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Design And Development Of A Web-Based Digital Credit Service And Qris Transaction System

Desain dan Pengembangan Layanan Kredit Digital Berbasis Web dan Sistem Transaksi Qris

Alya Abygael Kawengian[1]*, Benny Pinontoan[2] , Dodisutarma Lapihu[3]
[1*,2,3] Universitas Sam Ratulangi, Manado, Indonesia
*E-mail : alyakawengian@gmail.com

ABSTRACT

The rapid development of financial technology (fintech) has accelerated the adoption of digital payment and digital credit services. However, most digital credit services still rely on cash disbursement mechanisms, making it difficult to control the utilization of borrowed funds. This study aims to develop PayQRIS, a web-based Buy Now, Pay Later (PayLater) service integrated with QRIS payments that enables cashless transactions using credit limits without direct cash disbursement. The system was developed using the Prototyping model and evaluated through black-box testing and the System Usability Scale (SUS). The results show that PayQRIS successfully integrates PayLater services with QRIS payments into a single platform featuring credit limit determination, installment and bill management, bill extension, and secure transaction authentication. Functional testing confirmed that all system features operated according to the specified requirements, while the usability evaluation produced a SUS score of 83.25, indicating a high level of usability and user acceptance. Therefore, PayQRIS provides a web-based PayLater solution that supports QRIS payments through a more controlled digital credit mechanism.

Keywords: QRIS, PayLater, Digital Credit Service, Prototyping, System Usability Scale (SUS)

ABSTRAK

Perkembangan *financial technology* (fintech) telah mendorong meningkatnya penggunaan layanan pembayaran dan kredit digital. Namun, sebagian besar layanan kredit digital masih menggunakan mekanisme pencairan dana tunai sehingga penggunaan dana oleh pengguna menjadi lebih sulit dikendalikan. Penelitian ini bertujuan mengembangkan PayQRIS, yaitu sistem layanan *PayLater* berbasis web yang terintegrasi dengan pembayaran QRIS sehingga memungkinkan transaksi non-tunai menggunakan limit kredit tanpa mekanisme pencairan dana tunai. Sistem dikembangkan menggunakan model Prototyping dan dievaluasi melalui Black Box Testing serta System Usability Scale (SUS). Hasil penelitian menunjukkan bahwa PayQRIS berhasil mengintegrasikan layanan *PayLater* dengan pembayaran QRIS dalam satu platform yang dilengkapi fitur penentuan limit kredit, pengelolaan cicilan dan tagihan, perpanjangan tagihan, serta autentikasi transaksi. Hasil Black Box Testing menunjukkan seluruh fungsi sistem berjalan sesuai dengan kebutuhan, sedangkan pengujian SUS memperoleh skor 83,25 yang menunjukkan tingkat kegunaan yang tinggi dan dapat diterima oleh pengguna. Dengan demikian, PayQRIS memberikan solusi layanan *PayLater* berbasis web yang mendukung pembayaran QRIS melalui mekanisme kredit digital yang lebih terarah.

Kata Kunci : QRIS, *PayLater*, layanan kredit digital, Prototyping, *System Usability Scale* (SUS).

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INTRODUCTION

The rapid development of financial technology (fintech) has accelerated the digital transformation of financial services by providing faster, more convenient, and efficient transactions. Various fintech innovations have introduced digital payment systems, financing services, investment platforms, and digital credit services that can be accessed through electronic platforms [1]. One of the major fintech innovations in Indonesia is the Quick Response Code Indonesian Standard (QRIS), a national payment standard established by Bank Indonesia to integrate various QR code-based payment service providers into a single standard. The implementation of QRIS has promoted cashless transactions by enabling interoperability among different payment applications, thereby improving convenience for both consumers and merchants [2] [3] In addition, digital credit services, commonly known as PayLater, have gained increasing popularity by allowing users to complete transactions immediately while postponing payment to a later time.

Several studies have developed QRIS-based digital payment systems in different application domains. In addition, previous studies have demonstrated that web-based information systems can improve service effectiveness, enhance operational efficiency, and support digital service innovation across various application domains [4], [5]. Previous research has shown that integrating QRIS into web-based systems improves transaction efficiency while simplifying payment processing and transaction recording [6]. Meanwhile, existing PayLater services primarily focus on providing digital credit facilities to support electronic transactions. These developments demonstrate the significant potential of both QRIS and PayLater in supporting the digital payment ecosystem. However, their implementations are generally developed as separate services, resulting in limited integration between digital credit facilities and QRIS-based payment systems within a single platform.

