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Development of a web-based registration system for prospective parking attendants for data management efficiency

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Abstract: This study aims to develop a web-based registration system for prospective parking attendants at the UPTD Parking Service in the Transportation Department of Batam City. Currently, the process of managing prospective parking attendant data is done manually, leading to time-consuming registration procedures. The absence of a proper information system makes it difficult for prospective parking attendants to find information about the registration process at the Batam City Transportation Department. This system was developed by using PHP programming and MySQL database. The development follows the SDLC Waterfall model, which consists of five phases: requirements analysis, system design, coding, program testing, and system implementation. The system was modelled by using Unified Modeling Language (UML), including use case diagrams, activity diagrams, class diagrams, and sequence diagrams. System testing was conducted by using black-box testing and tested by users. The results of this study include the requirements analysis, system design with UML modeling, and eight supporting tables for the development of the web-based application. The system has been tested on local host and through black-box testing, and it is deemed successful in assisting the management of prospective parking attendant registration. However, the application is limited to the admin and user pages. There is a need for data classification on the system dashboard to present a more executive-level display in line with the registration form for prospective parking attendants. Additionally, there is a need for improvements in human resources to ensure proper operation and maintenance of the system.

Keywords: information system; parking attendants; waterfall; digitalization; parking management

1. Introduction

The rapid advancement of communication and information technology has significantly influenced various aspects of human life (Criollo-C et al., 2024; Prasetya et al., 2024, 2025). Technology is no longer merely a tool for communication and information exchange between individuals in social interactions but has also become a crucial component in institutional relationships, inter-regional connectivity, and even cross-border collaborations spanning continents (Dwivedi et al., 2020). This digital transformation has led to fundamental changes in societal behavior and interaction patterns. Traditional face-to-face communication has increasingly been replaced by technology-mediated interactions, leading to efficiency in various sectors (Al-Fodeh et al., 2021; Cavus et al., 2021; Nadeem et al., 2022). However, this shift has also raised concerns regarding the diminishing role of local wisdom, particularly in maintaining cultural heritage within a broader societal.

Batam City is experiencing rapid urban development, marked by continuous infrastructure expansion (Adi et al., 2024; Kusuma et al., 2023). This urbanization has resulted in a significant increase in motor vehicle ownership, further complicating parking space management. The growing number of vehicles necessitates

an efficient parking system to prevent congestion and improve accessibility (Kazi et al., 2018; Yan et al., 2019). In parallel, the rapid evolution of electronic information and transactions (ITE) has encouraged the adoption of digital solutions in various public service sectors (Putrevu & Mertzanis, 2024; Zhang & Kimathi, 2022). The Batam City Transportation Department recognizes the need for a web-based application that provides comprehensive parking information to the public. Such an application would facilitate access to real-time parking data, vehicle volume statistics, and details of parking attendants responsible for specific areas.

Despite the growing demand for an efficient parking management system, the Batam City Transportation Department currently lacks a structured and integrated information system to manage parking attendants' data effectively. The existing manual data collection process is highly susceptible to errors, inconsistencies, and potential misuse by unauthorized parties (Duggineni, 2023). This inefficient approach results in delays, inaccuracies, and challenges in tracking the registration and allocation of parking attendants. Therefore, a web-based registration information system for parking attendants is essential to streamline data collection, enhance accuracy, and improve overall efficiency in managing parking personnel.

Previous studies on parking management have primarily focused on optimizing parking space allocation using smart parking systems and IoT-based solutions (Aboshosha et al., 2023; Ahmad et al., 2022; Ayaz et al., 2019). While these innovations contribute to urban mobility improvements, limited research has explored the implementation of web-based registration systems specifically for managing parking attendants. Additionally, most existing studies emphasize infrastructure and vehicle management rather than addressing the administrative challenges faced by local transportation authorities in maintaining accurate personnel records (Sassani et al., 2021; Xia et al., 2023). This research gap highlights the necessity for a systematic approach to integrating digital solutions into administrative workflows within the public sector. Furthermore, while several cities worldwide have adopted digital parking management systems, the specific context of Batam City presents unique challenges (Yoga et al., 2024). The city's rapid expansion, coupled with an increasing number of informal parking attendants, demands a tailored solution that accommodates local regulatory frameworks and socio-economic conditions. Addressing this gap requires a structured methodology that ensures system effectiveness while maintaining compliance with local policies and improving transparency in parking attendant registration and management.

The urgency of this research stems from the pressing need to enhance public service efficiency through digital transformation. The increasing volume of vehicles in Batam City exacerbates parking-related issues, making it imperative to develop an integrated information system that supports data accuracy and efficient personnel management. By leveraging a web-based registration system, the Transportation Department can mitigate risks associated with manual record-keeping, prevent fraudulent activities, and ensure transparency in appointing parking attendants.

Moreover, this study aligns with the Sustainable Development Goals (SDGs), particularly SDG 9 (Industry, Innovation, and Infrastructure) (Saieed et al., 2021). By fostering technological advancements in public service management, the proposed system contributes to improving infrastructure development and enhancing service delivery efficiency. Additionally, implementing a robust data management system can serve as a model for other municipalities seeking to modernize their administrative processes and improve urban mobility management.

