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Design and Development of BonBake Cake Ordering Website Using the Waterfall Method for Software Engineering Implementation

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Abstract

This study presents the design and development of BonBake, a web-based cake ordering system aimed at supporting small culinary businesses through digital transformation. The system was developed using the Waterfall software development methodology, covering the phases of requirement analysis, system design, implementation, testing, and evaluation. The project serves both as an academic implementation of software engineering principles and a practical solution for streamlining online cake orders. The website was built using HTML, CSS, JavaScript, PHP, and MySQL, resulting in a responsive platform that enables customers to browse products, place orders, and manage transactions, while allowing admins to efficiently handle product and order data. The system's functionality is supported by UML modeling, a structured MySQL database, and an intuitive user interface. The successful implementation demonstrates the feasibility of applying structured software engineering methods in real-world MSME digitalization efforts.

Keywords: ordering system; website; waterfall method; software engineering; technology development

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1- Introduction

Digital transformation has become an important requirement in various industrial sectors, including the Micro, Small and Medium Enterprises (MSMEs) sector, which plays a strategic role in the national economy. In today's digital era, the utilization of information technology is not only an added value, but also a determining factor for the competitiveness of a business, including small-scale culinary businesses such as home-based cake shops. Digitalization of business processes allows MSME players to expand market reach, improve operational efficiency, and provide better and more responsive services to customers.

However, the reality is that many home-based cake businesses still carry out ordering activities manually, either through direct communication, social media, or instant messaging that has not been integrated with the system. The manual process is prone to errors, takes longer time, and makes it difficult to manage large amounts of order data. In addition, customers do not have access to a structured product catalog and complete information when they want to place an order, so the user experience becomes less than optimal.

In response to these problems, an information system solution is needed that is able to automate the ordering process and data management, while presenting product information in an interactive and organized manner. Therefore, this research developed an online cake ordering website named BonBake. This website is designed to be a digital media that makes it easy for customers to order cakes practically and efficiently, and helps business owners in monitoring and managing orders systematically.

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The development of this system was carried out using the Waterfall methodology approach, which consists of the stages of requirements analysis, design, implementation, testing, and maintenance. This project is also part of the implementation of the practicum of the Software Engineering course, with the aim of providing hands-on experience to students in designing and building web-based software in a structured manner. With this project, students are expected to understand and apply the principles of software engineering into the development of real solutions that are beneficial to society, especially in supporting the digitalization of MSMEs.

2- Methodology

1-1- Development Method

The Waterfall method is one of the sequential software development process models, where each stage of system development is carried out systematically and coherently from the initial to the final stage. This model is often used in projects that have clear needs and specifications from the start, because each stage must be completed before proceeding to the next stage. The main concept of the Waterfall method is a linear workflow that resembles a waterfall, where the development process flows from top to bottom through several main phases.

Here is the waterfall method of BonBake:

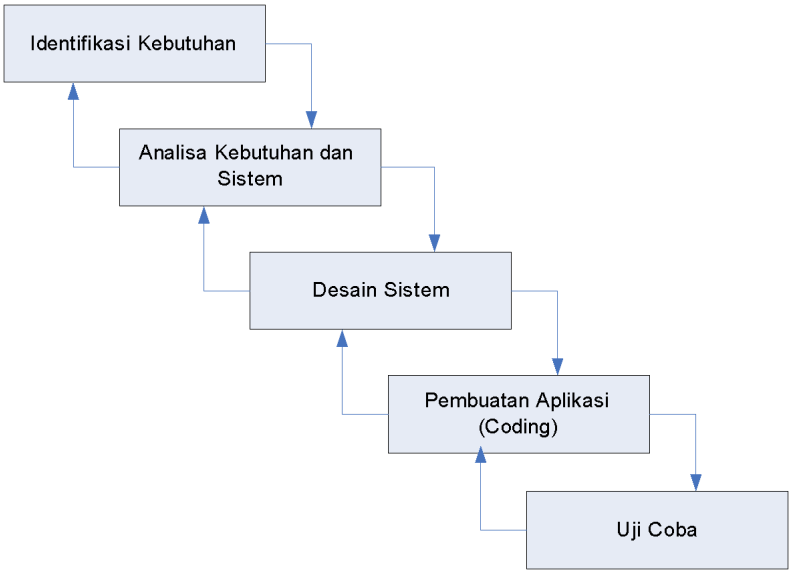

Figure 1. A diagram waterfall.

