



**MACAU UNIVERSITY OF SCIENCE AND
TECHNOLOGY**

School of Computer Science and Engineering

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<<Software Project for Course Software Engineering>>

Homework ID : Task1-Project Proposal

Report Title : Online Reservation Platform for Restaurants

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Abstract

In the context of rapid digital transformation and the increasing demand for online services, this proposal outlines the development of a comprehensive online restaurant reservation system. This system is designed to cater to the evolving needs of both regular and high-end users, providing flexible options such as standard bookings, auction-based reservations for popular restaurants, and online food ordering and delivery services. By conducting competitive market analysis, we identified opportunities to improve existing platforms by enhancing user experience, streamlining reservation processes, and offering personalized recommendations through an advanced membership system.

The proposed system will integrate modern web technologies such as Next.js for frontend development and PostgreSQL for robust data management. It emphasizes seamless user interaction, transparent restaurant information, and a detailed menu system, including pricing and user reviews. Furthermore, the system will provide restaurant administrators with an intuitive backend for managing reservations, auctions, menus, and user feedback. With features such as multi-dimensional search, real-time auction bidding, and personalized dining recommendations, this platform will redefine the online dining reservation experience.

By leveraging cloud deployment through Vercel and maintaining continuous integration with GitHub Actions, the project ensures a scalable, agile development process, supporting both user experience optimization and business needs in today's fast-paced digital landscape. The detailed architecture and database design further ensure the

scalability and maintainability of the system, making it adaptable to future expansions and integrations.

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Chapter 1 Introduction

1.1 Team Name

求败肥牛

1.2 Team Leader

Sun Yiran

1.3 Work Allocation

As a team leader, Sun Yiran worked on overall coordination, core functionality and system design. Firstly, in terms of system architecture design, Sun planned the application layer, domain layer and infrastructure layer and designed the database and divided the functional modules. Second, Sun designed the restaurant information management and other systems through management backend development. Third, Sun was responsible for overall project schedule coordination. By organizing several group discussions and planning the overall project timeline and controlling the schedule, we ultimately ensured that the project moved forward as planned.

Jin Huanxin is mainly responsible for front-end development and UI design. Firstly, Jin utilized the Next.js framework to develop the display functions responsible for restaurant search, reservation and menu. Secondly, Jin utilized Figma for the interface design to ensure that the system interface is beautiful and easy to use. Finally, Jin optimized the system to ensure that it would run smoothly on mobile.

Bai Jiacheng contributes a lot to the back-end development and database management. First Bai utilized Node.js and Express for back-end API development to provide the system with restaurants, menus, reservations, and other services. Secondly, Bai ensures the security, perfection and efficiency of the data of the whole system by designing the PostgreSQL database. Finally, Bai linked the core functions of the whole system by integrating the functionalized modules.

Teamwork is essential to the success of a project. We also did a lot of joint tasks. The three of us will participate in the functional testing of the system to ensure that the system works properly. In addition, the entire project plan will be written by us, with Sun being responsible for the overall documentation of the project, Jin for the front-end presentation, and Bai for the back-end and database technical documentation.

1.4 Project Repository

GitHub URL: <https://github.com/OneRan888/SF-Project-Proposal.git>

Chapter 2 Project Background

2.1 Competitive Analysis

2.1.1 Overview Analysis

Before we make a project proposal, we plan to conduct market research to determine our needs. We searched on Google and found several restaurant reservation websites. Below are screenshots of their websites.

