Development of an Information System for Operational Monitoring and Customer Loyalty

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Abstract. XYZ Gas Station is a mini gas station enterprise operating five branches that continue to rely on manual operational management. This practice generates several issues, including delayed reporting, redundant work processes, vulnerability to data loss, and limited accuracy of information across branches. These limitations hinder effective operational monitoring and managerial decision making, highlighting the necessity of an integrated information system. This study aims to design an application based system to support operational monitoring and enhance customer loyalty programs at XYZ Gas Station. The research employs a systems engineering methodology using the Framework for the Application of System Thinking (FAST) and a Model Driven Development (MDD) approach. The research object encompasses the operational workflow of XYZ Gas Station. Data were collected through primary sources, namely observations and interviews, as well as secondary sources consisting of operational documents. System development was carried out using the AppSheet and AppSheet Database platforms across eight FAST stages. The findings demonstrate that the proposed system improves the speed and accuracy of transaction recording, shortens reporting time, and enables real time operational control. Furthermore, the integrated customer loyalty feature supports improved customer retention. The study concludes that system implementation enhances efficiency and management quality in station operations.

Keywords: *AppSheet, FAST Method, Model Driven Development*.

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A. Introduction

Fossil fuels are currently a primary necessity for motor vehicles due to their vital role. Indonesians consume large amounts of fossil fuels to support their daily transportation activities. In line with this, the demand for fuel in Indonesia has increased year on year [7]. Based on data released by the Ministry of Energy and Mineral Resources through DataIndonesia.id, national fuel consumption in 2023 is recorded at 80.39 million kiloliters. The following diagram illustrates the trend of increasing fuel demand in Indonesia based on 2023 data from the Ministry of Energy and Mineral Resources [8].

Figure 1. Fuel Sales Volume in Indonesia [16]

The government's development of public fuel filling stations (SPBU) represents an effort to ensure the fulfillment of society's fuel needs, thereby improving accessibility to fuel for vehicle users . According to data from Statistics Indonesia, as of September 2024, a total of 7,751 SPBU were operating across Indonesia [3]. Along with this growth, new challenges have emerged in business management, particularly for SPBU operators with multi-branch networks, as many still rely on conventional systems to manage their operations and distribution [4]. The continued use of manual systems results in low operational efficiency, delays in information delivery, and an increased risk of errors in recording inventory data, sales transactions, and financial reports [7]. This situation indicates that service-sector companies, including fuel service providers, can no longer depend on traditional operational systems, thus necessitating a shift toward more agile and adaptive internal capabilities [2], [9]. The implementation of an integrated information system serves as a strategic solution to improve operational efficiency, ensure data accuracy, and support fast, information-based decision-making [6].

CV Mukti Berkah Riqnata is a business entity in the form of a Limited Partnership located at Jl. Pasir Ipis No. 34, Jayagiri, Lembang, West Bandung Regency, and conducts business activities across various sectors, including mining and quarrying; agriculture, forestry, and fisheries; as well as professional, scientific, and industrial activities. The company operates as a medium-scale service provider with a strategic focus on digitalization, research, and innovation to support the needs of diverse organizations . In this role, CV Mukti Berkah Riqnata contributes to assisting business entities in undergoing transformation processes and adapting to technological advancements and evolving business environments. One of its key functional units is the Research and Development Division, which is responsible for delivering consulting services and implementing digitalization initiatives, while also conducting comprehensive research to produce relevant and innovative solutions. In practice, the Research and Development Division received a visit from a client who owns five mini fuel stations, here in after referred to as SPBU XYZ, who expressed the intention to develop a startup-based application to monitor the operational activities of all owned fuel stations, as well as to enhance customer loyalty by offering exclusive promotional programs for customers who regularly refuel at these stations [15]. The following is the current business process implemented by the owner of the mini gas station, which can be seen in Figures 2.

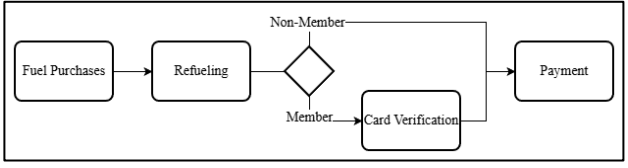

Figure 2. XYZ Gas Station Business Process [10]

The following is a description of problem identification using the PIECES framework, which can be seen in Table 1 [13].

