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Implementation of a Web-Mobile-Based Cashless Parking Retribution Payment System Using QR Code Method

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Abstract

The widespread practice of illegal parking in Batam City has led to a decline in Local Own-Source Revenue (PAD) and contributed to disorder in public spaces. The existing manual parking retribution payment system is deemed ineffective in addressing unauthorized fee collection and lacks transaction transparency. This study aims to develop a non-cash parking retribution payment system based on web mobile technology using QR Code methods. The system development method employed is Agile, encompassing the stages of Plan, Design, Develop, Test, Deploy, Review, and Launch. The application was developed using Kotlin for the Android platform and Laravel as the back-end framework, offering features such as QR Code scanning, automatic transaction recording, and a user-friendly interface. Testing results indicate that the system can enhance the efficiency of parking management, reduce direct interaction between users and parking attendants, and strengthen transparency and accountability in the recording of retribution payments. The implementation of this system is expected to serve as a sustainable solution for the modernization of parking services and the improvement of PAD in Batam City.

Keywords:

QR Code, Cashless Parking, Web Mobile Application, Local Revenue (PAD)

Introduction

The transportation sector and public space management in Indonesia face serious challenges due to the presence of unauthorized parking practices. Batam City, as one of the rapidly growing industrial and commercial cities, is experiencing similar issues. The presence of illegal parking attendants who collect parking fees unlawfully not only causes public discomfort but also directly reduces the region's Local Own-Source Revenue (Pendapatan Asli Daerah, PAD). Moreover, disorderly illegal parking practices contribute to traffic congestion and misuse of road space (Siregar & Pamadi, 2024)

A crackdown conducted by the Criminal Investigation Unit of Barelang Police during Operation Pekat Seligi 2025 revealed that eight illegal parking attendants were apprehended at several strategic points in Batam. The raids uncovered evidence such as unofficial parking tickets and illegally collected money, which confirms that illegal parking activities are still widespread beyond authorized operational hours (Btm.co.id, 2025). This situation indicates that conventional supervision has not been effective in addressing the issue. Consequently, there is a growing need for a technology-based approach to enhance transparency, efficiency, and accountability in the management of parking fees.

The advancement of digital technology, particularly in mobile-based applications, provides an opportunity to implement a cashless parking fee payment system using Quick Response (QR) code methods. This system can reduce direct contact between users and parking attendants, minimize illegal fee collection, and enable automated, real-time transaction recording. (Rahayu et al., 2023) stated that the implementation of an e-parking system in

Medan City successfully increased parking fee revenue by 49.10%, demonstrating that parking system digitalization can significantly improve local revenue management.

However, the manual system still employed in Batam City is considered ineffective in preventing revenue leakage due to weak supervision and lack of transparency. Therefore, the development of a digital parking payment application that is adaptive, user-friendly, and compatible with mobile devices is essential. (Putra, 2020) showed that implementing an Android-based application with QR code integration can simplify the payment process and reduce queues and physical interaction. Furthermore, (Arasy et al., 2024) applied a prototyping method in developing a smart parking application to improve functional accuracy before large-scale implementation. With adequate infrastructure support and public education, this system is expected to enhance orderly parking management and eliminate illegal parking practices in a sustainable manner.

Literature Review

Several studies have examined the application of digital technology in parking systems to enhance the efficiency and transparency of retribution management. (Fauzi et al., 2022) developed a hybrid e-parking system integrated with QRIS, achieving a user acceptance rate of 87.13%, demonstrating the potential of digital payments to improve user convenience. However, this study primarily focused on user acceptance and paid less attention to real-time transaction recording, which is crucial for retribution transparency.

(Aldy Purnomo et al., 2023) concentrated on the PARKIR-GO application, employing a knowledge management approach to improve the effectiveness of internal record-keeping and decision-making. Although this approach enhanced data management, it did not sufficiently address user engagement in the payment process, which is a primary focus of web-based mobile systems.

(Nurjoko et al., 2024) implemented a QR Code-based parking system in a campus parking lot to address space limitations. However, this solution did not integrate digital payment mechanisms that could strengthen financial accountability, rendering it less applicable to regional parking retribution management.

(Amras et al., 2023) developed a parking ticket system based on REST API and QR Code to reduce queues and dependence on physical tickets, demonstrating technical effectiveness. Nevertheless, this study did not discuss the direct impact on regional revenue enhancement or the prevention of illegal parking practices.

In policy studies, (Novaria, 2024) emphasized that the use of QRIS for parking retribution payments can increase local government revenue (PAD). Nonetheless, this research identified significant challenges such as low digital literacy and limited infrastructure, which hinder the optimal implementation of the system.

