Large-Scale Scientific Research Instrument Resource Information Sharing Platform through O2O Mode

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Abstract. Through the collection and integration of scientific instrument resources and scientific research services across the province, a scientific instrument public service system based on the O2O model will be constructed. The system takes the one-stop retrieval of scientific and technological resources as the hub, and provides accurate and convenient intelligent services for scientific and technological information for universities, scientific research institutes, key laboratories, high-tech enterprises, incubators and other units, realizing the co-construction and sharing of scientific instrument resources, Improve the utilization rate of scientific and technological resources, effectively improve the level of comprehensive sharing and efficient use of scientific instruments.

Keywords: Large-scale scientific research equipment, system; resource sharing, data mining.

1. Introduction

The sharing of large-scale scientific research instruments is an important resource and infrastructure for scientific and technological innovation. Since 2004, the state has successively initiated the construction of 6 major scientific and technological infrastructure platforms, and successively issued the "Opinions on the Construction of National Scientific and Technological Infrastructure Platforms" and the "State Council's Regarding the State The Opinions on the Opening of Major Scientific Research Infrastructure and Large-scale Scientific Research Instruments to the Society, the "Administrative Measures for the National Science and Technology Resource Sharing Service Platform" and other policy normative documents are included in the “Several Opinions of the State Council on Comprehensively Strengthening Basic Scientific Research”, Specific work arrangements have been made in documents such as "Several Opinions on Deepening the Reform of Institutions and Mechanisms and Accelerating the Implementation of the Innovation-Driven Development Strategy." The Ministry of Science and Technology is coordinating the sharing service of equipment at the national level through the construction of the "Major scientific research infrastructure and the national network management platform for large-scale scientific instruments and scientific research instruments", and conducts a national survey and service of equipment of more than 500,000 yuan each year.
Through nearly 15 years of construction, the sharing of scientific research instruments in Gansu Province has achieved very significant results. [1-8] In order to further promote the sharing of instruments, the author builds a scientific instrument public service platform based on the O2O model by collecting and integrating scientific instrument resources and scientific research services across the province.

2. Analysis of demand

2.1. Analysis of business needs
The degree of socialization is also an important indicator of the level of scientific and technological development of a country. With the rapid development of social economy and human beings entering the age of knowledge and information, science and technology themselves have developed more rapidly, and the state has gradually increased its investment in scientific research. Scientific research equipment is no longer just composed of small, single-piece equipment. The composition of instruments and equipment scattered in relatively independent scientific research units, those large-scale instruments and equipment or super-large scientific instrument clusters (instrument centers) with a large number of types, higher degrees of specialization, and higher values, and those that make full use of modern information technology and network construction large-scale instrument sharing system has become the core connotation of scientific research equipment. In order to improve the resource utilization rate of large-scale scientific instruments and equipment in our province, effectively enhance the timeliness of sharing services of large-scale scientific instruments in the province, and meet the needs of enterprise technological innovation and industrial transformation and upgrading, and innovation and entrepreneurial team technology development, product research and development process of equipment, inspection and testing technology urgent needs.

2.2. Analysis of platform demand
Through the establishment of a large-scale scientific research instrument resource sharing platform, a five-in-one full-process service chain of "service reservation, service acceptance, innovation coupon payment, offline service, and service evaluation" is formed. In order to accelerate the opening of scientific research facilities and instruments to universities, scientific research institutes, enterprises, social R&D organizations and other social users, realize resource sharing, avoid division of departments and unit monopoly, and fully release service potential, serve technological innovation and social needs, and implement Innovation-driven development strategy provides effective support.

3. Design of platform architecture
The platform is designed as a four-tier main system architecture, including the data layer, business support layer, application layer, and presentation layer, as shown in Figure 1.
Figure 1. Large-scale scientific research instrument resource sharing platform system architecture diagram.

(A) User layer
User-end devices can be laptops and desktop computers, or mobile terminal devices such as tablets and smart phones. When these client devices allow users to browse or input information, they are simultaneously connected with the presentation layer Web program. For system users, the client interface represents the entire system. The client system of the Web program mainly has the following functions: first, display the user interface; second, verify and confirm user input; third, communicate with the server; fourth, manage the dialogue status.

(B) Presentation layer
The presentation layer mainly accepts the user's request and the return of data, provides the client with application access, and provides the user with an interactive operation interface. The presentation layer is the embodiment of the user's personalized application. After the application authorization of the business system, it can satisfy all users of the system, extract and encapsulate the user's interaction request, submit it to the software service layer, get the return information, encapsulate it into page elements, and give feedback to Client. For the end user, it must be personalized to meet the needs of individualized work of different users.

(C) Software service layer

The software service layer adopts the SaaS cloud service method to provide services to users. In this platform, SaaS puts the background environment where all scientific and technological resource services run into the cloud, and provides services directly to end users through a thin client (Web browser). End users request services from the cloud on demand, without the need to maintain any infrastructure or software operating environment locally. The software service layer is the functional realization layer of the user's business. Because the software system construction is carried out in a unified planning method, it integrates the needs of related businesses and integrates related and similar needs in terms of planning. Each independent module is also conducive to improving the flexibility of the system and reducing the cost of information system construction and maintenance. The software services provided by the software service layer mainly include instrument reservation services, instrument release services, data resource management services, and technology innovation coupon management services.

(D) Data service layer

The data service layer includes relational database management system, external data access interface and so on. The main task of this layer is to respond to data requests from the software service layer, obtain data from the database, and implement data persistence management, including the implementation of Select, Insert, Update, and Delete operations on the data table. The main sources of data collection involved in the DaaS platform in this project: scientific instrument database, instrument center database, scientific research institute database, etc.