Image source:<https://www.truefoodkitchen.com/locations/>

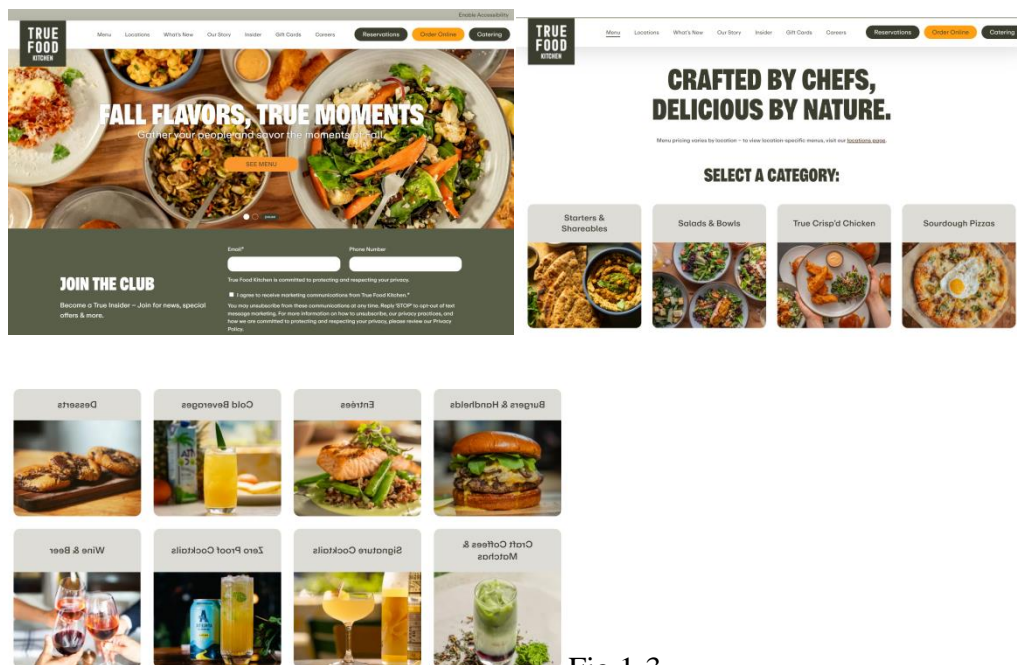


Fig.1-3

Image source:<https://shokuoku.com/>

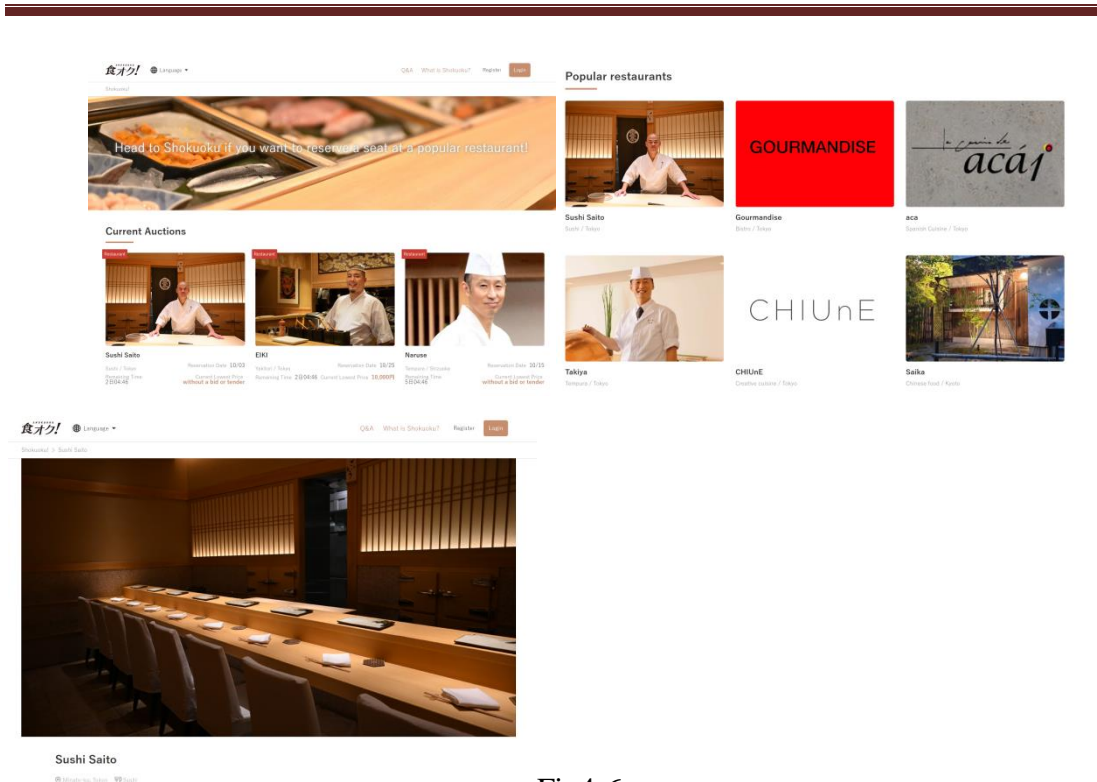


Fig4-6

We analyzed two online ordering platforms, True Food Kitchen and Shokuoku, compared their advantages and disadvantages, and provided improvement suggestions. We first made a simple comparison using a table, and then conducted a detailed analysis of each platform.

