

Research on Database Optimization Techniques and Methods of Public Library Management Information System under the Background of Big Data

Chuan Gao^{1,2,a}

¹University of San Carlos, Cebu 6000, Philippines

²Hunan University of Humanities, Science and Technology, Loudi, Hunan, 417000, China

^a631385861@qq.com

Keywords: Public Library, Management Information System, Database, Optimization Technology

Abstract: With the continuous improvement of information technology in the context of big data, the performance and security of database technology of management information system of public libraries are constantly optimized and improved. Operating system, hardware and software have many influences on the database performance of public library management information system. According to the principle of database optimization, the database optimization method of public library management information system is designed to optimize the performance of data technology of public library management information system.

1. Introduction

In the context of big data, although after years of efforts, some databases have been established in the management information system of public libraries, the overall layout of public libraries with databases is still relatively small, and quite a few public libraries have not yet developed databases. The level of modernization and communication technology need to be improved. Because of its low network coverage, the limited information resources can only be transmitted in a small range, and the databases of some library management information systems can't even be shared on the network, and the valuable information resources can't be well utilized, so the database construction needs to be developed urgently [1].

2. Influencing Factors of Database Performance of Public Library Management Information System

The performance of public library management information system database is affected by many factors. It is necessary to design the database reasonably, optimize the index, control the size and data volume of the database, select high-performance hardware devices, and set up the number of database connections and cache reasonably to improve the performance of the database. Oracle database is the most widely used relational database management system at present. Most public library management information systems use Oracle database, and the E-R model of library

database is shown in Figure 1. With the development of application business and public library management information system, the scale of database is expanding. Facing the increasing amount of data, the problem of database performance becomes more and more serious. How to use limited hardware resources to ensure more users' service, ensure users' response speed and improve data throughput has become the primary problem in the research and development of public library management information system. The key to solve these problems is how to optimize database performance, as shown in Figure 1 [2].

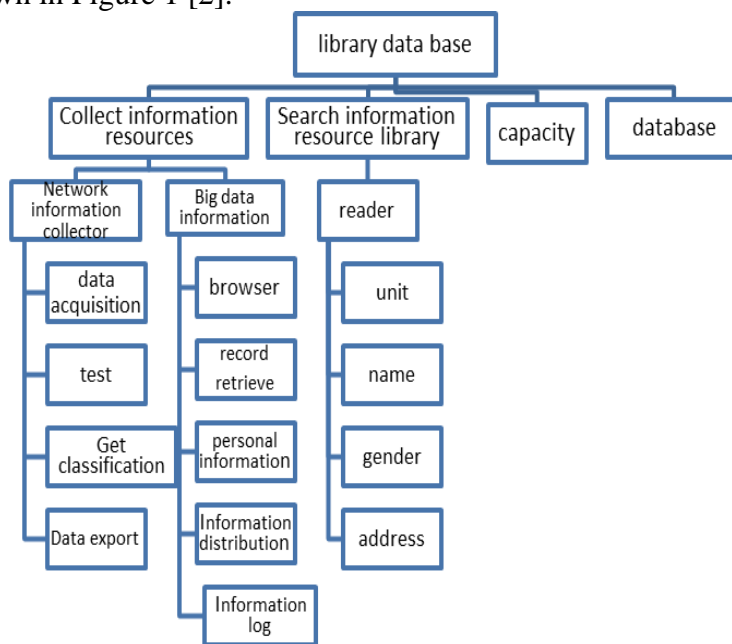


Figure 1: E-R model diagram of library database

The performance of the management information system database of public libraries is mainly reflected in the access efficiency and storage efficiency, that is, how to store the largest amount of data at the fastest speed. There are many factors that affect the performance of database application system, including software, hardware environment, network environment, database management and maintenance, as well as Oracle, MYSQL, DB2 and so on. No matter what kind of database will have the problem of running efficiency, this paper analyzes the factors that affect its performance from the performance of operating system, hardware performance of database server, physical design of database, SQL statement, fragmentation and parallelism (See Figure 2)[3].

