

Research Article

The Interactive Design of Library Information Sharing in View of Network Communication Technology

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From the perspective of data viewing, interactive design is to present abstract information and data in a visual form through a computer interface. It is formulated based on a humanized and flexible human-computer interaction model. The interaction process between computers and humans requires careful thinking and design. It must follow the principle of “user first, machine second.” Understanding the audience’s psychology and behavior characteristics can effectively enhance computer vision interaction and expand the scope of the audience. The research in this study aimed at the interactive design of library information sharing based on network communication technology. It introduces the organizational structure of the library and analyzes in detail the problems that the current library information resource sharing still faces. Then, this study proposes a dynamic differentiated service mechanism of DDSM to improve the success rate of information transmission in the interactive design system. This study designs an experiment on the interactive design of library information sharing by multiple types of users. The results of the experiment show that students of all grades and teachers use the library and library websites more frequently. For the interactive information service of the library, users are most satisfied with the project attitude of the book recommendation service method. Its satisfaction rate reaches 68%, and it is also the most popular among users. The main purpose of the interaction between library users is to share knowledge. However, the current domestic academic libraries have a general sense of interactive information services, and the development speed has always been slower than that in foreign countries.

1. Introduction

1.1. Background. At present, the rapid development of network communication technology and its in-depth application in logistics, transportation, medical, and other industries have promoted network communication technology in the direction of informatization and precision. This includes the construction of smart libraries. NFC technology and RFID technology are the two most important short-range wireless communication technologies in current network communication technologies, and they are also important integrated technologies in the development of enterprise technology. At present, RFID technology has been successfully integrated into the library system and has become an important driving force. The design of human-computer interaction must achieve two levels of space: one is the available space; the other is the

user experience platform. Available space is the most basic function of the interactive form. User experience is the comfortable and pleasant feeling it brings to users during the work process, and it is also the ultimate goal of human-computer interaction [1]. The use of interactive information visualization in Web pages is the main manifestation of the analysis of data and information. After verifying the authenticity and validity of the information, an optimized visual expression is created to enhance the visual effect. A good user experience can help users understand and select information and shorten work time. Incomplete graphic design can lead to inaccurate interpretations of information concepts and reduce the main purpose of visual information. Secondly, on the basis of good visual performance, the visualization of Web page interactive information increases the practicality and exploratory nature of user services.

1.2. Significance. Living in an era when interactive applications of information resources are becoming more and more complex, information dissemination has become more widespread [2]. Users can discover the important characteristics of visible information and data by adjusting the size, color, position, ability, and type, so that everyone can easily understand the original complex and obscure information and data. Libraries in the information age are no longer limited to traditional literary activities, but focus on the development of digital libraries, collecting and storing numerous digital information resources. To some extent, libraries are constantly increasing the capacity of digital information sources every day. On the other hand, the purchased digital information source is protected by intellectual property rights and authorized by the digital source provider, which can be used inside the library and cannot be accessed via the Internet. This prevents the spread of digital information sources to a certain extent and increases the time lag and energy costs between the information source and the information source. Therefore, it is very important to establish an effective digital information sharing and interactive mode.

Whether at home or abroad, the application of network communication technology in the field of libraries is increasing, and it has spread to major cities and university libraries. At present, the application of network communication technology has begun to be on the bright road of technology application [3]. However, the research and application of network communication technology in the field of libraries at home and abroad need to be further explored.

1.3. Related Work. The rapid development of the Internet of things technology has transformed the communication network from “information transmission” to “information service,” and this shows that people want to receive more than just information, but an excellent experience and quality service from the information transmission process [4]. First, Zhu H introduced the concept and characteristics of the Internet of things, namely the Internet of humans, machines, and things, aiming to realize intelligent information services. He discussed the corresponding key technologies. It includes the integration of communication, computing and control technology, heterogeneous network fusion theory and technology, smart sensor technology and short-distance networking theory, large-scale network transmission theory and technology, network virtualization and intelligent computing technology for information services, and collaborative network system and service mode for IoT applications. Finally, he analyzed the development trend of information technology and information network in the next five to ten years and made suggestions on the main research areas that need to be explored and key issues that need to be solved, but they have not yet been specifically applied [5].

With the increase in maritime activities and the rapid development of maritime economy, the fifth-generation (5G) mobile communication system is expected to be deployed at sea. Mobile edge computing (MEC) can achieve

high energy efficiency in MCN, but at the cost of high control plane delay and low reliability. In response to this problem, Zeng J proposed mobile edge communication, computing and caching (MEC3) technology, which converges mobile computing, network control, and storage to the network edge. Its new method of supporting efficient allocation of resources and reducing redundant data transmission can achieve reliable implementation of computational intensity and delay-sensitive applications. It uses an offloading algorithm based on best response (BROA) to optimize task offloading. The simulation results show that the task delay can be reduced by 26.5 ms, and the end user’s energy consumption can be reduced to 66.6%, but the practicality is not strong [6].

The understanding of library professional knowledge still needs to be deepened. D Sarkar demonstrated how libraries can incorporate photo-sharing applications into collection development and service provision to encourage users to increase participation around digital inclusion. He uses stratified sampling to select libraries from four continents. He collected data from 160 libraries and followed the evaluation model prepared for this purpose. The comparison of the implementation of photo-sharing applications demonstrates the relevance of the different methods adopted by the library and provides an overview of the implementation through supporting examples, but the current survey is limited to selected libraries on four continents and only to the English language websites. This research may be further expanded to include other types of libraries in different fields, including libraries that use non-English websites, to have a more comprehensive understanding of the implementation status. Therefore, the scope of this study was not yet comprehensive, and the reference nature needs further study [7].

The redesign, development, and evaluation of the African Storybook Initiative service in online and mobile applications have attracted much attention. The service supports the creation and reading of publicly licensed storybooks to support the development of literacy in Africa. The redesign of Amory A utilizes a series of cultural and historical activity theory principles, including activity objects (obyekt is an independent entity that satisfies the objective result of imagination in advance), tool intermediary, and shared objects. They are part of the third-generation activity system. Activities are implemented as shared objects, including libraries, creation, translation, and adjustment of activity objects. The experimental results proved that his design solved the problems discovered during the review. This research shows that reading and creation created by individuals have good results in supporting new storybooks (predmet), but the specific experimental content is not clear enough [8].

Robust design methods and optimized design search algorithms need to be integrated with commercial CAE simulation tools. Kim K H developed a new robust optimization design method and applied it to the design of plastic injection molding products. The interactive design space reduction method (IDSRM) based on orthogonal experimental design is a general optimization tool. Using

this system, designers can interactively adjust the design space in the process of searching for the optimal solution according to the experimental results. Compared with the initial design scheme, the optimized design using this method shows higher efficiency and better results in terms of design robustness against process changes. However, there are few available fields at present [9].