Dimension	True Food Kitchen	Shokuoku
Visual Design	Clean and tidy layout, with harmonious color schemes. Eye-catching food pictures that attract customers.	Simple and focused design. High-quality photos of the restaurant interior and chefs.
Information Categorization	Grouped by categories like "Appetizers," "Salads," "Fried Chicken," etc. High-quality images showcase each dish.	Categories based on restaurant type and location. Auction info is clearly displayed (time left, minimum bid).
Functionality	Easy-to-find reservation and online ordering buttons. Clear options for ordering, reservations, and catering.	Highlights current auctions and popular restaurants. Mostly auction-based reservations.

Membership System	Offers a "Join Membership" option for discounts and updates.	No clear membership system, mainly auction-based for registered users.
Navigation	Well-organized, with links to the menu, locations, and news.	Simple navigation with fewer options. Multi-language support available.
Unique Features	Detailed menu with lots of options.	Unique auction system for booking popular restaurants. Shows auction status and time left.
User Review System	Neither platform includes user reviews or rating systems.	Neither platform includes user reviews or rating systems.
Search Functionality	No standout search bar.	No visible search function, but allows search by auction or restaurant type.
Mobile Optimization	No clear mobile optimization info, but the desktop version looks good.	No clear mobile optimization info either, mainly designed for desktop use.
Reservation System	Standard reservation and ordering system.	Unique auction-based reservation system for popular restaurants.
Pricing Info	Prices aren't shown on the homepage; need to click to view.	Displays the minimum auction price, but no detailed menu pricing.

Table1

2.1.2 Problem Diagnosis & Optimization Strategy

The advantage of True Food Kitchen lies in its simple page design, comfortable color matching, and high-quality food images, which can attract customers' attention and provide a good overall experience.

The platform's dish categories are also very clear, such as appetizers, salads, fried chicken, etc., making it convenient for users to find the dishes they want. The buttons for booking and ordering are designed to be very prominent, and users can easily find them.

However, the homepage does not directly display the prices of dishes, and users need to click on them to see the prices, which is a bit troublesome and affects the experience.

In addition, the interactivity of the page is not strong, lacking hover prompts, and the interactivity is somewhat insufficient.

The highlight of Shokuoku is its unique auction booking system, where users can book seats at popular restaurants through bidding, which can attract customers who want to dine at well-known restaurants.

The platform clearly displays auction information such as the lowest bid and remaining time, making it convenient for users to understand the progress and competition situation.

The page design is simple, with clear display of restaurant information and auction functions. The pictures of restaurants and chefs are also of high quality, creating a strong atmosphere.

The homepage also recommends multiple popular restaurants, each with clear pictures and introductions to help users understand the restaurants they have chosen. The restaurant details page provides high-definition internal environment pictures, allowing users to experience the atmosphere of the restaurant in advance and make better booking decisions.

But the disadvantages are also obvious. The auction system of the platform is somewhat complex for new users, lacking detailed guidance information, which may lead to users not fully understanding the process.

The platform does not have a user review and rating system, so users cannot refer to other people's dining experiences, and restaurant inform

Based on the analysis of True Food Kitchen and Shokuoku platforms, users should have the following needs for an ideal restaurant:

1. High quality dining experience

High quality ingredients and exquisite dishes: Users expect delicious and healthy food, and restaurants need to choose fresh and healthy ingredients, provide innovative dish designs, and exquisite cooking techniques.

Unique dining atmosphere: The environment and ambiance of a restaurant directly affect the dining experience. An elegant and comfortable dining environment can greatly improve customer satisfaction, especially for high-end restaurants and special occasions where decoration, music, lighting, and other factors are all influencing factors.

2. Information Transparency and Clarity

Detailed restaurant information: An ideal restaurant should provide complete menu information, including dish descriptions, prices, and specialties, so that users can understand and make choices in advance. True Food Kitchen lacks price information and Shokuoku's restaurant information is not detailed, which can affect users' booking decisions.

User reviews and ratings: Customers typically evaluate restaurant quality based on the dining experiences of other users. A good review and rating system can help restaurants establish a good reputation and enhance users' trust.

3. convenient booking and ordering systems

Simplified booking process: Users want to book quickly, and the cumbersome process can make them feel troublesome. The registration process for True Food Kitchen is quite complicated, and Shokuoku's auction system is also cumbersome for new users. The ideal booking system should simplify the registration process, provide multiple login methods, and provide detailed guidance and instructions for the auction system.