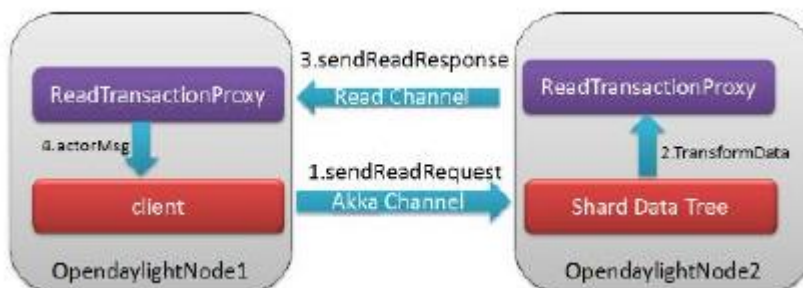


Figure 2: Data Flow Diagram

2.1. Performance Factors of the Operating System

The performance of operating system includes the resource utilization efficiency of computer processor, memory, hard disk and network. The performance of operating system is affected by response time, throughput, concurrency, scalability, reliability and security. In most cases, the performance of the management information system database of public libraries depends on the performance of the operating system. Operational performance directly affects database performance, such as speed. Datastore draws on the MVCC idea of database systems such as MySQL: during processing, read requests can be processed concurrently. The following is the official performance data compared with Cassandra (see Figure 3)[3]:

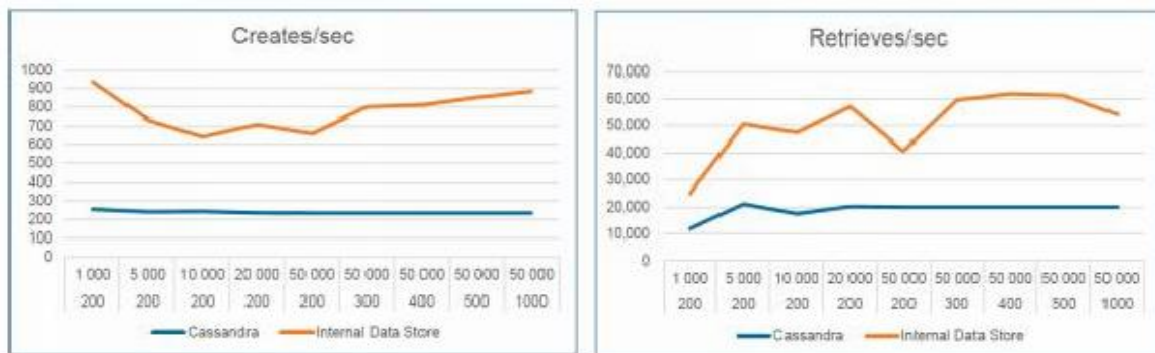


Figure 3: Performance comparison diagram

2.2. Database Server Hardware Performance Factors

The hardware performance of database server is an important factor affecting the performance of database system, which needs to be considered by processor, memory, storage equipment, network bandwidth, power supply and cooling equipment. Most database performance problems in the management information system of public libraries are caused by improper hardware configuration or insufficient hardware assembly. The influence of memory and CPU on database operation is enormous. Now this problem is solved by adjusting the I/O subsystem and reducing the access of the I/O subsystem [4].

2.3. Physical Design Factors of the Database

The physical design of the database aims at optimizing the performance, reliability and maintainability of the database. It is influenced by storage media, storage structure, index, partition, database cache, database security, database backup and recovery and other factors. By arranging the physical files in the database of the management information system of public libraries and allocating logical objects reasonably, the reading and writing speed of the database can be accelerated. Through the reasonable design and distribution of public library's management information system database, we can meet the needs of data processing, improve the performance of public library's management information system database, and reach the best state of public library's management information system [5].

