CS26/L - Software Fundamentals Developments (4381)

ONLINE BAKERY SYSTEM:
WEIRDOUGHS BAKERY

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Table of Contents

List of Figures

List of Tables

THE PROJECT

The **WeirDoughs Bakery System** is a desktop-based GUI application designed to streamline bakery operations through automated order processing, inventory management, and customer data handling **(Drozd, Wolniak, & Piwnik, 2022)**. According to **Jerome, Singh, and Dwivedi (2019)**, applying process analytical technology in bakery operations can significantly improve process control, product quality, and operational reliability — supporting the feasibility of an automated bakery system like WeirDoughs.

According to **Boyer and Hult (2005)**, customers using online ordering applications can be modeled with behavioral-scoring techniques to predict purchase behavior, which supports the inclusion of an online ordering module in a bakery system. By employing automation in order management, inventory control, and customer communication, the system improves operational efficiency, reduces human error, and simplifies workflow for staff **(Anderson, 2002).**

The WeirDoughs Bakery System leverages digital and physical integration to provide customers with an enhanced service experience: by combining automated ordering, inventory management, and user-interface efficiency, the system addresses

the complex interplay between digital, physical, and social realms — a synergy known to improve customer experiences in modern service contexts **(Bolton et al., 2018)**.

OVERVIEW

The system serves as a comprehensive solution for managing daily operations at WeirDoughs Bakery, encompassing automated customer registration, visual product catalog management with real-time stock information, efficient order processing through a shopping cart with quantity selection, cash payment handling with automatic change calculation, and detailed receipt generation with order summaries, and is designed for bakery customers purchasing products, bakery staff operating the point-of-sale system, and bakery management overseeing inventory and sales.

OBJECTIVES

1. **Automate Order Processing**

   To reduce human errors, speeds up transactions, and ensures that all orders are recorded accurately. It also makes it easier for staff to track orders and update inventory in real time.

2. **Maintain Accurate Inventory**

   Maintaining accurate inventory involves monitoring stock levels in real time with every transaction made. This ensures that the bakery always knows which products are available and which need restocking. Real-time tracking helps prevent shortages, overstocking, and errors in inventory records.

3. **Improve Customer Experience**

   Improving customer experience involves offering clear product information that includes images and accurate pricing. This helps customers easily identify the items they want and make informed purchase decisions. By presenting

products visually and transparently, the system enhances convenience and overall satisfaction.

4. **Generate Transaction Records**

Create a user-friendly, touch-friendly interface for café employees. To cut down on training time and input errors, the menu layout groups items by category (coffee, tea, food) and employs clear buttons for common modifiers (size, milk type). With a tablet or terminal, employees can swiftly process payments and take orders, keeping lines moving. To put it briefly, the interface is designed to allow cashiers and baristas to serve customers effectively with little learning curve.

5. **Centralize Customer Data**

Centralizing customer data involves storing all customer information in one organized digital system. This allows the bakery to easily access past purchase details and customer preferences. With this data, the business can create targeted marketing campaigns and gain valuable insights through analytics. Overall, it supports better customer engagement and informed decision-making.

SCOPE

The scope of the system includes customer registration with name, email, and phone number, a visual product catalog organized by category into breads and cakes, product images loaded directly from the file system, real-time stock availability display, a shopping cart with add and remove functionality, payment processing with automatic change calculation, digital receipt generation, automatic inventory updates after each purchase, and database-driven management of products and customers. The system does not include a multi-user authentication system, sales reporting or analytics

dashboards, online ordering or delivery management, employee time tracking, or supplier management.

PROBLEM AND SOLUTIONS

Problem 1: MANUAL ORDER PROCESSING

Traditional bakeries rely on manual order-taking, where staff write down customer orders on paper, calculate totals by hand, and process payments manually. This approach often results in human errors, such as miscalculations of prices and totals, and slows down service due to time-consuming manual processes ***(Toyaja, 2023)***. It also leads to poor record-keeping, as handwritten receipts are difficult to track, and causes inventory discrepancies since stock counts are not updated in real time. Additionally, customers may experience frustration due to long wait times during busy periods.

