

Restaurant Sales Optimization Through Collaborative Filtering and Market Basket Analysis Methods

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ABSTRACT

The wide variety of menu options in restaurants often triggers the paradox of choice phenomenon, a condition in which customers struggle to make decisions and tend to order the same items repeatedly. This behavior hinders the exploration of new products and limits the effectiveness of promoting featured menus, ultimately leading to revenue stagnation for the restaurant. This study aims to design and develop an Android-based restaurant ordering system to optimize sales through the real-time delivery of personalized menu recommendations. The system was developed using the ADDIE model (Analyze, Design, Development, Implementation, Evaluation) with technical implementation based on the Flutter and Golang frameworks. This research integrates Item-Based Collaborative Filtering and Market Basket Analysis (MBA). The MBA algorithm is utilized to efficiently calculate support values and item-to-item correlations as a statistical foundation for Collaborative Filtering in generating accurate predictions. Black Box testing validates that all functional features, including menu management, transactions, digital reservations, and the recommendation module, operate properly. In conclusion, the integration of these two methods has proven effective in improving the relevance of menu recommendations, supporting cross-selling and up-selling strategies, and significantly enhancing operational efficiency and customer decision-making quality.

Keywords: *Collaborative Filtering, Market Basket Analysis, Recommendation System, Addie*

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INTRODUCTION

Advancements in information technology over the past decades have significantly transformed the culinary industry, particularly through the widespread adoption of mobile-based food ordering applications. The Android platform has evolved beyond a digital transaction medium into a strategic infrastructure that connects customer preferences with restaurant business objectives (Stanley et al., 2022). As consumer behavior increasingly demands fast, intuitive, and personalized ordering experiences, the ability of a system to accurately understand user preferences has become a critical factor in maintaining customer loyalty and restaurant competitiveness.

From an operational perspective, restaurants face growing challenges in managing increasingly diverse menu catalogs (Mashudi et al., 2025). An excessive number of menu options often leads to the paradox of choice, where customers experience decision fatigue and tend to repeatedly select familiar menu items (Reza Syakif Afendi et al., 2025). This behavior limits menu exploration, reduces the visibility of signature or high-margin items, and may contribute to stagnation in average order value. Consequently, restaurants require intelligent mechanisms that can guide customers toward relevant menu choices without overwhelming them.

Recommendation systems offer a data-driven solution to this problem by filtering large volumes of menu information and presenting options aligned with individual user preferences (Yera et al., 2023). Collaborative Filtering (CF) is widely used in this context due to its effectiveness in identifying similarity patterns among users or items based on historical transaction data (prasetyo & Muliono, 2025). CF has been shown to support cross-selling and up-selling strategies in food ordering applications (Daulah & Sejati, 2024). However, conventional CF approaches may face efficiency challenges when computing item similarity matrices in real-time transactional environments.

Market Basket Analysis (MBA) provides an efficient alternative for modeling item relationships by analyzing co-purchase patterns using statistical measures such as support and confidence. By implementing MBA through aggregation-based SQL queries, item similarity matrices can be computed efficiently and stored directly within PostgreSQL databases. This approach enables stable and scalable recommendation processing, making it suitable for real-time restaurant ordering systems. The integration of CF as a recommendation framework and MBA as a computational method represents a practical hybrid solution for improving recommendation efficiency and business relevance.

Several previous studies have investigated recommendation systems in the restaurant domain. (Zunaidi et al., 2023) demonstrated that historical transaction data can enhance promotional strategies by identifying customer consumption patterns, while (Permana, 2024) compared user-based and item-based CF methods without examining their impact on actual purchasing behavior or sales outcomes. These studies reveal a research gap in the end-to-end integration of recommendation algorithms with real transactional processes and measurable business performance indicators.

This study addresses the gap through a case analysis of Mbok Thing-Thing Resto, where transaction data indicate low exploration of new menu items and repetitive ordering behavior. By integrating Item-Based Collaborative Filtering with Market Basket Analysis, this research aims to design and evaluate an Android-based restaurant ordering system that enhances menu personalization and optimizes restaurant sales performance.

METHOD

This study employs the ADDIE development model (Analyze, Design, Development, Implementation, Evaluation) as the methodological framework for designing and building a digital restaurant application integrated with a recommendation system. The ADDIE model was selected because it provides an adaptive and iterative development workflow, enabling

continuous refinement at each phase based on evaluation outcomes (Ade Rahayu, 2025). This approach is particularly suitable for software development that involves iterative interface design, data-driven feature optimization, and system scalability.

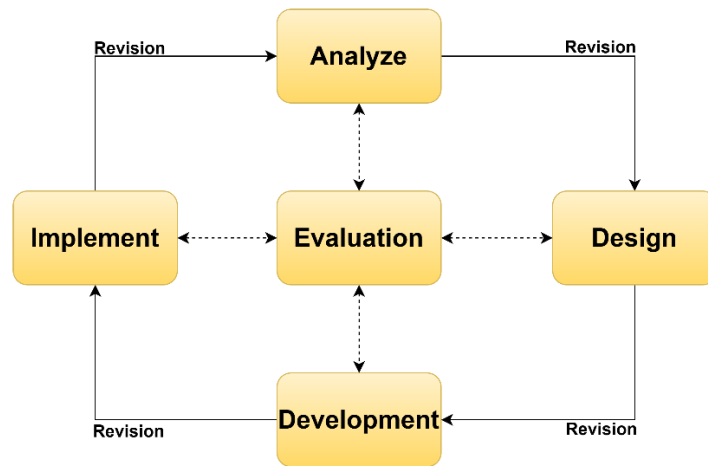


Figure 1: ADDIE

1. Analyze Phase

The Analyze phase was conducted to identify both functional and non-functional system requirements through business process analysis, user behavior identification, and examination of the primary transaction workflow of the food-ordering service (Rosita et al., 2024). This phase also analyzed the need for a recommendation module capable of utilizing historical transaction data to reduce customer decision-making complexity. The outcomes of this phase serve as the foundation for defining system specifications, including data management requirements, recommendation logic, and system integration constraints.

2. Data Description

The dataset used in this study consists of 208 historical restaurant transactions collected from the digital ordering system over a period of one week. The dataset involves 56 unique customers and 125 distinct menu items. Each transaction record contains one or more ordered menu items, transaction timestamps, and anonymized customer identifiers, enabling the identification of item co-occurrence patterns within individual purchases. The transaction data are stored in a PostgreSQL database and undergo preprocessing steps, including the removal of incomplete records, duplicate entries, and inconsistent data, before being used in the recommendation computation process.

