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Design and Implementation KP-SPAMS Transaction Information System utilizing Laravel Framework and Extreme Programming Methodology

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Abstract

The Community-Based Drinking Water and Sanitation Management Group (KP-SPAMS) oversees the Community-Based Drinking Water and Sanitation Provision Program (PAMSIMAS), which is essential for providing clean water services to rural areas. Nevertheless, KP-SPAMS continues to face challenges related to operational transaction management, such as the documentation of customer data, water usage, invoicing, and financial reporting. This research aims to develop a web-based transaction information system, utilizing the Laravel framework and the Extreme Programming methodology, to meet the specific requirements of KP-SPAMS Sumber Waras located in Ngenep Village, Malang Regency. The Extreme Programming methodology facilitates adaptable and cooperative software development, enabling quick responses to evolving customer requirements. The system's primary functionalities are customer registration, water usage recording, automatic billing, and payment reporting. The implementation results indicate that this system may enhance the operational efficiency, accountability, and traceability of all transaction processes in KP-SPAMS, facilitating improved decision-making and superior service quality for the community. User Acceptance Testing results show that 80% of users rated the system positively, with 53.33% agreeing and 26.67% strongly agreeing that the system meets their needs and provides a satisfactory experience. Only 6.67% of responses indicated dissatisfaction, and no respondents strongly disagreed, demonstrating that the system aligns well with user expectations and offers a solid foundation for future improvements.

Keywords: KP-SPAMS, information system, Laravel, Extreme Programming, transaction management, drinking water

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I. INTRODUCTION

To uphold its obligation to deliver quality and efficient drinking water and sanitation services to the community, the government depends on the Community-Based Drinking Water and Sanitation Provision Program (PAMSIMAS) to address essential service requirements unmet by public systems in rural areas [1]. The Community-Based Drinking Water and Sanitation Management Group (KP-SPAMS) is an autonomous entity under the PAMSIMAS program. It is designed to administer and supervise community-oriented drinking water and sanitation initiatives [2], [3]. KP-SPAMS oversees the administration and supply of potable water to inhabitants in designated regions. KP-SPAMS encounters a significant challenge in the effective and efficient management of operational procedures, including customer registration, water consumption recording, billing, and financial reporting [4]. KP-SPAMS asserts that the monitoring of operational transaction data is essential for ensuring the continuity and reliability of

the whole drinking water and sanitation delivery system it oversees. Controlling transaction data is essential for meeting service standards and regulations, and it is a strategic measure to enhance efficiency, accountability, and traceability in operational processes [5], [6].

Effective and precise handling of transaction data is essential for maintaining seamless operations and delivering satisfactory service to the community. Due to the complexity and scale of processes managed by KP-SPAMS, the administration of transaction data is essential for ensuring the system's sustainability and reliability [7]. To solve this issue, implementing a Transaction Data Management Information System has emerged as a strategic and acceptable solution. This system efficiently handles transaction data by integrating technology and management processes, facilitating enhanced monitoring and supporting informed decision-making [8]. Furthermore, the system improves operational efficiency, accountability, and traceability throughout all processes, enabling KP-SPAMS to provide better and more responsive services to the community [9].

KP-SPAMS Sumber Waras is an entity responsible for the operation and maintenance of drinking water and sanitation services in Ngenep Village, Karangploso District, Malang Regency. KP-SPAMS Sumber Waras was established in 2018 and is managed by the local community. Its objective is to provide better drinking water and appropriate sanitation services. In 2018, KP-SPAMS Sumber Waras initiated a project to construct water delivery infrastructure utilizing a local water source. Water from this source is extracted with HIPPAM (Association of Drinking Water Users) technology and conveyed to the community through a gravity-fed pipeline system. This initiative aims to ensure that all residents of Ngenep Village have reliable and sustainable access to safe drinking water and adequate sanitation.

KP-SPAMS Sumber Waras has successfully enhanced access to potable water in Ngenep Village. Nonetheless, challenges persist in executing transactional activities such as customer registration, consumer water meter readings, water bill payments, and reporting. These challenges often arise due to the existing system's inadequate fulfilment of the requirements of KP-SPAMS Sumber Waras.

This research seeks to create a transaction data management information system to fulfil the requirements of KP-SPAMS Sumber Waras. This system aims to deliver solutions that will aid KP-SPAMS Sumber Waras in addressing issues such as facilitating customer access to monthly water use billing information, enhancing customer service, and providing timely information that consumers have previously been unable to get.

The KP-SPAMS transaction information system is developed using the Laravel framework, a contemporary and extensively utilized PHP framework recognized for its robustness, scalability, and user-friendliness [10]. The Model-View-Controller (MVC) design of Laravel guarantees a well-structured application, facilitating management and extension for developers. Laravel offers a refined and sophisticated syntax that streamlines the development process, facilitating rapid prototyping and the effective management of intricate functions [11]. The integrated Eloquent ORM (Object-Relational Mapping) streamlines database interactions, facilitating effortless integration with KP-SPAMS's data, including customer records, water usage, and billing details.

The system utilizes Laravel to guarantee improved security, speed, and scalability. Essential functionalities, such as user authentication, data validation, and real-time updates, are readily integrated within the Laravel framework [12]. The framework facilitates the incorporation of supplementary tools and libraries, allowing KP-SPAMS to modify the system for future requirements, such as the integration of payment gateways or the generation of comprehensive reports. Laravel is an optimal selection for creating a sustainable and future-proof system that fulfils the present requirements of KP-SPAMS while allowing for seamless expansion as the organization evolves.

II. RESEARCH METHOD

The development of the KP-SPAMS Transaction Information System application is carried out using the Extreme Programming method. This method emphasizes a collaborative, adaptive approach focused on quality, thereby supporting the development team in creating software more efficiently, quickly, and capable of adapting to changing user needs [13]. This research uses the Extreme Programming method because it is considered the most suitable for accommodating the dynamic and frequently changing needs of user partners [14]. In the software development process, Extreme Programming allows development teams to quickly adapt to changes in specifications and additional requests from user partners. See in Figure 1 [15]. With a focus on short iterations, continuous testing, and intense communication between developers and users, this method ensures that the final product not only meets but also exceeds user expectations. As a result, the developed software can be adjusted to real field needs more efficiently and responsively.

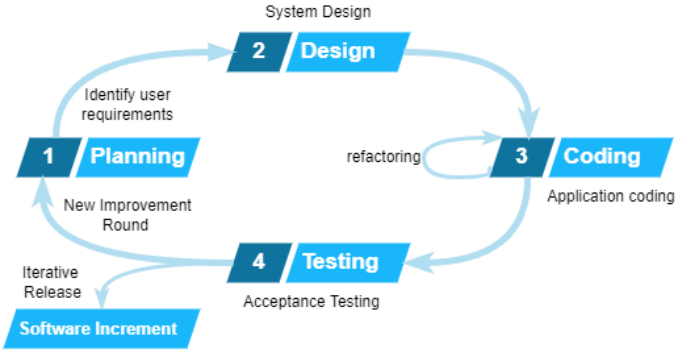


Fig. 1. Stages of the Extreme Programming Method [15]

A. Planning

The planning stage is conducted to formulate the comprehensive operation of the system. At this stage, the author identifies the problems requiring resolution, establishes the system's objectives, gathers essential data for system development, and identifies the system's requirements, particularly concerning transactions at KP-SPAMS Sumber Waras.

B. Design

The system workflow design is conducted at this stage based on the acquired data. Several proposed features have been identified from the conducted planning process, as illustrated in Figure 1. System users are categorized into four distinct types based on access rights.

a. Administrator**:** Individuals responsible for managing KP-SPAMS data, overseeing user management, and establishing transaction periods.
b. Management**:** System users are designed to oversee user billing transactions, cash transactions, and transaction reports.
c. Cashier**:** System users are designed to oversee billing and payment transactions, as well as incoming and outgoing cash transactions.
d. Water Meter Input Officer**:** Responsible for entering water meter usage data from customer meters into the system.

This access rights distribution allows tasks and responsibilities to be managed more efficiently, making it easier for partners to conduct transactions. Unified Modeling Language (UML) is one of the most suitable modelling approaches for designing object-oriented system development [15]. Therefore, this study employs UML in the system design process.