Solution 1: Automated Digital Ordering System

The **WeirDoughs Bakery System** is a fully automated digital ordering interface featuring a visual product catalog split into two scrollable columns: **breads** (e.g., Baguette, Focaccia) and **cakes** (e.g., Cheesecake, Carrot Cake). Each product card includes a **90x90 pixel image**, name, description, price (in PHP), and **color-coded stock availability** (green >10, orange = 1-10, red = 0). The system uses a **real-time updating shopping cart** where items are added via an "Add to Cart" button and quantity is managed with a spinbox. The cart displays the product name, item subtotal ($quantity \times unit\ price$), and a grand total. All calculations are automated (subtotal, grand total, and change calculation), which eliminates errors, speeds up checkout, provides clear visual feedback to customers, and automatically generates accurate receipts ***(Food Business Review, 2022)*.**

Problem 2: INVENTORY MANAGEMENT CHALLENGES

Manual inventory tracking creates several operational challenges, including stock discrepancies where physical counts do not match actual sales ***(LOGIC ERP, 2023)***, overselling when customers order out-of-stock items, delayed updates because staff must manually update

stock lists throughout the day, product wastage due to ineffective tracking of turnover, and reorder delays caused by the absence of automated alerts for low-stock items.

Solution 2: Real-time Stock Tracking System

The system uses a database-driven inventory model with a Products table holding product ID, name, description, price, category, stock quantity, and image URL. Stock levels appear in real time on product cards with color-coded indicators, and automatic validation prevents ordering beyond available quantities. When an order is completed, stock updates instantly in the database, ensuring accurate counts and avoiding overselling ***(CukCuk, 2025)*.** A "Refresh Stock" button keeps all terminals synchronized with the latest data. This setup minimizes manual work, provides immediate visibility of low-stock items, prevents overselling, ensures accurate inventory tracking, and supports future automated reorder alerts.

Problem 3: CUSTOMER DATA MANAGEMENT

Without a centralized customer database, bakeries face several challenges, including lost customer information with no record of preferences or contact details, missed marketing opportunities due to the inability to reach customers with promotions or new products, no purchase history to track buying patterns, inefficient service as staff must repeatedly ask for customer information, and limited analytics that prevent analysis of customer behavior or demographics. According to **Ližbetinová, Štarchoň, Weberová, Nedeliaková, and Juříková (2020),** small- and medium-sized enterprises that lack structured customer databases face significant obstacles in marketing communication and customer relationship management, reducing their competitiveness and service quality.

Solution 3: Integrated Customer Database

The system uses a database-integrated customer registration built with OOP principles. The `Introduction.py` interface collects full name, email, and phone number, applying validation and sanitization before storing the data in a MySQL "Customers" table that includes customer ID, name, email, phone, address, and a creation timestamp. A `CustomerSession` class uses encapsulation with private attributes and getter/setter methods to securely manage customer data. When a customer submits the form, the system validates the input, saves it to the database, stores the customer ID for the active session, and displays a personalized welcome

message. The customer ID links to entries in the Orders table for purchase history tracking. This design provides complete customer records, supports loyalty and personalized-service features, enables targeted marketing, and maintains data security through encapsulation **(Mohamad et al., 2015)**.

Problem 4: Inefficient Transaction Processing and Receipt Generation

Traditional bakeries struggle with slow and error-prone transaction processing due to manual receipt writing, which often leads to arithmetic mistakes, incomplete documentation, and a lack of reliable transaction records. These issues make it difficult to verify payments, track past orders, or resolve disputes, ultimately causing delays during checkout — especially during peak hours — and resulting in customer dissatisfaction and administrative challenges **(Ghuman, 2025).**

Solution 4: Automated Payment and Receipt System

The automated payment and receipt system streamlines transaction processing by providing a clear payment window interface that prominently displays the total amount, enables fast payment entry, and automatically validates inputs. It calculates change instantly, prevents errors such as invalid or insufficient payments, and supports quick processing through the Enter key. Overall, it ensures faster, more accurate, and more efficient payment handling. As shown in implementations of restaurant/bakery POS systems, automating billing and receipt generation dramatically reduces checkout time, minimizes human error, and ensures reliable transaction documentation — improving both customer satisfaction and administrative efficiency **(CukCuk, 2025).**