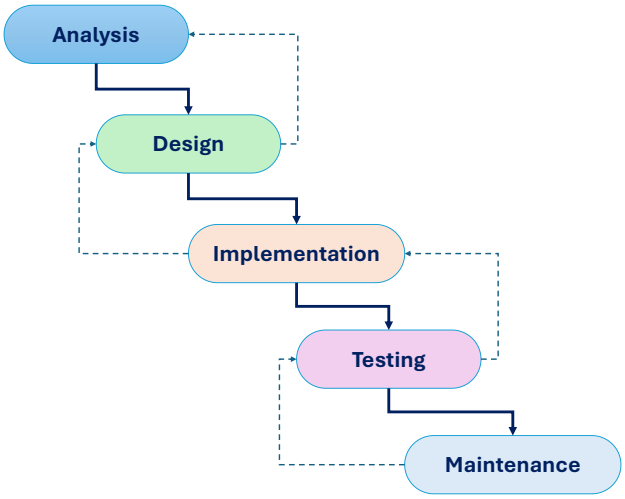
Given these considerations, this study aims to design and implement a web-based parking attendant registration information system using the waterfall methodology. The proposed system is expected to provide a structured, transparent, and efficient solution for managing parking attendant data while addressing the limitations of manual data processing. By integrating digital technology into administrative workflows, this research seeks to contribute to the broader discourse on digital governance and smart city development. To achieve these objectives, the study formulates the following research questions:

1. How can a web-based parking attendant registration information system be designed for the UPTD Pelayanan Parkir at the Batam City Transportation Department?
2. How can the designed system be effectively implemented to streamline the registration process and management of parking attendants?

2. Methods

The system development method used in this study follows the Waterfall Model. The Waterfall Model is a structured approach within the Software Development Life Cycle (SDLC) that is widely applied in information system and software development (Christanto & Singgalen, 2023; Pinciroli et al., 2022; Segura, 2021). This model follows a sequential process where each phase is completed before moving on to the next, ensuring systematic progression without skipping any steps. The development process begins with planning, followed by analysis, design, implementation, testing, and system maintenance (Aroral, 2021).

Figure 1. Stages of the waterfall model



2.1 Data collection

Data collection for system requirements analysis is conducted through both primary and secondary sources. Primary data is gathered through interviews with staff from the Technical Implementation Unit of the Batam City Transportation Department to understand the current registration process for parking attendants. Secondary data includes general and specific descriptions of the technical service unit, as well as manual registration forms that have been used in the existing system.

2.2 System analysis

System analysis is a problem-solving technique that breaks down system components to evaluate their functionality and interactions in achieving the system's objectives. The key aspects of the system being developed include a web-based system using PHP as the server-side scripting language and MySQL as the database. To facilitate development and maintenance, the system will be built using the CodeIgniter framework.

2.3 System design

The design phase focuses on defining the system architecture and user interface to ensure usability and efficiency. This includes database design to structure and organize parking attendant data efficiently, user interface design for an intuitive and user-friendly experience, and system workflow diagrams to visualize user interactions with system components.

2.4 System implementation

The implementation phase involves coding and developing the system based on design specifications. It includes developing the database schema and integrating it with the application, implementing core functionalities such as user authentication, data entry, and report generation, and deploying the system on a web server for initial testing and evaluation.

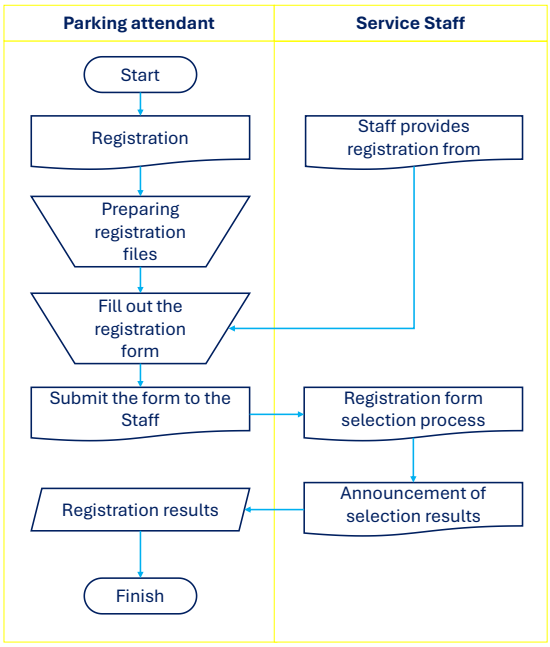
2.5 System testing and maintenance

The testing phase ensures the system functions correctly by identifying and resolving issues. This includes unit testing for individual components, integration testing to verify interactions between different modules, and user acceptance testing (UAT) to assess usability and effectiveness. Following deployment, ongoing maintenance will be conducted to address any bugs, implement necessary updates, and enhance system performance based on user feedback.