Interaction design originated from website design and graphic design, but has now grown into an independent field. Preciado L proposed a simple solution. The finite element method (FEM) interactive simulation of deformable objects includes a volume model, which directly uses a triangular mesh. Using a high-quality tetrahedral mesh and using the extended finite element method (XFEM) to perform a mesh intersection algorithm on the surface mesh, the surface mesh can be simulated in a stable manner. In his research, he improved the grid intersection method by increasing the robustness of simulating complex grids. At the same time, he showed how to realize user interaction in real time, but the experimental operation is a bit complicated [10].

The thinking method of interaction design is not only based on industrial design. Sheng W proposed a general three-dimensional method to simulate the fruit decay process. He used a visual model to digitally design the fruit. Through an interactive design method similar to traditional sketching tools, the corrosion resistance parameters of each point of the three-dimensional fruit model are generated. They derived an exponential function to calculate the recessed displacement of the geometric shape caused by decay. To draw wrinkles on the rotten area, he used normal noise maps to modify the normal vector model of the fruit and used the isotropic ward BRDF model to represent the appearance of the fruit. However, the experimental error value is not clear yet [11].

1.4. Innovation. For the special application environment of the library information sharing interactive system and the user side, it needs to design a reliable authentication and security mechanism. Therefore, this study proposes a dynamic differentiated service management mechanism used in the network to ensure the availability of wireless communication resources and data security and to improve the success rate of information transmission.

2. Interactive Design Method of Library Information Sharing on Account of Network Communication Technology

At present, when a personal computer terminal is directly connected to an Internet user, they can directly access any Internet resource through the personal computer and the same is true for the resources in the library. However, as a public library for information preservation and dissemination, for internal office and network security considerations, users must pass through two firewalls when accessing library websites or resources [12]. For other hosts in the library network, including servers for storing digital

information sources, they use internal IP addresses in the local network and ultimately access the local network. Therefore, users cannot directly pass through the second firewall through other means. This means that users outside the library cannot access the resources on the library's digital information server. Access to any library inside the library will pass through the firewall and then establish a connection. If library users want to access the internal server, they must be authorized by the network administrator to access through the proxy server, as shown in Figure 1.

From the perspective of the organizational structure of a library, it is usually divided into six parts: the editorial department, the reader service department, the technical department, the electronic library, the information department, and the office [13]. The content of the book collection editorial department is mainly to complete the book cataloging work, to ensure the update, sharing of library teaching materials, and to count the number of collections. The specific task is to contact the publisher to buy books and check the collection, as well as the production of book information. The main content of the reader service department is to complete reader management and book collection management [14]. The specific functions of reader management include managing the proof of borrowing books and dealing with readers' related issues. The specific functions of library collection management include book management and bookshelf management. The specific tasks of book circulation include borrowing, returning, and statistical distribution. The technical department is more important, mainly responsible for the work of library information technology [15]. The electronic reading room is the basis of library computer reading training. Readers can inquire about the latest developments, sources of books, and multimedia materials in the electronic reading room. The main task of the ministry of information is to develop the connection between Chinese and foreign language data centers and to provide training and services for teachers and students. It publishes information in the website library and reviews books and other related works. The office is the core of the library's leadership, responsible for the library's human resources and foreign exchanges. Under normal circumstances, the book collection editorial department and the technical department will not directly face the readers, and the reader service department will act as the reader's service department. The specific situation is shown in Figure 2.

At present, there are also many problems in information resource sharing, which are summarized as follows:

- (1) Lack of Awareness of Information Sharing: for a long time, under the influence of traditional library management technology, people have a tradition of using the number of collections as the library classification standard, but it ignores the problem of learning between people and books and the problem of communication between people.
- (2) Emphasize the Construction of Library Resources, But Ignore Resource Sharing: in the process of collecting and distributing Chinese literary

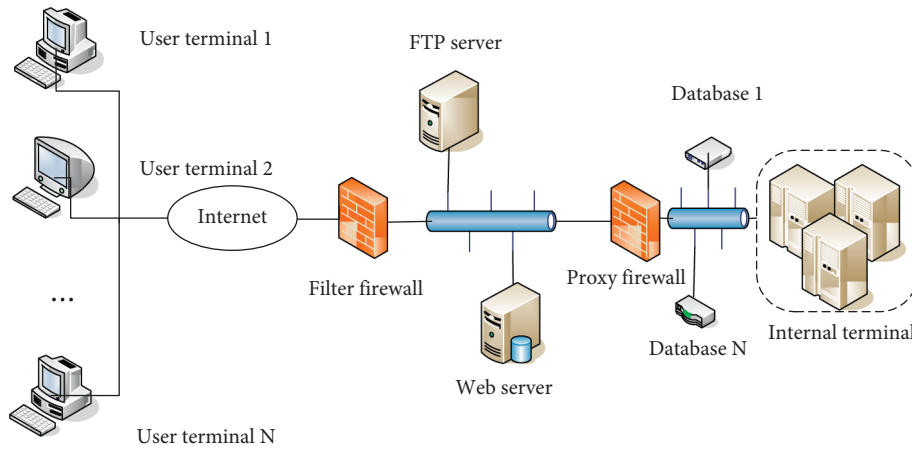


FIGURE 1: Public library network topology.

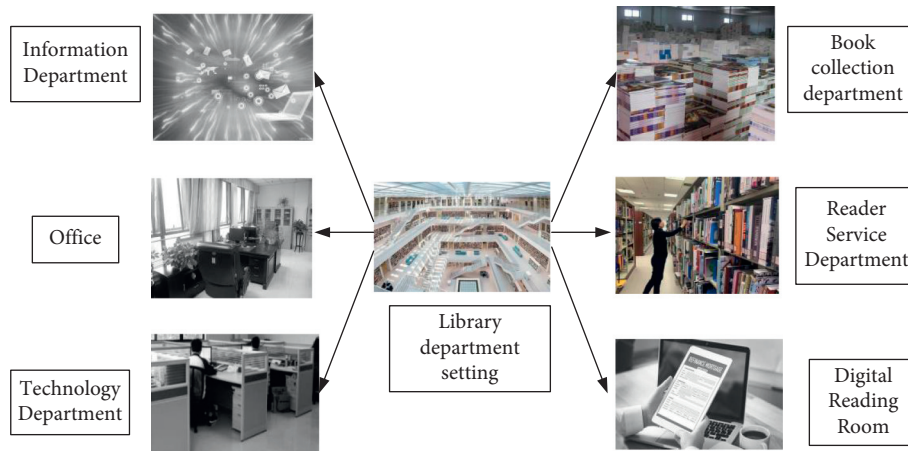


FIGURE 2: Library organization chart.