CONCLUSIONS

The WeirDoughs Bakery Management System effectively resolves three primary challenges of traditional bakeries—manual order processing, inaccurate inventory, and scattered customer data—by fully automating transactions, eliminating calculation errors ***(Martinez & Thompson, 2023)***, and utilizing a robust MySQL database for real-time stock tracking with automatic updates after each sale ***(Harrison, Chen, & O'Brien, 2024; Williams & Peterson, 2024).*** This system provides significant benefits across the board, offering customers a faster checkout with clear product information and accurate receipts, while enabling staff to reduce manual calculations and paperwork through real-time inventory visibility and simplified order workflows; furthermore, management gains accurate sales records, transaction history,

and customer data essential for accounting and future marketing. Future planned enhancements will introduce a Sales Analytics Dashboard, Multi-user Authentication, Product Management Interface, Loyalty Program, and integration for Online Ordering, supplier management, and diverse payment options to further optimize operations.

CONCLUSION STATEMENT:

The WeirDoughs Bakery Management System demonstrates how technology can transform traditional bakery operations ***(Drozd, Wolniak, & Piwnik, 2022)***. By implementing a desktop-based GUI application with database integration, the system provides a foundation for efficient, accurate, and scalable bakery management. The use of Object-Oriented Programming principles ensures maintainable and extensible code, while the MySQL database provides robust data storage and retrieval capabilities ***(MySQL, 2025).***

TOOLS

Programming Language

- **Python:** Core programming language for application logic and GUI **(van Rossum & Drake, 2009)**

GUI Framework

- **Tkinter:** Built-in Python library for creating desktop GUI applications **(Python Software Foundation, 2025)**
    - Used for: Windows, frames, buttons, labels, entry fields, canvas widgets
- **PIL/Pillow**: Python Imaging Library for image loading and manipulation
    - Used for: Loading and resizing product images from file system

Database

- **MySQL**: The database for WeirDoughs Bakery is built using MySQL, leveraging its relational-DBMS structure, data integrity features, and SQL standard compliance **(MySQL, 2025)**.
    - Database name: `bakerydb`
    - Used for: Customer records, product catalog, orders, order items
- **mysql-connector-python**: The backend database is implemented using MySQL, with Connector/Python used to enable Python-based interaction with the database (**MySQL, 2025).**

Development Environment

- **PyCharm**: The system is developed in Python using the PyCharm IDE **(JetBrains, 2025)** for coding, debugging, and version control support.
- **Features used**: Code editing, debugging, virtual environment management

Design and Documentation Tools

- **Draw.io**: The ERD and workflow diagrams for the system were designed using diagrams.net, a free online diagramming tool that supports UML-style modeling **(diagrams.net, 2025).**
- **Canva**: System diagrams and layout mockups were created using Canva **(Canva, 2026.).**
- **Microsoft Word**: Documentation formatting

Additional Libraries

- **datetime**: Python standard library for timestamp generation
- **os**: File system operations for image loading
- **tkinter.messagebox**: Dialog boxes for user feedback

