

## *Retraction*

# **Retracted: Optimization of IoT-Based Sporting Goods Consumer Service Management System**

### **Complexity**

Received 19 December 2023; Accepted 19 December 2023; Published 20 December 2023

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Manipulated or compromised peer review

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

### **References**

- [1] L. Yu and B. Duan, "Optimization of IoT-Based Sporting Goods Consumer Service Management System," *Complexity*, vol. 2021, Article ID 2914629, 13 pages, 2021.

## Research Article

# Optimization of IoT-Based Sporting Goods Consumer Service Management System

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Received 21 April 2021; Revised 9 June 2021; Accepted 11 June 2021; Published 18 June 2021

Academic Editor: Zhihan Lv

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With the rapid development of computer technology and information industry technology, the use of these technologies has been deeply applied to the management of various industries. Data time-sharing transmission can solve the problem that the system is not affected by the network; that is, it makes good use of the network and is not bound by the network. Even when the network speed is low or the network is not smooth, the system of each store can run normally, and when the network is smooth, the data will be uploaded in packets and automatically received by the server. The system is well designed with functional modules' management, including sports goods import and export management, inventory management, membership management, and ledger management. System operation can well solve the coordination work between the head office and stores; the head office can master the operation of each store, check the generated ledger at any time, form statistical reports, and guide the operation status of each store so that the stores can adjust their operation methods and learn from each other at any time. The system network management can make valuable data information aggregated, rather than single data. The head office can make overall data backup promptly to provide good logistic support for each store.

## 1. Introduction

In recent years, global climate change and biodiversity loss have become a major concern, and it has become increasingly important to seek manufacturing methods and consumption habits that minimize negative impacts on the environment. An innovation-driven model is the basic strategy for development, and the development of new information and communication technologies, digital technologies, and artificial intelligence technologies has brought new opportunities and challenges for green transformation and upgrading and sustainability of manufacturing industry [1]. The purpose of this paper is to define the components, system structure, system function, and operation mode of the Internet-based manufacturing green innovation system and analyze the open innovation of the manufacturing green innovation system by sorting out and drawing on the research results of economic theory and innovation theory, manufacturing green

innovation system, and open innovation in the context of the Internet and combining the new situation of the integration and development of the Internet industry and manufacturing industry [2]. The meaning and motives of the open innovation of the manufacturing green innovation system are analyzed [3]. It also reveals the evolution mechanism of open innovation in the Internet-based manufacturing green innovation system, determines the sequential parameters affecting the evolution of open innovation in the system, constructs three open green innovation modes matching its evolution stage, clarifies the selection method and transformation mode of the open innovation model of the system, and proposes the guarantee measures for the implementation of the open innovation model of the Internet-based manufacturing green innovation system. It provides theoretical support and reference for improving the open innovation level of manufacturing green innovation system and promoting the green development of the

manufacturing industry by implementing open innovation under the new economic situation in the background of the Internet.

The progress of society, along with the development of science and technology, has also made the retail industry undergo radical changes. With the rise of young consumer groups, online shopping has become a new popular way of consumption [4]. The Internet economy, represented by e-commerce, has brought an unprecedented impact on the physical stores of different formats such as department stores and supermarkets, overturning the traditional retail distribution model, and an increasing number of retailers are getting involved online. However, in recent years, with the disappearance of the traffic dividend, the cost of Internet traffic is getting higher and higher, making the operating costs of e-commerce also rising year by year, coupled with the poor experience of e-commerce platform, low quality of service, and other outstanding issues which have never been effectively resolved, and so e-commerce companies began to encounter development bottlenecks [5].

Also, in recent years, with the popularity of computer technology, sales management automation is receiving more and more attention, and sports goods sales management system collects the sales and management of sports goods and sports goods inventory management as one of the sales management software [6]. It should have a friendly and fresh software interface, to have strong inventory management, sales management, report query, financial management four-in-one inventory management, sales management, reporting, financial management, and other management functions. And sporting goods management software should also fully consider the needs of small- and medium-sized customers, incorporating advanced business concepts, designed from the perspective of managers, who should be the ideal sales management of software for sporting goods stores, sporting goods companies, and related industries for electronic information management [7]. Sporting goods stores are undergoing rapid corporate expansion in new business models such as operation, local distribution, control of market sales terminals, and management, but, at the same time, to some extent, there are epidemics such as poor information channels, weakened control, and reduced management efficiency [8]. How to make full use of modern information technology tools and equipment and use information management software to build a centralized, real-time reflection of each store is a question. The information management system that can reflect the operation and sales status of each store in a centralized and real-time manner is an effective measure and method to improve the timeliness and effectiveness of decision-making of sporting goods stores and to enhance the management monitoring ability of the top management of the sporting goods industry to the lower levels [9].

## 2. Status of Research

In recent years, many systematic studies have been conducted on management techniques in the garment industry [10]. Yang et al. developed a more fully functional

information system by investigating the common problems of ERP systems, dividing the functions and modules of the inventory system based on a detailed distillation of the actual user requirements, and using mature technologies [11]. Karatas and Kutanoglu pointed out some problems of traditional inventory control in the apparel industry and suggested that a new method for rational inventory control could be sought through BP neural network technology [6]. After thorough research and analysis of the inventory management process of the enterprise, an artificial neural network technique was used to predict the apparel demand, and the accuracy of the prediction was ensured by MATLAB simulation to construct an inventory replenishment model, and an inventory management system was developed accordingly [7]. The system is a bold attempt to apply innovative computer science and technology to garment inventory management by predicting the garment demand to predict the warehouse replenishment quantity, which reduces the warehouse stack to a certain extent [8]. Sodhro analyzed the shortcomings of current artificial intelligence algorithms for garment sales prediction and used a new neural network technology extreme learning machine (ELM). ELM supplements and optimizes a certain aspect to obtain more ideal prediction results [9].

