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SPORTS EVENT DATA MANAGEMENT SYSTEM AND ITS APPLICATION IN COMPETITION ORGANIZATION

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Abstract. Traditional sports competition data management systems have poor security and reliability in management results. The author proposes a new sports competition data management system based on a network platform. Integrating internal and external services to handle system business, designing pages using JSP dynamic page technology. Utilize network platforms to transmit data, and verify the transmission of data on the network platform through hardware and software firewalls. Realize data transmission between the system and the client through the designed network platform. Analyzed data backup and recovery methods to ensure data security. Track important business and operations of the system through the log tracking layer, and provide UML modeling for competition data management. The experimental results show that the recovery speed of the system is significantly faster than SSH and MDA systems, indicating strong data recovery performance of the system. It has been proven that the competition data management results of the designed system are reliable and the system performance is strong.

Key words: Online platform, Sports competitions, Data management system, JSP dynamic page technology

1. Introduction. The organization of large-scale sports events is a huge systematic project, especially the management of competition data, which is the core link of event organization work. However, with the continuous increase in the scale of sports events, not only have the operating costs of sports events become increasingly high, but the data management process of sports competitions has also become more complex, leading to increasing risks in organizing sports events. With the vigorous development of computer technology, powerful solutions have been provided for the complex management process of sports competition results. Currently, the management of sports competition results cannot be separated from the support of computer software systems [1].

The development of competition data management software systems is generally based on the relevant competition management regulations and rules formulated by sports event organization and management institutions, and other management technical specifications. However, different sports events generally have different competition management regulations and rules, so different sports event organization and management institutions also use their own competition management regulations and rule management software systems, which leads to the current sports competition data management system's weak universality and poor adaptability [2].

The sports event data management system is an information system that integrates data collection, storage, analysis, and display functions, widely used in the organization and management process of various sports events. With the continuous improvement of electronic technology and information technology, the application of sports event data management systems has become an indispensable part of modern sports organizations [3]. Through comprehensive, accurate, and real-time management of competition data, this system can provide better competition experiences and services to event organizers, participants, and spectators. The core function of a sports event data management system is data collection. During the competition, the system can collect real-time game data, including game results, scores, goals scored, fouls committed, etc., through various sensors and devices such as timers, scoreboards, cameras, etc [4]. These data are transmitted to the central server through wireless transmission or wired connections, achieving real-time updates and storage of data. Through data collection and storage, the sports event data management system can perform data analysis. The system can perform various statistics and calculations based on competition data, generating competition reports, data charts, and event analysis reports. These reports can help event organizers understand the overall situation of

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the competition, identify the strengths and weaknesses of athletes, and develop more scientific and reasonable training and competition strategies.

The sports event data management system also has the function of data display. Through the internet and mobile terminals, the system can display real-time competition data to the audience and participating players. Viewers can watch live matches through devices such as television, computers, and mobile phones to understand the progress and results of the matches. Contestants can view their competition results and rankings, as well as the performance of other contestants, through their mobile phones or computers. This real-time display method makes the competition more open and transparent, improving the fairness and credibility of the competition [5]. The application of sports event data management system can greatly improve the organization and management efficiency of sports events.

Traditional manual recording and statistical methods suffer from human errors and inaccurate data, while sports event data management systems can automate data collection, storage, and analysis to ensure accuracy and timeliness. This not only saves labor costs, but also improves the efficiency and accuracy of data management.