- resources, there are also constant problems. The construction of book resources naturally has the most fundamental importance and foundation. However, in academic research and discussion, it is always how to build, but how to share is rarely mentioned. In the actual process of co-construction, the issue of how to share is rarely considered [16]. For example, in the general catalog of a traditional library, there is no other way for readers to use the resources that other libraries can only obtain through interlibrary loan after finding the collection information.
- (3) Limitations of the Library Management System: the lagging problem of library management system hinders the further development of collecting and sharing library information sources. The management system is an important part of the collection and distribution of library information resources and plays the role of overall planning and integration. The management of the library determines the operational capacity, scale, form, and benefits of collecting and sharing information sources, but the

nature, function, rules and regulations, collection characteristics, methods, and functions of libraries also have a great influence on the distribution of information sources [17].

- (4) The Standardization of Information Resources: currently, data resources between libraries cannot be effectively connected, and network communication is severely restricted. As the main retrieval method of issued resources, the joint catalog has a small amount of compilation and low retrieval efficiency.
- (5) Information Technology Application Issues: the development of information sharing is based on computer network communication technology. In the past, due to funding, awareness, and other reasons, some professional libraries invested less in advanced facilities, and the level of modern technical facilities in each library was not uniform. There are language barriers, software development, and other problems. In addition, the search network of the database has not been fully established, and the automation level and scale of the distributed network members are inconsistent [18]. The cost of online

search is high, it is difficult to obtain the progress of the update, and the level of the resource allocation network is unified. In terms of multi-platform technology, most of them do not use C/S technology, and the client application does not support character terminals.

- (6) Information Security Issues: information security is an important prerequisite for library network construction. At present, due to the lack of security technology, network transmission has become without scope and the ability to filter spam is poor, etc., and network security has become more and more complicated [19]. Because there is no network security law, considering intellectual property and information security issues, many libraries do not want or dare not to network all information [20].

Libraries not only bear the burden of building national information resources but also guarantee people's access to information. Therefore, the above information resource sharing problems need to be solved in a timely manner and require the efforts of the state, society, and library managers, and technicians.

By constructing an information sharing service platform, the library can make full use of network communication technology to automatically integrate various information sharing resources and collect them into the standard data of the knowledge base library. As we know, for traditional libraries, access to book resources is often achieved only by going inside the library. It needs to search manually to find the target books. Using network communication technology has overcome these difficulties to some extent, and even other service functions can be developed on this basis, and interactive design is an example. The main core of the service platform is the library's data center, which includes communication networks, storage facilities, and other facilities that provide shared solutions. It is a standard communication sharing platform [21]. In the field of network communication technology, the data processing center can complete document data collection through communication networks and other means. Then, adding it to the sensor section for comprehensive analysis, in-depth analysis of the collected data is conducted, and a data center library is built to identify documents and understand the shared information source of the entire system. The basic collaboration center is the main part of the platform, including libraries and reference rooms, which can share information, data, and other resources on the platform and can determine the connection of each source and the optimization of multiple sources. The user application layer can provide users with services such as document retrieval, drawing, and personalization to truly realize information sharing. Figure 3 shows the distribution of an interactive service platform for library information resource sharing [22].

Squid is a proxy service used in the Linux operating system. Its first task is to accept the access request when the user logs in to the application, then connect to the corresponding server, and at the same time send the data that the user needs back to the user, and then back up the cache. Next

time, other users need to access the same data information, and they do not need to connect to the source server, but restore the data stored on the proxy server to the user, saving a lot of access time [23]. Squid supports multiple network protocols, such as HTTP, FTP, and SSL. The difference between it and other agent software is that it uses a separate process to complete the agent function.

The main advantage of Squid is that it uses Access Control Index (ACL) and access authorization list (ARL) to manage all connection requests through the Internet. When an illegal or unauthorized connection request is detected, Squid will confirm the content of the list to ensure the security of the host in the local area network [24]. This can easily and conveniently make the agent's work stable and safe. The Squid proxy process is shown in Figure 4.

As can be seen from Figure 4, Squid is a transit port for proxy user access requests. When a user wants to access a resource server on the Internet, if the server is set up with a Squid server, the user logs in to the Squid server. Squid first defines the user login request and verifies whether the origin server still allows access. If allowed, Squid will receive the data needed by the user from the source server and send it back to the user for backup caching. Squid will periodically clean up the data in the cache area to ensure that there is enough space to cache other users' data access [25]. Squid is relatively simple to use, and its complete functions can be used through a less complex configuration.

The construction of interaction design is user-centered design. In the design process, the social background, personal behavior, use mode, and aesthetic experience of the user are fully considered, and the interaction between people and the product is emphasized, and the design requirements are realized according to the design direction, so that the design ultimately meets the needs of users. The concept of interaction design is the concept of "interaction" as the highest form of design [26]. As the basis of this concept, "interaction" determines the method of the technician at the beginning of the design and in the design process.

Interactive design is both a practical product and a concept. It is not only necessary to study the behavior and characteristics of interpersonal communication but also necessary to use effective expressions and methods. Its performance is a profound discovery of the essence of human nature. It can communicate and interact with design projects or design objects in an intuitive and natural way and can bring immersive emotional experience to audience. It allows us to gain different insights and feelings in the process of communicating with the project. In general, interactive display design embodies the characteristics of "communication," "interaction," "immersion," and "perception" [27].

The process of human-computer interaction is an important part of every information sharing. Figure 5 shows the process of human and information interaction. The interactive information overview in the network builds a bridge between original information and user information and plays an important role in human-machine "communication." After the first-hand data are collected, the data analyst organizes and analyzes them. It screens out the key elements and the internal connections between them.

