

Dissertation

by Lijie Shao

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Design of reservation ordering system

by

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Project submitted as part of the requirements for
the award of MSC Software Engineering

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DECLARATION

I, Lijie Shao declare that I am the sole author of this Project; that all references cited have been consulted; that I have conducted all work of which this is a record, and that the finished work lies within the prescribed word limits.

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Abstract

The information level of the traditional catering industry is low, and the ordering process is basically carried out manually. This way is inefficient when there are many people, and it is not convenient for consumers. The outbreak of the Covid-9 epidemic in 2020 has changed the traditional way of ordering food. In order to avoid overcrowding, many restaurants have to take some measures. With the popularity of 4G, the rise of the 5G network, and the popularity of smartphones, the tide of the mobile information age has come. The hottest spots in the IT industry began to focus on the mobile Internet. The popularity of the mobile Internet has led me to the idea of combining current technologies and tools to create a better way for more restaurants to be better managed. Therefore, this topic arises at a historic moment.

In this paper, bootstrap and Vue are used to develop this project. Node.js technology to achieve the development of the back-end, using the MongoDB database for data storage and sharing. The application realizes the management of ordering, dining, bill, and checkout of consumers, and the management of the server, dishes, and orders of the administrator, and realizes the design goal of functional planning of the application at the beginning. The use of this system can improve the management efficiency of the restaurant, liberate some manpower, save the cost of manpower, and improve the consumption experience of consumers to a certain extent. This is also the product of the times under the trend of mobile phone intelligent development.

The ordering system can effectively complete the basic ordering operation required by users, with a friendly interface and simple operation. Through the system test, the system runs well, basically achieves the expected development goal, and can basically meet the actual application needs of consumers.

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Chapter 1 Introduction

As we all know, the development of computer science and technology has accelerated the development of mobile networks. The network penetrates into all aspects of human society and integrates into all walks of life. It has a profound impact on and changes the way people live, study, and work. Nowadays, the smart phone is an indispensable tool in people's lives, which greatly improves the quality of people's lives and brings great convenience to people's life.

The catering industry has also received the impact of the development of the Internet, online ordering business has developed rapidly. In recent years, many offline enterprises have begun to take out the development of websites and apps, which makes people's habit of ordering takeout gradually change from "telephone ordering" to "online ordering". Online ordering has become an inevitable development trend. At the same time, it is also changing people's lifestyles and habits.

Most of the traditional ordering software is designed to provide takeaway service, and most of them are based on the principle of "one meal, one order", that is, it can not provide reservation service. However, the new epidemic situation in 2020 has changed the way of life of consumers and their eating habits, bringing a huge blow to the catering industry. In order to reduce the contact between people, some restaurants have to take certain measures, such as only one person can enter the store to order food, or drive to order food. However, this method will consume a lot of manpower and financial resources, which is not suitable for long-term implementation. Only by changing the marketing strategy and adapting to the changed consumption habits of consumers can the catering industry get out of the predicament and usher in the spring.

Through this design, the majority of consumers can browse through the ordering system to rich food and beverage information and order their favorite food and beverage without leaving home, which is of great convenience. For businesses, the

menu management of the ordering system is convenient and updated in time, which solves the problems of traditional leaflet pages affected by price changes and other factors. Online catering publicity information can be permanently saved, which can reduce the manual distribution of leaflets, resulting in high cost and low efficiency. At the same time, it also solves the problem of busy phone calls during the peak period of the order, which can ensure that every consumer's order will not be missed during the peak period of the meal.

1.1 Aim

The main aim of this report is:

Design an ordering system, users can order online, and can make an appointment according to their own time.

1.2 Objectives

After the implementation of the system, the following objectives are expected to be achieved:

- (1) The operation of the system is simple and convenient, and the interface is simple and beautiful.
- (2) Customers can take out their mobile phones to directly log in to the ordering interface of the restaurant when they need to order. Customers can choose their favorite dishes and query the order status and information at any time.
- (3) The interaction of the system is good. When the user selects a product, the product information is automatically loaded into the shopping cart. The quantity can be changed on the shopping cart page and the price changes with the quantity.
- (4) Businesses can manage dishes, including image upload function, which can upload food pictures locally.
- (5) According to PWA, users can add this application to the first screen, which is

convenient for users to use the application next time.

1.3 Structure of the report

The project has three main components. First of all, through some theoretical work to lay the foundation for the implementation of the project. This paper analyzes the advantages and disadvantages of the existing system and the requirements of the system to be designed from the aspects of literature review and practice. The second part introduces the requirement analysis of the system in detail, and the design and implementation according to the requirement analysis. Finally, the third part tests and explains the design results, compares the results with the objectives, and puts forward improvement suggestions according to the current implementation.

The first chapter gives an overview of the report and details its purpose, objectives, and structure.

The second chapter is the literature review, mainly through literature research to understand the challenges facing the catering industry, and compared the advantages and disadvantages of other ordering systems. The research direction of the system is put forward, and the technical route of the system design is determined by searching the technology.

The third chapter describes the research method in detail, and combined with the characteristics of the system, puts forward the development method based on the prototype method.

The fourth chapter makes a detailed analysis of the system requirements, including functional analysis and non-functional analysis. Through the basic use case diagram of different roles division, people can have a more in-depth understanding of the whole system function. The feasibility of the system implementation is analyzed, including technical feasibility and economic feasibility analysis.

The fifth chapter is the design and implementation of the system. This chapter is mainly divided into two parts. Firstly, the design of the ordering system is introduced in detail, including the design of the database, the division of functional modules, and the design of key functional modules. In the database part, it mainly describes the use of the overall ER diagram and data table of the system database and establishes the data tables of various data needed in the system, such as the data table related to customers and the data table related to dishes. The system functions are divided into modules according to user roles, and the functions of each module are described in detail. Then it introduces the implementation process of the system, and according to the module section, gives the system interface implementation, and writes the key code. The key code is the verification of the implementation system. According to the different functions of different modules, this chapter gives the main interface or code flow chart.

The sixth chapter analyzes the results and puts forward two aspects of testing, one is the interface test of the system, the other is the function test of the system. And through the test results to achieve and target comparison.

The seventh chapter summarizes the implementation process of the system, and puts forward suggestions for further work on the results of the implementation.

The eighth chapter is the author's reflection on the research process.

Chapter 2 Literature review

2.1 Challenges faced by catering industry

Catering industry is an industry closely related to people's life. Due to the busy work of people, in order to save time, more and more people will choose to eat out. With the growth of this trend, restaurant operators also implement positive strategies to meet the needs of customers. Many studies have shown that although menu content and food quality are important factors related to restaurant selection, variables such as atmosphere, comfort, service quality and waiting time also play an important role in creating an unforgettable dining experience (Anderson & Mossberg, 2004)[1].

2.1.1 Deficiency of traditional ordering

For the traditional catering service industry, people can choose to order or make an appointment by phone, but the ordering process is recorded by the waiter [2]. This traditional ordering method may have some human factors, such as language barriers and spelling errors of orders (Chan, Tang, & sou, 2017)[3]. In addition, once the restaurant enters the peak period, because the waiters can not receive all customers at the same time, customers have to wait for a long time to order, even if the order is completed, customers also need to spend some time to wait for the meal, which will inevitably reduce customer satisfaction.

With the rapid development of scientific and technological innovation, the traditional way of ordering food is also changing. Restaurant operators began to improve their menus and ordering. Especially for some fast food restaurants, they have begun to implement touch screen technology as part of their business plan [4]. For example, in some large fast food chains, when customers enter and order, they can use self-service kiosks to order. Studies have shown that self-service kiosks have a positive impact on customers' purchase behavior (Baba, N., shahril, a. m., &

hanafiah, M. h, 2020) [5]. This way avoids the language barrier and spelling problems of manual ordering. This technology can save the labor cost to a certain extent and can reduce the waiting time of customers to a certain extent. However, because restaurants can not guarantee to provide enough self-service ordering equipment, the use of this technology does not completely solve the problem that customers need to wait for order in the peak period. In addition, for some small and medium-sized restaurants, buying self-service ordering kiosks and placing them in the dining hall brings not only economic but also spatial costs.

2.1.2 Challenges faced by catering industry in the new situation

Moreover, in 2020, the Covid-9 outbreak broke out in the world. In order to prevent and control the epidemic as soon as possible, many countries and regions entered the lockdown period, which affected most enterprises. Ross [6] pointed out that the most affected may be the small and medium-sized enterprises, micro-enterprises and start-ups. This crisis led to a quarter of British enterprises temporarily closing their own enterprises. Among them, some social consumption and service aggregation industries, such as tourism, catering, hotels have been greatly impacted. In order to reduce the cross infection caused by going out and traveling far, many scenic spots, restaurants and hotels were forced to close down. During this period, some online retailers and food distribution companies were developing, and a large number of people chose to take out or delivery services during the lockdown period. However, Thompson [7] pointed out that with the increase of online distribution, the profitability of restaurants is declining. This is mainly due to the high fees charged by online food delivery services, it is not only for services and delivery to consumers but also for restaurants. Most online food delivery services charge restaurants 20% to 30% of the cost of each purchase (Jack, 2020) [8].

With the resumption of work, in addition to the take away and delivery mode, the physical service industry is still important to the local community. In the early days of returning to work, in order to maintain a safe social distance, people are still

subject to great restrictions when eating in restaurants. For example, they can only order by car, only one customer can enter the restaurant to order at a time, or the dining table in the store should be kept at a distance of one meter. But with the resumption of work, it is obvious that these methods can not meet people's daily needs. The traditional ordering method is inefficient, which makes people have to wait in line. Even if some restaurants use the self-service ordering booth technology, they still need to wait in the peak period of dining. This situation will lead to dense personnel and it is difficult for people to ensure a safe distance.

But now the mobile phone business has developed rapidly, almost everyone has a smart phone. Therefore, in this case, the development of an ordering application based on a mobile phone can solve some catering industry problems in the current situation.

Compared with the ordinary menu, the menu of mobile self-service ordering system has many advantages. For example, the ordinary menu is easy to be dirty and needs to be written by the service personnel, and the documents are easy to be lost, and the calculation is easy to make mistakes due to the complex financial accounting work. While the mobile self-service ordering system is convenient, flexible and does not require too many service personnel to wait for customers to order, which is convenient for management and self-service in order to save manpower and time [9]. This method can not only solve the problem that people need to wait in line to order meals in peak hours, but also avoid the crowd problem caused by waiting. In some special periods, it can reduce the possibility of virus transmission due to the use of public facilities such as public ordering kiosks.

2.2 Comparison with traditional ordering

2.2.1 Menu ordering system based on touch screen

The ordering system based on a touch screen is a wireless ordering mode combining software and hardware. Anantapur[10] proposed a design scheme of menu ordering

system based on a touch screen for small and medium-sized hotels. Using ZigBee short-range wireless communication technology and the ARM11 processor as hardware, a quick order system is realized. It consists of a graphical user interface (GUI) on the client's desk, which is used as a remote control and kitchen monitor to systematically display ordering information. The system uses a small module (an electronic tablet with a touch screen and stylus) placed on each table for customers to place orders. Order by selecting the menu item on the touch screen. This data is provided with the menu. ZigBee communication system will send signals to the ordering area and automatically display on the kitchen screen.

Advantages:

The system has the advantages of low power consumption, high reliability and friendly user interface. This way can realize customers' self-service ordering and reduce the mistakes that will occur when ordering meals manually. It makes the restaurant more efficient, more skilled, and improves the utilization of human resources.

Disadvantages:

In order to make it possible for customers to use such equipment, the restaurant must take out a large sum of money to purchase the equipment, which brings financial pressure to the restaurant, which is a great burden for some small and medium-sized enterprises.

2.2.2 Mobile device ordering system based on Android

With the popularity of 4G and the rise of 5G network, smart phone has become an indispensable tool in people's daily life. The tide of mobile information era has come. Wei Liu [11] uses Java language and XML for development, uses Android studio as a development tool, uses SQLite database for data storage and sharing, and uses HTTP protocol to access the network, so as to complete the development of mobile ordering system based on Android platform. The application realizes the

management of ordering, dining and bill of consumers, as well as the management of the shop attendants, cooks, dishes and turnover. To achieve a kind of consumer self-ordering consumption, reduce the workload of waiters, improve the efficiency and image of the restaurant planning.

Advantages:

The system can improve the management efficiency of restaurants, liberate some manpower, save labor costs, and improve the consumption experience of consumers to a certain extent. And restaurants don't need to buy equipment, customers just need to use their own mobile phones. This method greatly saves the investment of the restaurant.

