Research on the Design of E-commerce Platform Based on Cloud Computing Technology

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Abstract. Cloud computing is the leading technology of the next generation of the internet and the information age. With the continuous development of computer and network technologies, computers have infiltrated various domains. Applying cloud computing to e-commerce websites will bring about significant transformations and usher in a new era of electronic commerce. This paper, drawing from practical work experience, designs and implements an e-commerce website based on cloud computing technology, effectively applying e-commerce theory to real-world business activities. The e-commerce platform studied in this paper comprises both a front-end system and a back-end system. The front-end system includes key functionalities such as product search, shopping cart, checkout, free trade zone, member personal information management, and interactive communication area. The back-end system is divided into seven major functions: product management, member management, free trade zone management, order management, interactive communication area management, and analytical chart display. In the implementation process, cloud computing technology is employed to enhance query efficiency, resulting in the creation of a small-scale e-commerce platform. This platform utilizes a technical combination of JAVA, SQL Server, and cloud computing technology to process various types of information and business operations. Its advantage lies in the substantial resources provided by cloud computing technology compared to traditional B/S architecture. It has transitioned from vertical queries in the past to a cross-sectional resource query model today. The application of this technology offers significant advantages and vast development prospects for e-commerce platforms.

Keywords: Cloud computing technology, E-commerce, Internet, Platform design

1 Introduction

In recent years, an increasing number of internet users have turned to online banking for their transactions, finding it both convenient and expedient. Simultaneously, this mode of shopping has brought boundless enjoyment to people [1]. Most contemporary internet users have experienced online shopping, and this system is an electronic commerce marketing platform developed specifically for small and medium-sized product manufacturing and marketing enterprises [2]. With the rapid development and widespread use of the internet, e-commerce and online shopping have become another fashionable mode of shopping, gradually gaining acceptance among people [3]. For small and medium-sized enterprises, internet marketing is poised to become a significant market in the future. The realization of e-commerce enables

individuals to conveniently shop, transact, or access services from anywhere globally at any time [4]. It allows for in-depth understanding and extensive sharing of information about products and services. Customers can browse and compare products and services widely, reducing the cost and time of shopping or transactions. It also facilitates optimizing the supply chain for businesses, making it more conducive to expanding into global markets and achieving economies of scale [5-6]. Additionally, it contributes to enhancing and improving the management capabilities of enterprises or merchants [7]. The purpose of constructing this system is to provide a virtual environment and a business operational space tailored to the Chinese context for the vast number of small and medium-sized enterprises. This platform can assist small and medium-sized enterprises, and even individuals, in independently establishing and marketing an internet shopping mall, with the goal of achieving rapid profitability.

2 System Development Platform and Operating Environment

2.1 Development Platform

Based on SUN's Java technology, which is open and platform-independent, we have adopted a B/S architecture [8]. This technology fully complies with J2EE standards for application development. The system utilizes JSP/Java technology, enabling it to run on Unix and Unix-like systems, as well as various hardware servers, except for Windows systems. This technology choice has rapidly gained widespread application and promotion across various types of systems and continues to expand in the field of software development [9-10].

2.2 Operating Environment

A. Programming Languages: Java, HTML, JavaScript, XML.

B. Database: SQL Server 2005.

C. Operating Systems: Windows 98/2000/2003 and Windows NT/2000 (Intel).

D. Development Machine: A desktop computer capable of running SQL Server client and integrated Java development environment.

E. Server: CPU not less than P4 2.9 GHz; memory not less than 2GB; hard disk not less than 160GB.

3 System Overall Design

3.1 Overall System Design

(1)General Functional Design

The platform's functionality consists of a front-end system and a back-end system. While these modules may appear to be independent from a surface perspective, they are closely interconnected in terms of database access. All modules access the same database, differing only in the tables they access. The functionality of each module is arranged and developed based on the data collected during research. According to the analysis of the above functions,