However, in general, it seems that most of the previous garment management systems are only based on simple web technologies and frameworks developed in a stand-alone environment [12]. Although they can improve enterprise informatization to some extent, they are still not very convenient as they are only based on bar codes to complete basic operations, and the performance of the system is also difficult to meet the new challenges [13]. Also, less research is involved in garment management within garment stores. Although some authors also use some more innovative technologies such as artificial intelligence to improve the store shopping experience; however, it is difficult to be applied in real enterprises for the time being due to the high implementation cost [14]. Other authors have used relatively new algorithms to predict apparel sales, thus better-informing business decisions, although the accuracy of these predictions needs to rely on the accuracy of the data that have been obtained, which is currently lacking in domestic apparel management systems [15]. The analysis shows that a management system that can accurately and timely respond to clothing data is particularly important; that is, it can make up for the low level of information technology and poor performance of the previous management system and can provide more accurate data for certain new forecasting methods to help business decisions [16]. This paper focuses on apparel management in apparel stores and designs and implements a high-performance apparel management system that can quickly and accurately reflect store apparel information and greatly reduce human resources [17]. This paper adopts a theoretical research method and then uses literature research method, case study method, questionnaire survey method, and quantitative and qualitative combination analysis method. By combining the actual situation of the development of precision marketing in Oren

Expo, we propose solutions and corresponding strategies for precision marketing based on big data.

The system design adopts the data distribution management method and time-sharing technology to ensure that the data save to the main store for data aggregation and analysis, to form the report ledger statistics, and also to ensure that each store system can run independently. Data time-sharing transmission can solve the problem that the system is not affected by the network; that is, it makes good use of the network and is not bound by the network. Even when the network speed is low or the network is not smooth, the system of each store can run normally, and when the network is smooth, the data will be uploaded in packets and automatically received by the server. The system is designed with perfect functional module management, including sports goods import and export management, inventory management, membership management, and ledger management. On this basis, sporting goods stores came into being, but compared to foreign sporting goods stores, there are still obvious gaps, such that the financial strength of these enterprises is not strong enough, in the management of technology and business concepts are not advanced enough, and in the development of enterprises and future planning it should also be more focused on the long-term and future interests. But along with the gradual expansion of China's sporting goods market, as well as the gradual opening of the retail industry market, there will be increased companies involved in the sporting goods sales industry in the future, and the competition in the market will become increasingly intense. As a result, the management of sporting goods stores will have higher requirements.

### 3. Optimization Analysis of Sports Goods Consumption Service Management System of Internet of Things

*3.1. Design of IoT-Based Management System.* As a bridge connecting smart hardware and the cloud, IoT middleware is different from traditional middleware systems. With the dramatic increase in the number of smart hardware terminals, MDM-IoT has the efficient and stable data-carrying capacity and training capacity of big data in the face of the introduction of massive sensory data [18]. The architecture is roughly divided into two parts, big data server cluster and algorithm server, whose structure is shown in Figure 1.

The big data server cluster integrates distributed hash load balancing algorithm and weighted polling load balancing algorithm to guarantee the parallel operation of multiple tasks. Also, data information appears to be stored in partitions throughout the cluster, with a single big data server as a zone, providing multiple partitions for data consumption by the algorithm server at a later stage, creating a system for massive data processing. Dynamic algorithm extension function: in the algorithm server, provide algorithm registration interface to customize algorithm for data analysis. Using container technology, the custom algorithm is rapidly extended, and both deployment and management are flexible and convenient. The smart hardware terminal

maintains a long connection mechanism with the MDM-IoT middleware, and in addition to the sensory data information that needs to be parsed, independently designed heartbeat data are added to monitor the status of the smart hardware terminal in real time. Also, remotely related operations can be performed for the smart hardware terminal, such as terminal application upgrade and working state switching. From the above functional analysis, the main functions of the MDM-IoT middleware platform are massive data processing function, dynamic algorithm expansion function, and remote monitoring function. Also, it needs to be coupled by MDM-IoT big data server for sense data, load balancing design, and intelligent reverse tracking design and trained by cloud algorithm server for machine learning of big data, etc., both making IoT products present the situation of end-cloud integration.

Sports goods sales service management system is based on the Internet of Things, including a network server; the network server is located in a sales center and is connected to an information collection client, a supervision client, a sales client, and a logistics client through the network. The information collection client is located in a school, a gymnasium, a fitness center, or a sports activity center; the sales client is located in each sales outlet. The information collection client, the sales client, and the logistics client collects information on the use of sporting goods by the population and transmits it to the web server and the supervisory client through the network, and the web server classifies and processes the information on the use of sporting goods by the population and sends the processing results to the information collection client, the supervisory client, the sales client, and the logistics client. Compared with the prior art, the invention can quickly and effectively collect and process sales and storage coordination information, help production, sales, and decision-making departments to improve efficiency and meet market demand.

Perception data are provided by IoT smart hardware devices, after the first packet loss judgment by MDM-IoT middleware, after the asynchronous queue for the original data, analysis data, upload data for cache-related operations, the data type for classification and push, where the feature parameters extracted within the perception data are handed over to the algorithm server for big data training and the heartbeat data are directly connected to the website for long communication, to ensure the normal communication of IoT devices; monitoring data will also include the location of the device, the current device environment temperature, humidity, and many other parameters, in addition to knowing the device. The results are pushed from the algorithm server-side to the website, and the website will do the final data display.

Under the C/S architecture, the current batch number will be recorded locally each time the client-side makes a data transfer. If the batch number difference is not one, the cached data will be sent. The batch number starts with 170 and ends with 250, and once the batch number reaches 250, the next group of data processing will be carried out. After receiving the data from the IoT intelligent hardware side, the big data server-side will parse the received data and extract