Table 1. Problem Identification using the PIECES Framework [12]

PIECES Category	Identifying Problems in Projects (Summary)
P - *Performance*	Operational inefficiencies arise from manual processes and double entries into Excel, which are time-consuming and increase the administrative burden on employees.
I - *Information*	The inefficiency of physical tracking and the potential for double input errors lead to inaccurate data, a situation that worsens without an automated analysis system.
E - *Economics*	The accumulated operational costs of using physical stationery are compounded by the threat of real losses due to stamp manipulation and the risk of irretrievable data loss.
C - *Control and Security*	Obstacles in stamp validation and the absence of an electronic audit system mean that gas station owners do not have sufficient control to monitor branch performance transparently and in detail.
E - *Efficiency*	In addition to causing duplication that disrupts customer service, manual, physical-based processes significantly hinder the speed of reporting and work connectivity between branches.
S - *Service*	Reliance on physical stamp cards hinders the claims process and increases the risk of data loss, while the lack of digital tracking features makes the customer experience less transparent and suboptimal.

Referring to the background described above, the research questions in this study are:

1. What are the main business processes currently running at the XYZ gas station?
2. How can an information system meet the operational and managerial needs at the XYZ gas station caused by the limitations of conventional systems in recording and reporting?
3. How can an information system be designed to solve the problems of operational monitoring and customer loyalty at the XYZ gas station?

In addition, referring to the research questions that have been presented, the objectives of this study are:

1. Identify ongoing business processes at the XYZ gas station by examining key activities such as fueling, transaction recording, fuel stock management, and daily operational reporting.
2. Identify and analyze the information system requirements needed at the XYZ gas station by looking at the need for a digital recording system, automatic stock monitoring, and sales data integration.

Select and develop an information system that can be implemented at the XYZ gas station business by considering the use of an integrated Point of Sale (POS) system, inventory management system, and reporting modules that support managerial decision-making.

B. Method

Research methodology is a set of principles, procedures, and systematic approaches used by researchers to design, conduct, analyze, and evaluate a study in order to obtain answers to research questions [14]. The research design was conducted using a qualitative approach, which clarifies social situations by accurately describing them through the collection and analysis of data from natural situations.

This research was conducted at a gas station with several branches, focusing on the development of a website-based information system using the Appsheet platform. The initial stage included interviews with the owner of the XYZ gas station to understand the business flow, from customer purchases and stamp receipts to employee reporting mechanisms. Next, an analysis was conducted to identify problems, formulate research objectives, and define the scope of the problem.

The information system design utilized Appsheet as a development tool, Appsheet Database as a database, and Google Drive as online storage (cloud). The FAST (Framework for the Application of System Thinking) method was chosen as the basis for the design, applying the Model Driven Development (MDD) strategy [11]. In the FAST methodology, the system model serves to visualize and facilitate communication related to data components, processes, and interfaces in information systems [13]. The following are the stages of research as shown in Figure 3.

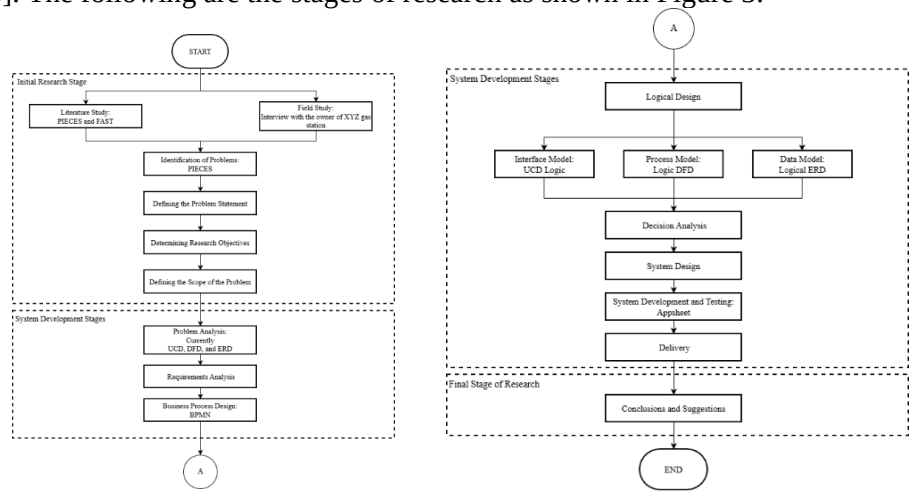

Figure 3. Rules of Procedure.