3. Results and discussion

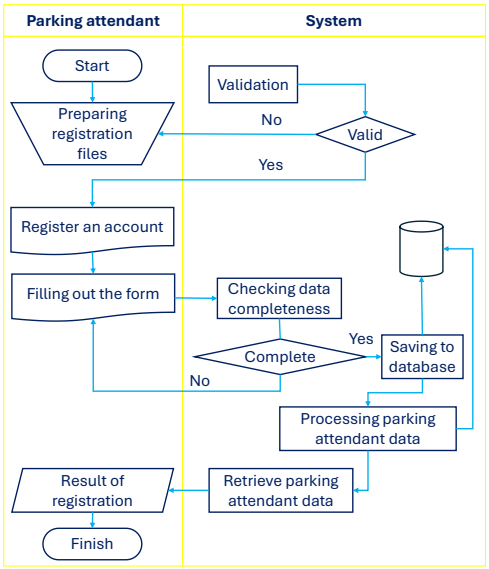
3.1 Requirement

Based on the results of interviews and an analysis of registration documents, the recruitment process begins with prospective parking attendants registering in person at the Batam City Transportation Agency office. The candidates are then required to fill out a registration form, after which the officers conduct an assessment and validation process. The selection results are determined, and to check their acceptance status, candidates must visit the Batam City Transportation Agency office to view the announcement of the selection outcome (Figure 2.a). This traditional registration system serves as the foundation for developing a new web-based registration system (Figure 2.b). In the previous system, registration forms were still in printed format, and reports were managed using Microsoft Excel and Word. However, in the newly developed system, digitalization improves the efficiency and accessibility of the registration process.



(a)

Figure 2. Registration system: (a) Traditional registration process and (b) Web-based registration process



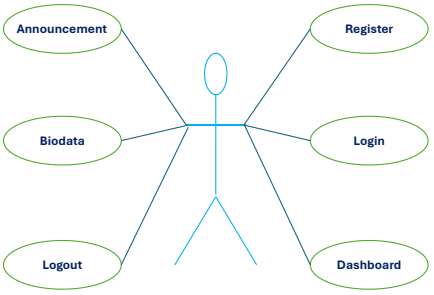
(b)

3.2 Design

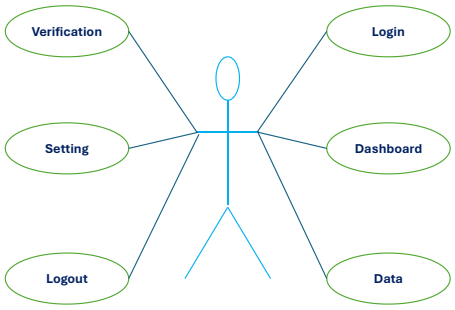
3.2.1 Use case diagram

The system design requirements are represented using UML for the development of the web-based Parking Attendant Registration Information System. The user in this system refers to prospective parking attendants, who can access the web-based registration system, which includes a login page, an informational section, and a registration menu. The admin is responsible for managing the system and has full access rights to the Parking Attendant Registration Information System application. The admin can add, modify, delete, print reports, and manage the verification of parking attendant candidates.

Figure 3.
Use case diagram: (a) User perspective and (b) Admin perspective



(a)



(b)

The definition of the proposed use case diagram for the web-based Parking Attendant Registration Information System application is presented in Table 1.

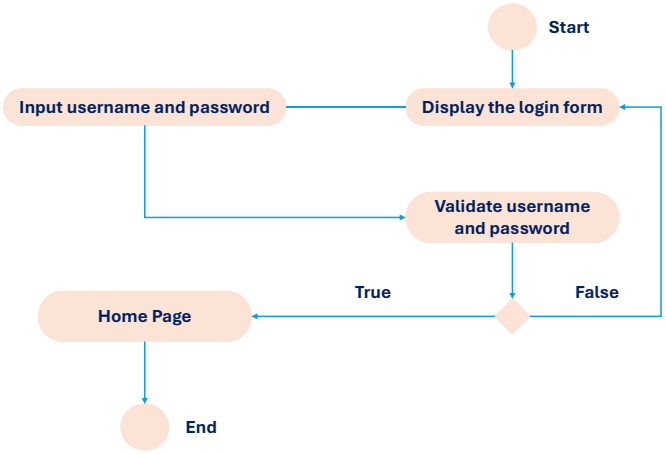
Table 1. Definition of use case diagram for admin in the parking attendant registration system

Use case	Description
Login	The process of entering, editing, or deleting user login data performed by the admin.
Data	The process of validating, editing, or deleting data performed by the admin.
Verification	The process of checking, editing, or deleting registration data conducted by the admin.
Settings	The process of managing the profile and changing the password.

3.2.2 Activity diagram

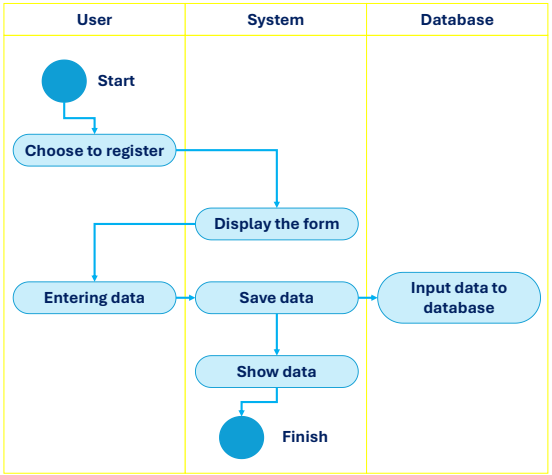
An activity diagram is another method used to model the flow of events. Several activity diagrams illustrate the ongoing process of the Parking Attendant Registration Information System. The admin and user login activity diagram is presented in Figure 4. In this diagram, both the admin and the user can access the system and view the login page. If the correct username and password are entered, the system directs them to the admin's main page. However, if incorrect credentials are entered, the system remains on the login page and displays a notification stating, "Username and password combination not found."