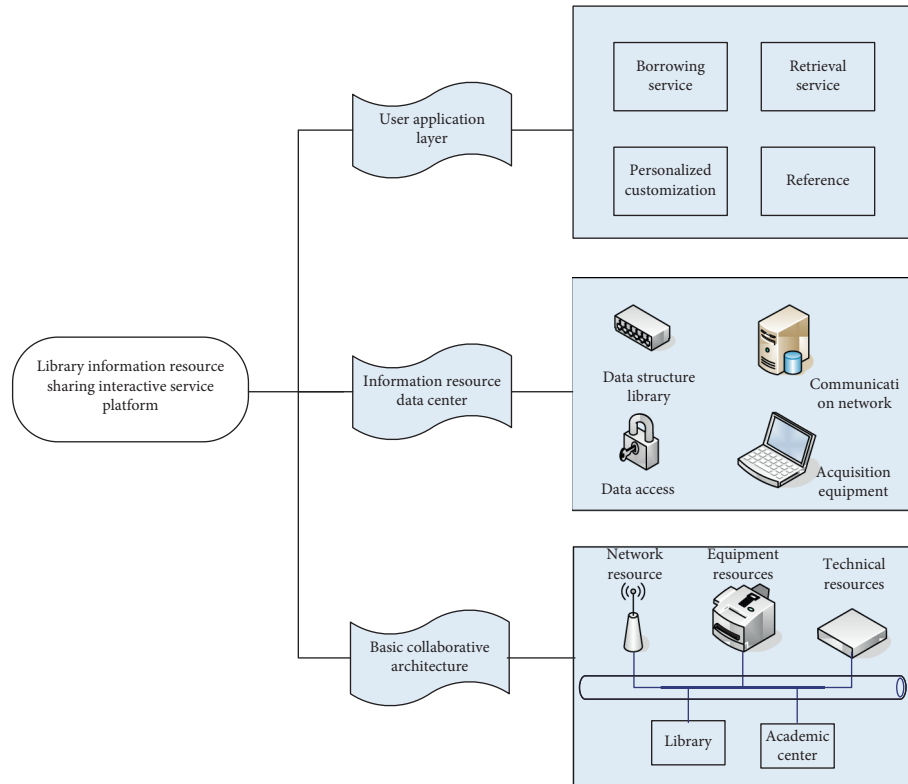


FIGURE 3: Library information resource sharing interactive service platform.

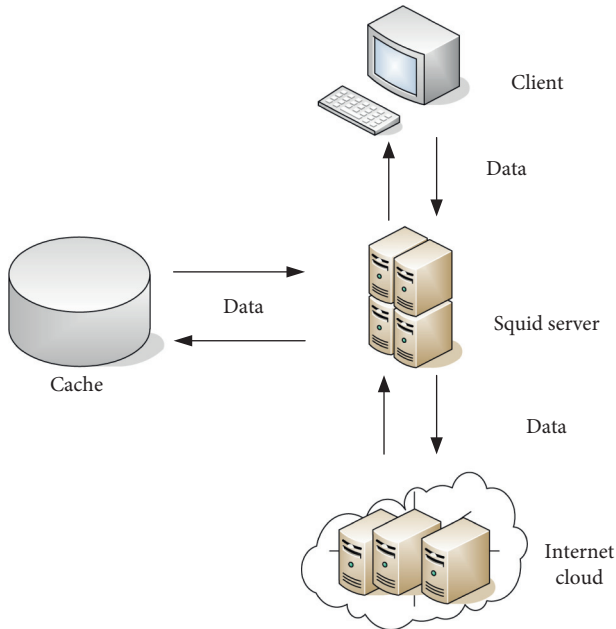


FIGURE 4: Squid's working mechanism.

Interaction designers use visual images to beautify information, use images, colors, sounds, animations, and other elements to encode them into the visual information view, and display them on the platform in the Web view. The information receiver then determines the information on the visual interface through his own cognitive system, so that the

information can be obtained step by step. The visual interaction in the network contains rich information elements, which can make users feel emotions and follow-up thinking, and further promote the sharing and dissemination of information. Finally, the real-time update visualization will transmit the new information data to the computer database. This process reflects the infinite cycle of interaction between humans and information and achieves the ultimate goal of information sharing.

The information transfer system has the characteristics of delay tolerance network (DTN) [28]. In the network, when data are circulating, the end-to-end connection may not be maintained due to the delay effect and arbitrary disconnection, making the Internet protocol process unable to continue. The concept of "store and forward" is used to solve problems caused by arbitrary connections and long variable delays. DTN is a fundamental change to the traditional network architecture [29]. When sending data, messages (called bundles) follow a path and are repeatedly transmitted from one node to another. Taking into account the application and communication characteristics of library information resources, in the system, the key to determining the robustness of the system is the success of message sending and receiving. If the success rate of sending and receiving is low, the system will lose a lot of costs. It can make full use of the storage resources in the network, reduce the packet loss rate alone, and achieve a better queuing system. It needs a new differentiated service management system to provide queue integration. Best Land's storage management and queuing configuration management

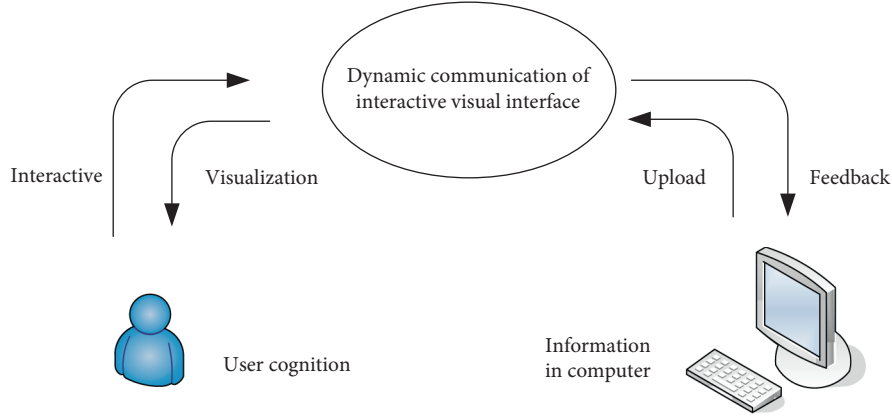


FIGURE 5: Process of human information interaction.

provide excellent differentiated service quality assurance for a variety of application services in the network. According to the characteristics of many information sources that need to be disseminated, this study proposes a network dynamic differentiated service management system (DDSM) [30].

The DDSM combines queue buffer management and queue configuration management. The buffer threshold of each queue is dynamically adjusted. To this end, two key parameters are proposed: emergency coefficient (abbreviated as K) and priority coefficient (abbreviated as λ).

The urgency coefficient is calculated by multiplying the ratio of the current queue length to the total length of the distributed storage and the average survival time of the current queue. It indicates the urgency of the message. The length of the message life cycle will affect the urgency coefficient, which will affect the dynamic calculation of the buffer threshold of an adjustment cycle and the dynamic adjustment of the queue scheduling weight. The priority coefficient is set according to the main priority of the queue, which can represent the proportion of each queue in the process of dynamic adjustment [31].

The definition formulas of the average queue length and urgency coefficient used in DDSM are as follows.