C. Result and Discussion

This section presents the results of using the FAST method for the system at the XYZ gas station, focusing on the transformation from running system analysis and requirements to the design of a solution whose performance is validated using PIECES analysis [1].

In the initial stage, an analysis of the operational flow of the XYZ gas station was conducted. Confirmation through an interview with the Head of the Research and Development Division revealed that the company still relies on physical archives and Microsoft Excel for data management due to the absence of a database system. Details of the current business process are illustrated in Figure 4.

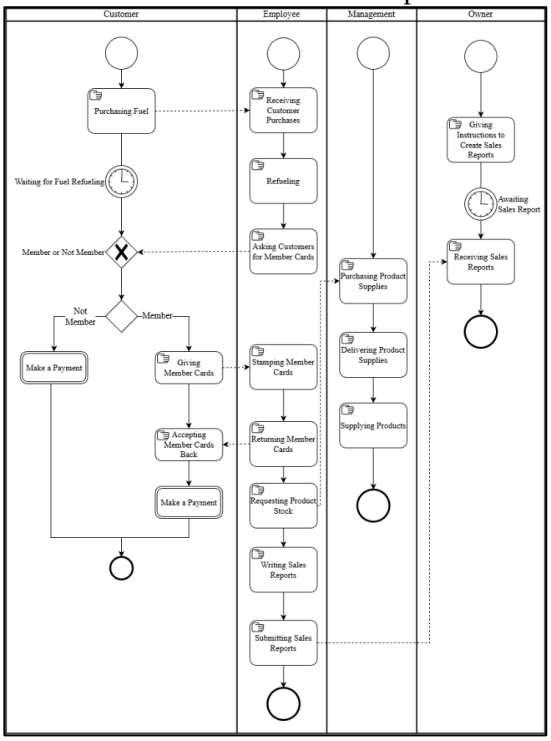

Figure 4. Current XYZ Gas Station Business Processes

Based on the mapping of these processes, a number of crucial obstacles were identified, including the lack of a specific application for recording transactions, manual data storage and processing methods, and the absence of detailed information about customer profiles.

Requirements Analysis

The preparation of system requirements specifications was carried out as a follow-up step to ensure that the solution designed was on target [5]. This analysis resulted in a list of mandatory functional features, the details of which for the Operational Monitoring and Customer Loyalty Information System at XYZ Gas Station can be seen in Table 2.

Table 2. Functional Requirements Analysis

Number	Functional Requirements
	Transaction Form
1	The system can view and modify transactions
2	The system can record transactions that occur
	Inventory
3	The system can view and change product data
4	The system can record products that come in and go out.
5	The system can check material stock as needed.
	Customer Profiles
6	The system can view and change customer data

Decision Analysis

The evaluation of system requirements resulted in the decision to develop four core modules, namely the Gasoline Purchasing System, Point Exchange, Inventory Management, and Transaction Reporting. In the execution process, the design of this information system adopted AppSheet as an application development framework that is directly integrated with the AppSheet Database for data storage purposes.

Proposed Business Process Design

A new business process was developed to overcome the limitations of the old system through the digitization of stock monitoring and customer transaction history. This change allows customers to monitor their accumulated points independently (self-service) through the application, while the role of officers has transformed from simply manual recorders to verifiers of reward claims and more efficient service managers.