C. Coding

At this stage, the implementation process, from design and planning into programming code is carried out. The system is constructed utilizing the PHP programming language with the Laravel framework. The Laravel framework is utilized due to its extensive functionality, requisite libraries, and organized, clean code structure [11]. The environmental parameters for system development are shown in Table I.

TABLE I. PROGRAM CODING COMPONENTS

No	Component	Description
1	Programming Language	PHP 8.2
2	Framework	Laravel 10
3	Website Template	AdminLTE 3.2.0
4	Library	− Laravel Datatables − Laravel Dompdf − Laravel Captcha − Ramsey/Uuid − phpoffice/phpspreadsheet

D. Testing

This phase involves the evaluation of the developed modules. Module testing is performed to verify that each developed feature operates well and satisfies user requirements. This testing occurs subsequent to the completion of the coding step. The testing step employs the black-box testing methodology and user acceptability testing (UAT). The black-box testing approach assesses the functional functioning of all system features, whereas User Acceptance Testing (UAT) determines if these features satisfy user requirements.

III. RESULTS AND DISCUSSION

A. Planning

The identification of system requirements was conducted via surveys and interviews with partners. The survey and interview results identified several system needs, including:

a. The system's usability is characterized by its legacy desktop-based architecture, with data stored locally on the computer. The transactional process of KP-SPAMS is contingent upon that computer.
b. The process of recording water meters has been simplified; previously, staff utilized existing record sheets and entered water meter data individually based on customer numbers.
c. The new system facilitates the recording of cash inflow and outflow transactions, addressing the limitations of the previous system, which did not support the documentation of non-customer bill cash transactions.
d. The new system facilitates the verification of customer payment status, addressing the limitations of the previous system, which did not support a comprehensive list of paid bills. Consequently, officers were required to verify payment data for every customer.
e. The transaction period can be easily determined, allowing the officer to modify the current transaction period with ease.

This phase establishes the basis for the complete system development lifecycle. This research utilizes transactional data from KP-SPAMS Sumber Waras, Ngenep Village, and Malang Regency. The utilized data comprises information:

- Customer Data refers to information derived from the community utilizing the KP-SPAMS Sumber Waras services. The customer data retained in the KP-SPAMS Sumber Waras services encompasses significant information on people or households utilizing these services.
- Tariff Data is a crucial component of the KP-SPAMS Sumber Waras service, as it dictates the fees imposed on consumers according to the specific service rendered. Tariff data must be meticulously kept and updated by KP-SPAMS Sumber Waras to guarantee that the charges imposed adhere to relevant legislation and are equitable for consumers. Furthermore, diligent administration of tariff data can facilitate precise and uniform computations in the billing process for clients.
- Customer group data comprises information utilized by KP-SPAMS to classify service users according to defined criteria. This data facilitates the effective administration and delivery of services in alignment with user requirements.
- Water use data (water meter) comprises information that documents consumers' monthly water consumption. This data is crucial for monitoring, invoicing, and managing water resources. The water use statistics encompass the following information:
    a. Water Meter Measurement: The data documents the water meter readings at the commencement and conclusion of the monthly interval. The disparity between these two measurements signifies the volume of water used by the consumer during that timeframe.
    b. Usage Period: The data encompasses the timeframe during which water consumption is quantified, often on a monthly basis. This is crucial for precise computation and invoicing.
    c. Water usage: Water usage data quantifies the volume of water consumed by consumers in designated units, such as cubic meters (m^3). This assists in determining the expenses that consumers must incur.

  Water usage data is essential for water resource management, particularly for water businesses or service providers aiming to monitor consumption, identify leaks, manage supply, and calculate customer bills. This data may be utilized to examine temporal water usage trends and strategize suitable infrastructure expenditures.
- Cash inflow encompasses the financial records pertaining to non-billable money received by a business, organization, or institution, including donations, government grants, and other income sources. Cash inflow transaction data is crucial for financial management and reporting, particularly

for non-profit organizations, foundations, government agencies, and other entities that receive non-billable income. This data facilitates the oversight of the organization's revenue, guarantees the allocation of money in accordance with designated objectives, and satisfies requisite reporting requirements.

- Cash-out encompasses the documentation of all expenses spent by KP-SPAM or affiliated organizations in the management and maintenance of the drinking water system. This is a crucial component in the financial management and budgetary planning of KP-SPAM. It facilitates the oversight and administration of operating expenditures, the upkeep of drinking water infrastructure, and the strategic planning of investments for the enhancement or expansion of the drinking water system. This data is crucial for meeting reporting and financial accounting requirements.
- Bill Payment Data encompasses the documentation of revenue generated from clients' monthly bill payment activities. Bill payment data is a crucial component of financial management and revenue oversight for KP-SPAM. This data facilitates timely client bill payments, detects delinquent consumers, and documents collected income. This data is essential for financial reporting and monitoring client payment history.
- Reporting is the submission of transactional data to management, enabling the derivation of conclusions regarding revenues and costs within KP-SPAMS.

B. Design

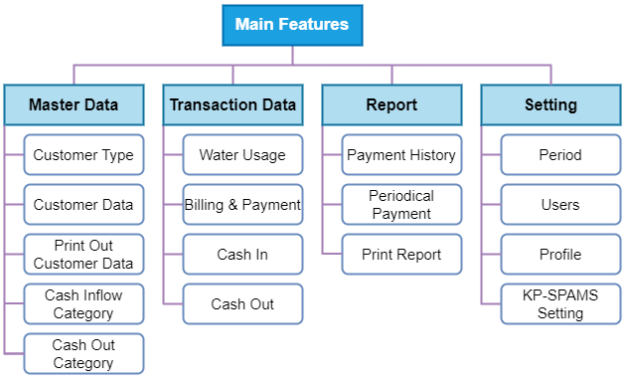


Fig. 2. System features

Figure 2 indicates that the system comprises 16 features designed to meet the requirements of partners. The defined features will be categorized into various access levels based on user attributes. This is the design for the distribution of feature access. The Use Case Diagram of this system involves four actors who play roles in the system. The Administrator is tasked with data and user management responsibilities. Secondly, management plays a crucial role in overseeing financial and administrative functions. Third, the cashier is responsible for managing billing and payment activities for water meter accounts, as well as overseeing cash inflow and outflow operations. Fourth, there exists the function of an officer engaged in the operational duties of inputting client water meter readings into the system. Users must first complete an authentication procedure (login) to utilize the system. The system is locked, allowing access exclusively to registered users.

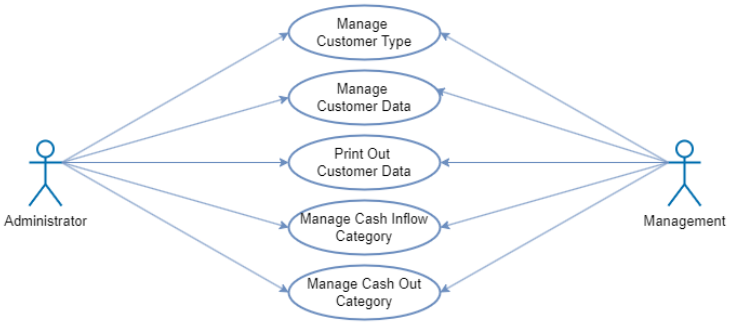


Fig. 3. Use Case: Master Data

Figure 3 shows the use case for Data Master. There are two actors involved, namely the Administrator and Management, who interact with several use cases in the system. The Administrator and Management actors have the same access, which is

1. Manage Customer Types: This use case allows Administrators and Management to manage customer types. This management can include the addition, deletion, or modification of information related to customer categories, such as regular customers, public facilities, industries, or other types of customers.
2. Manage Customer Data: Administrators and Management possess the authority to oversee client information within the system. This may entail enrolling new clients, updating client information, or removing obsolete client data.
3. Print Customer Data: This use case enables Administrators and Management to generate printed reports or data pertaining to customers. The printed data may encompass a comprehensive report on customer profiles and generate printed customer labels to be placed in each residence.
4. Manage Incoming Cash Categories: Administrators and Management can oversee incoming cash categories inside the system, categorizing money by its origin, such as sales, investments, or other income. This management includes the addition, deletion, or modification of categories.
5. Oversee Cash-Out Categories: Administrators and Management also oversee cash-out categories inside the system, including operating costs, vendor payments, or acquisitions. This management includes the addition, deletion, or modification of cash-out categories.

