



Design and Development of a Subsidized LPG Gas Distribution Monitoring System Using the Prototyping Method

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Abstrak: *The LPG distribution system plays an important role in ensuring energy availability for the community, yet the manual processes still commonly used often lead to issues such as delayed stock information, recording errors, and a lack of transparency between agents, distribution points, and supervisory authorities. This study aims to design and develop an LPG distribution application using Flutter and the Prototyping method, which allows developers and users to interact directly during development so that system requirements can be quickly adjusted based on user feedback. The application consists of several main modules: the Agent module for sending and managing LPG stock, the Distribution Point module for confirming stock reception and recording sales to customers, and the Disperindag module for monitoring sales reports and distribution activities. The backend is developed using PHP and MySQL to support fast and real-time data communication. The results of this study indicate that the Prototyping approach accelerates the development process and improves the alignment of system features with user needs. With this application, the LPG distribution process becomes more efficient, transparent, and easier for relevant stakeholders to monitor.*

Keywords: *Application, LPG Gas, Prototyping, Monitoring.*

1. Introduction

The Department of Industry and Trade of Bengkalis Regency (Disperindag) is a local government agency responsible for managing and supervising the industrial and trade sectors in Bengkalis Regency, Riau, Indonesia. The distribution of subsidized LPG is intended to ensure that customers receive the product in good condition and on time[1]. A distribution channel refers to the route that goods should follow from producers to wholesalers and ultimately to consumers; it can also be defined as the pathway through which goods or services are delivered to end users. Liquefied Petroleum Gas (LPG) plays a critical role in the energy sector and everyday life[2]. In household applications, LPG provides various benefits and generally has a lower environmental impact than many other fossil fuels. However, LPG is categorized as a subsidized fuel in Indonesia, particularly the 3 kg cylinder, which is considered a special commodity due to specific conditions related to its users, intended use, packaging, volume, and subsidized price[3].

In Bengkalis District, LPG agents and distribution outlets (pangkalan) still manage distribution records manually, primarily using Excel spreadsheets and reporting via WhatsApp messages[4]. For 3 kg LPG orders, outlet owners typically announce stock availability only at certain hours, which prevents retailers from monitoring stock levels on a regular basis. As a result, record-keeping becomes time-consuming, especially for preparing sales report documents, because sales administrators must compile monthly reports by aggregating daily transactions. In addition to requiring substantial time, this manual recapitulation process is highly prone to errors, such as

missing transactions or losing sales records. These issues inevitably reduce the accuracy and reliability of the reports produced[5].

Moreover, customers must register before purchasing by submitting photocopies of the household family card (KK) and the head-of-household identity card (KTP). Registered customers receive a purchase control card used to regulate subsidized LPG purchases[6]. This mechanism is necessary because the product is subsidized by the government; therefore, each household is permitted to purchase only one cylinder per week, or up to five purchases per month. While many small-scale traders have begun adopting computerized systems, the current processes at the agent and outlet levels still require better digital integration to ensure that records are stored, managed, and targeted appropriately during purchases, and to streamline distribution from agents to outlets and from outlets to customers[7].

This research aims to develop an application-based system that enables customers to view purchasing locations and restrict purchases to the designated zone determined by the local authority. The system also allows residents to register and meet the eligibility requirements for purchasing limited subsidized LPG. Furthermore, agents can record distribution data more efficiently through online input, and Disperindag can more effectively supervise the distribution of 3 kg subsidized LPG to ensure that it is delivered accurately, efficiently, and without subsidy misuse across agents and outlets throughout Bengkalis District. Therefore, Disperindag requires an online LPG distribution data system implemented as an application and developed using the prototyping method[8].

The prototyping method is selected because it supports iterative refinement of the user interface, including detailed improvements in color, typography, imagery, animations, and other design elements. More importantly, prototyping is well-suited for software development because it provides a clearer understanding of user requirements. By presenting an early version of the system, developers can obtain direct feedback from users, helping to ensure that requirements are accurately captured from the beginning. In addition, prototyping accelerates development by enabling the team to quickly produce a functional representation of the product without requiring highly detailed documentation at the initial stage.

2. Research Methods

To develop this application, it is necessary to collect data and conduct direct observation of the application design and development process[9]. The required data include Excel-based records from LPG agents and distribution outlets (pangkalan), location addresses, LPG quota allocations, and monthly distribution realizations. These data were obtained through consultations with the Department of Industry and Trade (Disperindag) to identify software requirements, as well as through direct field observation at one of the LPG distribution outlets to understand the actual operational workflow[10]. In this study, the prototyping development method is employed. This method consists of four main research procedures, namely: communication, rapid design and modeling, prototype construction and development, and feedback and evaluation. illustrated in Figure 1.



