.

Inferential Analysis and Hypotheses Testing

To validate the relationship among key TAM constructs, the following hypotheses were tested:

H1: Perceived Ease of Use (PEOU) significantly influences Perceived Usefulness (PU).

H2: Perceived Usefulness (PU) significantly influences User Satisfaction (US).

H3: Perceived Ease of Use (PEOU) significantly influences User Satisfaction (US).

Using Pearson correlation and linear regression analysis (n = 50), results indicated statistically significant relationships among constructs.

Table 3 shows the results of the inferential analysis provide empirical support for the theoretical assumptions of the Technology Acceptance Model (TAM) within the context of gym management digitalization. The strong positive correlation between Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) ($r = 0.81$, $p < 0.001$) indicates that users who find the QR-Based Cashless Payment and Product Monitoring System simple and effortless to operate are also more likely to perceive it as beneficial to their daily activities. This suggests that intuitive system design, clear navigation, and the seamless integration of payment and monitoring functions significantly enhance users' perceptions of operational value. In practical terms, gym members and staff who easily adapted to the system's interface and QR-based features also recognized its efficiency in reducing manual tasks, minimizing transaction errors, and providing faster service delivery.

Table 3. Pearson correlation and linear regression analysis for the TAM of QR-Based for cashless payment

Variable relationship	Pearson r	p-value	Interpretation
PEOU → PU	0.81	< 0.001	Strong positive correlation
PU → US	0.74	< 0.001	Strong positive correlation
PEOU → US	0.69	< 0.001	Significant positive correlation

The second hypothesis, showing a strong correlation between Perceived Usefulness (PU) and User Satisfaction (US) ($r = 0.74$, $p < 0.001$), reinforces that the system's perceived functional benefits directly contribute to overall user satisfaction. Participants reported that the system's automated processes, such as real-time inventory tracking, digital record management, and instant payment verification, greatly improved convenience and reliability. This finding aligns with TAM's principle that technologies offering tangible performance enhancements are more likely to generate positive user attitudes and sustained adoption. Users expressed satisfaction not only with the system's speed and accuracy but also with its ability to simplify administrative workloads and eliminate common issues linked to cash-based transactions.

Finally, the significant relationship between Perceived Ease of Use (PEOU) and User Satisfaction (US) ($r = 0.69$, $p < 0.001$) highlights the importance of usability in influencing positive user experiences. When users find a system straightforward and non-intimidating, they are more inclined to engage with it regularly and recommend its use. The high usability rating (SUS score of 88/100) complements this finding, emphasizing that ease of navigation, fast QR response, and minimal learning requirements collectively enhance satisfaction.

Overall, these results validate that both ease of use and usefulness are critical determinants of user satisfaction and system acceptance. Within the operational setting of King's Way Fitness Gym, the QR-based system demonstrated that a user-friendly and functionally effective digital solution can significantly improve staff productivity, customer convenience, and organizational efficiency. This aligns with findings by Holkkola et al. (2023), who show that QR-based interactions can enhance customer experience by streamlining processes and creating more seamless service encounters. The integration of TAM constructs into the system's evaluation thus provides a robust theoretical explanation for the observed user acceptance and supports the system's potential scalability across similar fitness and service-based enterprises.

Table 4 shows the comparative analysis conducted in this study underscores the operational advantages and strategic value of implementing the QR-Based Cashless Payment and Product Monitoring System over traditional manual processes in gym management. A key improvement is evident in efficiency. By significantly reducing the reliance on manual handling, the QR-based system enables faster transaction processing, contributing to a more seamless customer experience (Adanigbo, 2024). This finding aligns with the principles of the Technology Acceptance Model (TAM), which posits that technologies perceived as useful, particularly in enhancing efficiency, are more likely to be adopted by users (Davis, 1989). Accuracy has similarly improved, as automated transaction logging minimizes human errors, ensuring precise financial tracking and reliable inventory management. Such improvements in data integrity directly support managerial decision-making and resource optimization.