- Needs Identification

In this initial stage, information was collected about user needs and the purpose of the system to be developed. This process includes initial discussions with relevant parties (such as the owner of the BonBake cake business and the development team) to understand the cake ordering process that runs manually, as well as the problems faced. The result of this stage is a list of functional and non-functional system requirements.

- Needs and System Analysis

After the requirements are collected, the next step is to analyze the requirements and translate them into system specifications. This analysis includes designing system workflows, entities involved (such as customers and admins), and data flows. The result of this stage is a system requirement specification document that will serve as a reference in the design process.

- System Design

The design stage aims to design the system structure based on the results of the previous analysis. At this stage, the user interface (UI/UX), database structure, and system architecture are designed. Tools such as Figma are used to design the interface, while ERD diagrams are used to design the database that will be used in system development.

- Application Development (Website Coding)

This stage is the implementation of the system design into the form of program code. The technologies used are HTML, CSS, and JavaScript for the frontend, and PHP and MySQL for system logic and data management (backend). Development is done using the Visual Studio Code text editor and the Laragon local server environment.

- Testing

System testing was carried out using the exploratory black-box testing method, by directly testing all features without a formal test scenario. During the testing process, key functions such as cake ordering, admin login, and product management were tested one by one. If bugs were found, fixes were made on the spot. This approach was chosen because it is more flexible and suitable for the modest scale of the project, so as to ensure the system runs as needed efficiently.

1-2- Information Flow

Information Flow is a description of how information or data flows from one process to another in the system. In the context of software development, information flow is used to show the relationship between the stages of system development, from needs analysis to final evaluation. The goal is to make it easier to understand the overall workflow of the system, both by developers and other related parties.

Through information flow, each stage is displayed sequentially and interconnected, so that it can be seen how the output of one stage becomes the input for the next stage. Thus, this diagram not only visualizes the development process, but also helps in ensuring that each stage has been carried out in a systematic and structured manner.

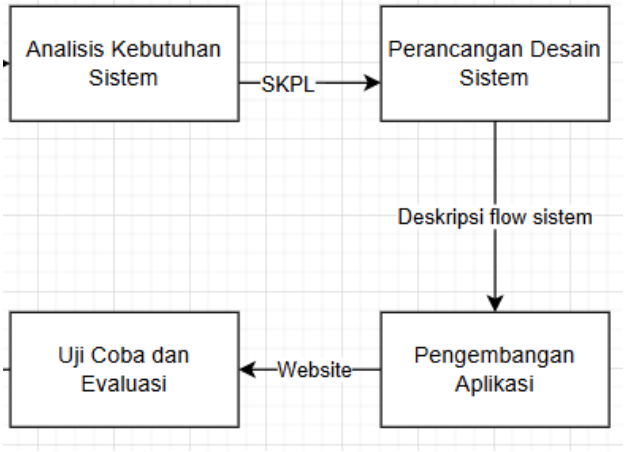

Figure 2. A diagram information flow.

The information flow diagram of the BonBake system illustrates the main stages in the system development process, starting from the needs analysis to the final evaluation stage. The process begins with system requirements analysis, which is the collection of information about the features needed by users, both from the customer and admin sides. The results of this stage are then poured into the Software Requirements Specification (SKPL) document. Furthermore, information from the SKPL is used in designing the system design, which includes creating a database structure, designing user interfaces, and system process flows. After the system design is complete, the next stage is application development, which is the process of implementing the design into a real program using HTML, CSS, PHP, and MySQL technologies. The results of this development then enter the trial and evaluation stage, where the system is thoroughly tested to ensure all features run well and as needed. If bugs are found, improvements are made before the system is declared ready for use. This flow shows that each stage is interconnected and becomes the basis for the next stage in building a functional cake ordering website.

3- Results and Discussion

In this research process, a web-based information system has been designed for BonBake stores to overcome manual management constraints. This system aims to simplify the cake ordering process, speed up the management of order data, and improve the work efficiency of the admin in managing products. The design of the system is carried out in stages and structured, taking into account the flow of user interaction with the system and how data is processed in it.

