A Database Optimization Model for Java Web Architecture

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Abstract — **With the rapid development of information and Internet technology, enterprise information system applications based on Java Web technology is being used widely. In order to improve the stability and efficiency of the system, ensuring access to database performance is extremely important. With the increasing information and complexity characteristics of network data transmission information, common database technology has been unable to quickly and efficiently give the data exchange with complete server database. Several issues come to light such as: i) how to do reasonable database design and management, ii) how to improve database query optimization, leading to an urgent need to solve the problem with a Web application system in the era of massive data. In this paper we address Java Web information system architecture of the most prominent database access performance issues, and study database optimization techniques. At the same time, against the database access latency problems that occurred in operation of the project, the paper gives a detailed database optimization. The results show that through those database optimization we can greatly improve running speed. The developed methodologies can be directly transplanted to run on another platform and does not require the application of the system during the relevant adjustments and modifications for applications in aircraft design and component reuse.**

Keywords — Java Web technology; database optimization; enterprise information system.

I. INTRODUCTION

In recent years, information technology development, the application of information systems are increasingly being used. Java Web technology has lower hardware requirements, good scalability, easy maintainability late, and shorter development cycles. it is widely applied in the information system[1-3]. For the information system that be stabilized in various fields, efficient operation, the most important thing is to ensure that the database access performance [4]. But with the surge of information and data, network data transmission became busy, throughput information system became large, which the performance of these databases of information systems caused a lot of pressure, database optimizationis becoming more and more attention [5]. Currently, Java Web technology is mainly based on J2EE platform development [6]. J2EE is the Java language development needs through adaptive evolved a development platform, J2EE platform development thinking and now distributed boxes and may not consider the compatibility of application platform, a platform with concurrency in the application system , can be directly transplanted to run on another platform and does not require the application of the system during the relevant adjustments and modifications to aircraft design and component reuse is quite similar to JDBB [7-10]. Therefore, to optimize Java Web-based database architecture has a strong value. In this paper, this paper, for Java Web information system architecture of the most prominent database access performance issues, in-depth study of the database optimization techniques. At the same time against the database access latency problems occurred in operation of the project, the paper gives a detailed database optimization.

II. THEORETICAL REVIEW

A. Database Optimization

Database optimization refers primarily through a number of measures to reduce information technology and system time and resource consumption in the database access, and thus achieve the purpose of improving system performance. Comprising: a database connection pool technology; database indexing techniques; SQL statement tuning techniques; DataSet object dump optimization techniques.

Database Connection Pool is first to establish a buffer pool, and makes a certain number of objects stored in the database connection. In the system before the database access required in advance to request a database connection pool connection object, if there is an idle connection pool connection object, the connection pool will be allocated free of objects to the system, direct connection technology compared to JDBC, connection speed greatly improved, and can greatly enhance the performance of the database system. Number of database connection pool is the core of ideological connection multiplexing, in connection pool will have its own mechanism to connect the object to create, manage and closed, and the control connection object and length of connection exists, will use complete connection objects recovered released to the pool, can once again be used to avoid frequent database access and database connection establishment closed, saving time and overhead access resources.

In the database access, the main operation or database query. In the duration of database access, query length is also the largest proportion. So the database query optimization optimization is a critical step. Query Optimization is the best way to optimize the database indexing techniques. In fact, the index is a database structure that can assist to speed up

the field column query speed can be properly indexed by a particular sort, so when the data table scan does not have to be a full table scan, do not have the extra data recorded eleven scan when reducing the query to the number of records scanned data, saving the time required for a query.

SQL (Structured Query Language)is a computer language used to access and manipulate standard databases. Under the right conditions to ensure that the SQL statement, and then make the appropriate adjustments and its optimization, it can greatly save the time required for the system to access the database. SQL statement tuning technology mainly refers to the SQL statement by changing the format to minimize the amount of data to be scanned table query, or query to reduce the required number of tables to find an optimal query path. Dataset Objects dump technique it is the result obtained from the database dump set object Resultset objects as a collection of objects, staging the data set to the collection, processing program data set when the data processing can be carried out by operating the collection objects.