Flexible ordering methods: should support online ordering, dine in reservations, and takeout to meet the different needs of users. At the same time, the search function of the menu should be obvious, making it convenient for users to quickly find the dishes they need.

Through these improvements, restaurants can provide an experience that better meets user needs and enhance customer satisfaction.

Chapter 3 Requirements Documents

3.1 Project Overview

The purpose of this project is to develop a comprehensive online restaurant reservation system that facilitates users in booking restaurant tables, ordering dishes, and participating in auction bookings. This system can support multiple booking methods and provide detailed information about restaurants and user reviews to users.

3.2 Target Users

(1) Ordinary users: those who have the need to book restaurants, view menu and price information, browse user reviews, and select dining locations.

(2) High end users: those who book seats at popular restaurants through bidding and enjoy exquisite dining experiences.

(3) Restaurant administrator: Administrators can manage restaurant information, menus, and prices, view reservation status, and user feedback.

3.3 Functional Features & Detailed Requirements

Function Module	Feature	Description
Restaurant Search and Browse	Keyword Search	Search by restaurant name, dish name, cuisine type, or location.
	Filter	Filter results by price, rating, distance, or restaurant type.
	Category Browse	Browse restaurants by cuisine, dining scene, or region.
Restaurant Details Page	Restaurant Info Display	Shows the restaurant's name, address, phone number, hours, photos, chef intro, etc.

	Detailed Menu	Displays dish names, pictures, prices, ingredients, and allergen info.
	User Reviews and Ratings	Users can rate the ambiance, service, and food quality. Text reviews and photo uploads are supported.
Reservation and Ordering	Standard Reservation	Users pick a dining time, number of guests, and seating preferences. Can add special requests like allergies or celebrations.
	Auction Reservation	Users bid for popular restaurant seats. Shows the lowest bid, current bidders, time left, and includes bid reminders.
	Online Ordering	Users pre-select dishes before arriving. Syncs with the menu and allows adding, editing, or canceling orders.
	Delivery Service	Offers delivery with options for multiple addresses and online payment.
Membership & Personalized Recommendations	Membership Tiers and Benefits	Different levels of membership with perks include discounts, priority reservations, and points for rewards.
	Personalized Recommendations	Suggests restaurants and dishes based on user dining history and preferences. Includes special holiday offers (e.g., Valentine's Day specials).
Restaurant Management Backend	Restaurant Info Management	Admins can manage restaurant info, menu, prices, view reservations, and user reviews.
	Reservation Management	View, confirm, and cancel reservations. Export booking records. Manage auction bookings (set auction time, minimum bids, etc.).
	User Review Management	View and respond to reviews, handle malicious comments and complaints.

Table2

Chapter 4 Project Documentation

The purpose of our restaurant's online booking system is to meet the diverse needs of both ordinary and high-end users. The core functions include restaurant search and browsing, restaurant information, booking and ordering, membership system and personalized recommendations, as well as restaurant management backend. The system will support multiple booking modes, including traditional booking, auction booking, and food delivery services. Users can quickly find the restaurant they want to go to through keyword search and multi-dimensional filtering, and browse the menu and user reviews. The membership system provides different levels of benefits, and personalized recommendations are based on users' dining or takeaway history and preferences, which can enhance the user experience. Restaurant administrators can efficiently manage restaurant information, menus, and reservation status through the backend system.

To achieve this goal, this system will be developed using the Next.js framework, combined with the Vercel platform to achieve rapid deployment and continuous integration, in order to better support SEO and agile development. The following is a detailed content plan for the project document:

4.1 Skill

In order to meet the needs of our restaurant's online booking system, we have chosen an efficient, flexible, and easy to maintain technology stack. This technology stack can support efficient development of front-end, back-end, and database, and combines the advantages of cloud deployment and continuous integration. The following table provides a detailed display of various technologies and their advantages, and explains them in conjunction with the specific requirements in the requirements document.

