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Design and Development of Kumpul.in Mobile Application for Schedulled Wasted Collection System

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ABSTRACT

Community-level waste management often struggles with poor coordination between garbage collectors and local residents, leading to irregular collection schedules. To address this issue, this study aims to design and build Kumpul.in, a mobile application serving as a scheduled waste collection information system at KSM TPS Ceria Sumampir. Following the Waterfall development model, the system underwent four key stages: requirements analysis, system design, implementation, and testing. The application was built using Flutter, paired with Firebase as a real-time database. Field results indicate that Kumpul.in improved both coordination efficiency and schedule regularity by up to 90% compared to previous manual methods. Ultimately, this application provides an efficient and sustainable digital tool for community-based waste management.

Keywords: *mobile application, waste management, information system, Waterfall, KSM*

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INTRODUCTION

Waste management remains a persistent environmental challenge for local communities, particularly in densely populated residential areas. Rapid population growth alongside rising daily consumption drives up household waste volumes each year. Left unmanaged, this issue leads to environmental degradation, health risks, and a decline in overall quality of life (Badlisyah et al., 2021). In many regions, including *KSM TPS Sumampir*, waste handling still relies heavily on manual processes. Common obstacles include irregular collection schedules, delayed updates to residents, and ineffective coordination between collectors and the community. Furthermore, waste transit routes in the area remain inefficient, as evidenced by frequent waste accumulation at Temporary Disposal Sites (*TPS*) (Putri et al., 2023). Suboptimal urban waste collection systems inflict immediate negative consequences on both daily community life and long-term environmental sustainability (Fitrisia et al., 2023). Addressing these critical concerns requires active involvement and collaboration among all stakeholders (Ayu Nur Wulandari et al., 2023). Traditional methods—such as logbooks, word-of-mouth communication, or unannounced notices—frequently cause miscommunication and disrupt service delivery (Widjaja & Lovianda Gunawan, 2022).

Recent literature suggests that digitalizing waste operations through mobile information systems can substantially improve service quality. Mobile applications help streamline scheduling, accelerate information sharing, and bring greater transparency to public services (Aplikasi Bank Sampah et al., 2023b). Moreover, mobile technology offers an effective framework for community-based waste initiatives due to its accessibility and real-time processing capabilities (Airudani & Retnowo, 2023). Given these requirements, *KSM TPS Sumampir* needs a Mobile-Based Scheduled Waste Collection Information System to organize schedules, notify residents, log collection activities, and facilitate smoother communication between field workers and local households. To build this system, the Waterfall software engineering approach was selected, as its structured methodology ensures a clear progression from initial requirements analysis to final implementation (Daud, 2022).

Unlike previous studies, the Kumpul.in application provides an integration of real-time scheduling, pickup requests, payment monitoring, notifications, and report dashboards within a single platform, thereby enhancing the integrated coordination of *KSM*.

The remainder of this paper is organized as follows: The second section reviews relevant theoretical literature, followed by the research methodology in the third section, which details the application of the Waterfall model. The fourth section presents the results and discussion, while the final section outlines the conclusion and future recommendations (Fajri et al., 2023). Ultimately, this study aims to deliver a practical digital solution to resolve waste management bottlenecks at *KSM TPS Sumampir* (Fitrisia et al., 2023).

RESEARCH METHOD

The software development method used in this study is the Waterfall Model. The Waterfall method was selected because it emphasizes a sequential and systematic approach, where each development phase must be fully completed before proceeding to the next. This approach is well-suited for Information System Design and Development projects, as it ensures detailed documentation and structured testing at every stage.

The five main stages involved in developing the Kumpul.in mobile application include:

1. Research Approach and Type
   a. Research Approach: A Qualitative Descriptive Approach is employed in this study. This approach aims to analyze and describe the conditions of the existing manual waste management system, identify constraints faced by *KSM*, collectors, and residents, and formulate functional and non-functional requirements for the proposed mobile application.
   b. Research Type: This study is categorized as System Development Research. The primary focus of the research is to build a functional prototype of the Kumpul.in mobile application, serving as a concrete solution to waste collection scheduling issues.
2. Data Collection Techniques

   Accurate and relevant data collection is a crucial stage to produce a targeted application. The techniques used are:

   1. Observation
      a. Conducted at the location of *KSM TPS Ceria Sumampir* and its surrounding service areas.
      b. The focus of the observation is to directly observe the current workflow, routes, and waste collection schedules, as well as to document frequent communication gaps and schedule inaccuracies.
   2. Wawancara (*Interview*)

      Carried out in a structured manner using an interview guide to gather in-depth insights into work processes, operational constraints, and expectations for the new system.

