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Customer Billing Information System and Whatsapp Notification With Web-Based FCFS Method

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Digital transformation in the public service sector is now crucial to support work efficiency and effectiveness. At the Tirtanadi Water Company (PDAM) in North Sumatra, customer scheduling and billing activities are already carried out using an application, but still face several obstacles, such as the rarity of ordinary people to open the application to view their bills, resulting in many people experiencing delays in paying their bills, resulting in continued arrears and resulting in interest accruals. To address these challenges, a web-based information system was developed that implements the First Come First Serve (FCFS) scheduling algorithm. This algorithm functions to manage queues and schedules based on the order of incoming requests, resulting in a more structured and fair process. The implementation of this system is expected to increase efficiency in the billing process and support more responsive and accurate customer service within the PDAM.
Keywords: Customer Billing, Information System, First Come First Serve, Automatic Scheduling.

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1. Introduction

internships integrate campus programs with partner institutions to build students' skills through real work experience. Students need both technical competence and mental readiness, as well as an understanding of future career paths. Limited work experience often becomes a barrier to entering the workforce. With rapid technological growth, especially in the IT field, creativity and innovation are essential, making work experience and soft skills crucial for adapting to the professional world.(Mahasiswa et al., 2025).

PDAM Tirtanadi is a provincially owned enterprise that provides clean drinking water to support community welfare in North Sumatra. Its mission includes supporting regional economic growth, increasing local revenue, and improving environmental quality. Serving thousands of customers daily, customer billing is one of its main operational activities. However, the billing process is still partially manual and not fully integrated, resulting in delays, long queues, data errors, and limited transparency(Apriani & Siregar, 2022).

PDAM Tirtanadi was chosen as the location for the Practical Work because of its important role in providing clean water services that directly impact the community. The institution also has complex administrative and operational processes, especially in customer scheduling and billing, making it a suitable place to apply and develop academic knowledge and skills. Through this internship, real operational issues can be identified and addressed using technology-based solutions. Factors such as ineffective billing notifications and limited staff contribute to customer arrears. Therefore, this Practical Work is expected to enhance personal competencies while providing practical benefits to the institution(Februari et al., 2024).

This internship was carried out at PDAM Tirtanadi North Sumatra in the customer scheduling and billing department. During the internship, the author was involved in administrative and customer service

activities related to the billing schedule system. Although a digital system has been implemented, several issues remain, including ineffective billing notifications that are only delivered through the PDAM application, which is not regularly accessed by all customers. As a result, customers often receive billing information late, leading to delayed payments. Other challenges include network limitations and low customer awareness of timely bill payments.(Putu et al., 2023). In addition, the billing process still experiences delays, overlapping notification schedules, and difficulties in comprehensive transaction tracking. These issues are further exacerbated by limited admin access that is restricted to the central PDAM, making it challenging for branch units to monitor and manage billing activities directly and in real time.

Based on these issues, a solution is proposed in the form of an information system that applies a scheduling algorithm using the First Come First Served (FCFS) method. FCFS prioritizes processes based on the order of arrival to ensure fair and sequential service (Riyadi Purwanto et al., 2022). This method was chosen because it enables more structured, efficient, and fair scheduling and billing processes. With a web-based system accessible to PDAM administrators and integrated with automatic WhatsApp notifications, billing activities become easier to monitor, more effective, and able to reduce late payments caused by delayed customer awareness. In addition, the system allows real-time billing management without reliance on a centralized system.

2. Method

The data research method used in this study is qualitative. This data collection method includes literature study, interviews, and observation(Utama et al., 2024). The types of data sources are divided into two parts, namely secondary data and primary data(Utami, 2022).