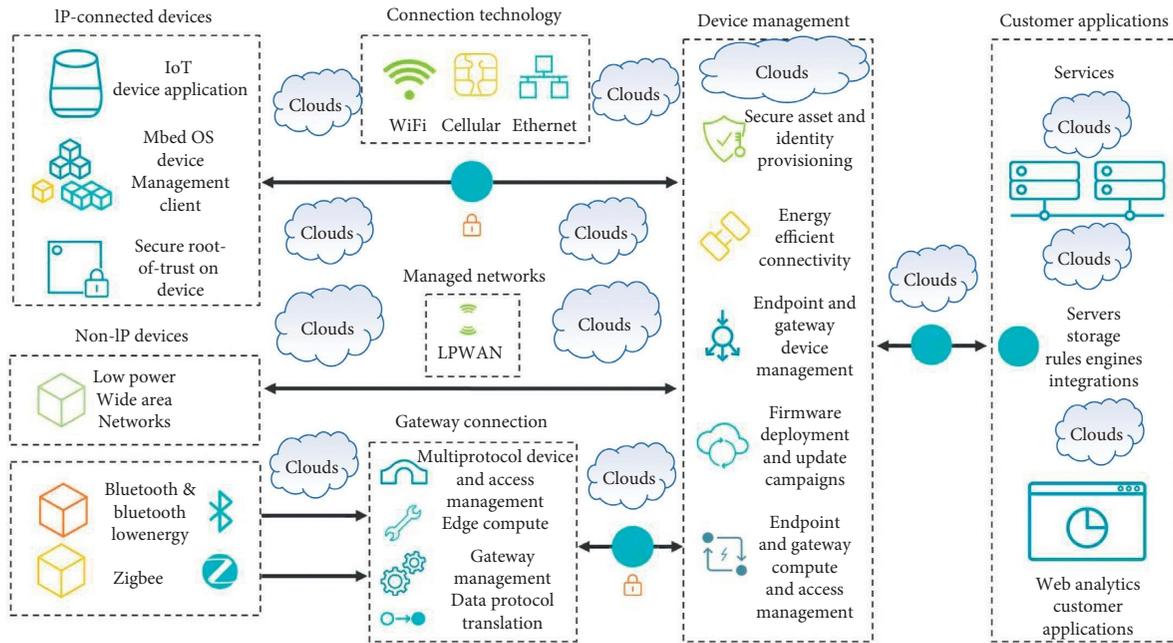


FIGURE 1: MDM-IoT structure diagram.

the response from the data batch number in the packet to the IoT intelligent hardware side, and the IoT intelligent hardware side can only make the next data transmission after receiving the response signal if the size of the batch number in the response signal is equal to the size of the batch number to be sent last time, that is, smaller than the value of the batch number to be sent this time. If the batch number in the response signal is equal to the last batch number to be sent, i.e., smaller than the value of the batch number to be sent, the transmission data are considered complete, and a set of batch numbers can contain multiple sensory data, only that the packet processing is done here; if the packet batch number reaches 250, the next set of packet batch numbers then starts from 170; if the above conditions are not met, the client is asked to resend the data, and the server is asked to perform the above operations in turn after receiving the data, to ensure the data integrity. If at this time the communication is not complete, the client is asked to resend the data. If there is a communication failure at this time, resulting in packets still not sent, the monitoring data, which are also known as heartbeat packets, can be seen such that an IoT device terminal is offline, but the resent data are limited by the size of the buffer of the IoT terminal device.

Feasibility analysis is a kind of examination and appraisal of the project in the early stage of establishing a management information system, mainly for analyzing the possible problems in operation, technology, and economy. At present, the degree of development and application of management information systems has become one of the important symbols to measure the scientific, technological, and economic strength of a country, department, enterprise, or institution. Its important goal is to determine whether the problem can be solved in the shortest possible time with the least possible cost. Feasibility analysis includes three main aspects: technology, operation, and cost. In the computer

industry, the general workforce requires a certain proficiency in computer technology, requires a certain foundation in software as well as hardware, can be skilled in the use of various management software, and should be familiar with computer products [19]. In some stores, the quality of staff requirements is relatively high, from the upper management to the following sales staff, requiring to have a certain degree of computer operation, so the system is put into use. If the store's staff got simple training, explaining some of the functions of the system and the use of the method, this basically gives full play to the superiority of the system, so that the system can smoothly operate.

Now is the era of networking, and although each store and the head office have a network but are still limited to stand-alone software management, there is no real-time management between the head office and the store; the head office cannot apply the management of each store data and cannot master the store operation, not to mention the business guidance according to the problems reflected in the store data. Networked management cannot be applied, each store not only needs to be equipped with marketing clerks but also needs to be equipped with professional technical staff, which wastes a lot of financial, material, and human resources. For all these reasons, the development of a set of network-based management of sports goods management platform has become an urgent need.

The task of requirements analysis is to fully understand the work of the original system through a detailed investigation of the objects to be handled in the real world and to clarify the various requirements of different users, and then to determine the functionality of the new system on this basis. The new system must consider possible future expansions and changes, not just the current application requirements for the database design. The focus of the survey is on "data" and "processing," through the survey, collection,

and analysis of data, to obtain the user's needs for data information, processing needs, security, and integrity of the database requirements, as shown in Figure 2.

The system supports LAN operation and, considering that there are many stores, the inherent shortcomings such as high bandwidth consumption and difficulty in updating and maintenance, which cannot be overcome by simply adopting a C/S mode management system, appear to be increasingly unsuitable. Therefore, the system adopts a B/S structure for front-end management and a C/S structure for back-end maintenance. The B/S structure design of the system front-end management follows the three-layer architecture design, which can make good use of the existing networked resources for an application. Each store is centrally and uniformly managed through the management system data, and each store is authorized to query its data through the browser method and the ledger management carried out through the management system. The backend maintenance management is mainly for table structure maintenance, auxiliary data dictionary maintenance, user rights management, and account management. Compared to the B/S architecture, the C/S architecture has the advantage of security in network transmission, but the transmission speed is not comparable to the B/S architecture. For the above reasons, the system is designed with B/S architecture for front-end applications, which can provide users with a good application for query, entry, and account management, and C/S architecture for back-end management, which can make permission management and user management more secure.

The backend administrator uses C/S architecture to connect to the WEB server through LAN; each store uses B/S architecture to access the sales management system of the sporting goods store through Internet, and the management staff can access the system through LAN and Internet to realize the management of each organization in the store, statistical management, staff management, inventory management, and adjustment of discount information [20]. The management staff can access the system through LAN and Internet to realize the functions of management, statistics management, staff management, inventory management, and adjustment of discount information of each organization in the store. Each store staff can only access the system through the Internet to realize the functions of selling, returning, and viewing the discount information of consumers.