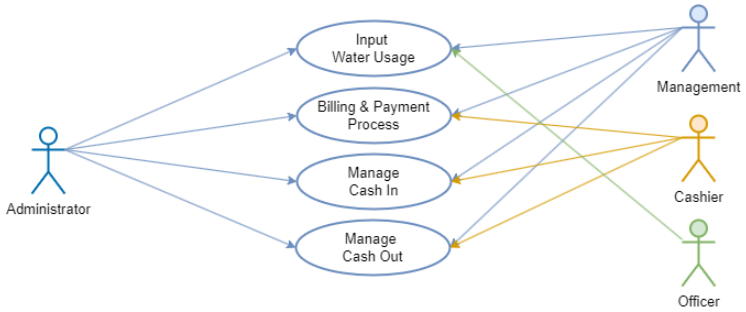


Fig. 4. Use Case: Transaction Data

Figure 4 shows the use case of Transaction Data inside the system. Four different roles are involved: the Administrator, management, cashier, and officer, who engage with various use cases in the system pertaining to water consumption, billing, payment, and cash management operations. Certain accesses in the transaction data use case encompass

1. Input Water Usage: This use case enables the officer actor to enter client water usage data into the system following field inspections. The administrator and management personnel can access or oversee the water use statistics entered by the officer. This case guarantees the precise recording of client water consumption data in the system, which will provide the foundation for producing monthly invoices.
2. Billing and Payment Process: This use case oversees the comprehensive billing and payment procedures for consumers. The administrator actor oversees the entire process, while the cashier actor is tasked with processing consumer payments and verifying transactions. Simultaneously, the management entity oversees payment and invoicing operations. The objective of this case is to guarantee the seamless operation of the billing and payment process, encompassing the generation of invoices based on water consumption and the collection and documentation of payments inside the system.
3. Manage Incoming Cash: This use case enables the Administrator to oversee the influx of cash into the system. The cashier records cash inflows from customer payments and other income activities. Meanwhile, the management entity may oversee and authenticate the cash influx. Guaranteeing the precise documentation of all cash inflow transactions inside the system, including water bill payments and other activities.
4. Oversee Cash Outflows: The Administrator is responsible for managing cash outflows, encompassing operating payments and other expenditures. The cashier tracks the expenditures incurred by KP-SPAMS. Conversely, the management actor oversees cash outflow operations and can regulate spending. The objective of this instance is to guarantee accurate recording of costs and facilitate monitoring for enhanced financial transparency.

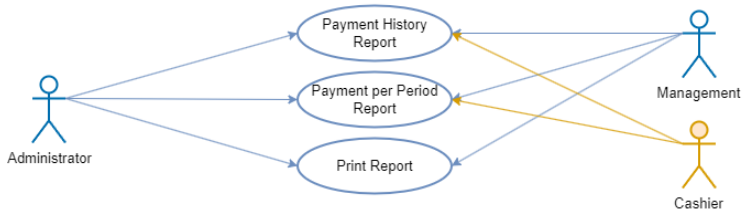


Fig. 5. Use Case: Report

Figure 5 illustrates three actors engaged in interactions with various reports in the system: the Administrator, management, and cashier. They engage with several reporting functionalities, including payment history, monthly payments, and report generation.

1. Payment History Report: The Administrator, management, and cashier roles have the ability to see customers' payment history. This report encompasses transaction specifics, payment times, amounts paid, and additional data pertinent to consumer payments. This access aims to guarantee the accurate recording of all payments and provide the examination of transaction history for analysis and auditing purposes if required.
2. Periodic Payment Reports: Administrators, managers, and cashiers are able to obtain reports that encapsulate payments categorized by monthly intervals. These reports offer a summary of the total payments received during that timeframe and can be utilized to monitor payment performance. This access aims to enable the tracking of payments over a designated timeframe, aiding in financial analysis and reporting for both internal and external objectives.
3. Print Report: This use case enables the administrator and management actors to generate the necessary reports in printed form. Reports may encompass payment histories, periodic reports, or additional paperwork required for reporting purposes. This access aims to guarantee the availability of printed reports for meetings, assessments, and archival preservation, among other purposes.

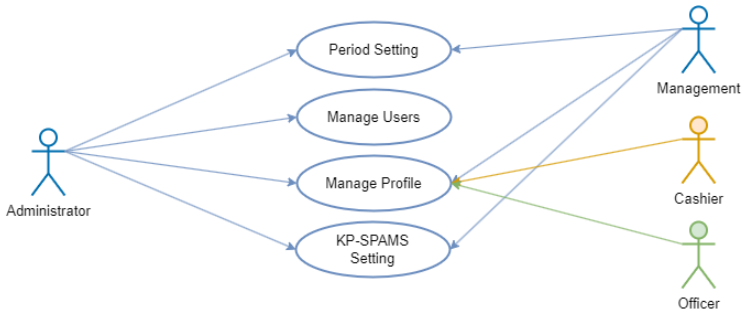


Fig. 6. Use Case: Setting

According to Figure 6, four actors are engaged in the settings menu: the Administrator, management, cashier, and officer. The four roles participate in many contexts inside the system, including period settings, user administration, account configurations, and KP-SPAMS settings.

1. Period Settings: The Administrator and management personnel are able to oversee the period settings inside the system. This encompasses the identification of the active period for transactions in KP-SPAMS. The active period refers to the month actively engaged in water meter recording, billing process assessment, and payment transaction implementation. This access aims to guarantee that the system functions within a timeframe that satisfies the requirements of the organization or KP-SPAMS and to facilitate oversight for the specification of pertinent periods. Consequently, it facilitates user transaction execution.
2. User Management: The Administrator possesses the power to add, remove, or oversee users inside the system. This entails overseeing accounts for diverse participants in the system, including management, cashiers, and cops. The objective of this access is to guarantee that each system user possesses access commensurate with their roles and responsibilities while also streamlining user access management.
3. Account Settings: All participants are authorized to modify account settings. Account settings are functionalities that enable users to modify their personal information related to their profile data and to update their passwords.

4. KP-SPAMS Configurations; Administrators and management has authority over configurations pertaining to KP-SPAMS, encompassing operating parameters and other system settings. This access aims to facilitate the adjustment of KP-SPAMS settings in accordance with the organization's requirements, including operational control and access to pertinent information for cashiers and officials.

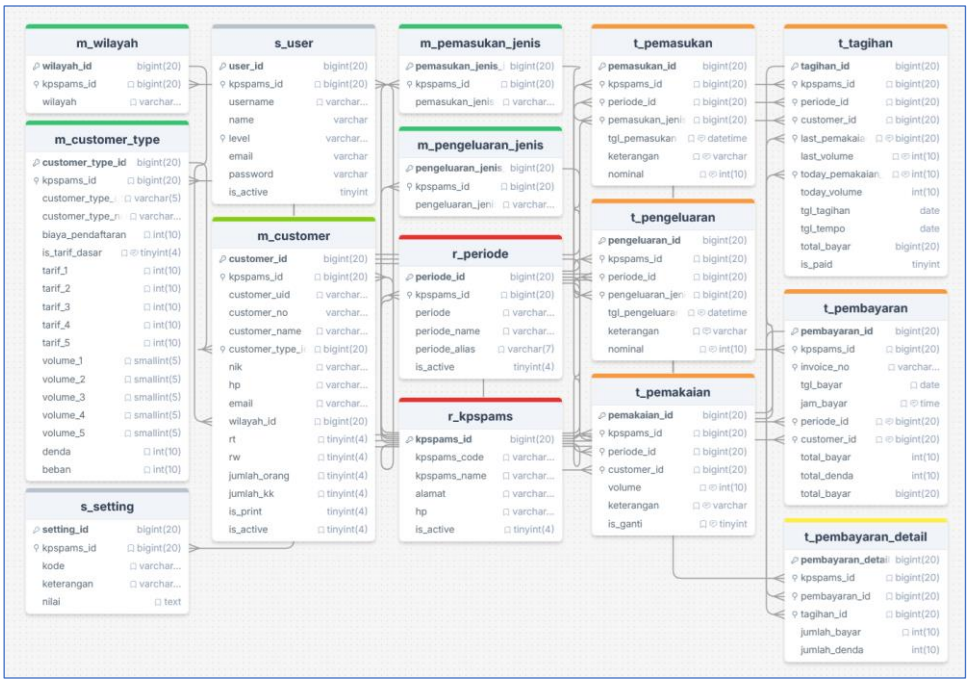


Fig. 7. Database Design

Figure 7 illustrates the database design for the KP-SPAMS system. This database design is structured to support the efficient management of essential data related to customer information, water usage, billing, and financial transactions. The design follows a relational database model, where various tables are interconnected through defined relationships to ensure data integrity, consistency, and easy retrieval.