Figure 4. Activity diagram for admin and user login



The registration activity diagram is shown in Figure 5. In this diagram, when users select the "Registration" menu, the system displays a registration form. Users then enter their data, which is stored in the system and added to the database. The stored data is displayed for user confirmation before final submission.

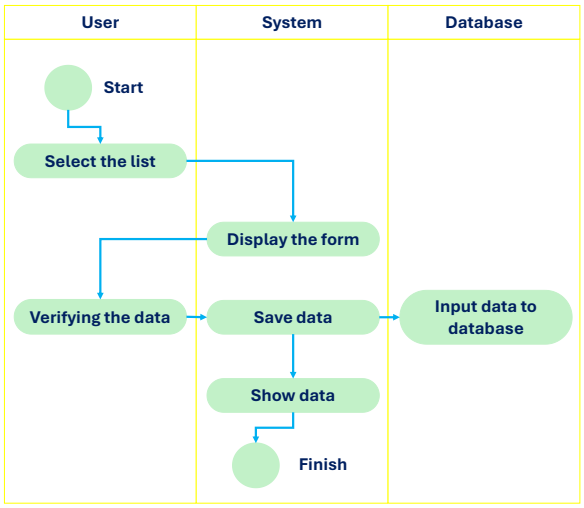
Figure 5. Activity diagram for registration



The verification activity diagram is illustrated in Figure 6. The verification process is conducted by the admin based on the registration data submitted by users. When the admin selects the verification function,

the system retrieves and displays the relevant data. The admin then verifies the data, after which the system saves and records it in the database. Once verified, the data is displayed as part of the verified records.

Figure 6.
Activity diagram for verification



3.2.3 Sequence diagram

A sequence diagram is a visual representation that illustrates interactions between objects within a system, including the messages exchanged and their execution sequence (Alvin et al., 2021). Figure 7 presents the admin and user login sequence diagram, which demonstrates the login process for both admins and authorized personnel. If the username and password are correct, the system grants access; otherwise, the system redirects the user back to the login page.

Figure 7.
Sequence diagram for admin and user login

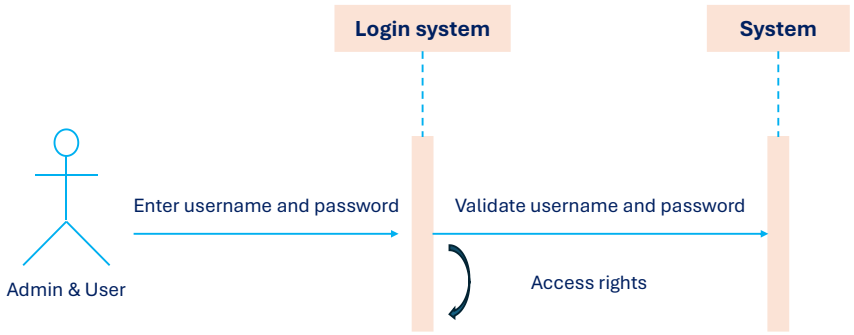
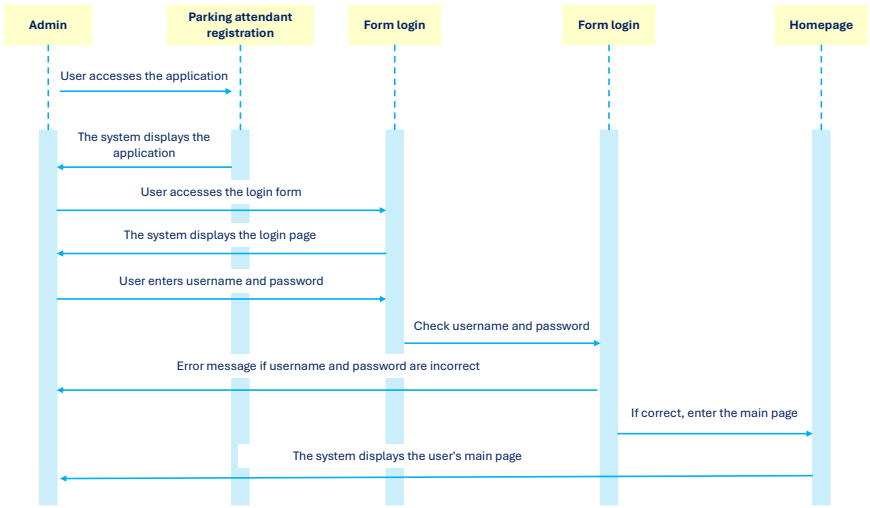


Figure 8.
Sequence diagram for parking attendant registration application



3.2.4 Database structure design

The database design supporting the web-based Parking Attendant Registration Information System at the Batam City Transportation Agency's UPTD Parking Service is presented in Table 2.