      Key informants include:
      a. Head/Management of *KSM*: To understand organizational policies and management requirements.
      b. Waste Collectors: To obtain field data regarding collection routes, effective working hours, and operational bottlenecks.
      c. Residents/Customers: To collect feedback regarding difficulties in accessing schedule information and desired features in the application.
   3. Literature Review

      A literature review is an essential stage to establish a solid conceptual framework for this study. This technique was conducted by examining and analyzing accredited scientific journals relevant to the topic. The journal review specifically focuses on:
      a. Theoretical Foundations of System Development
      b. Waste Management Information Systems
      c. Waste Collection Scheduling Information Systems

3. Application Development Stages (Waterfall Method)

The development of the Kumpul.in mobile application is carried out through five maind sequential phases of the Waterfall Model. Each phase is designed to ensure system quality validity before moving on to the next stage:

1. Requirements Analysis Phase
   The Requirements Analysis Phase is a fundamental stage in the waterfall Method that serves to guide system development. In this phase, several main focus areas must be addressed and documented, namely:
   a. The requirements analysis phase serves as the initial foundation aimed at producing a comprehensive system requirements specification document.
   b. These specifications cover all functional features needed by both Residents (such as viewing schedules and receiving notifications) and *KSM* Officers (such as waste collection confirmations).
   c. The determination of these requirements is strictly based on primary data gathered through field observations and interviews.
2. System Design Phase
   This stage plays a key role in translating all collected system requirements into a technical design blueprint before the coding process begins:
   a. UI/UX Design: This activity involves using Figma to design application interfaces (mockups), with a primary focus on user-friendliness for all users.
   b. Database Design: An efficient data structure is designed in Firebase to serve as a reliable repository, storing all essential information—such as schedules, customer data, and collection histories—in real time.
3. Testing Phase (Verification)
   Testing is a crucial verification stage to ensure that the system runs according to plan and established requirement specifications:
   a. Functional Testing: Includes Black Box Testing to verify the core functionalities of the applications.
   b. Field Validation Testing: Conducting User Testing directly in the field with KAS officers and local residents.
4. Maintennance Phase
   The Maintenance phase is a post-implementation support phase that is vital to guarantee system sustainability and stability in a live operational environment. This phase focusses on four key areas:
   a. Application Development: the Kumpul.in mobile application is built using Flutter SDK as its primary framework
   b. Platform Combability: The use of flutter ensures that the application operates effectively across both Android an iOS platform.
   c. Backend Integration: Full integration is performed with Firebase to manage data storage, user authentication, and real-time push notofocation delivery.
   d. Hardware: Programming is conducted on a Laptop/PC, while Smartphones are utiled for direct device testing.

RESULTS AND DISCUSSION

This section presents the outcomes of each stage in the system development process, following the Waterfall methodology. The discussion focuses on how the application was designed and implemented to address the primary issues at *KSM TPS Sumampir*, namely poor coordination and the uncertainty of waste collection schedules. To provide a comprehensive understanding, this section elaborates on the analysis of current business processes, followed by a visualization of the system workflow using flowcharts, and concludes with the implementation of the user interface (UI/UX) within the application. The application's workflow and operational procedures are illustrated in Figure 1.