In addition, the sports event data management system can also provide more commercial value for event organizers. By analyzing and mining competition data, the potential and market value of athletes can be discovered, providing more business cooperation opportunities and sponsorship resources for event organizers. At the same time, through the display and promotion of event data, it can attract more audiences and fans, improve the visibility and influence of the event [6]. However, the application of sports event data management systems also faces some challenges and problems. Firstly, data security and privacy protection are important considerations. The competition data includes personal information and performance data of athletes, and strict security measures need to be taken to prevent data leakage and abuse. Secondly, the stability and reliability of the system are also key issues. Once the system malfunctions or data is lost, it will have a serious impact on the organization of the event and the participating players. Finally, the popularization and promotion of sports event data management systems also need to overcome technical barriers and cost issues, so that more sports organizations and events can enjoy the convenience and advantages of information management. In summary, the application of sports event data management systems has become an important component of modern sports organizations [7]. By comprehensively, accurately, and in real-time managing competition data, the system provides better event experiences and services for event organizers, participants, and spectators. With the continuous development and innovation of technology, it is believed that the sports event data management system will play a more important role in the future, promoting the development and progress of the sports industry. For this purpose, a new sports competition data management system based on a network platform has been designed.

2. Sports Competition Data Management System on Network Platform.

2.1. Overall System Design. The designed sports competition data management system based on network platform is described in Figure 2.1.

Design a system that combines internal and external services to handle system business, and use JSP dynamic page technology to design pages, thereby reducing the complexity of page code writing.

In order to ensure the timeliness and security of the system, this section uses the network platform to transmit data, verifies the transmission requests of the network platform through hardware and software firewalls, intercepts abnormal requests, and only allows legitimate requests to access the system. Simultaneously utilizing different technological constraints to ensure data integrity [8].

2.2. Network Platform Design. The network platform is mainly used to achieve data transmission between the system and the client, consisting of server clusters, gateways, firewalls, and other network infrastructure devices. Due to the large amount of sports competition result data, in order to improve transmission efficiency, the system chooses a distributed processing system, adopts ASP technology and B/S architecture, and operates in a local area network and external network environment. The B-end is mainly used for inputting, managing, and outputting data, while the S-end is mainly used for saving, accessing, and processing data. The network platform structure is shown in Figure 2.2.

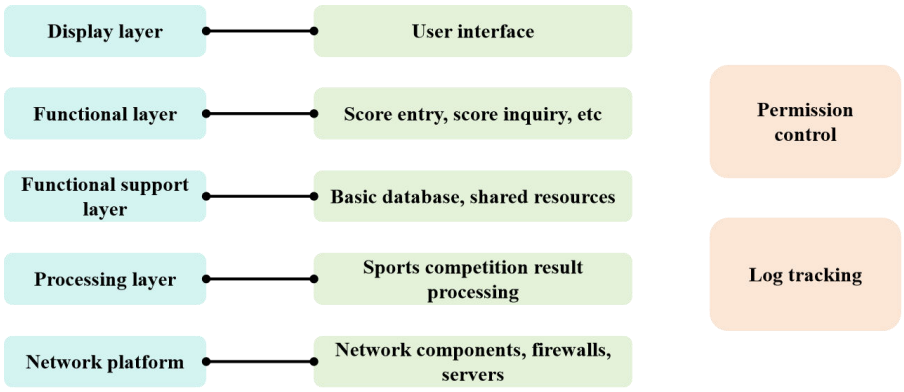

Fig. 2.1: Overall structure of the system

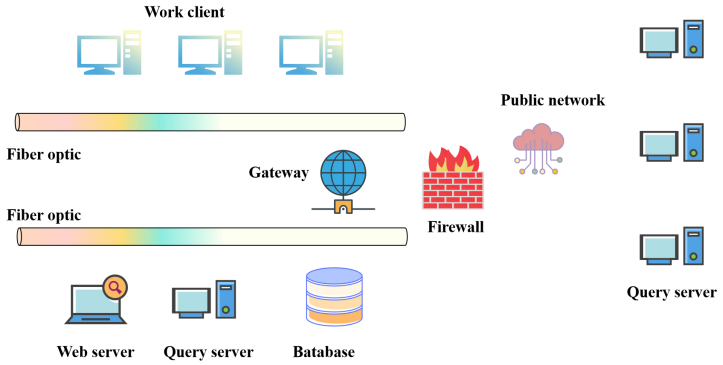

Fig. 2.2: Structure of the network platform

2.3. Functional Support Layer and Functional Layer Design. The functional support layer refers to the data center of the sports competition data management system and other network support, including components such as data storage and caching. Before athletes register online, the system administrator will publish the sports competition items and corresponding numbers, athlete grouping settings, and relevant information, making it easier for athletes to register independently [9].