3-1 Diagram UML

This chapter will present several main diagrams in system modeling, namely Use Case Diagram, Activity Diagram, Sequence Diagram, and Class Diagram. Each diagram has a function to explain different aspects of the system being built. Use Case Diagram describes the interaction between actors (users) and the system, as well as the main functions available. Activity Diagram describes the logical flow of activities of a process in the system. Sequence Diagram shows the sequence of interactions between objects or system components in carrying out a process. Meanwhile, Class Diagram is used to model the data structure and relationships between classes in the system. The following is an explanation of the website diagram:

3-1-1 Use Case Diagram

Use Case Diagram is one type of diagram in the Unified Modeling Language (UML) that is used to model the interaction between users (actors) and the system based on the functions or services provided by the system. This diagram visually depicts who uses the system (actors) and what they can do (use cases). The main purpose of use case diagrams is to provide a comprehensive overview of the system's functional requirements in a simple and easy-to-understand manner, both by developers, clients, and other stakeholders. With use case diagrams, the system design process becomes more structured because every major function required by users can be identified from the start.

In the BonBake Bakery Website project, use case diagrams are used to show the interaction between customer and admin actors with the system, such as placing orders, logging in, viewing menus, and managing products and orders. This diagram is an important reference in the overall system design and development process.

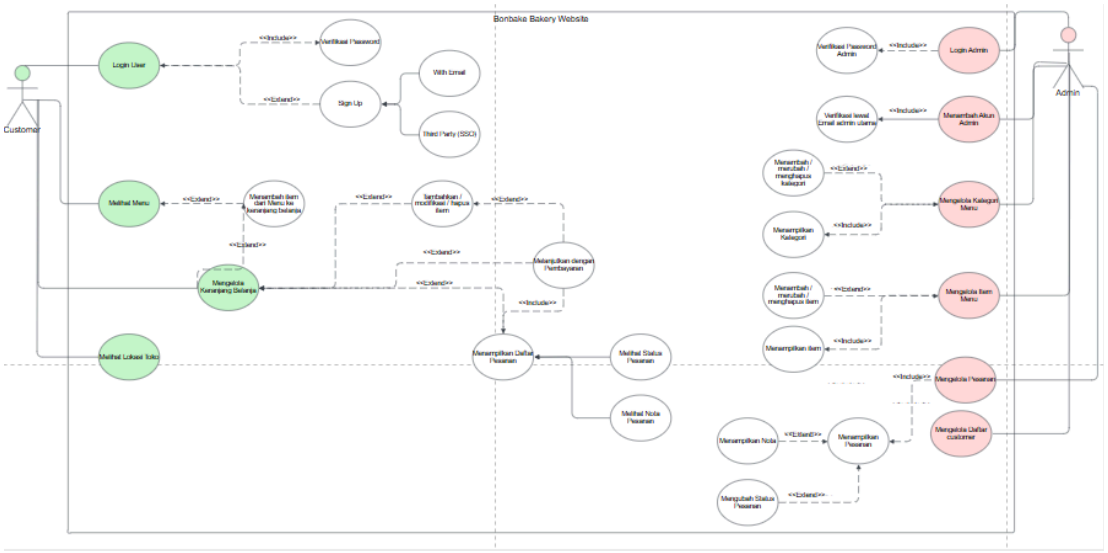

Figure 3. An Use Case Diagram.

Use Case Diagram on BonBake Bakery Website system describes the interaction between the two main actors, namely Customer and Admin, with the main functions available in the system. This diagram maps the functional requirements of the system visually. Customers can login or register, view the cake menu, select and put products in the cart, continue the ordering process, and view the order status and receipt.

Meanwhile, Admins have access rights to login, add new admin accounts, manage categories and product data, manage order status, print receipts, and view customer lists. With this diagram, the flow of user interaction with the system can be clearly understood and become a reference in feature development.

3-1-2 Activity Diagram

Activity Diagram is a UML diagram that describes the flow of processes or activities in the system, including the sequence of actions, decisions, and start to end conditions. This diagram helps understand how a process runs logically and systematically.