B.   Java Web Technology

Java Web is to use the Java language and technical aspects of WEB-based application development, it is the development of technology in general.
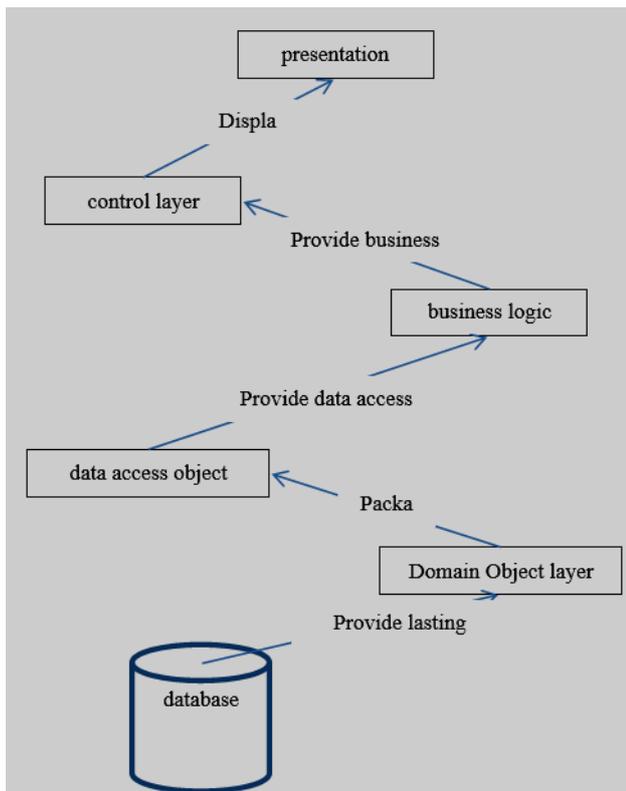

Figure1. The relationship between layers

Currently, Java Web development platform for J2EE platform, J2EE is the Java language development needs through adaptive evolved a development platform, J2EE platform development thinking and now distributed frame, and can not be considered compatible application platform sex, on a platform with concurrency and applications can be ported directly to run on another platform and does not require the application of the system during the relevant adjustments and modifications to aircraft design and component reuse is quite similar. Development framework J2EE platform can be divided into the presentation layer, control layer, business logic layer, data access object layer, Domain Object layer, wherein the layers of the relationship is shown as Figure 1.

III. JAVA WEB DATABASE ARCHITECTURE OPTIMIZATION

A.   Performance Issues Overview

This selection of the base station has the following main issues: the large amount of data, relevance, complexity and rate of change of the database table fast.

The amount of data is divided into two parts: one part is the amount of data in database tables, because in today's rapid development of the communications industry, the development of the base station is also a higher demand, regardless of the number of base stations or base station inspection information have sharply ushered in the period of growth, leading to the size of the database becomes large, required management database table primary key to increase the amount of data; another part is the amount of data required to operate the database traversal because the system function implementation, often require a nested query, the query result records accumulated product of the way, the amount of data access will become bloated. The two parts of the large amount of data, causing the system to spend a lot of time and resources when data is inserted or data query, thereby affecting the performance of the system.

Because of the complexity of the base station inspection information, so the system database design, designed a total of four types of inspection table, 6 class inspection information table, as well as 14 class exception information table. These data have the same field, table data information is also associated. In some database access operations, often need these data tables to be considered as a whole, this will lead to operation of the database SQL statement logic is very complex, very confusing decision condition further impact on system performance.

Since the operation and maintenance of communications needs, need to regularly patrol base station testing and maintenance, regularly updated database table inspection information. Data System database updates at a certain period of time is often not the law, so the system will have access to some uncertainty, the number of operations required for database access has increased, and cost a lot of system resources, and access time.

B. Demand Analysis of Database Performance Optimization

Demand analysis of database connection optimization. The base station detects management system, the most important function modules for the insertion and query data

logging, transaction operations periodically more intensive. And each perform a data record is inserted, once for each query data need to establish a database connection. In particular when the inspection data query module, since many search criteria, your query will be more cumulative, so you need to carry out frequent the establishment and release database connections. In the database processing, it is the largest resource Jian pin to establish a database connection, such as under the previous processing mode, each performed to establish and release database connections, will consume a lot of resources and time, but also easily lead to memory leaks, system maintenance difficulties.

Demand analysis of database operations optimization. In Java Web technologies, SQL statements can also affect the efficiency of database access. With the rapid development of the communications industry, the amount of data generated by the continuous inspection system _ to rise, become more and more large-scale database. In the inspection system, integrated data query and analysis functions occupy far more than the proportion of other functional modules, and a lot of system function module requires linking table query, the query result records the cumulative product of the way (1000 multiplied by 1000 will be 100 Query million records), also caused the query becomes long. But with the growing size of the database, query every time will be more longer required, database access efficiency becomes inevitable under.