3. Design Phase

The Design phase focuses on defining the system architecture, modeling structured process flows, and designing user interactions to ensure alignment with the identified requirements (Nugraha & Setiyawan, 2025). Flowcharts are used to represent the end-to-end transaction and recommendation processes, from order placement to

recommendation generation (Samsul Hadi et al., 2023). Use case diagrams are developed to specify system functionalities based on user roles, including customers and administrators (Hidayah et al., 2025). In addition, user interface prototypes are designed to ensure intuitive navigation, usability consistency, and seamless interaction between ordering and recommendation features.

4. Development Phase

In the Development phase, the system design is implemented into a functional application using Golang for backend services, Flutter for the mobile application, and React for the web-based administrative interface. The recommendation system is developed by integrating Item-Based Collaborative Filtering (CF) and Market Basket Analysis (MBA). Collaborative Filtering serves as the prediction framework by identifying similarities between menu items based on user ordering patterns, enabling personalized menu recommendations (Yusmar et al., 2021).

Market Basket Analysis is applied to compute item-to-item associations based on transaction co-occurrence frequencies. This study utilizes the Support metric to quantify the strength of relationships between menu items, as restaurant transaction data typically do not contain explicit rating values (Hossain et al., 2025). The Support value is defined as:

$$\text{Support}(A, B) = \frac{\text{Number of Transactions Containing } \{A, B\}}{\text{Total Transactions}}$$

The calculated Support values are used to construct an item correlation matrix, which serves as the input for the Collaborative Filtering process. This integration enables MBA to handle efficient association computation, while CF performs recommendation prediction, resulting in a system that is computationally efficient and aligned with real transaction patterns.

5. Implementation Phase

The Implementation phase involves integrating all system components, including backend services, mobile and web interfaces, and the recommendation engine. Historical transaction data are processed incrementally to ensure system stability and data consistency. Each module is tested during the integration process to verify that recommendation results are correctly generated and delivered within the application workflow.

6. Evaluation Phase

The Evaluation phase is conducted to assess the functionality, effectiveness, performance, and usability of the developed restaurant ordering application integrated with a Collaborative Filtering based recommendation system. Functional evaluation is performed using black box testing to ensure that all admin and customer features operate according to predefined requirements without examining internal code structures (Abdillah et al., 2023). Recommendation system effectiveness is evaluated through offline testing using historical transaction data and measured using Precision,

Recall, and F1 Score to assess the relevance of recommended menu items. System performance is evaluated by measuring the average response time of key operations, particularly recommendation generation and checkout processes. In addition, limited user evaluation is conducted using a Likert scale questionnaire to assess ease of use, clarity of the ordering flow, recommendation relevance, and overall user satisfaction. The evaluation results are used as feedback for iterative refinement across earlier phases of the ADDIE development model.

7. Ethical Considerations and Data Security

To ensure ethical compliance, all customer data used in this study are anonymized and processed solely for research and system development purposes. No personally identifiable information is stored or analyzed. Access to transaction data is restricted, and all records are securely stored within the database to prevent unauthorized use.

FINDING AND DISCUSSION

1. Results of the Analyze Phase

The Analyze phase was conducted to identify system requirements based on the restaurant's business processes, user characteristics, and operational challenges at Mbok Thing-Thing Resto. The analysis revealed that customers tend to order the same menu items repeatedly due to the large variety of available options, resulting in low exploration of new menus and suboptimal promotion of signature dishes. This phenomenon is associated with the paradox of choice, where an abundance of options makes decision-making more difficult for customers. Therefore, a recommendation system capable of filtering information and presenting menus aligned with customer preferences is needed. The user requirement analysis also indicated the importance of an intuitive application interface, a streamlined ordering flow, and fast system response to support user convenience during transactions.

From a technical perspective, the functional requirements of the system include food ordering modules, menu management, transaction processing, and the integration of Collaborative Filtering as a recommendation mechanism based on historical ordering data. This method is selected due to its ability to identify similarity patterns among customers, thereby increasing recommendation relevance and supporting both cross-selling and up-selling strategies. The identified non-functional requirements include data security, performance stability, Android device compatibility, and system scalability. Overall, the Analyze phase provides the conceptual foundation for the Design phase, particularly regarding the integration of the recommendation feature with the ordering workflow to enhance customer decision-making and optimize restaurant sales.

2. Design

In this phase, the design of interaction flows, user activities, and system architecture was carried out through the use of flowcharts, use case diagrams, and application architecture designs to ensure that the application development aligns with the defined functional and non-functional specifications. These three design

components serve as the primary foundation that guides the Development phase that follows.

Figure 2 illustrates the system architecture consisting of the Mobile Application, Web Admin interface, API service, and Database that work together within a client-server framework. The Mobile App and Web Admin serve as user endpoints for customers and administrators, while the API functions as the central controller that processes business logic, handles data communication, and manages request validation. All operational data are stored in the Database, including menus, users, transactions, reservations, and historical ordering records that support the implementation of Collaborative Filtering. This architectural separation ensures secure data processing, scalable system performance, and seamless integration of ordering and recommendation features.

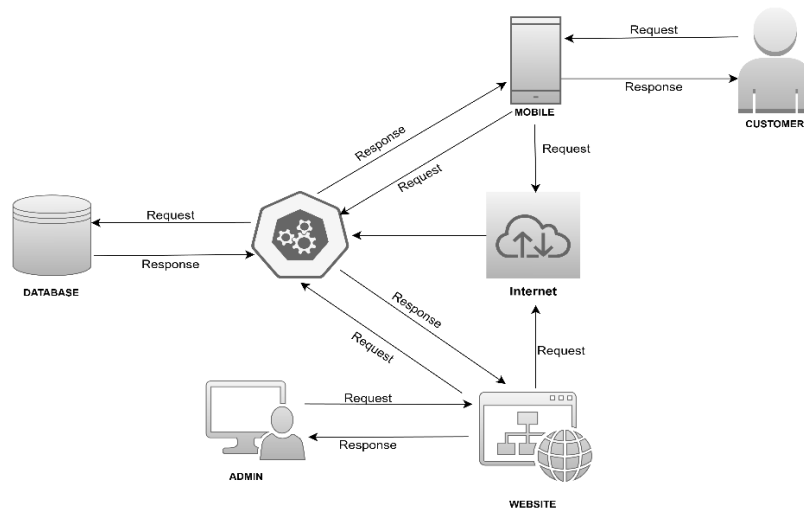


Figure 2: System Architecture

Figure 3 presents the use case diagram, which outlines the relationships between actors (admin and customer) and system functionalities. This diagram provides a comprehensive view of access rights and the roles of each user within the application, including the login process, menu management by the admin, and menu ordering by customers. The design serves as a basis for determining functional requirements and dividing system modules to ensure that implementation proceeds within the defined scope.