2.4. SQL Statement Factors

SQL statement is composed of multiple keywords and grammatical elements. SQL statement optimization refers to the effect that we bring to the database when we send instructions to the database. Influenced by data query, data operation, data definition, data control, data aggregation,

data connection and other factors [6]. Good SQL statements can be reused by the management information system database of public libraries to reduce the analysis time. Adjusting SQL statements can change the memory hit rate in public library management information system, reduce I/O subsystem access, and improve the performance of public library management information system [7].

2.5. Database Fragmentation Handling Factors

Database fragmentation processing is affected by storage engine, hardware configuration, backup and recovery, running time and other factors. When two or more data objects in the system have a common fragment, these cross fragments are database fragments. Too many database fragments will take up extra memory, which will be more time-consuming when dealing with the management information system data of public libraries, and affect the performance of the database. To eliminate this fragmentation, you need to create a tablespace, and put static or small growth in this tablespace, and dynamic large growth in their respective tablespaces [8].

2.6. Parallelism Factors

Parallelism means that some functions are executed in parallel in the database of management information system of public library, and multiple servers execute processing at the same time. Parallelism is influenced by hardware resources, database design, access mode, database management system and application program design. Functions that can be executed in parallel include index creation, data loading and database recovery. Using parallel mechanism to query the management information system data of public libraries can reduce the query time [9].

3. The Database Optimization Principle of Public Library Management Information System

For the database optimization of public library management information system, we need to consider database design, hardware optimization, SQL statement optimization, statistical information collection, backup and recovery, security management and other factors to improve the performance and reliability of the database. We hope you find the information in this template useful in the preparation of your submission [10].

The main indicators of Oracle database performance are: user response time and database throughput in public library database. Database user response time can be subdivided into system service time and user waiting time. It can be seen that there are two ways to improve the performance of the database system of the management information system of public libraries: to reduce the waiting time of users by reducing the conflict rate of accessing the database resources of the management information system of public libraries; Reduce the system service time by increasing the throughput of the management information system database of public libraries. Oracle database performance optimization should be carried out in a certain order, as shown in Figure 4 [2].

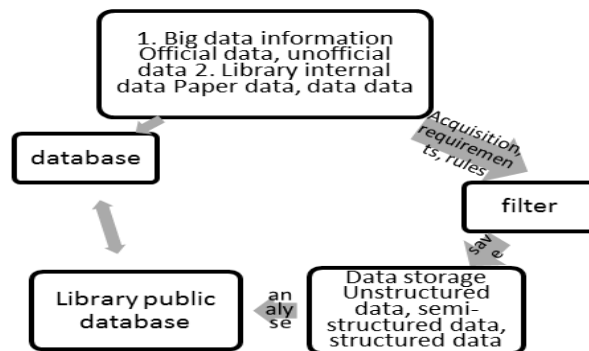


Figure 4: Flow chart of library database optimization

The management information system of public library is an important system, which needs to support a large number of data processing and query to maximize the performance and reliability of the database. The main principles to be followed in database optimization of public library management information system are:

The principle of normalization of database structure design: the structure design of database is normalized to avoid data redundancy and inconsistency; The principle of reasonable relationship between database tables: the relationship between database tables should be based on correct data types to ensure the integrity and consistency of data; Avoid using too many triggers and stored procedures: too many triggers and stored procedures will lead to the decline of database performance, so we should try to avoid using too many triggers and stored procedures; Principle of cleaning useless data regularly: cleaning useless data regularly can improve the performance of database, reduce the occupation of storage space, and thus speed up the query; Principles of database backup and recovery: database backup should be carried out regularly to avoid data loss and damage, and recovery function should also be tested to ensure the reliability of backup; Principle of application optimization: besides the optimization of the database itself, we should also optimize the application, reduce the number of queries to the database as much as possible, and use cache technology to improve the performance of the application; Principle of monitoring database performance: performance monitoring tools should be used to monitor database performance, find performance bottlenecks in time, and take corresponding measures to optimize the database [11].