During the competition, the system will promptly release competition information, and athletes can check their competition results through their own information. During the competition, the administrator inputs the competition results in real-time based on the competition status, and implements operations such as athlete grouping and competition result summary through the system. Users mainly include all sports competition staff, management personnel, athletes, etc., and can perform real-time queries on competition results[10]. The data flow diagram of the designed sports competition data management system is described in Figure 2.3.

During sports competitions, there are a large number of athletes, managers, and staff entering information, resulting in a large scale of data and heavy workload. Manual input can lead to data errors. In order to prevent these phenomena from occurring, data backup and recovery functions are provided in the design of the system to ensure the reliability of results. A detailed analysis will be conducted in the following text [11].

Before sports competitions, the administrator sets the competition items according to the requirements of the competition and processes the data based on the athlete's registration situation. The competition committee can check the athlete's competition results through online platforms, confirm them to be correct, and then output the results.

The functional layer contains several different types of functional modules, mainly responsible for imple-

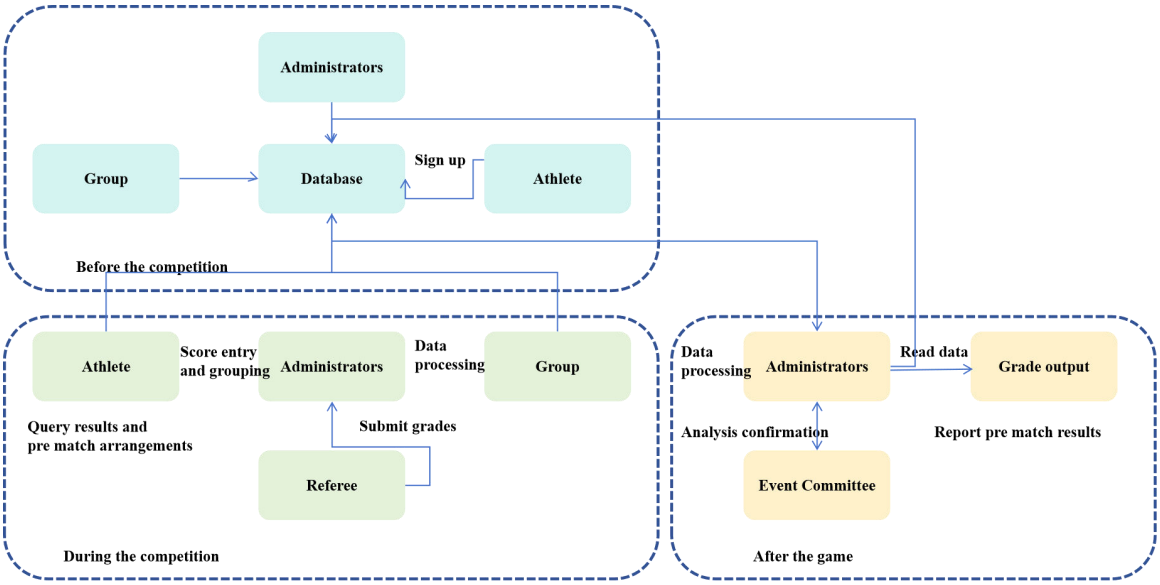

Fig. 2.3: Flow diagram of the system data

menting various business processes. By utilizing the interaction between the functional support layer and the data layer, corresponding business processing can be achieved, which not only displays information to users but also collects information from them[12].

2.4. Design of permission control layer. When designing the system, a firewall will be installed, with corresponding log records for all businesses in the system, mainly including operators and detailed operation information, for easy query.

In order to ensure the security of sports competition results, the system provides data backup and recovery functions. The system can autonomously backup data and recover it in the event of a failure, avoiding data loss [13].