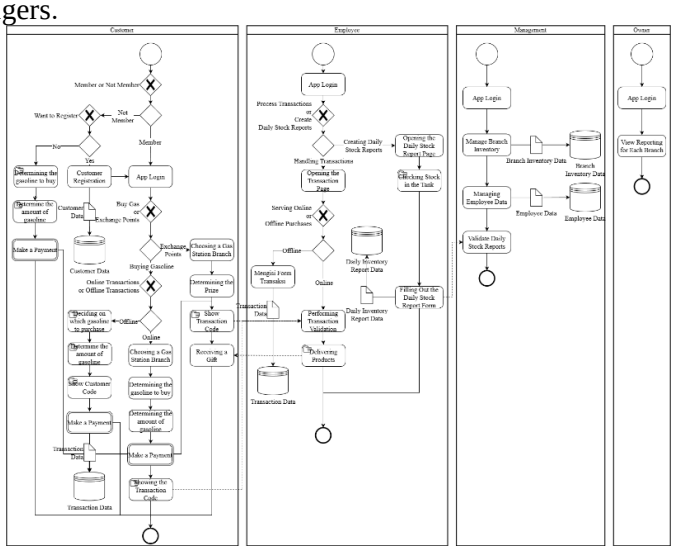

Figure 5. Business Process Redesign of XYZ Gas Station

Physical Application Design

The physical design phase aims to transform the logical requirements of users into technical specifications and system models that are ready for implementation. The design process, which covers aspects of interaction, data flow, and scalable storage structures, is then visualized technically using diagramming tools such as ERD, UCD, and DFD Level 0 and Level 1.

First, the visualization of the fiscal communication system through the Use Case Diagram (UCD) covers transaction and inventory management carried out by three main actors, namely Customers and their derivatives (Members), Admin, and Employees. The system features facilitate Customers to register, make purchases, and access profiles, while Member status provides additional privileges in the form of loyalty point redemption features. Internally, Admin is responsible for user management and stock availability, while Employees focus on transaction execution and monthly reporting, where the entire process dependency structure is technically mapped through association, include, and extend relationships.

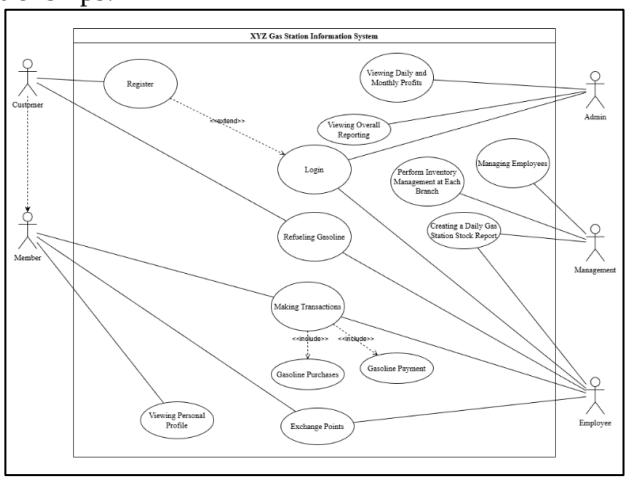

Figure 6. Use Case Diagram (UCD)

Next, physical visualization of the system through level 0 and level 1 Data Flow Diagrams (DFDs) maps the flow of information distribution, starting from the interaction between customers and employees. In its operational process, the system processes inputs such as registrations and transaction details from users into various important outputs, ranging from receipts, validations, point histories, to transaction confirmations for Employees. Completing the data cycle, Admins receive dashboard-based information for monitoring and obtain management confirmation in response to management activities carried out.