1. Literature Study, data that has been collected previously by other parties and can be used to obtain information relevant to the research objectives. This data is secondary data that can include published data, archived data, or data available electronically(Tuerah et al., 2023).
2. Interviews, based on the results of an interview with Mr. Febry, an employee in the finance division of PDAM Tirtanadi, who explained that the billing process still has a number of obstacles. Even though digital payment options are available, there are still frequent system problems, and bills are often delivered late and unnoticed by customers. As a result, many customers experience delays in paying their water bills and are subject to fines for late payments. This information forms the basis for designing a web-based automatic billing system that uses the FCFS queueing method to improve efficiency and fairness in the billing process. This data is primary data obtained directly from respondents in a case or issue through interviews(Syariah et al., n.d.).
3. Observation: Based on observations at PDAM Tirtanadi in North Sumatra, it was found that even though an application for customer scheduling and billing was available, the system was not running optimally because billing notifications were often out of order and were not always received on time by customers. In addition, many customers rarely open the application to check their bills, especially those from the general public who are less familiar with technology. This situation causes late payments and arrears. Therefore, a web-based automatic billing system equipped with direct notifications via WhatsApp and payment links should be developed to make the billing process faster, more efficient, and more accessible to customers.

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Algoritma FCFS (*First Come First Serve*)

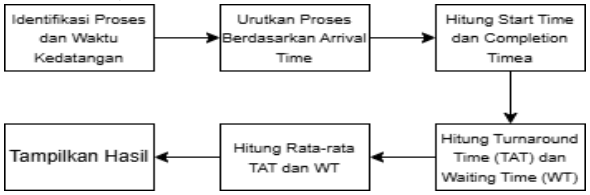

Figure 1.Method FCS

FCFS is one of the simplest scheduling algorithms in queueing systems(Handoyo & Nur Laila, 2025). The working principle is first come, first served, as in this case, first in line, first billed, where processes or requests that arrive first will be executed first, without considering the duration of the process (burst time)(Prahasti et al., 2022). Each process will be executed until it is completed before the next process is served. If there is more than one process that arrives at the same time, the order of execution is determined based on the position in the queue. This algorithm is considered fair because it provides services according to the order of arrival without any special priority(Daulay et al., 2023). The formula used in FCFS is as follows:

TA = Waiting Time + Execution Time

Average TA = ∑TA / ∑Job

Waiting Time = Start of Execution – Arrival Time.

Waiting Time measures the duration of time that a process must experience before it begins to be processed(Mayadi et al., 2025).

Waterfall Development Method

The method used in developing this web-based customer billing information system is Waterfall. The Waterfall method is a linearly structured framework consisting of a series of stages carried out sequentially, starting from analysis, design, implementation, testing, and maintenance(Rahayu et al., 2024),(Raya, 2021),(Hasbid et al., 2021). The waterfall model can also be referred to as SDLC (System Development Life Cycle)(Marlene Anthoneta Sumolang, 2024). The waterfall model approach is the first SDLC model used and is widely used in software engineering to determine the success of a project(Ganiron, 2020).

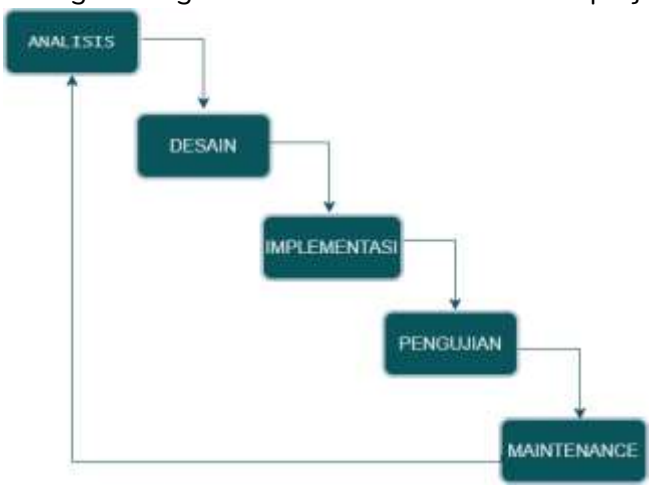

Figure 2.Method *Waterfall.*

Analysis

The analysis phase is the phase in which the current system is studied and a replacement system is proposed. In this phase, the current system is described, problems and opportunities are defined, and general recommendations on how to repair, improve, or replace the current system are proposed(Mahardika et al., 2023).