A synthesis of these studies indicates that QR Code and QRIS technologies have proven substantial potential in improving the efficiency and transparency of parking payment systems. However, most research remains focused on technical and operational aspects, with limited examination of adaptive, real-time web-based mobile system integration and comprehensive socio-economic impact evaluations. Therefore, this study aims to address these gaps by developing a non-cash parking retribution payment system based on web mobile technology using QR Code methods that not only facilitate transactions but also enhance accountability and reduce illegal parking practices in Batam City.

In order to strengthen the development of an integrated, adaptive, and accountable mobile web-based parking retribution payment system, it is essential to elaborate on several foundational concepts. These include the definition and significance of parking retribution, along with the core technologies that support the system, such as Quick Response (QR) Code, Android, Kotlin, Laravel, and flowchart-based modeling. Each of these components plays a critical role in shaping the functionality and reliability of the proposed digital system.

1) Parking Retribution

Parking retribution refers to a type of regional levy imposed by local governments on the utilization of public parking facilities, serving as a direct source of Local Own-Source Revenue (PAD). According to (Tanan & Horo, 2024) such levies are integral to local revenue systems, particularly in sectors such as vehicle inspections, terminals, and parking services. A case study in Kupang Regency revealed that while vehicle inspection levies significantly

contributed to PAD, parking and terminal levies remained comparatively low. This disparity underscores the need for enhanced governance, supervision, and strategic management to optimize the revenue-generating potential of all retribution sectors and to support sustainable regional development financing.

2) Quick Response (QR) Code

The Quick Response (QR) Code is a two-dimensional barcode technology capable of encoding information into a visual format that can be swiftly read by mobile devices such as Android smartphones (Suradi et al., 2023). Within parking systems, QR Codes facilitate efficient vehicle verification and the automated logging of entry and exit times, eliminating the need for additional hardware such as computers or ticket printers. Key data—such as vehicle license plate numbers and timestamps—can be captured in real-time and stored directly in a centralized database. This not only increases operational accuracy and efficiency but also supports full integration with cloud-based infrastructures, thereby enhancing system responsiveness and transparency.

3) Android

Android is an open-source mobile operating system based on the Linux kernel, widely utilized in smartphones and tablet devices (Rahmat Gunawan et al., 2021). It offers a user-centric interface, comprehensive support for Google services, and significant flexibility for developers in designing customized applications. The Android development ecosystem includes robust tools such as Android Studio and the Android Software Development Kit (SDK), which collectively streamline the coding, debugging, and testing processes. These capabilities make Android a highly suitable platform for deploying scalable, mobile-based public service applications, including parking payment systems.

4) Kotlin

Kotlin is a modern programming language that combines object-oriented and functional programming paradigms and runs on the Java Virtual Machine (JVM (Formasi et al., 2024). It offers a concise and expressive syntax, which contributes to writing clean and maintainable code. Kotlin is fully integrated into the Android Studio environment and is officially supported by Google for Android development. Its increasing popularity among developers and its adoption in high-profile applications such as Google Play and Netflix reflect its industrial reliability. As such, Kotlin provides an effective tool for accelerating and optimizing the development of mobile-based solutions.

5) Laravel

Laravel is an open-source PHP web application framework designed to simplify the software development process through the implementation of the Model-View-Controller (MVC) architectural pattern (Amanullah & Santoso, 2023) It provides a suite of built-in features including routing, middleware, session management, and user authentication, all of which contribute to the rapid and secure development of dynamic web applications. Laravel's modular structure, extensive documentation, and active community support make it a preferred framework for building modern, responsive, and maintainable web platforms—particularly for administrative and backend services within integrated systems.

Research Methods

This study was conducted through a series of structured stages, beginning from planning to system testing. The initial phase involved data collection aimed at obtaining information and identifying the needs faced by parking attendants and users in Batam City. Data collection was carried out using direct field observations as well as informal interviews with parking attendants and users. Through this approach, the researchers were able to gain a direct understanding of the current parking fee payment process, as well as various challenges encountered, such as potential illegal levies, limitations in transaction recording, and low transparency. The interviews included questions regarding the parking fee payment flow, the involvement of attendants in recording payments, and public responses to the possible implementation of a digital QR Code-based payment system. Additionally, secondary data were obtained from relevant literature, including previous research journals related to parking system digitalization, the use of QR Code methods in payments, and technologies employed in developing web-based mobile applications.

