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Design and Development of an Android-Based E-Commerce Application for A&Y Frozen Food Store

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Abstract

The shift in public shopping patterns toward digital services drives frozen food retailers to provide more practical ordering media. At A&Y Frozen Food Store, ordering is still conducted via WhatsApp and direct purchases, leaving transaction data, stock, and order status unmanaged centrally. This condition causes disorganized records, non-transparent stock information, and manual reporting. This study aims to design and build an Android-based mobile e-commerce application for A&Y Frozen Food Store to make the sales process more digital, structured, and efficient. The system development uses the Agile method, covering planning, design, sprint development, testing, evaluation, implementation, and maintenance. The system consists of an Android mobile application for customers (from registration to order tracking) and an admin website for the store (data management and reporting). The results show that the application successfully integrates and computerizes the sales process. Testing using the black-box method on main features yielded valid results, indicating the application runs according to system requirements. Thus, this application enhances transaction efficiency, minimizes recording errors, simplifies data management, and improves customer service quality.

Keywords: *E-commerce, Android Application, Agile Method, Black-Box Testing, Frozen Food*

1. Introduction

The rapid growth of data technology in the current digital era has provided numerous conveniences in human life. One of the most widely used technologies is the Android-based smartphone. Today, smartphones are utilized not only as communication tools but also as platforms for various digital activities, such as retrieving information, conducting financial transactions, ordering food, and shopping online. The expansion of online shopping through the Internet and mobile applications has spread widely across Indonesia; hence, the presence of online stores or e-commerce platforms has become a strategic approach for business players to market products and maintain customer relationships[1][2]. E-commerce refers to the process of buying and selling goods or services through electronic media, particularly the Internet. In business activities, e-commerce assists both companies and MSMEs (Micro, Small, and Medium Enterprises) in marketing products more broadly, storing transaction data, and generating sales reports more easily. Prior studies have demonstrated that e-commerce enables businesses to expand their market reach, secure data and reports stored via digital platforms, and enhance business transaction efficiency[1]. Furthermore, integrating e-commerce into MSMEs can support digital transformation, elevate customer experience, and strengthen business competitiveness[3].

In addition to web-based e-commerce, the evolution of digital transactions has shifted toward mobile commerce, or M-commerce. M-commerce is defined as buying and selling activities conducted through mobile devices such as smartphones. This development is primarily driven by high smartphone penetration in society. Research on Android-based M-commerce applications reveals that contemporary buying and selling transactions increasingly leverage mobile gadgets to offer consumers greater convenience in conducting transactions[4].

A&Y Frozen Food Store is a business enterprise operating in the retail of frozen food products. The products offered include nuggets, sausages, meatballs, dim sum, processed seafood, frozen potatoes, and other frozen food items. Frozen food products are highly demanded by the public due to their practicality, ease of preparation, and long shelf life. However, in its daily sales operations, A&Y Frozen Food Store still encounters several challenges. The existing issues include a manual ordering process that relies on WhatsApp messages or direct store visits, unorganized transaction logging, the unavailability of real-time product stock information for customers, and a manual process for generating sales reports. These conventional methods often lead to recording errors, delayed customer responses, and difficulties for the store owner in monitoring sales data. Based on these problems, an Android-based mobile e-commerce application is required to assist A&Y Frozen Food Store in managing its sales processes digitally. This application is expected to facilitate customers in viewing product catalogs, selecting items, placing orders, filling out shipping addresses, making payments, and tracking order statuses. From an administrative perspective, the application is designed to streamline the management of products, orders, payments, customers, shipping, and sales reports [5]. Additionally, the e-commerce system must prioritize reliability, security, technological infrastructure, and customer experience to support business requirements optimally [6].

The approach applied in this study is the Agile methodology. The selection of this method is based on its flexible and adaptive characteristics in responding to changing user requirements. Reflecting previous research concerning MSME e-commerce, the Agile

method has proven effective due to its capacity to adapt to market dynamics while supporting iterative and incremental application development [7]. With the implementation of this Android-based mobile e-commerce application, it is anticipated that A&Y Frozen Food Store can optimize its operational efficiency and accelerate transaction processes. Moreover, this system is engineered to mitigate the risk of data logging errors, expand market reach, and improve the standard of customer service.

2. Theoretical Basis

2.1. The Definition of E-commerce

E-commerce is the trading activity of goods or services utilizing computer networks or the internet. Through this electronic system, the entire process of receiving and managing orders can be carried out digitally. Although ordering is conducted online, the payment and shipping processes do not always have to be performed online [5]. E-commerce can also help MSMEs expand their market, increase sales efficiency, and support digital product marketing [7]. In this study, e-commerce is implemented at A&Y Frozen Food Store to make it easier for customers to view products, check prices, place orders, and monitor order status.

2.2. The Definition of Sales Information System

A sales information system is a computerized platform designed to manage product data, customers, orders, payments, inventory, and transaction reports. The implementation of this web-based system can assist small and medium enterprises in expanding their promotional reach and optimizing product sales [5]. Furthermore, several studies explain that this system facilitates sellers in managing products, stock, payments, sales reports, and order tracking [8]. Consequently, sales information systems play a crucial role in supporting business processes to ensure transactions are more effective, efficient, and easily accessible to customers.

2.3. The Definition of Website

A website is a collection of interconnected web pages residing under a single domain that serves as a means to convey information to users [9]. Each page has a specific URL and can contain text, images, videos, interactive elements, and hyperlinks that connect one page to another. A web page itself is a component of a website, allowing a single website to host various pages with different contents, topics, or functions [10]. Consequently, websites can be effectively utilized as a medium for information sharing, promotion, and online transactions because they are universally accessible to users via the internet.

2.4. The Definition of Laravel

Laravel is a PHP framework designed to build web-based applications in a more structured manner. This framework implements the Model-View-Controller (MVC) architecture, where the model manages data and the database, the view displays the user interface, and the controller handles the process logic while bridging the model and the view [11]. Utilizing Laravel helps developers accelerate the system development process as it provides various reusable libraries. Furthermore, Laravel supports the development of responsive web applications that are accessible across diverse browsers [11]. Additionally, the framework can be effectively leveraged in developing website-based information systems due to its built-in supporting features, such as authentication, login, session, and database management [12]. In this study, Laravel is employed to manage and structure the data processing for products, customers, orders, inventory, delivery services, and sales reports.