Disadvantages:

The system is based on Android system and cannot be used across platforms. Not all customers are Android mobile phone users. For users using IOS system, it is impossible to order meals with mobile devices. And the customer needs to download the app to the phone, so it will definitely occupy the memory of the customer's mobile phone.

2.2.3 Online ordering system based on Wechat applet

Wechat can run in most mobile terminals. At present, the WeChat open platform supports the Android system, IOS system and WP8 system, and can send and receive information through WeChat Group [12]. Especially in China, WeChat is an indispensable software in smart phones, and also a social platform for people's daily communication. Wechat applet is an application that can be used without downloading and installing [13]. GuotingFan[14] designed a two-dimensional code ordering system based on WeChat applet under the guidance of software engineering, using the MINA framework of Wechat applet and combining JavaScript.

Advantages:

Since Wechat is supported by most systems, it is not necessary to consider the issue of cross platform operation when ordering. The ordering system using WeChat applet does not require customers to download and install, which greatly saves the memory of users' mobile phones.

Disadvantages:

WeChat applets can only run in the running environment set by WeChat. Although WeChat has a huge user base in China, its usage rate is not high in other countries, so it is very inconvenient for customers who don't use WeChat to order meals by using WeChat applet.

2.3 The research direction of this system

According to the above analysis of several popular ordering systems, smart phones are popular, powerful, numerous users and easy to use. It is possible for users to order meals through mobile phones. Ordering meals in advance through mobile phones will solve some of the above problems. This paper presents an online ordering application of progressive web application (PWA). It can run directly in the browser without considering the problem of cross platform. It does not need to run in a specific environment like WeChat applets. PWA combines the capabilities of native applications with the scope of web access. It provides good user experience and gives people a sense of integration [15]. It makes people no longer need to download and install native applications, and saves the memory space of the mobile phone. It promotes the web application to a new level, so that users can have the experience of using the native application when using the web application.

2.4 Technical introduction

The system is a web app based on PWA technology, and some related technologies and development tools need to be designed in the development process.

2.4.1 PWA and related technologies

When users use a web app, they can directly open the browser and enter the address to find the information content, so its path is relatively short, and the shorter path means that the loss rate of users will be less. However, the web app also has some shortcomings, which can be summarized into two parts: first, in terms of user experience, the web app interaction is more stuck than the native app, and loading is slower. When the network is offline, the native app can generally use the cache to return some available data, while the web app can only return a 404 error reporting interface. Secondly, the stickiness of users. A big problem with the web app is the entrance. When users use a web app, they use the search engine to browse a site, so it costs more to open it again. Even if it is implemented through the browser's favorites, there is a considerable gap with the native app. So PWA came into being.

PWA is not a separate technology, it is a web app after using some technologies to optimize the experience. These technologies include Web App Manifest, Service Worker, Push API and Notification API.

Web app manifest: It allows the browser to add a user's site to the user's phone screen, and then add a shortcut to the phone screen by adding a button to the home screen. Open this shortcut, through some loading animation, users can enter the immersive experience. It has no browser address bar, menu bar, so it looks basically the same as native app. PWA manifest includes its name, author, icon, version, description, and a list of all necessary resources (among others) [16].

Service worker: it is a script running in the background independent of the web page, between the browser and the server [17]. It uses JavaScript to control the associated page or website. Its function is to intercept and process network requests and operate cache [18]. In addition, it also supports push API and notification API. It can also be used for background synchronization, update cache, to provide better services. Service worker is event driven and has a lifecycle, but the lifecycle is

independent of the page. It can also exit when the associated page is not closed, and it can be started when there is no associated page.

The Push API gives web applications the ability to receive push messages from the server, whether or not the web application is in the foreground of the user's device or even just finished loading. In this way, developers can send asynchronous notifications and updates to users, so that users can get new content more timely [19]. The notification API allows web control to display system notifications to end-users. These are outside the top-level browsing context view, so they can be displayed even if the user switches tabs or moves to a different application. The API is designed to be compatible with existing notification systems across different platforms [20].

2.4.2 Vue

Vue.js is a progressive framework for front-end development, focusing only on layers, using bottom-up incremental development design. The goal of Vue is to implement the data binding of the response and the combined view components through as simple an API as possible. Vue has significant performance advantages in virtual DOM, bidirectional data binding and component development [21].

DOM refers to the document object model. In the past development, the content and structure of a document are usually accessed and modified by operating the DOM that exists in the page. But Vue uses virtual DOM, which is a virtual DOM tree model. DOM state is only a mapping of data state, that is, $UI = VM(\text{state})$. When the state on the right side of the equation changes, the UI of the page display part will change accordingly. The core algorithm of virtual DOM is Diff algorithm, which makes the operation of DOM on the page less accessible in Vue software operation, which avoids a lot of invalid calculation and improves the running speed.

Vue is a front-end framework based on MVVM, which solves the disadvantages of single data transmission in traditional MVC mode [22]. MVVM can be divided into

three parts: Model, ViewModel and View. The frame diagram is shown below.

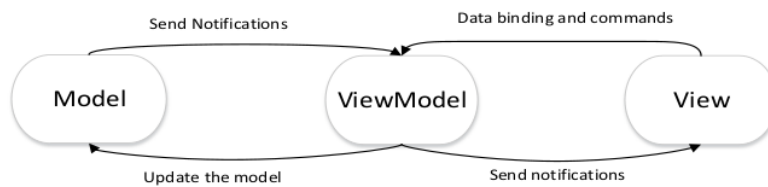


Diagram 1 MVVM framework

Model refers to the data transmitted by the back-end. After receiving the data sent by the server to the client, the data is stored and processed in the model layer to reduce the interaction with the server. View is mainly used for data display, which is responsible for displaying the visual UI of the system to users. After separation from the back-end, the coupling is reduced, and the view layer is more convenient for optimizing the display of users Demand. ViewModel is the bridge between view and model. It can realize two-way data binding: one is to transform the model into a view by means of data binding, that is, the data passed by the back-end is transformed into the page that you see. The other is to convert the view into model by Dom event monitoring, that is, the page is transformed into the back-end data. The ViewModel layer can synchronize the data and the view completely, and it can also make developers do not need to operate DOM frequently, so as to reduce the performance loss of the client.

The "everything is a component" concept of Vue means that any code block that completes encapsulation can be regarded as a component [23]. The idea of component development is to divide the front-end page into components, and each component can be reconstructed into a new page. When the browser loads, all components are loaded together. A page jump is a switch between components. It is not necessary to ask the server to load the page again when the page jumps. This reduces the load pressure of the server, reduces the workload of developers and improves the maintainability of the system.

2.4.3 Bootatrap

In the selection of front-end technology development, after comparing the current mainstream front-end technology, the system decided to use bootstrap to realize the development of the front-end page. Bootstrap is an open-source front-end interactive technology framework proposed by Twitter, which can be used to quickly develop web applications and web pages, and is one of the most popular front-end technologies. Bootstrap is based on HTML, CSS, and JavaScript. It is concise and flexible, which makes the development of front-end pages more efficient. It also has the following advantages:

- (1) Mobile device first: the framework provides style support for all kinds of mobile devices.
- (2) Browser support: almost all mainstream browsers, such as ie, Google Chrome, firefox they all support bootstrap.
- (3) Easy to get started: as long as you have a basic knowledge of HTML and CSS, you can start developing.

Bootstrap.

- (4) Responsive design: bootstrap's responsive CSS is adaptive to desktop, tablet, and mobile phone. For future business expansion, it can be quickly applied to different terminals.
- (5) Unified solution: it provides a simple and unified solution for developers to create common page components

Program.

- (6) Open source and free: this advantage is very important in ordinary enterprise development, and it doesn't need to buy an additional license.

2.4.4 Node.js

Node.js is a JavaScript runtime environment based on the Chrome V8 engine, and provides an alternative API to enable Chrome V8 engine to run in a non-browser environment. Its main purpose is to enable the server to execute and run JavaScript code [24]. Node.js application on the server side is the front-end and background development language is consistent, reduces the cost of front-end and background conversion, and makes the code style more unified [25]. The biggest feature of Node.js is event-driven and non-blocking I / O [26]

JavaScript is a single thread language, only the main thread. It can not do concurrent processing. But there is a thread pool in the Node.js [27]. The main function of this thread pool is to collect all the asynchronous operations when the synchronous operations are executed, and then start to execute the asynchronous operations in the thread pool when all synchronous operations are completed. When processing asynchronous operations, it is only responsible for allocating execution events, and all operations that may affect the thread will be allocated to the inner line city, thus ensuring that the main thread will not be blocked.

2.4.5 Express framework

Express is a simple and flexible Node.js web application framework, supports jade and other templates and routing control. It has rich HTTP tools and provides a series of powerful features to help create various web applications [28]. The Express framework can process various HTTP requests submitted by clients on the server side and use the routing mechanism to process these requests. Express can call the third-party class library through the use of middleware. These middleware can be used to realize user identity authentication, parse request data, upload files, save cookie data and session data, and capture and handle server-side errors. In addition, the Express framework can also dynamically render HTML pages by passing parameters to the template engine.

2.4.6 MongoDB

MongoDB is an outstanding representative of many NoSQL database products, written by C + +. MongoDB does not use tables and rows in relational databases but is built on the architecture of collections and documents. It has a powerful feature of dynamically creating and modifying the schema. It is the nonrelational database most like the relational database. Although it is also a NoSQL database, it is completely different from the memory database processing scenarios such as Redis. MongoDB is the representative of the document NoSQL database. At the same time, MongoDB has extremely superior performance in processing massive data. Although both MongoDB and Redis are NoSQL databases, they are completely different. MongoDB is a document database, its status is the same as the traditional database MySQL; Redis is mainly used as a cache database, which is the supplement of MySQL and MongoDB.

In addition, MongoDB has the following characteristics: free schema; support full index, support embedded object structure; support dynamic query, the query expression is very rich. Bson format is used for data storage, which is suitable for storing object type data;

Based on the above characteristics, MongoDB is especially suitable for real-time data updates and query application scenarios, such as storing website data. And it is suitable for high scalability application scenarios. Furthermore, the MongoDB database uses Bson data format. When developing this platform, JSON objects can be directly stored in the database without any conversion.

2.5 Conclusion

This chapter mainly analyzes the problems existing in the ordering process of the catering industry, as well as the challenges faced by the catering industry in the new world situation. Several ordering systems are studied. The menu ordering system based on the touch screen increases the investment of restaurants. The ordering

system of mobile devices based on Android is limited by the mobile phone system. The online ordering system based on Wechat applet can not meet the needs of all users. Aiming at the problems existing in the above system, a reasonable solution is proposed, and a reasonable and effective development technology is determined.

The next chapter will introduce the research methods and design of this project.

Chapter 3 Research methodology

3.1 Research overview

The following diagram shows the research methodology used in the research process, mainly including research approach, research philosophy and research strategy.



Diagram 2 Research Overview

3.1.1 Research approach

The research method of inductive reasoning is adopted in this project. The inductive method transits from a certain degree of view about individual things to a wide range of views, and the interpretation methods of general principles and principles are derived from special and specific cases. By using this method, the common problems existing in the current ordering mode can be inferred through the research on several ordering platforms.

3.1.2 Research Philosophy

This project adopts the guiding ideology of qualitative research. Qualitative research mostly uses observation and in-depth interviews to obtain first-hand information. By participating in observation, researchers can not only observe the reason, attitude, effort procedure and decision-making basis of the observed. It can also obtain the feeling of a member in a specific social situation, so that researchers can understand the action more comprehensively.

3.1.3 Research strategy

The research strategy adopted in this project is literature research and case study. From multiple perspectives, this paper further analyzes the problems existing in the ordering process, and proposes solutions according to these problems. Through literature research, the literature about the current situation of the catering industry and the changes in the catering industry under the influence of covid-9 are searched to the greatest extent, and the advantages and disadvantages of several different types of ordering system are analyzed in depth. In view of these shortcomings, combined with the existing problems under the current situation and the development trend of the Internet, the preliminary scheme to solve the problem is proposed. Through the way of case study, in a specific environment, people's demand for ordering at different time points is understood. In line with the principle of removing disadvantages and retaining advantages, it can save restaurant investment and ensure customers' efficient and safe ordering.