The system mainly includes six functional modules: incoming goods management, sales management, inventory management, statistical management, user management, and system maintenance. Among them, incoming goods management realizes purchasing incoming goods and purchasing return function; sales function module realizes goods sales, return management, discount activity management, etc.; inventory management module realizes stock transfer, split bundle, etc.; statistics management module realizes sales statistics, goods purchase statistics, inventory statistics, etc.; role management realizes staff authority management, membership management, etc.; system maintenance module realizes data backup, data recovery,

and other system maintenance functions. The system maintenance module realizes data backup, data recovery, and other system maintenance functions. Different database products have different requirements for the naming of objects; therefore, the naming of various objects in the database and the code writing of the backend program should adopt various case-sensitive forms, and the length of the naming of various objects should not exceed 30 characters, which can facilitate the application of the system to adapt to different databases. To ensure the consistency and integrity of the database, designers usually design a wide variety of intertable associations (relation) to reduce the redundancy between data as much as possible. Intertable association is a mandatory measure, after the establishment of the parent table and child table of the insertion, update, and deletion of the various operations to occupy the system's overhead; also, it is best not to use the identify attribute of the relevant fields as the primary key and child table for the association.

*3.2. Experiment on Optimization of Sporting Goods Consumer Service Management System.* The commodity data query function provides users with a variety of ways to query commodity data flexibly; in order of priority, the exact query with the commodity barcode is entered, the partial fuzzy query by commodity name with the category is selected, and the global fuzzy query is by commodity name. According to the actual situation, users choose whether to enter the barcode and select category and other query conditions. The flowchart of the commodity data query function is shown in Figure 3.

If the user knows the commodity barcode of a product or already holds a product and wants to get the detailed information of the product, they use the scan gun or manually enter the barcode and click the query button to check the information of the product. If the user wants to view a certain category of goods, select the major category in the drop-down box next to the major category of goods on the page, select the minor category in the drop-down box next to the minor category of goods, and click the query button to query all the goods in the selected category. If you want to search for products by product name, enter the product name you want to find in the product name input box and click the query button to fuzzy search all products with matching conditions. The search results are displayed in pages, with each page set to 10 items. Click the arrow at the bottom of the page to turn to the first page, turn to the front page, turn to the back page, or turn to the last page. The left side of the page will show the total number of pages of query results; enter the number to jump to a certain page. The right side of the bottom of the page will show how many records have been queried. The reset button is used to reset the input and selected query criteria.

The open innovation system is composed of several subsystems, among which the green complementary resource system  $q_1$  and the green innovation network system  $q_2$  are dominated by sequential parametric complementary resources and network capabilities and are the subsystems

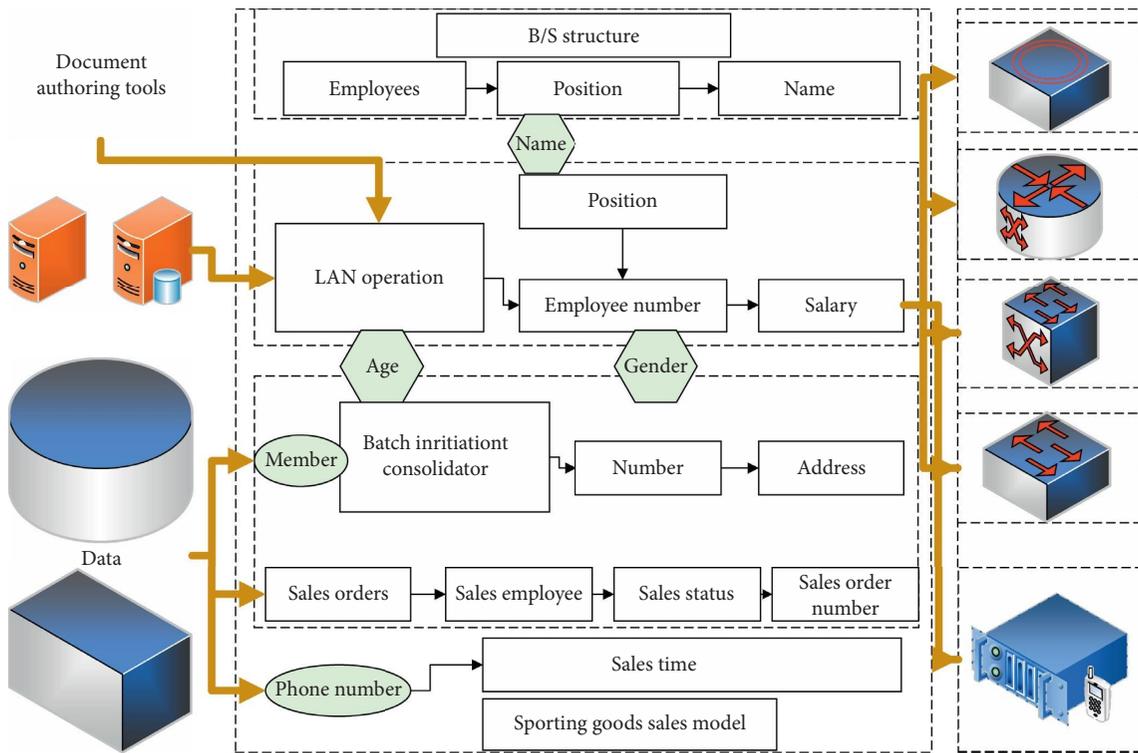


FIGURE 2: Sporting goods sales model.