2.5. The Definition of Database

A database is a collection of systematically stored data or records within a computer that can be accessed, managed, and reused according to needs. Through the querying process, this stored data can be processed into useful information to support decision-making [13]. A database system consists of a collection of interrelated files and programs that allow users to access and modify the data. Furthermore, a database conceals the physical data storage details, enabling users to view the data in a more logical and comprehensible format [14].

2.6. The Definition of Unified Modeling Language (UML)

Unified Modeling Language (UML) is a standardized visual modeling language used to specify, design, and document object-oriented software systems. In application architecture and design, UML serves as a graphical instrument to map business processes and data flows, making the system architecture easier to comprehend prior to the coding phase [15]. UML encompasses a diverse range of notations that can be utilized to model systems from various perspectives and levels of abstraction [16]. In addition, UML is widely relied upon in software architecture modeling due to its capability to represent systems through various types of diagrams, such as class diagrams, sequence diagrams, activity diagrams, component diagrams, and deployment diagrams [17].

2.7. The Definition of Flutter

Flutter is a framework that facilitates developers in building multiplatform mobile applications. As a Software Development Kit (SDK) and modern user interface framework, Flutter enables highly efficient hybrid application development. Released by Google in 2018, this open-source framework allows the global community to contribute to updating and refining its system [18]. As a cross-platform framework, Flutter enables application development for various operating systems utilizing only a single codebase. This framework adopts the Dart programming language and supports application creation across Android, iOS, Windows, and MacOS platforms. Furthermore, the presence of the Hot Reload feature significantly assists developers in monitoring code changes instantly, which ultimately accelerates the application development lifecycle [19].

2.8. The Definition of Mobile E-commerce

Mobile E-commerce, commonly referred to as M-commerce, is an extension of e-commerce that enables commercial transactions to be conducted through mobile devices such as smartphones and tablets [20]. The advancement of M-commerce is progressing rapidly, driven by the increasing proliferation of mobile device usage and more accessible internet connectivity. Consequently, M-commerce offers convenience and flexibility for consumers to execute transactions anytime and anywhere.

2.9. The Definition of Testing

Software testing is an essential instrument for exposing errors within program code and validating entire system performance, through both manual and automated methods [21]. Furthermore, testing serves as a form of quality assurance to ensure that all system functionalities operate in alignment with the specified requirements, while simultaneously detecting defects early to minimize software maintenance and repair costs [22].

2.10. The Definition of Black Box Testing

The black-box testing method is fully oriented toward the functional aspects of the system. Evaluation in this method is conducted by testing the alignment between the provided inputs and the resulting outputs, without inspecting the internal code structure of the software [23].

3. Research Methodology

3.1. Research Type

This study was conducted by observing the sales processes at A&Y Frozen Food Store, focusing specifically on product ordering, transaction logging, stock checking, and shipment management. The observation results served as the baseline for formulation of the system requirements, encompassing both the customer mobile application and the administrator website.

3.2. Research Method

This study applied the Agile software development approach. This method was adopted because the application development process in this project required flexible and adaptive development to accommodate the dynamic nature of user requirements [3]. Through a series of incremental sprints, the processes of system design, development, testing, and refinement could be executed iteratively and more systematically [13].

3.3. System Development Lifecycle

The development of the Android-based e-commerce application for A&Y Frozen Food Store was executed using the Agile methodology. This approach was selected due to its dynamic, flexible, and adaptive development lifecycle in responding to user feedback and changing requirements. The development cycle initiated with the requirements planning phase, which oriented toward identifying system specifications through observation and in-depth interviews with the store owner. The data gathered during this preliminary stage focused on crucial feature clusters, such as the product module, shopping cart, ordering mechanism, payment channels, order management, and customer database. Once the requirement specifications were mapped out, the process advanced to the system design phase, which encompassed the user interface (UI) design, database architecture, and system workflow modeling to guarantee operational ease of use for both consumers and store administrators. Software construction was subsequently executed through incremental and iterative sprint development phases. Each sprint was concentrated on completing specific feature components, ranging from user authentication, product cataloging, cart management, and the checkout module, to order tracking and the admin data management dashboard. Every functionality completed within each sprint was immediately deployed into the system testing phase utilizing the Black-Box Testing method. This step was crucial to validate the functional reliability of the application, particularly regarding user login, transaction workflows, payment processing, and shipment status synchronization.

Any defects or constraints identified during the testing phase, combined with user feedback, served as the primary inputs for evaluation and refinement. If bugs or feature discrepancies were detected, revision and optimization schedules were integrated into the subsequent sprint. Once the entire ecosystem of core features was declared stable and passed the tests, the application entered the system implementation phase for immediate deployment by A&Y Frozen Food Store to digitalize its commercial transactions. Finally, the cycle concluded with a long-term maintenance phase dedicated to post-release bug fixing, new functionality adjustments, and further feature development to accommodate future business scaling.

3.4. Research Location

The observation and data collection phases were carried out at A&Y Frozen Food Store, located in Lhokseumawe City. This location was determined purposively, considering that the store is currently in a transition phase toward business digitalization yet lacks a dedicated mobile-based sales platform.

3.5. Data Collection Techniques

Data collection in this study relied on three primary techniques:

1. Observation: The researcher conducted direct observations of sales activities, transaction logging, and order management processes, which were previously executed manually.
2. Interviews: Face-to-face interviews were conducted with the store owner to identify business constraints, functional software requirements, and the necessary e-commerce features.
3. Literature Review: Theoretical references and information were gathered from scientific journals, books, and related documentation concerning Android application design, development, and e-commerce engineering.

3.6. System Design

System design was performed to map out the architecture and workflow of the A&Y Frozen Food e-commerce application prior to the coding phase. The designs constructed include:

1. Use Case Diagram

   The following is the use case diagram for the A&Y Frozen Food Application. The A&Y Frozen Food E-Commerce system integrates both the User and the Admin into a single platform. On the front-end interface, the User is responsible for registration, product selection, and adding items to the shopping cart. Upon checkout, users are required to fill out their shipping addresses, select a payment method, confirm the order, and upload payment proof, after which they can monitor their order status and history.