Definition 1. The average queue length refers to the average of the queue length in an adjustment period. Each time a bundle message that needs to be forwarded is received, the length of each queue is sampled. Whenever a bundle message that needs to be forwarded is received, its length is sampled. Assuming that T bundle messages are received within the adjustment period T , and the length of the queue when the first message arrives, the average queue length of each queue is as follows:

$$l_m = \frac{1}{T} \times \sum_{q=1}^T L_{m,n}. \quad (1)$$

Definition 2. The urgency coefficient is represented by the average survival time \bar{A} of queue messages. In the adjustment period t , the buffer thresholds of queue p ($1 \leq p \leq Q$) are, respectively, $t_{p,\min}$ and $t_{p,\max}$, and the average length is

l_p , and then, the urgency coefficient K_p of the queue is as follows:

When $t_{p,\min} < l_p \leq t_{p,\max}$,

$$K_p = \frac{l_p - t_{p,\min}}{t_{p,\max} - t_{p,\min}} \times \frac{TL - \bar{A}}{TL}. \quad (2)$$

When $l_p \leq t_{p,\min}$,

$$K_p = 0. \quad (3)$$

2.1. Dynamic Buffer Threshold Adjustment Algorithm

- (1) The maximum drop probability $P_{p,\max}$ and priority coefficient λ_p are set for different priority queues. Allocating the static buffer by the queue, suppose the static buffer size of the p ($1 \leq p \leq Q$)th queue is E_p , and the total buffer size is E , then the requirements are met:

$$\sum_{p=1}^Q E_p < E, \quad (4)$$

$$E' = E - \sum_{p=1}^Q E_p.$$

Suppose the two thresholds of the queue are $t_{p,\min}$ and $t_{p,\max}$, respectively, then at the beginning there are:

$$t_{p,\min} < E_m, \quad (5)$$

$$t_{p,\max} = E_m + \frac{\lambda_m}{\sum_{q=1}^Q \lambda_n} \times E'.$$

- (2) Whenever a bundle message is received, which queue to enter according to the forwarding strategy is determined, and the queue length L_m is obtained. If $t_{p,\min} \leq L_p \leq t_{p,\max}$, the data packet according to probability P is discarded. The calculation method of P is as follows:

$$F = P_{p, \max} \times \frac{(L_p - t_{p, \min})}{(t_{p, \max} - t_{p, \min})} \quad (6)$$

$$P = \frac{F}{(1 - \text{count} \times F)}.$$

Among them, count represents the number of packets that have entered the queue since the last packet loss. At the same time, the count variable B is modified, the current length L_p is obtained for each queue $p (1 \leq p \leq Q)$, and the captain cumulative variable α_p is modified, namely:

$$B = B + 1 \quad (7)$$

$$\alpha_p = \alpha_p + L_p.$$

Among them, B and α_p are set to 0 during the initialization of each adjustment cycle [32].

- (3) At the end of each adjustment period T , the urgency of each queue [33] is calculated, that is:

$$K_p = \begin{cases} 0 & \frac{\alpha_p}{B} \leq t_{p, \min}, \\ \frac{\alpha_p/B - t_{p, \min}}{t_{p, \max} - t_{p, \min}} \times \frac{TL - \bar{A}}{TL} & t_{p, \min} < \frac{\alpha_p}{B} \leq t_{p, \max}. \end{cases} \quad (8)$$

The size of the buffer threshold is adjusted according to the urgency λ_p , and the calculation method is as follows:

$$t_{p, \max} = E_p + \frac{P_p \cdot K(p)}{\sum_{q=1}^Q P_q \cdot K(q)} \times E'. \quad (9)$$

2.2. Dynamic Weighted Scheduling Strategy

- (1) Basic weights to each queue are assigned, the normalized basic weight of the $p (1 \leq p \leq Q)$ th priority queue to W_p is set, and then:

$$\sum_{p=1}^N W_p < 1W' = 1 - \sum_{p=1}^Q W_p. \quad (10)$$

Initially, the weight W' is distributed to each queue in proportion; that is, there are:

$$W'_p = W_p + \frac{W_p}{\sum_{p=1}^Q W_p} \times W'. \quad (11)$$

- (2) The queue urgency coefficient K_p is used to adjust the size of the weight, and the calculation method is as follows:

$$W'_p = (1 - \beta)(W'_p - W_p) + \frac{K_p}{\sum_{q=1}^Q K_q} \times \sum_{n=1}^Q \beta \cdot (W'_q - W_q)$$

$$= (1 - \beta)(W'_p - W_p) + \frac{\beta \cdot K_p \cdot W'}{\sum_{q=1}^Q K_q}. \quad (12)$$

Among them, β is the adjustment factor, which is used to determine the ratio of the redistributable weight to the total weight that can be allocated for each adjustment. The purpose is to avoid excessive weight oscillation in the adjustment process.

- (3) For each queue with a weight of $W'_p (1 \leq p \leq Q)$, a weighted scheduling algorithm (algorithms such as weighted round Robin scheduling (WRR), weighted fair queuing (WFQ)) is used for scheduling.

2.3. DDSM Formal Algorithm Performance Analysis. When the queue length is L_q , the drop probability $P(n)$ is expressed as follows:

$$P(q) = \begin{cases} 0, & L_n < t_{\min}, \\ \frac{L_n - t_{\min}}{t_{\max} - t_{\min}} \cdot P_{\max}, & t_{\min} \leq L_n \leq t_{\min}, \\ 1, & L_n \geq t_{\max}. \end{cases} \quad (13)$$

Among them, the value range of t_{\max} to queue i is $E_i \leq t_{i, \max} \leq E_i + E'$. When $p_i = 0$ or $K_i = 0$ takes the minimum value, DDSM degenerates to RED algorithm. When $\sum_{j \neq i} p_j K_j = 0$, t_{\max} takes the maximum value, that is, the queue uses all remaining buffer E' . The drop probability comparison between DDSM and static priority scheduling mechanism is shown in Figure 6.

The arrival rate of bundle messages conforms to the Poisson distribution with parameter ω , and the service time conforms to the exponential distribution with parameter σ , so the queue length Lq is the M/M/1 birth and death process with limited state space. The state is $(0, 1, 2, \dots, t_{\max})$, the rate of growth is $(1 - P(n))\omega$, and the rate of extinction is σ . Let $\rho = \omega/\sigma$ be the service intensity of the system, and δ_q is the steady-state probability of being in the state q , so:

$$\delta_q = \delta(0)\rho^q \prod_{j=0}^{q-1} (1 - P(j)). \quad (14)$$

Among them,

$$\delta(0) = \frac{1}{\sum_{j=0}^{t_{\max}} \rho^j \prod_{i=0}^{j-1} (1 - P(i))}. \quad (15)$$

The packet loss rate function of the packet is as follows:

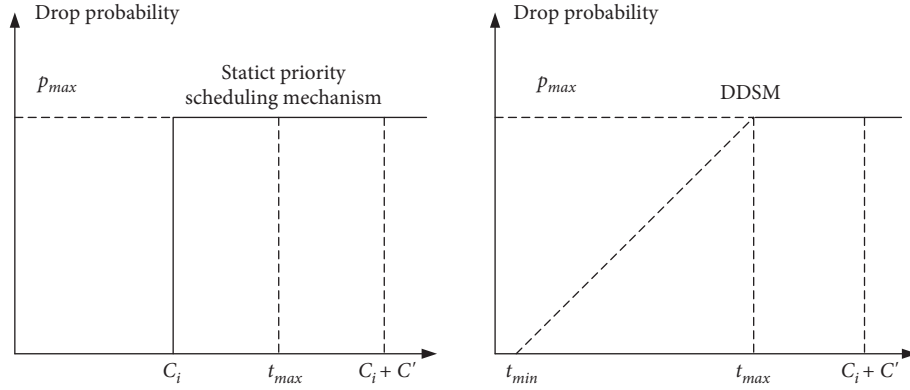


FIGURE 6: Drop probability comparison.

$$LB = 1 - \sum_{q=0}^{t_{\max}} \delta(q)(1 - P(q)). \quad (16)$$

Correspondingly, the effective throughput function is as follows:

$$H = \omega \sum_{q=0}^{t_{\max}-1} \delta(q)(1 - P(q)). \quad (17)$$

Since the average service time of the packet is $1/\eta$, the delay function of the packet is as follows:

$$\begin{aligned} D &= \frac{H(L_q)}{\eta} \\ &= \frac{1}{\eta} \sum_{k=0}^{t_{\max}-1} (q+1)\delta(q)(1 - P(q)). \end{aligned} \quad (18)$$

It can be seen from expressions (21) and (22) that when the bundle message arrival rate ω is constant, the packet loss rate and effective throughput rate of the queue are determined by the threshold and service time. Therefore, DDSM can reduce the packet loss rate by adjusting the scheduling weight of the buffer threshold and improve the robustness of the system [34].

The network service area is defined at the macro-level. It reflects the overall level of information technology development in a country or region and is a test of the library service system's ability to negotiate and communicate. It can be said that the library network service area is an important part of the user experience, but there are often important factors such as slow service and poor software applications that lead to a poor experience. Figure 7 shows the interaction between the library and the network service environment and the improvement design process [35].

Communication and collaboration with network operators should be an indispensable part of library services. It improves their network services so that users can experience more library services seamlessly, safely, and quickly. One is to rely on advanced network communication technology, match the workbench, create a network environment, and carry out networking and intelligent design according to the

requirements of the operating system. Second, it matches the access point to different networks on the client and server. The server establishes a specific communication link to ensure the normal function of the application, thereby improving the efficiency of the user's use of the library.

3. Research Experiment on Interactive Design of Library Information Sharing

Traditional regional libraries also have interactive information services, but the interactive design of libraries under the network environment makes the development of information and services faster. The basic premise of an information sharing system is that information is obtained, not collected randomly. Information should not be passive instillation of knowledge. The learning process is not machine learning, but requires user enthusiasm to bring us into the experience. Knowledge is governed by mutual interaction. The interactive information sharing system recommends a new user environment to make users more interested in the library. Initiating interactive projects emphasizes that users not only learn theoretical knowledge from books but also cultivate their self-learning and creative potential. The technical core of intelligent user interface design is to provide convenient support for users to use digital repository, which is the window of communication between digital library system and users.

To improve the efficiency of the system, the information sharing system adopts the MVC model. It is a widely popular application model. Its purpose is to realize the function division of Web system. The main purpose of the model is to divide the application into three parts according to the template (model), view (view), and controller (control). The model application stores application data and business intelligence and has nothing to do with the design of the user interface. Its role is only to store and manage application data. All template elements used are layer designs. Viewing objects refer to the things that can be seen on the screen and are the main manifestations in response to the user's viewing input. All visual elements of the application are visual aspects. The control application is the link between the visual object and the template application. It contains a version 30 application that is mainly used to respond to multiple events

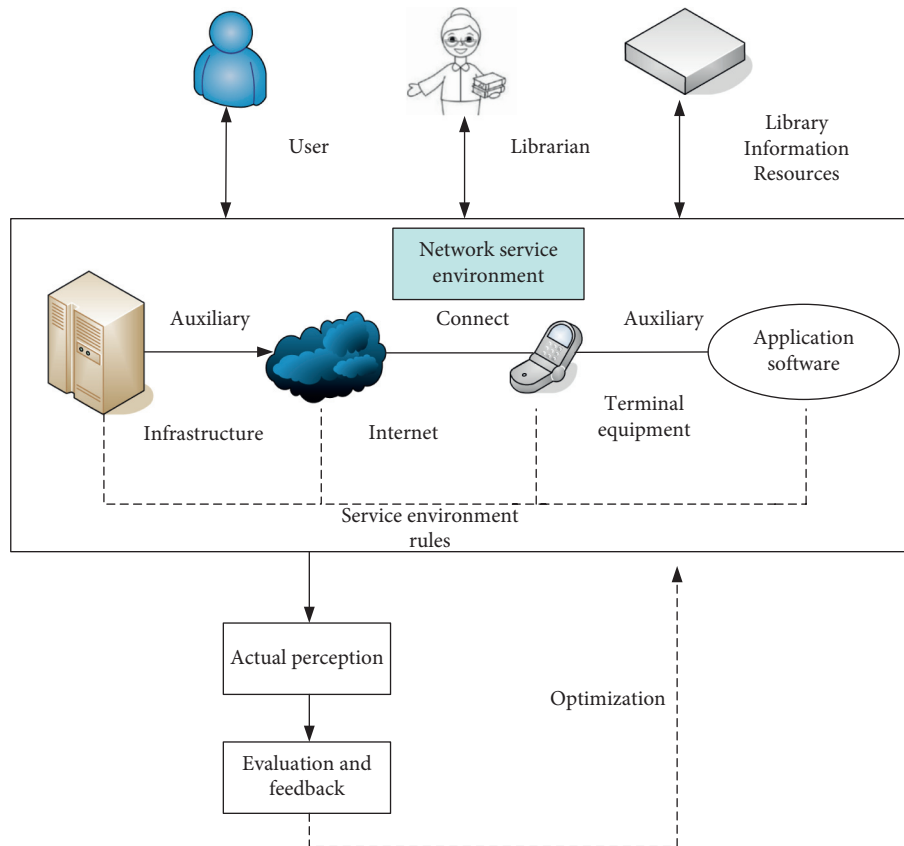


FIGURE 7: Interaction and optimization design with network service environment.

from interfaces the but also to manage data flow and layer views between model objects.

Since there is no direct interaction between model objects and visual objects, the controller first receives messages from the objects and then sends work instructions to other objects.

The three parts of MVC design are independent but require collaboration. The view shows the user the visual interface of the program, which is the main window for human-computer interaction. According to the problem information management work, corresponding to the model process, after the template receives the call information from the administrator, it immediately starts logical analysis and data processing and submits the processing result to the controller after the processing is completed. Then, the controller updates the visual information according to the changes in the model application, thereby completing the interaction between the user and the program. Based on the complex background computing and communication with high real-time foreground control system, this study uses the software of microcontroller interactive training program.