Table 2. Database structure for the web-based parking attendant registration system

Table name	Description
tbl_jukir	Stores parking attendant registration data
tbl_pdd	Stores education data
tbl_working	Stores employment data
tbl_ announcements	Stores announcement data for registration results
tbl_ income	Stores income data
tbl_user	Stores user login data for admin access
Verification	Stores verification data for registrations
web	Contains information about the registration process

3.2.5 Writing program code

This stage involves system or application development using software and hardware in accordance with the analysis and design phases to produce a fully functional system. Coding refers to the process of transforming the completed analysis and design into a working system. The system is developed using PHP programming language and a MySQL database for processing program code. Sublime Text and Notepad++ are utilized as the development environments for running the application. Once the coding phase is completed, an example of a connection program code implementation is provided.

Coding 1. Program code for the prospective parking attendant registration application

```
<?php
$db['default'] = array(
   'dsn'       => '',
   'hostname'   => 'localhost',
   'username'   => 'root',
   'password'   => 'dbjukir',
   'database'   => 'dbsdhost',
   'dbdriver'   => 'mysqli',
   'dbprefix'   => '',
   'pconnect'   => FALSE,
   'db_debug'   => (ENVIRONMENT !== 'production'),
   'cache_on'   => FALSE,
   'cachedir'   => '',
   'char_set'   => 'utf8',
   'dbcollat'   => 'utf8_general_ci',
   'swap_pre'   => '',
   'encrypt'    => FALSE,
   'compress'   => FALSE,
   'stricton'   => FALSE,
   'failover'   => array(),
   'save_queries' => TRUE
);
?>
```

3.3 Testing

Testing was conducted on each coding component using the black-box testing method. This testing process was carried out during system development, specifically focusing on program code testing. Black-

box testing was employed to assess whether the developed system aligns with the functional specifications. Additionally, black-box testing was utilized to evaluate the functionalities of the Web-based Prospective Parking Attendant Registration Information System implemented at the Parking Service Unit (UPTD) of the Batam City Department of Transportation.

Table 3. Testing of the Prospective Parking Attendant Registration Application Page

Testing activity	Expected outcome	Result
Admin main page	Login menu appears	Success
Dashboard	Dashboard data displayed	Success
Data	Data page displayed	Success
Modify data	Data modification page displayed	Success
Delete data	Delete command appears	Success
Search data	Search results displayed	Success
Print	Printable data displayed	Success
Verification	Verification data displayed	Success
Modify data	Data modification page displayed	Success
Delete data	Delete command appears	Success
Search data	Search results displayed	Success
Settings	Account settings page displayed	Success
Change password	Password change page displayed	Success
Logout	Redirect to admin login page	Success
User main page	User dashboard displayed	Success
Registration	Registration page displayed	Success
Terms & Conditions	Terms & conditions page displayed	Success
Personal Information	Identity input page displayed	Success
Address	Address registration page displayed	Success
Regional Data	Regional registration page displayed	Success
Confirmation	Registration confirmation page displayed	Success
Save Data	Registration data saved	Success
User Login Page	Login menu displayed	Success
Announcement Page	Announcement information displayed	Success
Personal Information	Personal information page displayed	Success
Select File	File selection page displayed	Success
Select Photo	Photo selection page displayed	Success
Logout	Redirect to home page	Success

Based on the testing results obtained from sample test cases, it can be concluded that the software functions properly. However, the testing process is not yet comprehensive, as it only covered one aspect of the system. Nevertheless, the conducted tests are expected to represent other functional tests within the Web-based Complaint Service Information System at the Parking Service Unit (UPTD) of the Batam City Department of Transportation.

3.4 System implementation

System implementation refers to the deployment phase of the developed system design, as outlined in the previous chapter. This process aims to ensure that the Web-based Prospective Parking Attendant Registration Information System at the Parking Service Unit (UPTD) of the Batam City Department of Transportation operates as intended. The system was developed using PHP as the programming language

and MySQL as the database management system. XAMPP for Windows version 5.6.23 was utilized as the web server. PHP was chosen due to its various features that facilitate efficient web-based system development, while MySQL handles data storage and management. Software tools used in the development process include Sublime Text as the code editor and Mozilla Firefox as the web browser for system testing.

The system consists of two interfaces with different user access levels: the administrator and the user (prospective parking attendant). To ensure optimal system performance, the recommended hardware specifications for administrators include a minimum Intel Pentium IV 2.0 GHz processor, at least 60 GB of storage space, and a minimum of 512 MB of RAM. Additionally, a graphics card (VGA) with a minimum capacity of 32 MB and input-output devices such as a mouse, keyboard, and monitor are required for effective system interaction. The installation of the program was carried out to ensure that the Web-based Prospective Parking Attendant Registration Information System functions optimally at the Parking Service Unit (UPTD) of the Batam City Department of Transportation. The installation process begins with downloading the required software, followed by installing XAMPP. Users must approve the installation confirmation message by clicking "Yes" and then proceed by clicking "Next." Subsequently, users will be prompted to select the XAMPP components to be installed, with Apache and PHP being installed automatically. To ensure proper system functionality, users should check the options for MySQL and phpMyAdmin while leaving other options unchanged.