   Behind the scenes, the admin is responsible for managing products, categories, and stock levels. Additionally, the admin manages incoming orders by assigning a delivery courier (Ojek), updating order statuses, and monitoring business growth through sales reports. This visualization delineates user access privileges, wherein the User side focuses on transactional activities such as checkout and uploading payment proofs, while the admin side maintains full responsibility over master data management (products, categories, stock) and sales report monitoring.

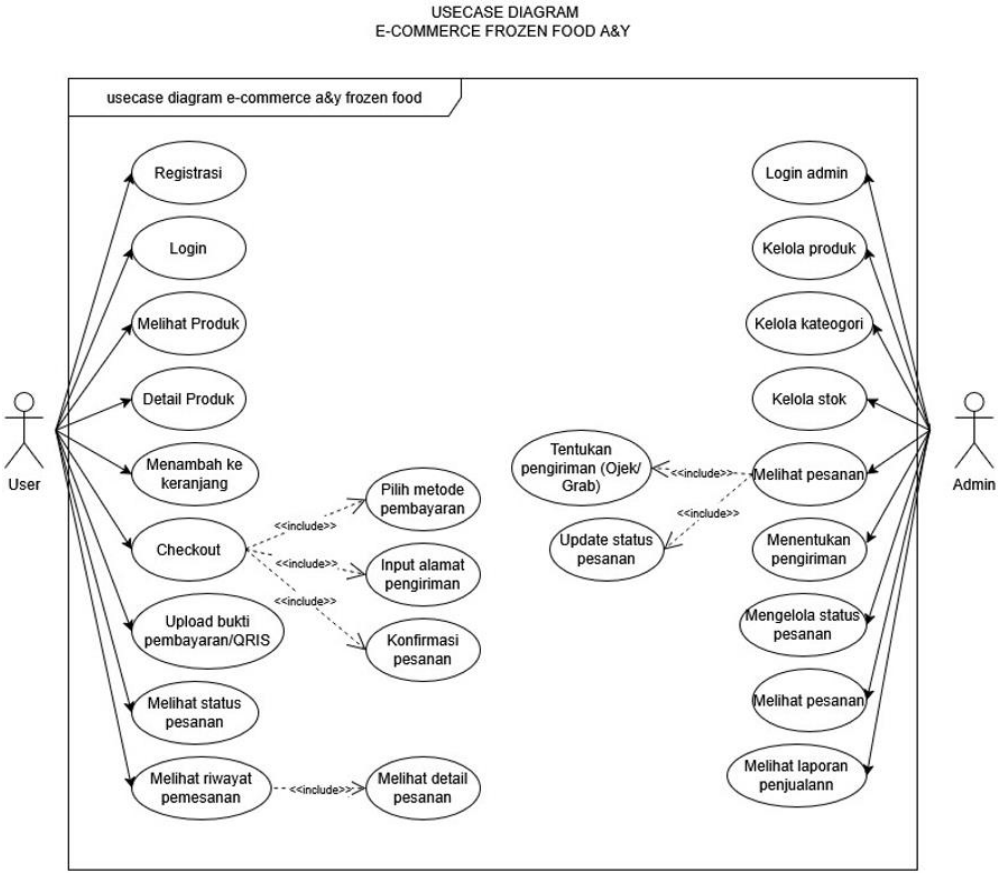

Fig. 1 : Use Case Diagram of A&Y Frozen Food Application

2. Class Diagram

   The Class Diagram is utilized to map the data structure, attributes, methods, and relationships between objects that constitute the application system and its database. This class diagram illustrates the database architecture of the A&Y Frozen Food e-commerce system, which comprises several entities: customer data, admin, products, categories, carts, orders, addresses, and chats.

The customer entity stores customer-related data, whereas users are utilized for administrative data. The categories of entity functions to group products, and products stores specific product details such as name, price, stock, image, and description. The shopping process leverages carts as the temporary shopping repository and cart_items to log into the detailed contents of the cart. Upon checkout, the data is recorded into orders, while the specific breakdown of the purchased products is preserved in order_items.

Furthermore, customer_addresses store the shipping addresses of the customers, while chats and chat_messages facilitate communication between customers and administrators. In general, this diagram delineates the systematic workflow from product selection and cart insertion by the customer to the final order completion and the administrative management of orders and chats.