the front-end module of this system is further divided into several sub-modules, which are then further subdivided. This is illustrated in Figure 1.
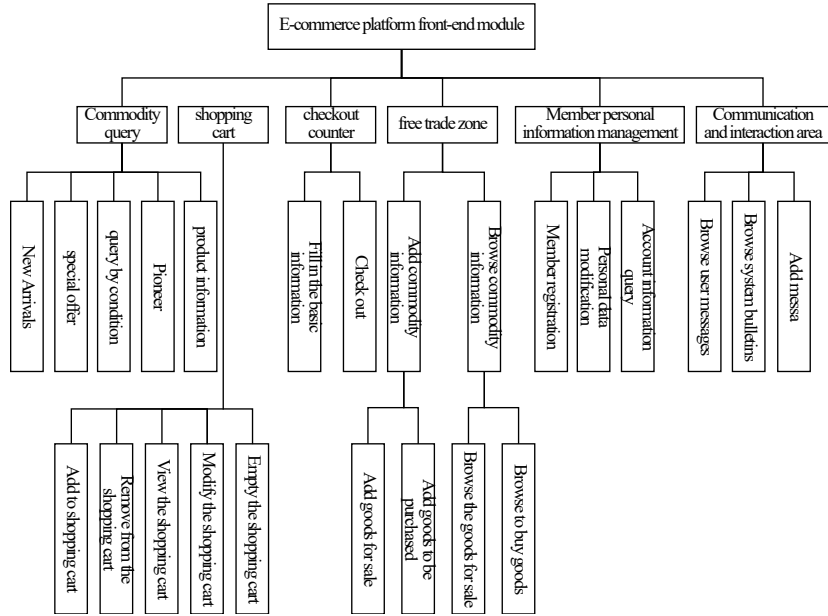

Fig. 1. Introduction to the front desk functions of the system

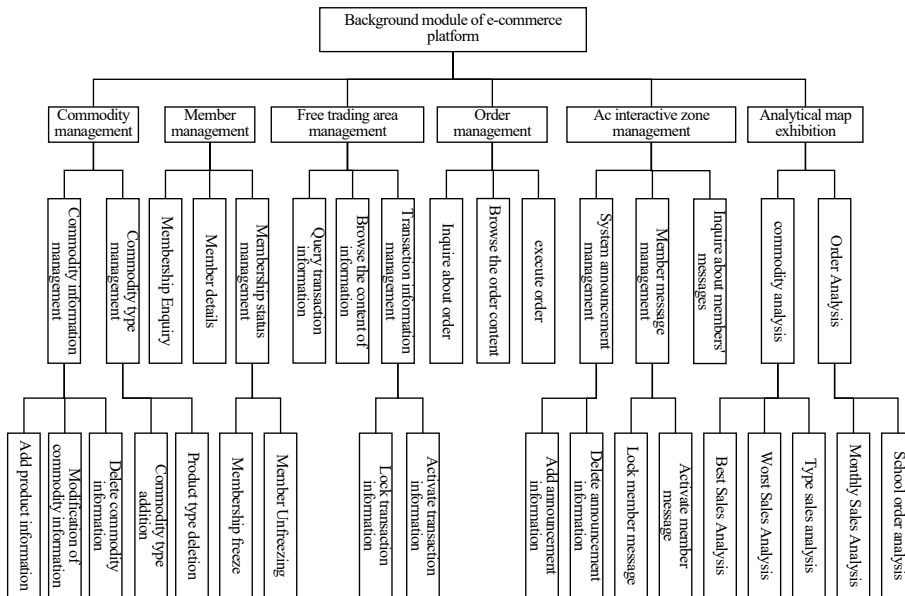The background function module is shown in Figure 2.

Fig. 2. Introduction to System Backend Functions

(2) Overall Framework Design

The logical division of the system into layers, namely the component layer, business layer, and application layer, forms the framework structure of the system. The component layer provides the necessary components for the system's operation. These components abstract certain common functionalities from various business systems and transform them into independent subsystems. The business layer centrally manages the common business engines in the system, while the application layer directly interfaces with users, presenting the functional modules for user utilization. This structure is illustrated in Figure 3.
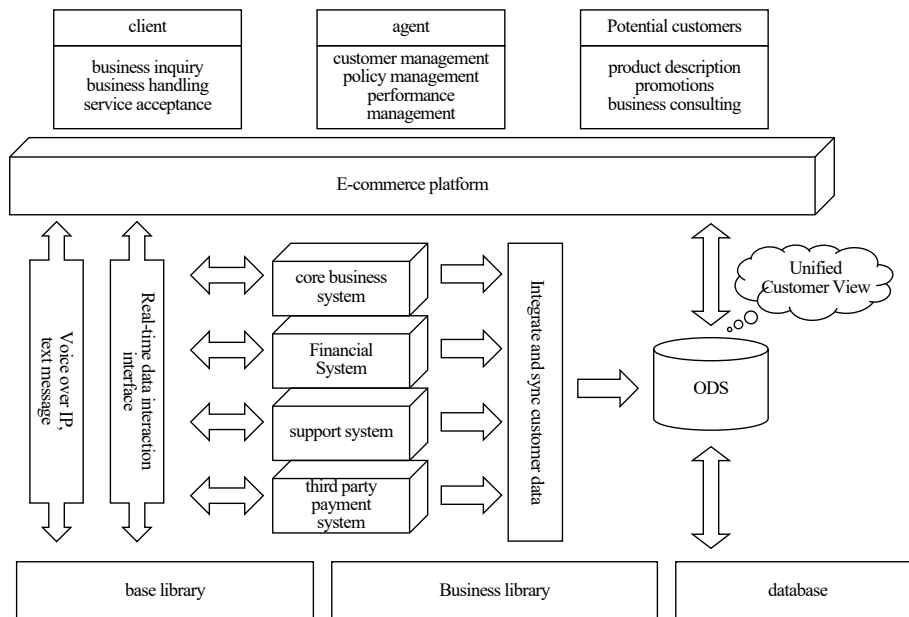