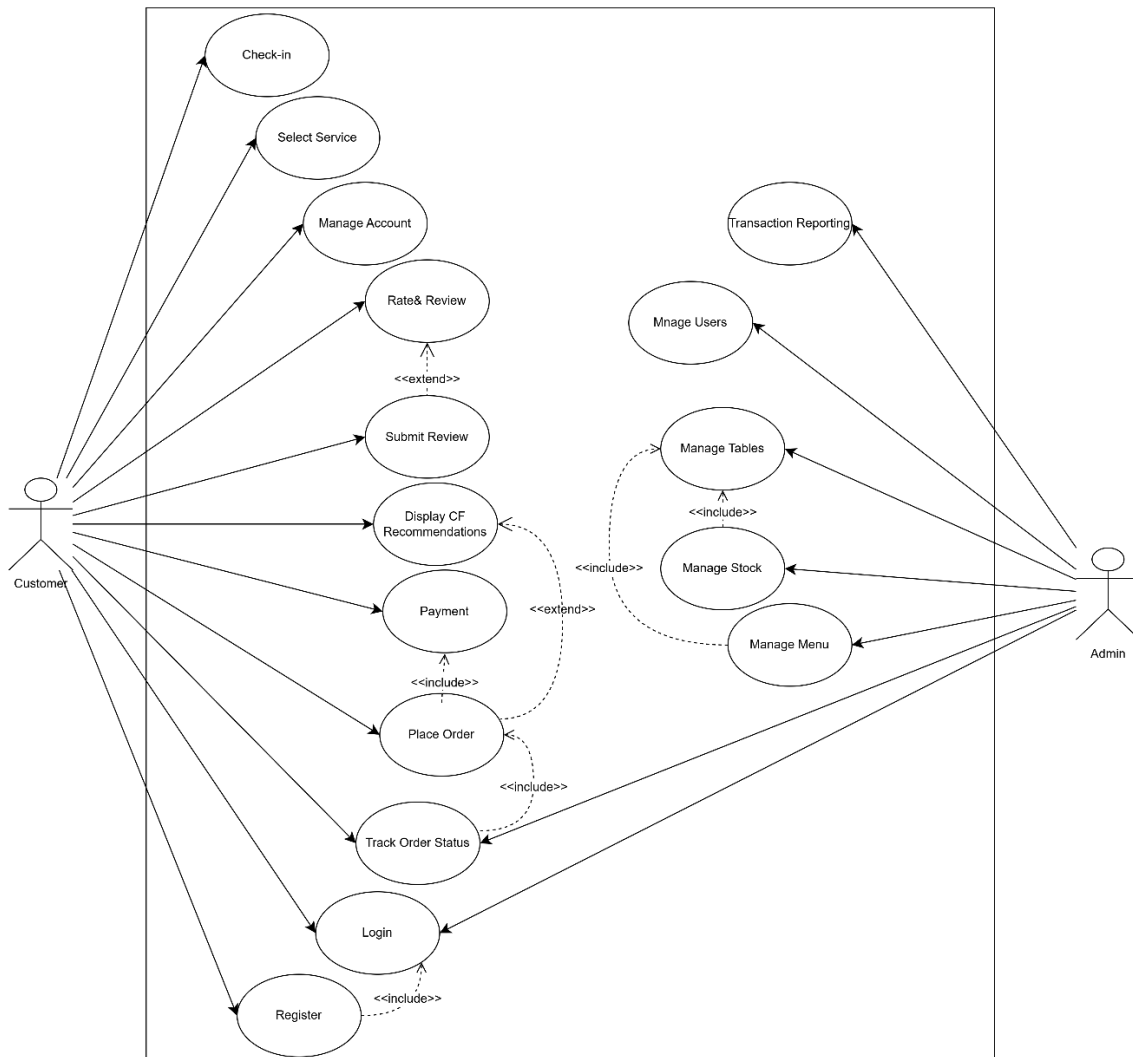


Figure 3: Use Case Diagram

The admin flowchart (Figure 4) illustrates the sequence of activities performed by administrators when accessing and managing the system through the web dashboard. The process begins with opening the login page, entering email and password, and validating credentials. Once successfully authenticated, administrators are directed to the Admin Dashboard, where they can choose various management modules, including User Management, Menu Management, Table Management, Transaction Management, and Package Management. Each module supports specific operations such as adding, editing, or deactivating user accounts, managing menu items and availability, updating table status, monitoring orders and payment information, and configuring menu packages. This flowchart presents a structured representation of the admin workflow, ensuring clarity in system operations and supporting the consistency of administrative tasks within the application.

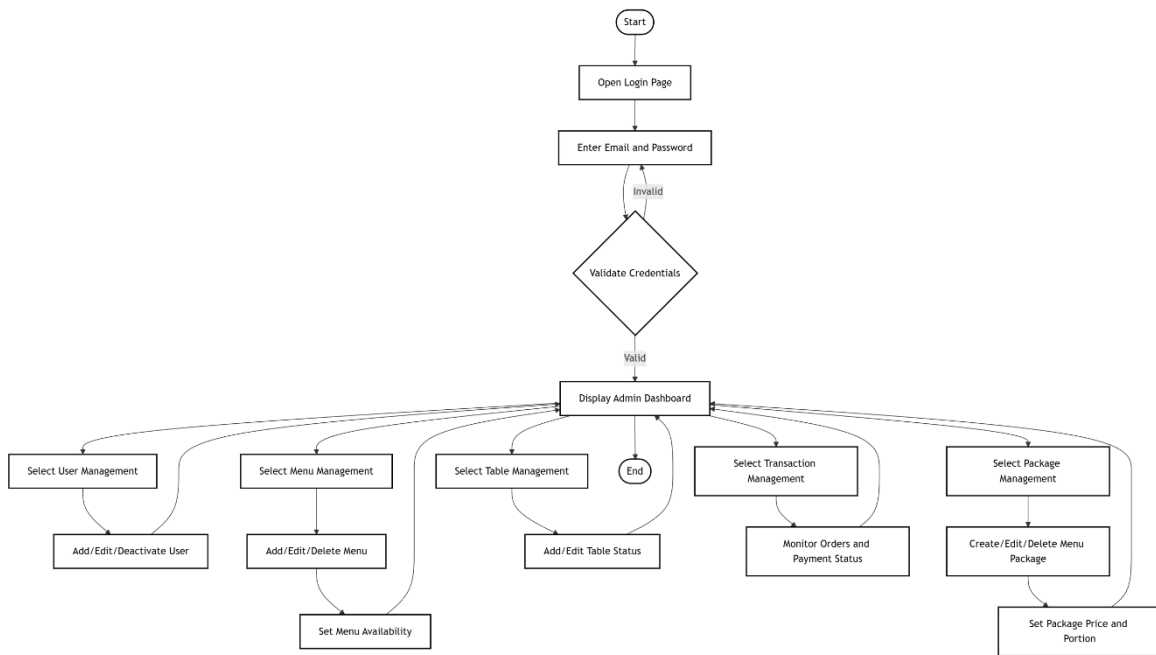


Figure 4: Admin Flowchart

The customer flowchart (Figure 5) illustrates the sequence of user interactions starting from opening the application and going through the login or registration process before entering the home page, where users can choose various actions such as viewing recommended menus, browsing the menu catalog, performing dine-in verification by scanning a QR code or entering a table number, and making reservations by checking table availability. After selecting menu items and reviewing the shopping cart, users may modify their orders or view add-on suggestions before proceeding to payment. The process then continues with choosing a payment method, completing the transaction, receiving confirmation, and tracking the order status, with the entire flow designed to remain clear, responsive, and to assist users in completing their orders efficiently.