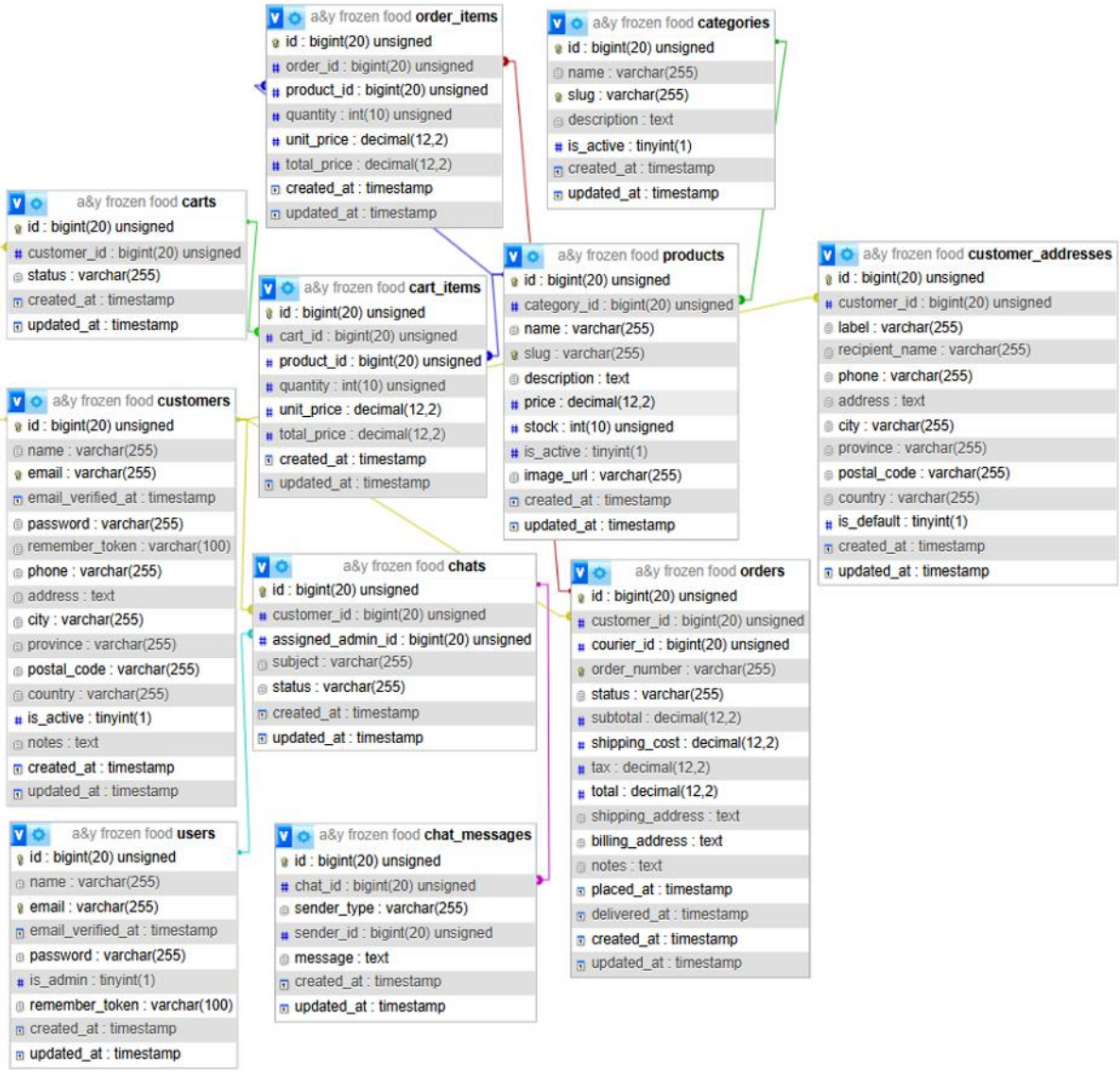

Fig. 2 : Class Diagram of A&Y Frozen Food Application

4. Results and Discussion

4.1. System Requirements Analysis

The system requirements analysis was conducted to determine user requirements for the A&Y Frozen Food e-commerce application. These requirements were gathered through direct interviews with the store management. Based on the interview results, it was identified that the sales process requires a system capable of managing products, orders, customers, payments, and order status tracking in a more structured manner. The developed system consists of two main components: a mobile application for customers and a website for the admin. The mobile application is utilized by customers to view products, place orders, check out, make payments, track order status, and manage profiles. Meanwhile, the admin website is utilized by the store management to manage product data, customer data, order data, delivery services, order status, and sales reports.

This system requirements analysis is classified into two main categories: functional specifications and non-functional specifications. Regarding the functional aspects directly related to the supporting features of the system, this application is designed to enable customers to register, log in to their accounts, and browse the list as well as details of frozen food products, which include names, prices, stock

availability, and comprehensive descriptions. Furthermore, customers are facilitated to add products to the shopping cart, perform the checkout process, complete delivery addresses, select payment methods, monitor order history and status, and update their profiles, addresses, or passwords. On the other hand, admin access rights are provided through a dedicated website that allows for comprehensive product data management-including adding, updating, and deleting data-as well as customer data management. The admin also holds the authority to review and process incoming orders, assign internal couriers or store delivery services, update order statuses periodically from the pending stage through to completion or cancellation, and monitor periodic sales report summaries.

Meanwhile, regarding the non-functional requirements that focus on performance and operational convenience, this system is developed by prioritizing ease of navigation for both customers and administrators. Access to flexibility is achieved through a mobile platform for general users and a web browser for the administrator, both of which are fully integrated into a shared database. The system's performance is required to present product data and order information responsively and rapidly, supported by an interface design that is minimalist, clean, and intuitive. In terms of security, user data protection is guaranteed through a login authentication mechanism. Overall, the implementation of these non-functional aspects is expected to optimize the store's management efficiency. The primary difference between this system and general e-commerce platforms lies in the delivery process. In the A&Y Frozen Food system, the admin can select internal store delivery services to deliver customer orders. This is tailored to the store's business workflow, which utilizes local delivery to ensure that frozen food products arrive in good condition.

4.2. Database Design

Database design was conducted to store and manage all data utilized within the A&Y Frozen Food e-commerce system. The database is designed to ensure that the customer's mobile application and the admin website are interconnected using the same shared data. With an integrated database, data regarding products, customers, orders, payments, and shipments can be managed in a more structured manner. The database in this system consists of several main tables, including the admin, customer, product, category, order, order_detail, payment, and delivery_service tables. Each table serves its respective functions in accordance with the system requirements.

The admin table is used to store account data for administrators who access the admin website. The customer table is utilized to store application user data, such as names, phone numbers, addresses, emails, and passwords. The category table is used to group products based on their types. The product table serves to store frozen food product data, including product names, categories, prices, stock levels, descriptions, and product photos. The order table is used to store primary transaction data performed by customers, such as order dates, total payments, delivery addresses, payment methods, order statuses, and the assigned delivery services. The order_detail table is utilized to store the specific details of products purchased in each order, such as product names, product quantities, prices, and subtotals. The payment table is used to record customer payment information, while the delivery_service table is used to store data regarding store delivery personnel responsible for delivering the orders.

Relationships between tables are designed to ensure data connectivity. One customer can have many orders, and one order can contain multiple order details. Similarly, one product can appear in many order details, and one category can include multiple products. Furthermore, one delivery service can be assigned to deliver multiple orders. Through these relationships, the system can display comprehensive transaction data, ranging from customer profiles, purchased products, purchase quantities, and payments, to shipping statuses. This database design aims to make data storage more structured, minimize data duplication, and assist the admin in managing sales transactions in a computerized manner.