Figure 1. Research Flow

2.1 Communication

In this stage, the developer met with Disperindag to discuss the software requirements for an LPG distribution information system in Bengkalis District. The developer collaborated with Disperindag to collect data needs and understand the current data-recording workflow. Currently, reporting is conducted by submitting documents containing stock quantities, agent and outlet names, outlet locations, and quota data. Disperindag then compiles these reports manually using Excel. Due to long distances, the reporting process is time-consuming and delays data updates. In addition, document submission is prone to errors, including misdelivery and occasional loss of records.

Table 1. Question

No.	Question	Answer
1	How is LPG stock and distribution currently managed at the outlet?	We currently record stock manually using a logbook, which makes it difficult to track stock levels and daily distribution.
2	system for ordering or stock tracking? If not, what is the constraint?	We do not use an application yet because most processes are still manual, and we have not found an application that matches our needs.
3	What key features do you expect from an application to support outlet operations?	We need features for real-time stock tracking, processing customer orders, and sending notifications when stock is running low.
4	How do you interact with agents and customers in LPG ordering? Are there any difficulties?	We often struggle to manage orders via phone, and recording errors sometimes occur. We need a more organized ordering system.
5	Are you interested in digital payments for LPG transactions?	We still use cash payments, but we are open to digital payments if they make transactions easier for customers.
6	Do you have routine reports related to LPG stock and distribution? How are they prepared currently?	We prepare stock and distribution reports manually every week. An application that can generate reports automatically would be very helpful.

2.2 Quick Plan

In this stage, the author defines the system’s functional and non-functional requirements, establishes the application workflow, and identifies the core features required to support faster and more accurate LPG distribution reporting. The initial plan includes designing the database structure, drafting the user interface, and specifying the integration mechanism among agents, outlets (pangkalan), and the government office (Disperindag) as the supervisory authority. In addition, a testing strategy is prepared to ensure the system operates according to user requirements and remains easy to use for all stakeholders.

1. Use Case Diagram

A use case is employed to represent the actions performed by actors within the proposed system. The use case diagram describes the relationships between system actors and the system functionalities. It is useful for clarifying system functions and identifying the access rights granted to each actor to perform those functions. This stage begins with the design of the use case diagram [11].

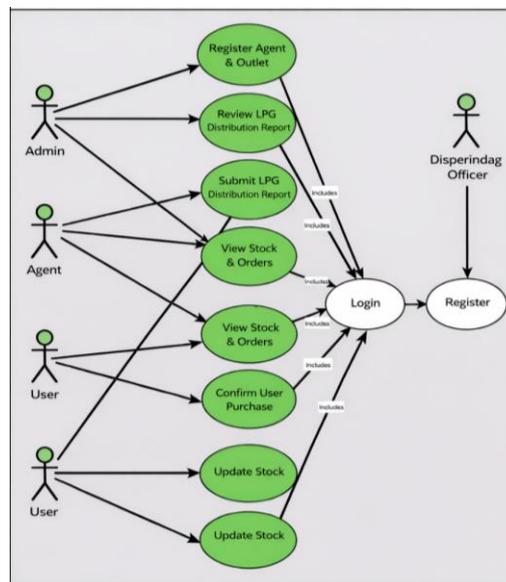


Figure 2. Use Case Diagram

2.3 Modeling Quick Design

In the Modeling Quick Design stage, the developer prepares an initial design for the LPG distribution data collection and reporting application based on requirements gathered from Disperindag, agents, outlets (pangkalan), and general users. The quick design provides a clear overview of the system structure and key process flows. It includes early UI drafts such as role-based login pages (admin, agent, outlet, and public users), access-based dashboards, and core functional modules for LPG stock management, agent-to-outlet distribution recording, outlet stock confirmation, and community purchase transactions[12].

1. Activity Diagram: LPG Purchase

The purchase process starts when a user opens the LPG purchase page and inputs NIK, name, phone number, and the number of cylinders. The system validates completeness and ensures the quantity does not exceed the allowed limit. The request is then sent to the server to check stock availability and daily purchase limits can show in the Figure 3.

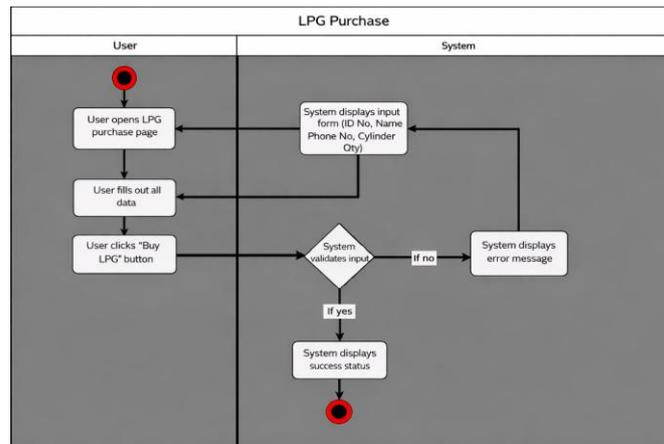


Figure 3. activity diagram making purchases of LPG gas

2. Activity Diagram: Sending Stock to an Outlet

Stock delivery begins by loading the user authentication token and retrieving the list of available outlets. The agent selects a target outlet and enters the quantity to be delivered. After clicking “Send Stock,” the system validates the input and submits the request via an API can show in the Figure 4.