Fig. 3. Overall Framework Design of the Platform

Cloud Computing Framework Design: What is commonly referred to as "cloud computing" typically involves an infrastructure platform. Developing and deploying various cloud-based applications on this platform can provide users with more and better services. This includes services for information resources, product resources, physical resources, e-commerce, and more. During the development process, the system will utilize cloud computing technology for product management. Based on its own requirements and the characteristics of cloud computing, it can flexibly control and apply public and private products. This provides significant room for the system's development and ensures the security of its transactions and information. Therefore, under normal traffic conditions, the system uses its internal data center to process product queries and, based on customer needs, searches for similar product resources on other websites for comparison. This was not achievable in the past. Illustrated in Figure 4.
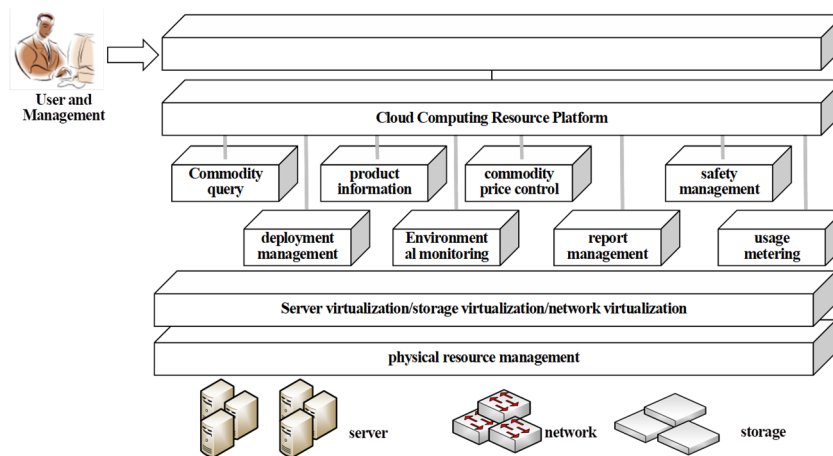
Fig. 4. System Cloud Computing Architecture

The entire system adopts a B/S architecture, based on a data-driven mode of thinking where data is at the center of everything, and data analysis and mining are key. Each application is equipped with a data collection system. When users access the application, the data collection system extracts their browsing information, which is then appropriately filtered and organized before entering the database. Subsequently, comprehensive data analysis is performed using analytical and mining tools, with the analysis results being pushed to the publishing server as the basis for decision analysis.

(3) Basic Business Processes and Design Philosophy

The overall system framework design is composed of two categories of users: customers and product providers, as illustrated in Figure 5. The e-commerce platform encompasses functions such as registration, login, products, orders, payment, settlement, reviews, reputation, and assistance. The arrows represent the actions of users and service providers, with the numbers on the arrows indicating the order of these actions, as well as the execution sequence. The text on the arrows labels these actions. When the action numbers for users and service providers are the same, it indicates that there is no specific order for these actions. Similarly, when the action numbers for individual users or service providers are the same, it means these actions are completed simultaneously. The overall execution steps for actions are as follows:

A. User or service provider registration and login (1.2).

B. Service provider converts services into products (3).

C. Service provider publishes product information on the platform (4).

D. Users search for products, looking for those they need and are satisfied with (5).

E. Once users find products they are satisfied with, they place orders and transfer the calculated funds to the platform (6).

F. After receiving the order, the service provider checks whether the user's funds have been transferred to the platform as specified (7).

G. The service provider provides the service to the user (8).

H. The user "enjoys" the service (9).

I. After "enjoying" the service, the user confirms the settlement through the platform (10).

J. After the service provider confirms the user's settlement, the funds are officially transferred to the service provider (11).