Although digital credit services provide easier access to financing, most existing services still rely on direct cash disbursement mechanisms. This approach offers users greater flexibility in utilizing borrowed funds but makes it more difficult for service providers to monitor whether the funds are used for their intended purposes [7] Furthermore, based on previous studies, no research has integrated QRIS payments with a web-based PayLater service that incorporates credit limit determination, installment management, bill management, and bill extension within a single platform. This indicates an opportunity to develop a more integrated digital credit system that supports cashless transactions through a more controlled financing mechanism.

Based on these issues, this study develops PayQRIS, a web-based PayLater system integrated with QRIS payments. The proposed system is developed using the Prototyping model and provides features including credit limit determination based on users' financial capacity, installment and bill management, bill extension, and transaction authentication. Therefore, this study aims to provide an alternative approach to digital credit services by supporting QRIS payments without direct cash disbursement while contributing to the development of web-based digital payment systems.

TINJAUAN PUSTAKA

1. Quick Response Code Indonesian Standard (QRIS)

Quick Response Code Indonesian Standard (QRIS) is Indonesia's national QR code payment standard established by Bank Indonesia to integrate various payment service providers into a single interoperable system. Through QRIS, users can perform cashless transactions using different payment applications while merchants only need to provide one standardized QR code. This standard simplifies the payment process, improves transaction efficiency, and supports the expansion of the digital payment ecosystem in Indonesia [2].

2. Digital Credit Service

Digital credit services, commonly known as Buy Now, Pay Later (BNPL) or PayLater, enable users to complete transactions immediately while deferring payment either in full or through installments. Compared with conventional financing, digital credit services provide faster access through digital platforms and simpler application procedures. However, many existing services still rely on direct cash disbursement, making it difficult for providers to monitor whether the borrowed funds are used for their intended purposes [7] Therefore, this study integrates digital credit services directly with QRIS payments to support more controlled cashless transactions.

3. Prototyping

The Prototyping model is a software development approach that emphasizes iterative development through continuous interaction between developers and users. According to Pressman and Maxim, prototyping allows developers to identify user requirements, build an initial prototype, obtain feedback, and refine the system until it satisfies stakeholder needs. This iterative process helps ensure that the final system meets user expectations while reducing misunderstandings during software development [8], [9]

4. Black Box Testing

Black Box Testing is a functional testing method that evaluates whether each feature of a system operates according to its specified requirements without considering the internal program structure. The testing process focuses on system inputs and outputs to identify functional errors, interface problems, incorrect processing, or missing functions. In this study, Black Box Testing was used to verify that all features of the developed system functioned as expected [9]

5. System Usability Scale (SUS)

The System Usability Scale (SUS) is a standardized questionnaire consisting of ten statements designed to evaluate the usability of a system. SUS provides a usability score ranging from 0 to 100 based on users' perceptions of system effectiveness, efficiency, and ease of use [8] The interpretation of SUS scores follows the acceptability ranges and adjective ratings proposed by Bangor et al., allowing researchers to assess the overall usability level of the developed system [10]

RESEARCH METHOD

System Development Method

This study employed the Prototyping software development model to develop a web-based PayLater system integrated with QRIS payments. The prototyping approach was selected because it enables continuous interaction between developers and users throughout the development process, allowing system requirements to be refined iteratively based on user feedback. The developed system was implemented using PHP as the programming language and MySQL as the database management system.

The system development process followed the five stages of the Prototyping model proposed by Pressman and Maxim, namely Communication, Quick Plan, Modeling Quick

Design, Construction of Prototype, and Deployment, Delivery, and Feedback [9]. The development workflow is illustrated in Figure 1.

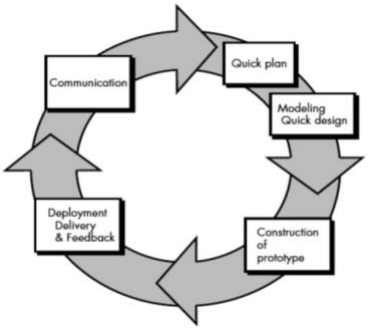


Figure 1. Prototyping Model
(Source: Pressman & Maxim, 2019)

The stages of the Prototyping model implemented in this study are as follows:
1. Communication involved identifying user requirements, research objectives, and system functional requirements through literature review and requirement analysis..