4.3. Website Admin Application Implementation

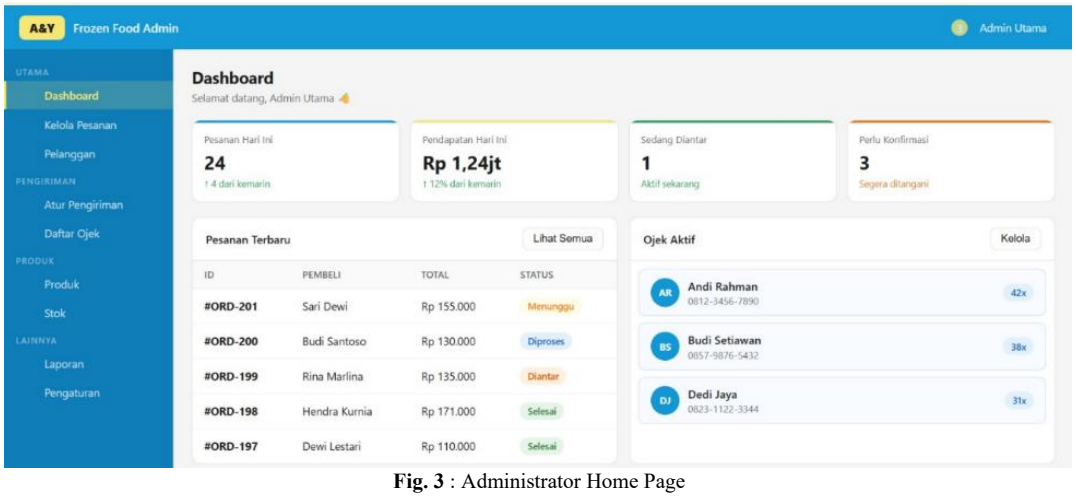

Fig. 3 : Administrator Home Page

The figure displays the Admin Dashboard page of the A&Y Frozen Food e-commerce system. On this page, the administrator can monitor various critical pieces of information, such as the total number of products, customer data, incoming orders, shipping statuses, and sales reports. Furthermore, the dashboard displays recent order information, top-selling products, and daily sales graphs. The dashboard interface is designed to facilitate the administrator in managing store operations efficiently and in a structured manner.

4.4. Mobile Application Implementation

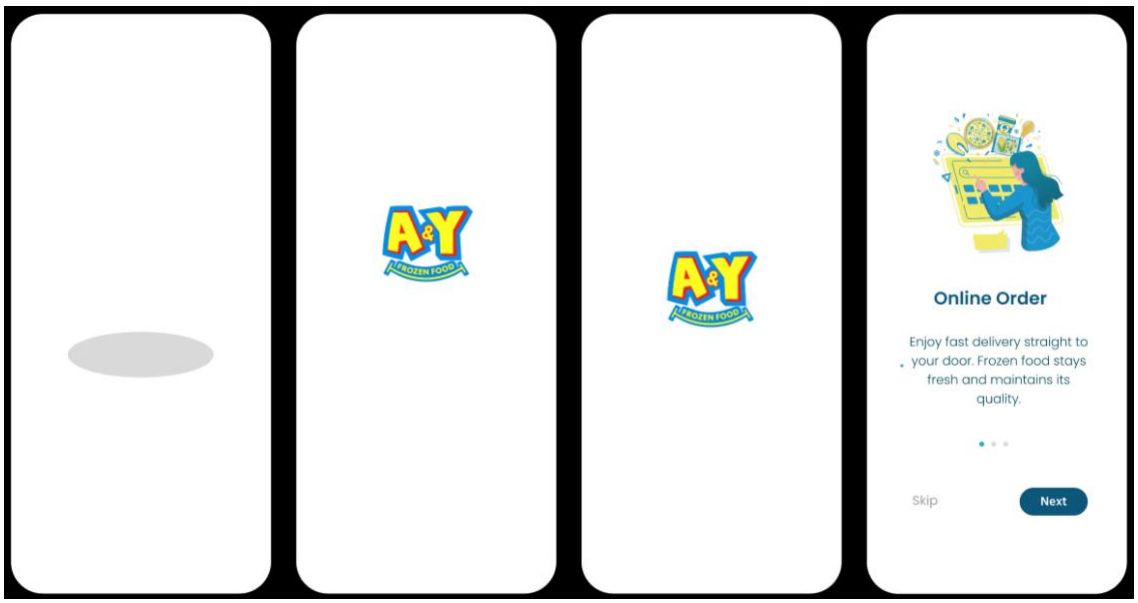

Fig. 4 : Splash Shscreen Page

The figure displays the initial view or Splash Screen of the A&Y Frozen Food mobile application. This view is the first page that appears when a user opens the application. It features the logo and application name as the primary identity of the system before the user is redirected to the subsequent page. The splash screen serves to provide an engaging initial impression while introducing the application to users.