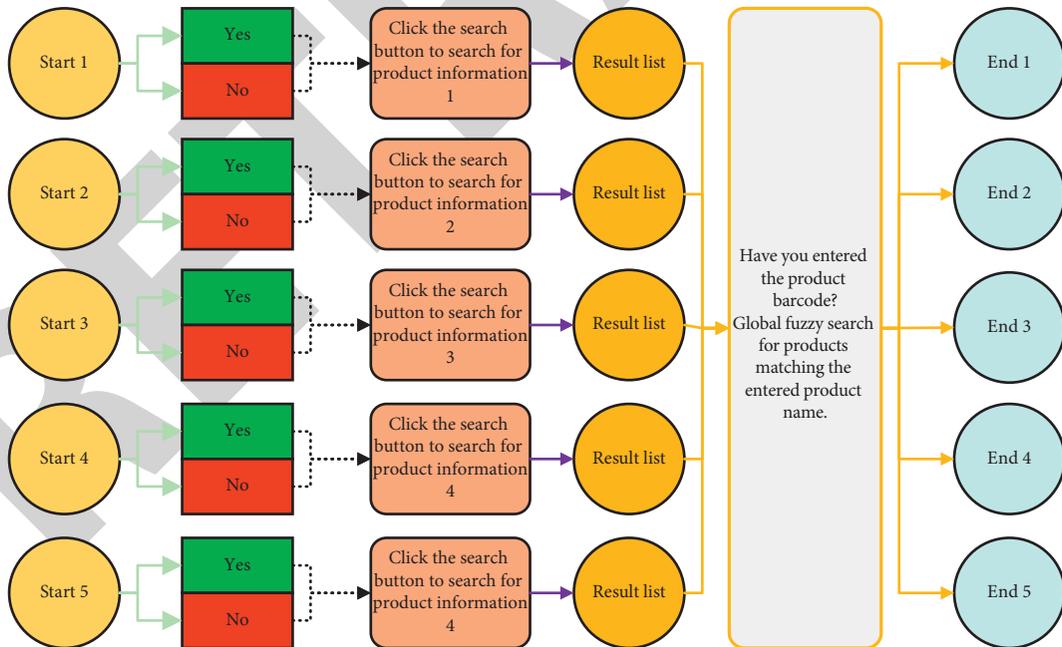


FIGURE 3: Flowchart of commodity data query.

constituting the open innovation composite system  $Q$ . Establishing the synergistic mechanism of the composite system, each subsystem influences the other and collaborates to promote the continuous evolution of the open innovation complex system  $Q$ . Based on the basic idea of cooperation theory and according to the evaluation criteria of the overall effectiveness of the complex system, there are

$$E(q_j) = E[F(q_1), F(q_2), F(q_3), \dots, F(q_k)] \leq \lim_{k \rightarrow \infty} \sum_{j=1}^k E(q_j). \quad (1)$$

Equation (1) shows that under the influence of the system cooperation mechanism, important changes occur within and between subsystems, resulting in the overall effectiveness of each system being greater than the linear sum of subsystem effectiveness in a nonsynergistic environment, and this phenomenon represents a positive synergistic effect between systems. The resulting formula for calculating the degree of the orderliness of the subsystem  $\gamma_j(x_{ij})$  is

$$\gamma_j(x_{ij}) = \begin{cases} \frac{x_{ij} - \beta_{ij}}{\alpha_{ij} + \beta_{ij}}, & i \in [1, \rho], \\ \frac{\alpha_{ij} - x_{ij}}{\alpha_{ij} + \beta_{ij}}, & i \in [\rho + 1, n]. \end{cases} \quad (2)$$

From the perspective of the composite system, the degree of order of the system is mainly affected by both the values of the order parameters and the effects of the order parameters. From this, the contribution of each ordinal component  $x_{ij}$  to the degree of order of the subsystem  $w_i$  can be expressed by the integration  $\gamma_j(x_{ij})$  of the ordinal components. Here, the orderliness of the system  $\beta_{ij}$  can be integrated by the linear weighted summation method or the geometric mean method. The calculation equations are, respectively:

$$\gamma_j(x_i) = \lim_{n \rightarrow \infty} \sum_{i=1}^n w_i \gamma_j(x_i), \quad w_i \geq 0, \quad (3)$$

$$\gamma_i(x_j) = \lim_{n \rightarrow \infty} \sqrt[n]{\prod_{i=1}^n \gamma_j(x_{ij})}. \quad (4)$$

The degree of cooperation refers to the degree of synchronous operation and harmonious development among the subsystems in a composite system. Over time, the degree of composite system cooperation changes according to the orderliness of each subsystem and the change of system order parameters. The degree of the cooperation of the open innovation composite system of the Internet-based manufacturing green innovation system is quantified by the interaction and coordination between the green complementary resource subsystem and the green innovation network subsystem through the coordination system and cooperation degree between the subsystems. The coordination coefficient measurement model is established based on the operational model of calculating the capacity coupling coefficient in physics as follows:

$$CI = me^{\left\{ (\gamma_1/\gamma_2/\gamma_3 \dots / \gamma_i)^{1-m} \cdot (\gamma_1 - \gamma_2 - \gamma_3 \dots - \gamma_i)^m \right\}^2}, \quad (5)$$

where  $CI$  represents the coefficient of composite system cooperation, under the premise of  $CI \in [0, 1]$ . The higher the  $CI$  value, the better the coordination between subsystems, and vice versa, and the lower the correlation and coordination between subsystems.  $m$  represents the number of mutually coordinated subsystems in the composite system, and in this paper,  $m$  takes the value of 2.

The coordination coefficient is an important index to discriminate the strength of subsystem coordination in a certain time interval, but due to the dynamic development and instability of the subsystem itself, the coordination coefficient can hardly reflect the overall efficacy of the composite system; especially when the subsystem sequential parameter values are similar and very low, the cooperation coefficient is often very high, which can easily lead to wrong evaluation results. Therefore, to ensure the scientific accuracy of the evaluation results, it is necessary to further construct the cooperation measurement model with the following process:

$$D(t) = \sqrt{\frac{CI}{CI + T}}, \quad (6)$$

$$T = \lambda_1 \gamma_1 - \lim_{m \rightarrow \infty} \sum_{i=1}^m \lambda_i \gamma_i, \quad (7)$$

where  $D(t)$  is the system coordination degree at time  $t$ ,  $T$  is the overall level of the system comprehensive evaluation index, and  $\lambda$  is the weight  $D \in [0, 1]$ . The larger the value of  $D$ , the stronger degree of order among sequential parameters, and the subsystems are in a period of the stronger degree of synergistic development among them.

The store receiving function is also used to realize the scheduling of garments within the enterprise, corresponding to store transfer, where the garments transferred out from one store are received at another store. When the transferring party confirms the transfer, the system will generate the corresponding receiving order and notify the receiving store. After the transferred garments are transported to the store, the store staff use Personal Digital Assistant (PDA) to read the box label, check the box information, and check whether it is sent to the store. On this page, the consignee selects their store, clicks the query to see all the receiving orders sent to this store, finds the corresponding receiving order, and clicks the details button. You can see the receiving details, against the read box information, and you can judge whether this box of goods contains the goods to be received by his store and whether the goods received are complete. If you find that there is a lack of certain clothing, you can contact the shipper and the administrator to confirm solution. If there is no problem, you can confirm the receipt, as shown in Figure 4.