Design

Software design is a systematic process that focuses on planning and developing software systems, including data structures, system architecture, interface design, and coding procedures (Ramdhani et al., 2020). At this stage, system designs are created based on user requirements using tools such as UML diagrams, wireframes, and initial database designs (Al-Saqqa et al., 2020). The system design components include:

1. Use Case Diagram:
   The use case diagram describes system functionality from the user's perspective by illustrating interactions between actors and the system. It emphasizes system behavior based on the sequence of events and functional requirements (Parameswari et al., 2022).
2. Class Diagram:
   The class diagram represents the object-oriented structure of the system by defining classes as core components. Each class describes attributes and methods that support system functions and state manipulation, consisting of three main parts: class name, attributes, and operations (Wahyudi, 2020),(Wayahdi & Ruziq, 2023).
3. Activity Diagram:
   An activity diagram illustrates the workflow of system or user activities, including the sequence of actions and interactions involved in completing a process (Sari, 2023).

Implementation

This phase focuses on translating the system design into executable code and deploying it into a functional application or website, including the creation of databases and supporting files(Heriyanti & Ishak, 2020). The system is developed using the PHP programming language with the Laravel 10 framework to handle backend processes and business logic, while MySQL is used as the database management system for storing and processing system data.

Testing

Testing is the final stage of the waterfall model, aimed at evaluating whether the developed software functions as expected and fulfills the specified requirements (Rusdiyan Yusron & Huda, 2021).

3. Results and Disccusion

Analysis

At this stage, requirements are analyzed through observations, interviews, and literature studies to define functional and non-functional needs, forming the basis for system design that addresses user requirements and existing issues.

Implementation of the FCFS Method

Table 1. Tirtanadi Water Company Customer Data

Kode	Name	Registrasi	Arrears
A1	B1	30/12/2025	29/01/2026
A2	B2	14/12/2025	13/01/2026
A3	B3	04/12/2025	03/01/2026
A4	B4	02/12/2025	01/01/2026
A5	B5	01/12/2025	31/12/2025
A6	B6	28/10/2025	27/11/2025

1. B1 (first)
   a. Waiting = 0 days (first does not wait)
   b. Waiting = 0 × 1440 = 0 minutes
   c. Burst = 1 minute
   d. TA = 0 + 1 = 1 minute
2. B2
   a. Start_prev = 2025-11-27 → Start_now = 2025-12-31
   b. Calculate the difference in days: from Nov 27 → Dec 31 = 34 days
   (Nov 27 → Nov 30 = 3 days, + Dec 1→31 = 31 days → total 3+31 = 34)
   c. Waiting = 34 × 1440 = 48,960 minutes
   d. Burst = 1 minute
   e. TA = 48,960 + 1 = 48,961 minutes

(Waiting = (2025-12-31 − 2025-11-27) = 34 days ; 34×1440 = 48,960)

Table 2. Manual FCFS calculation results

Name	START Difference (days)	Waiting (minutes)	Burst (minutes)	TA (minutes)
B1	0	0	1	1
B2	34	48,96	1	48,961
B3	1	1,44	1	1,441
B4	2	2,88	1	2,881
B5	10	14,4	1	14,401
B6.	16	23,04	1	23,041

1. Total waiting time = 90,720 minutes
2. Total average time = 90,726 minutes
3. Average time = 15,121 minutes = 10 days 12 hours 1 minute

The system is running

The existing system handles PDAM water bill payments through the PDAM INFO application, where customers log in to view their bills and make payments via bank transfers or QRIS. The system subsequently verifies the payments, and officers monitor the transaction reports. However, several limitations remain, including the absence of automatic WhatsApp notifications and restricted access for the accounting department, which requires financial reports to be processed manually.

The proposed system addresses these limitations by integrating automatic WhatsApp notifications that deliver arrears information, payment status, and payment links to customers. Furthermore, administrators are able to grant report access to the accounting department, allowing accounting staff to view, download, and print transaction reports. With these improvements, payment management is expected to become more efficient, transparent, and less prone to errors in financial recording.