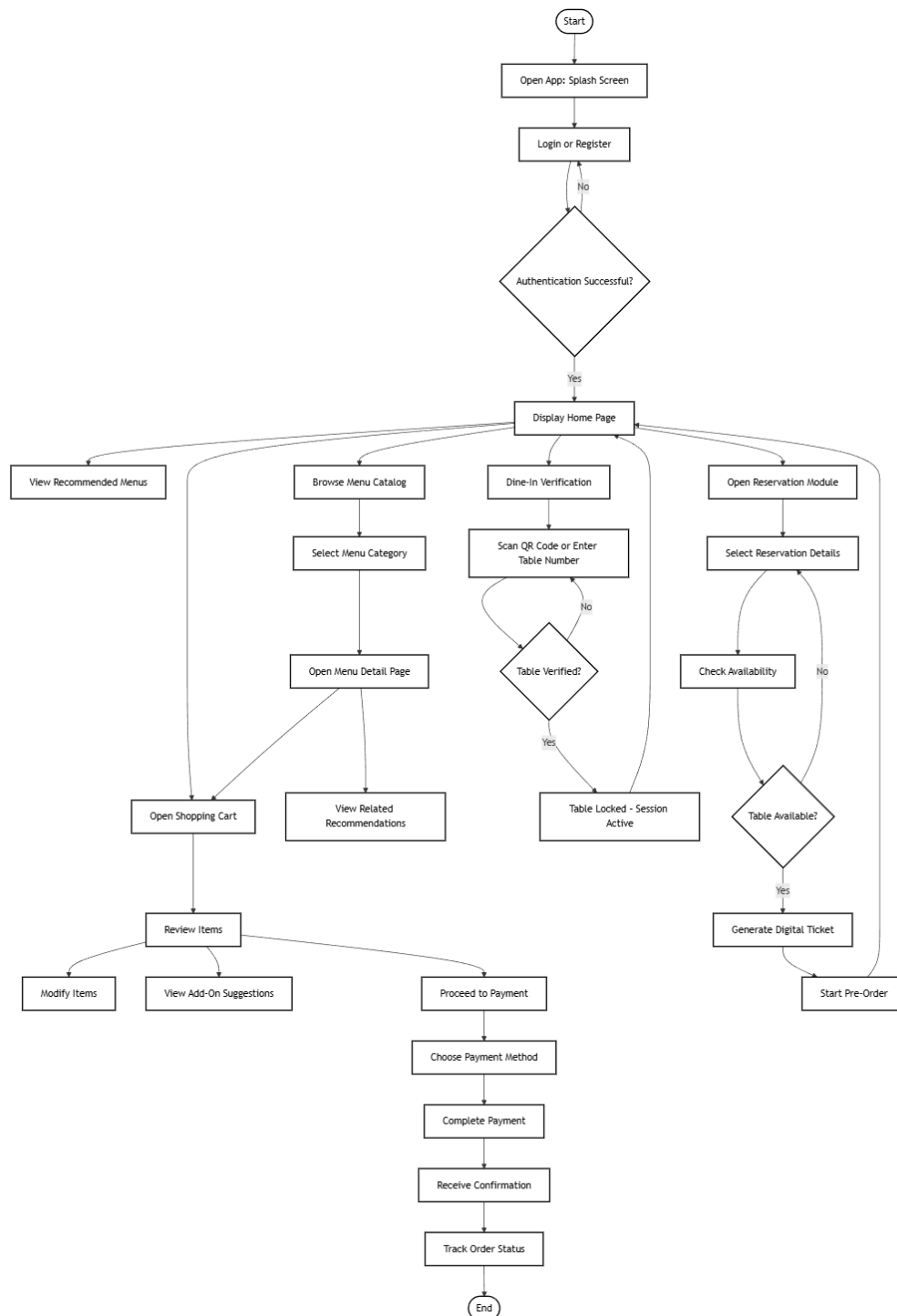


Figure 5 Customer Flowchart

3. Development

The Development phase translates all designs from the Design stage into a fully operational application. In this phase, the backend is developed using Golang to handle

core business processes, order data management, user authentication, and the computation of Collaborative Filtering–based recommendations accessed through a RESTful API. The Flutter-based mobile application is implemented to provide a responsive ordering interface, covering features such as menu search, category selection, checkout processes, and the presentation of real-time recommendations retrieved from the server. Meanwhile, the web-based admin application is built using React to support restaurant operational activities, including menu management, category updates, order verification, and real-time transaction monitoring. All components are then integrated through internal testing to ensure that the connections between the API, user interfaces, and the database function consistently according to system requirements before proceeding to the implementation and evaluation stages.

4. Implementation

This chapter presents the implementation results of the system, which are divided into two main components: the admin interface and the customer application. The admin interface focuses on restaurant operational management, including menu management, transaction monitoring, and sales analysis. Meanwhile, the customer application provides an interactive ordering flow integrated with the recommendation system to enhance menu selection efficiency and overall user experience.

a. Admin

Before accessing the main features, the system requires a login process to ensure data security. Figure 6 shows the Login page, which is designed to be simple yet functional. On this page, administrators enter their email and encrypted password. The system performs real-time validation by matching the credentials with the user database. This process serves as the primary security gateway, preventing unauthorized access to critical features such as financial management and customer data.