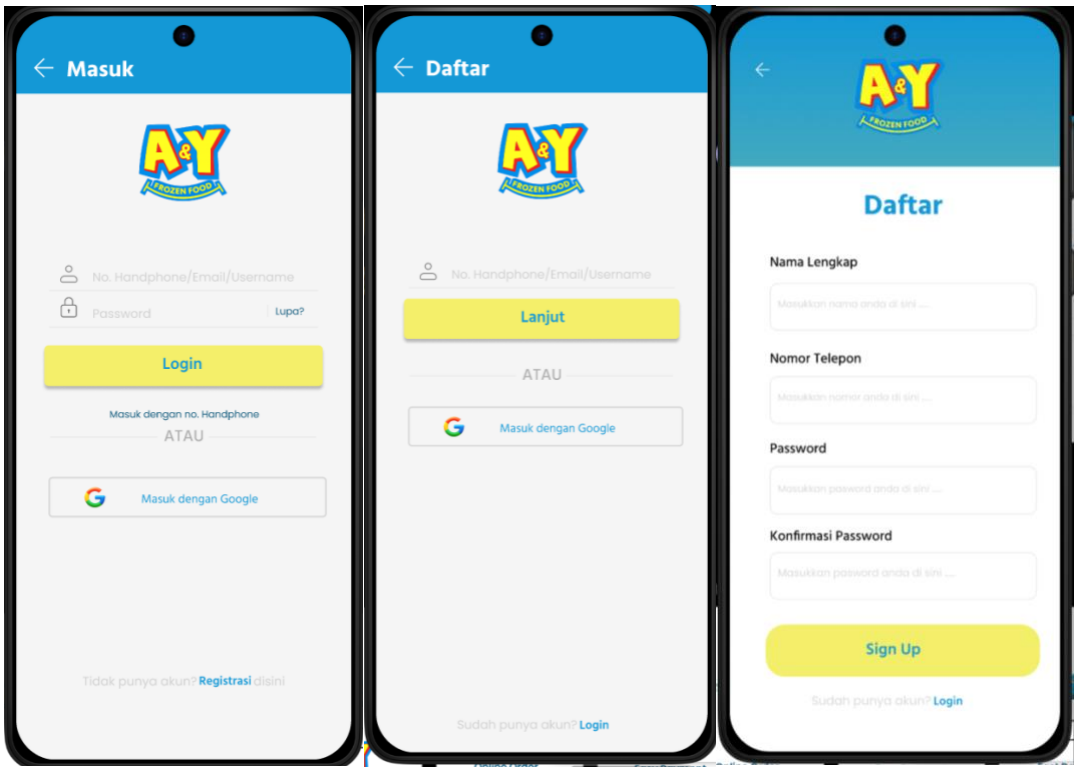

Fig. 5 : Login and Registration Page

The figure shows two interface layouts of the A&Y Frozen Food application, specifically the login page and the registration page. On the login page, users are required to input their email or phone number along with their password to access their accounts. Meanwhile, the registration page is utilized by new users to create an account by providing data such as name, email, phone number, address, and password. Both pages are designed with a minimalist layout to ensure ease of use for customers.

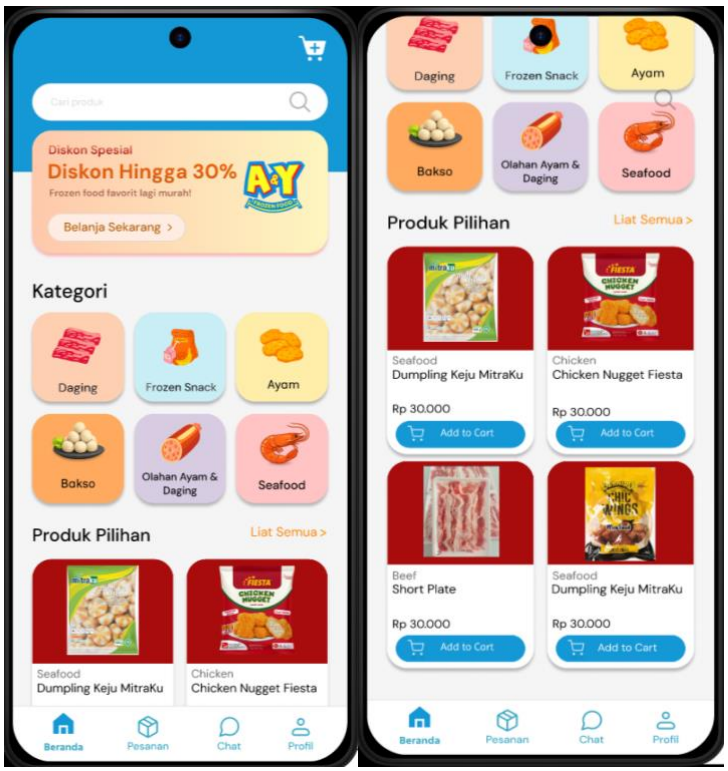

Fig. 6: Home Page

The figure shows the main page interface of the A&Y Frozen Food application. On this page, users can access the product search feature, promotional banners, frozen food product categories, a list of top-selling products, and other available items. The main page layout is designed to enable users to search for and select their desired products with ease.

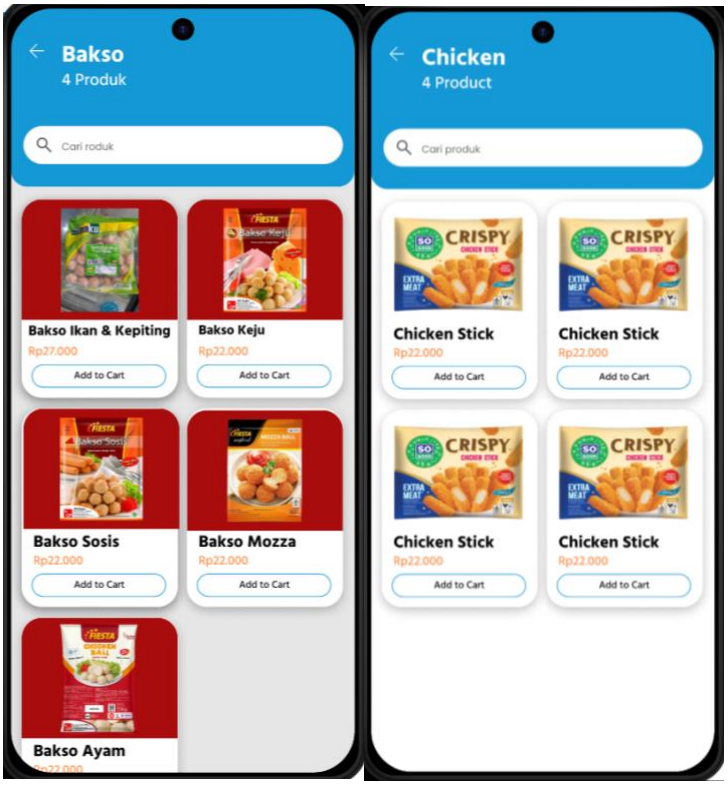

Fig. 7 : Product Category Page

The figure displays the product list interface categorized by specific types within the A&Y Frozen Food application. The product categories include meatballs, sausages, nuggets, seafood, processed chicken, processed meat, and other frozen foods. This categorization feature facilitates users in searching for products according to their needs and preferred food types.