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Figure 3. Running system analysis

C. Proposal system

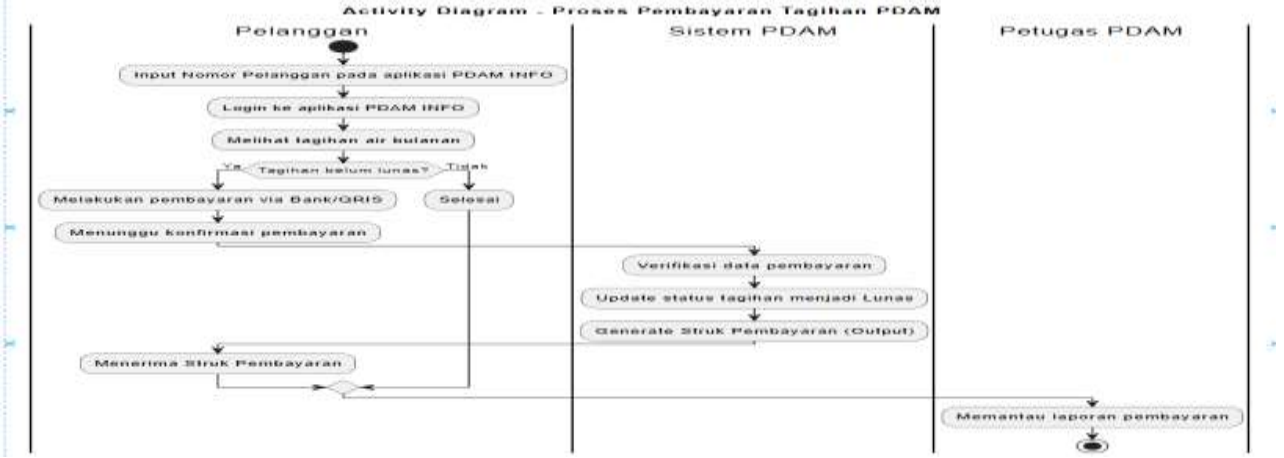

Figure 4. Proposed system analysis

PDAM customer billing is processed automatically in a structured workflow, where the admin is the only authorized user to manage customer data, validate bills, and initiate payment notifications. After validation, the system sends WhatsApp messages containing billing details and payment links to customers based on the First Come First Served (FCFS) method to ensure sequential notification and payment confirmation. Customers are not required to log in to the system and can complete payments directly through the provided link, after which the system updates the billing status automatically. This workflowimproves administrative efficiency while maintaining convenience for customers without the need for additional applications.

Design

System Architecture Design

This system uses a client–server architecture, where administrators and customers access the application via a browser, while all business processes are handled on the server. The system is developed using the Laravel framework for application logic and database management, with Bootstrap to ensure a responsive

user interface. It is also integrated with Midtrans or Tripay as QRIS payment gateways to enable secure and efficient online transactions.