Next, users must specify the installation directory, with the recommended path being C:\xampp. At the subsequent stage, there is an option to install Bitnami, which facilitates the installation of WordPress, Drupal, and Joomla. However, since WordPress will be manually installed, users should uncheck the option "Learn more about Bitnami for XAMPP" before proceeding by clicking "Next." The installation process will commence, and upon completion, users can launch the XAMPP Control Panel by clicking "Finish." To verify XAMPP functionality, users must open the application and click "Start" on both Apache and MySQL until they turn green.

Once installation is complete, the information system files must be placed within the htdocs folder in the xampp directory. To access the system, users can open a web browser and enter localhost/foldername before pressing "Enter." In this study, the system access folder was named daftarjukir. Apart from software installation, database implementation is a crucial component of the computerized information system. This system was designed using MySQL databases with relational table structures to ensure optimal data integration. The database implementation includes the admin table and the user table, which manage information related to system users.

Coding 2. Program Code for the User Table (SQL)

```
CREATE TABLE `tbl_user` (
  `id_user` int(11) NOT NULL AUTO_INCREMENT,
  `username` varchar(100) NOT NULL,
  `password` text NOT NULL,
  `nama_lengkap` varchar(100) NOT NULL,
  `alamat` varchar(100) NOT NULL,
  `email` varchar(100) NOT NULL,
  `website` varchar(100) NOT NULL,
  `telp` varchar(100) NOT NULL,
  `level` varchar(10) NOT NULL,
  `tgl_daftar` datetime NOT NULL,
  PRIMARY KEY (`id_user`)
) ENGINE=InnoDB DEFAULT CHARSET=utf8mb4;
```

Coding 3. Program Code for the Verification Table (SQL)

```
CREATE TABLE `tbl_verifikasi` (
  `id_verifikasi` int(10) NOT NULL AUTO_INCREMENT,
  `isi` text NOT NULL,
  `ket` text NOT NULL,
  `tgl_verifikasi` datetime NOT NULL,
  PRIMARY KEY (`id_verifikasi`)
) ENGINE=InnoDB DEFAULT CHARSET=utf8mb4;
```

3.5 Implementation of a Web-based information system for prospective parking caretaker registration

The Web-based Information System for Prospective Parking Caretaker Registration, implemented at the Parking Service Unit (UPTD) of the Department of Transportation in Batam City, comprises two primary interfaces: the administrator interface and the user interface (for prospective parking caretakers). The administrator interface provides a range of essential features that facilitate effective system management. To access the system, administrators must enter a valid username and password. If the entered credentials are correct, the system directs them to the main dashboard; otherwise, they remain on the login page. Upon successful login, the dashboard displays a summary of registration data and the verification status of prospective parking caretakers. Administrators have the authority to review, approve, or reject registration applications through the data verification feature. Additionally, they can manage registrant data by adding, editing, and deleting records. The account settings feature allows administrators to modify account details and reset passwords. To ensure session security, administrators can log out using the logout feature. The illustrations of the administrator interface are presented in Figures 9-11.