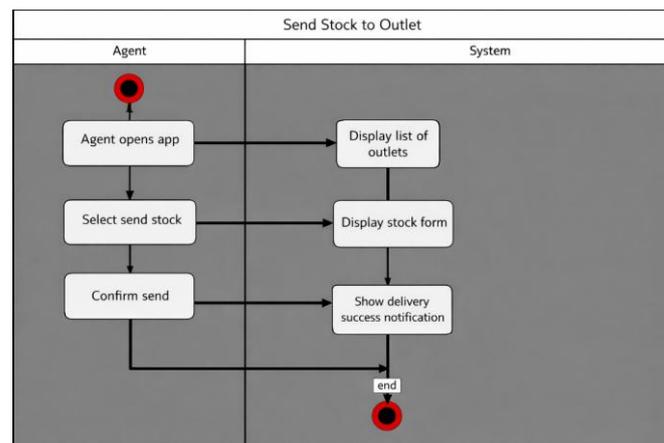


Figure 4. Activity diagram for sending stock to the base

2.4 Construction of Prototype

In this phase, the developer builds an initial functional prototype based on the quick design to validate system workflows in real operational conditions. The prototype includes role-based login, dashboards for each user role, distribution modules (agent-to-outlet), and outlet confirmation features that update stock automatically. The prototype integrates a Laravel-based backend API with a Flutter application, enabling near real-time data presentation. Although still simple, the prototype is intended for stakeholder testing to identify gaps and improvements before full-scale development.

2.5 Deployment, Delivery, and Feedback

In this stage, the prototype is evaluated to refine software requirements and assess implementation progress [13]. System testing is conducted using Black-Box Testing, focusing on the user interface and functional behavior. The results indicate whether each feature operates correctly and how the application responds to user actions, providing input for further refinement.

3. Results and Discussion

The prototyping-based application design resulted in a digital system that simplifies the monitoring and distribution of subsidized LPG. This approach enables close collaboration between developers and users, allowing requirements to be refined rapidly based on feedback.

3.1 Home Page for Community Users, Agents, and Outlets

The home page is the first interface displayed after users log in. On this page, community users, agents, and outlets (pangkalan) can access the available menus according to their respective roles and permissions can be seen in the Figure 5.



Figure 5. Home Page

3.2 Registration Page

This figure shows the Registration Page of the application. The page is used by new users to create an account before accessing the system. Users are required to enter their National Identification Number (NIK), full name, email address, and password. A checkbox is provided to indicate agreement with the system requirements or terms, followed by a Register button to submit the data. This registration process ensures that only authorized users with valid identity information can access the LPG distribution monitoring system. can be seen in the Figure 6.



Figure 6. Registration

3.3 Gas Outlet Page

This figure shows the Gas Outlet (Pangkalan) Dashboard Page. The page displays important information related to the outlet's operations. At the top, there is a notification reminding users to verify their identity (KTP) to enable full access to system features. The dashboard provides menus

such as Outlet Data Verification and Edit Outlet Profile, allowing the outlet to manage its registration data can be seen in the Figure 7.

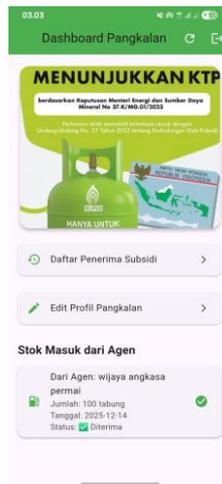


Figure 7. Gas Outlet

3.4 Subsidized LPG Page

This figure presents the Subsidized LPG Recipient Data Page. The page displays a list of registered recipients who are eligible to receive subsidized LPG. Each entry includes key information such as the recipient's name, National Identification Number (NIK), address, and subsidy status. The search field at the top allows users to quickly find specific recipients based on their name or identification number. can be seen in the Figure 8.



Figure 8. Subsidized

3.5 LPG Agent Dashboard Page

This figure shows the LPG Agent Dashboard Page. The page provides agents with tools to manage and monitor LPG distribution activities. At the top, the agent can view stock information and input the amount of LPG to be distributed in cylinders. can be seen in the Figure 9.

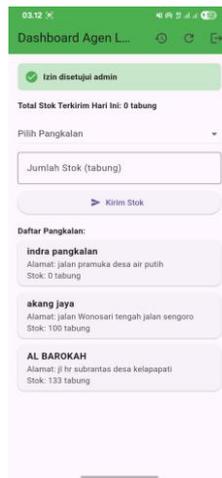


Figure 9. Agent Dashboard

4. Conclusions

Based on the results of developing the LPG distribution application using the Prototyping method, it can be concluded that this approach is effective in accelerating the application development process and facilitating the validation of user requirements. The creation of prototypes allows users to directly interact with the application interface and provide feedback, enabling developers to iteratively refine and improve the system until it fully meets user needs.

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