DEVELOPMENT OF A WEB-BASED INFORMATION SYSTEM FOR DISTRIBUTING USED COOKING OIL USING THE WATERFALL METHOD

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Abstract

Improper disposal of used cooking oil remains a serious environmental problem in Indonesia, including in Sidoarjo, where high waste generation and low public awareness contribute to water and soil pollution. In response to this issue, this study develops a website-based information system designed to support the management and distribution of used cooking oil more effectively and systematically. The system was developed using the Waterfall method, which includes stages of requirements to ensure a structured development process. Through observations, both functional and non-functional requirements were identified, resulting in features such as user registration, input of cooking oil collection data, tracking of collection history, incentive calculation, data visualization, and administrative reporting. Black-box testing confirmed that all major system functions operated according to the defined requirements. The resulting information system is expected to improve transparency, coordination, and efficiency in used cooking oil management, encourage community participation through a digital platform, and provide a practical technological solution to reduce environmental problems caused by improper cooking oil disposal.

Keywords: disposal, website, cooking oil, information system, waterfall

1. INTRODUCTION

Used cooking oil waste is a significant environmental problem in Indonesia. A household survey by LPEM FEB UI found that 60–70% of used cooking oil has reuse potential, yet most of it is discarded into drains, rivers, or mixed with household waste (Halimatussadiah et al., 2021). This issue is also prominent in Sidoarjo Regency, the largest waste producer in East Java, generating 406.85 thousand tons of waste in 2021 (Anggraini et al., 2024). Palm oil consumption in Sidoarjo reaches 0.22 liters per capita per week, with about 20% used as cooking oil (Ariza, 2022). Improper disposal pollutes soil and water, clogs drainage, and disrupts aquatic ecosystems (Prabowo et al., 2025).

Used cooking oil management in Sidoarjo still faces systemic challenges. A survey of MSMEs revealed that all respondents dispose of used oil directly into the environment and are unaware of its environmental impacts (Agustina et al., 2025). Although local initiatives such as the Tri Tunggal Dwi Group in Kalitengah Village collect up to 486 liters per month from 417 customers (Ariza, 2022), their reach remains limited and not yet integrated into a district-wide coordination system.

Technology based information systems can enhance the effectiveness of used cooking oil management through transparent data recording and improved coordination between communities and managers (Adenowo & Adenowo, 2020). Experience in Kalitengah Village shows that shifting from manual to digital systems increases customer trust by providing clear records of collected oil and its economic value (Ariza, 2022).

This study aims to develop a web-based information system for distributing used cooking oil waste in Sidoarjo Regency using the Waterfall method. The method was selected for its structured development stages, including requirements analysis, design, implementation, testing, and maintenance (Adenowo & Adenowo, 2020). The system is designed to coordinate collection and distribution, provide rewards for contributors, and generate periodic transaction reports for management. Its implementation is expected to improve management efficiency, increase public participation, and support SDGs 12 on Responsible Consumption and Production.

2. METHODOLOGY

The development of the Waste Cooking Oil Management Information System was conducted using the Software Development Life Cycle (SDLC) with the Waterfall model. This model was selected because it provides a structured and sequential development process, where each stage must be completed before proceeding to the next stage (Pressman & Maxim, 2015). The research stages consisted of requirement analysis, system design, implementation, testing, and evaluation. The stages of the SDLC Waterfall model used in this study are illustrated in Fig. 1.

Figure 1. The Waterfall Model
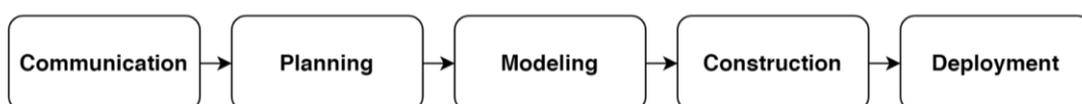
Source: Pressman & Maxim (2015)

2.1 Communication

The communication stage focused on identifying problems and analyzing system requirements. This stage aimed to understand the existing waste cooking oil management process and to determine user needs and system expectations. Data were collected through observations, which provided insights into current workflows, challenges, and functional requirements. The results of this stage were used as the foundation for defining system requirements.