Figure 9. Admin login page

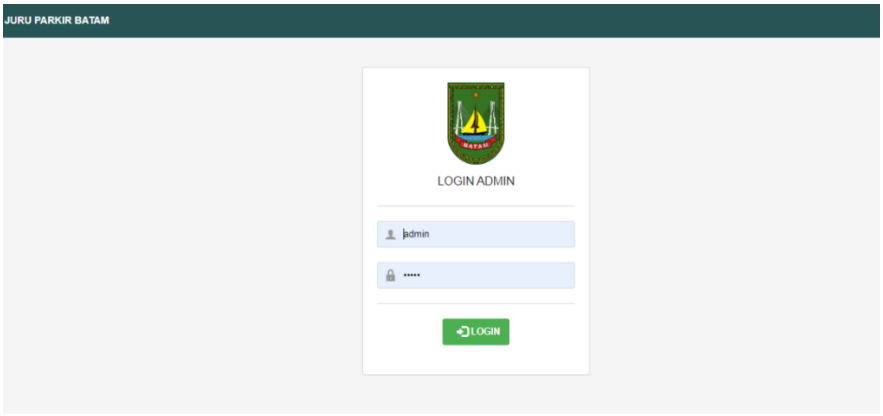


Figure 10. Admin verification page

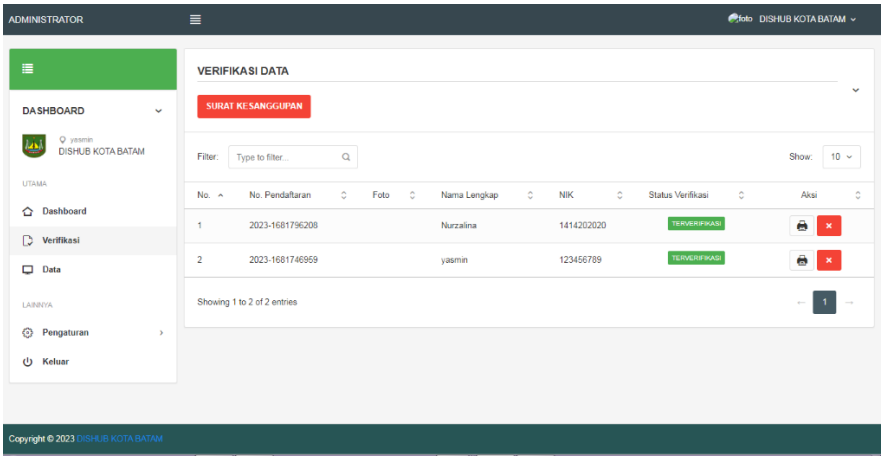
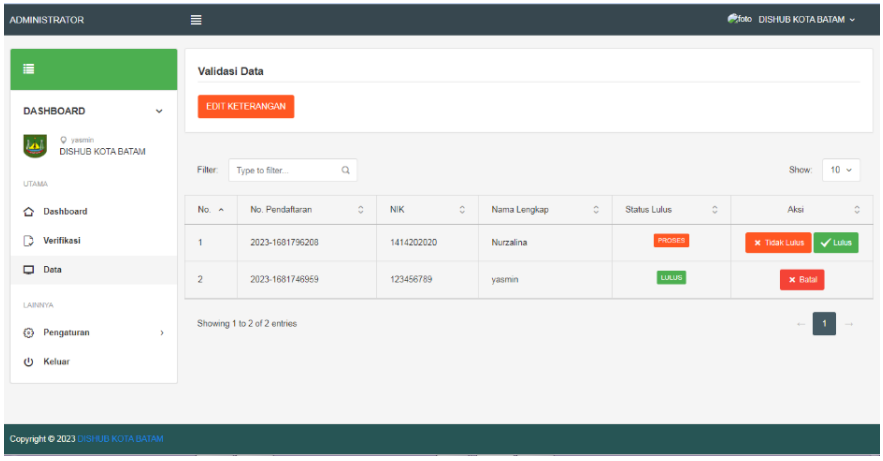


Figure 11. Admin data validation page



The user interface is designed to facilitate prospective parking caretakers in the registration process and provide relevant information regarding the selection process. On the registration page, users are required to complete a form with personal details, work area preferences, and supporting documents. Once registered, users can log in using their created accounts. The user dashboard presents information on the registration status and the latest announcements. Additionally, users can view and update their personal information through the biodata feature. To check selection results and further steps, users can access the announcement feature. For security purposes, users can safely log out of the system using the logout feature. The illustrations of the user interface are depicted in Figures 12-15.