2. Quick Plan focused on planning the system architecture, identifying user roles, selecting the development tools, and determining the technologies required for system implementation.

3. Modeling Quick Design involved designing the system using Unified Modeling Language (UML) and user interface wireframes before system implementation.

4. Construction of Prototype involved implementing the system design into a functional web-based application. The prototype integrated the main functionalities required to support QRIS-based PayLater services into a single platform.

5. Deployment, Delivery, and Feedback involved evaluating the developed prototype through Black Box Testing and the System Usability Scale (SUS). The evaluation results and user feedback were used to verify that the system met the specified functional and usability requirements.

System Testing Method

The developed system was evaluated using Black Box Testing and the System Usability Scale (SUS). Black Box Testing was conducted to verify that every system function operated according to its specified functional requirements. Meanwhile, usability evaluation was performed using the System Usability Scale (SUS), a ten-item questionnaire developed by Brooke, and the obtained scores were interpreted based on the acceptability ranges and adjective ratings proposed by Bangor et al. [10],[8].

RESULTS AND DISCUSSION

This section presents the results and discussion of the system development based on the Prototyping model, covering the stages of Communication, Quick Plan, Modeling Quick Design, Construction of Prototype, and Deployment, Delivery, and Feedback.

1. Communication

The Communication stage focused on identifying the functional requirements of the proposed PayQRIS system through requirement analysis. The identified functional requirements are presented in Table 1 and served as the foundation for the subsequent stages of system development.

Table 1. Functional Requirements

Code	User Story
FR-01	The system shall allow users to register an account.
FR-02	The system shall verify the OTP entered by the user before activating the account.
FR-03	The system shall require users to create a secure password during registration.
FR-04	The system shall allow users to log into the PayQRIS system.
FR-05	The system shall allow users to apply for a credit limit.
FR-06	The system allows administrators to review, approve, or reject credit limit applications.
FR-07	The system allows users to scan a QRIS code and display the payment information.
FR-08	The system allows users to make QRIS payments and select an installment tenor.
FR-09	The system verifies transactions using a transaction PIN.
FR-10	The system temporarily locks transaction verification for five minutes after three consecutive incorrect PIN attempts.
FR-11	The system allows users to reset their transaction PIN through email verification.
FR-12	The system allows users to view their transaction history.
FR-13	The system generates a payment QR Code for bill payments and updates the bill status after successful payment.
FR-14	The system allows users to extend eligible bills.
FR-15	The system sends notifications related to account activities and transactions.
FR-16	The system allows administrators to monitor payment transactions.
FR-17	The system provides administrators with a dashboard displaying system information and transaction summaries.

2. Quick Plan

At the Quick Plan stage, the overall system concept, user roles, and technical requirements were determined to support the development of the proposed PayQRIS system.

System Overview

The proposed PayQRIS system was planned as a web-based platform that integrates PayLater services with QRIS payments. The system enables users to perform cashless transactions using their available credit limits while providing features for installment payments, bill management, and bill extension.

User Identification

Three user roles were identified during this stage: Master Admin, Admin, and User. The Master Admin manages administrator accounts and oversees system operations; the Admin verifies user data and monitors transactions; while the User performs QRIS-based PayLater transactions and manages bills.

Technical Requirements

The system was planned to be developed as a web-based application using PHP, HTML, CSS, and JavaScript. MySQL was selected as the database management system, XAMPP as the local web server, and Figma was used to design the user interface before implementation.

3. Modeling Quick Design

The Modeling Quick Design stage transformed the identified functional requirements into a visual system design. Unified Modeling Language (UML) was used to model the interactions between the system and its users. The resulting Use Case Diagram is presented in Figure 2.