C. Coding

This section provides a comprehensive overview of the outcomes of the development of the KP-SPAMS transaction information system. The system has been successfully implemented to address the identified operational challenges and enhance efficiency. Below are detailed descriptions and visual representations of key system interfaces, showcasing the functionality and features that have been integrated to meet user requirements.

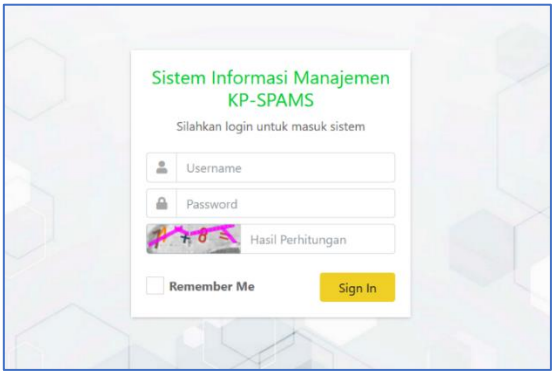


Fig. 8. Login page

Figure 8 displays the interface of the system's login page. This page serves as the initial gateway for users to access the system. Only registered users are permitted to log in, ensuring secure and authorized

access to the system's functionalities. This login mechanism is a critical step to maintain data confidentiality and system integrity.

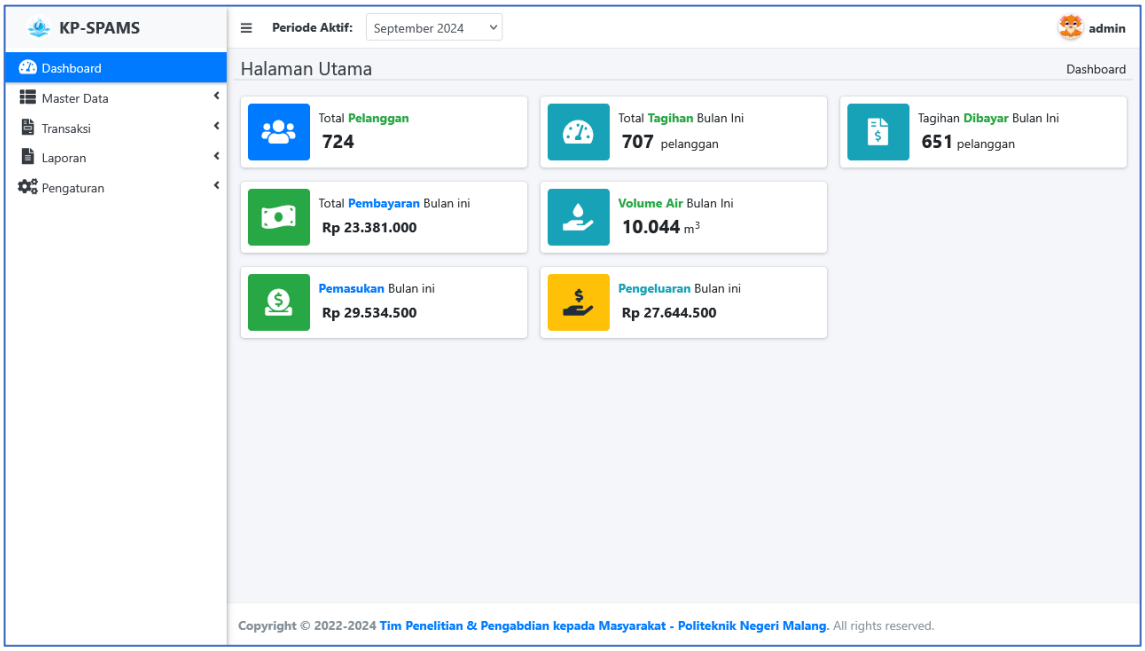


Fig. 9. System Dashboard Page

Figure 9 illustrates the interface of the main page (dashboard) of the KP-SPAMS transaction information system. The dashboard is engineered to offer a comprehensive overview of essential information for users. The page presents critical statistics and reports pertaining to SPAMS data, encompassing the number of active customers, billing details, payment statuses, and the financial condition of KP-SPAMS. The dashboard acts as a central hub, enabling users to monitor critical operational metrics efficiently and make informed decisions based on real-time data.

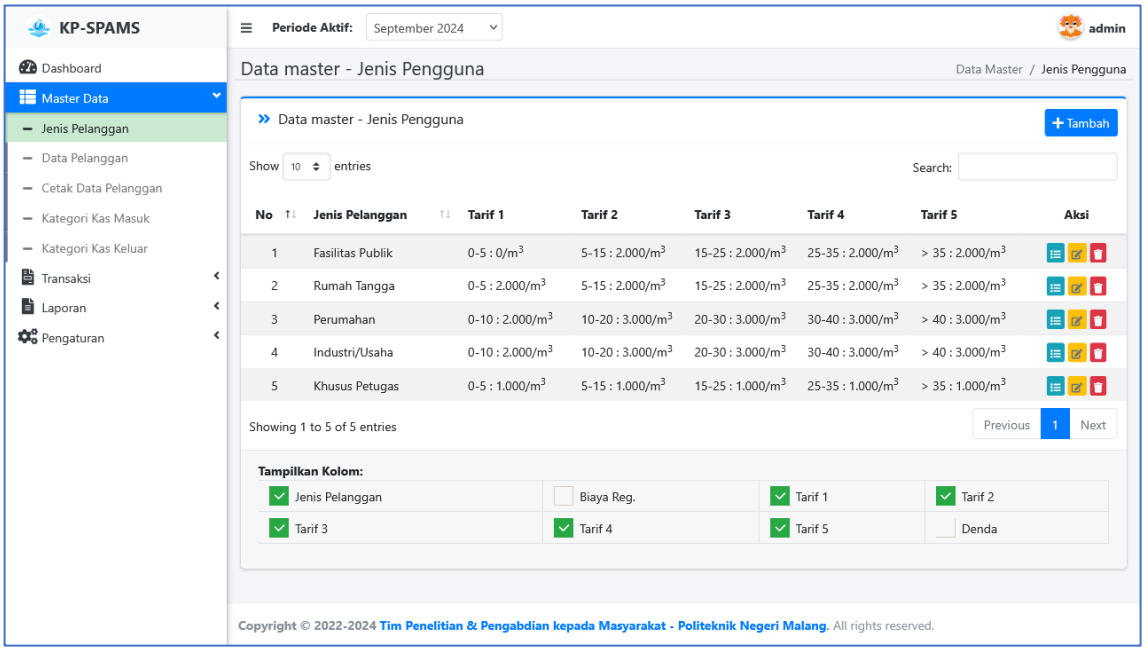


Fig. 10. Customer Type Page

Figure 10 shows the interface of the Customer Type page in the KP-SPAMS transaction information system. This page is primarily intended to manage customer category data. Users may categorize customers into several classes, including households, industrial users, or public facilities. Each client category has

comprehensive information that may be administered, including the establishment of water use rates per cubic meter, initial registration costs for new customers, and penalties for late payments. This classification facilitates efficient data administration and guarantees that billing and service policies are customized to the distinct requirements of each client segment.