3.2 Research design

Taking a fast food restaurant as the research object, the environment of the fast food restaurant is a business district with relatively more people flow, and the customers are mostly students and office workers. Observe the dining environment provided by the restaurant, and make statistics on the flow of people in the

restaurant from 11:00 to 1:00 at noon and from 5:00 to 7:00 in the evening, and through the survey of customer satisfaction. The survey results are as follows.

1. There are two ways to order in this fast food restaurant: one is that customers need to order through the server at the counter, and the server records the order information through the ordering machine on the counter and transmits the order information to the kitchen. Customers can pay in cash or by mobile phone. The second is through a self-service ordering machine set up in the store. The menu is displayed on the machine. After ordering, customers can pay by bank card or mobile phone, and pick up the meal through the order number printed on the machine.

2. Through observation, it is found that there are still a lot of people waiting in front of the counter and self-service ordering machine in the peak period of dining, especially at 12:00 p.m. and 6:00 p.m. on weekdays. If too many people wait in line, the crowd will be crowded, which is not conducive to maintaining social distance.

3. After investigation, it is found that if a customer is waiting in line when ordering, most customers will choose to order as soon as possible, and seldom have the opportunity to browse the menu to compare and order. For the time tight office workers, queuing for meals will take up too much time during the peak period of dining.

4. After talking with the shop assistants, it is found that more and more people start to order takeout, even if they are close to the restaurant, because it can save their waiting time. In view of the above problems, an application that allows customers to order meals in advance with their mobile phones is necessary.

3.3 Development methods

This system adopts the software development method of the prototype method. With the development of computer software technology, especially on the basis of the relational database system, the fourth generation program generation language and various system development and generation environments, prototype method

is a new system development method from design ideas, tools and means. It abandons the tedious method of step-by-step careful investigation and analysis, and then gradually sort out the text files, and finally let users see the results [29].

The prototype method is applicable to the project with fuzzy customer requirements in the early stage of design. According to the initial needs of users, the prototype method uses system development tools to quickly establish the system model. Users evaluate the prototype based on the use of the prototype and put forward suggestions for improvement. The developer modifies the prototype according to the user's opinion. The evaluation process is repeated so that the prototype is gradually improved until the needs of users are met. The prototype method can be used to develop a practical system model in a limited time with the most economical method, which saves manpower and material resources, facilitates communication with users and develops rapidly.

Prototype design process:

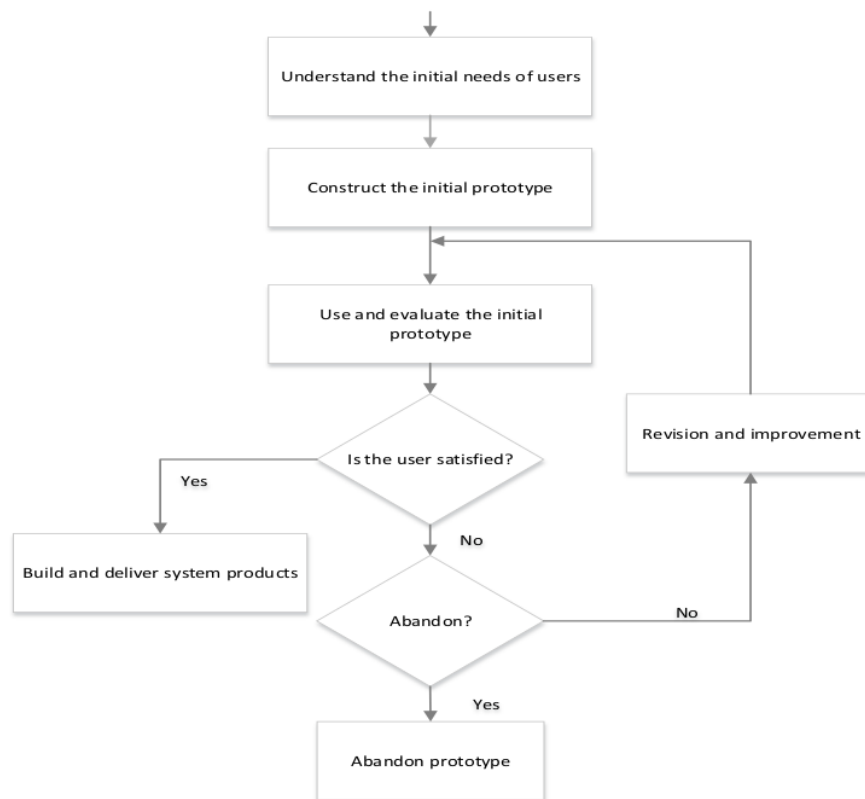


Diagram 3 Prototyping

(1) Through the research of some systems, and collect the user's demand in the daily order. According to the needs of users, each functional module is analyzed, designed and implemented. It can browse menu, add shopping cart, select dining time, place order and cancel order.

(2) Assemble the functional modules from the previous step to implement and determine the initial system prototype.

(3) Then the system is evaluated and modified according to the problems of the prototype

(4) After continuous testing and correction, the final development system to meet the requirements.

3.4 Conclusion

This chapter describes the research process and design in detail, selects the method of combination of induction and qualitative research to conduct literature review and case study. The method, process and results of the case study are given. The development method based on prototype method is proposed.

The next chapter will discuss the functional and non functional requirements of the system, and analyze the feasibility.

Chapter 4 System Analysis

This chapter will carry on the demand analysis and the feasibility analysis of the ordering system studied in this topic, and list the functions and problems that need to be realized one by one, so as to clarify the key points that need to be paid attention to in the process of system development. This is very important work, but also very difficult work. The degree of completion of this work directly affects the subsequent design and development work, and even determines the success or failure of the whole system. Therefore, only after careful, detailed and well-considered demand analysis, can a perfect and usable system be completed as far as possible.

4.1 Requirement analysis

4.1.1 Functional requirement analysis

This ordering system should be divided into two parts: the server and the client. It can also be the background and the front desk. There is no doubt that the target of the front desk is consumers. For consumers, the platform should have the functions of registering users, logging into the platform, browsing dishes offered by the restaurant, adding dishes to the shopping cart, placing orders and commenting. And the object that uses backstage is restaurant attendant and system administrator. For the restaurant attendants, the backstage needs to have the management functions such as viewing the order information and changing the order status. The system administrator has the functions of restaurant attendants management, product management, order management, sales statistics management, and so on.

Based on the above simple analysis, the analysis of system functions can be described from the perspective of consumers, restaurant attendants and system administrators.

1. Functions for consumers

(1) Registration and login: Users can access the website through the mobile terminal. If they have registered, they can log in through their existing account and password. If they have not yet registered as users of this website, they can choose to register and become users of this website by filling in their personal information. Only registered users can order meals. When registering, the phone number should be automatically detected to prevent the same phone number from registering multiple accounts.

(2) Retrieve account: When the users need to log into the system but forgets the login password, they can reset a new login password according to the registered mobile phone number.

(3) Browsing dishes: When users log in, they can browse the dish information on the platform, so the platform should have the function of displaying dish information. Consumers can browse dishes according to their own needs through the dishes classification provided by the platform.

(4) Modify personal information: Users can modify personal information according to their own situation.

(5) Shopping cart: The system needs to realize the shopping cart function, users can add the dishes they want to order to the shopping cart. Besides they can modify the number of dishes in the shopping cart and delete products they do not want to order according to their own needs.

(6) Confirmation of order information: Due to the impact of the new epidemic, people's lifestyle has also changed. In order to facilitate people's dining, customers can choose the time to order in advance when confirming the order information in this system. Customers can choose not only the specific time of taking meals but also the starting and ending dates. And customers can choose the way to eat according to their own needs, such as eat at the restaurant and takeout.

(7) Order management: This system can generate orders when users submit dishes in the shopping cart, users can also view historical orders. In addition, the order can

be canceled before the server of the restaurant confirms the order.

(8) Comment function: Users can express their feelings about dishes. The comments are open to other users. When other users log in to the system, they can see all users' comments on the dishes.

(9) Add to mobile phone screen: Users can add the app to the mobile phone desktop without downloading which can help users to find the application more convenient.

2. Functions of restaurant attendants

(1) View order information: the order information includes the order placing time, meal taking time, customer mobile phone number and other information.

(2) Change the status of an order: it includes confirming an order, making an order, completing an order, etc.

3. Functions for system administrators

(1) Restaurant attendant management: The administrator of the system can add, delete and modify the attendants account information.

(2) Order management: The system administrator can view the details of the order, including the mealtime, user's mobile phone number, etc. It can also realize the function of changing order status, including confirming the order, making the order, completing the order, etc.

(3) Commodity management: The system administrator can add, delete dishes, and modify the pictures of dishes, the detailed introduction of dishes, the prices of dishes, the names of dishes and the classification of dishes.

(5) Sales statistics: The system administrator can view the total sales amount of all orders.

4.1.2 Use case diagram

Use case diagram is a very important step in requirements analysis, through which designers can fully describe how to use a system[30]. The use case diagram can clearly show the users of the system and the function services provided by the system so that the system users can understand the implementation of these elements by users and developers. Next, this section will show the users of the system, the interaction between users and functions through the use case diagram. Through the analysis of the functions that consumers, restaurant attendants and system administrators should have, the user use case diagram is as follows.

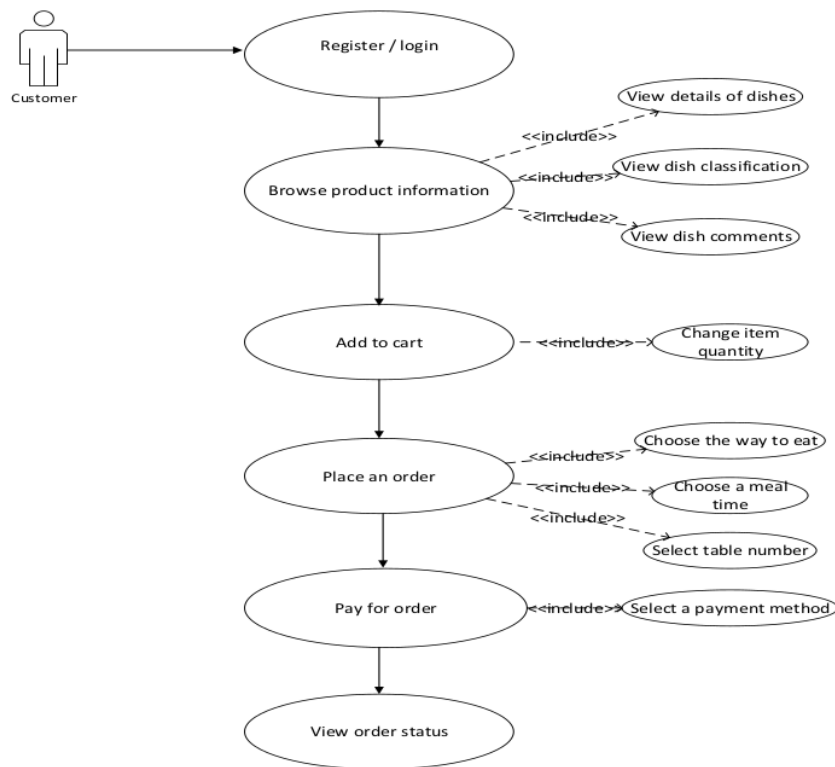


Diagram 4 Use case diagram of customer

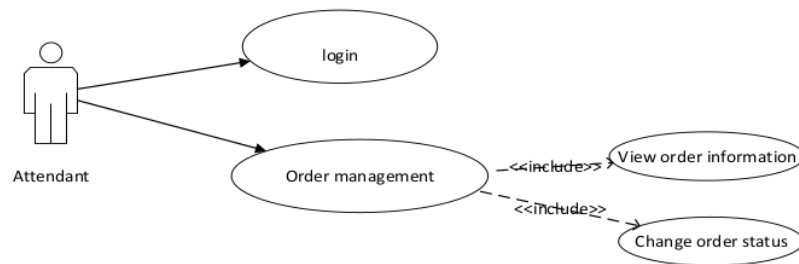


Diagram 5 Use case diagram of attendant

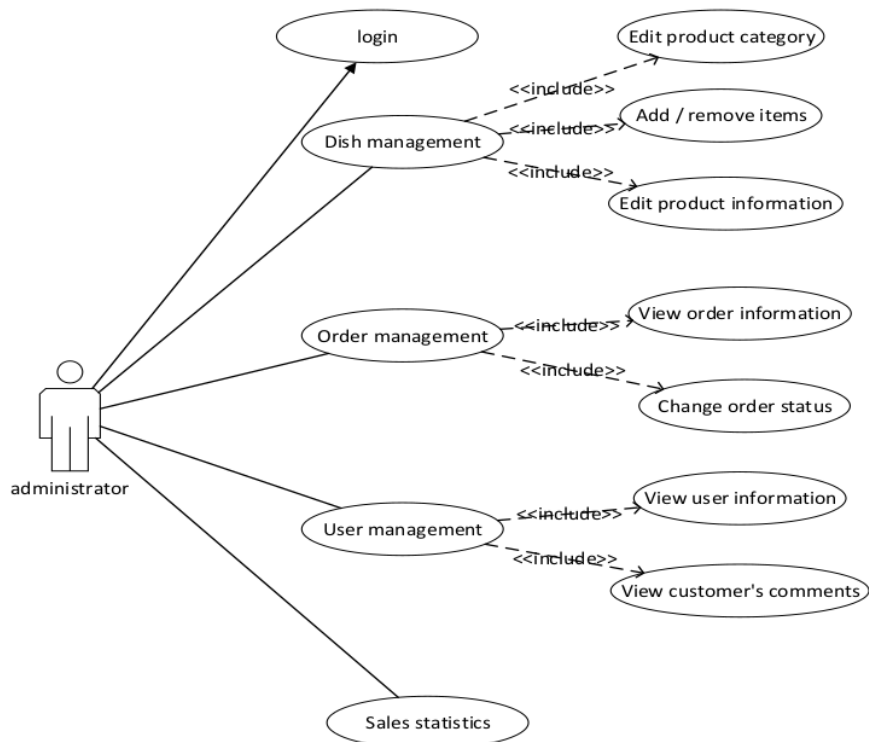


Diagram 6 Use case diagram of administrator

4.1.3 Non-functional requirements analysis

This section will make a brief analysis of some non-functional requirements for system operation.