When backing up sports competition data, encapsulate the request as a backup record and transfer it to the cache. The backup record mainly includes information such as the processing object, write length, and detailed data. The format is as follows:

$$\begin{aligned} R_{backup} =& \{< tid, offset, len, data > | tid \in N, offset \in N, len \in N, \\ & data \in (0,1)^t, t \in N\} \end{aligned} \tag{2.1}$$

In the formula: tid is used to describe the excessive task identifier; Offset is used to describe the offset address of the data to be processed; Len is used to describe the length of written data; Data is used to describe writing data to a disk; N is used to describe a set of natural numbers. The process of recovering sports competition data is as follows:

1. Segmentation of sports competition data blocks and allocation of recovery tasks.
2. Calculate the summary values of different data and transfer the task record R_{task} to different remote backup servers for recovery. The task format is as follows:

$$R_{task} = \{< tid, offset, len, LTH_i > | tid \in N, offset \in N, len \in N, LTH_i \in N\} \tag{2.2}$$

   In the formula:$LTH_i = H(L_i)$; H is used to describe the summary value function obtained; Li is used to describe sports competition data to be restored.
3. After obtaining task records, read the object data block R_i from the remote backup server using a predetermined offset and data block size.

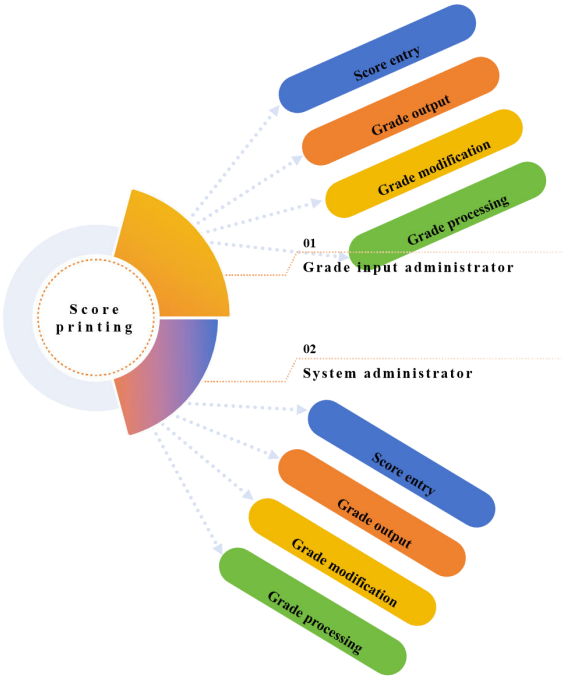

Fig. 2.4: Performance management: UML modeling

4. Find the summary values of different data blocks and compare them with the summary values transmitted by the local server. If they are inconsistent, it is considered that the data at both ends of the data block is different and needs to be restored; Otherwise, it is considered unnecessary to restore it[14].
5. Encapsulate the corresponding data blocks of different remote backup servers into recovery records and transmit them to the local server. The recovery record format is as follows:

$$R_{recovery} = \{< tid, offset, len, data > | tid \in N, offset \in N, len \in N, data \in (0,1)^t, t \in N\} \tag{2.3}$$

6. After receiving data records, the local server transfers the data to the corresponding location on the disk through offset to achieve data recovery.

2.5. Log tracking design. The log tracking layer is mainly responsible for tracking important business and operations of the system, and recording relevant information in the form of logs, mainly including operation time, operator information, and specific operation information, in order to avoid losses caused by misoperations [15].

2.6. Processing layer design. The processing layer is mainly responsible for sports competition data management and is the core of the entire system. After the completion of different stages of the competition, the processing layer is responsible for inputting, processing, modifying, and printing the athlete's competition results, and grouping subsequent competitions based on the competition results. Detailed UML modeling is described using Figure 2.4.

3. Experiments and Result Analysis. The experiment tested the system from two aspects: The effectiveness of competition data management and system performance. In order to verify the effectiveness of the system, the SSH architecture system and MDA system were compared to manage the results of the men's 200m competition. The comparison results of the data management of the three systems are shown in Table 3.1.