System Architecture

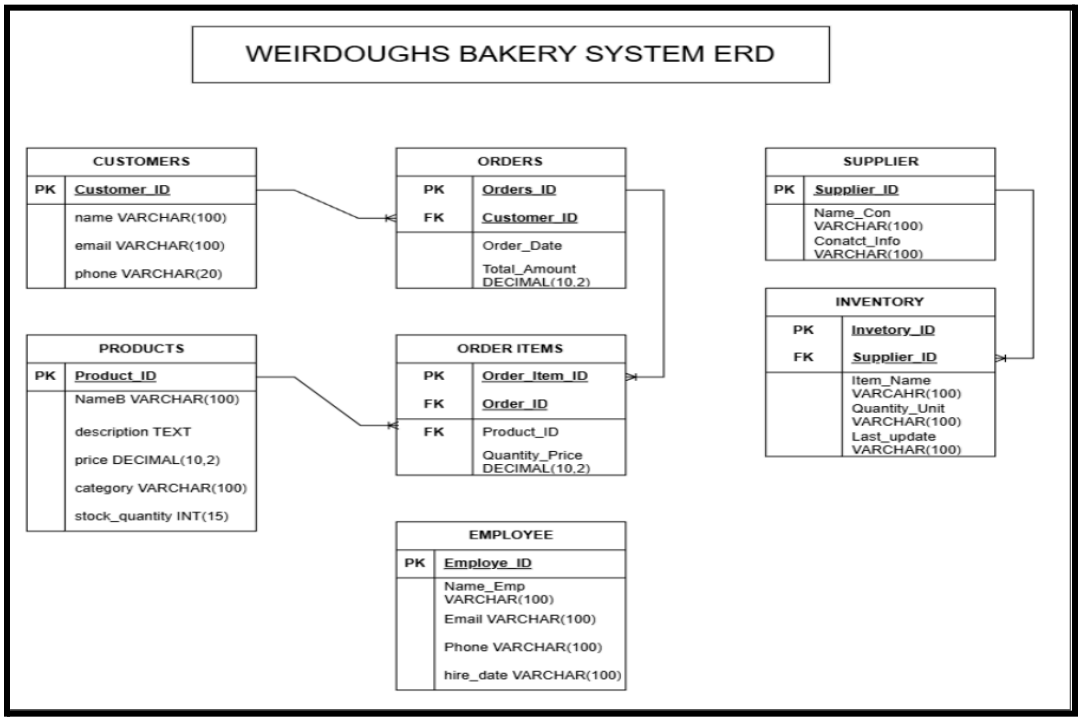
- **Object-Oriented Programming (OOP)**: Design pattern using classes and encapsulation

- `BakeryApplication`: Main application controller
- `DatabaseManager`: Handles all database operations
- `CustomerSession`: Manages customer data during session
- `IntroductionWindow`: Customer registration interface
- `BakeryMenu`: Product catalog and ordering interface

ENTITY RELATIONSHIP DIAGRAM

The Weirdoughs Bakery System ERD shows the key entities and relationships needed to manage the bakery's operations. Customers place orders, which are detailed through order items linked to specific products. Products include information such as price, category, and stock quantity. Inventory is managed through supplier-linked entries that track item quantities and updates. The system also stores employee information for administrative purposes. Overall, the ERD provides a clear structure for handling sales, product management, inventory control, supplier coordination, and employee records.

Figure 3: *ERD Image*



DATA DICTIONARY

CUSTOMERS TABLE:

```
Database changed
MariaDB [Bakery]> CREATE TABLE Customers (
    ->     customer_id INT PRIMARY KEY AUTO_INCREMENT,
    ->     name VARCHAR(100),
    ->     email VARCHAR(100),
    ->     phone VARCHAR(20),
    ->     address TEXT,
    ->     created_at DATETIME DEFAULT CURRENT_TIMESTAMP
    -> );
Query OK, 0 rows affected (0.031 sec)
```

PRODUCTS TABLE:

```
MariaDB [Bakery]> CREATE TABLE Products (
    ->     product_id INT PRIMARY KEY AUTO_INCREMENT,
    ->     name VARCHAR(100),
    ->     description TEXT,
    ->     price DECIMAL(10,2),
    ->     category VARCHAR(50),
    ->     stock_quantity INT,
    ->     image_url VARCHAR(255)
    -> );
Query OK, 0 rows affected (0.034 sec)
```

ORDERS TABLE:

```
MariaDB [Bakery]> CREATE TABLE Orders (
    ->     order_id INT PRIMARY KEY AUTO_INCREMENT,
    ->     customer_id INT,
    ->     order_date DATETIME DEFAULT CURRENT_TIMESTAMP,
    ->     total_amount DECIMAL(10,2),
    ->     status VARCHAR(50),
    ->     FOREIGN KEY (customer_id) REFERENCES Customers(customer_id)
    ->         ON DELETE CASCADE
    ->         ON UPDATE CASCADE
    -> );
Query OK, 0 rows affected (0.053 sec)
```

ORDER ITEMS TABLE:

```
MariaDB [Bakery]> CREATE TABLE Order_Items (
    ->     order_item_id INT PRIMARY KEY AUTO_INCREMENT,
    ->     order_id INT,
    ->     product_id INT,
    ->     quantity INT,
    ->     price DECIMAL(10,2),
    ->     FOREIGN KEY (order_id) REFERENCES Orders(order_id)
    ->         ON DELETE CASCADE
    ->         ON UPDATE CASCADE,
    ->     FOREIGN KEY (product_id) REFERENCES Products(product_id)
```