A store returns function to achieve the rapid return of out-of-season clothing within the enterprise. Store clerks receive the return task message from the administrator, use the PDA in the store to find all the clothing to be returned to

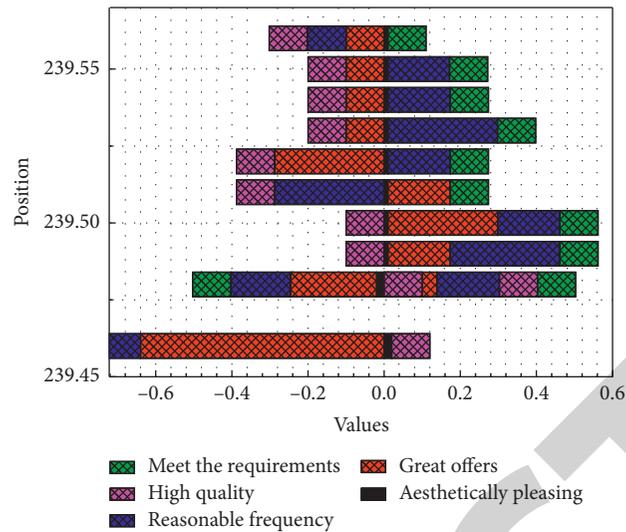


FIGURE 4: Statistics that meets the needs of members.

the warehouse, and then read the Radio Frequency Identification (RFID) tags of these garments through RFID readers; the readers read and submit the data to the server side for processing. The server side processes the data and checks whether it is consistent against the return list [21–24]. If they do not meet, the difference will be prompted until they are consistent or the clerk has looked for a few times and the corresponding product cannot be found in the store. Then, the clerk finds the clothing box and clicks on the store return page to confirm the return. In the return, you need to click the print button to print the sticker on the box and finally send the goods to the destination warehouse.

#### 4. Results and Discussion

Logging into the system uses the store unit, clear account name, and login password for user authentication. The system uses the dual authentication method of identity authentication and authority authentication. Identity authentication determines whether the user has the authority to enter the system, while county-wide authentication is used to verify the user's authority to use the system and determine whether it is an administrator, management staff, or an ordinary user. The incoming goods management includes two functions of purchasing incoming goods and purchasing outgoing goods. It mainly completes the management of sporting goods incoming information and the formulation of incoming goods plan. This module provides sports goods stores with the registration and inquiry of the entire store's incoming goods and can also make detailed inquiries of sports goods information and generate a list of incoming goods reports. Purchase return mainly realizes the function of sporting goods return. Its logic flowchart is shown in Figure 5.

Inventory management is divided into stock transfer and split bundle. Through inventory management to grasp the amount of inventory, at any time to adjust the allocation of goods. Sales management includes product sales, promotion management, and return management. Through this

module, you can manage the sale of goods and various promotional activities. Merchandising can write sales information to the sales list and add, delete, and change the inventory list, and the user can query and print the inventory information. Discount management can manage discount sales for customers and members, and the system automatically calculates the discount according to the discount settings. Statistical management includes commodity purchase statistics, inventory cost statistics, and sales statistics. Complete the statistical reports of each link, as shown in Figure 6.

System maintenance includes data backup and recovery management, and system setup. The system initialization setting and data backup and restoration operations are completed through this module. The system architecture of the core management system is a combination of two-tier structure and three-tier structure, and the interpenetration of the application layer and business processing layer is deeper [25–27]. The system adopts component technology for system construction, and the system components are divided into core (basic) components and extended components. The overall design idea of components is extracting the basically consistent processing classification in the business as the core component; each independent and inconsistent processing is extracted into the extended component. As a product system, the core system and its specific business system will undergo a long-term process of improvement and enhancement, and the application architecture library and the corresponding component library for document management will be gradually constructed in the development process.

It is required that the core system can be easily extended into a specific business system based on the core system, such as store inventory management system and warehouse management system. For the core system, this type of extension is mainly to add specific business functions to handle. The demand for systems that provide application operations using BROWSER browsers will become stronger and stronger, and the core system and business systems should be designed with a reasonable component structure

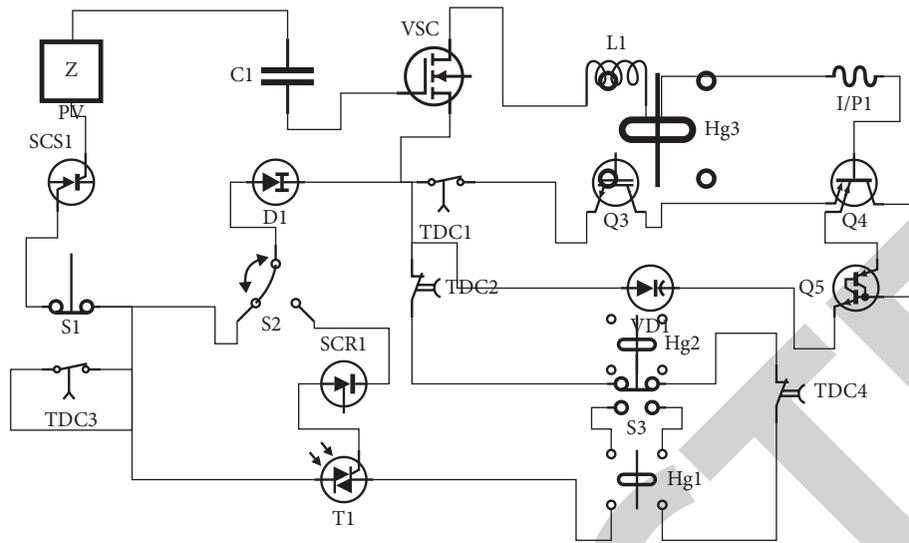


FIGURE 5: Logical flowchart of incoming goods management module.