(E) Infrastructure layer

The infrastructure layer uses the virtualization technology of the underlying hardware to form pooled hardware resources (computing resources, storage resources, network resources), and provides unified services to users through the management of the IaaS management platform. IaaS has good scalability and reliability. On the one hand, it can expand flexibly, and on the other hand, it can provide users with resources on demand, and can modify and change the resource configuration in a timely manner. IaaS can realize the automatic monitoring and allocation of resources, and the automatic deployment of services, and can more closely integrate equipment resources and user needs.

4. Platform key technology

4.1. Intelligent retrieval and recommendation

Build a large-scale scientific research instrument resource sharing platform under the background of big data to realize "one-stop" search service. The platform relies on Elasticsearch big data analysis and mining technology to perform fuzzy search or precise matching of search keywords, and adopts TF-IDF, LUCentere correlation, etc. The algorithm calculates the relevance score of each document and ranks it. First extract the keyword stems, match them through fields such as title, content, unit, etc., set the minimum matching degree to 70%, and display them in order of relevance. Among them, the title field is weighted heavily, so that the stems appearing on the title field have a higher matching score than the documents appearing on other fields.

4.2. Multi-system integration application

The use of multi-system integrated application method realizes the construction of a large-scale scientific research instrument resource sharing platform, makes full use of big data technology,
standardizes the management of scientific and technological innovation resources with the idea of a platform, and establishes an instrument and big data monitoring mechanism, which effectively solves the problem of being able to view each the task of operating and using large-scale instruments and equipment can realize the ability to monitor remote equipment failures, improve alarm processing capabilities, understand real-time data dynamics, improve the utilization of scientific and technological resources in our province, and improve service quality.

5. Function of the platform
The large-scale scientific research instrument resource sharing platform is divided into functions such as user registration, information inquiry, product release, instrument review, instrument reservation, order acceptance, and user evaluation according to the business process.

5.1. User registration
User registration information includes account number, password, mobile phone number, etc. When registering, the user needs to obtain the mobile phone verification code, and the platform can only register successfully after the mobile phone verification code is verified.

5.2. Information query
Ordinary users can access the platform to browse instrument information and query data, including popular instrument recommendation queries, scientific instrument queries, and instrument big data analysis queries. The popular instrument recommendation query is based on the user's recent visits to the instrument popularity.

Users can search for required instruments based on search conditions such as instrument category, application field, sharing method, instrument name, instrument unit manufacturer, and application scope.

5.3. Product release and review
After ordinary users register and pass the review, they become registered users. Registered users can log on to the platform to release the instrument and submit it for review after confirmation. The management user reviews the instrument, and after the review is passed, the instrument is put on the shelf. After the instrument is released, it needs to be submitted to management for review. The management user reviews the instrument information released by the service organization. After the information is approved, the product can be put on the shelf to provide external services.

5.4. Instrument reservation
Registered users can log in to the platform to browse instrument information. After inquiring about the required instrument services, make instrument reservations and confirmations, manage users to accept and distribute orders, and provide offline services after receiving orders and provide services. Information is fed back online. After the service is completed, the registered user can make online payment. After the payment is successful, the service can be evaluated, and the management user can perform statistical analysis on the service.

5.5. Order acceptance
The service organization user logs on to the platform, inquires about the reservation service of the demander, and accepts the order.

5.6. User Evaluation
The service organization provides services to the demander, and the demander evaluates the services provided by the service organization after the service is completed.
6. Design of system safety

(a) The system adopts the RBAC (Role-Based Access Control) model to design permissions based on the "hierarchical and hierarchical" management idea. The permissions are associated with roles. Users can obtain the permissions of these roles by becoming members of appropriate roles. Simplify the management of permissions. Different user types are assigned different operation permissions to avoid user misoperation or chaotic operation, and minimize data damage by illegal users.

(b) Before the server officially processes the data, it checks the validity of the data, replaces or deletes sensitive characters/strings, encapsulates the information submitted by the client and shields the error information, effectively preventing SQL injection attacks and cross-site attacks (XSS).

(c) The core business data is encrypted and stored in the database. For some key sensitive data stored in the database, such as user passwords, the program encrypts and stores these data, making it impossible to obtain the clear code in any other software environment.

(d) In the network topology design, hardware firewalls and intrusion detection equipment are deployed, and strict security policies are set. Only the HTTP ports necessary for access to the system are opened, preventing hackers from exploiting port vulnerabilities to attack.

7. Conclusion

Through the construction and improvement of the platform, a professional and networked management service system covering various scientific research facilities and instruments, unified standards and complete functions will be formed. Realize the interconnection and resource exchange of equipment management platforms at all levels, and provide innovative carriers with a five-in-one full-process collaborative service of "online appointment, network acceptance, innovative coupon payment, offline service, and supervision and evaluation".

At the same time, the sharing of large-scale instruments and equipment is an important issue in the allocation and management of scientific and technological resources. Since the opening and sharing of large-scale instruments and equipment resources has been carried out, significant results have been achieved. However, this work has also encountered some challenges in its development. The problems that need to be solved urgently: the procurement system leads to imbalances and contradictions in the allocation of resources, restrictions on the property rights mechanism, resulting in low sharing enthusiasm, difficulties in subsidies and incentive mechanisms, and problems with instrument sharing assessment indicators that need to be further optimized.

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