Use Case Diagram

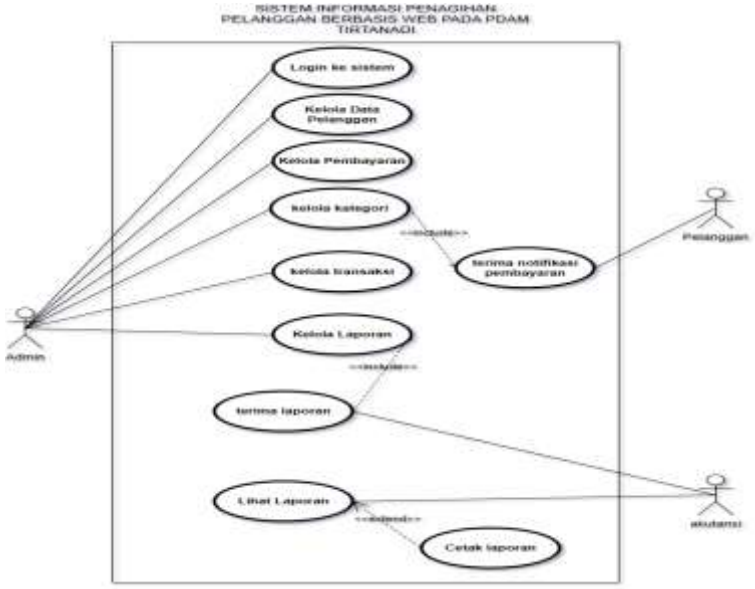

Figure 5.Customer billing system use case diagram

In the proposed system, customer billing is handled automatically and in a structured manner, with the admin as the only user authorized to manage customer data, validate bills, and initiate payment notifications. After validation, the system sends WhatsApp messages containing billing details and payment links using the First Come First Served (FCFS) method to ensure sequential processing. Customers are not required to log in to the system and can complete payments directly through the provided link, after which the system automatically updates the billing status. This workflow improves administrative efficiency while offering greater convenience for customers.Admin page requirements analysis

a. Admin page requirments, Admin is a crucial user in the system as they have full access to all system features. The admin is responsible for logging into the system and managing customer data, transactions, and related categories involved in the billing process.
b. Customer Page Requirements Analysis, Customers are key actors in this system because it is designed to facilitate overdue payment transactions at PDAM Tirtanadi. The customer page requirements include receiving payment notifications sent directly via WhatsApp and the display of QRIS codes to enable overdue bill payments.
c. Accounting Page Requirements Analysis, The accounting actor plays an important role in monitoring transactions and financial reports. The accounting page must provide customer transaction reports in tabular form, which can be viewed and printed for financial reporting purposes.

Class Diagram

PDAM customer billing system, the class diagram includes the main classes: User, Customer, Bill, and Transaction. The User class acts as an administrator responsible for managing customer and billing data. Each Customer may have multiple Bills, while each Bill is associated with a single Transaction as proof of payment. These class relationships illustrate an integrated system flow in which billing management and payment recording are performed automatically and in a structured manner.

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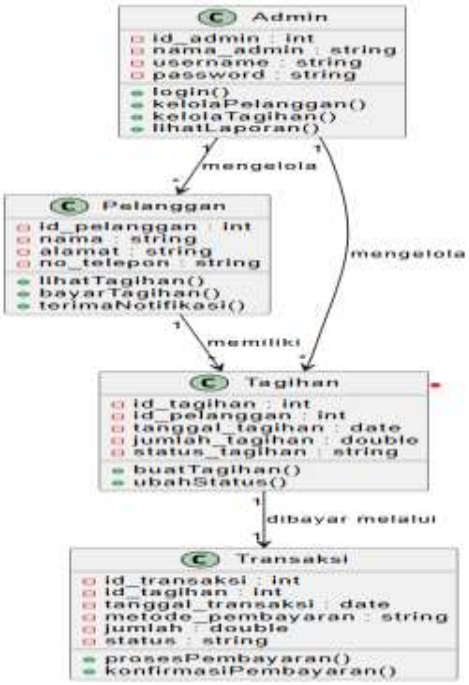

Figure 6. Billing System Class Diagram

Activity Diagram

The use of the customer billing information system will be illustrated with an activity diagram. Activities can also describe actor activities in the use case diagram that has been explained.