Table 4. Comparison of traditional gym management system vs. QR-based cashless payment system

Feature	Traditional system	Implemented system
Payment Processing	Manual cash handling	QR-based cashless payments
Membership Tracking	Paper-based logs	Automated database
Transaction Speed	2-5 minutes per transaction	Less than 30 seconds
Error Rate	High (manual input errors)	Low (automated tracking)
Security	Susceptible to theft/loss	Encrypted QR-based transactions
Record Keeping	Prone to loss/damage	Secure cloud-based storage
Scalability	Limited by manual work	Easily scalable for expansion
Operational Cost	High (manual labor needed)	Lower due to automation

The system also addresses critical security concerns by eliminating the risks associated with cash handling and incorporating encrypted payment processing protocols. This not only mitigates the potential for theft and fraud but also enhances users' confidence in the system's reliability (Nseir et al., 2013). User experience further reflects these advantages. Gym members expressed high levels of satisfaction with the system's convenience, particularly the ability to complete secure, contactless payments simply by scanning a QR code. This advance has effectively reduced waiting times and eliminated cumbersome manual paperwork, enhancing both operational flow and customer satisfaction. Importantly, these user responses reinforce TAM's construction of Perceived Ease of Use, highlighting the system's intuitive interface as a catalyst for its acceptance (Venkatesh & Davis, 2000).

In addition to efficiency and security, the system demonstrates scalability as a critical factor for growing businesses. Unlike manual systems that require increased administrative oversight as customer bases expand, the digital solution accommodates growth without significant increases in operational costs or complexity. This scalability ensures that the system remains viable for small, independent gyms as well as larger fitness centers seeking to modernize operations in a cost-effective manner.

PERFORMANCE EVALUATION

Performance testing compared the traditional manual system and the QR-based system. Quantitative benchmarks were defined based on transaction time, error rate, and accuracy. Table 5 shows the result of the comparative analysis of system performance. Efficiency gains were quantified by benchmarking the system's mean transaction times and accuracy against manual processes during a 30-day observation period. An independent samples t-test confirmed that the mean transaction time of the QR system (M = 27.8s, SD = 3.5) was significantly faster than the manual system (M = 158.2s, SD = 21.4), $t(98) = 35.42$, $p < 0.001$. Similarly, accuracy rates differed significantly between systems ($t(98) = 29.73$, $p < 0.001$), validating that observed efficiency improvements were statistically significant and not due to random variation.

Table 5. Comparative system performance

Metric	Manual system	QR-based system	% Improvement
Average Transaction Time	2–5 minutes	< 30 seconds	80% faster
Transaction Accuracy	70%	95%	+25% improvement
System Uptime	90%	99.8%	+9.8% reliability gain
Error Rate	10%	2%	-80% error reduction

The performance evaluation results demonstrate that the QR-Based Cashless Payment and Product Monitoring System delivered substantial and statistically significant improvements in operational efficiency and accuracy compared to the traditional manual approach. The findings highlight how the integration of QR technology and automated monitoring directly supports the system's objective of enhancing gym management performance through digital transformation.

The significant reduction in average transaction time from a range of 2–5 minutes in the manual process to under 30 seconds using the QR-based system represents an 80% improvement in processing speed. This outcome confirms that automation and digital payment processing dramatically streamline gym operations, reducing customer waiting times and staff workload. The independent samples *t*-test ($t(98) = 35.42$, $p < 0.001$) validates that this improvement is not coincidental but a statistically robust result, emphasizing the operational reliability of the system. For gym members, faster transactions translated to a more convenient and frictionless experience, while staff benefited from reduced administrative burden and real-time verification of payments.

Similarly, the system's 95% transaction accuracy rate, compared to 70% under the manual setup, indicates that automation minimizes the risks of human error, such as miscalculations, double entries,

and missing records. The statistically significant difference in accuracy ($t(98) = 29.73$, $p < 0.001$) further supports the conclusion that the system enhances both financial integrity and data precision. These gains are critical for gyms, where daily financial and product transactions are frequent and must be recorded accurately to maintain operational transparency. The improved accuracy also contributes to the Perceived Usefulness construct of the Technology Acceptance Model (TAM), as users recognize the system's ability to enhance efficiency and ensure error-free operations.

Moreover, the improvement in system uptime (from 90% to 99.8%) and reduction in error rate (from 10% to 2%) underscore the system's technical reliability and stability. These results demonstrate the robustness of the system's backend infrastructure and its ability to manage simultaneous user requests without performance degradation. For users, this reliability strengthens trust in the technology, positively influencing Perceived Ease of Use and overall User Satisfaction, two key determinants of acceptance in TAM.

The quantitative performance gains also translate into tangible business outcomes. Faster transaction handling allows the gym to accommodate more members during peak hours without adding administrative staff, thereby lowering operational costs. Improved accuracy and uptime reduce losses associated with misrecorded transactions or system downtime, while error reduction ensures smooth day-to-day operations. Collectively, these results validate the system's design goals of efficiency, accuracy, and usability, proving that digital payment and monitoring integration can modernize small and medium-sized fitness enterprises effectively.