The software architecture of the MCU interactive training program is divided into three layers: data layer, logic layer, and presentation layer. In the data layer, data are divided into scene database and business database. The scene data are the original graphic data of the three-dimensional model. These

data are real data and raw data, including the name, size, location, and other information of the device. Graphic data are real graphic information. It is a general image usually taken from the scene, which can show the appearance, color, shape, and other details of the object. Using these graphic details as a sketch of the 3D model can reduce the complexity of the 3D model and improve the simulation degree of the modeling. The original data need to be further linked to the building data before it can be used in the program. The business database includes information such as logical connections between devices, task management modes, and operation modes. In the logic layer, the interactive control between three-dimensional elements is mainly completed by the intelligent control module. The 3DMax model software can be used to process the obtained model view information, so that the original data and image data can be used to complete the model production in one place. Unity3D provides a 3D engine that can integrate components, write scripts, and control 3D models. In the presentation layer, because it is in the human-computer interaction interface, it has basic functions such as input keys and production interface. The presentation layer can interact and display the background data, display the performance results of the same layer on the screen according to the user's requirements, and understand the virtual space simulation, status display, model control, and experimental control functions.

4. Research and Analysis of Interactive Design of Library Information Sharing

To verify the model, this study conducts a practical research on the current situation of the interactive function design of domestic academic libraries. This research is based on the principles of objectivity and completeness and adopts a sample research method. In this study, 400 questionnaires were distributed among the people entering the library of a university library, and a total of 400 questionnaires were returned, with a recovery rate of 100%. There are 360 valid questionnaires, and the effective rate is 90%. The questionnaire is valid. The problem is solved by sorting out and analyzing the first-hand research data and the original data obtained in this research. Table 1 shows the identity of the surveyed users, and Figure 8 shows the frequency analysis of the surveyed use of libraries and library websites.

It can be seen from Figure 8 that the frequency of using the library and library website for students and teachers of all grades is the largest number of people per day or week, up to 50 people. Very few people use it once every semester or more than half a year. This shows that the use of library resources is very important to the use of students and teachers. The role of the library is to select valuable information and then organize this information into categories for better access by all, even if they do not have the time to go within the library for information and knowledge acquisition, they visit the library website through the Internet. Therefore, it is of great importance to use advanced network communication technology to achieve library information sharing.

Through the investigation of 400 university library websites, 100 of them are famous foreign university libraries. In terms of the interactive information service projects opened by various university libraries, the interactive information services of famous foreign university libraries have developed well, but the interactive information services of many domestic university libraries are not ideal. The survey results show that the best-performing libraries have opened 6 interactive information services. Some libraries only opened one interactive information service, as shown in Figure 9.

As can be seen from the figure, domestic academic libraries have general awareness of interactive information services. Since 2013, the number of interactive information services has been basically concentrated in three, and the development speed has been slower than that in foreign countries. Until 2020, the proportion of libraries with six interactive information services accounted for only 5%. Therefore, it is urgent to improve the quality of interactive information services in domestic academic libraries.

Interactive information services can be roughly divided into two aspects: one is interactive digital information services and the other is personalized customized interactive information services. Digital information service is a typical interactive information communication service. From the perspective of interaction time, it can be divided into asynchronous interaction and synchronous interaction.

TABLE 1: Identity analysis of surveyed users.

User identity	Number of people	Proportion (%)
Freshmen and sophomores	96	24
Junior and senior students	120	30
Master's degree	104	26
Doctoral candidate	60	15
Teacher	20	5

Asynchronous interaction is currently the most commonly used network communication method in learning libraries; for example, email emphasizes the interaction between users and librarians, which can meet their personalized needs. Synchronous interactive service is like "face-to-face" real-time communication on the network, such as call center, synchronous browsing, and other functions, which are often affected by some objective factors (such as system stability). Table 2 shows the attitude of users to specific service methods.

It can be seen from Table 2 that for the interactive information service of the library, users are most satisfied with the project attitudes of book recommendation and reader network training. Among them, the satisfaction of book recommendation reached 68%, but high satisfaction does not mean the higher the user's favorite value. For example, the satisfaction of readers' online training service method reached 56%, but the user's favorite value ranking ranked 4.

Table 3 shows the comparison between traditional library information services and modern library interactive information services.

It can be seen from Table 3 that the use of traditional library information service users is relatively high, and the use of it by juniors and seniors is as high as 74%. However, compared with the use of traditional library information service users, the use of modern library interactive information services has increased correspondingly.

Personalized customization is a personalized embodiment of an agency's interactive information service. Through direct or indirect communication with users, users' information needs are understood and explained, and users are provided with information services suitable for their individual needs. For example, the human-computer interaction information service provided by some university libraries is mainly My Library. Table 4 shows the research results of traditional libraries and libraries that use information sharing and interactive systems to carry out personalized activities.

The widespread popularity of social networks and knowledge communities provides diversified channels for library user interaction and promotes interaction between users. Figure 10 is an analysis of the purpose of interaction between library users.

It can be seen from Figure 10 that the purpose of interaction between library users is mainly to share knowledge, but for some grades of students, information consultation and entertainment are also important roles. For example, post-graduates for information consultation accounted for 70% of them, and freshman and sophomore students accounted for 55% of interactive purposes for entertainment.

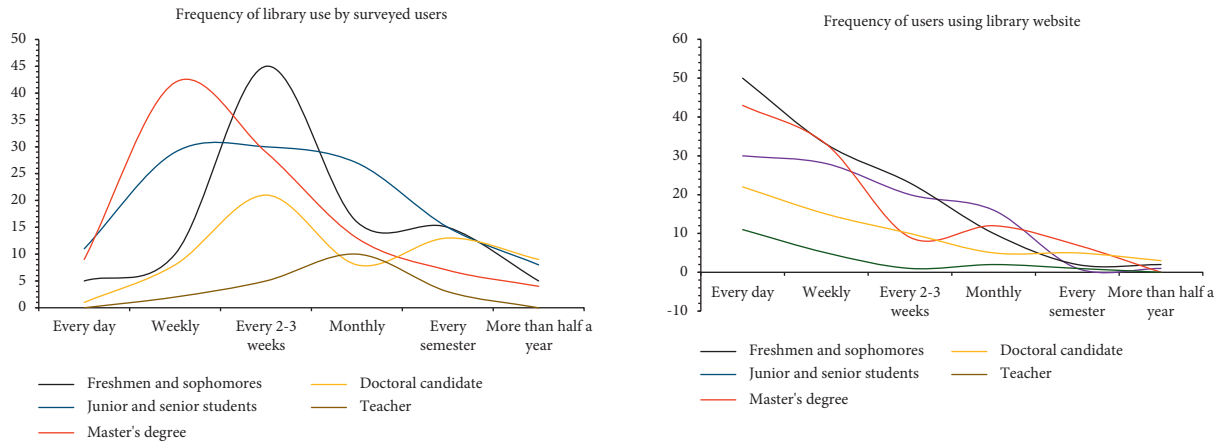


FIGURE 8: Frequency analysis of library and library website use by surveyed users.