(1) Accuracy requirements

The input, output and calculation of various data in the system should meet the

calculation requirements in accuracy according to the specific situation.

(2) Time requirement

The system should fully meet the user's requirements for access response time, data conversion time and update processing time.

(3) Portability requirements

The system adopts Vue + mongodb+ node.js combined technical solutions, which are highly portable.

(4) Expansibility

The system provides the interface of the follow-up functions.

(5) Ease of use

For restaurant customers, it is through mobile devices to access the ordering system, which requires a clear interface structure, simple operation, easy interaction and good experience; for service and management personnel, the interface design should be systematic, easy to manage the system, and easy to access.

4.2 Feasibility analysis

The purpose of feasibility analysis is to analyze and demonstrate whether the project is feasible, whether the scheme is reasonable and possible risks from the content of system construction and its supporting conditions. This is a very important work before the implementation of software, which is related to the success or failure of the project [31]. This section will make a comprehensive analysis and elaboration on the feasibility of implementing the ordering system. Next, it will be summarized from the following aspects.

4.2.1 Technical feasibility analysis

Bootstrap, Vue, webpack, PWA and other technologies are used in the front end of

the system. MongoDB is used for the database and Node.js is used for the server. At present, these technologies are relatively mature and open-source products. On the one hand, the development cost is low, on the other hand, there are more learning materials on technology, which greatly promotes the success of system development. In addition, the developers of this system have mastered the web system development technology and database system knowledge and can realize the development of the functional modules of the system.

4.2.2 Necessity of system construction

With the development of mobile intelligent terminal technology, nowadays the popularity of smartphones is very high. The development and construction of applications based on the mobile terminal platform will bring great convenience to mobile users so that mobile users can access the system platform anytime and anywhere, and enjoy the services provided by the system. This is the development trend of the mobile Internet era [26].

At present, there are many ways to order in restaurants, and these platforms have their own characteristics. However, the ordering system based on PWA is still in the primary stage of research, so it is worth trying to develop this platform. Building an ordering platform based on PWA can enable users to use the ordering app without downloading, which not only helps mobile users better interact with restaurant administrators but also improves user experience. Therefore, it is necessary to establish a reservation system based on PWA.

4.2.3 Economic feasibility

If the income is not greater than the investment, then the investment and development of the project are meaningless. In fact, the development of this system is very economical and feasible. On the one hand, because of the popularity of smartphones, on the other hand, the development of the system does not need too much human and capital costs. It can be said that the system fully considers the

issue of economic feasibility, all the implementation will not cause more capital costs.

4.3 Conclusion

This chapter first carries out the requirements analysis, including functional requirements analysis, use case diagram design and non-functional requirements analysis. The demand analysis mainly introduces the functional requirements of the system according to the three roles of consumer, restaurant attendant and system administrator. Finally, the feasibility of the whole system is considered. Through the requirement analysis of this chapter, the detailed design of the system can be carried out smoothly.

Chapter 5 Design and implementation of system

In the design of a system, full requirements analysis is a good start, system design is a good continuation on the basis of requirements analysis. On the basis of the above requirement analysis, this chapter will further design the system and abstract the database table design and key function modules of the system.

5.1 The design of databases

Database design is a very important link in software development. The running efficiency of the system is directly determined by whether the design is reasonable or not. Therefore, to design a good database for this system, first of all, the business requirements of the system should be met, and then on this basis, improve the query efficiency and ensure the consistency and scalability of data. The system will be analyzed and designed from two stages: conceptual structure design and physical structure [33]. Finally, the physical structure is implemented on MongoDB database.

5.1.1 E-R diagram of the system

The conceptual structure design of the database is a process of abstracting data information structure based on requirement analysis [34]. This system adopts the popular E-R (entity relation) method to analyze and design. Firstly, the local application is designed, and then the local view is integrated to form the global model of the whole system.

1.Customer entity

According to the demand analysis, the customer entity should have the following attributes: user ID, user name, password, Phone number.

2.Restaurant attendant entity

According to the demand analysis, the entity of restaurant attendants should have the following attributes: User ID, Phone number, password.

3. Restaurant administrator entity

According to the demand analysis, the restaurant administrator entity should have the following attributes: user ID and password.

4. Product entity

According to the demand analysis, the product entity should at least have the following attributes: Product number, Product name, classification, price, description and picture.

5. Comment entity

According to the requirement analysis, the comment entity should have the following attributes: comment ID, proposer, corresponding product, comment content, comment time.

6. Order entity

According to the demand analysis, the order entity should have the following attributes: order number, order time, order status, user information and product information.

7. Relationship between entities

According to the above analysis of local entities and system requirements, the relationship between entities in the system is obtained, including the following aspects:

(1) After logging in, consumers can browse all the dishes displayed by businesses, so consumers and dishes are one to many related.

(2) Consumers can order, and after ordering, the system will generate orders, which are attributes of consumers. And after completing an order, consumers can continue more orders, so consumers and orders are one to many association.

(3) Restaurant attendants can manage all orders, and there can be multiple servers in the restaurant, so their relationship with the order is many to many.

(4) Restaurant administrators can manage the information of multiple products, so the relationship between restaurant administrators and products is one to many relationship.

(5) Restaurant administrators can also manage all orders, but the system has only one system administrator, so the relationship between system administrators and orders is one to many.

(6) The restaurant administrator can also manage multiple waiters, so the relationship between the restaurant administrator and the restaurant attendant is one to many.

(7) Dishes are attributes of orders. An order can contain multiple dishes, so there is a many to many relationship between orders and dishes.

(8) Users can submit comments and submit multiple comments, so the relationship between users and comments is one to many association.

To sum up, the E-R diagrams between the entities of the system is shown in the diagrams.

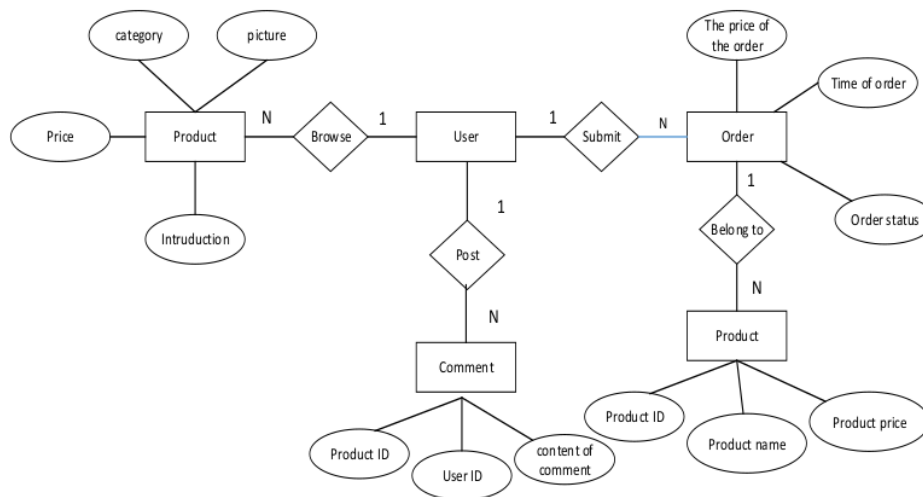


Diagram 7 E-R Diagram of user and order

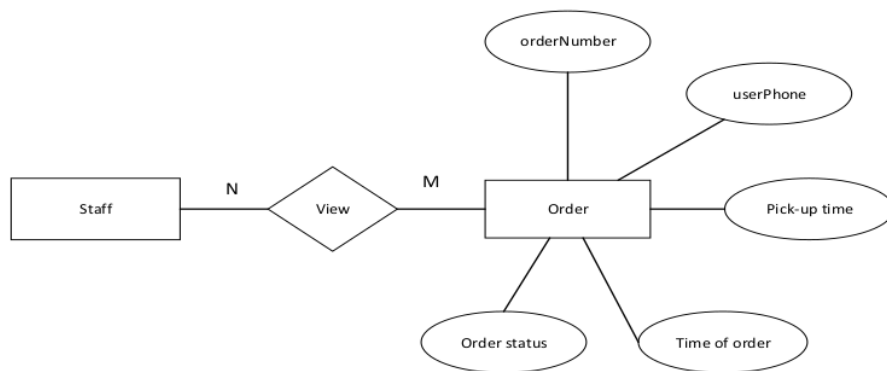


Diagram 8 E-R Diagram of staff and order

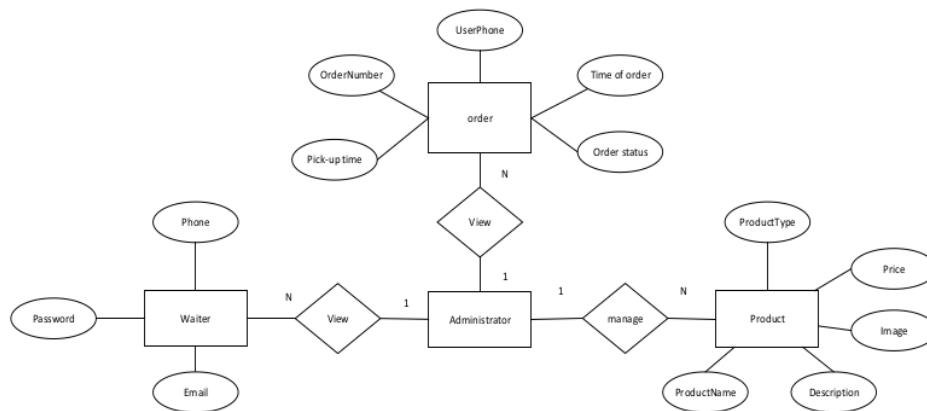


Diagram 9 E-R Diagram of Waiter, administrator and product

5.1.2 The design of data table

Through the above analysis of the system entities and the relationship between entities, this section will further design the physical implementation details of the

entity model, so as to determine the data table structure of the data model, mainly including determining the table name, field name, field type, etc. According to the requirements of the system, the system mainly includes the following data tables: customer table, restaurant attendant table, restaurant administrator table, product table, comment table, order table.

MongoDB belongs to the document-oriented database. The type of storage data is BSON, a kind of structured data similar to JSON. MongoDB has the concept of DB / Collection similar to the relational database Database / Table, but MongoDB is more flexible. Documents in the same collection can have different attributes. However, this flexibility does not mean that it is unnecessary to design its structure. In the project, it is necessary to design the structure before code implementation. In order to show the data structure clearly, the ordering system regards the collection as a table, and the data in each collection is consistent. MongoDB does not support server-side join queries, so the top objects should be stored in a separate collection. When it is not necessary to create a collection for each object in the system, it can be implemented by an embedded object. Combined with the application of the ordering system, the specific schema model of each collection is designed, that is, the specific content of each table. Together, they form the models of the database, as shown below.