Activity Diagram admin

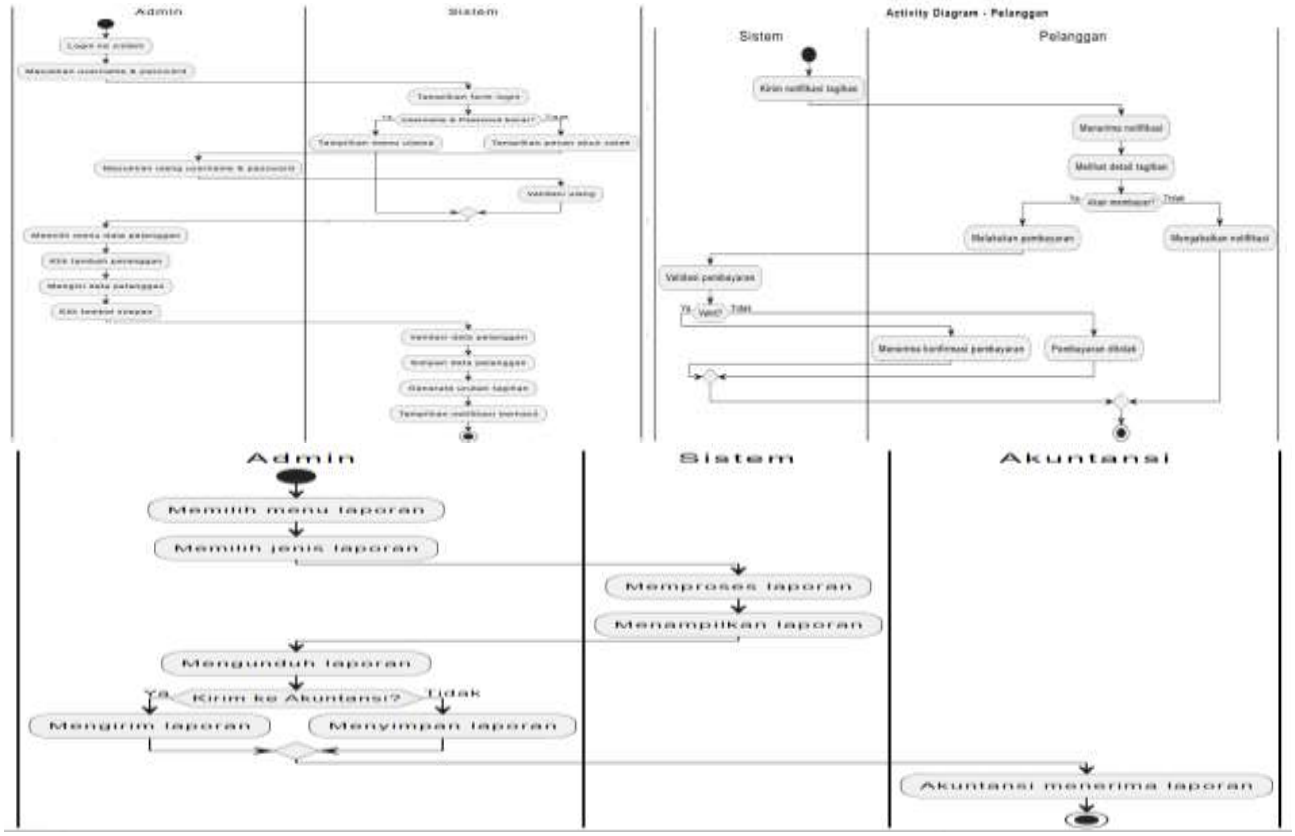

Figure 7. Activity Diagram system

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Implementation

The system was developed in stages using the waterfall method, starting with basic features and progressing to payment integration and FCFS logic. This process involved coding using Laravel as the backend and Bootstrap for the user interface.