Demand analysis of database storage process optimization. Since the inspection system is Java Web technology, and in Java Web technology, business processing logic in the application were based, this will involve multiple database connections. Database and business logic in your application, and each time the query needs individually, code reuse rate is low, resulting in unnecessary waste of resources.

C. Design of Database Optimization Scheme

System based on JAVA Web technology, so optimization techniques will be selected under the restrictions of Java technology. In general, information systems for database access is generally divided into three steps:

The first step is to establish a connection to the database. Database access must establish a database connection. So that it can send the program database operation statement to the database for analysis, in order to obtain the data from the database. In Java technology, a dedicated database access interface JDBC.

The second step is to perform database operations. The main database operations to add, delete, change, check. In Java technology, database operations can send statements to the database run by the Statement object or PreparedStatement object.

The third step is to access the process data records. Programs need to query the database derived data recording taken from the front page is processed by the analysis or display. In Java technology, data recording will generally be made to store temporarily stored in ResuhSet object, and transmits the object handed required when needed.

Database access, these three steps will affect access efficiency. Therefore, this paper proceeds in three steps for

database access research and analysis, identify key points will affect the efficiency of database access and analysis can be improved technology.

In Java technology, if the design SQL statement unreasonable, will also affect the efficiency of access to the database. Thus, in the program requires SQL statement is optimized to minimize running time of SQL statements. For example, try not where statement for the field null judgment, caution in and not in, avoid this in a function where statements and the like. Through a lot of practice found that the efficiency of optimized SQL statements to access the information system will greatly improve.

When the database table to be queried in a large number of data, once for each query will be a full table scan, this will waste a lot of time and system resources query process, it needs to be indexed to the query keywords. Key Field column index would we want to sort the query, this will speed up the query speed, improve access efficiency. Based on past experience, inappropriate index design will result in improper SQL sentence, so we want to create an index, but also to design appropriate index.

From the application programming optimized for database access can preclude the use of technology: servlet + JDBC Access Technology, JavaBean technology, Connection pool technology, Dataset Objects dump technology.

In Java, JDBC (Java Database Connectivity) is a commonly used database connection technology. servlet + JDBC, the JDBC data access operation code is encapsulated into JavaBean (such as DAO objects), and by the Servlet calls. Operation of the database used to establish a unified interface, unified through the factory model instantiation, a program run faster and more convenient.

The main task of JavaBean is responsible for solving the problem of code reuse, the upcoming program packaged as such, after the write once, in other environments and platforms can also be directly reused. JavaBean is actually a class, which by some database access object packaged as such, can carry the result set database access control layer may be JavaBean class forwarded to the presentation layer, the data results in the presentation layer to obtain access through JavaBean class object.

Connection Pool can get enough one-time database connection, the application while obtaining a connection object, you can apply directly to the connection pool. After access is complete, the connection object is returned to the pool, not to be deleted so that the same object can be connected to the next reuse.

Dataset Objects dump technology is the result obtained from the database dump set object Resultset objects as a collection of objects, staging the data set to the collection, data processing can be performed by manipulating objects collection program processing data sets. This ResultSet object, Statement (PreparedStatement or CallableStatement) object and the Connection object can be closed ahead of the release of system resources.

D. Specific Design

The first step is to establish a database connection pool. To reduce the waste of time and resources to establish a database connection, the global data source for this paper system to establish a database connection pool. All database connections unified management. Always you need to request a database connection pool database connections to access the database.Connection pool optimization designed is shown as figure2.
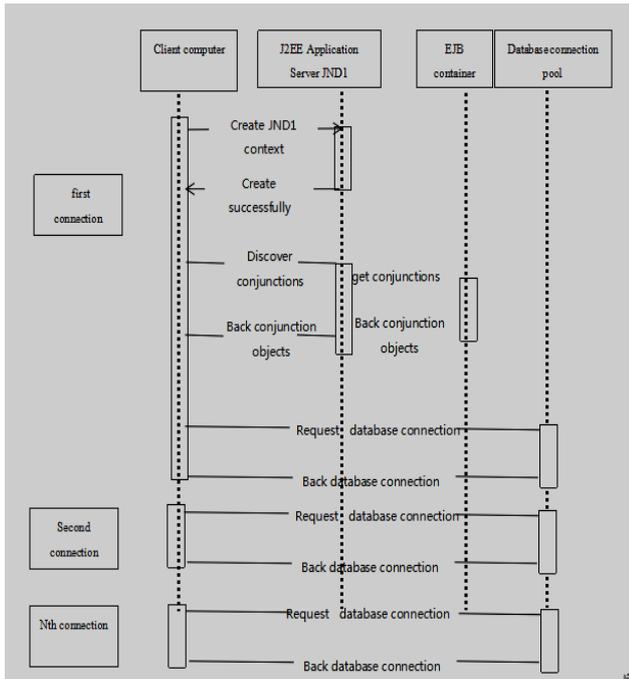