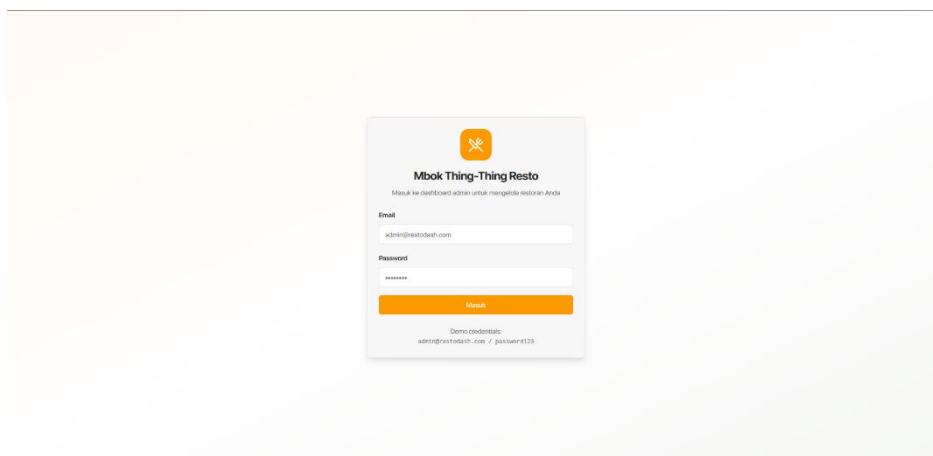


Figure 6: Administrator Login Page

Figure 7 presents the implemented admin dashboard, which functions as the central hub for monitoring the restaurant's operational performance. The dashboard displays key metrics such as total revenue, number of orders, number of customers, and best-selling menu items in the form of information cards and interactive charts. Visual elements, including the weekly revenue graph and the order category distribution chart, assist administrators in quickly understanding sales patterns and customer behavior, thereby supporting data-driven decision-making. Additionally, the list of top-selling menu items shown at the bottom provides insights into each product's contribution to the restaurant's overall revenue. Overall, the dashboard design demonstrates the successful implementation of an admin interface that is informative, responsive, and aligned with the operational needs of Mbok Thing-Thing Resto.

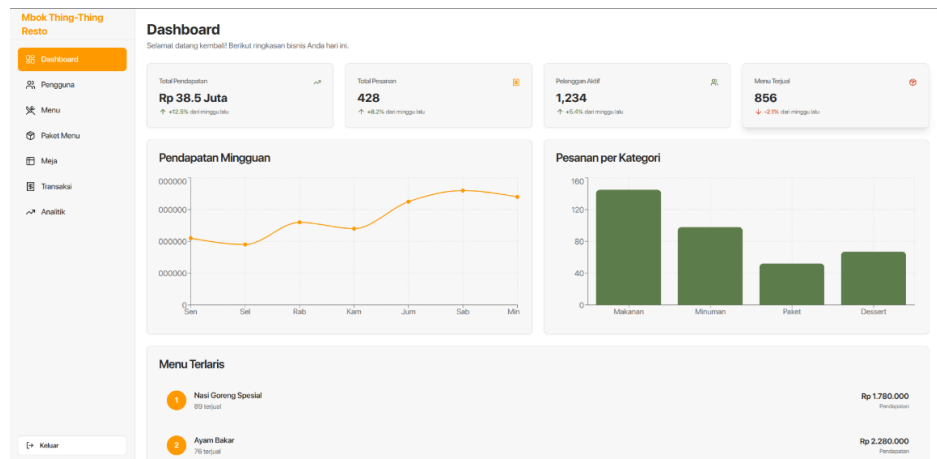


Figure 7: Admin Dashboard

The system provides a User Management module that applies the Role-Based Access Control (RBAC) concept. As shown in Figure 8, the primary administrator has the authority to add, edit, and deactivate other user accounts. The table displays key information such as name, email, user role, and account status. The role classification into Admin, Cashier, Waiter, and Manager is implemented to restrict access according to each responsibility to maintain system data security and integrity.

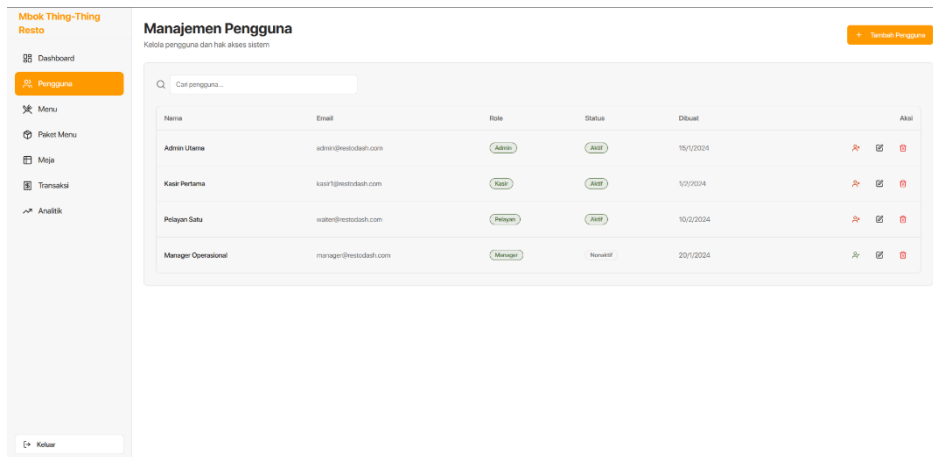


Figure 8: User Management Page

The Menu Management module shown in Figure 9 allows administrators to manage menu items comprehensively, including adding, viewing, updating, and deleting menus. This interface includes product photos, categories, descriptions, and prices. Administrators can also adjust menu availability through a dedicated toggle button, ensuring that unavailable items are immediately hidden from the customer application. Synchronization is performed in real time to prevent customers from ordering items that are out of stock.

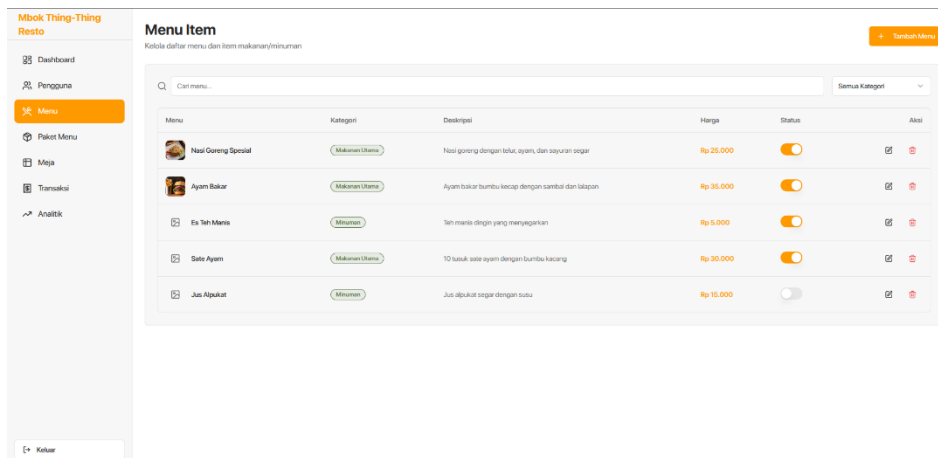


Figure 9: Menu Management Page

In addition to regular menu items, the system also includes a module for managing menu packages, as shown in Figure 10. This feature enables administrators to create combo packages tailored to customer needs, such as family packages, couple sets, or business event packages. Menu packages contain additional information such as portion capacity—for example, for four people or ten people. This feature helps group customers choose meals more efficiently and supports the restaurant in increasing transaction value. Administrators can configure package

contents, set special prices, and activate or deactivate packages based on promotional periods.