1. Customer collection

The customer collection is used to store customer information, which includes five attributes: User ID, User name, Password, Phone number and Email address. Since each customer will generate an order after the payment is completed, the order is also an attribute of the customer, and the order owned by a customer can be queried, so the order object should be embedded in the customer collection. As shown in the table:

Field	type	Note
UserID	String	
Username	String	
Password	String	
Email	String	
Phonenumber	String	
Order	Object	Order Time, mealTime, wayOfTakingMeals, Status, price

Table 1 Customer collection

2. The restaurant attendants collection

The collection of restaurant attendants is used to store personal information of restaurant attendants. The collection includes User Id, User name, Password and Phone number. The collection structure of restaurant attendants is shown in the following table:

Field	type
UserID	String
Phone Number	String
Email	String
Password	String

Table 2 Restaurant attendants collection

3. The restaurant administrators collection

In this system, only one administrator is needed, and only the basic account password is needed to log in to the system. Therefore, the restaurant administrator entity should have the following attributes: User Id password. The structure of the restaurant administrator collection is shown below:

Field	type
UserID	String
Password	String

Table 3 Restaurant administrators collection

4. Product collection

The product collection is used to store basic information of dishes. This collection mainly includes six attributes: Product ID, name, type, price, introduction and picture. Because the picture needs to be imported from external resources, this attribute is a link to the image file. The product collection structure is shown below:

Field	type	Note
ProductID	String	
Productname	String	
ProductType	String	
Price	String	
Introduction	String	
ImageUrl	String	The url of picture

Table 4 Product collection

5. Comment collection

The comment collection is used to store the user's comments on the dishes. This collection mainly includes Comments Id, Proposer, Product, Content and Time. Since it is necessary to know which customer is commenting on which product, the customer collection and product collection need to be embedded into the comment collection. The structure of the comment collection is shown below.

Field	Type	Note
CommentID	String	
Content	String	
Time	Date	
Customer	Object	Including the attributes of customer
Product	Object	Including the attributes of product

Table 5 Comment collection

6. Order information collection

Order information is mainly used to store the main information of the user's order. The order collection should have the following attributes: Order Id, Order time, Mealttime, Wayoftakingmeals, Order status, User information and product information. Wayoftakingmeals means that customers choose to eat in the store or pack them away. The order status mainly includes confirming, making, taking, cancelled and so on. Because the customer information and product information need to be shown in the order. Therefore, the embedded method is adopted here to embed the products and customers that are objects into the order information set. The structure of the order set is shown in the following table.

Field	Type	NOte
OrderID	String	
Order Time	Date	
MeallTime	Date	
price	String	
Status	String	Confirming, making,taking
wayOfTakingMeals	String	Eat in or take out
Customer	Object	
Product	Object	

Table 6 Order information collection

5.2 Function design of key modules

5.2.1 Division of function modules

From the perspective of requirement analysis, the system can be divided into functional modules according to user roles, as follows.

1. Function module for consumer role

According to the characteristics of consumer roles, the function modules for consumers include personal information management, shopping cart, viewing dishes, order management and comment. The details are shown in diagram.

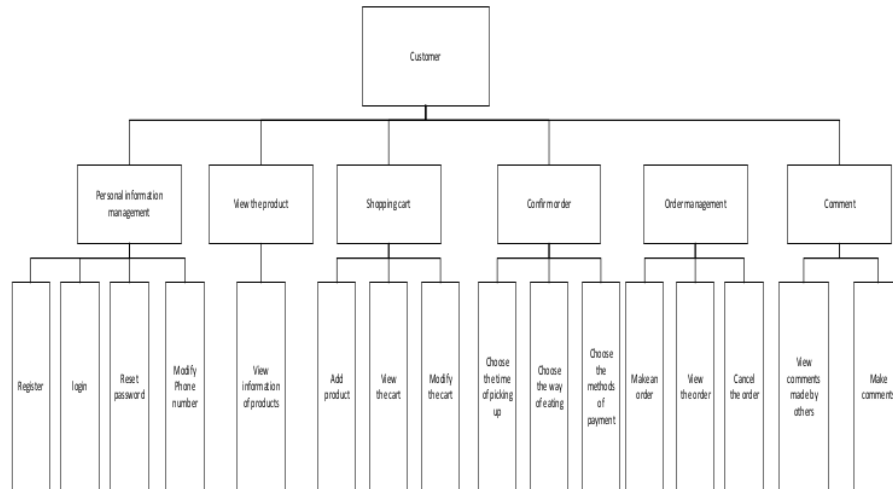


Diagram 10 Function module for consumer role

2. Function module for the role of restaurant administrator

According to the characteristics of the role of restaurant administrator and its management characteristics, the function modules for the role of restaurant administrator include personal information management, restaurant attendant information management, dish information management, order management and sales statistics, as shown in diagram 11.



Diagram 11 Function module for the role of restaurant administrator

3.Function module for the role of restaurant attendants

According to the characteristics of the role of restaurant attendants, the function modules for the role of restaurant attendants include personal information management and order management. The details are shown in diagram 12.

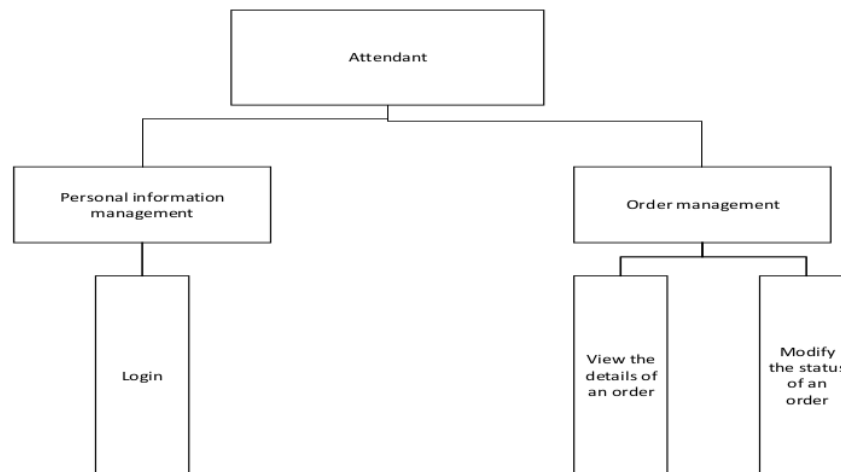


Diagram 12 Function module for the role of restaurant attendants

5.2.2 Design of key modules

1.Consumer information management

Anyone who uses the terminal with internet access can access the system, but only the consumers registered as the platform can log in to the platform through mobile phone number and password, and carry out personal information maintenance, such as changing the password. Because a mobile phone number corresponds to a user, and the mobile phone number will be used as a meal voucher, the user's mobile number is not modifiable. The business flow chart of consumer information management is shown in diagram 13.

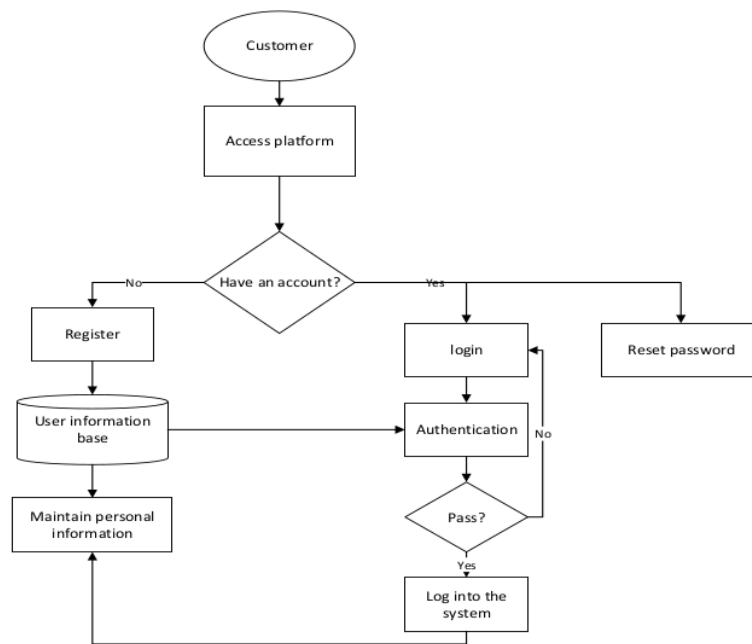


Diagram 13 consumer information management

The specific process is as follows:

- (1) Users access the platform through the terminal.

(2) If the customer does not have an account number, it needs to register the account first, and the system will save the registration information to the database.

(3) If the customer already has an account, he can directly login to the account and password to the system.

(4) When the customer logs in, the system will conduct authentication, and if the customer passes the authentication, he can enter the system. If the verification fails, it will give a prompt message and stay in the login interface to wait for the user to continue to input.

(5) If the user forgets the login password, the password can be reset by the original mobile phone number.

2.Shopping cart function module

After logging into the platform, consumers can use the shopping cart function, and can add dishes to the shopping cart, modify the number of dishes in the shopping cart or delete dishes. Users can select dishes in the shopping cart to submit according to their own needs. The business flow chart of the shopping cart function module is shown in diagram 14.

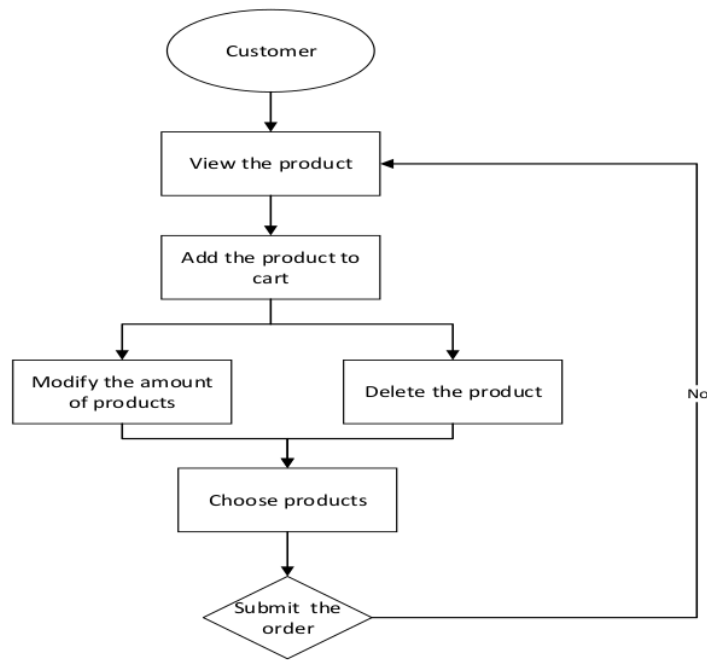


Diagram 14 Shopping cart function module

The specific process is as follows:

- (1) Consumers can log in to the platform to view dishes and find the dishes they need according to the classification of dishes.
- (2) Customers can add dishes to the shopping cart, enter the shopping cart interface to modify the number of dishes they subscribe to, or delete the dishes they don't need.
- (3) Customers choose the products they need to buy
- (4) Submit order

3.Order confirmation module

After the consumer confirms and submits the goods in the shopping cart, the page will jump to the order confirmation page. On this page, customers can choose the time and method of taking meals according to their needs. The business process of order information confirmation page is shown in the following diagram 15:

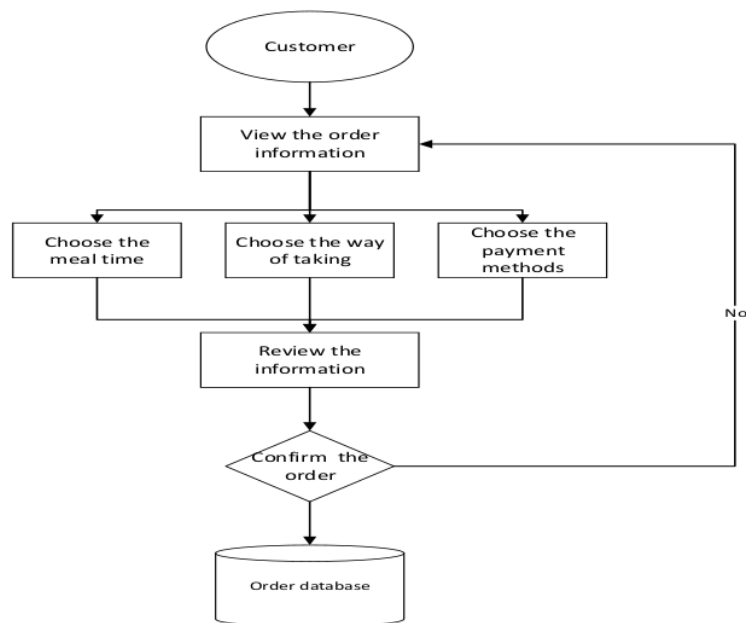


Diagram 15 Order confirmation module

The specific process is as follows:

- (1) After entering the order details page, customers can select the start time and end time of the order,
- (2) Choose the way to pick up the meal, including in-store dining and packing
- (3) Choose the payment method.
- (3) Confirm order submission. After confirming the order submission, customers can enter the order management interface.