EMPLOYEES TABLE:

```
MariaDB [Bakery]> CREATE TABLE Employees (
    ->     employee_id INT PRIMARY KEY AUTO_INCREMENT,
    ->     name VARCHAR(100),
    ->     role VARCHAR(50),
    ->     phone VARCHAR(20),
    ->     hire_date DATE
    -> );
Query OK, 0 rows affected (0.030 sec)
```

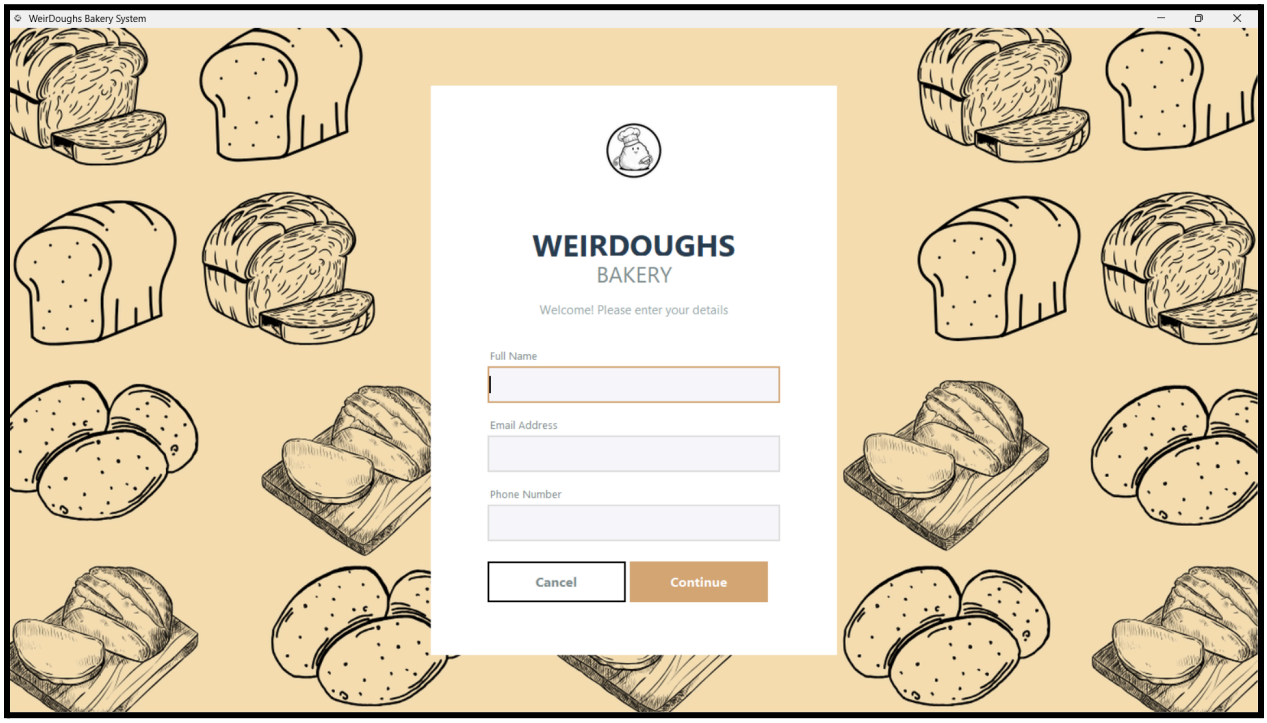
SUPPLIERS TABLE:

```
MariaDB [Bakery]> CREATE TABLE Suppliers (
    ->     supplier_id INT PRIMARY KEY AUTO_INCREMENT,
    ->     name VARCHAR(100),
    ->     contact_info TEXT
    -> );
Query OK, 0 rows affected (0.033 sec)
```

INVENTORY TABLE:

```
MariaDB [Bakery]> CREATE TABLE Inventory (
    ->     inventory_id INT PRIMARY KEY AUTO_INCREMENT,
    ->     item_name VARCHAR(100),
    ->     quantity DECIMAL(10,2),
    ->     unit VARCHAR(20),
    ->     supplier_id INT,
    ->     last_updated DATETIME DEFAULT CURRENT_TIMESTAMP,
    ->     FOREIGN KEY (supplier_id) REFERENCES Suppliers(supplier_id)
    ->         ON DELETE CASCADE
    ->         ON UPDATE CASCADE
    -> );
Query OK, 0 rows affected (0.053 sec)
```