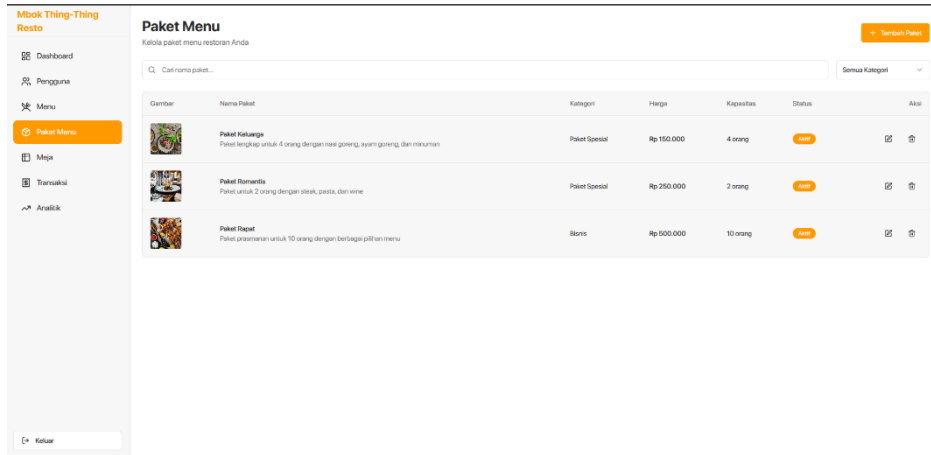


Figure 10: Menu Package Management Page

To support dine-in services, the system provides a table management feature. Figure 11 illustrates the Table Management interface, which displays table numbers, seating capacity, table location, and the current status indicating whether a table is available or occupied. This feature enables restaurant administrators to digitally monitor seating availability, streamline the arrangement of incoming customers, and obtain insights into the restaurant’s occupancy levels at specific times.

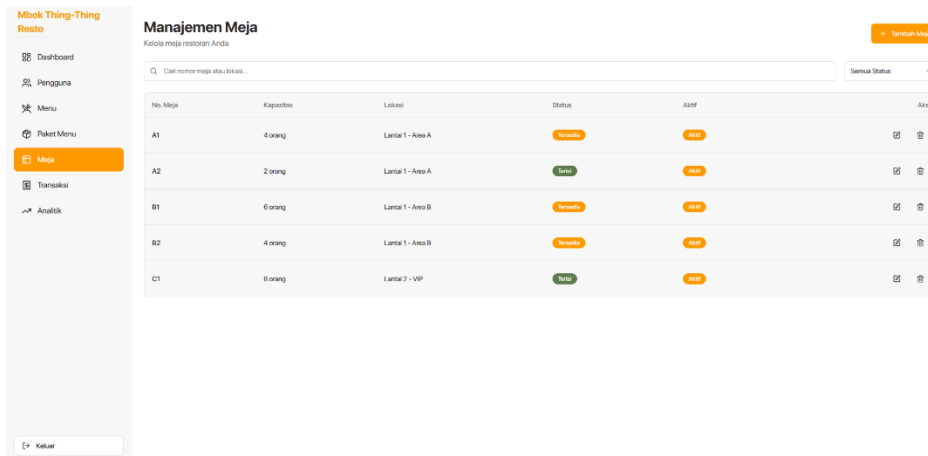


Figure 11: Table Management Page

All operational activities within the restaurant are recorded in the Transaction Management module, as shown in Figure 12. This page allows administrators to monitor orders in real time, both for dine-in and delivery services. The transaction table displays customer identity, table number, service type, total payment, and payment status. This feature assists cashiers in verifying payments and

ensures accurate financial records. Additionally, the transaction data collected serves as a dataset for the Collaborative Filtering algorithm, enabling the system to generate personalized menu recommendations for customers.

ID Transaksi	Pelanggan	Meja	Metode	Total	Status	Tanggal	Aksi
#1001	customer1@email.com	A1	Dine In Cash	Rp 159.500	Lulus	15/1/2025, 12:30:00	🗑️
#1002	customer2@email.com	B2	Dine In Credit Card	Rp 308.000	Lulus	15/1/2025, 13:45:00	🗑️
#1003	customer3@email.com	-	Delivery Transfer	Rp 104.500	Menunggu	15/1/2025, 14:20:00	🗑️ \$

Figure 12: Transaction Management Page

b. Customer

Figure 13 shows the initial display of the mobile application, including the Splash Screen and the authentication module for Login and Registration. The interface is designed to be intuitive, offering both standard registration and social login options such as Google and Facebook. This authentication mechanism serves as an identity validation gateway, enabling the system to record each user’s ordering history, which becomes the primary dataset for the Collaborative Filtering algorithm.

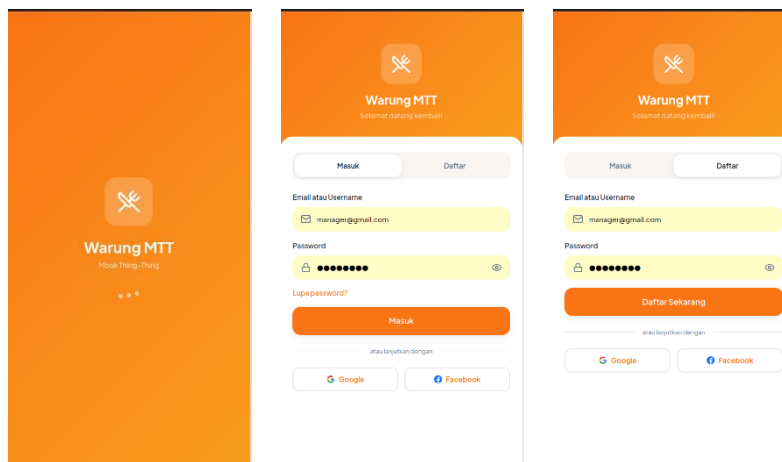


Figure 13: Splash Screen, Login, and Registration Interfaces

After logging in, users are directed to the Home Page, which serves as the central navigation hub. The main feature displayed on this page is “Recommended for You,” where personalized menu suggestions are generated based on Collaborative

Filtering. This feature helps customers discover relevant menu items more efficiently, reducing cognitive load during decision-making.

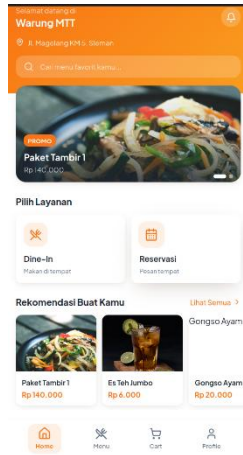


Figure 14: Home Page Interface

User interaction in browsing menu items is supported through the Menu Catalog and Menu Detail pages, as illustrated in Figure 15. On the Catalog page, users can explore products by category. When an item is selected, the Menu Detail page presents complete product information along with the “You Might Also Like” feature powered by Item-Based Collaborative Filtering. This algorithm analyzes historical co-purchase patterns to automatically recommend complementary items, supporting personalized and relevant cross-selling.