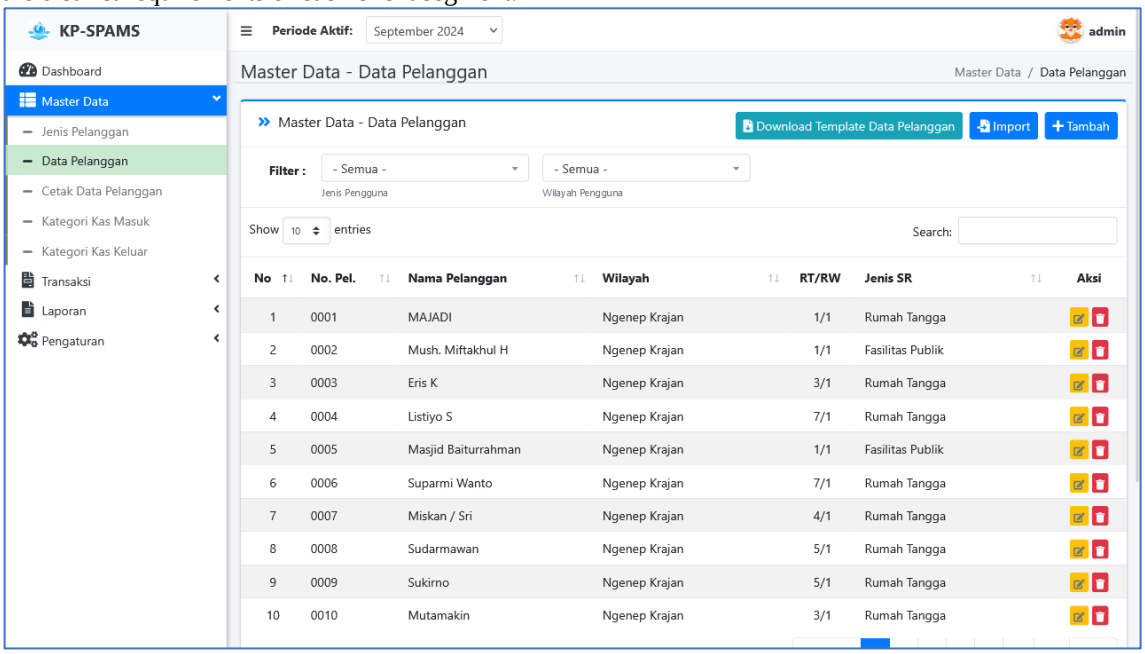


Fig. 11. Customer Data Page

Figure 11 illustrates the interface of the Customer Data page, which is intended to streamline the management of user information. This page allows system users to access a list of registered customers, including essential details such as name, address, customer identification number, and customer category. This page enables the addition, modification, or removal of customer data, thereby maintaining the accuracy and currency of records. The system includes search and filtering features that enable users to efficiently locate specific customer data according to attributes like customer type or geographic area. These capabilities optimize the management of customer information and improve overall operational efficiency.

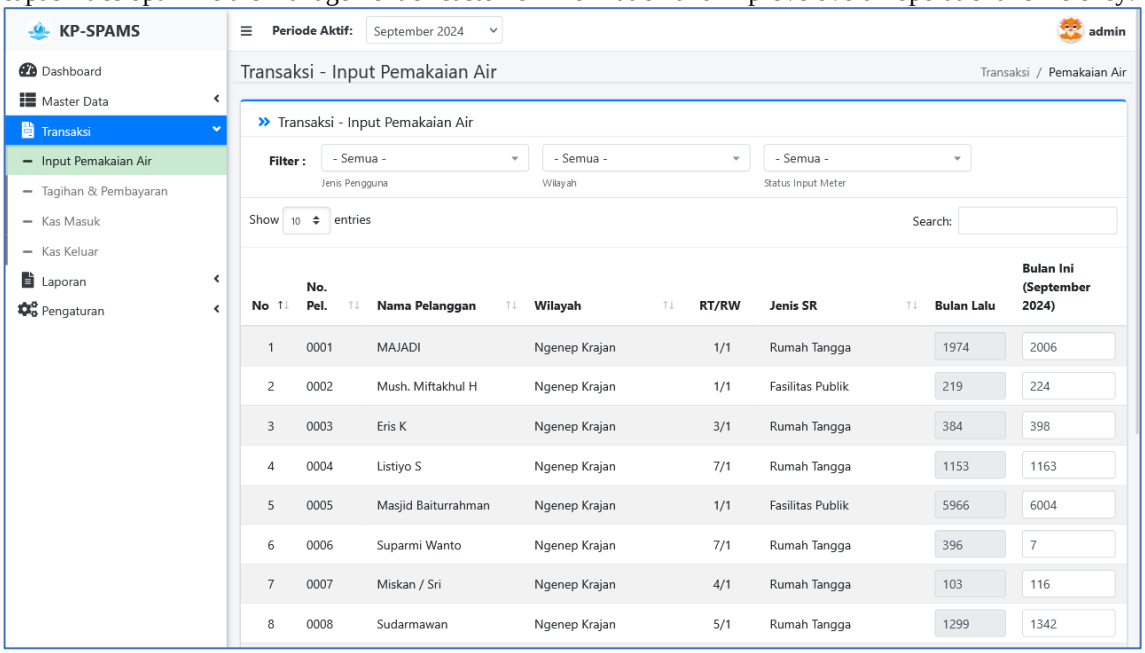


Fig. 12. Water Usage Input Page

Figure 12 illustrates the interface of the Water Usage Input page, which is intended for recording and monitoring customer water consumption within the KP-SPAMS system. This page enables system users to

enter monthly water usage data for each customer according to meter readings. The interface comprises fields for customer information, prior month's usage, and input fields for the current month's usage (active period). Upon data entry, the system automatically computes the bill according to the relevant rates for each customer category. This page includes automatic validation to ensure the accuracy and consistency of entered data with prior meter readings. The page includes a customer search function and a bulk entry feature, allowing staff to input water usage data for multiple customers at once efficiently. Usage data is utilized to generate monthly reports and invoices for customers.