4.Dishes management module of the system administrator

The system administrator is responsible for the management of dishes. After logging into the system, the administrator can add, delete, modify and query dishes according to specific requirements. The specific business process is as follows:

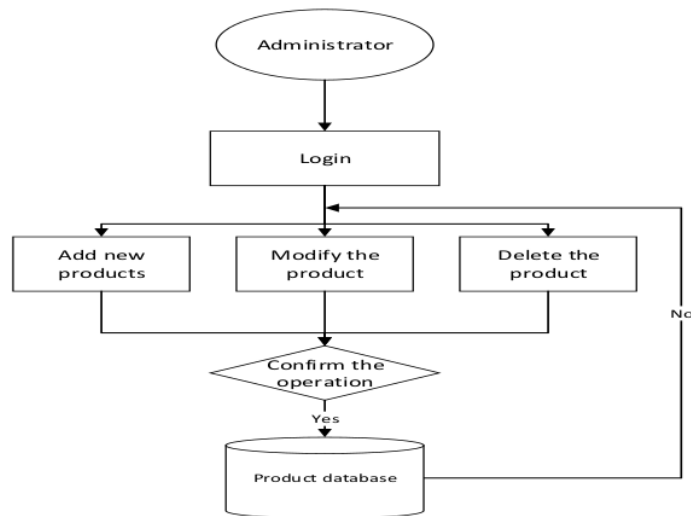


Diagram 16 Dishes management module of the system administrator

The specific process is as follows:

- (1) The system administrator logs in the system through the account and password
- (2) The administrator can add the product information , change the product information and delete the product according to the demand.
- (3) After confirming the product information, it will be submitted to the system, and the product information will be stored in the database.

5. Order management module for the restaurant administrator and attendants

Because restaurant administrators and restaurant attendants can manage orders, their order management function can be realized in a function module

The business flow chart is as follows:

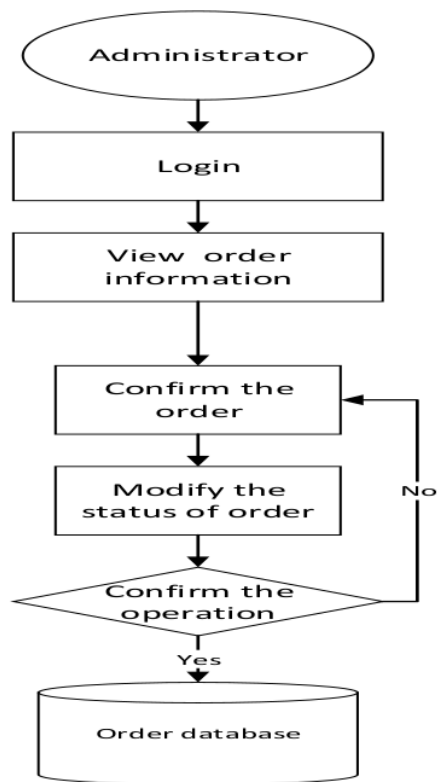


Diagram 17 Order management module

The specific process is as follows:

- (1) After the administrator and attendants log in to the system, they can view all the order information.
- (2) For the order just submitted, the administrator or the server can confirm the order. After the order is confirmed, the status of the order is changed to being made. At this time, the customer can not cancel the order.
- (3) After the order is made, the administrator or the server can change the current order status to taking, indicating that the order is waiting for the customer to pick up the meal.

5.3 Construction of development environment

5.3.1 System development environment

The development language of this system is JavaScript, and the front-end development framework is Vue.js. Because the customer-oriented pages need to adapt to different terminals and need to do responsive processing to achieve this function, the foreground page uses the bootstrap style library. Back end development uses Node.js. Because Node.js community has rich third-party toolkits, many tool classes of Node.js are downloaded and installed through its package management tool NPM, which is extremely convenient. Build the packaging tool as Webpack. The code editor is the Visual Studio Code. The database of this system uses MongoDB which is a non-relational database. The front-end running environment is the Chrome browser which simulates mobile devices.

5.3.2 Building development environment

The main steps of building the development environment are as follows:

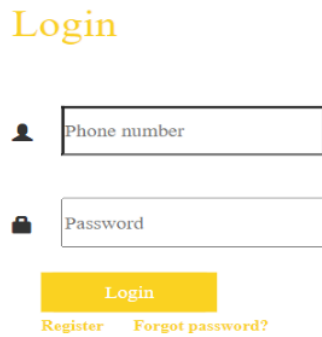
1. First download the Node.js development environment. The package manager NPM of Node.js will be installed with the installation of Node.js.
2. Vue is installed with NPM when Node.js is available. Using NPM install -g@vue/cli to install Vue.
3. After downloading, enter the statement of vue create ordering to create the project, and select some configurations to complete the project creation.

After the development environment is set up, the specific implementation can be carried out according to the function design introduced in the previous chapters.

5.4 Implementation of client module

5.4.1 Implementation of login and registration module

Consumers can access the system by inputting the website address of the system through the mobile browser, enter the account number and password to log in to the system and enjoy the services provided by the system. The specific login interface is shown in figure 1.

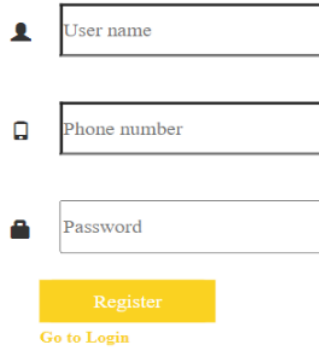


The image shows a login interface with a yellow title 'Login'. Below the title, there are two input fields: the first is labeled 'Phone number' with a person icon to its left, and the second is labeled 'Password' with a lock icon to its left. Below these fields is a yellow 'Login' button. At the bottom, there are two links: 'Register' and 'Forgot password?', both in yellow text.

Figure 1 Login interface

If the consumer has not registered as a user of the system, click the registration button to enter the registration page, as shown in figure 2. Consumers need to fill in the mobile phone number, name, password and other information for registration. After clicking the registration button, the registration information will be submitted to the background server. The system will search the user information database, judge the uniqueness of the account number, and give the corresponding prompt. The logic of uniqueness judgment is shown in the figure 3.

Register



The registration form consists of three input fields, each with an icon to its left: a person icon for 'User name', a mobile phone icon for 'Phone number', and a padlock icon for 'Password'. Below these fields is a yellow 'Register' button and a 'Go to Login' link.

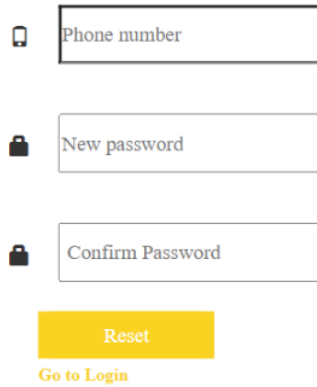
Figure 2 Registration page

```
guestRouter.post('/guest', async function (req, res) {  
  const doc = await dao.postGuest(req.body);  
  if (doc === 1000) {  
    res.send('phone already been registered!');  
  } else {  
    res.send(doc);  
  }  
});
```

Figure 3 The logic of uniqueness judgment

If the user already has an account of the platform and forgets the password when logging in to the system again, the user can click reset password to obtain permission to continue using the account. The page to retrieve the password is shown in figure 4.

Reset Password



The form consists of three input fields, each preceded by a small icon: a mobile phone icon for 'Phone number', a padlock icon for 'New password', and another padlock icon for 'Confirm Password'. Below these fields is a yellow 'Reset' button and a 'Go to Login' link.

Phone number

New password

Confirm Password

Reset

[Go to Login](#)

Figure 4 Retrieve the password

5.4.2 View products module

After the user logs in to the foreground system, the system will automatically display the menu module page, as shown in figure 5. Users can understand the details of dishes through the introduction and pictures of dishes on the interface, and can also quickly find dishes according to different categories. Customers can also click the shopping cart icon below the dishes to add dishes to the shopping cart.

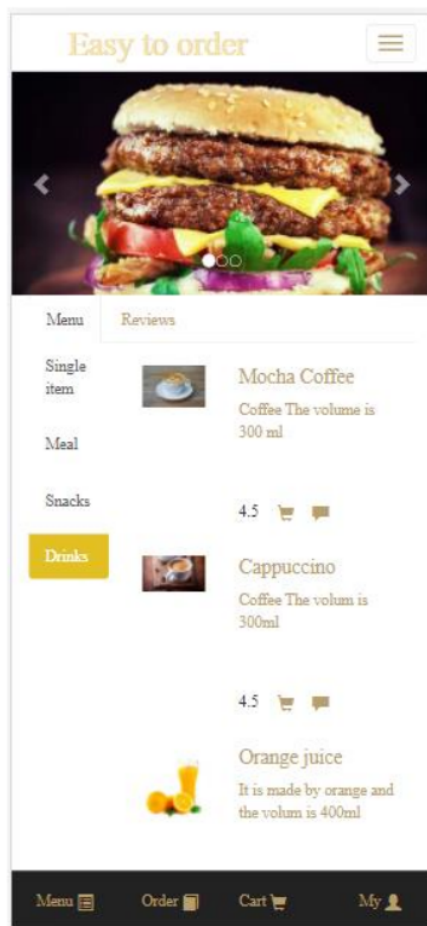


Figure 5 Menu page

5.4.3 Comment module

If the customer wants to evaluate the dishes, they can click the Comment button next to the shopping cart image. When the customer clicks on the comment, the page will jump to the comment page. At this time, the customer can evaluate the dish. The details of the comment page are shown in figure 6. Users can also view their own and other users' comments, as shown in figure 7.

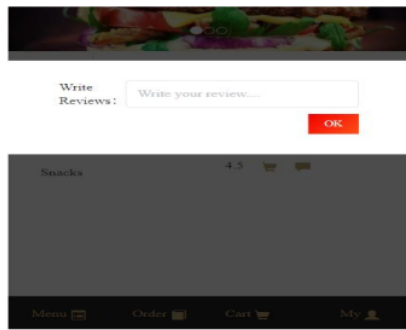


Figure 6 Make Comment

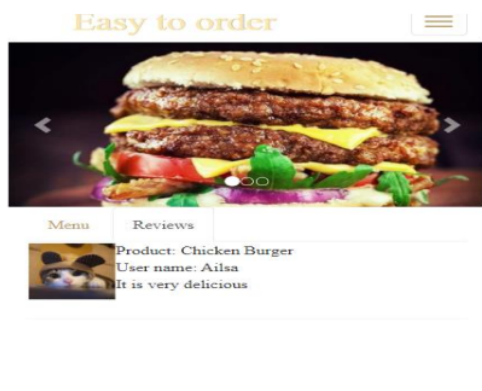


Figure 7 View comment

5.4.4 Shopping cart module

After the user clicks the Add button on the home page to add the product to the shopping cart, the number of products will be displayed in the bottom navigation bar, and the display effect is shown in figure 8. Customers can click the shopping cart button in the navigation bar to enter the shopping cart page. After entering the shopping cart page, they can manage the selected dishes. The shopping cart page also displays the total price of all products on the current page. The specific page details are shown in figure 9.