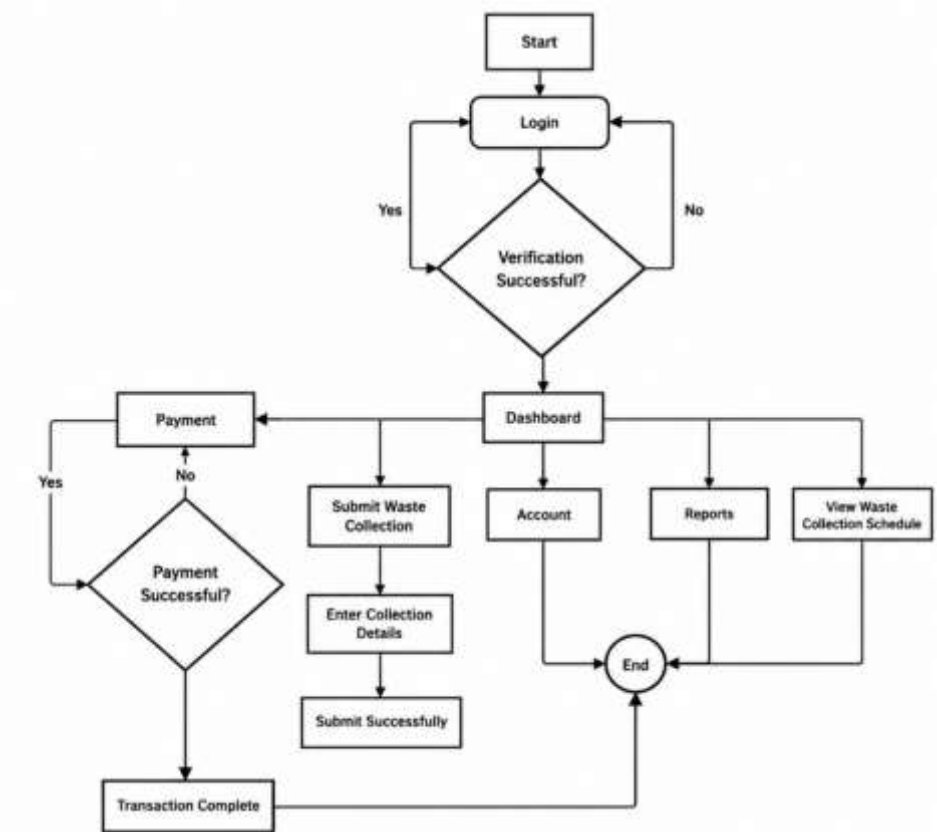

Figure 1. Flowchart of Waste Collection Application 1

1.1 Splash Screen

The Splash Screen interface serves as the opening page that appears when the user launches the applications for the first time.

Figure 2. Splash Screen

This page serves as the visual identity of *KSM TPS Sumampir* and provides the system with time to initialize essential data and core components. Featuring a simple design centered on *KSM*'s branding, the Splash Screen aims to deliver a professional first impression and ensure a smooth initial user experience.

Figure 3. Dashboard

Its primary feature, Up-to-Date Schedule Information, is displayed in real time at the top of the screen, providing certainty regarding waste collection timing and eliminating miscommunication. For added flexibility, a shortcut button for Pickup Request transforms verbal inquiries into digital transactions recorded by the *KSM* Administrator. Additionally, Notification integration ensures residents receive critical status updates, such as schedule reminders and pickup confirmations. Finally, the dashboard facilitates access to History and Other Services, promoting transparency and allowing residents to monitor their transactions. Overall, this interface reflects enhanced service effectiveness achieved through digital modernization..

Unlike previous studies, the Kumpul.in application offers an integration of real-time scheduling, pickup requests, payment monitoring, notifications, and report dashboards within a single platform, thereby enhancing the integrated coordination of *KSM*. In the following section, the researchers provide a detailed explanation of each page and feature within the *Kumpul.in* application.

1.2 Report Page

The Waster Collection Schedule Page is designed to provide full and historical visibility regarding waste collection services.

Figure 4. Report Page

This pag serves as a digital logbook for residents, transparently displaying all schedules set by *KSM*, including both upcoming schedules and completed collection history.

1.3 Admin Login Page

The Admin login interface id designed with three primary inputs: *KSM* Name, Email, and Password.

Figure 5. Admin Login Page

It serves to ensure that only administrators or parties with admin-level access privileges can log in and manage data, schedules, and broader system settings.

1.4 Admin Home Page

Figure 6. Admin Home Page

The Home Page is designed as the main dashboard of the application, displaying current location and weather information, a personalized greeting for the user, and two primary features: the Payment menu and the Request Waste Pickup menu. This layout allows users to quickly and easily access priority services through simplified navigation.

1.5 Payment Transaction Page

The Payment Transaction History Page serves as an information hub regarding the status of waste service fee payments made by residents.

Gambar 7. Payment Transaction

This page transparently displays residents' payment transaction histories, including resident names, fee amounts, payment dates, and a SUCCESS status. This feature promotes financial transparency for residents and assists *KSM* Administrators in reconciling and automatically recording fee receipts, thereby ensuring data validity.

1.6 Waste Reposty Page

The Waste Report Page is a *KSM* data management dashboard feature tht displays vita statistic regarding waste collection operations.

Figure 8. Waste Report Page

This page presents monthly waste collection data in easily readable visual formats, such as bar charts for Total Waste (in kilograms) and line charts for Completed Pickups per month. Additionally, a pie chart illustrates the composition of waste types (Organic, Plastic, Paper, Glass). Detailed monthly data is displayed in a table, accompanied by PDF Export and Excel Export options to facilitate data reporting by *KSM* personnel. This dashboard supports the digitalization of waste management and aids management in decision-making.

CONCLUSION

Based on the design and development of the Kumpul.in mobile application as an information support system for scheduled waste collection at *KSM TPS Ceria Sumampir,* it can be concluded that this application serves as an effective digital solution for enhancing waste management efficiency. Through primary features such as scheduled waste collection information, notifications, resident data recording, and centralized communication between personnel and residents, the application helps minimize miscommunication and ensures a more structured collection process.

The application of observation and interview methods in this study provided a deeper understanding of user needs, both from the perspectives of residents and *KSM* personnel. The results of this needs analysis served as a strong foundation for designing a user-friendly interface and workflow tailored to field conditions

Overall, Kumpul.in successfully supports the waste management information system at *KSM TPS Ceria Sumampir* by providing faster, more accurate, and integrated services. With further development and ongoing system maintenance, this application holds potential for broader implementation and for improving the quality of community waste management.

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