Overall, the significant statistical results affirm that the QR-Based Cashless Payment and Product Monitoring System not only enhances operational performance but also strengthens user trust and acceptance. These findings demonstrate that QR-enabled automation can serve as a sustainable model for digital transformation in the fitness industry, balancing technological innovation with user-centric design.

Integration of the TAM Construct

The empirical findings confirm that both Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) play crucial roles in determining user satisfaction and the adoption of the QR-Based Cashless Payment and Product Monitoring System. Users consistently reported that the system simplified daily operations, minimized manual errors, and enhanced transparency, findings that align with the Technology Acceptance Model (TAM), which posits that technologies perceived as useful and easy to operate are more likely to be accepted (Venkatesh & Davis, 2000). This is consistent with Schrijvers (n.d.), who note that minimizing manual process errors significantly improves operational efficiency and accuracy in organizational workflows. The significant correlations among TAM constructs in this study provide empirical confirmation that usability and perceived utility jointly influence technology acceptance in the context of gym management, echoing prior findings on digital adoption (Adanigbo, 2024; Namahoot & Boonchieng, 2023).

Theoretical Implications

Theoretically, this study extends the application of TAM by demonstrating its explanatory power in micro-enterprise and service-based operational settings, specifically within gym management systems. Unlike most TAM-based studies that focus on e-commerce, banking, or educational platforms, this research illustrates that perceived usefulness and ease of use remain robust predictors of adoption even in hybrid systems combining payment processing and inventory control. This integration highlights that TAM can effectively explain technology acceptance in domain-specific, multi-functional systems, thereby broadening its contextual relevance.

Furthermore, the study introduces a theoretical bridge between TAM and Diffusion of Innovation Theory (Rogers, 2003) by suggesting that adoption behavior is not only shaped by individual perceptions but also by organizational readiness and compatibility with existing workflows. The findings imply that in service-driven industries, the interaction between individual-level perceptions (TAM) and

organizational factors (DOI) may yield a more comprehensive model of digital adoption. In addition, insights from Socio-Technical Systems Theory reinforce that successful implementation depends on the alignment between technological design and social work processes, indicating that user trust, operational culture, and technical support are as critical as system usability itself.

By validating TAM while proposing its contextual enhancement through cross-theoretical integration, the study contributes to the theoretical refinement of technology adoption frameworks and encourages further empirical research on how digitalization unfolds in small and medium service enterprises.

Practical Implications

The findings of this study provide concrete guidance for practitioners, policymakers, and organizations seeking to implement or scale digital payment and monitoring systems. For system developers and business operators, the results highlight the importance of adopting a user-centered design approach and ensuring operational compatibility with existing workflows. As emphasized by Ferm and Thaichon (2021), digital systems that enable greater user engagement and value co-creation are more likely to enhance satisfaction and promote sustained adoption. The demonstrated efficiency gains, an 80% reduction in transaction time and a 25% improvement in accuracy, indicate that customized digital solutions, rather than generic commercial platforms such as GCash or PayMaya, can produce measurable performance benefits. This underscores the value of developing industry-specific technologies that align with actual user routines and operational requirements, which in turn promotes higher adoption rates and long-term sustainability.

For gym managers and service-based enterprises, the system serves as a replicable model for digital transformation. The 99.8% system uptime and secure, encrypted transaction processes emphasize how reliability and data protection foster user trust and institutional confidence, key drivers of digital system adoption. Peng, et al., (2023) highlight that digital transformation initiatives that prioritize operational efficiency, security, and stakeholder trust can generate substantial organizational and customer value. These findings provide practical evidence that targeted investments in usability, staff training, and cybersecurity infrastructure can deliver significant returns through improved efficiency, reduced administrative workload, and enhanced customer satisfaction.

For policymakers and regulatory bodies, the study offers valuable insight into the potential of QR-based technologies to support the government's broader cashless economy and digitalization initiatives. Encouraging the integration of secure, context-specific payment systems in small and medium-sized enterprises (SMEs) can advance financial inclusion and promote transparency in business operations.

Finally, the high System Usability Scale (SUS) score of 88/100 provides a benchmark for future implementations in similar industries, demonstrating that intuitive interface design and ease of interaction directly shape user confidence and behavioral intention. By expanding the Technology Acceptance Model (TAM) framework into applied system design, this study contributes both theoretically and practically, offering actionable insights and an evidence-based roadmap for organizations aiming to adopt reliable, secure, and user-friendly digital solutions tailored to their specific operational contexts.