4. Database Optimization Method of Public Library Management Information System

From the front, we can know the factors that affect the database performance of the management information system of public libraries. Therefore, when optimizing the database, we should take the application program, I/O subsystem and operating system as the basis of consideration, and make improvements from the following aspects[12].

4.1. Reasonable Design of Public Library Management Information System Database and Management Table

The design of MIS database needs to fully consider business requirements and data characteristics, reasonably set table structure and index, avoid redundant data, reduce data storage space and improve query efficiency. The logical feasibility of management table correctly reflects the relationship between data and other data, but these do not reflect the access path used by users to obtain data. If users' access is confirmed, many queries about table design will be useless. Therefore, the design table should design the simplest and most direct way for users to meet the real needs of customers. While making full use of table partition, we should also consider possible data

changes when creating tables, and minimize row links and row migration in data query of management information system of public libraries.

4.2. Tuning and Optimizing Disk I/O

Tuning and optimizing disk I/O is one of the important methods to improve system performance, which can improve system bottleneck and increase response speed and throughput. Optimizing disk I/O can be achieved in many ways, including increasing disk bandwidth, using high-speed disks, optimizing file system and access mode, and caching data. Choosing the appropriate optimization method according to the specific application scenarios and system characteristics can improve the system performance and response speed.

The most important aspect of database performance of management information system of public library is disk I/O operation. Reducing I/O disk operation can greatly improve the performance of public library database system. The basic method is to store frequently used data in the cache, that is, we can find frequently used data and directly read the information in the cache without reading all the disks, which will reduce the number of visits and disk I/O operations. Separate data from indexes. In short, this means distributing as much I/O as possible evenly among multiple disks and disk controllers. Principles to be followed when there are too many disks: separate static data from dynamic business data; Separate the system tablespace from the user tablespace; Separating data segments from the data dictionary; Put data and log files on separate disks; Create a specific tablespace as a temporary tablespace; Create separate tablespaces for tables and their indexes and put them on separate disks; Put frequently indexed statements on a disk.

4.3. Adjust the Memory of the Management Information System Database of Public Libraries

Adjusting the memory of the management information system database of public libraries is also one of the important methods to improve the performance of the database. By increasing the buffer size, optimizing the caching algorithm, allocating more physical memory, optimizing the database index and reducing unnecessary operations, the performance and response speed of the database can be improved. Generally speaking, people access data a lot, and the number of visits is very large, so we must deal with the use of memory resources. We must allocate the memory buffer effectively, so as to speed up the data query of the management information system of public libraries and greatly improve the stability of the system. If we want to adjust the problem of the database, we should have enough memory resources in the operating system first. If the operating system aims to allocate more memory for the database at the expense of frequent exchange and paging, this method will not achieve the expected effect, and will also lead to a great increase in I/O expenses and reduce the performance of the database system of the management information system of public libraries.

In addition, we should make a major adjustment (SGA) to the system global area in the database. In Oracle, the system global area covers many aspects and needs enough memory. Assuming that the memory allocated to database buffer, log buffer and data dictionary buffer is not enough, the system structure can not be well adjusted; If the memory allocated to the log buffer is not enough, the system cannot capture the contents of the log well; If there is not enough memory allocated to the data dictionary buffer, the accuracy of the management information system of public libraries will be greatly reduced. Therefore, we must adjust these databases. Only when these memory buffers are set reasonably, the data query speed and accuracy of the management information system of public libraries will be significantly improved [13].