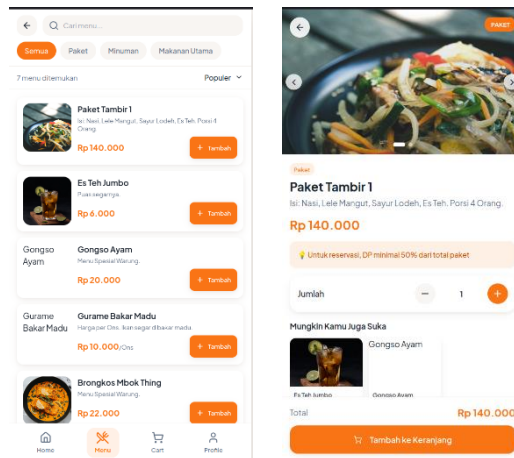


Figure 15: Menu Catalog and Detail Page

For dine-in services, the system applies a digital table verification mechanism, as shown in Figure 16. Users may scan a QR code or manually input a table number to associate their session with a specific table. Once verified, the system activates a session lock and displays a “Table Locked” notification, ensuring that all

orders are accurately recorded according to their designated table and reducing the risk of delivery errors.

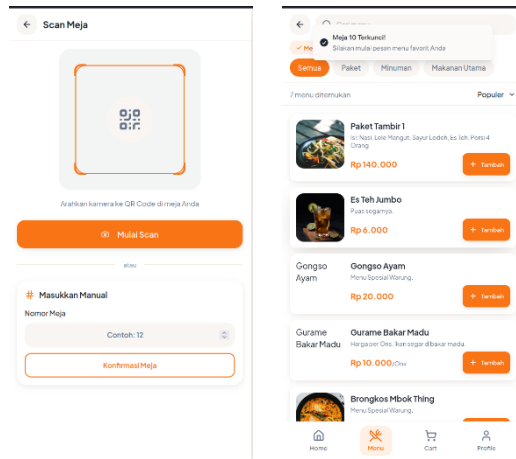


Figure 16: Dine-In Service Integration Page View

The Shopping Cart page, as shown in Figure 17, allows users to review and manage their orders by adjusting item quantities or removing items. The system applies Collaborative Filtering to analyze the cart contents and provide contextual add-on recommendations, such as suggesting complementary side dishes. This feature helps users complete their orders more effectively while increasing transaction value through relevant item suggestions.

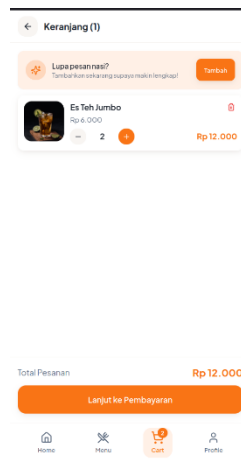


Figure 17: Shopping Cart Page

The final stage of the ordering process, as shown in Figure 18, includes the payment procedure and real time order tracking. The system provides multiple payment options such as QRIS, e wallet, and cash, along with a Split Payment feature that automatically divides the bill among customers. After the transaction is completed, users receive an instant confirmation and can monitor the status of their

order in real time, starting from confirmation, preparation, and continuing to delivery. This feature enhances service transparency and reduces customer anxiety related to waiting times.

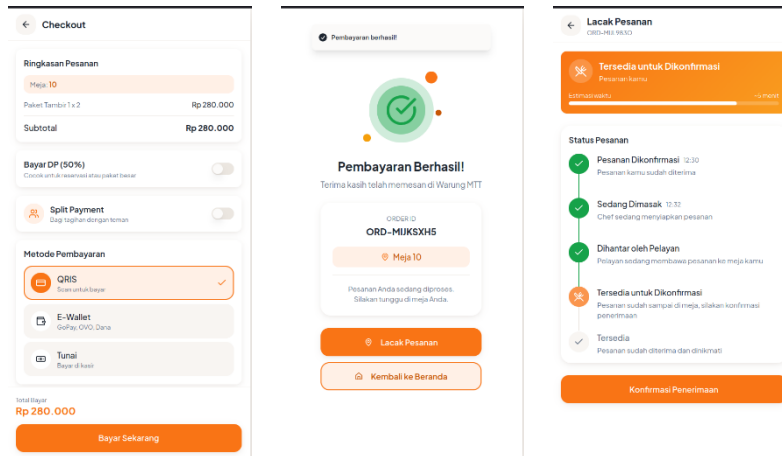


Figure 18: Payment and Order Tracking Interface

The system also provides a Digital Reservation module to support users in scheduling their visit, as illustrated in Figure 19. Customers can select the date, time, and number of guests, after which the system verifies table availability. Once confirmed, a Digital Ticket is generated containing the reservation schedule, table number, and a unique QR code for check-in. The ticket also includes a “Start Ordering” feature, enabling pre-ordering before arrival to reduce waiting time and improve table turnover efficiency.

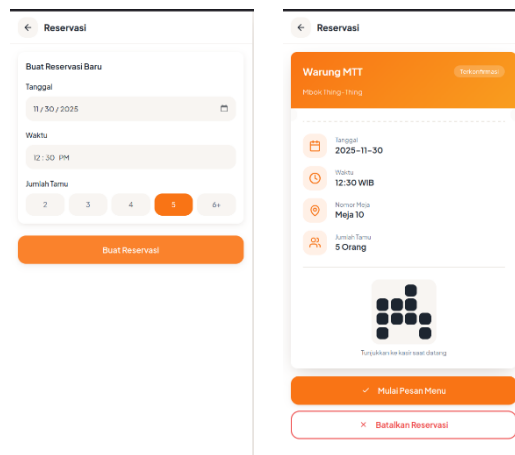


Figure 19: Digital Reservation Interface

5. Evaluation

This section presents the evaluation results of the developed restaurant ordering application integrated with a Collaborative Filtering based recommendation system. The evaluation aims to assess system functionality, recommendation

effectiveness, system performance, and user usability. Since the system is implemented as a prototype and has not been publicly deployed, the evaluation was conducted through functional testing, offline recommendation performance analysis, controlled system performance measurement, and limited user testing. This evaluation approach is commonly adopted in early stage system development research to validate system feasibility and effectiveness

5.1 Black Box Testing

Functional testing was conducted using the Black Box Testing method to verify whether all system features operate according to the predefined functional requirements. This testing focuses on validating system behavior based on given inputs and expected outputs without examining internal code structures. The evaluated features include admin side modules such as user management, menu management, table management, transaction monitoring, and package management, as well as customer side modules including authentication, recommendation display, ordering flow, payment processing, order tracking, and reservation features.