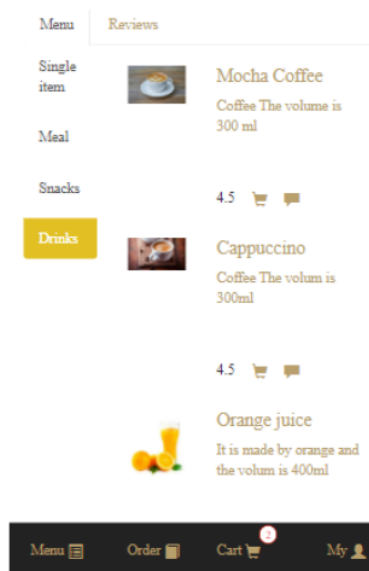


Figure 8 Shopping cart in the bottom navigation bar

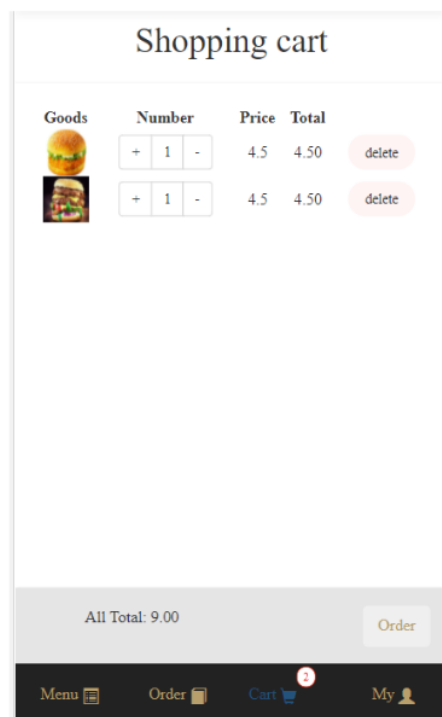


Figure 9 Shopping cart

Customers only need to click the shopping cart icon once on the home page to add products to the shopping cart, and then they can operate on the number of products in the shopping cart page. Customers can click the add sign to add the number of products, or click the minus sign to reduce the number of a product, but the number of products is at least 1. When the number of products is equal to 1, customers can not click the minus sign to reduce the number of products. At this time, customers can choose the delete function to delete the products they don't want to buy.

The logic of quantity judgment is as follows:

```
<button type="button" class="btn btn-default" @click="() => f.count = f.count - 1 === 0 ? 1 : f.count - 1">-</button>
```

Figure 10 The logic of quantity judgment

5.4.5 Order confirmation module

When the user submits an order from the shopping cart page, the system will automatically jump to the confirm order details page. The details are shown in Figure 11.

Easy to order

Pay

Detail info

Reserved user: Ailsa

Reserved Phone: 12345678909

Pick-up time: Choose Time 12:00

Reserve Start Date: Choose Start Date 2020-10-29

Reserve End Date: Choose End Date 2020-10-29

Pay Method: Choose Pay Method Card

Pay Method: Choose Eat Type Pick up at store

Total: 9.00

Make Order

Menu Order Cart (2) My

Figure 11 Order confirmation page

On this page, customers can also choose how to pick up the meal and how to pay. Customers can also choose a specific time to pick up the meal, including the time point, the starting date and the ending date. However, when the customer selects the time to pick up the meal, the system will judge the time of taking a meal. If the current time has been reserved, it will give a prompt message. The specific implementation code is as follows:

```

async function postOrder(arrOrders) {
  const allOrder = await Order.find();
  const times = allOrder.map(({ mealTime }) => getTxt(new Date(mealTime)));
  const clientTimes = arrOrders.map(({ mealTime }) => getTxt(new Date(mealTime)));

  for (let i = 0; i < times.length; i++) {
    const rs = clientTimes.filter(timeStr => timeStr === times[i]);
    if (rs.length >= 1) {
      return { msg: 'sorry, mealTime conflict with other customer, please change mealTime time ! ', code: '-1' }
    }
  }

  for (let i = 0; i < arrOrders.length; i++) {
    await new Order(arrOrders[i]).save();
  }

  return { msg: 'success' };
}

```

Figure 12 Time judgement

5.4.6 Order management module

After placing an order, the user can select the "order" button to enter the order management page, as shown in figure 13. On the order management page, you can view the order details. If you find that the order is wrong, before the restaurant confirms the order, the customer can click the "cancel order" button to cancel the order. Customers can view the status information of the current order so that they can pick up the meal on time.

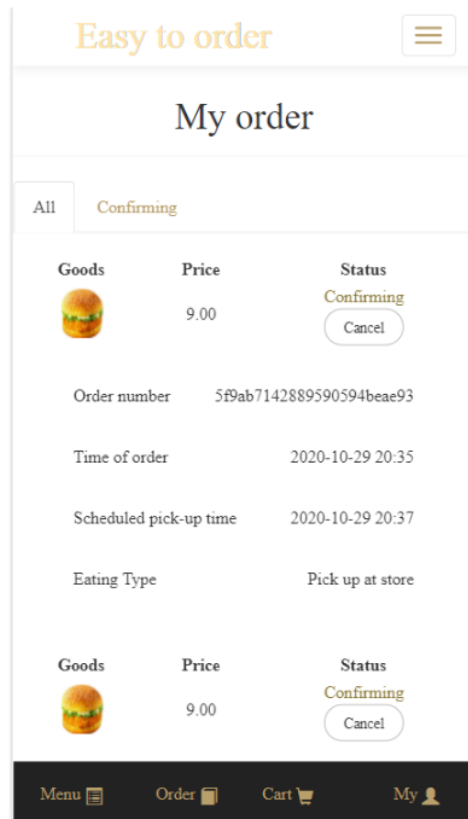


Figure 13 Order page

5.4.7 Add to the home page

This system is mainly for mobile phone users, but the general web app needs users to enter the URL each time to find the system. According to PWA technology, the system realizes the function of adding the application to the screen home page. Users can choose to add the application to the mobile phone desktop after logging in to the system for the first time. When users need to use the system again, they can find the application quickly and conveniently. Features added to the desktop need to add a descriptive profile to the project manifest.json. It is a part of PWA. It is a file in JSON format, which is used to describe application-related information. The purpose is to provide the function of adding the application to desktop so that

users can open web applications from the desktop without downloading. The function code added to the main screen is shown below:

```
{
  "name": "order-fe",
  "short_name": "order-fe",
  "theme_color": "#4DBA87",
  "icons": [
    {
      "src": "./img/icons/android-chrome-192x192.png",
      "sizes": "192x192",
      "type": "image/png"
    },
    {
      "src": "./img/icons/android-chrome-512x512.png",
      "sizes": "512x512",
      "type": "image/png"
    },
    {
      "src": "./img/icons/android-chrome-maskable-192x192.png",
      "sizes": "192x192",
      "type": "image/png",
      "purpose": "maskable"
    },
    {
      "src": "./img/icons/android-chrome-maskable-512x512.png",
      "sizes": "512x512",
      "type": "image/png",
      "purpose": "maskable"
    }
  ],
  "start_url": ".",
  "display": "standalone",
  "background_color": "#000000"
}
```

Figure 14 Manifest.json

5.5 Implementation of server module

5.5.1 Product management module

The page details of the product management module are shown in figure 15. In the product management module, the administrator can click the Add button to add a new product. After clicking the button, the page for editing product details will pop up. The administrator can edit the specific information of the product on this page. The product details editing page is shown in figure 16.

The administrator can also edit the dishes that already exist in the system. When the administrator clicks the box in front of the dish, the edit and the delete buttons will be activated. At this time, the administrator can click the Edit button to change the product information, or click the delete button to delete the product.

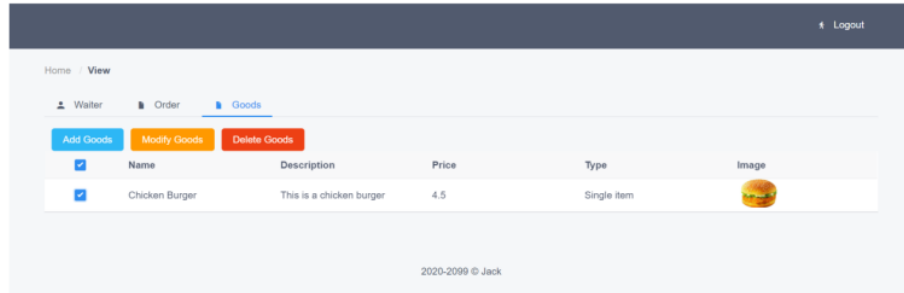


Figure 15 Product management page

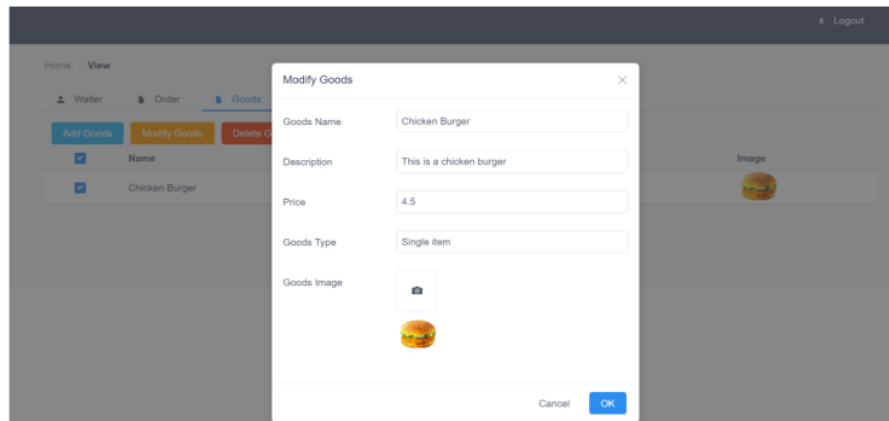
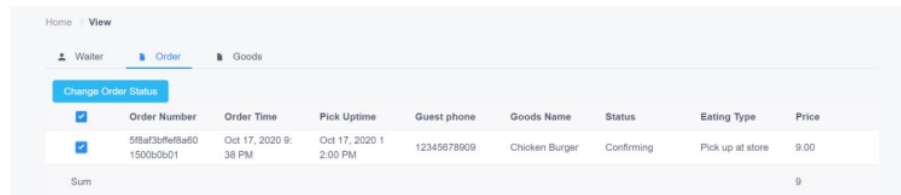


Figure 16 Product details editing page

5.5.2 Order management module

Restaurant administrators and waiters can view and manage orders. The specific page is shown in figure 17. After receiving a new order, the server can confirm the order. After confirmation, the customer can not cancel the order. When the order is started to be made, the server should change the status information of the order in time, and the status of the order should be making. When the order is finished, the

status of the order should be changed to taking, which means that the order is waiting for the customer to pick it up.



Home / View

Waiter Order Goods

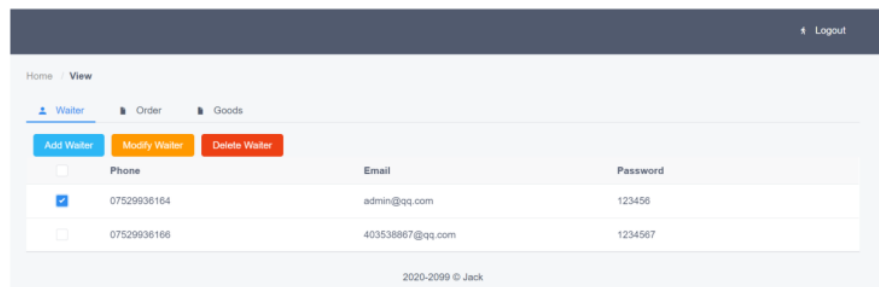
Change Order Status

☒	Order Number	Order Time	Pick Uptime	Guest phone	Goods Name	Status	Eating Type	Price
☒	5f8af3bffe8a501500b0b01	Oct 17, 2020 9:38 PM	Oct 17, 2020 12:00 PM	12345678909	Chicken Burger	Confirming	Pick up at store	9.00
Sum								9

Figure 17 Order management page

5.5.3 Server management module

The restaurant attendant can be managed as shown in Figure 18. The administrator can apply for a new account for the restaurant attendant, modify and delete the existing account information. The specific operation page is shown in figure 5-5-5.



Home / View

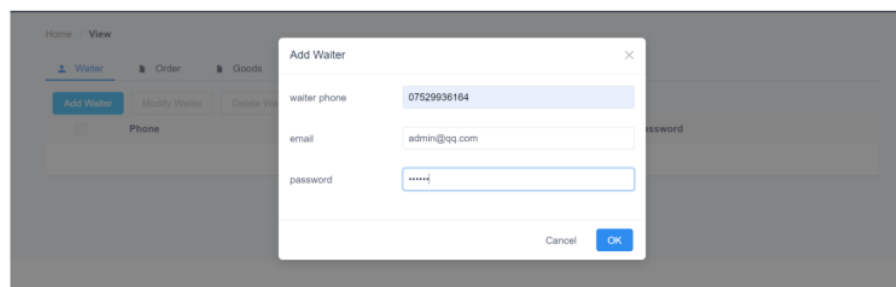
Waiter Order Goods

Add Waiter Modify Waiter Delete Waiter

☐	Phone	Email	Password
☒	07529936164	admin@qq.com	123456
☐	07529936166	403538867@qq.com	1234567

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Figure 18 Server management



Home / View

Waiter Order Goods

Add Waiter Modify Waiter Delete Waiter

Add Waiter

waiter phone 07529936164

email admin@qq.com

password *****

Cancel OK

Figure 19 Server details editing page

5.6 Conclusion

This chapter is mainly based on the system requirements analysis proposed in the previous chapter, combined with the characteristics of the system, designed the system database, including use case diagrams and tables. According to the division of user roles, different functional modules are designed and the functions of each module are realized. The key modules include login function, view dishes function, comment function, order confirmation function, and order management function. The system is operated step by step, and the screenshot of system operation is reserved, which is more convenient for customers' solution and operating system.