Function Module	Tool/Framework	Purpose	Advantages	Description Related to Requirements
UI/UX Design	Figma	Prototype and Interface Design	Real-time collaboration	Quick design of interactive prototypes
Frontend Framework	Next.js	Frontend Development, SSR, SSG	SEO optimization	Optimize SEO and load speed for restaurant pages

Function Module	Tool/Framework	Purpose	Advantages	Description Related to Requirements
Backend Development	Node.js + Express	Backend Logic and API Interfaces	High performance	Provide API services
Database	PostgreSQL	Data Storage and Management	Strong transaction processing	Store restaurant and user data
ORM Tool	Prisma	Database Operations and ORM	Type safety	Simplify database operations and maintenance
Cloud Deployment	Vercel	Frontend Deployment and Hosting	Automated deployment	Enable automated frontend deployment
Version Control	Git + GitHub	Version Management and Collaborative Development	Easy branch management	Manage project code
Continuous Integration	GitHub Actions	Automated Building and Testing	Flexible configuration	Automate builds and testing
Logging and Monitoring	Sentry + Datadog	Error Monitoring and Performance Monitoring	Real-time error capture	Real-time system status monitoring

Table3

4.2 System Architecture

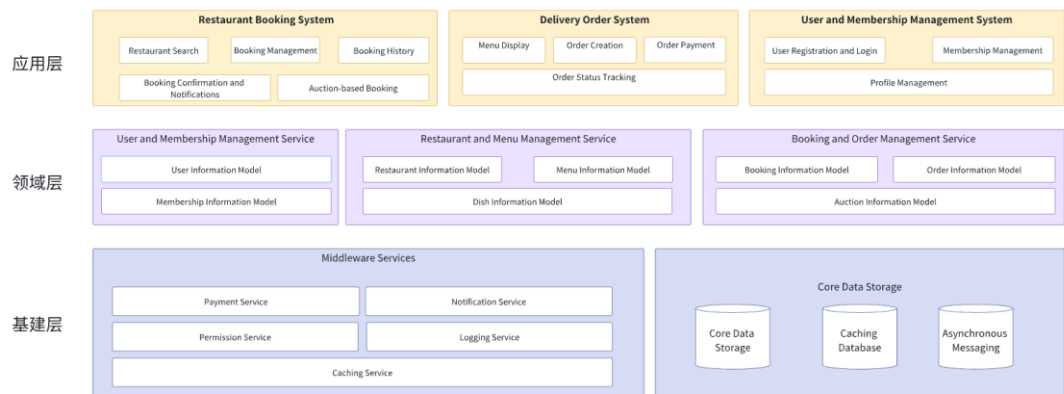


Fig7

Application Layer: Includes the restaurant reservation system, takeout order system, and user/member management system. Key functions are reservations, ordering, and membership management.

Domain Layer: Comprises user management, restaurant and menu management, and reservation/order management services. It defines business logic and data models to support the application layer.

Infrastructure Layer: Contains middleware services like payment, notifications, and permission management. It also includes core data storage such as data storage, caching, and message queues, providing essential functionalities and data management.

4.3 Database Design

The database design of our restaurant's online reservation system adopts PostgreSQL. The database structure is designed around core functions, including user management, restaurant information management, menu and dish management, reservation management, auction management, and evaluation management modules. Database design needs to ensure data integrity, consistency, and efficiency while supporting system functionality expansion and maintenance.

4.3.1 Table Structure Design

1. Users Table

Stores basic user information, including username, email, password, and role.

Field Name	Type	Description
user_id	SERIAL (PK)	Unique identifier for the user
username	VARCHAR(100)	Username
email	VARCHAR(255)	User email
password	VARCHAR(255)	User password (encrypted storage)
phone_number	VARCHAR(20)	User phone number
role	VARCHAR(50)	User role (e.g.r user, admin)
created_at	TIMESTAMP	Creation time

updated_at	TIMESTAMP	Update time
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Table4

2. Memberships Table

Stores user membership levels and benefits information.

Field Name	Type	Description
membership_id	SERIAL (PK)	Unique identifier for the membership
user_id	INTEGER (FK)	User's unique identifier
level	VARCHAR(50)	Membership level (e.g., regular, silver, gold)
points	INTEGER	Points quantity
benefits	TEXT	Description of membership benefits
created_at	TIMESTAMP	Creation time
updated_at	TIMESTAMP	Update time

Table5

3. Restaurants Table

Stores basic restaurant information, including name, address, phone number, and description.