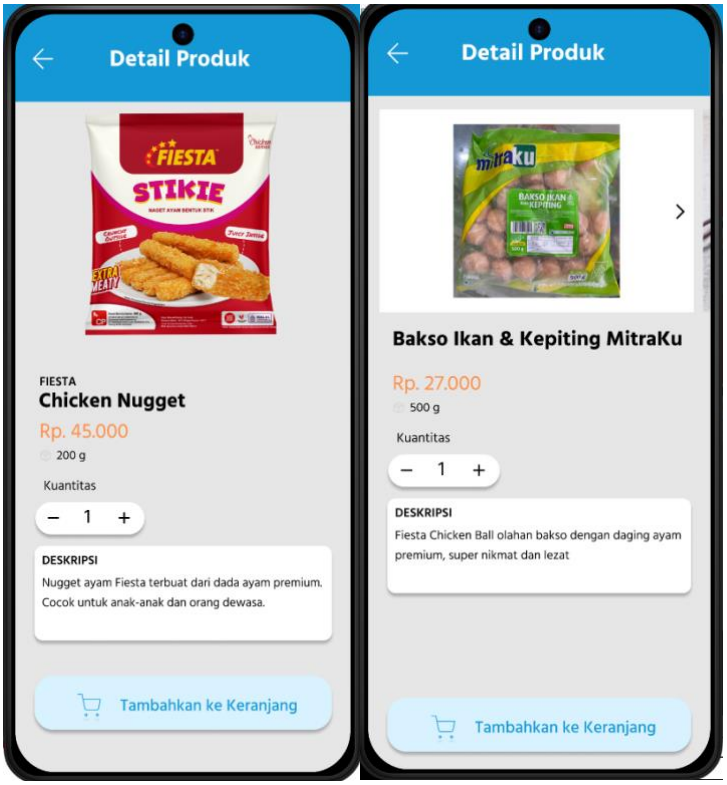

Fig. 8 : Product Detail Page

The figure displays the frozen food product detail page within the A&Y Frozen Food application. On this page, users can view comprehensive product details, specify the purchase quantity, view the total price, and select the option to either buy the product instantly or add it to the shopping cart.

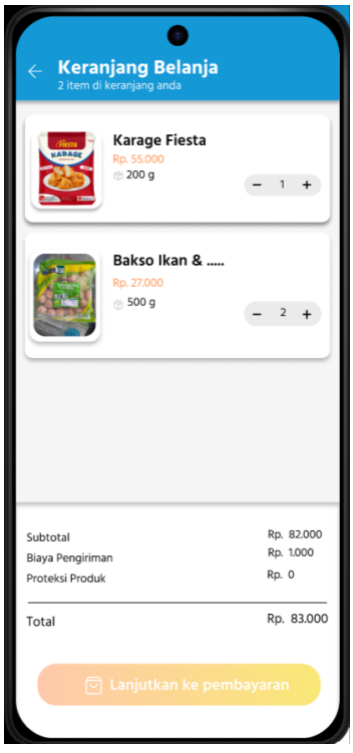

Fig. 9 : Shopping Cart Page

The figure displays the shopping cart page interface of the A&Y Frozen Food application. On this page, users can find the list of selected items, adjust the quantity of each item, and view the cost summary details consisting of the subtotal, shipping fee, product protection, and the total overall cost. There is also a "Lanjutkan ke pembayaran" (Proceed to payment) button to continue to the payment stage.

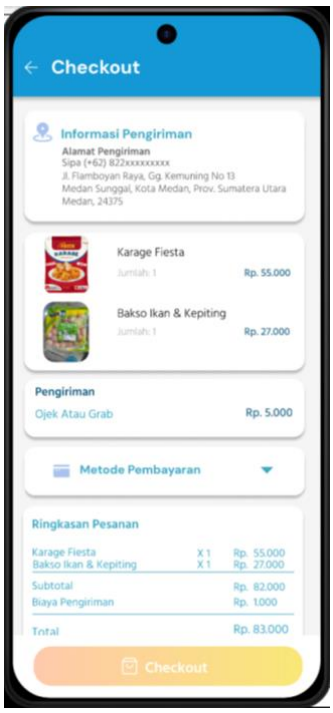

Fig. 10 : Checkout Page

The figure displays the shopping cart and order confirmation page within the A&Y Frozen Food application. This page allows users to review their selected products, purchase quantities, subtotals, delivery addresses, payment methods, and the total order cost prior to proceeding to checkout.