K. Both parties provide mutual feedback (12).

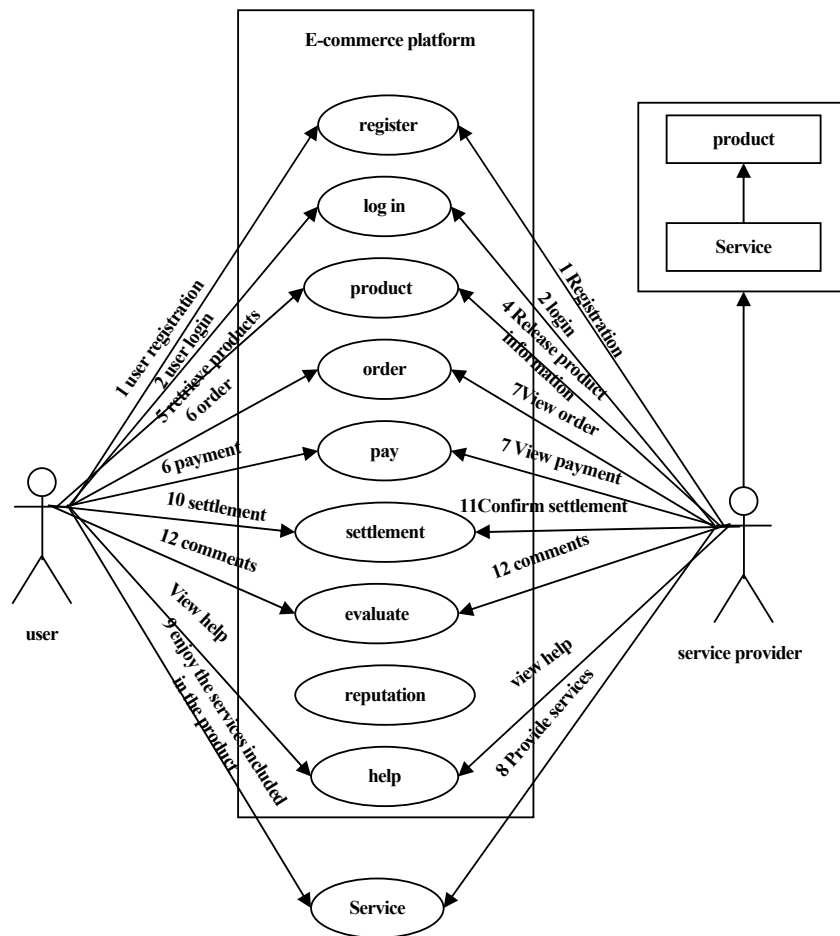

Fig. 5. System Overall Framework Design

3.2 System Database Design and Implementation

(1) Database Design

The primary users of the platform include:

Enterprise decision-makers: Referring to the upper-level leaders of the enterprise.

Ordinary browsers: Referring to general users who access the website.

Suppliers: Referring to intermediaries or direct manufacturers capable of providing goods. Suppliers must undergo qualification certification by the website before they can perform operations such as publishing information.

Buyers: Referring to customers who can place orders on the website. Buyers can be individuals, companies, or enterprises. However, they need to undergo qualification certification by the website before performing operations such as publishing information or placing orders.

Platform Functions:

Online, the platform can accomplish the following:

Business activities such as order processing and negotiations.

Online product showcasing, online supply and demand information publishing, and a series of e-commerce activities.

Implementation of modern marketing methods such as market automation and sales automation, thereby significantly reducing costs and improving operational efficiency.

(2) Business Process Implementation

The business processes primarily include the member process and the order process.

1) Member Process:

New member registration.

Existing members modify their information.

Suppliers enter and modify product information they submit.

Members can change their passwords without approval, directly modifying the password in the user table (t_userinfo). All unapproved content is stored in the temporary member table (t_member_bak), where the user ID (n_id) is a varchar(50) with a default value of 0, indicating newly registered users. This includes newly registered users and existing users who need to update their information. In the formal user table, the user ID (n_id) is an auto-increment field. After approval, users who pass the approval process are stored in the login user table (t_userinfo). When existing users need to modify their information, the updated information is stored in the temporary table (t_member_bak). At this point, the user ID corresponds to the user's ID in the formal table. After administrator approval, the user's information in the temporary table is updated into the formal table, and then an email notification is sent to inform the user of the successful change. Finally, the temporary data in the temporary table is deleted.