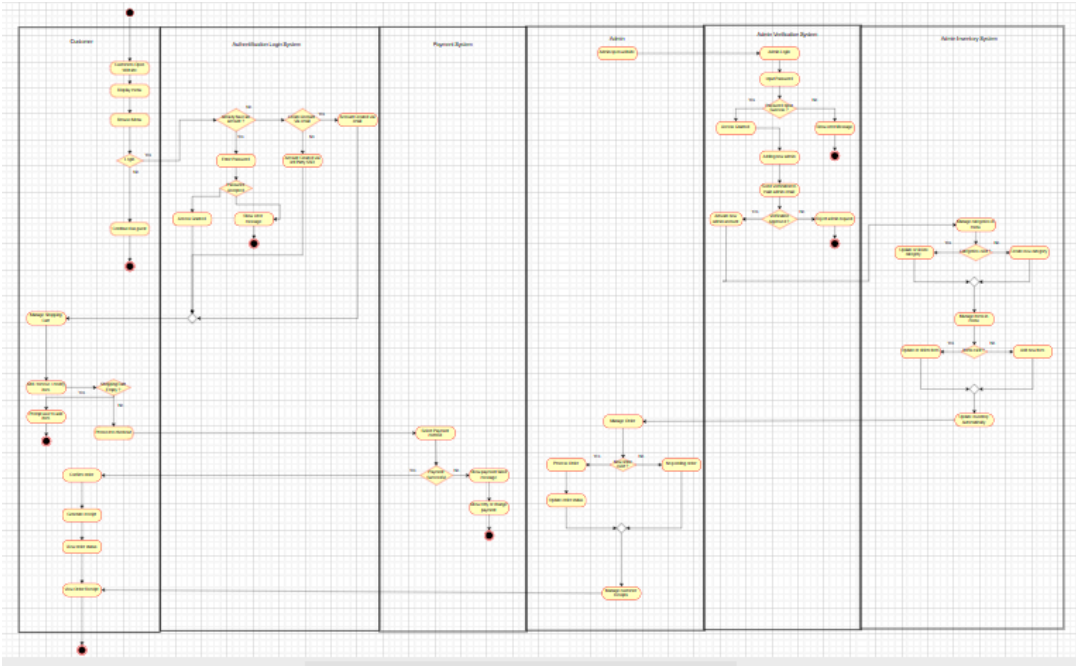

Figure 4. An Activity Diagram Activation.

This diagram is divided into several main parts. For customers, the activity starts from the login or account registration process, which includes validating user data and checking login credentials. After successfully logging into the system, the customer can view the products, select the desired items, and add them to the shopping cart. Next, users can proceed to the ordering process, where they fill in the order data and select a payment method. Once the order is confirmed, the system will process and display the order status to the user. Meanwhile, on the admin side, the activity starts from logging in to the dashboard. After successfully logging in, the admin can perform key functions such as managing products (adding, editing, or deleting cake data), managing product categories, and processing incoming orders. The admin is also responsible for verifying payment status, printing receipts, and updating delivery or order completion status.

This diagram uses standard UML symbols such as initial node, activity, decision, and final node to visualize the entire process flow that occurs in the system. With this activity diagram, system development becomes more focused because each process has been documented clearly and systematically. In addition, this diagram also makes it easier for the development team to understand the logic of the system's work from the user's point of view and the user's perspective.

3-1-3 Sequence Diagram

Sequence Diagram is a type of UML (Unified Modeling Language) diagram that is used to describe the sequence of interactions between objects in a system based on time. This diagram shows how objects communicate with each other through messages in chronological order to execute a process or feature. The main purpose of sequence diagrams is to explain the flow of the process dynamically, starting from the actor (e.g. user) initiating an action, until the system responds and produces output. This diagram consists of a lifeline (timeline of each object), communication arrows, and system activities in a top-down sequence.

Sequence Diagram on BonBake Bakery Website system describes the sequence of interactions between actors (users) and system objects in completing a process, based on time flow. This diagram is divided into two main parts, namely from the customer and admin side. On the customer side, the sequence diagram shows the process flow starting from the user logging in or registering, viewing and selecting products, adding to the cart, then proceeding to the checkout process. After that, the system will process the order and direct the customer to the payment system. After the payment is confirmed by the payment system, the website will update the order status, send a notification to the customer, and present the receipt and delivery status information automatically.

Meanwhile, in the admin section, the diagram shows the process starting from logging into the system and authenticating. After successfully logging in, the admin can view the order list, update the order status, and manage product stock. The system then automatically updates the stock data in the Inventory System according to the orders that have been processed and provides confirmation that the data has been successfully updated. Through this sequence diagram, developers can understand how the system responds to each user action chronologically and

dynamically. This diagram becomes an important guideline in building system logic that suits user needs, both from the frontend (customer) and backend (admin) sides.