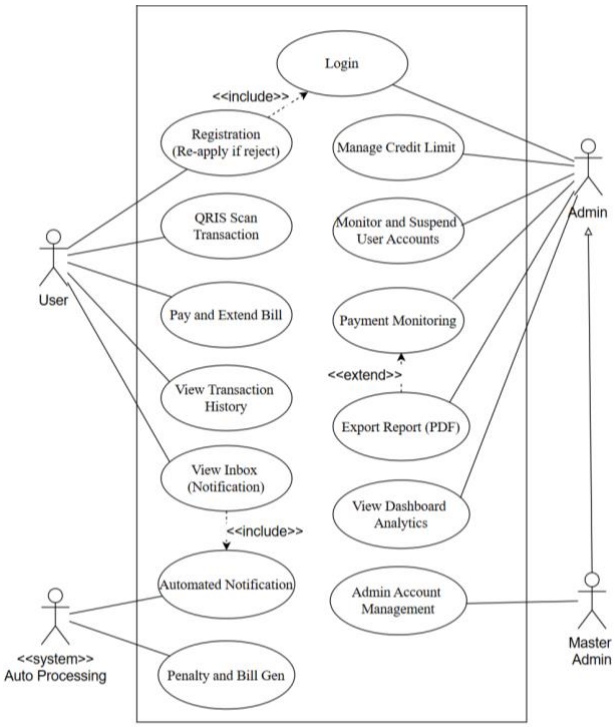


Figure 2. Use Case Diagram of the Proposed PayQRIS System

Figure 2 illustrates the interactions between the Master Admin, Admin, and User with the proposed PayQRIS system. The diagram represents the main system functionalities identified during the Communication stage and serves as the basis for system implementation.

4. Construction of Prototype

During the Construction of Prototype stage, the proposed PayQRIS system was implemented as a functional web-based application. The developed prototype consists of several core modules, including user authentication, credit limit calculation, QRIS-based PayLater transactions, and installment and bill management. The implementation of these modules is presented in the following sections.

User Authentication

The user authentication module was implemented to ensure that only authorized users can access the PayQRIS system. Users are required to log in using their registered

email address and password before accessing the available system features. The implementation of the login interface is presented in Figure 3.

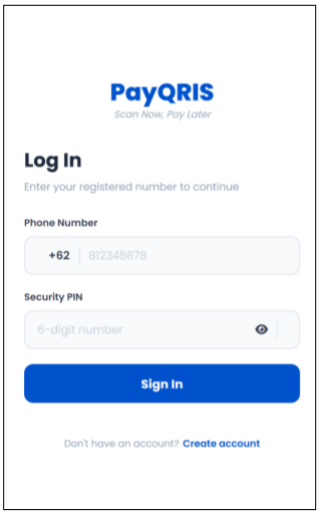


Figure 3. Login Interface of the Proposed PayQRIS System

As shown in Figure 3, the system provides a responsive login interface that can be accessed through desktop and mobile devices. After successful authentication, users are granted access to the PayQRIS dashboard according to their assigned roles.

QRIS-Based PayLater Transaction

The QRIS-based PayLater transaction module enables users to perform cashless payments using their available credit limit. Before a transaction can be completed, the system determines the user's credit limit based on monthly income. In accordance with OJK Circular Letter Number 19/SEOJK.06/2023, the maximum initial credit limit is set at 30% of the user's monthly income, as calculated using Equation (1).

$$Credit\ Limit = Monthly\ Income \times 30\% \quad (1)$$

After the available credit limit has been determined, users can perform QRIS-based PayLater transactions through QRIS code scanning, installment tenor selection, and transaction PIN verification. The implemented transaction flow is presented in Figure 4.