4.4. SQL Statement Optimization

SQL statement is the key of MIS database optimization. SQL statements can be optimized by indexing, linking, batch processing, subquery and other technologies to improve the efficiency and performance of database query. Shortening the execution time of target SQL is the purpose of SQL optimization in the database of management information system of public library, so as to ensure that the information of tables or indexes related to target SQL is fully considered, otherwise statistical information needs to be collected again. In order to achieve the purpose of shortening the execution time, the methods adopted are: reducing resource consumption by shortening the execution time; Specific optimization methods include query rewriting, index adjustment, using batch processing to reduce the number of interactions, adding hints to change the scanning or association of tables, etc. Reduce execution time by increasing resource consumption. This method will consume more resources, so when other SQL optimization methods fail to work, we can sacrifice some hardware resources to improve efficiency. The specific method is the parallel mechanism, which can parallelize a single table or index and open a specific SQL in parallel [14].

5. Conclusion

With the continuous improvement of information technology under the background of big data, the performance and security of database technology of management information system of public libraries are constantly optimized and improved. Database technology will be greatly developed, which will provide more powerful information management capabilities for the management information system of public libraries. The current management information system of public library can't meet the long-term demand for information management, so it is necessary to optimize the performance of data technology of management information system of public library from different aspects, promote the long-term development of management information system of public library, and provide a wider application for database technology [15].

Acknowledgements

In 2021, Hunan Philosophy and Social Science Fund Project: "Research on Database Optimization of Management Information System of Public Libraries in Poverty-stricken Areas in Western Hunan", project number: 21YBQ092.

The research project of teaching reform in Hunan University of Humanities and Science and Technology in 2022: "Application and exploration of computer laboratory management information system in experimental teaching", project number: RKJGY2235.

References

- [1] Sun L, Zhang W, & Sun, Y. (2022) Research on the optimization of the public library management information system database based on the integration of cloud computing and big data. *Journal of Physics: Conference Series*, 2022(1985), 012126.
- [2] Liu Chuxiong, Liang Yingying. *Database performance optimization technology of management information system*. Science and Technology Plaza, 2011(05):89-91.
- [3] Yin Zuanxing. Design and implementation of database optimization technology for agricultural information service platform. *Guangzhou: Zhongkai University of agriculture and engineering*, 2020:18-25.
- [4] Li X, Li X, & Zhou, S. (2020) Optimization of public library management information system database based on big data. *Journal of Physics: Conference Series*, 2020(1566), 042076.
- [5] Zhang Z, & Chen, S. (2021). Database optimization of public library management information system based on big data. *Journal of Physics: Conference Series*, 2021(1805), 042002.

- [6] He H, & Ma W. (2021). Database optimization of public library management information system based on data mining. *Proceedings of the 2nd International Conference on Computer Science and Application Engineering*, 139-144.
- [7] Wu Y, Wu, J, & Zhou, J. (2021). Research on the optimization of public library management information system database based on cloud computing. *Journal of Physics: Conference Series*, 2021(1921), 012137.
- [8] Jiang Xiang, Li Jiayi. Research on database optimization of public library management information system based on cloud computing technology. *Modern Electronic Technology*, 2020, 43(19):131-134.
- [9] Shang J, Zhang L, & Chen Y. (2021). A study of database optimization for public library management information system. In *2021 3rd International Conference on Computer Engineering, Network and Intelligent Multimedia (CENIM2021)* (pp.269-273).
- [10] Chen H, Li X, & Li Y. (2020). Optimization of the database system of a public library based on cloud computing technology. *Journal of Physics: Conference Series*, 1618(4), 042118.
- [11] Kuo M. S, & Chen, S. C. (2020) Database optimization for the circulation management of a public library using data mining techniques. *Journal of Ambient Intelligence and Humanized Computing*, 11(3), 1043-1053.
- [12] Jie Chen, Kong Yuhong. Research on optimization of public library management information system based on relational database technology. *Modern Information*, 2021, 41(5):81-86.
- [13] Marco. Research on database optimization of public library management information system based on data mining. *Information Science*, 2021, 39(4):123-127.
- [14] Li Zhimin, Liao Mingchao. Research on database optimization method of large-scale management information system. *Modern Information Technology*, 2018(04):14-15.
- [15] Zhao Xuheng. *Design and implementation of library public database based on big data*. Changchun: Jilin University, 2016.