2.2 Planning

The planning stage involved preparing a development plan to guide the system implementation process. This stage included defining the development schedule, determining required resources, and identifying system scope and constraints.

Planning ensured that system development could be carried out in an organized and systematic manner according to the defined objectives.

2.3 Modeling

The modeling stage focused on designing the system based on the identified requirements. This stage included the creation of system models such as use case diagrams, system flowcharts, and database designs, including Conceptual Data Model (CDM) and Physical Data Model (PDM). In addition, user interface designs were developed to provide a clear representation of system interactions and functionalities.

2.4 Construction

The construction stage involved translating the system design into program code and conducting system testing. The web-based Waste Cooking Oil Management Information System was developed according to the defined design and functional specifications. System testing was performed using black-box testing to ensure that all system functions operated correctly and met the specified requirements.

2.5 Deployment

The deployment stage involved delivering and implementing the developed system for actual use. At this stage, the system was prepared and handed over for operational use so that it could be accessed and utilized as intended. This stage marked the completion of the system development process.

3. FINDINGS AND DISCUSSION

The text in each section or subsection must begin one line after the title. Avoid using hard tabs. Use line breaks only at the end of a paragraph. Add as many sections and subsections as needed.

3.1 Communication

All functional and non-functional requirements are then summarized in a table as the basis for system design and development in the next stage, which can be seen in Tables 1 and 2 below.

Table 1. Functional Requirements

Features	Features Description
Registration	Allows users to create an account as collectors and gain access to participate in the used cooking oil collection process.
Collector Page	Used to display data the total amount of oil and money collected, and to fill in data on the address and amount of oil in liters, as well as the scale of home or restaurant oil collection.
Collector History	Displaying the oil collection history according to the collector's account.
Profile	Used to view and edit the user profile.

Features	Features Description
Dashboard Admin	It displays the total number of collectors, total oil collected, total incentives, and a list of collection requests that admins can accept or reject.
Collector List	Displaying the contents of the collector data
Collector History Admin	Displaying the oil collection history for each user
Collector Reports	Displaying the top collector visualization results, monthly oil extraction, and printing to PDF

Table 2. Non Functional Requirements

Aspect	Description
Ease of Use	The system has a simple, easy-to-understand, and responsive interface
Availability	The system can be accessed at any time via a browser as long as it is connected to the internet.
Maintainability	The system is easy to maintain and update because it uses the Laravel framework with an organized code structure.

3.2 Planning

The planning stage establishes the work schedule, including task durations and completion targets. As shown in Fig. 2, this preparation ensures the system is developed on time.
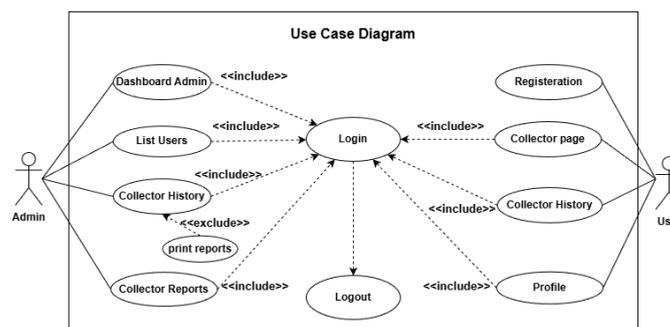
Figure 2. Project Schedule
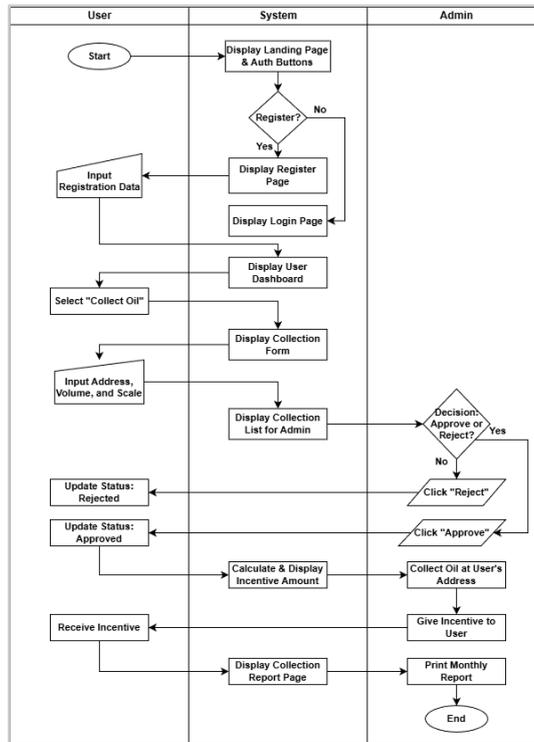