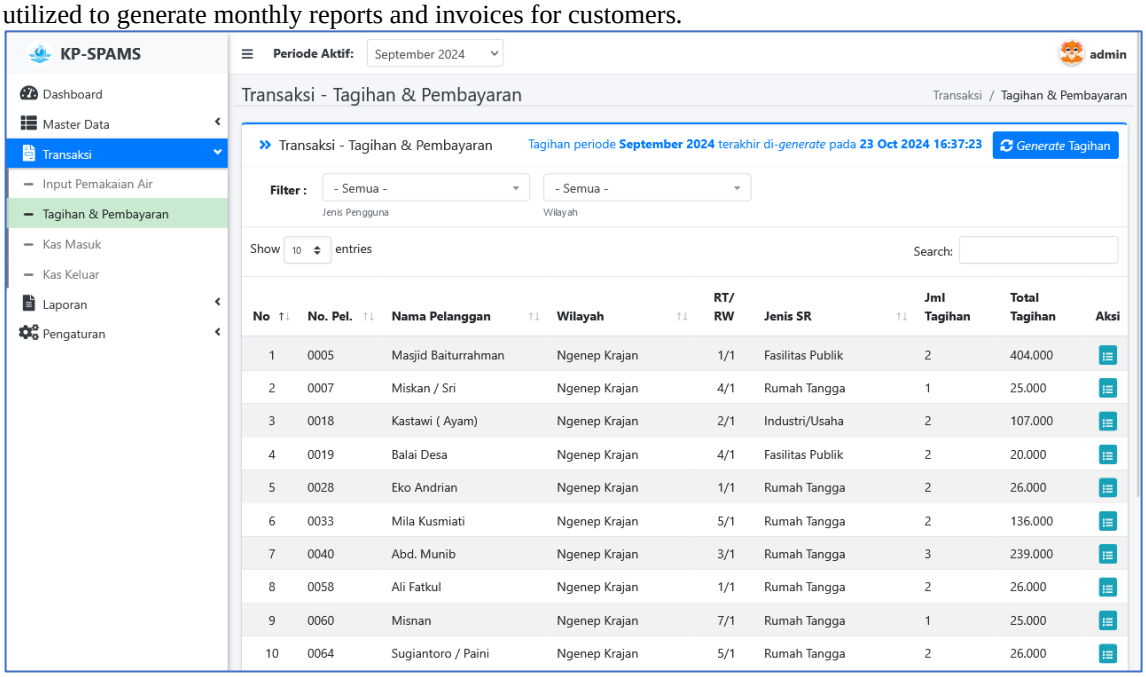


Fig. 13. Figure 1. Billing and Payment Page

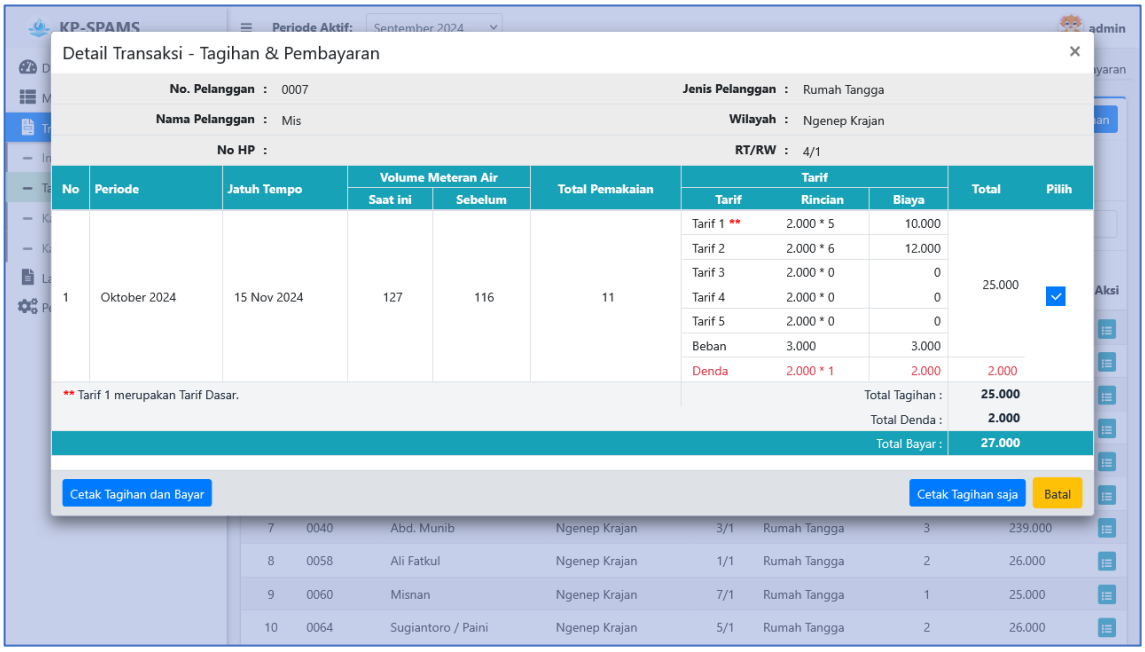


Fig. 14. Figure 2. Billing Page

Figure 13 illustrates the Billing page interface, which facilitates the management and processing of customer bills in the KP-SPAMS system. This page presents a compilation of bills derived from individual customer water consumption over a designated timeframe. It presents essential data, including customer counts, water usage volumes, relevant rates, and overall billing totals. Each bill contains comprehensive records, allowing both customers and administrators to confirm the data's accuracy.

Figure 14 depicts the Payment feature page, enabling users to document payments received from customers. Staff can enter payments, and the payment status is updated in real time following successful recording. The system generates a payment receipt that can be printed and given to the customer for documentation purposes.

The Billing page features search and filtering capabilities, enabling users to find bills according to customer data, geographic region, or designated time frames. This interface aims to enhance the management of billing and payment processes, promoting efficiency and transparency in administrative operations.

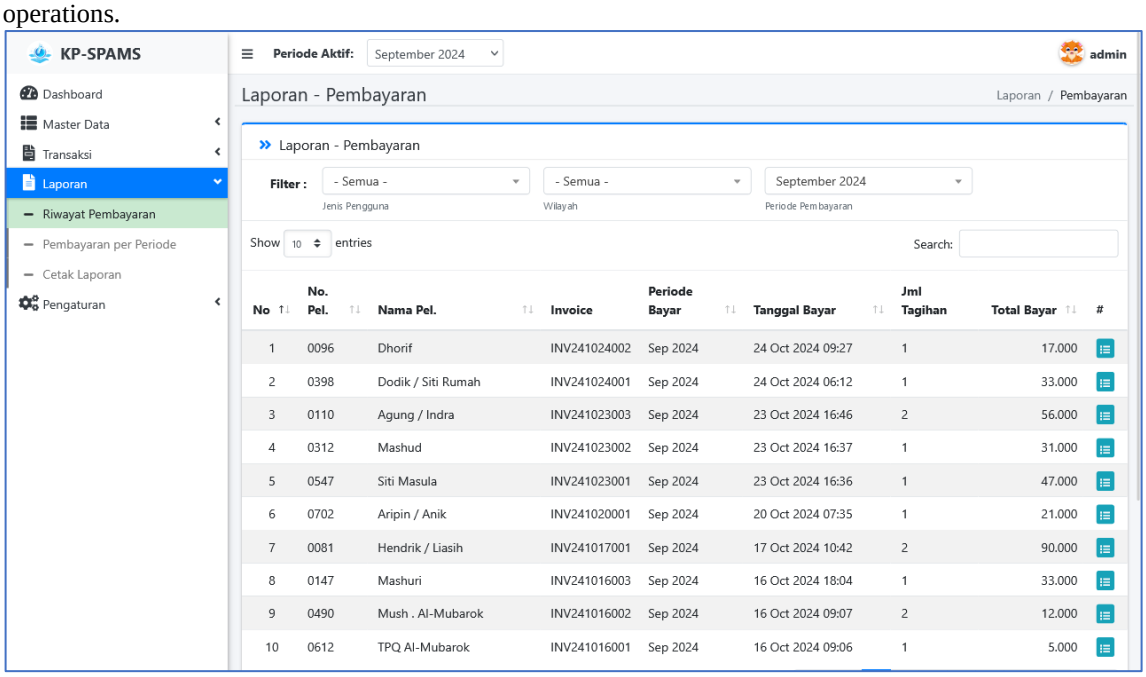


Fig. 15. Payment History Page

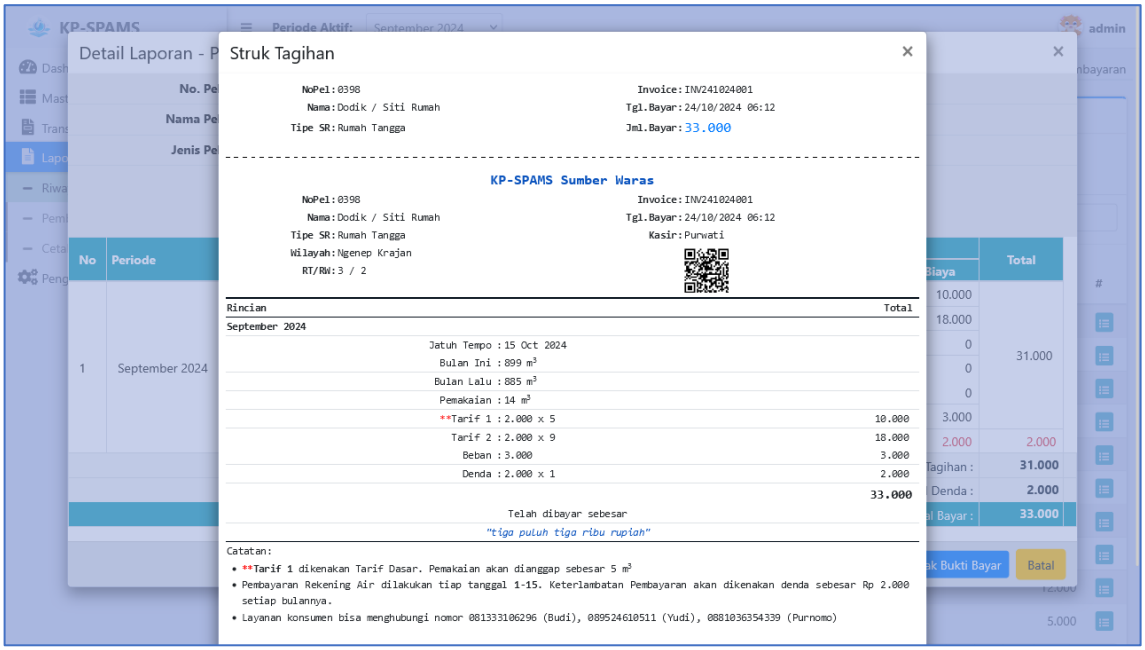


Fig. 16. Payment Receipt Page

Figure 15 illustrates the interface of the Customer Payment History page, which is intended to present the payment records for all KP-SPAMS customers. This page presents comprehensive data on payment transactions, encompassing customer identifiers, payment dates, amounts remitted, and the billing periods associated with each transaction. System users have the capability to select particular customers in order to

access their comprehensive payment histories. Each payment entry comprises details, including the volume of water consumed in cubic meters and the total payment provided. The page includes search and filtering functionalities that allow users to effectively identify transactions according to criteria such as periods, customer regions/blocks, customer types, or customer numbers. Figure 16 presents the comprehensive Payment History view, featuring the capability to reprint payment receipts for customers. This feature improves accessibility and promotes transparency in the management of payment records.