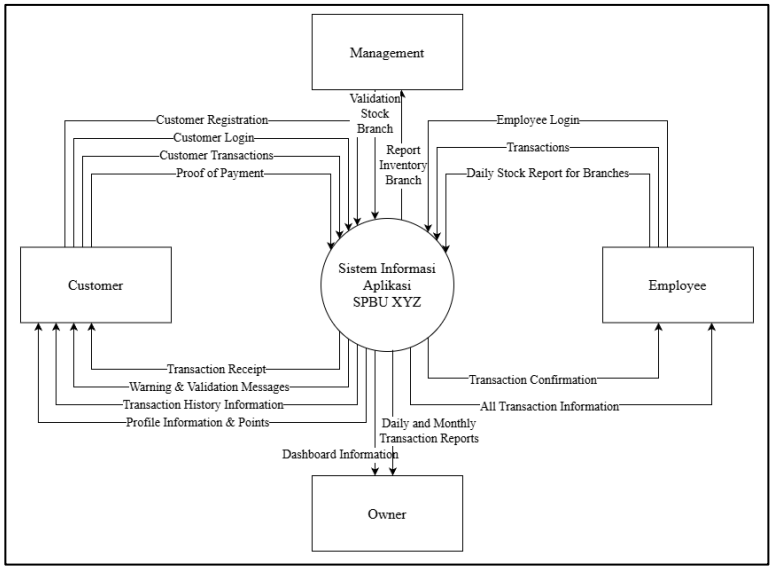

Figure 7. Data Flow Diagram Level 0

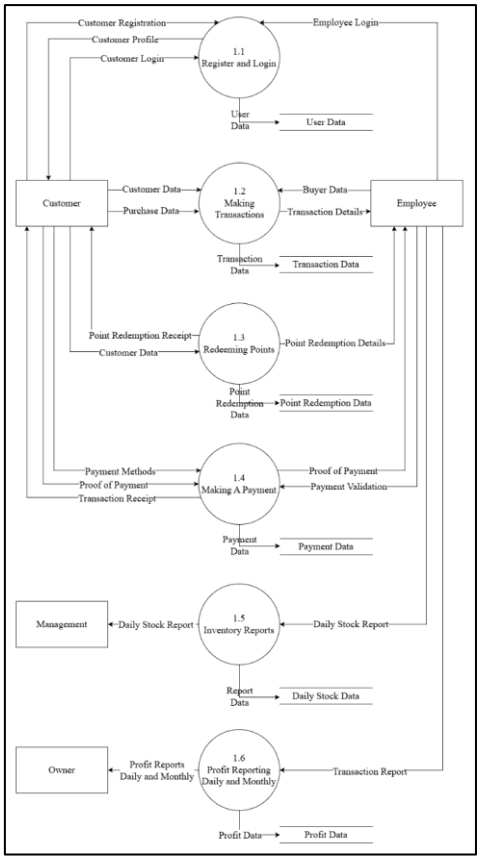

Figure 8. Data Flow Diagram Level 1

As a final step in physical design, the data storage structure is mapped using an Entity Relationship Diagram (ERD) [6]. At this stage, the design is realized into a comprehensive database schema, where relationships between tables are formed and data types for each attribute are specifically defined.

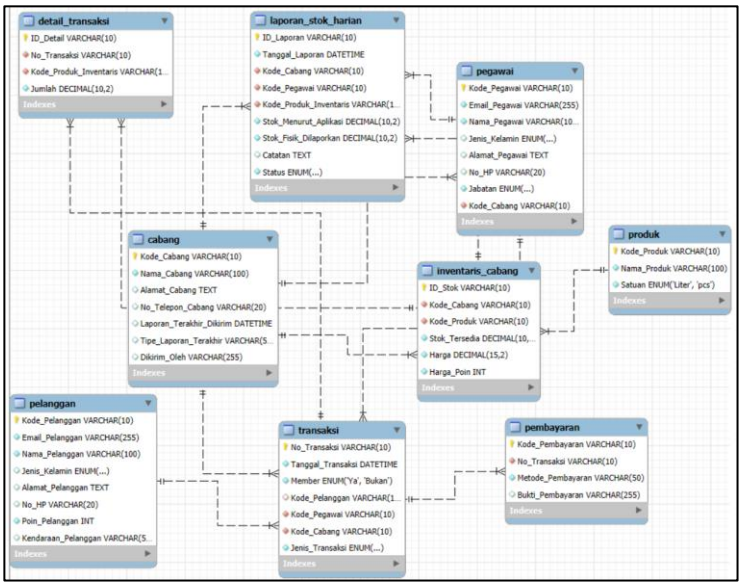

Figure 9. Entity Relationship Diagram (ERD)

The physical design was realized through the development of a functional software prototype. In this process, the interface design was developed to visualize the targeted system display in concrete terms. The following are the results of the implementation of the system's main interface.