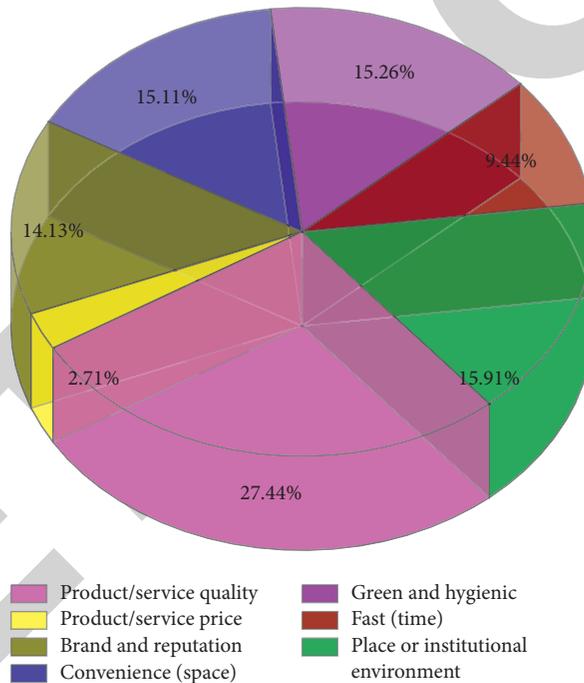


FIGURE 6: Consideration analysis.

for the future implementation of WEB-based systems. The vitality of the core system and the specific business system also lies in their high integrability. The integration is demonstrated by the integration with other systems: the integration with third-party technologies and products, such as third-party encryption algorithms and full-text search. According to the measurement results in the previous section, the software is applied to establish the relationship diagram between subsystem orderliness and open innovation complex system cooperation, as shown in Figure 7.

As can be seen from the figure, the system cooperation is below 0.5 until 2018, which is the primary period of open innovation evolution, and open innovation is in the digital

resource allocation stage. Although the orderliness of the green complementary resource subsystem is higher than that of the green innovation network subsystem before 2017, both are below 0.5, so the digital open green innovation model should be the dominant open innovation model at that time. After the beginning of 2016, the increase of orderliness of the innovation network subsystem has increased significantly, which has contributed to the growth of the open innovation composite system cooperation. Therefore, since the end of 2018, the open innovation composite system cooperation degree is in the range from 0.5 to 0.8, indicating that the cooperation between subsystems is better. Open innovation has evolved to the

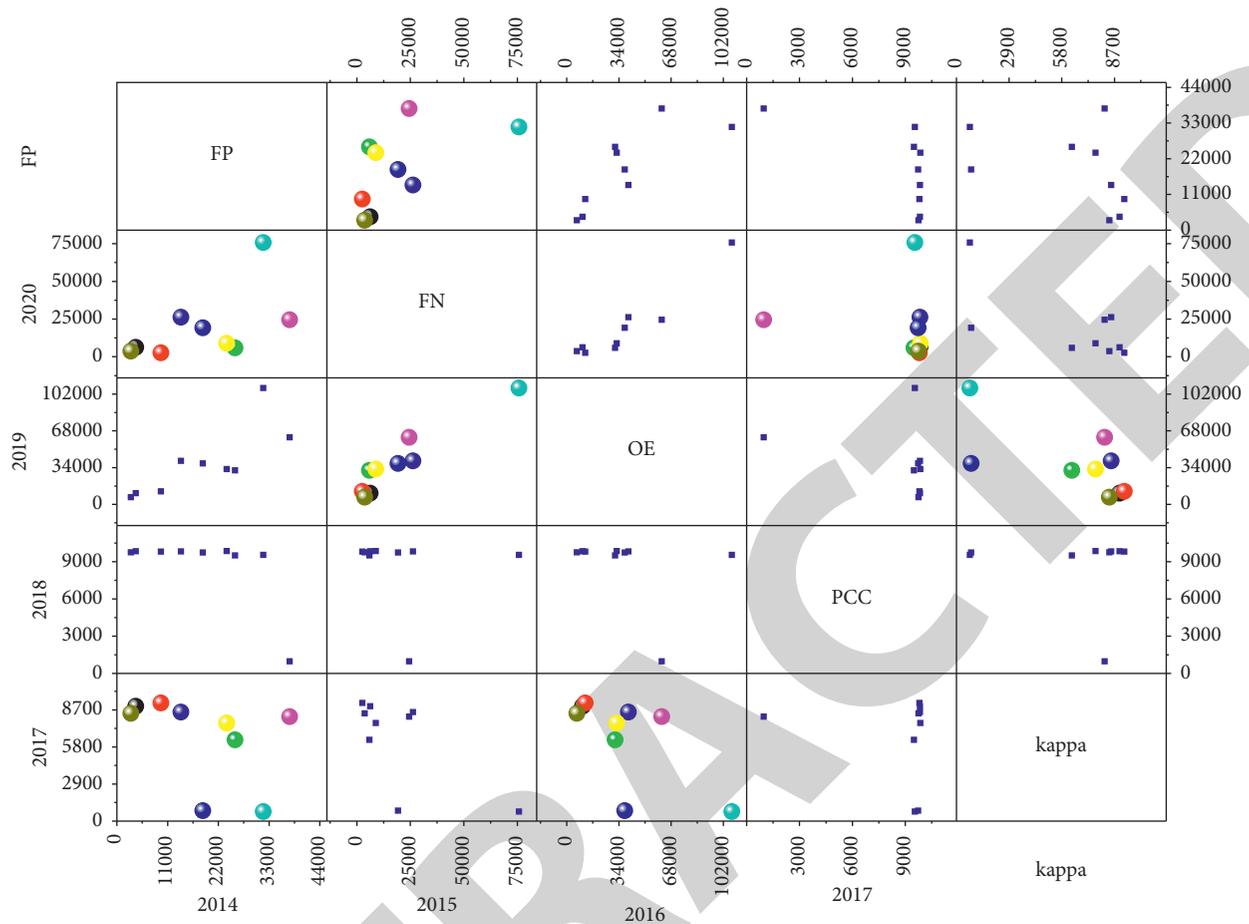


FIGURE 7: Relationship between subsystem orderliness and composite system cooperation.

network integration stage, and the networked open green innovation model is the dominant innovation model in this period. Since the orderliness of the green complementary resource subsystem is still lower than that of the green innovation network subsystem, the digital open green innovation model is the auxiliary innovation model at this stage. According to the growth law of system cooperation in these six years, it can be inferred that the open innovation of Internet-based innovation system is still in the network integration stage so far, and it needs to integrate the open innovation model to adapt to the changes of green innovation environment by further measuring the subsystem orderliness represented by the order parameter.