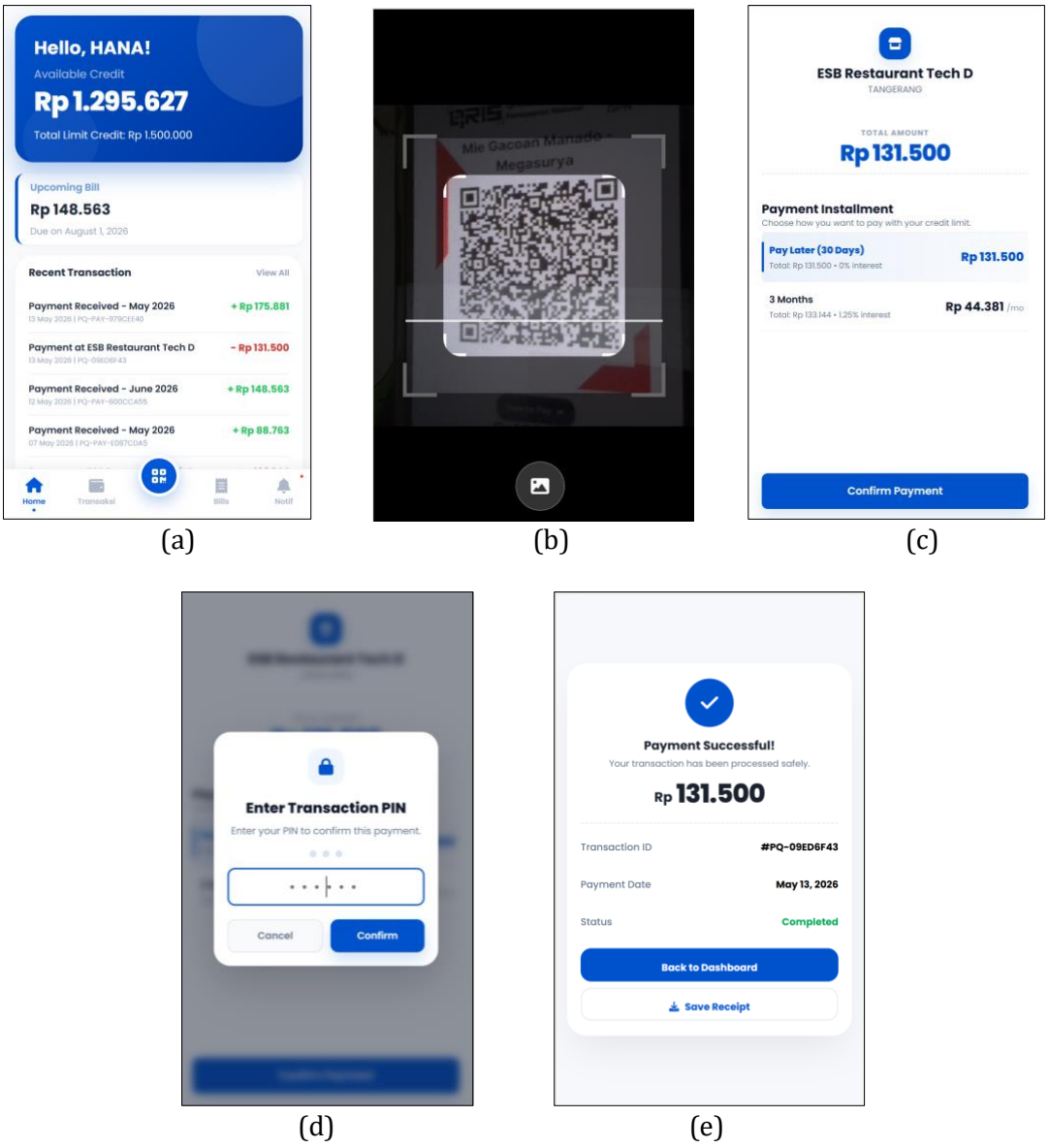


Figure 4. QRIS-Based PayLater Transaction

As shown in Figure 4(a), the dashboard displays the user's available credit limit before a transaction is initiated. Users then scan a QRIS code using the scanner interface shown in Figure 4(b). After the QRIS code is successfully recognized, the system displays the transaction details and available installment options for payment confirmation, as illustrated in Figure 4(c). The applicable interest rate and monthly installment are automatically calculated based on the selected installment tenor using the flat-rate method presented in Equation (2). The transaction is subsequently verified using a transaction PIN (Figure 4(d)) before the payment is successfully completed, as shown in Figure 4(e).

Interest Rate

The applicable interest rates used in the PayQRIS system are based on the interest rate scheme implemented by SPayLater (Shopee), one of the PayLater services operating under the supervision of the Financial Services Authority (OJK). These rates are used as simulation parameters to calculate the monthly installments for each available installment tenor. The interest rates applied in the system are presented in Table 2.

Table 2. Interest Rate Percentage

Tenor Option	Interest Rate
1 Month	0%
3 Months	2.95%
6 Months	2.95%
12 Months	2.95%