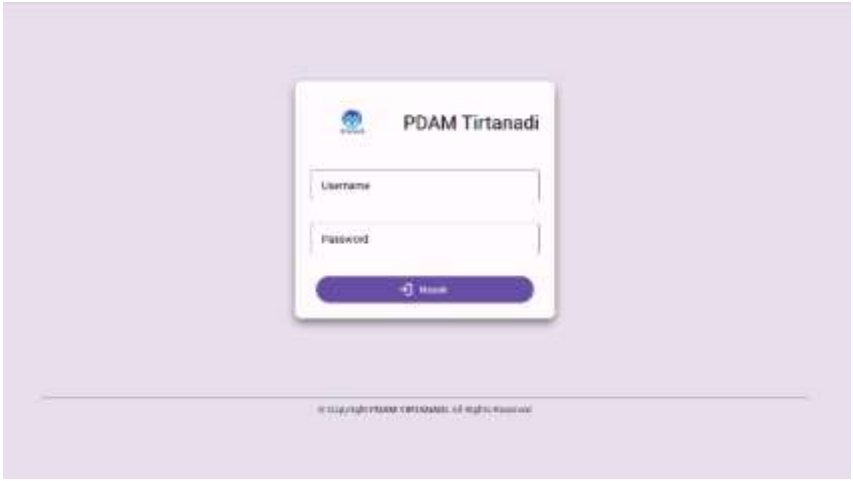

Figure 8. Login

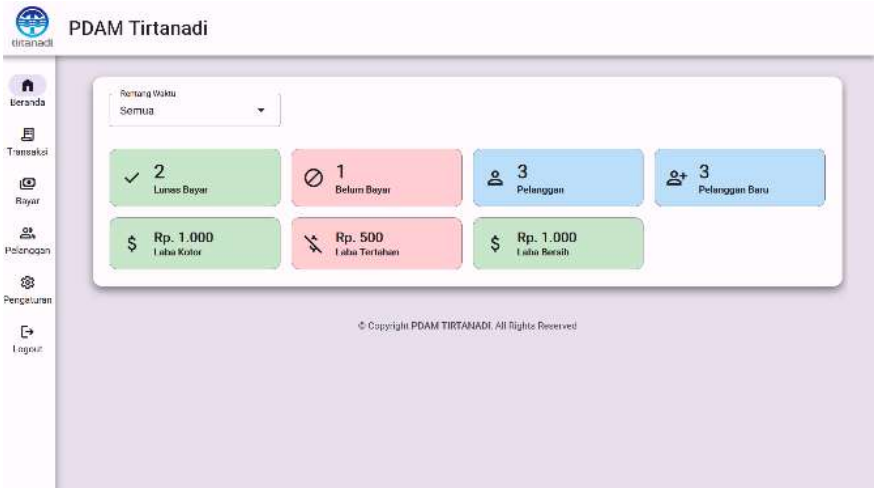

Figure 9. Home Page

Figure 10. Payment page

FCFS logic in the billing process means that customers who set up their water accounts earlier will have earlier due dates because the system calculates a 30-day grace period from the date of installation.

Therefore, customers who register earlier will be the first priority in monthly billing. The system will sort the customer list based on the order of delinquency, then process the bills one by one according to the due date queue. This logic ensures that billing is carried out fairly, systematically, and efficiently, and makes it easier for administrators to monitor and resolve customer arrears in a timely manner.

Testing

Blackbox testing was conducted on the system's main features, such as login, customer data management, billing, QRIS payment integration, and auto-confirmation of payment.
Here are the test results:

Table 3. System Functional Testing

No	Tested Features	Input	Expected Output	Test Results
1	Login Admin	Username & Password valid	Successfully logged into the dashboard	Success
2	Add Customers	Complete customer data	Data stored in the database	Success
3	Create an Invoice	Select customer + input cost	Invoice appears in the list	Success
4	Notification Notice	Share notifikasi	Notification of arrears & notification of full payment	Success
5	QRIS payment	Scan the QR code and pay	Paid in full status	Success
6	Report	print & share reports	Reports can be printed and shared via WhatsApp, Gmail.	Success
7	First-Come-First-Served Payment Queue	Some customers pay together	The system processes in chronological order.	Success

Maintenance

After completing the planning, design, development, and testing stages, the web-based PDAM customer billing information system was successfully developed according to requirements. The system uses Laravel for backend development, Bootstrap for the user interface, and supports digital payments via QRIS through Midtrans integration.

Table 4. System Feature Summary

No	System Features	Status	Description
1	Login Admin	Finished	System user authentication
2	CRUD Customer Data	Finished	Add, edit, delete, and view customers
3	CRUD Invoices	Finished	Input and update invoices based on the period
4	QRIS Integration (Midtrans/Tripay)	Finished	Payment via QR code scan
5	First-Come-First-Served Payment Queue	Finished	Transactions are processed based on payment time

4. Conclusion

Based on the results of system design and implementation, it can be concluded that the development of a web-based customer billing information system at PDAM has been successfully implemented using the waterfall approach and First Come First Serve (FCFS) queue logic. All key features, ranging from user authentication, customer and billing data management, to auto-confirmation of payments, have been implemented in stages. Functional testing shows that the system runs according to specifications, including sequential transaction processing based on payment time, which reflects the FCFS principle.

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