The data collection period for this study spanned from april 05, 2025, to may 03, 2025. During this four-week timeframe, the data gathered comprised information about the payment process flow, the role of parking attendants, types of payment methods used, and obstacles faced in the implementation of the manual system. Furthermore, documentation was conducted on parking locations, physical evidence of manual parking tickets, and interactions between service users and attendants. Throughout this period, the necessary data to support the application development were available and could be used as a basis for requirements analysis and the design of a non-cash QR Code-based payment application.

The research method applied in this study is the Agile method, which is a software development approach based on the principle of incremental system expansion within a short timeframe. This method emphasizes the importance of rapid and continuous interaction between the development team and changes occurring in various forms during the development process. Generally, Agile is implemented through repeated iterative cycles, completing small parts gradually, thus allowing effective adjustments in the application development without having to complete the entire process simultaneously.

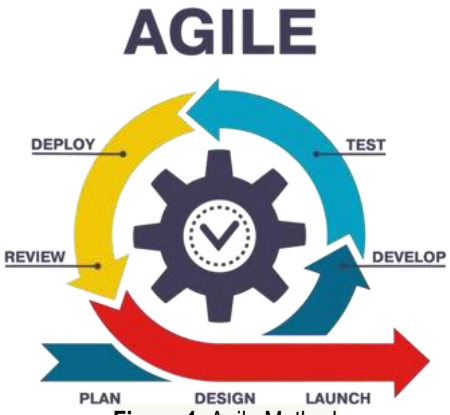

Figure 1. Agile Method

The system development process in this research followed the Agile framework, which consists of seven main stages: Plan, Design, Develop, Test, Deploy, Review, and Launch. Each of these stages is elaborated below.

In the Plan stage, the researchers conducted an initial identification of the parking retribution issues in Batam City, including illegal fee collection practices, the lack of transaction transparency, and the limitations of the manual system. This process involved field observations and informal interviews with both parking attendants and service users. The collected information was used to define the system requirements and to identify key features to be developed in the application, such as QR Code integration, automatic transaction logging, and a user-friendly interface.

The second stage, Design, focused on developing the system layout and user interface. This process began with the creation of wireframes as the initial layout sketches, which were then further developed into mockups and prototypes. At this stage, the researchers ensured that the application flow would be intuitive and efficient for public use. The design included QR Code scanning schemes, cashless payment workflows, and the display of transaction data.

The Develop stage involved building the application based on the previously finalized designs. Key features, such as QR Code scanning functionality, real-time retribution recording, and a dashboard for administrative data management, were developed incrementally. A modular approach was applied to facilitate debugging and system maintenance. The entire development process followed clean code principles to maintain high-quality and well-structured programming standards.

Next, the Test stage was conducted to ensure that each feature worked as expected and that the system was free from bugs. Testing was carried out using the black box testing method, which focuses on validating the

application's functionality without accessing its internal code. This testing included simulating user transactions, scanning QR Codes, and recording transaction data into the system.

The fifth stage, Deploy, involved uploading the application to a staging environment to be tested under real-world conditions. During this phase, the researchers monitored the system's performance and device compatibility, and initial configuration steps were taken to ensure the application could be accessed and used optimally.

The Review stage was conducted with key stakeholders, including representatives from the Batam City Department of Transportation and members of the public who use parking services. In this session, the developed features were comprehensively reviewed. Feedback from stakeholders served as the basis for making improvements, whether technical, interface-related, or usability-related.

The final stage was Launch, which marked the release of the application into a production environment for official public use. Prior to launch, the application was ensured to be stable and ready for deployment. After its release, the system was continuously monitored to anticipate potential issues such as bugs or server errors, which would be addressed promptly to maintain reliable service continuity.

Results and Discussion

Based on the identified problems and the solution developed using the agile methodology, an Android- based online parking payment system was built. The application utilizes Kotlin as the front-end programming language and the Laravel framework as the back-end. The following is a flowchart illustrating the system workflow.