3.3 Modeling
3.3.1 Use Case Diagram

Figure 3. Use Case Diagram

As shown in Fig. 3 two actors, User and Admin, must Login to access their respective features: oil collection for Users and reporting/management for Admins.

3.3.2 Flowchart

Figure 4. Flowchart

As shown in Fig. 4, the process starts with User registration/login and request submission. The Admin then validates the request, performs physical oil collection, and generates a monthly report once the incentive is rewarded.

3.3.3 CDM (Conceptual Data Model)
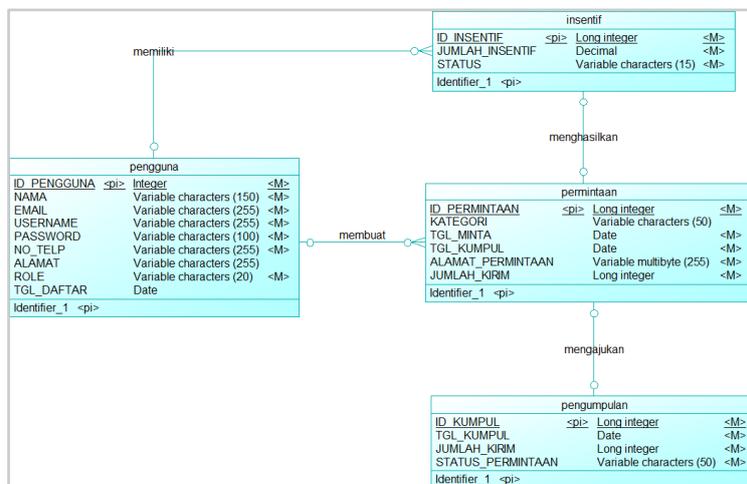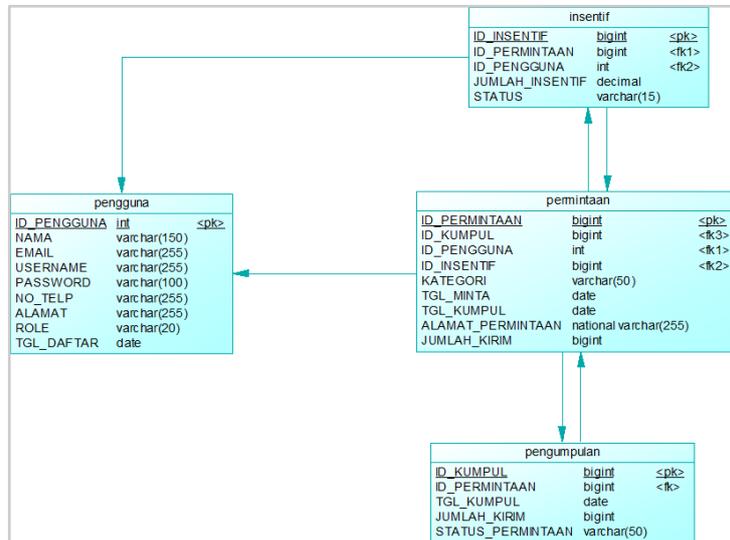
Figure 5. Conceptual Data Model (CDM)

Fig. 5 shows the database structure consists of four primary entities: Pengguna (User), Permintaan (Request), Pengumpulan (Collection), and Insentif (Incentive).

3.3.4 PDM (Physical Data Model)
Figure 6. Physical Data Model (PDM)

The PDM in Fig. 6 implements the CDM by defining physical tables and enforcing relational integrity through primary and foreign keys. It assigns a technical database to ensure precise storage for users, requests, collections, and incentives.

3.4 Construction

The SiJelantah website has a main feature for managing used cooking oil collection data, allowing users to record the amount of collected oil and view their collection history in a structured manner. The stored data serves as the central information source and is used to monitor and manage used cooking oil collection activities.