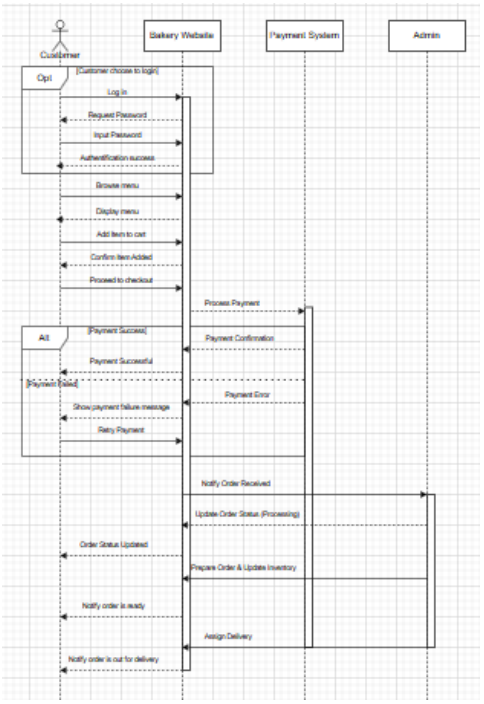

Figure 5. A Sequence Diagram Customer.

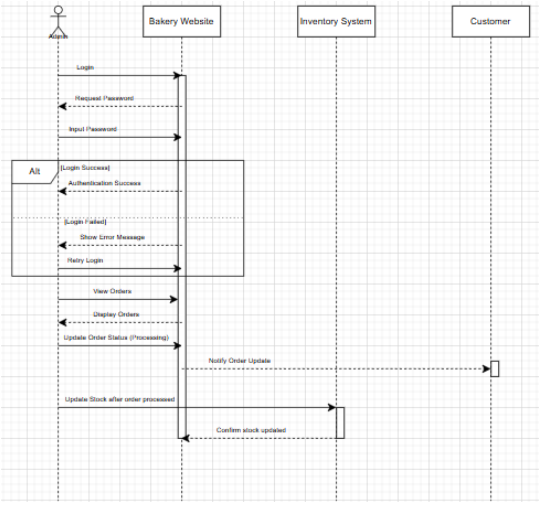

Figure 6. A Sequence Diagram Admin.

3–1-4 Class Diagram

Class Diagram is a UML diagram that statically describes the structure of the system, including the classes used, attributes, methods, and relationships between classes. This diagram helps in designing the framework of the system before the coding process.

The Class Diagram on the BonBake Bakery Website system is used to statically model the system data structure, including attributes, methods, and relationships between classes. This diagram shows that the User class is a superclass that is derived to two subclasses, namely Customer and Admin. Customer has attributes such as phone and address, while Admin has specialized functions such as managing order data and updating status. The Product class is related to the Category class that categorizes product types. Customers can add products to the Shopping Cart, which contains a

collection of Items. After the checkout process, the system will create an Order object that records the transaction details, including time, total price, and status. Each order can generate a Receipt and be processed through the Payment class to record payment information. All classes are interconnected through association and composition, forming an interrelated system structure.

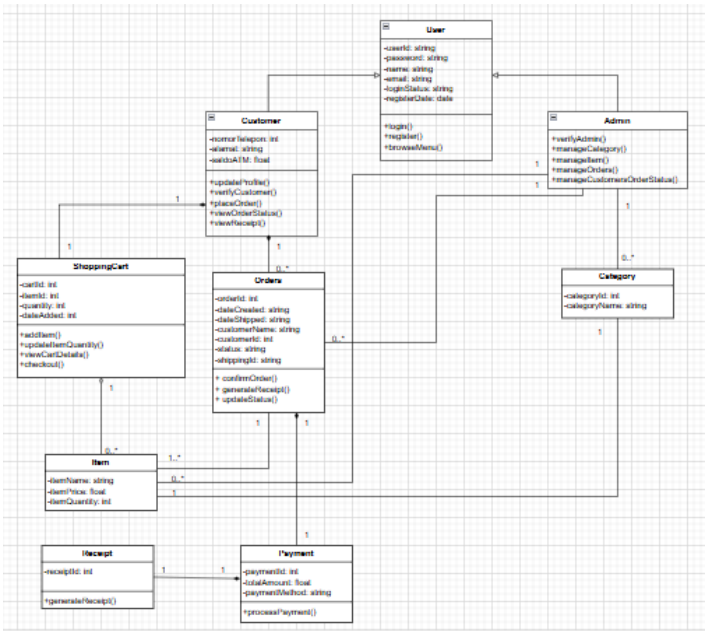

Figure 7. A Class Diagram.