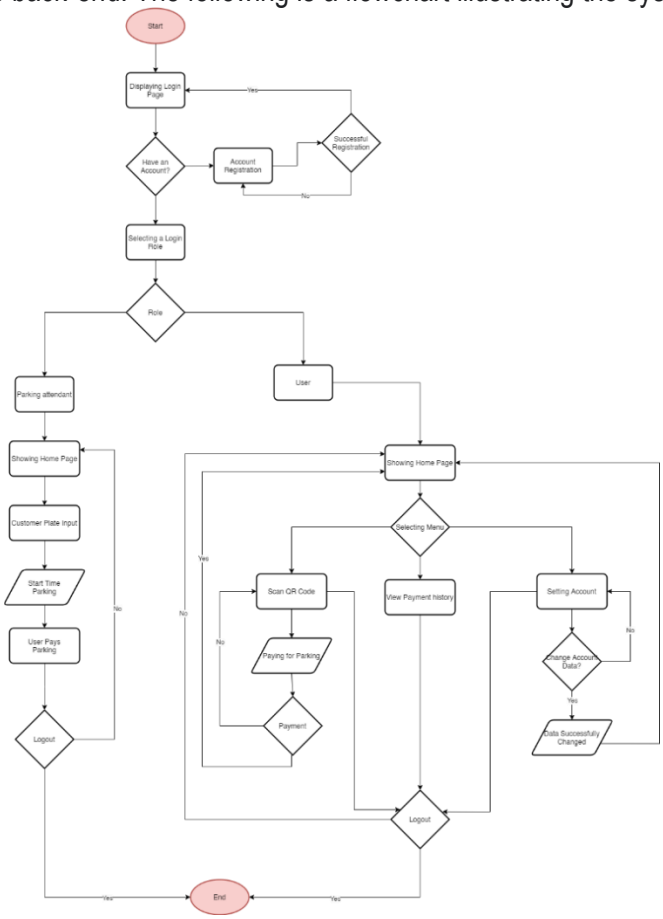

Figure 2. Flowchart

The system is divided into two user roles: regular users and parking attendants, starting from the login page. Users can register for an account if they do not have one or select their role if they already have an account. Regular users are directed to the main page, where they can enter their vehicle license plate number, view payment history,

or manage their account. Parking attendants input parking time. The system supports payments via QR code and allows users to log out, with the process ending upon successful logout or data modification

Figure 3. Splash Screen Page

The splash screen is used to display the name of the parking application to make it look more responsive. The splash screen appears when the application is first opened before being directed to the login page.

Figure 4. Login Page

The login page used by parking attendants and users to access the application. On this page there is an email and password input. This input must match what has been registered. If the user does not have an account, they can register.

Figure 5. Register Page

On this registration page is only intended for users. for parking attendants can be directly registered by the admin via the admin web. at the registration stage users are required to enter their full name, email, password, telephone number. and the role that has been set by the customer because this list is only intended for customers.

Figure 6. Parking Attendant Homepage

On the parking attendant's homepage there is information about the parking attendant's name and email. then there are 2 menus, namely add parking and active parking. on the add parking page it is used to input new motorcyclists who will park at the shop. then there is active parking which is used to provide information to the parking attendant about drivers who are still parked at the shop.

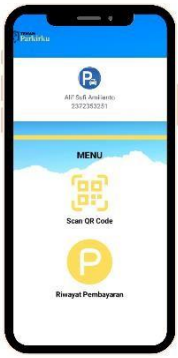

Figure 7. Customer Homepage

On this page there is information such as the application logo, username and email displayed according to the user who is logged in. there are 2 main menus, namely the "bayar parkir"menu and the user's "history pembayaran". when the user selects the parking payment menu, they will automatically be directed to the "payment details" page.

Figure 8. Payment Details Page

On this registration page is only intended for users. for parking attendants can be directly registered by the admin via the admin web. at the registration stage users are required to enter their full name, email, password, telephone number. and the role that has been set by the customer because this list is only intended for customers.

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On this page there is information such as the application logo, username and email displayed according to the user who is logged in. there are 2 main menus, namely the "bayar parkir"menu and the user's "history pembayaran". when the user selects the parking payment menu, they will automatically be directed to the "payment details" page.

Figure 8. Payment Details Page

On this page there is information about the vehicle plate number, parking start time, hourly parking rate, and parking time duration. This page is used for information before making a payment.

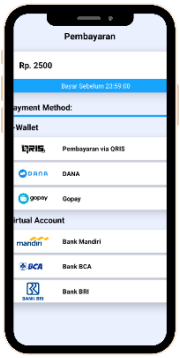

Figure 9. Select Payment Page

On this page there is information about how to choose a parking payment method for users. On this page you can see how much the fee is to be paid, the payment deadline, and the payment method chosen by the user.

Conclusions

This research has successfully developed a non-cash parking retribution payment system using QR Code technology. This Android-based application built with the Kotlin and Laravel frameworks effectively addresses illegal parking practices and increases revenue transparency. This system features multiple user roles, automatic transaction recording, and an intuitive interface developed through agile methodology. The implementation results show significant potential to eliminate revenue leakage, reduce physical contact between users and officers, and increase parking management efficiency. This digital solution provides a sustainable approach to modernizing parking services while strengthening local revenue collection systems through enhanced accountability and real-time monitoring capabilities.

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