Chapter 6 Evaluation

In order to evaluate whether the implementation of the system meets the expectation, and find out the defects in the software system, ensure the high quality and reliability of the software. Software testing is proposed in the system implementation and deployment phase, and the user questionnaire is used to evaluate the design level and user experience of the system. Because this system mainly has the user page and the backstage management part. For the user page, use the mobile terminal to test. For the background management page, it needs to be tested in the browser environment to verify the correctness and completeness of the program.

6.1 Test content

The system test discussed in this paper mainly includes two aspects: the interface test and function test. The following tests are carried out from these two aspects.

1. Interface testing

The interface is the direct carrier of the interaction between the system and the user. The interface of the system should be neat and generous, and the operation of the interface should be relatively flexible. The UI of the system will not change much under different resolutions of smartphones and PCs. The interface test is to check each interface according to the UI design diagram to see whether the interface is consistent with the design, mainly including:

- (1) Whether the interface style is one, whether the display is neat and consistent, not messy;
- (2) Whether each area is divided according to the function so that the user can operate conveniently, concisely and improve the user experience;
- (3) Whether the operability of the interface conforms to the habits of most users, and whether the operation process is concise and clear.

2. Function test

The purpose of functional testing is to verify whether the functional logic in the system is implemented correctly according to the requirements and design. It is the most important part of system testing, which mainly includes:

(1) Logic test: whether the response of each page to the system users' key input is reasonable, and whether there is an error display, for example, the user clicks the submit order page and does not jump to the order page.

(2) Link test: including testing whether all active links are linked to the linked page according to the instructions, whether the linked page exists, and whether there are isolated interfaces in the whole system. That is to let users do not know how to jump back or jump to another interface and cannot return to the home page for menu browsing.

6.2 Test methods

6.2.1 Interface test

This test invited 10 participants to evaluate the system. The main content of the test is the style of the interface, the rationality of the functional area design, and whether the operation process can quickly meet the needs of users. After completing the test, the participants filled in the questionnaire. The main questions are:

1. What do you think of the operability of the software?
2. Is the interface style unified?
3. Is the functional interface of APP clearly divided?
4. Do you think the shopping process of the app is simple?
5. Do you have any problems browsing dishes?

6. Do you have any problems adding items to the shopping cart?

7. When you place an order, do the functions provided by the app meet your needs?

8. Does the comment function provided by the app meet your needs?

6.2.2 Function test

The function test of the system mainly depends on the manual operation of the tester. The tester completes all operations according to the prepared test cases and judges whether the system has achieved the expected function goal. The main test cases are as follows:

Test items	Test procedure	Preconditions	Expected results	Test status
User login test	1. The user input the wrong mobile phone number on the login page. 2. The user input the correct mobile phone number and wrong password		Prompt the customer that the mobile phone number or password is incorrect	The test passed
Appointment time test	1.The user enters the page to fill in the order information. 2. The user selects the time to pick up the meal	The order time selected by the user is consistent with that of other customers	It indicates that the current meal taking time has been reserved	The test passed
Meal recall test	1. User submit subscription	The current time is pick-up time	Prompt the customer to pick up	The test passed

	Single to backstage	the meal		
Shopping cart jump test	The user chooses to order from the shopping cart page	There are items in the user's shopping cart	Go to fill in order details page	The test passed

Table 7 Test cases

6.3 Conclusions from the test

After several adjustments in the process of design and development, the interface of the system has basically met the requirements. In the final test of the system, the interface of smartphones with different resolutions and different browsers is tested. Ten testers were asked to use the system and fill in the questionnaire after the test. According to the questionnaire collected, 80% of people like the style design of this page. 90% of the people think that the functional interface is clearly divided and that the operation process of the software is simple and clear, and the shopping process is relatively simple. 90% said they could add items to their shopping cart and submit orders when shopping. The interface test results show that the interface test of the system is good and meets the user requirements.

The system function test is carried out in the development process. After the development of a certain function and the code is submitted, the test of the completed function is started to check whether the function is correctly realized. If defects are found, they are modified and tested again at the next test readiness point. After all the functional modules are completed, the system is tested in a centralized way. Each function of each page and the connection between the functions are tested, and the operations of adding, deleting, modifying, and saving are tested repeatedly to ensure the correct realization of each function. At present, the system has passed most of the test cases, and the system function basically covers the design requirements.

6.4 Realization with literature review

The design of this system is consistent with the literature review. First of all, the system can be a restaurant that does not need to spend huge costs to buy self-service ordering kiosks, especially for small and medium-sized restaurants, which not only reduces investment but also saves space. Secondly, the system is based on web development, not affected by the mobile phone system. Users only need a mobile terminal which can be connected to the Internet to use the system. Third, the system can be used without downloading, which saves memory space and is convenient for users.

6.5 Aim implementation

The system first uses bootstrap to realize the response processing of the page, and the system can run on different terminals. Secondly, this system uses Vue to process the page component and use the node.js to interact with the background. Finally, it realizes the function of ordering meals by using the system. Users can make reservations and order according to their own time demand. To this point, the report has met the main part of the aim settled before, even though there are still some issues in detail that need to be talked about in further works.

6.6 Objects implementation

The design of this system achieves its purpose. First of all, this paper makes a comparative analysis of the literature, and then puts forward the research and design methods. A set of the practical prototype is designed through the field investigation of the restaurant. Secondly, the system is developed on the basis of the design prototype, and the function is constantly improved and the interface is optimized in the development process. After the initial implementation of the system, the complex design in the original interface is simplified by using the test, which makes the operation process simple and makes the function more powerful.

Finally, the system which can order online and make an appointment is realized. In the end, the technology of PWA is used to realize the effect of adding the application to the first screen. So on the whole, the system has completed the initial goal setting.

6.7 Expected results

In general, the results of the design system are consistent with the expected results, because users can not only browse the dishes, add the dishes to the shopping cart function, but also set the ordering time. This function includes both the date and the specific time. In the current environment, in order to avoid crowding when taking meals, the system also judges the time of taking meals. If a meal pick-up time has been scheduled, the system will prompt the user to select another meal pick-up time. However, due to time reasons, the statistical function in the administrator part of this system is not perfect. This function only realizes the statistics of all sales amount, and does not make a more detailed division. However, the interface of this function has been reserved and can be implemented later.

6.8 Do it again

If I do the design of the ordering system again, I will spend more time on the page design, enrich the page design, add some comparative elements, and make the page more attractive. And to strengthen the connection between the page elements, to establish a clear, delicate, and refreshing appearance.

Chapter 7 Conclusions and recommendation

7.1 Summary

In the main part of the report, according to the development status of the catering industry, as well as the difficulties and challenges brought to the catering industry under the current new coronavirus environment, this paper puts forward the common problems in the catering industry ordering system and puts forward the purpose and goal of this study as the premise of the system realization. Then, this paper combs the previous research and literature, analyzes and compares several different ordering systems, and puts forward the advantages and disadvantages of different systems, and puts forward the preliminary solutions according to these advantages and disadvantages. Then, before the beginning of the design, the main technologies are determined, and the existing technologies are compared and analyzed according to the requirements. Finally, bootstrap is used to realize responsive page processing in the front-end page, and the front-end page also uses the VUE.js Framework, which is used to build a progressive JavaScript framework for the user interface. The back end uses Node.js To achieve. MongoDB is used as the database.

In the main part of the report, i.e. the design and implementation of the system, the research issues are reformulated and the design objectives are clarified. Then, the system needs analysis and feasibility analysis, and according to the system requirements of the database design and key module function design and implementation. The prototype development method is adopted in the system development, and the system will be tested after each implementation. And according to the test results to improve.

7.2 Conclusion

The rapid development of mobile devices and the Internet has brought great

changes to people's lives. Relying on the intelligent terminal and Internet technology, the traditional ordering mode can be improved, which not only saves hardware cost and time cost for businesses but also brings convenience to consumers. Online ordering and order in advance not only improve service efficiency but also improve customer satisfaction.

This paper mainly studies the ordering system based on the mobile web. Firstly, it analyzes the development status of the ordering system. Secondly, it analyzes the requirements of the system in detail through the use case diagram and analyzes the feasibility and non-functional requirements of the system. On the basis of system analysis, the overall architecture of the system is designed by using E-R diagrams and business flow charts. According to the different functional requirements of the system, different modules are divided, and the detailed design scheme of some modules is emphatically introduced. Based on the detailed design of the system to realize the system functions, this paper introduces the realization of the key technology of the system, and then introduces the specific implementation of the key function modules, and introduces the realization of the user interface and functions from the user level. After that, according to the requirements of the system and the software testing process, the detailed function and interface test of the system are carried out. The test results show that the system has met the requirements of the system and can be used. The foreground page of this system adopts the current popular HTML5 and bootstrap technology, which can prompt error information friendly and greatly improve the user's experience; the background technology adopts open source cross-platform technology, which can effectively improve the portability of the system.

7.3 Suggestions for further study

According to the display of the system implementation, the system has achieved the expected results, but due to the limited personal ability, time limit, the complexity of the system's business logic, and technical complexity, there are still some

shortcomings in the system. After a comparative analysis, the system should also carry out the following work, these works will be in the future learning process, through the continuous improvement of their own technical capabilities to solve and improve. The specific work to be carried out is as follows:

(1) Further research should be made on the operation mode of the online ordering system and further summarizing its business process, add the functions of rush purchase, group purchase, and points.

(2) Further strengthen the study of the art design, improve the aesthetic feeling of the user interface, and improve the user experience degree to attract more users to use.

(3) Due to the limitation of conditions, the system has not been tested on the real mobile terminal, and the subsequent conditions allow the real environment should be used to test the situation of the system, and the system should be improved by discovering and correcting the defects tolerance.

(4) When the number of users increases to a certain extent, the execution speed of the system may be the bottleneck. Therefore, code optimization and database query optimization should be strengthened to further improve the execution efficiency of the system.

In short, as long as we study and learn constantly, the system will be more and more perfect.

Chapter 8 Reflection

The process of this research has benefited me a lot. From the determination of the research topic to the completion of this project, I have experienced confusion, anxiety, and joy. In the process, I encountered some problems, and I tried my best to overcome these difficulties. Now this project has been completed initially, I have more experience and harvest to share.

I was most confused when I knew that I need to start to determine the theme of the paper, because I did not know what I want to do, and I did not know what level to achieve to meet the needs of the paper. So at the beginning, the work didn't go well. But fortunately, with the help of school teachers, they guided me and let me know what I really wanted to do.

At that time, it was the outbreak period of the new coronavirus. Everyone was at a loss about the arrival of the virus. We did not know what effective measures should be taken to protect ourselves and others. In the context of this environment, received the Enlightenment of McDonald's driving order, I began to investigate the project. First of all, I made a preliminary understanding of the current ordering system based on my own practical experience and social phenomena. Then I began to read a lot of literature, and combined with the design of the ordering system proposed in the literature for comparative analysis. On this basis, the author puts forward his own research direction.

In the process of the project, I also encountered a lot of problems, whenever I encountered problems, I would feel anxious, because solving these problems will definitely cost me a lot of events, which will delay my development progress. One of the most profound problems in my memory is that I designed a prototype at the beginning of the project development, and used bootstrap to implement the prototype. This is also a necessary step in the prototyping method. However, when I really started to develop, I needed to integrate my prototype code with Vue, but the code failed to run due to a version problem that I didn't notice in time. Of course,

every time a function module is implemented, it is my most fulfilling moment.

Finally, through the research of this topic, I have mastered a system design and development method, learned the basic principle of database design, and understood the interaction between the front end and the back end. In the system development process, there are many mature technologies that can be used. Through the comparison of databases, we can understand the differences between different databases, and learn the use of restful architecture. In the future, I will further develop the related technologies of the web to prepare for future research work.

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