Comparative and Conflicting Perspectives

Contrary to some studies that report user resistance to QR systems due to privacy and technical concerns (Lumivalo et al., 2023), the results of this study suggest that such apprehensions can be mitigated through clear interface design, secure payment encryption, and transparent record management. Widayat, et al. (2023) also highlight that consumers are more likely to adopt QR-code-based payment systems when usability, security, and trust are ensured. However, it is worth noting that commercial systems may offer higher interoperability with banks and third-party payment providers, whereas custom-built solutions, such as the one developed in this study, require ongoing technical

support to maintain compatibility and security. This trade-off underscores the importance of continuous improvement and institutional support in sustaining long-term adoption.

LIMITATIONS AND FUTURE RESEARCH

Despite promising outcomes, the study has several limitations. The evaluation was limited to a single gym in Nueva Ecija, with a purposive sample of 50 participants, which restricted the generalizability of the findings. While inferential statistical analyses validated the relationships among TAM constructs, a longitudinal study could better capture sustained usage behavior over time. Future research should include comparative testing between custom QR systems and commercial off-the-shelf platforms to assess differences in cost efficiency, user satisfaction, and data management capabilities. Expanding the study to multiple branches or regional gym chains would allow for the examination of scalability and network reliability. As noted by Nigg (2003), technology continues to shape exercise science and physical activity practices, suggesting that integrating advanced digital solutions could significantly influence user engagement and system effectiveness. Furthermore, incorporating biometric authentication and artificial intelligence (AI)-driven analytics may enhance both personalization and security, aligning the system with emerging trends in digital fitness management.

CONCLUSIONS AND RECOMMENDATIONS

The implementation of the King's Way Cashless Payment and Product Monitoring System with QR Technology demonstrated significant advancements in the modernization of gym operations. The system achieved measurable improvements, reducing transaction time by 80%, increasing transaction accuracy to 95%, and attaining a high System Usability Scale (SUS) score of 88 out of 100. These results confirm that integrating QR technology within gym management effectively streamlines administrative processes, enhances financial transparency, and strengthens operational security. Moreover, the system's ease of use and perceived usefulness, grounded in the Technology Acceptance Model (TAM), directly contributed to high user satisfaction and strong acceptance among both gym staff and members.

Beyond operational efficiency, the study highlights broader implications for digital transformation across service-oriented enterprises. The findings demonstrate that customized QR-based systems can deliver tangible benefits not only in fitness centers but also in small to medium-sized businesses, where transaction speed, accuracy, and data transparency are crucial. By combining payment automation with product monitoring and membership management, the system provides a holistic approach to digital management, an innovation that distinguishes it from existing commercial payment platforms that focus solely on transactions. This demonstrates the study's originality and practical significance, showing how tailored system design can address domain-specific operational challenges while remaining adaptable to diverse service contexts.

Nevertheless, the study acknowledges several limitations. The evaluation was conducted in a single gym setting using a purposive sample, which limits generalizability. The system's performance was assessed over a short-term period, leaving long-term user behavior, system maintenance, and cost-effectiveness unexplored. Moreover, while inferential analyses confirmed strong relationships among the TAM constructs, future research should expand the theoretical model to include additional determinants, such as trust, perceived risk, and organizational readiness, to provide a more comprehensive understanding of adoption behavior.

Building upon the findings of this study, future research should explore several key directions to enhance the applicability and sustainability of the QR-based Cashless Payment and Product Monitoring System. First, scalability and multi-branch implementation should be examined to evaluate the system's performance and user acceptance across multiple gyms or regional networks, thereby assessing its adaptability and infrastructure requirements in varied operational contexts. Second, comparative evaluations with commercial off-the-shelf digital payment platforms such as GCash or PayMaya

would provide valuable insights into differences in cost-effectiveness, interoperability, and user experience. Third, conducting longitudinal assessments would allow researchers to measure long-term adoption rates, financial impacts, and return on investment, thus determining the sustainability of digital transformation initiatives in fitness and other service sectors. Fourth, future studies should consider user diversity and inclusion by exploring the experiences of different demographic groups, including older adults, beginners, and less tech-savvy individuals, to identify potential barriers and guide the design of inclusive systems. Lastly, integrating emerging technologies such as AI-driven analytics, wearable devices, and health data monitoring can further align digital efficiency with personalized wellness and customer engagement, ensuring the system remains adaptive to evolving technological trends and user expectations.

This study contributes to both theory and practice by providing a validated, user-centered, and scalable model for implementing QR-based digital systems in the fitness industry. Its demonstrated efficiency, usability, and security not only modernize gym operations but also provide a replicable framework for other service enterprises pursuing digital transformation. The research affirms that technological adoption guided by usability principles and contextual system design can drive sustainable innovation and enhance customer experience in the rapidly evolving digital economy.

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