3–2 Database

In the development of the BonBake Cake Ordering Website, the database serves as the core component for managing and storing various types of information related to the business process. This includes customer data, product details (cakes and pastries), order transactions, payment status, and administrator activities.

The database was designed during the System Design phase of the Waterfall model. The chosen database management system (DBMS) for this project is MySQL, due to its compatibility with PHP, ease of use, and support for relational data modeling.

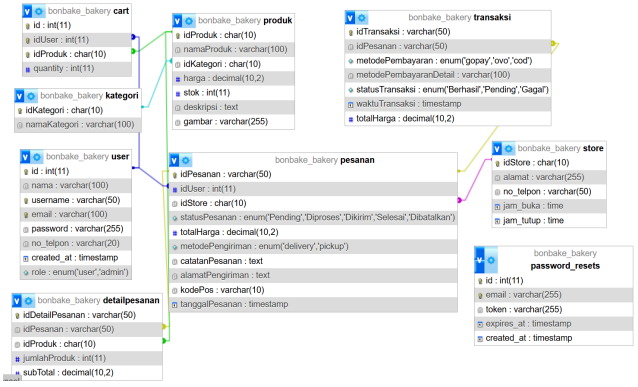

Figure 8. Database

The BonBake Cake Ordering Website utilizes a structured relational database consisting of several interconnected tables to support its operational processes. Key tables include user for storing customer and admin account data, produk for managing product information such as cakes and pastries, and kategori to classify these products. The cart and detailpesanan tables track selected items and individual order details, while the pesanan and transaksi tables handle overall order management and payment records. Additional tables like store and password_resets enhance backend functionality and security. This database design ensures organized data handling, supports user interaction, and facilitates efficient order processing across the website.

3-3 System Display

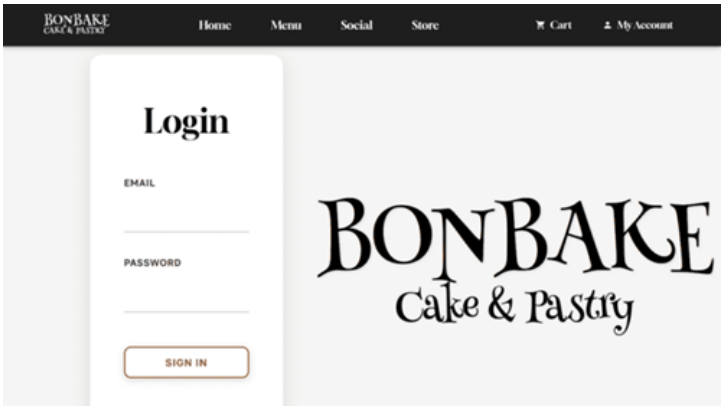

Figure. 9 Login Page

Figure 5 shows the login page featuring the prominent "BonBake Cake & Pastry" logo and a login form that includes fields for email and password, along with a "Sign In" button. The top navigation menu contains options such as "Home," "Menu," "Social," "Store," "Cart," and "My Account."

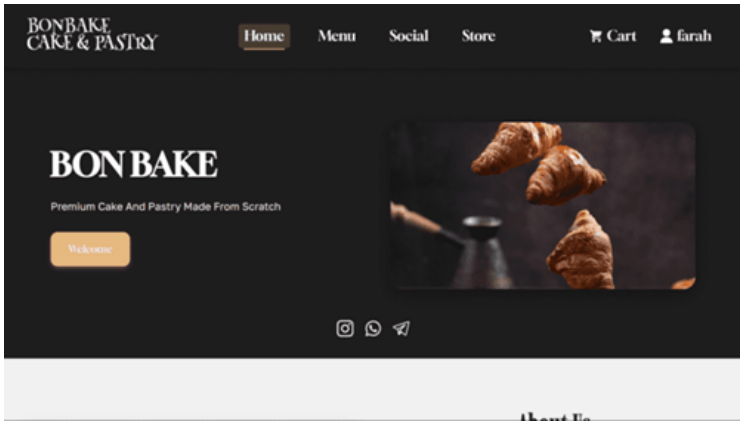

Figure 10 Home Page

Next, the main page of "BonBake Cake & Pastry" displays a design with a prominent logo and a navigation bar that includes "Home," "Menu," "Social," "Store," and "Cart."