Field Name	Type	Description
restaurant_id	SERIAL (PK)	Unique identifier for the restaurant
name	VARCHAR(100)	Restaurant name
address	VARCHAR(255)	Restaurant address
phone_number	VARCHAR(20)	Restaurant phone number
description	TEXT	Restaurant description

rating	DECIMAL(2, 1)	Restaurant rating (1-5)
created_at	TIMESTAMP	Creation time
updated_at	TIMESTAMP	Update time

Table6

4. Menus Table

Stores menu information for restaurants; a restaurant can have multiple menus (e.g., lunch menu, dinner menu).

Field Name	Type	Description
menu_id	SERIAL (PK)	Unique identifier for the menu
restaurant_id	INTEGER (FK)	Restaurant identifier (foreign key)
name	VARCHAR(100)	Menu name
description	TEXT	Menu description
created_at	TIMESTAMP	Creation time
updated_at	TIMESTAMP	Update time

Table7

5. Dishes Table

Stores dish information under menus, including dish name, description, price, and availability.

Field Name	Type	Description
dish_id	SERIAL (PK)	Unique identifier for the dish
menu_id	INTEGER (FK)	Menu identifier (foreign key)
name	VARCHAR(100)	Dish name
description	TEXT	Dish description

price	DECIMAL(10, 2)	Dish price
is_available	BOOLEAN	Whether the dish is available
created_at	TIMESTAMP	Creation time
updated_at	TIMESTAMP	Update time

Table8

6. Reservations Table

Stores restaurant reservation information for users, including reservation time, number of people, and status.

Field Name	Type	Description
reservation_id	SERIAL (PK)	Unique identifier for the reservation
user_id	INTEGER (FK)	User identifier (foreign key)
restaurant_id	INTEGER (FK)	Restaurant identifier (foreign key)
reservation_time	TIMESTAMP	Reservation time
number_of_people	INTEGER	Number of diners
special_request	TEXT	Special requests (e.g., allergy info)
status	VARCHAR(50)	Reservation status (e.g., pending, confirmed)
created_at	TIMESTAMP	Creation time
updated_at	TIMESTAMP	Update time

Table9

7. Auctions Table

Stores auction information for restaurant seats, including auction time, starting price, current price, and highest bidder.

Field Name	Type	Description
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auction_id	SERIAL (PK)	Unique identifier for the auction
restaurant_id	INTEGER (FK)	Restaurant identifier (foreign key)
start_time	TIMESTAMP	Auction start time
end_time	TIMESTAMP	Auction end time
starting_price	DECIMAL(10, 2)	Starting price
current_price	DECIMAL(10, 2)	Current highest bid
highest_bidder____	INTEGER (FK)	User identifier of the highest bidder
created_at	TIMESTAMP	Creation time
updated_at	TIMESTAMP	Update time

Table10

8. DeliveryOrders Table

Stores information about users' delivery orders, including order status, total amount, and delivery address.

Field Name	Type	Deserption
delivery_order_id	SERIAL (PK)	Unique identifier for the delivery order
user_id	INTEGER (FK)	User identifier (foreign key)
address	VARCHAR(255)	Delivery address
total_amount	DECIMAL(10, 2)	Total order amount
delivery_status	VARCHAR(50)	Order status (e.g., pending, in delivery)
created_at	TIMESTAMP	Creation time
updated_at	TIMESTAMP	Update time

Table11

9. OrderItems Table

Stores detailed dish information for delivery orders, including dish name, quantity, and price.

Field Name	Type	Description
order_item__	SERIAL (PK)	Unique identifier for the order item
delivery_order_id	INTEGER (FK)	Delivery order identifier (foreign key)
dish_id	INTEGER (FK)	Dish identifier (foreign key)
quantity	INTEGER	Quantity of the dish
price	DECIMAL(10, 2)	Price per dish
created_at	TIMESTAMP	Creation time
updated_at	TIMESTAMP	Update time

Table12

10. Returns Table

Stores information about users' return requests, including reason, status, and processing result.

Field Name	Type	Description
retur__id	SERIAL (PK)	Unique identifier for the return
delivery_order_id	INTEGER (FK)	Delivery order identifier (foreign key)
user__	INTEGER (FK)	User identifier (foreign key)
reason	TEXT	Return reason
status	VARCHAR(50)	Return status (e.g., pending, processed)
created_at	TIMESTAMP	Creation time
updated_at	TIMESTAMP	Update time

Table13

11. Reviews Table

Stores users' reviews of restaurants, including rating and comments.