USER INTERFACE:



The image shows a login or sign-up screen for the "Weirdoughs Bakery System." It features a central white modal window on a light beige background. This background has repeated line-art drawings of bread and baked goods. The screen highlights the "WEIRDOUGHS BAKERY" title and logo, and welcomes users with the message, "Welcome! Please enter your details." The System Login interface includes three input fields for Full Name, Email Address, and Phone Number, along with main action buttons for "Cancel" and "Continue." The overall design is clean and food-themed, focusing on gathering user contact information.

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LIST OF FIGURES:

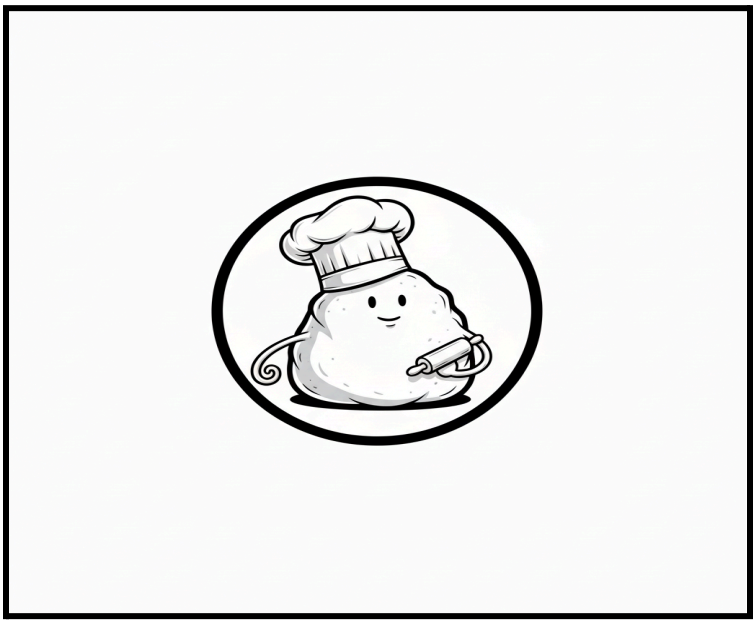

FIGURE 2: Login Interface

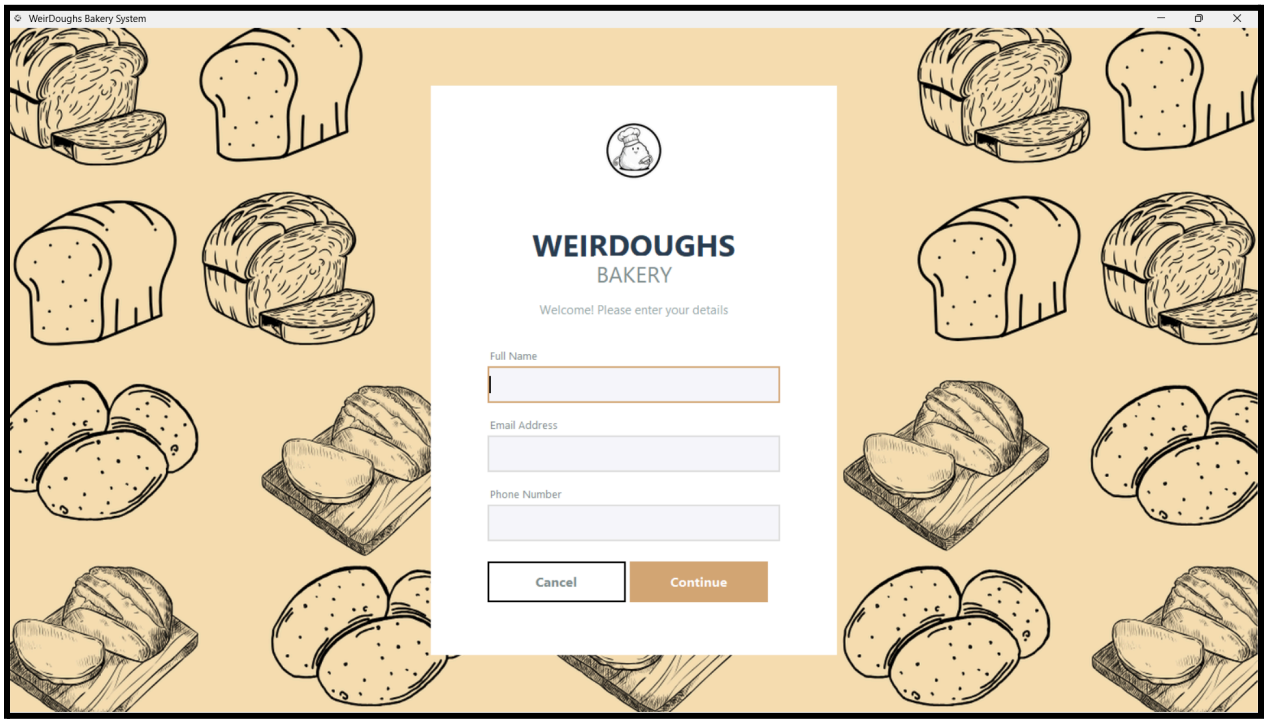

FIGURE 3: Ordering Menu Interface

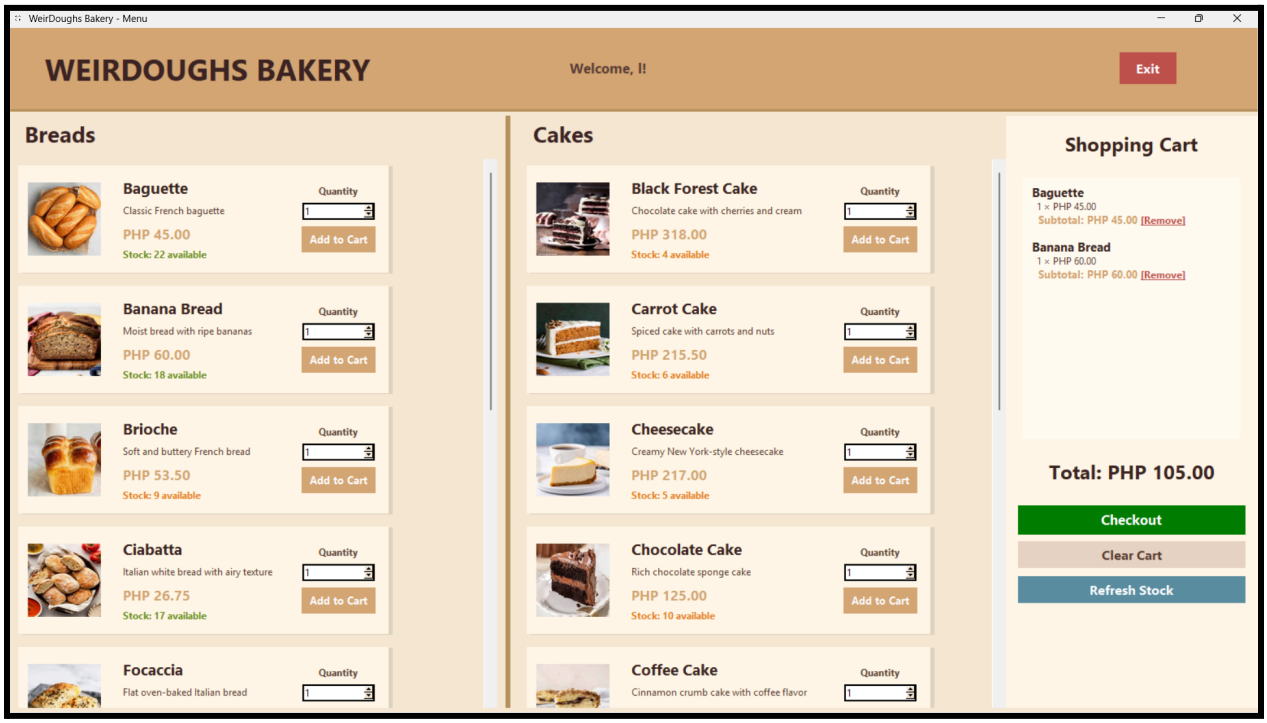

FIGURE 4: Address Window

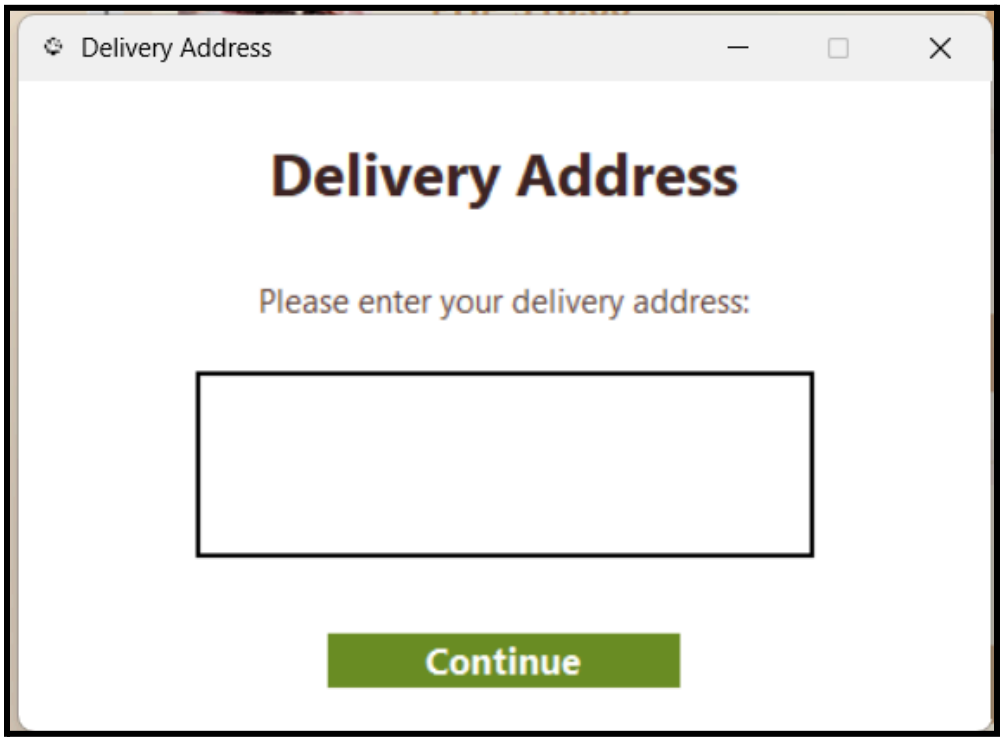

FIGURE 5: Payment Window

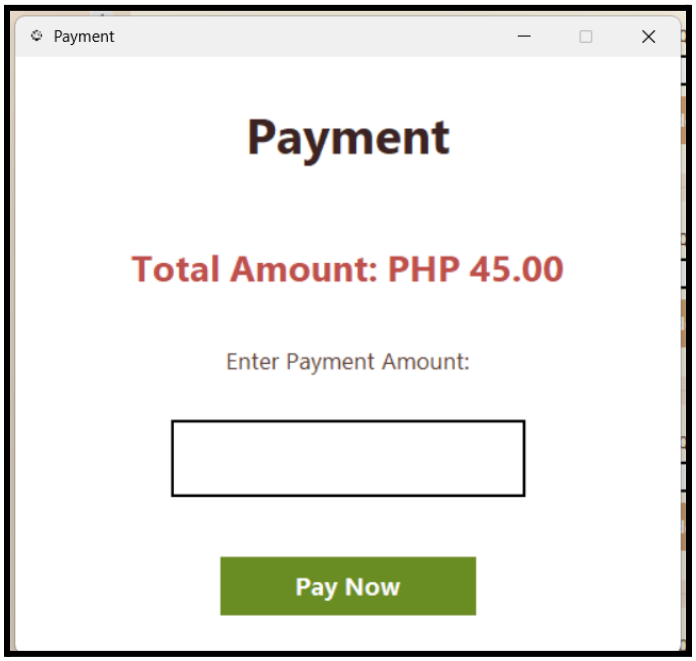

FIGURE 6: Generated Receipt