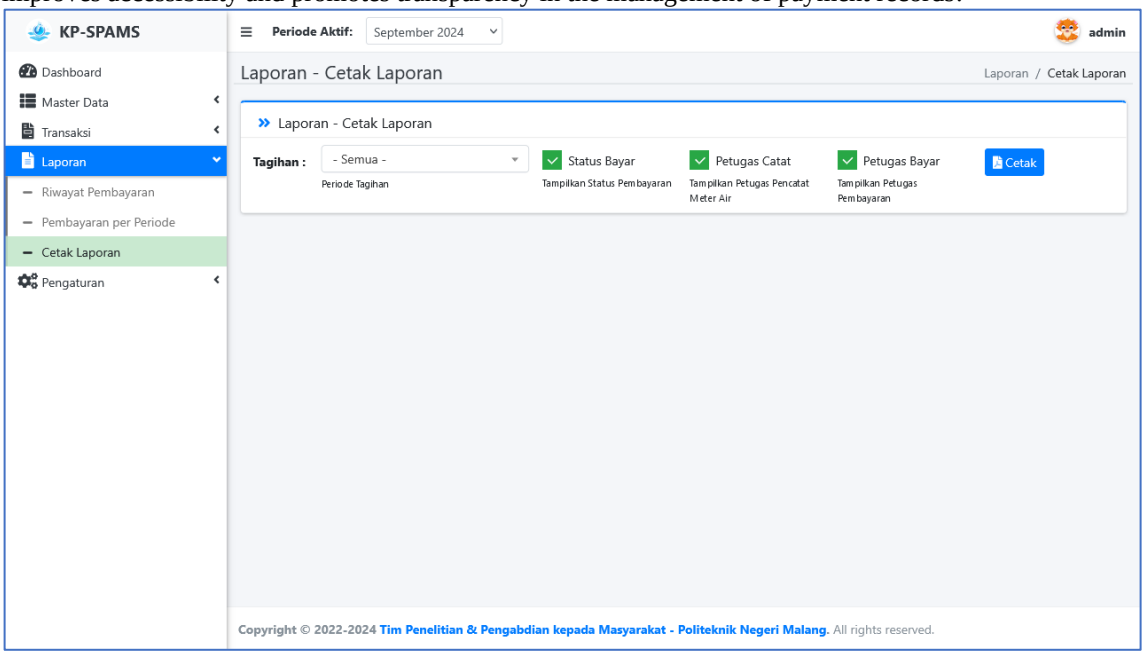
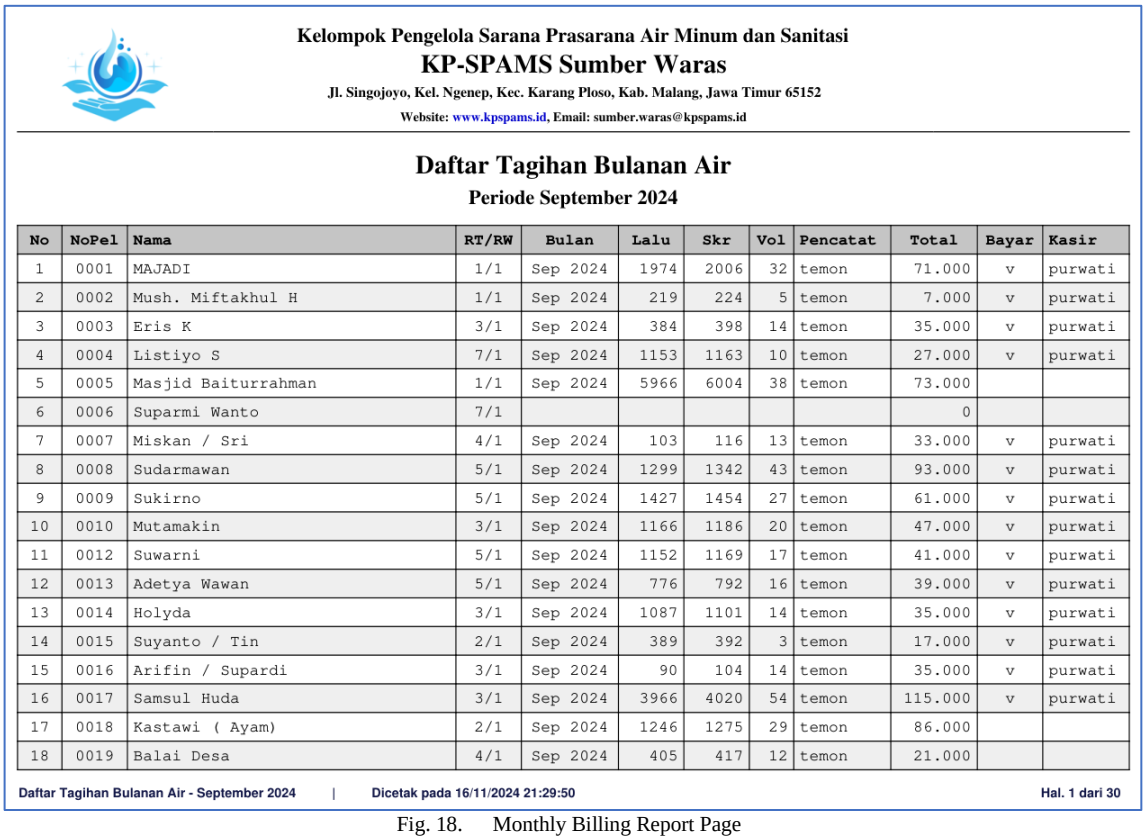


Fig. 17. Print Report Page



Kelompok Pengelola Sarana Prasarana Air Minum dan Sanitasi

KP-SPAMS Sumber Waras

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Daftar Tagihan Bulanan Air

Periode September 2024

No	NoPel	Nama	RT/RW	Bulan	Lalu	Skr	Vol	Pencatat	Total	Bayar	Kasir
1	0001	MAJADI	1/1	Sep 2024	1974	2006	32	temon	71.000	v	purwati
2	0002	Mush. Miftakhul H	1/1	Sep 2024	219	224	5	temon	7.000	v	purwati
3	0003	Eris K	3/1	Sep 2024	384	398	14	temon	35.000	v	purwati
4	0004	Listiyo S	7/1	Sep 2024	1153	1163	10	temon	27.000	v	purwati
5	0005	Masjid Baiturrahman	1/1	Sep 2024	5966	6004	38	temon	73.000		
6	0006	Suparmi Wanto	7/1						0		
7	0007	Miskan / Sri	4/1	Sep 2024	103	116	13	temon	33.000	v	purwati
8	0008	Sudarmawan	5/1	Sep 2024	1299	1342	43	temon	93.000	v	purwati
9	0009	Sukirno	5/1	Sep 2024	1427	1454	27	temon	61.000	v	purwati
10	0010	Mutamakin	3/1	Sep 2024	1166	1186	20	temon	47.000	v	purwati
11	0012	Suwarni	5/1	Sep 2024	1152	1169	17	temon	41.000	v	purwati
12	0013	Adetya Wawan	5/1	Sep 2024	776	792	16	temon	39.000	v	purwati
13	0014	Holyda	3/1	Sep 2024	1087	1101	14	temon	35.000	v	purwati
14	0015	Suyanto / Tin	2/1	Sep 2024	389	392	3	temon	17.000	v	purwati
15	0016	Arifin / Supardi	3/1	Sep 2024	90	104	14	temon	35.000	v	purwati
16	0017	Samsul Huda	3/1	Sep 2024	3966	4020	54	temon	115.000	v	purwati
17	0018	Kastawi (Ayam)	2/1	Sep 2024	1246	1275	29	temon	86.000		
18	0019	Balai Desa	4/1	Sep 2024	405	417	12	temon	21.000		

Daftar Tagihan Bulanan Air - September 2024 | Dicetak pada 16/11/2024 21:29:50 Hal. 1 dari 30

Fig. 18. Monthly Billing Report Page

Figure 17 illustrates the Print Options interface for the Monthly Billing Report page, intended for the generation of monthly billing reports for all KP-SPAMS customers. This page allows system users to select

options for customizing the report to meet specific requirements. Options include selecting the billing period and payment status, identifying the meter reader responsible for recording water usage and displaying the staff who processed the payments.