Installment Calculation

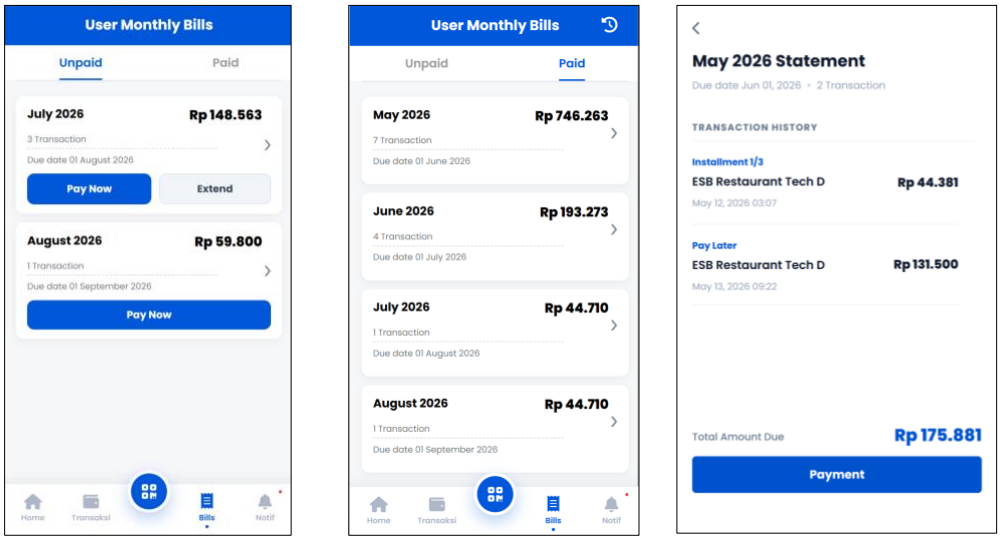
The PayQRIS system calculates monthly installments using the flat-rate method, in which the interest amount remains constant throughout the repayment period. The monthly interest is calculated using Equation (2).

$$Monthly\ Interest = \frac{P \times i \times t}{jb} \quad (2)$$

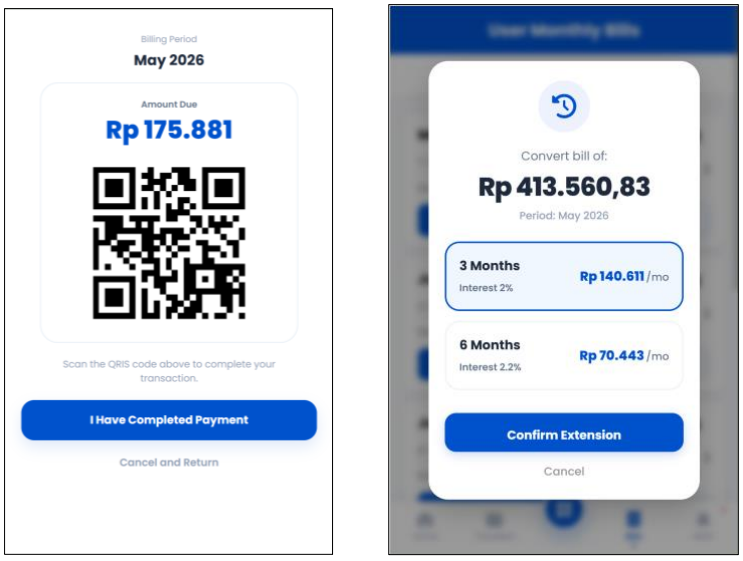
where P is the transaction amount, $i$is the interest rate, $t$is the installment period in years, and jb is the number of installment months. Based on this calculation, the system automatically determines the monthly installment amount according to the selected installment tenor.

Bill Management

The bill management module enables users to monitor outstanding bills, complete installment payments, and request bill extensions directly through the PayQRIS system. In addition, the system automatically applies a late payment penalty when payments are made after the specified due date. The implementation of the bill management module is presented in Figure 5.



(a) (b) (c)



(d) (e)

Figure 5. Bill Management Interface

As shown in Figure 5(a) and Figure 5(b), the system displays users' unpaid and paid bills. Users can view detailed billing information and complete installment payments through the interfaces presented in Figure 5(c) and Figure 5(d), respectively. For eligible bills, the system also provides a bill extension feature, as illustrated in Figure 5(e), allowing users to extend the repayment period according to the available installment options.

Late Payment Penalty

The PayQRIS system automatically applies a late payment penalty to bills that remain unpaid after the due date. In accordance with OJK Circular Letter Number 19/SEOJK.06/2023, the penalty rate is set at 0.1% per calendar day of the outstanding bill. The penalty is calculated using Equation (3).

$$Penalty = Outstanding\ Bill \times 0.1\% \times Late\ Days \quad (3)$$

where *Outstanding Bill* represents the total unpaid bill and *Late Days* represents the number of days the payment is overdue. Using this calculation, the system automatically adds the penalty amount to the outstanding bill when the payment is made after the due date

Administrative Functions

The administrative module was implemented to support system management and monitoring activities. Through this module, administrators can review credit limit applications, monitor user accounts and payment activities, and access system summaries through a centralized dashboard. The implementation of the administrative interface is presented in Figure 6.