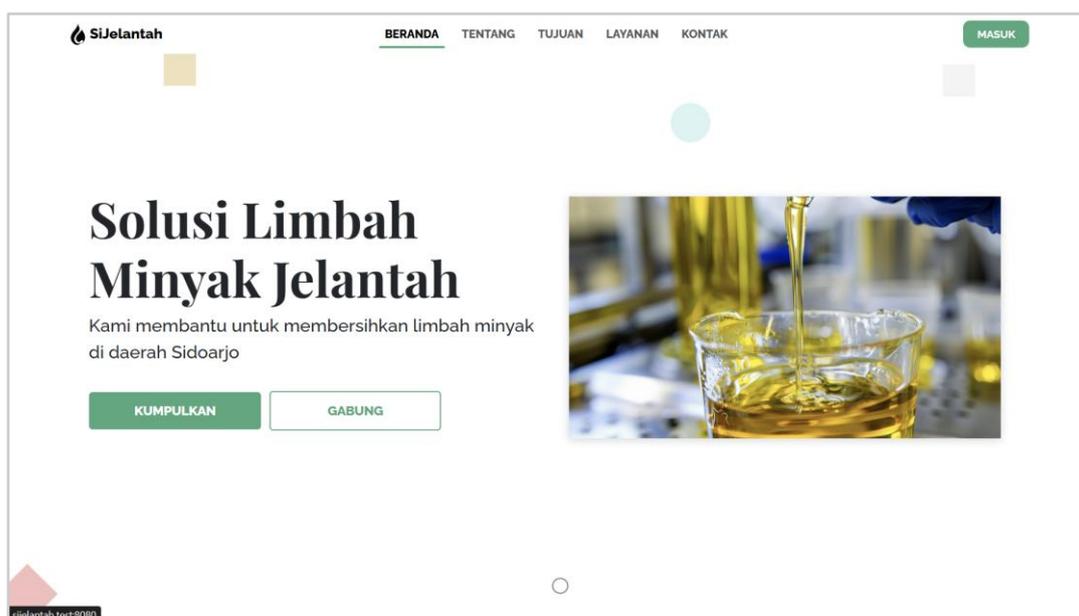**Figure 7. Landing Page SiJelantah**

Fig. 7 serves as the primary entry point, featuring the system's vision to manage oil waste in Sidoarjo and providing quick access buttons for users to "Collect" or "Join".
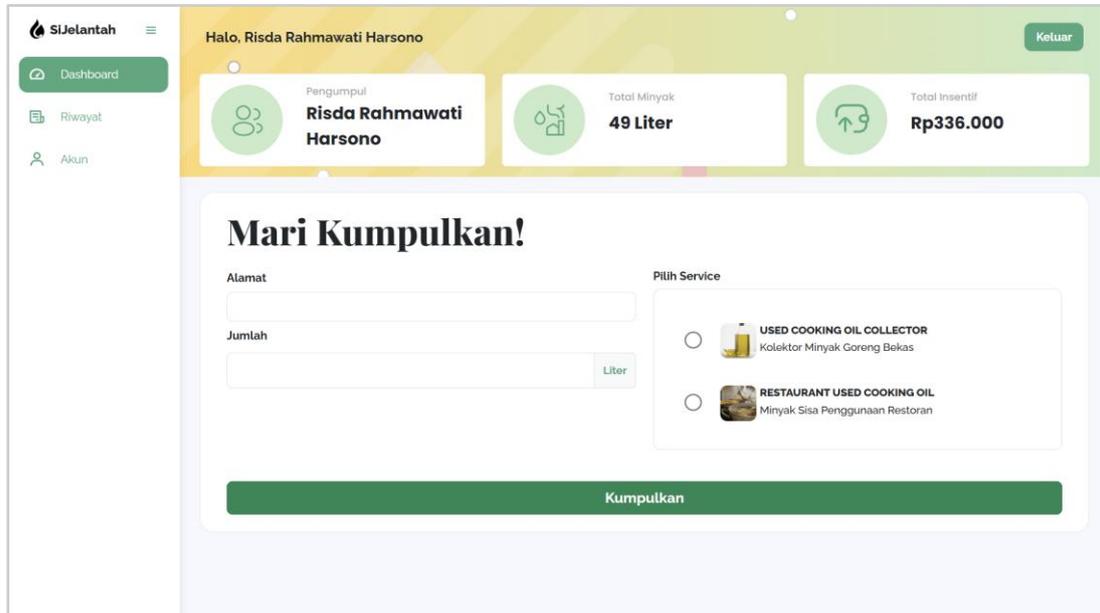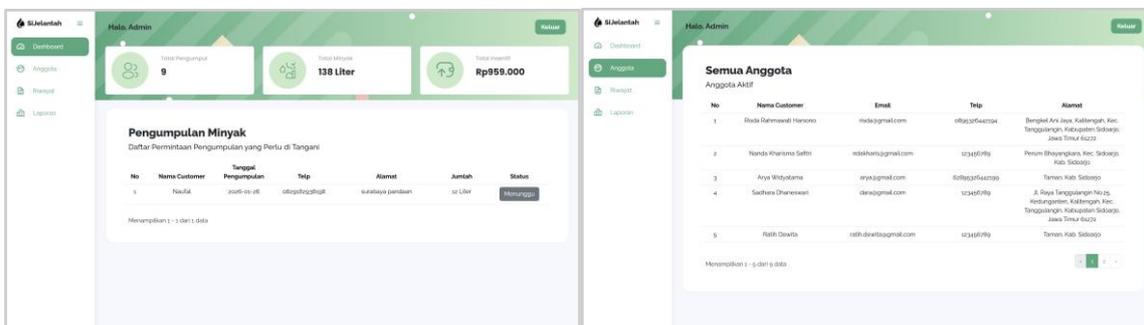
Figure 8. User Dashboard