Table 3.1: Management results of the three systems

Ranking	Actual grades	This article systematically announces the results	SSH system releases results	MDA system releases results
First place	20 54	20 54	20 52	20 54
Second place	21 23	21 23	21 23	21 23
Third place	21 59	21 59	21 59	21 46
Fourth place	22 16	22 16	22 35	22 23
Fifth place	22 59	22 59	22 55	22 59
Sixth place	23 12	23 12	23 12	23 12

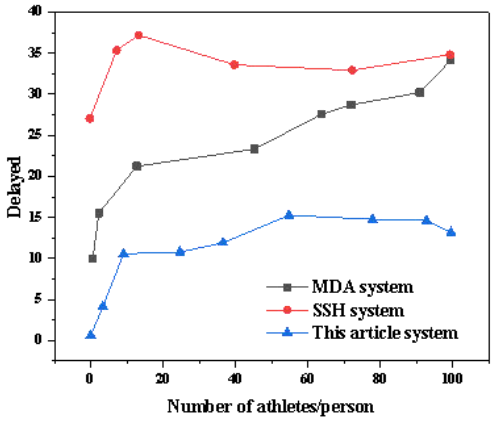

Fig. 3.1: Time delay comparison results of the three systems

According to Table 3.1, the results published by the system are completely consistent with the actual results of the athletes, while the SSH system has three results that do not match the actual results, and the MDA system has two results that do not match the actual results. This indicates that the data management results of the system are reliable and effective.

During the testing process, the memory usage of the system remained within the range of 1-2 GB, and the memory growth remained stable without any memory leakage, effectively ensuring that the server provided real-time services to users [16]. In order to verify the timeliness of the system, a comparison was made on the query latency of competition results for 100 athletes in different events under the system, SSH system, and MDA system. The results are shown in Figure 3.1.

Analyzing Figure 3.1, it can be seen that the query latency of the system is significantly lower than that of SSH and MDA systems, indicating that the system not only has high management reliability but also good query timeliness [17-20].

The data recovery performance is a security factor that affects the security of system data. The data recovery speeds of this system, SSH system, and MDA system are compared below, and the results are described in Figure 3.2. Analyzing Figure 3.2, it can be seen that the recovery speed of the system is significantly faster than that of SSH and MDA systems, indicating that the system has strong data recovery performance and high security.

4. Conclusion. The author has designed a new sports competition data management system based on a network platform, provided the overall structure of the designed system, and introduced the design process at each level. The sports event data management system is a software system that integrates multiple functions,

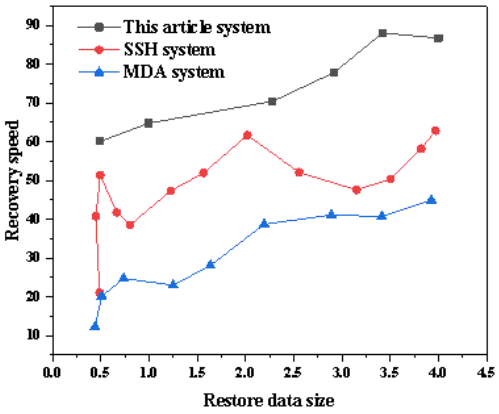

Fig. 3.2: Comparison of the data recovery speed of the three systems

which can help match organizers efficiently collect, store, and analyze match data. The basic principle of this system is to collect various data during the competition, such as competition time, scores, statistical data, etc., through various sensors and devices, and then store these data in a database for subsequent analysis. The experimental results show that the designed system has reliable competition data management results and strong system performance. This system has high practical value and can be applied to various sports events to improve the management efficiency and accuracy of competition results. With the continuous development of technology, there is still room for further development and improvement of the system in the future.

REFERENCES

[1] Yao, L. , & Zou, J. . (2021). Research on sports competition information management based on computer database technology. Journal of Physics Conference Series, 1744(3), 032138.