For new users who are approved successfully and stored in the formal table, their information is similarly removed from the temporary table. The temporary table contains only unapproved information for both new and existing users.

2) Order Process:

The order process involves the generation and fulfillment of orders. The specific steps are as follows:

A. Generating Draft Orders:

The shopping cart uses the basic unit (unit in ptype) to form a general order, which then generates an order number stored in the main order table (dlyndxorder). The fields to be inserted include vchcode (document number), date (document generation date), btypeid (customer ID), and draft (document type: 1 = draft, 2 = contract). In the order detail table (bakdlyorder), the following fields are inserted: vchcode (document number), ptypeid (product ID), qty (quantity), price (unit price), and total (amount = quantity * unit price).

B. Converting Draft Orders into Contracts:

When an order is fulfilled and becomes a contract, the order status in the main order table is updated to draft = 2 (document type: 1 = draft, 2 = contract), creating a record.

Suppliers and customers can access this module in the frontend. They can upload supply and demand information. In this table, the attribute (c_type) is used to determine whether it is a supply information (c_type = 1) or a demand information (c_type = 2). Backend administrators perform the following tasks:

A. Maintain New Products: Directly maintain various product information for new products in the product information table (ptype).

B. Approve New Products: Approve product information submitted by suppliers. After organizing and approving, insert the data into the formal table (ptype).

C. Add New User Information: Add new user information to the login user table (t_userinfo).

D. Approve New Members: Approve newly registered members to make them eligible for login. Insert relevant data from the member temporary table (t_member_bak) into the login user table (t_userinfo).

4 System Stress Testing

Here, we will use the stress testing of the frontend shopping cart functionality as an example to describe the entire testing process of the system.

4.1 Testing Process

(1) Test Case Description:

Simulate multiple user logins and create 1000 instances consecutively for user shopping in the shopping cart functionality. Perform load and stress performance testing on a single machine and in a clustered testing environment. The pressure is directly applied to one application server.

(2) Test Objectives:

Evaluate whether the adoption of a clustering solution is effective for the application system and whether server resources are used reasonably.

(3) Concurrent Execution of Test Data:

Concurrently execute test data for multiple users.

(4) Resource Utilization:

During the system's use, instances are created purposefully, and the number of users is gradually increased to track the usage metrics of the system. Below are the resource utilization test results.

Cluster testing was conducted, and the resource utilization of two application servers and the database server in the clustered testing environment is shown in Table 1.

Table 1. Resource occupancy

Test Case	Number of concurrent users and resource occupancy indicators		maximum value	average value	minimum value
create instanceA	1000	CPU Utilization%	33.8	10.054	2.9
		Paging Rate	2.5	0.082	0
		Disk Traffic	9.75	0.813	0
	1200	CPU Utilization%	38.1	15.713	0.875
		Paging Rate	0.25	0.015	0
		Disk Traffic	2.6	0.336	0

4.2 Test Results:

From the response time of the single-machine environment and the clustered environment, it can be seen that the response time of creating instance A in the cluster is faster than in the single-machine environment. This indicates that the efficiency of the cluster is superior to that of the single-machine environment in terms of system performance. In other words, the level of client concurrency performance that the system can provide in a clustered environment is superior to that in a single-machine environment. Analysis of resource utilization monitoring data for application servers and database servers in the single-machine test environment shows that the resources of the application and database servers are used reasonably, and there are no bottlenecks. As the system load increases, the cluster solution is effective. However, in the single-machine environment, it was found that the CPU utilization of the database server was already very high when creating instances. The cluster strategy of the application server allows the system to withstand more concurrent loads, which puts more pressure on the database server, and CPU usage becomes a bottleneck.

5 Conclusion

This paper starts from the current status and design of an e-commerce platform, provides a detailed explanation of the business processes, and uses cloud computing technology to integrate various resources, allowing users to receive more complete and timely services. The system processes various information and business operations through the technical combination of JAVA, SQL Server, and cloud computing technology. Cloud computing technology has significant advantages and broad prospects compared to traditional B/S structures. Its use directly enhances the stability of the entire platform. What's important is that

enterprises can open up a unique sales channel through this platform and provide a virtual space that can comprehensively showcase their products and services in terms of variety and quantity. This enhances the visibility and business reputation of enterprises, facilitating their participation in international competition. Small and medium-sized enterprises can also use this platform to conduct modern trade, gain opportunities for equal competition with large enterprises, and achieve greater development space. This results in reduced operating costs, significantly improved operational efficiency, and substantial savings, enabling small and medium-sized enterprises to concentrate funds on developing core business.

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