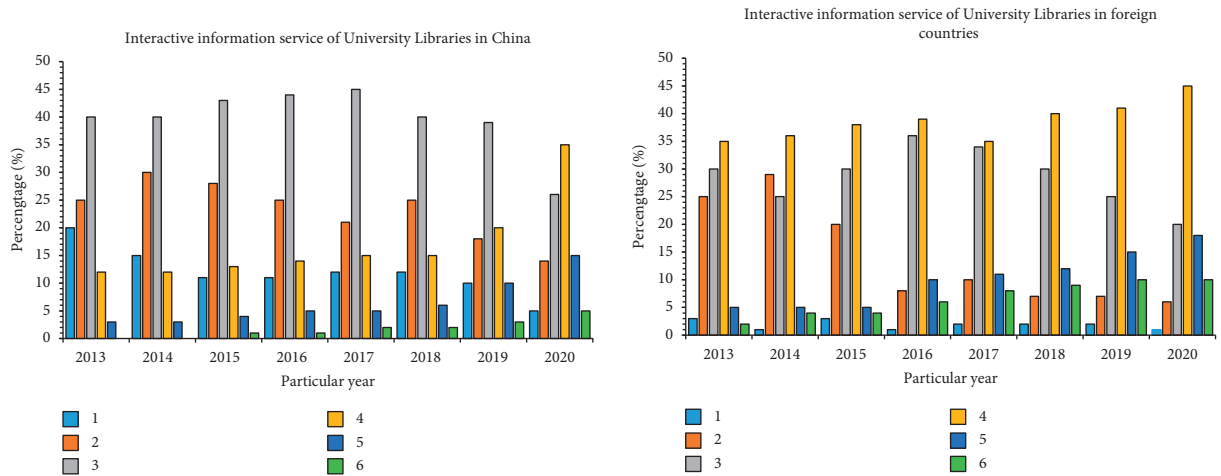


FIGURE 9: Opening of interactive information service projects at home and abroad.

TABLE 2: Users' attitudes towards specific consulting services.

Consulting service mode	Percentage of users in total (%)	Liking ranking
Email consultation	30	5
Reader forum	40	3
Common problem	45	2
Book recommendation	68	1
Reader network training	56	4

TABLE 3: Comparison of the user degree of traditional library information service and modern library interactive information service.

User identity	Traditional library information service (%)	Modern library interactive information service (%)
Freshmen and sophomores	60	70
Junior and senior students	74	76
Master's degree	45	55
Doctoral candidate	60	75
Teacher	45	68

Enhanced interaction between user interfaces can make information clearer, more natural, and more intuitive. For example, information visibility provides consumers with feedback, voting, and other activities that encourage more

users to participate in the dissemination and sharing of information; it provides online communication capabilities and creates graphical visual representations of the content that users carry in real presentations. The relationship

TABLE 4: Survey results on the implementation of personalized customized services.

Attitude	Traditional library (%)	Library using information sharing interactive system (%)
Very satisfied	40	51
Satisfied	31	40
General	20	9
Not satisfied	7	0
Very dissatisfied	2	0

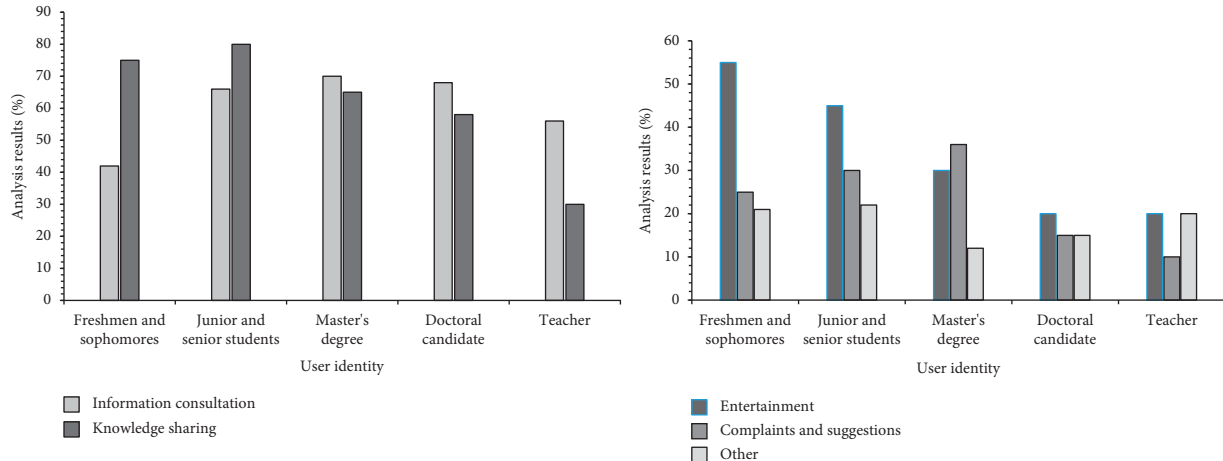


FIGURE 10: Purpose analysis of interaction between library users.

between information and data can be added to the information view of the Web interface; the visual theme is relevant and attractive to the content of consumers' lives, involving people's food, clothing, housing, and transportation. Consumer's interest: good human interaction cannot be achieved without active human thinking and additional feedback. In this process, users, information, and Web interface form a good relationship circle, which greatly improves the efficiency of information dissemination.

5. Conclusion

In the network environment, the development of interactive information services has put forward new demands on the information services of higher education libraries. At present, many libraries are trying information interaction services under the network environment and have achieved certain results, but there are also some problems. Therefore, this article aims to study the optimization of interactive information sharing in university libraries under network communication technology. First of all, this article introduces the organizational structure of the library and on this basis analyzes the problem of information transmission in the library information release, as well as the current situation of the implementation of interactive information services in domestic academic libraries. At present, it is relatively common to develop interactive information services in libraries. By optimizing library interactive information services, to meet the needs of various users, it needs to be supported by information sources, technologies, and users, truly understand the importance of user services, and

achieve the fundamental purpose of information sharing. However, this article still has many weaknesses. For example, in terms of user's personalized customization, it is also necessary to investigate the user's personalized needs and integrate them to get an improvement.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

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