Figure 12. User home page

Figure 13. User registration and biodata page

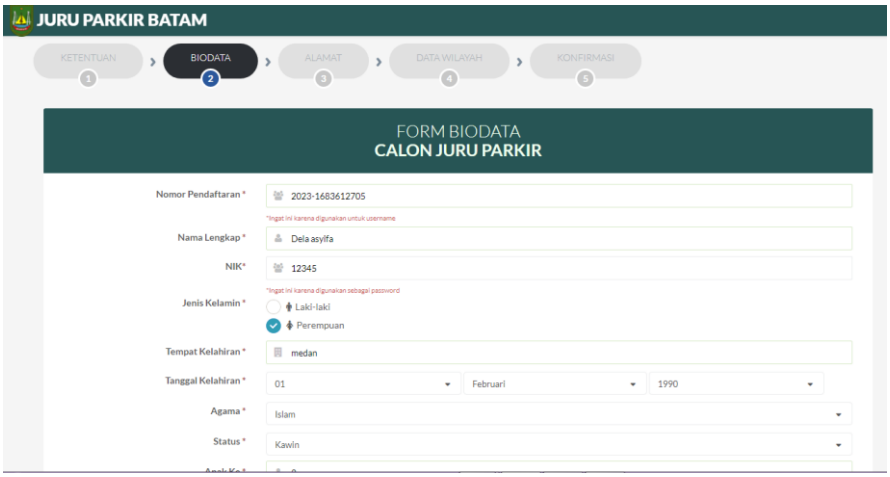


Figure 14.
User login page

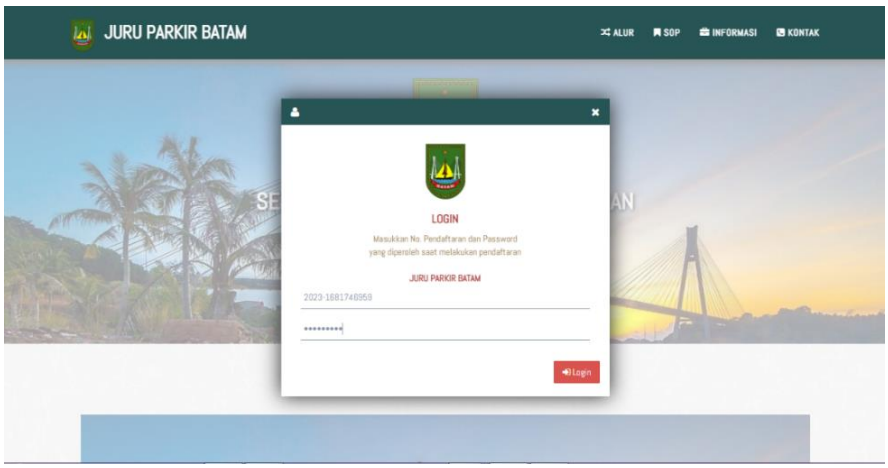
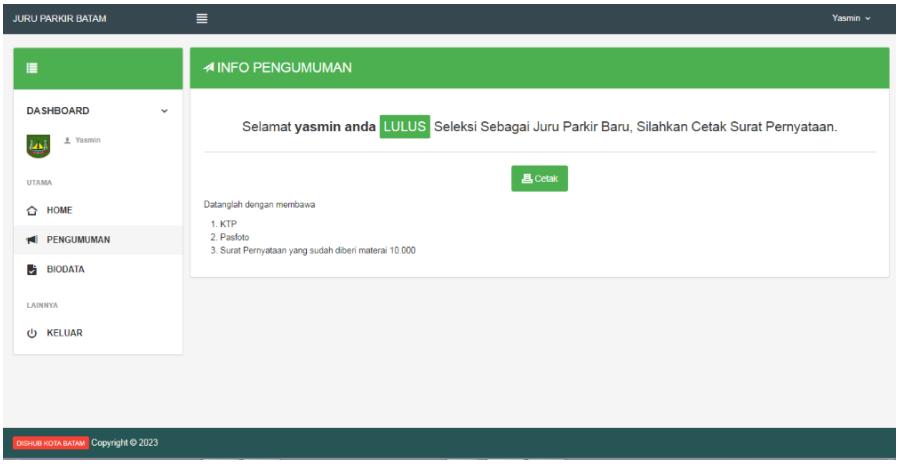


Figure 15.
User announcement page



3.6 Data maintenance and backup

Data maintenance and backup are conducted periodically to ensure system sustainability and prevent data loss due to technical errors or cyber threats. The data backup process follows several key steps using phpMyAdmin. First, users must access phpMyAdmin via a web browser by entering the URL http://localhost/phpmyadmin/. Once the phpMyAdmin interface is open, users select the database of the parking caretaker registration system for export.

Subsequently, the database export process is carried out by selecting the Export menu, where users can choose from various backup file formats, such as SQL, CSV, PDF, PHP array, CSV for MS Excel, and Open Document Text. For this study, the SQL format is selected to ensure compatibility and ease of data recovery in the future. Subsequently, users click Send to initiate the export process, and the system generates a backup file named dbde.sql. This file is then saved in a predefined location, such as the computer desktop, to facilitate easy access and data restoration when necessary.

The implementation of this information system has successfully automated the registration process for prospective parking caretakers by providing features that simplify data management for administrators and registration procedures for users. Moreover, routine data backup is crucial for ensuring system security and sustainability, minimizing the risk of data loss due to technical disruptions or cyberattacks.

4. Conclusion

This study successfully designed and implemented a web-based information system for the registration of parking attendants at the UPTD Parking Service Unit of the Batam City Transportation Department. The system was developed using the Waterfall model, ensuring that each development phase was carried out

systematically, from requirement analysis to testing and maintenance. By utilizing PHP as the server-side programming language and MySQL as the database, the system enhances efficiency and transparency in the registration process of parking attendants.

The findings indicate that the developed system effectively addresses several issues previously encountered in the manual registration process, such as inefficiencies in data management, the risk of recording errors, and limited access to information for stakeholders. The implementation of this system is expected to improve data accuracy, expedite the registration process, and reduce the potential for misuse of authority in managing parking attendants. With this system in place, the Batam City Transportation Department can more effectively monitor and manage parking attendants, ultimately contributing to improved public service and better traffic management in Batam City.

To enhance the effectiveness and functionality of the system in the future, several developments can be pursued. One crucial improvement is integrating the system with digital payment solutions to increase transparency and efficiency in managing parking fee transactions. Additionally, implementing Internet of Things (IoT) technology through parking sensors can provide real-time information on parking space availability, thereby optimizing parking lot usage. Developing Android and iOS-based applications also presents a strategic solution to facilitate registration access and monitoring for both parking attendants and the general public. Furthermore, leveraging artificial intelligence (AI) and big data analytics to analyze parking usage patterns can help predict parking demands across various locations. Through these advancements, the system is expected to become a more comprehensive solution in supporting modern and efficient parking management in Batam City.

Author's Declaration

Author contribution

Atman Lucky Fernandes: Conceptualization, Investigation, and Writing - Original Draft. **Ghea Paulina Suri:** Methodology, Validation and Formal analysis. **Yasmin Hamidah Nur Ghaliah:** Data Curation and Writing - Original Draft. **Yera Wahda Wahdi:** Data Curation and Writing - Review & Editing.

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Conflict of interest

The authors confirm that they have no identifiable financial interests or personal associations that could potentially influence the findings presented in this paper.

Ethical clearance

This research does not involve humans as subjects.

AI Statement

This article is the original work of the authors, produced without the assistance of artificial intelligence (AI) in the writing of sentences or in the creation and editing of tables and figures included in the manuscript. The grammatical structure of the article has been refined using ChatGPT. The language use of this article has been validated and verified by a English language professional.

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Researcher and Lecturer Society as the publisher and Editor of Journal of Computer-Based Instructional Media state that there is no conflict of interest towards this article publication.

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