This test is mainly black-box testing, a comprehensive test of all required modules of the management system, which includes the appearance and function test of each module. Also, the structure of the base module is complex and many interfaces can be externalized to other modules, so a lot of time and workforce were spent on this basis to do the module-level testing for integration. After the test, it proved that the system can complete the functions required by the demand. This test encountered many difficulties, the most important of which was the time problem. In the process of

doing module testing and integration testing to take into account the testing of the network, the integration testing of the basic modules, and the development and testing of some auxiliary tools, as well as a lot of code changes and writing, the testers were required to follow up the testing in real time, while some testers were not too familiar with the business and not too clear about the testing specifications, so some errors were inevitably missed in the testing, as shown in Figure 8.

Online e-commerce traffic dividend has gradually reached the ceiling, the price advantage no longer exists, in the face of many homogeneous commodity competition, and e-commerce companies are difficult to cry out of the siege, having to slowly shift the position to offline. On the other hand, as consumers increasingly demand a higher quality of goods, the problem of online counterfeit sales has become more prominent, and the inability to experience the goods in person makes consumers make increasingly risky shopping, resulting in greater customer flow from online to offline physical stores. When entering any sporting goods retail store, trying on and trying out has become the most basic experience service. Customers can put on sports shoes and clothing to experience whether the size fits, whether the

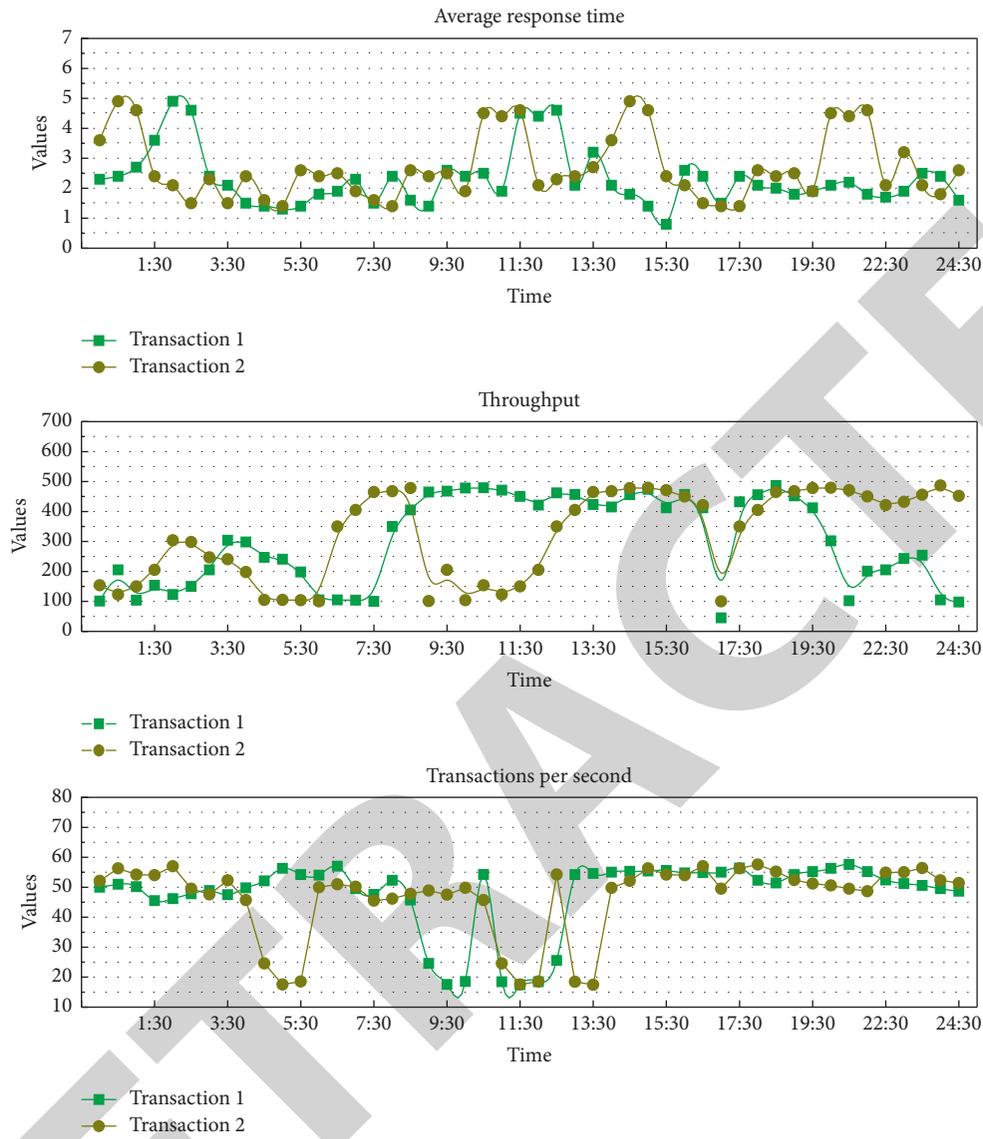


FIGURE 8: System orderliness measurement results.

material is comfortable, whether the performance is good, etc. They can also try on sports equipment to feel its material, quality, feel, etc. Retail stores can even provide professional venues for testing the performance of equipment. In this series of experiences, the service staff will always introduce the products and provide diversified services for customers with their good image and enthusiastic attitude.

## 5. Conclusions

The Internet is becoming increasingly known and more people are using it as a tool to shop online. Therefore, the development of the sporting goods industry requires the support of computers and other related technologies. The increased efficiency in the management of specialty stores can be used to expand the source of customers, and the establishment of an efficient sporting goods specialty store

management system can both increase the revenue from product sales and expand the original target customer population. The purpose of this paper focuses on how to build a sporting goods specialty store management and maintenance system to support the normal operation of the front-end physical stores, to achieve sports goods sales, staff management, store management, inventory management, and other functions in one sports goods store management system and to later support the system's maintenance and upgrade and other functions. Before developing the system, we explored the background, purpose, content, and status of the research. We also studied the technical theories that will be applied in the process of system development. Finally, the developed system was tested, and the system was adjusted and modified during the testing process, and finally, the system was implemented and improved.

## Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

## Acknowledgments

This work was supported by the 13th Five-Year Plan of Social Science in Jiangxi Province: a study on the attributes of college students' sporting goods brand selection and the construction of IPA model of consumption behavior based on the perspective of brand consumption (20TY11).

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