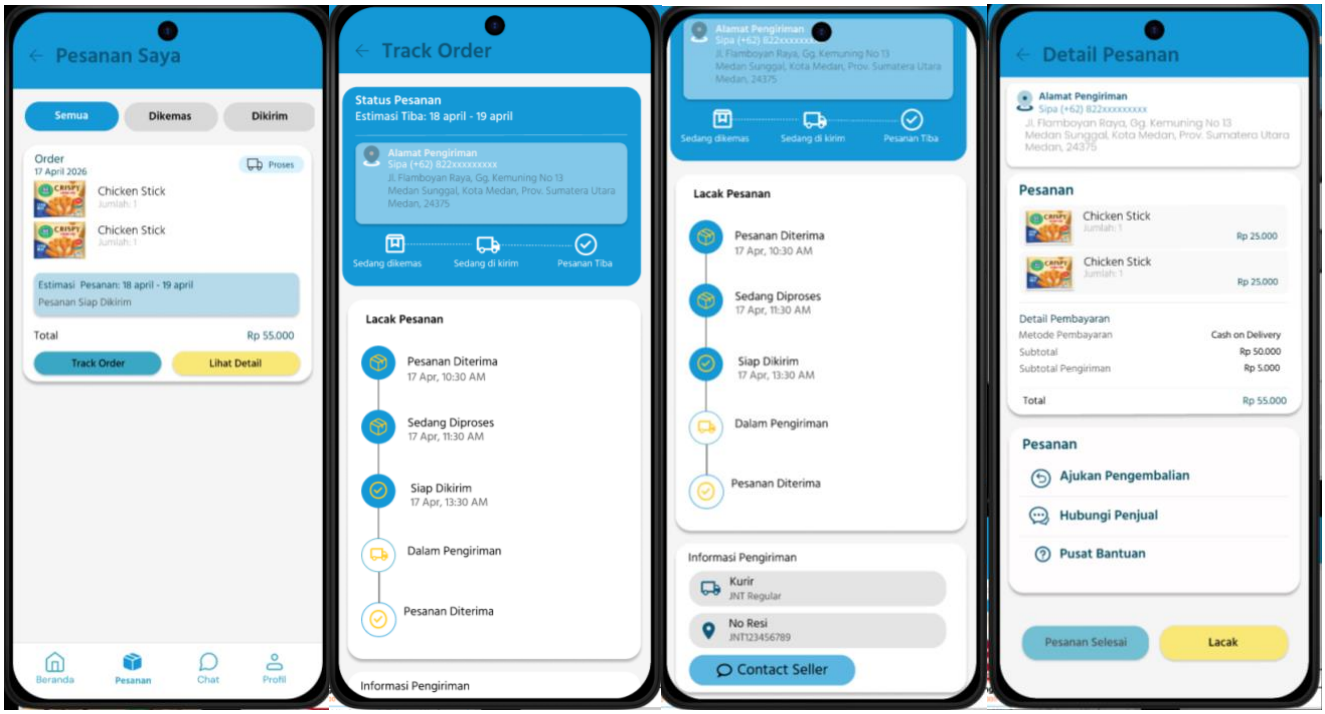

Fig. 11 : Order Page

The figure displays the order tracking page within the A&Y Frozen Food application. This page serves to monitor the user's order status, ranging from order creation, processing, and delivery by the store's internal personnel, through to order completion. Through this page, users can easily track the real-time progress of their orders.

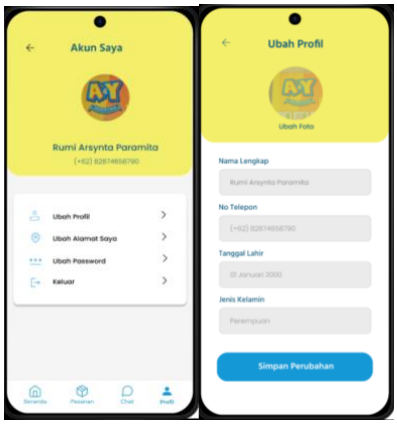

Fig. 12 : User Profile Page

The figure displays the User Profile page within the A&Y Frozen Food application. On this page, users can view their account information and manage configurations such as updating profiles, modifying delivery addresses, changing passwords, and logging out. This feature facilitates users in managing personal data utilized throughout the ordering process.

4.5. Black Box Testing

Functional testing of the application was conducted using the Black Box Testing method to ensure that all features operate in accordance with user requirements. The test scenarios encompass interactions from both the user and administrator perspectives, with detailed results presented in the following table.

Table. 1 : Black-Box Testing

No.	Test Scenario	Test Case	Expected Result	Result
1	Account Registration	The user fills in the registration data correctly	The system successfully creates a new account	Valid
2	Account Registration	The user leaves one required field empty	The system displays a message stating that the field is required	Valid
3	User Login	The user enters the correct email and password	The system successfully redirects the user to the home page	Valid
4	User Login	The user enters an incorrect email or password	The system displays a login failed message	Valid
5	Viewing Products	The user selects a product category	The system displays the list of available products	Valid
6	Viewing Product Details	The user selects one product	The system displays detailed product information	Valid
7	Adding Product to Cart	The user adds a product to the shopping cart	The product is successfully added to the shopping cart	Valid
8	Checkout Process	The user performs checkout with products in the cart	The system displays the checkout page	Valid
9	Viewing Order Status	The user opens the order tracking menu	The system displays the latest order status	Valid
10	Admin Manages Products	The admin adds new product data	The product is successfully saved in the system	Valid
11	Admin Manages Stock	The admin increases the product stock quantity	The product stock is successfully updated in the system	Valid
12	Admin Views Orders	The admin opens the order menu	The system displays the list of customer orders	Valid
13	Admin Determines Delivery	The admin selects a delivery service	The system saves the delivery data	Valid
14	Admin Manages Order Status	The admin changes the order status to “Processed”	The order status is successfully updated	Valid
15	Admin Views Sales Report	The admin selects the sales report menu	The system displays the sales report based on transaction data	Valid

The functional testing results using the Black Box Testing method demonstrate that all functionalities within the application operate in accordance with system requirements. A total of 15 test scenarios were executed to evaluate the features utilized by both users and administrators. Each scenario yielded outputs consistent with the expected results, under both normal conditions and input error scenarios. Furthermore, the system's validation mechanism functioned effectively in handling invalid data. Consequently, all tests achieved a valid status, leading to the conclusion that the application has successfully met all designed functional specifications.

5. Conclusion

This study successfully delivers an Android-based mobile e-commerce application integrated with an administrative website to support the sales processes at A&Y Frozen Food Store. The system effectively transforms the previously manual ordering process into a more

structured workflow through features such as product catalogs, shopping carts, checkout mechanisms, order tracking, product management, stock control, shipment handling, and sales reporting.The developed system consists of two primary components: a mobile application for customers and a web-based administration platform for store management. Within the customer application, users can perform registration, log into accounts, browse product listings, view product details, add items to the shopping cart, execute checkouts, select payment methods, monitor order statuses, and manage profile data. Concurrently, the admin website serves to assist the store management in administering products, customers, orders, inventory, delivery couriers, order status updates, and sales reports.

The implementation of the Agile methodology in this research enabled an incremental and highly flexible system development process. Each phase, spanning from requirements analysis, system design, and feature development to testing and evaluation, was tailored to the precise requirements of A&Y Frozen Food Store. Through this approach, the system construction became more structured and closely aligned with user needs.

The results of system testing using the Black-Box Testing method indicated that all evaluated features functioned exactly as anticipated. Key functionalities—including registration, login, product browsing, product details, shopping cart, checkout, order tracking, product management, stock control, shipment handling, order status updates, and sales reporting—yielded valid results. This demonstrates that the system fully satisfies the predefined functional requirements.

With the deployment of this application, the sales operations at A&Y Frozen Food Store can run in a more effective, efficient, and structured manner. Furthermore, the system assists the store management in mitigating data logging errors, accelerating transaction processing, and streamlining data management, while simultaneously offering customers a convenient platform to purchase frozen food products online.

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