Figure 6. Administrative Interface

As shown in Figure 6(a), the administrator dashboard provides an overview of system information, including recent transactions and pending credit limit requests. Credit limit applications submitted by users can be reviewed, approved, rejected, or adjusted through the interface shown in Figure 6(b). The user directory in Figure 6(c) enables administrators to manage user accounts and view user information, while Figure 6(d) presents the payment monitoring interface, which allows administrators to monitor users' payment activities and credit limit utilization.

5. Deployment, Delivery, and Feedback

The Deployment, Delivery, and Feedback stage focused on evaluating the implemented PayQRIS system to ensure that all functionalities operated correctly and that the system provided a satisfactory user experience. The evaluation was conducted using Black Box Testing to verify the functional requirements and the System Usability Scale (SUS) questionnaire to measure system usability.

Black Box Testing

Black Box Testing was conducted to verify whether the functional requirements identified during the Communication stage (Table 1) were successfully implemented and operated according to the specified system behavior. The testing focused on validating the system's inputs, outputs, and expected behavior without examining the internal program code. The summary of the testing results is presented in Table 3.

Table 3. Summary of Black Box Testing Results

FR Code	Test Scenario	Expected Result	Test Result
FR-01	Log in to the system using a registered email address and password.	The user is successfully logged into the PayQRIS system.	Passed

FR-05	Submit a credit limit application.	The credit limit application is successfully submitted.	Passed
FR-06	Review, approve, or reject a credit limit application.	The application status is updated according to the administrator's decision.	Passed
FR-08	Complete a QRIS payment and select an installment tenor.	The payment is successfully processed according to the selected tenor.	Passed
FR-09	Enter the correct transaction PIN.	The transaction is successfully verified.	Passed
FR-10	Enter an incorrect transaction PIN three consecutive times.	Transaction verification is locked for five minutes.	Passed
FR-13	Pay a bill using the generated payment QR Code.	The bill status is updated after successful payment.	Passed
FR-14	Extend an eligible bill.	The bill repayment period is successfully extended.	Passed
FR-16	Access the payment transaction monitoring page.	Payment transaction data is displayed correctly.	Passed

The testing results indicate that all tested functional requirements performed as expected. No functional failures were identified during the testing process, indicating that the implemented modules operated according to the specified functional requirements. These results confirm that the proposed PayQRIS system successfully fulfilled the functional requirements defined in Table 1. Functional Requirements.

System Usability Scale (SUS)

The usability of the proposed PayQRIS system was evaluated using the System Usability Scale (SUS). The evaluation involved users who interacted with the implemented system and completed a ten-item questionnaire using a five-point Likert scale. The SUS evaluation results are presented in Table 4.

Table 4. System Usability Scale (SUS) Evaluation Results

Evaluation	Result
SUS Score	83.25
Acceptability	Acceptable
Grade Scale	B
Adjective Rating	Excellent

The obtained SUS score of 83.25 indicates that the proposed PayQRIS system provides a satisfactory user experience. Based on the SUS interpretation, the system is considered acceptable, achieves Grade B, and is classified as Excellent in terms of usability. These findings demonstrate that the implemented system is easy to learn, efficient to use, and well accepted by users. Furthermore, the results suggest that users were able to complete the main system functions with minimal difficulty, indicating that the proposed interface effectively supports the QRIS-based PayLater transaction workflow.

CONCLUSION AND SUGGESTIONS

Conclusion

This study successfully developed PayQRIS, a web-based PayLater system for QRIS payments using the Prototyping development method. The developed system provides

features including user authentication, credit limit calculation, QRIS-based PayLater transactions, bill management, and administrative functions. Functional evaluation using Black Box Testing confirmed that the implemented system fulfilled the specified functional requirements. In addition, the usability evaluation produced a System Usability Scale (SUS) score of 83.25, indicating that the proposed system is acceptable and provides a satisfactory user experience. These results demonstrate that the proposed PayQRIS system can support QRIS-based PayLater transactions effectively while offering good usability.

Suggestions

Future research may focus on integrating the proposed system with actual QRIS payment gateways and financial institutions to enable real-time payment processing and more comprehensive financial service features. Furthermore, future studies may enhance the proposed system by implementing more comprehensive credit assessment mechanisms, strengthening transaction security, and expanding system functionalities to better support practical implementation in the financial technology sector.

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