Field Name	Type	Description
review_id	SERIAL (PK)	Unique identifier for the review
user_id	INTEGER (FK)	User identifier (foreign key)
restaurant_id	INTEGER (FK)	Restaurant identifier (foreign key)
rating	DECIMAL(2,1)	Rating given by the user (1-5)
comment	TEXT	Review comment
created_at	TIMESTAMP	Creation time
updated_at	TIMESTAMP	Update time

Table14

4.3.2 Entity-Relationship Diagram (ER Diagram) Description

1. User Management Module

This module handles users' basic information and membership benefits. The Users table stores details like username, email, and password. The Memberships table manages users' membership levels, points, and benefits. These two tables are linked by the unique user identifier (user_id), ensuring that membership information and personal information can be updated together.

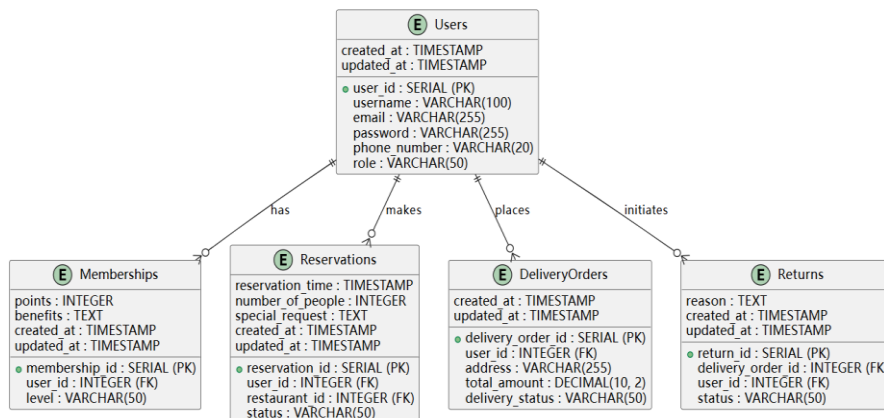


Fig8

2. Restaurant and Dish Management Module

This module is used to store and manage restaurant and dish information. The Restaurants table contains basic details like name, address, and contact information. The Menus table manages each restaurant's menus, with multiple menus linked by the restaurant identifier (restaurant_id). The Dishes table stores specific dish information under each menu, including name, description, and price, linked by the menu identifier (menu_id).

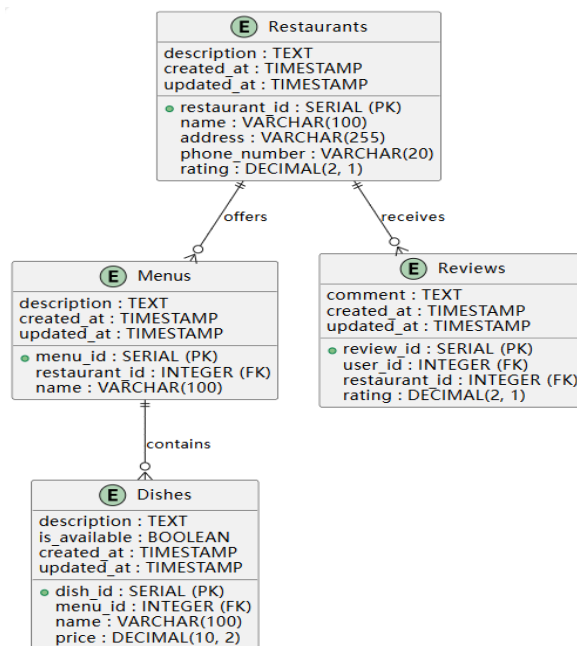


Fig9

3. Reservation and Order Management Module

This module manages users' restaurant reservations and takeout orders. The Reservations table records users' reservation details, including time, number of people, and status, and links to the Users and Restaurants tables. The DeliveryOrders table manages users' takeout orders, including delivery addresses and order status. The OrderItems table stores specific dish information for takeout orders. The Returns table records users' return requests and their processing status, while the Reviews table collects user feedback on restaurants to enhance the overall user experience.