Figure 18 displays the generated report, which includes billing information such as customer numbers, customer names, water usage (in cubic meters), total bills, and payment statuses according to the selected options. The report is formatted as a PDF to enable regular billing monitoring, ensuring consistency in the billing process and promoting financial transparency in administrative operations.

D. Testing

The testing phase of the KP-SPAMS application was conducted to ensure that all functionalities operate as expected and meet user requirements. Two testing methods were employed: Black-box Testing and User Acceptance Testing (UAT).

1. Black-box testing

Black-box testing was conducted to assess the system's functionality without analyzing the internal code structure. The main objective was to ascertain if the application's input and output corresponded with the expected outcomes. The primary areas assessed included:

1. Login and Authentication:
   - Ensuring that access to the system is restricted to registered users possessing valid credentials.
   - Providing appropriate error messages for unsuccessful login attempts.
2. Management of Customer Data:
   - Evaluating the processes of adding, updating, and deleting customer records.
   - Evaluating the accuracy of the search and filtering functionalities.
3. Management of Transaction Data:
   - Input Meter Reading:
     - Evaluating the procedure for entering water meter data for various customers.
     - Accurate validation of input values against prior meter readings is essential to prevent errors.
     - Confirming that the computed water usage aligns with the provided data.
   - Billing and Payment Transactions:
     - Testing the automated creation of invoices based on documented water usage and relevant pricing structures.
     - It is essential to ensure that modifications in rates and penalties are accurately implemented in the billing process.
     - Assessing the precision of payment processing, encompassing real-time updates on payment status and the production of receipts.
4. Reporting:
   - Verifying the generation and export of monthly billing and payment history reports.
   - Ensuring appropriate filtering options for tailored reports.

The Black-box testing process involved assessing the functionality of each feature page. This encompasses the evaluation of essential functionalities, including data list display, data addition, data modification, data deletion, detailed data viewing, data searching, and data filtering.

TABLE II. BLACKBOX TESTING RESULT

Scope	Number of scenarios	Number of successes	Number of failures
Credential and Dashboard	4	3	1
Master Data	27	27	0
Transaction Data	42	38	4
Report	21	20	1
Setting	20	18	2

The Blackbox testing results in Table II for the KP-SPAMS system demonstrate a significant degree of reliability, with 114 test scenarios conducted across multiple modules. Out of the total, 106 scenarios achieved success, yielding a success rate of 93%, whereas 8 scenarios (7%) faced challenges. The Credential and Dashboard module exhibited slight reliability issues, evidenced by 1 failure in 4 scenarios. The Master Data module operated effectively, attaining a 100% success rate across 27 scenarios. In the Transaction Data module, 38 of 42 scenarios were successful, while 4 necessitated further attention. The

Report module exhibited robust functionality, achieving success in 20 out of 21 scenarios, while the Setting module revealed minor deficiencies, with 2 failures among 20 scenarios. The results indicate the system's robustness in various areas while identifying specific improvements required in transaction data, settings, and dashboard functionalities to achieve optimal performance.

2. User Acceptance Testing (UAT)

The testing phase involved administering a survey to users who had evaluated the application. This survey aimed to collect user feedback and evaluations concerning their experiences with the application following testing. The collection of user responses and comments aimed to analyze how well the application meets user needs and expectations while also identifying potential areas for improvement.

User Acceptance Testing (UAT) was conducted alongside the survey to verify that the application meets practical user requirements and operational workflows. User Acceptance Testing (UAT) engaged actual users in simulated operational scenarios, emphasizing essential functionalities, including data input, billing, payment processing, and reporting. This testing enabled users to assess the system's usability, reliability, and performance in executing their daily tasks. The results can be seen in Table III.

TABLE III. USER ACCEPTANCE TEST RESULTS

No	Question	Rating Scale					Total
		1	2	3	4	5	
1	I think I will use this system again.	0	0	0	3	3	6
2	I find this system difficult to use.	1	2	0	2	1	6
3	I find this system easy to use.	0	0	0	3	3	6
4	I need help from others or a technician to use this system.	0	0	3	1	2	6
5	I feel the system's features are functioning properly.	0	0	0	5	1	6
6	I feel there are many inconsistencies in the system.	0	4	0	2	0	6
7	I feel others will understand how to use this system quickly.	0	0	2	3	1	6
8	I feel this system is confusing.	0	4	0	2	0	6
9	I feel there are no barriers to using this system.	0	0	0	4	2	6
10	I need to familiarize myself with the system before using it.	0	0	2	2	2	6

Rating Scale:
1: Strongly Disagree
2: Disagree
3: Neutral
4: Agree
5: Strongly Agree

Six respondents participated in both the survey and UAT processes, including one administrator user, one management user, one cashier user, and three field officer users. Their feedback was essential in enhancing the application to guarantee it provides robust, efficient, and user-friendly solutions for KP-SPAMS operations. The UAT process involved 10 key questions aimed at evaluating the KP-SPAMS system's usability, functionality, and overall user satisfaction. A total of 60 responses were recorded, with each question answered on a 5-point Likert scale ranging from "Strongly Disagree" (1) to "Strongly Agree" (5). Responses were rated on a 5-point Likert scale, where "Strongly Disagree" indicates the application does not meet user needs, and "Strongly Agree" indicates the application aligns with user requirements and users are highly satisfied.

TABLE IV. USER ACCEPTANCE TEST SUMMARY

/	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	4	8	32	16	60
Percent (%)	0	6,67	13,33	53,33	26,67	100

The results of User Acceptance Testing (UAT) in Table IV demonstrate that the KP-SPAMS system effectively fulfils user requirements and delivers a satisfactory experience for most users. 80% of responses indicated "Agree" or "Strongly Agree," demonstrating that the majority of users perceived the system as functional, aligned with their requirements, and satisfactory for use. Approximately 26.67% of respondents indicated "Strongly Agree," suggesting that a considerable number of users perceived the application as effectively meeting their needs and delivering a satisfying experience. Additionally, 13.33% of responses were neutral, indicating that certain elements of the system may require refinement to meet user expectations or enhance usability more effectively. Only 6.67% of responses indicated "Disagree," reflecting minimal dissatisfaction, and there were no "Strongly Disagree" responses, which confirms that

no users perceived the application as entirely inadequate in meeting their requirements. The results indicate the system effectively meets essential user needs, with the potential for further improvements to increase satisfaction and usability. The UAT results suggest that while the KP-SPAMS system is largely effective in meeting user requirements and delivering a satisfactory experience, there are areas where additional improvements could be made. Enhancing system usability, addressing specific user needs, and fine-tuning certain features could further increase user satisfaction and ensure the system is fully aligned with user expectations.

IV. CONCLUSION

The information system developed for KP-SPAMS Sumber Waras effectively addresses transactional management requirements, encompassing customer registration, water usage recording, billing, and financial reporting. The application of the Extreme Programming (XP) methodology facilitated a flexible and adaptive system development process, effectively addressing the challenges encountered by KP-SPAMS in managing complex data and operational processes. This Laravel-based system has proven effective in improving operational efficiency, transparency, and accountability in the management of community-based water services. The system includes a user-friendly interface and comprehensive functionalities, such as dashboards, tariff management, water usage tracking, and payment reports, facilitating quicker and more responsive decision-making in accordance with community needs. The system's effectiveness was confirmed via comprehensive Blackbox Testing, achieving a 93% success rate in test scenarios, thereby validating the functionality of essential features such as data input, billing, reporting, and user interface performance. The User Acceptance Testing (UAT) indicated that 80% of user feedback was categorized as "Agree" and "Strongly Agree," suggesting that the system fulfils user requirements and offers a satisfactory experience. No respondents rated the system as "Strongly Disagree," indicating its conformity with user requirements.

The implementation of this system is expected to be sustainable and to significantly enhance the quality of water service delivery in rural areas. Continuous improvements, informed by user feedback, will ensure ongoing enhancement and increased user satisfaction.

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