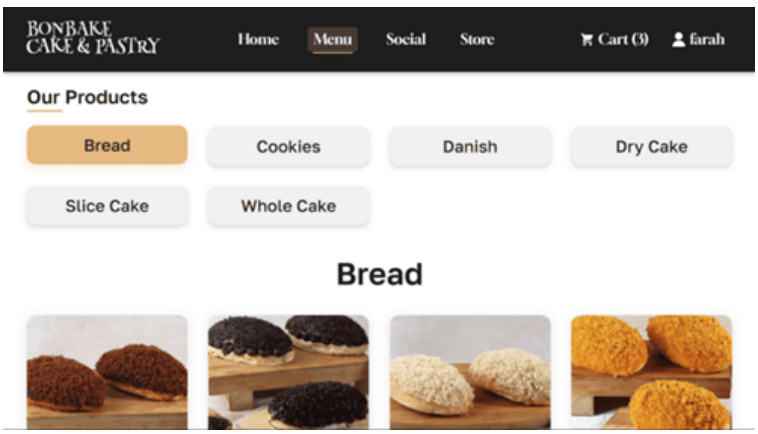

Figure 11. Menu Page

The "Menu" or "Our Products" page of "BonBake Cake & Pastry" showcases categories such as Bread, Cookies, Danish, Dry Cake, Slice Cake, and Whole Cake.

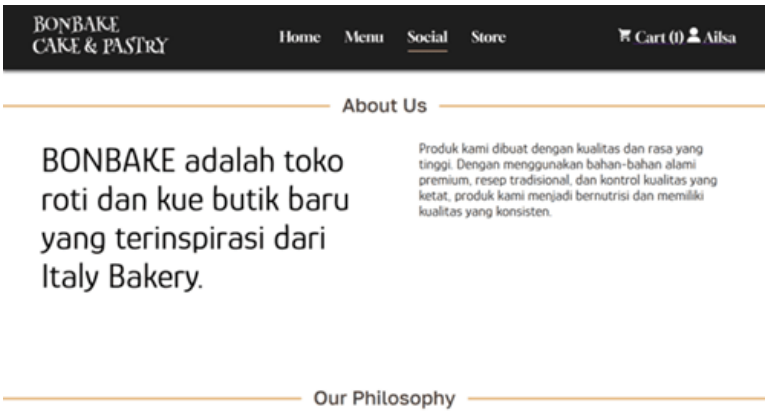

Figure 12. Social Page

Figure 8 presents the social page, which contains information or fun facts about BonBake Bakery.

Figure 13. Store Page

The "Stores" page displays information about store locations spread across Indonesia. There is a city selection dropdown to view illustrations of BonBake Bakery in different cities.

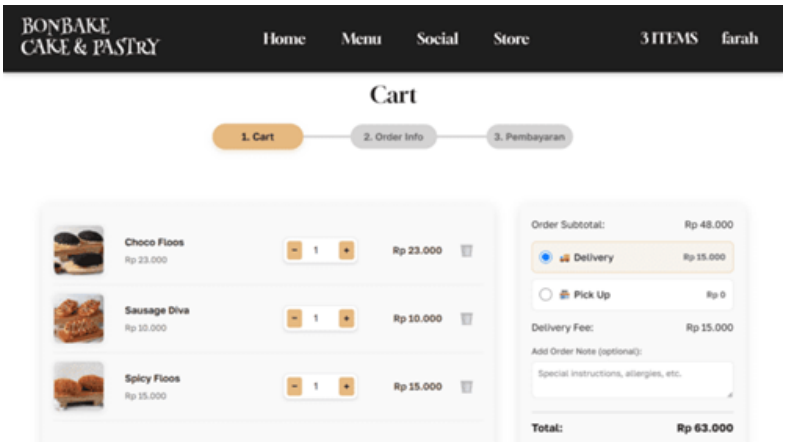

Figure 14. Cart Page

Next is the cart page, which functions as a temporary storage for items selected by users before making a payment. Users can add products to the cart, adjust quantities, and proceed to checkout by selecting delivery or pickup options, then complete the transaction.