Figure 10. Homepage

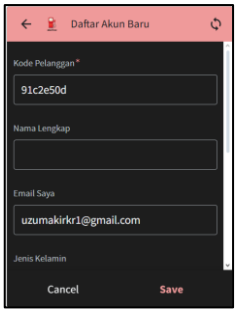

Figure 11. Customer Registration Page

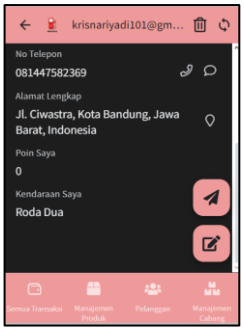

Figure 12. Customer Profile Page

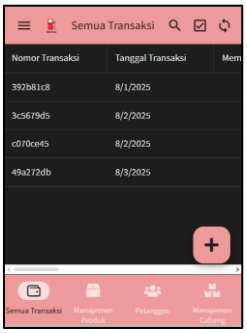

Figure 13. Transaction Page

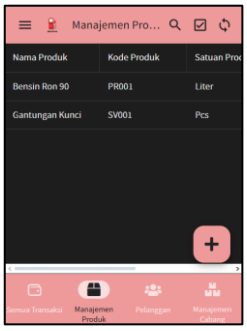

Figure 14. Product Management Page

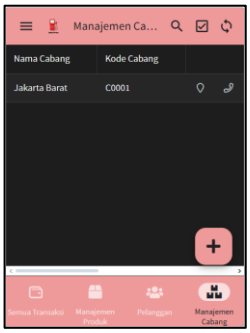

Figure 15. Branch Management Page

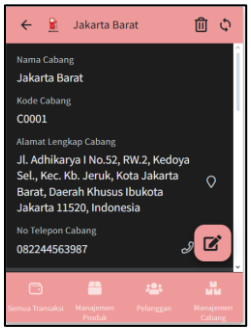

Figure 16. Branch Inventory Page

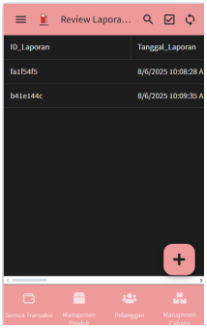

Figure 17. Branch Inventory Report Page

Figure 18. Administrator Dashboard Page

Analysis and Discussion

The final stage of the research focused on evaluating the performance of the proposed system, which included usability testing. Given the dynamic nature of system development, business processes may undergo adjustments to accommodate end-user requirements identified during the functional analysis phase. These steps to meet requirements are crucial to ensuring optimal company operations.

Table 3. Functional Requirements Analysis Status

No	System Functional Requirements	Status
1	Viewing transactions	Fulfilled
2	Modifying transactions	Fulfilled
3	Recording transactions that occur	Fulfilled
4	View product data	Fulfilled
5	Changing product data	Fulfilled

No	System Functional Requirements	Status
6	Recording outgoing products	Fulfilled
7	Recording incoming products	Fulfilled
8	Check stock levels of materials as needed	Fulfilled
9	View customer data	Fulfilled
10	Changing customer data	Fulfilled

Based on the evaluation results, all functional requirements of the system have been met, indicating that previous operational constraints have been successfully overcome through digitization. The conventional system that was previously in place was highly dependent on inefficient manual interactions, ranging from fuel purchasing procedures, membership verification using physical cards and stamps, to handwritten sales reports. Under this old scheme, business owners had limited access because they only received final reports without direct visibility, while reliance on physical documents led to risks of delays, data recording errors, and reporting flow inefficiencies.

A significant transformation occurred after the implementation of the digital system, where business processes are now integrated through a login mechanism for customers, employees, and owners. Customers can register independently, make transactions flexibly, and exchange loyalty points for souvenirs or coupons directly in the application, while the administrative burden on employees is reduced because transaction validation and daily stock reports are done automatically without manual recording. These changes have also revolutionized the flow of information; data that was previously scattered in physical records is now centralized in a database and processed automatically, allowing owners to monitor performance through real-time dashboards and access vital information without the barriers of multi-level bureaucracy.

D. Conclusion

Based on the results of analysis, design, and development of an information system prototype at the XYZ gas station, it can be concluded that the current business processes are still carried out manually and are highly dependent on the role of employees, from fuel filling services to transaction recording. This situation causes various problems, such as the risk of recording errors, data loss, delays in report preparation, and stock data discrepancies. Therefore, the need for an integrated information system is important in order to improve operational efficiency and accuracy. The development of a Point of Sale (POS)-based information system integrated with stock management and customer databases can be a solution to replace manual processes through real-time transaction recording automation, more accurate fuel stock monitoring, and the provision of information that can support managerial decision-making.

As a suggestion for further research development, the information system that has been designed needs to be continuously evaluated and refined so that it can operate more optimally in accordance with user needs. In addition, socialization and training are needed for end users to ensure that the system can be used to its full potential and that workflows are well understood. Subsequent research could also develop the system by adding supporting features, such as integrating Google Maps-based gas station branch location maps, using QR codes in transactions or customer loyalty programs, and implementing other latest technologies to improve service quality and broaden the benefits of the system.

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