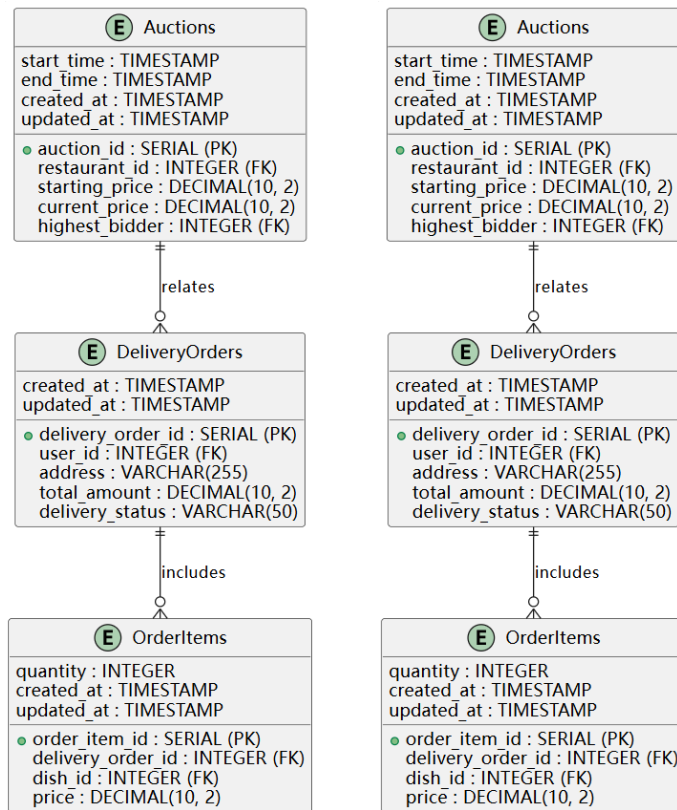


Fig10-11

Chapter 5 Work Plan

5.1 Stage 1: Market Research and Demand Clarification

The goal of this stage is to conduct market research and then clarify the needs based on the research results.

Task Assignment:

Sun: Communicate the project plan with relevant stakeholders, collect descriptions of core functions and key user requirements,

Jin: Write a requirements document to specify the description of functional and non-functional requirements,

Bai: Write a design document and create a system architecture diagram, data flow diagram, and function module division based on the document.

5.2 Stage 2: System Architecture Design

The main goal of this stage is to design the system architecture, including database design, front-end UI design, back-end API design, and determining the deployment environment.

Sun: Determine the front-end environment and project structure, set up the Next project structure and configure the redirect logic.

Jin: Design the back-end API interface, configure the basic interface request.

Bai: Set up the PostgreSQL database environment, write the table structure and insert initial data.

5.3 Stage 3: Specific Development

The main goal of this stage is to perform specific development tasks.

Sun: Responsible for front-end development,

Jin: Responsible for database development,

Bai: Responsible for back-end development.

5.4 Stage 4: Project Testing

The main goal of this stage is to conduct project testing and provide feedback on the results.

Sun: Conduct front-end functional testing using automated testing tools.

Jin: Verify backend API data interactions using tools.

Bai: Optimize database performance, monitor system performance indicators, and fix database-related issues.

Milestones: Complete system functional testing and performance optimization, fully preparing for the live version.

Chapter 6 Qualitative Property

We predict that the project is likely to generate the following qualitative contributions:

1. Improve the overall performance of the system, so that users can still maintain smooth access during peak periods, especially to ensure that the system can respond to user requests within 2 seconds during complex bidding processes.
2. Ensure the security of users' personal data (e.g. booking records, payment information, etc.) during transmission and storage within the system, in compliance with international data security standards (e.g. GDPR or ISO27001)
3. By analyzing users' historical booking and consumption data and using machine learning algorithms to develop a recommendation system that can learn from itself, we continuously improve the accuracy of personalized recommendations and ensure that the click-through rate of recommended content is increased by more than 20%.

Chapter 7 Conclusion

This project proposes to develop an intelligent restaurant reservation system that integrates standard reservation, bidding for seats, online ordering and other functions. Users can quickly make dining decisions through personalized recommendations and detailed evaluations, while the restaurant easily manages reservations and feedback through the backend. Technically, the system adopts advanced architecture to ensure efficient operation and flexible expansion, laying a solid foundation for future development.

In the future, with the growing demand for online catering services, intelligent restaurant reservation systems will further optimize user experience and restaurant operational efficiency. By introducing more AI technologies, such as personalized recommendation and natural language processing^[1], the system is able to capture user preferences more accurately and improve customer satisfaction. Looking forward to the future more perfect restaurant service class system can bring more convenience to life!

References

- [1] Smith, J. (2020). AI in Dining: Enhancing User Experiences. *Journal of Modern Technologies in Hospitality*.