[2] Zhang, Y. , Zhao, X. , Shen, J. , Shi, K. , Yu, Y. , & Shi, G. . (2021). Optimization of sports event management system based on wireless sensor network. Journal of Sensors(Pt.8), 41(2), 156-165.

[3] Zhang, S. , & Liu, M. . (2021). Computer aided management system of sports horse registration based on distributed storage system and deep fusion learning - sciencedirect. Microprocessors and Microsystems, 40(3), 740-752.

[4] Mu, X. , Yin, J. , Zhang, L. , & Jan, N. . (2022). Application and evaluation of sports event management method based on recurrent neural network. Mathematical Problems in Engineering: Theory, Methods and Applications, 33(1), 7-9.

[5] Liu, J. , Zhao, Q. , Yao, Y. , Wang, J. , & Gu, Y. . (2021). Data organization method of distribution network management system based on geographic information system. Proceedings of the 2021 5th International Conference on Electronic Information Technology and Computer Engineering, 112(5), 651-653.

[6] Babenko, V. , Baksalova, O. , Prokhorova, V. , Dykan, V. , & Chobitok, V. . (2021). Information and consulting service using in the organization of personnel management. Studies of Applied Economics, 38(4),74-78.

[7] Yamashita, N. , & Hori, A. . (2023). Two-stage distributionally robust noncooperative games: existence of nash equilibrium and its application to cournot–nash competition. Journal of Industrial and Management Optimization, 19(9), 6430-6450.

[8] Saukh, I. , & Vikarchuk, O. . (2021). Creativity in management and creative management: meta-analysis. Marketing and Management of Innovations,96(1), 65-80.

[9] Doan, T. , Manenti, F. M. , & Mariuzzo, F. . (2023). Reprint of: platform competition in the tablet pc market: the effect of application quality. International Journal of Industrial Organization, 25(1), 78-85.

[10] Zinina, O. V. , Sharopatova, A. V. , & Olentsova, J. A. . (2021). Management of an agricultural organization based on building a quality management system. IOP Conference Series: Earth and Environmental Science, 677(2), 022029 (7pp).

[11] Prasad, S. , & Tanase, S. . (2021). Competition, collaboration and organization design. Journal of Economic Behavior & Organization, 183(2), 1-18.

[12] Liu, Y. . (2021). Characteristics of organization and management of private colleges and universities based on the big data analysis. Journal of Physics Conference Series, 1744(4), 042090.

[13] Huang, H. , & Tan, X. . (2021). Application of reinforcement learning algorithm in delivery order system under supply chain environment. Hindawi Limited, 25(1), 85-116.

[14] A, W. J. , & A, Z. S. . (2021). Design of sports course management system based on multi-core embedded system and motion capture - sciencedirect. Microprocessors and Microsystems, 82.
[15] Fonti, F. , Ross, J. M. , & Aversa, P. . (2023). Using sports data to advance management research: a review and a guide for future studies. Journal of management, 18(2), 203-243.
[16] Udroiu, A. M. , Sandu, I. , & Dumitrache, M. . (2022). Integrated information system for the management of activities in the organization. Studies in informatics and control, 38(2), 255-266.
[17] Kombate, B. , Emmanuel, M. , & Richard, K. K. . (2021). The implication of the strategic implementation style and middle management effort in public organization strategic management implementation and its organizational performance. Journal of Public Administration and Governance, 11(1), 1.
[18] Song, C. . (2022). Analysis of the organization, management and operation of blantyre water board in malawi: future reforms and perspectives. Environmental quality management, 14(3), 494-523.
[19] Parabakaran, D. , Bin, M. , & Lasi, A. . (2021). Human resource management practices and its impact on employee engagement and performance in an organization a study on labour force in malaysia. Malaysian E Commerce Journal, 4(1), 29-35.
[20] Shust, O. , Grinchuk, Y. , Paska, I. , & Tkachenko, K. . (2021). Investment attractiveness in the system of management and business reputation of agricultural enterprises. Ekonomìka ta upravlìnn APK, 29(3), 23-42.

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