Table 1: Black Box Testing Results

No	Question	Expected Result	Result
1.	The admin enters valid and invalid email and password combinations.	The system accepts login with valid credentials and rejects invalid ones, displaying a clear error message.	Successful
2.	Checking the display of revenue summaries, orders, customers, best-selling menus, and interactive charts.	All data appear accurately and in real time, and the charts are fully interactive with no visualization errors.	Successful
3	Adding, editing, and deactivating user accounts with different roles.	All actions are saved to the database, the user list is updated, access is restricted based on roles, and success notifications appear.	Successful
4.	Adding, modifying, deleting, and updating the availability status of menu items.	Menu changes are saved, unavailable items do not appear in the customer app, and synchronization occurs in real time.	Successful
5.	Creating, modifying, and deleting menu packages, adjusting prices and serving capacities.	All configurations appear correctly, prices and capacities are saved, and inactive packages do not appear in the customer app.	Successful
6.	Adding, modifying, and monitoring table status.	Table status updates in real time, and information on table number, seating	Successful

		capacity, and location appears accurately.	
7.	Monitoring dine-in and delivery orders, including payment status.	All transactions are recorded, payment status is accurate, and the data can be used for Collaborative Filtering recommendations.	Successful
8.	Customer account registration and login via email or social accounts.	Authentication is successful, accounts are stored, and error messages appear for invalid data.	Successful
9.	Displaying personalized menu recommendations.	Recommended menus appear according to purchase patterns, and navigation runs smoothly without errors.	Successful
10.	Searching by category and viewing product details.	Products appear correctly based on selected categories, item recommendations are relevant, and detail pages are complete and responsive.	Successful
11.	Scanning QR Codes and entering table numbers.	Table sessions are recorded accurately, the "Table Locked" notification appears, and the risk of delivery errors is reduced.	Successful
12.	Adding, reducing, or removing items in the shopping cart.	The cart updates in real time and the total payment adjusts according to changes.	Successful
13.	Booking a table by selecting date, time, and number of guests, and receiving a digital ticket with a QR Code.	Reservations are recorded, the digital ticket displays accurate data, and the pre-order feature is active and functional.	Successful
14.	Making payments using various methods such as QRIS, e-wallets, and cash, including split payment.	All payment methods are processed correctly, the total bill is calculated accurately, and payment confirmations are received instantly.	Successful
15.	Tracking order status in real time from confirmation to cooking and delivery.	Order status appears accurately at each stage, users can track progress without errors, and status notifications appear promptly.	Successful

5.2 Recommendation System Performance Evaluation

The performance of the Collaborative Filtering recommendation system was evaluated through offline testing using historical transaction data collected during

system trials. The dataset was divided into training data and testing data to measure the relevance of recommended menu items. Standard evaluation metrics including Precision, Recall, and F1 Score were used to assess recommendation accuracy.

Table 2: Recommendation System Performance Metrics

Metric	Value
Precision	0,67
Recall	0,8
F1 Score	0,73

5.3 System Performance Evaluation

System performance evaluation was conducted to assess application responsiveness and processing efficiency, particularly in handling recommendation generation and transaction processing. Performance measurements were carried out in a controlled environment by calculating the average response time of key system operations across multiple execution cycles.

Table 3: System Performance Evaluation Results

Operation	Average Response Time
Recommendation generation	120 ms
Add item to Cart	95 ms
Checkout process	180 ms
Payment confirmation	160 ms

5.4 User Evaluation

User evaluation was conducted through limited usability testing involving a small group of participants. The evaluation focused on ease of use, clarity of navigation, recommendation relevance, and overall satisfaction. Participants interacted with the application and completed a questionnaire using a five-point Likert scale (1 = strongly disagree, 5 = strongly agree).

Table 4: User Evaluation Results

Evaluation Aspect	Mean Score (1–5)
Ease of use	4.4
Clarity of ordering flow	4.5
Recommendation relevance	4.8
Interface design	4.3
Overall satisfaction	4.4

DISCUSSION

The findings indicate that the integration of Item-Based Collaborative Filtering and Market Basket Analysis (MBA) in the Android-based restaurant ordering application enhances the relevance of menu recommendations and helps reduce customers' cognitive load during menu selection. This approach addresses the paradox of choice identified in the Analyze phase, where customers tend to repeatedly order the same menu items due to the abundance of available options. The combination of MBA, which examines item associations using support values, and Collaborative Filtering, which predicts preferences based on historical ordering patterns, produces contextual and personalized recommendations aligned with observed transaction data. These findings suggest that the proposed integration improves user experience and supports restaurant business strategies by facilitating cross-selling and up-selling opportunities.

The results are consistent with (Zunaidi et al., 2023), who reported that historical transaction data can improve restaurant promotion effectiveness by mapping customer consumption patterns. However, while Zunaidi's study focused on consumption analysis, the present research operationalizes these patterns within a recommendation system embedded directly in the ordering workflow. Additionally, (Permana, 2024) found that Item-Based Collaborative Filtering offers stability in environments with high user variability, supporting the choice of an item-based approach in this study. The integration of MBA further enables efficient item similarity computation through aggregation-based SQL queries, contributing to system responsiveness in real-time environments.

Beyond supporting prior studies, this research contributes practical insights into how recommendation systems can be embedded within restaurant ordering applications. By integrating recommendations at multiple interaction points, such as the homepage, item detail pages, and shopping cart, the system facilitates more guided menu selection and encourages broader item exploration. These observations align with (Yera et al., 2023), who emphasized the role of contextual recommendations in reducing decision ambiguity, and with (Daulah & Sejati, 2024), who highlighted the contribution of recommendation systems to digital sales strategies. Accordingly, the main contribution of this study lies in the implementation of a data driven recommendation model that is fully integrated into the restaurant transaction workflow, providing value for both customers and business operations.

CONCLUSION

This study successfully designed and implemented an Android-based restaurant ordering system integrating Item-Based Collaborative Filtering and Market Basket Analysis to improve menu recommendation effectiveness at Mbok Thing-Thing Resto. The proposed integration enables personalized recommendations based on historical ordering patterns, while Market Basket Analysis efficiently computes item associations using support metrics, ensuring stable performance in a real-time operational environment. The system also supports core restaurant functions, including menu management, transactions, table administration, reservations, and recommendation delivery.

Functional validation through black box testing confirms that all major features on both customer and admin interfaces operate according to specifications and demonstrate reliable system performance. The results indicate that the integration of Collaborative Filtering and Market Basket Analysis enhances menu personalization, supports the promotion of signature and high-margin items, and contributes to improved customer decision-making quality, thereby offering potential benefits for restaurant sales optimization.

For future work, the system can be enhanced by incorporating larger and more diverse transaction datasets, implementing hybrid recommendation models that combine Collaborative Filtering with content-based or machine learning approaches, and conducting A/B testing to quantitatively measure recommendation accuracy and business impact. These improvements would strengthen the system's scalability, recommendation precision, and applicability for broader adoption in the restaurant industry.

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