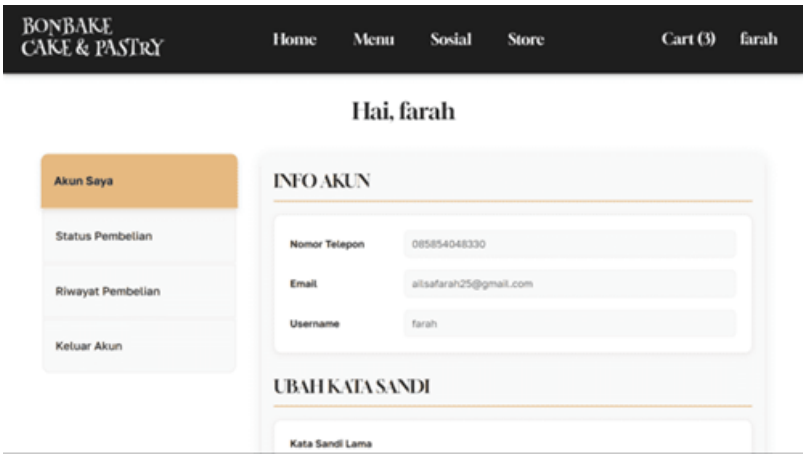

Figure 15. Profile Page

The next page displays the user profile with options such as "My Account," "Purchase Status," "Purchase History," and "Log Out." The "Account Info" section includes phone number, email, and username, while the "Change Password" section offers the option to update the password.

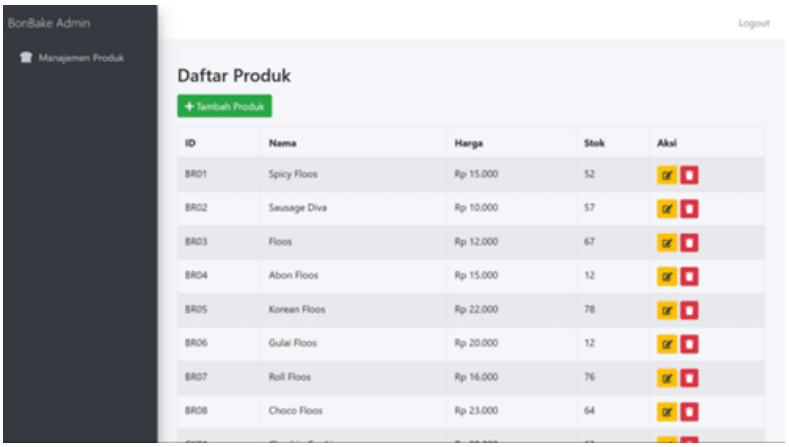

Figure 16. Admin Page

The final page of the BonBake website is the admin page, which includes CRUD functionalities—allowing the admin to create, view, edit, and delete products.

2- Declarations

2-1- Author Contributions

Conceptualization, Nasywah Aulia and Dhio Rizqi; methodology, Ailsa Farah; software, M. Zainal; validation, Dhio Rizqi and Ailsa Farah; formal analysis, Nasywah Aulia and M. Zainal; investigation, Nasywah Aulia; resources, Ailsa Farah; data curation, Dhio Rizqi; writing—original draft preparation, Dhio Rizqi; writing—review and editing, Ailsa Farah; visualization, Dhio Rizqi; supervision, Nasywah Aulia; project administration, M. Zainal; funding acquisition, *not applicable*. All authors have read and agreed to the published version of the manuscript.

2-2- Data Availability Statement

Data sharing not applicable: No new data were created or analyzed in this study. Data sharing is not applicable to this article.

2-3- Funding

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2-4- Acknowledgements

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2-5- Institutional Review Board Statement

Not applicable. This study did not involve any experiments on human participants or animals, and therefore did not require ethical approval.

2-6- Informed Consent Statement

Not applicable. The study did not involve human participants and thus no informed consent was required.

2-7- Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript. In addition, all ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

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