Fig. 8 provides a personal overview of the user's total collected oil and earned incentives, including a submission form to input pickup addresses and oil volume.

Figure 9. Dashboard Admin and Collector

In addition, the system provides an incentive calculation feature that is directly integrated with the collection data, enabling users to see the incentives they earn transparently. To support evaluation and monitoring, the website also includes data visualization in the form of charts and reporting features that allow data export in PDF and Excel formats for documentation and reporting purposes.

During the construction phase, after the implementation of the main features was completed, system testing was conducted to ensure that each function operated according to the specified requirements. The testing method used was black-box testing, which focuses on functional testing by comparing system inputs and outputs without considering the internal code structure. The testing in Table 3 results indicate that all main system functions worked as expected.

Table 3. Black-Box Testing Results

Tested Feature	Features Description	Status
User Registration	The user registers a new account by completing the registration form, and the system successfully saves the data and allows access to the system	Passed
User Login	The user logs in using valid credentials, and the system successfully grants access to the dashboard	Passed
Used Cooking Oil Collection Data	The user inputs used cooking oil collection data, and the system successfully stores and displays the data in the collection history	Passed
Incentive Calculation	The system calculates incentive values based on the recorded collection data and displays the results correctly	Passed
Data Visualization	The system displays used cooking oil collection data in the form of charts based on stored data	Passed
Report Generation	The system generates reports in PDF and Excel formats based on stored collection data	Passed

3.5 Deployment

The deployment stage is the final stage in the Waterfall method, where the application that has been developed and tested is then fully documented. At this stage, technical documentation, user guides, and system test results have been prepared as part of the research deliverables. However, the process of hosting and publishing the website online has not yet been implemented in this study, so the deployment stage focuses on preparing documentation and waiting for the opportunity to be hosted in the futureThe deployment phase is the final stage in the Waterfall method, where the application that has been developed and tested is then comprehensively documented. In this phase, technical documentation, user manuals, and system testing results have been prepared as part of the research deliverables. However, the hosting and online publication of the website have not been implemented in this research, therefore the deployment phase is focused on documentation preparation and awaiting opportunities for hosting in the future.

4. CONCLUSION

The cooking oil website was designed to help collect used cooking oil in the Sidoarjo area more effectively and in an organized manner. The system development

uses the Waterfall Pressman method, which includes the communication stage for determining system requirements and features, planning for project scheduling, modeling for wireframe design, construction for application development using Laravel, and deployment for system implementation and usage documentation. The Sijelantah website is expected to support a more optimal and sustainable used cooking oil management process.

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