Figure2 Connection pool optimization design

SQL statements to access the database efficiency is a critical factor, thus optimizing SQL statements is the most critical in the optimization program.

Since the system abnormality information inquiry and inspection information queries involving multiple database tables, when there is no information to the base station, you need to connect all of the table query, the SQL statement optimization optimization mainly for multi-table join queries.

The main optimization measures:

(1) first and then connect the filter to minimize the data record when the query to be scanned. When the abnormality information or inspection information inquiry, according to the first query criteria will each database table hoof election, the election results and then hoof joint access.

(2) replace with EXISTS IN, NOT IN substitution with NOT EXISTS. Meet the conditions on the basis of need, determine the conditions sometimes from another table, then the join query, EXISTS (or NOT EXISTS) query efficiency will be higher.

(3)optimization Where statement, the condition of the order, the conditions detailed arrangement left. In MySql database resolution order where statements in the absence of the index is from left to right. The more detailed search

criteria to filter out the large number of data records to avoid a full table scan.

(4) reduce the number of visits of the database table. When abnormal query, a total of 14 exception table, if each table query, then need to scan records far exceeds the number of records in a table of the grip, the time required for a query that is greatly increased. So before the query to determine the data to be queried table as possible.

The index is the most common job database optimizations, indexing can narrow the scope of the query, the query does not need the extra data, can significantly improve database access efficiency.

(1)The absence of designated foreign key and often query data column is indexed. As power detection table "The meter readings" field, the query is in charge will check the information field, will not affect the other table query, so indexing can optimize query performance.

(2)Index on a column to sort or group frequently (groijp by or order by operation). As the abnormality information inquiry and inspection information query, the need to count the number of inspection, it is necessary to press the base station name and time of the inspection group. In the abnormality detection and diagnosis of positioning, we need to sort of abnormal information, check the latest exception information to determine whether an exception was restored.

(3)Retrieving the establishment of different values more columns in the conditional expression often used. In the abnormality information inquiry, the exception types are divided into 14 categories, each category there are at least more than one type of abnormal abnormal parameters, each parameter there are at least two abnormal outliers. Discover judgment is very complex, so the need to create indexes on the exception type, exception and exception parameter value field columns.

Application processing data, always maintained a Connection object, Statement (PreparedStatement or CallableStatemeHt) Resultset objects and objects, which will take up system resources for a long time. So you can use collection will Resultset object data set dump, closed in advance database access objects and data processing will be a direct reference to a collection of objects.

IV. DATABASE OPTIMIZATION DESIGN AND IMPLEMENTATION

A. *Implementation of Database Connection Pool*

Database connection pool configuration files. Create a new file in jizhaaxml 7.0 \ conf ^ Catalina \ localhost directory under Tomcat, which reads as follows:

```
<?xml version="l- 0" encoding="UTF-8"?>
<Context                              path="/j
izhan" docBase="jizhan" crossContext=="true ">
  〈Resource name="jdbc/jizhan" auth="Container"
  type="j avax-sql.DataSource"
  driverClassName="com,mysql.jdbc.Driver"
  maxActive="100" maxldle="30" maxWa11="10000"
  username="root" password:"123"
  url="            jdbc:mysql:            //localhost:
3306/jizhan?useCJnicode=true
```

4.4

&characterEncoding=utf8&2eroDateTimeBehavior=con
vertToN

ull "/>

</Context>

To access the system by the Servlet container managed JNDI Resource, also you need the JNDI Resource references declared in the web.xml file. Below are the jizhan project \ WEB-INF directory "web.xml file referenced in the statement.

```
<resource-ref>
<ciescription>DB Connection</description>
<res-ref-name>jdbc/jizhan</res-ref-name>
<res-type>j avax.sql?DataSource</res-type>
<res-auth>Container</res-auth>
</resource-ref>
```

Access data sources. Previous database access through JDBC directly connected, after optimization design, we need to modify the database connection pool before all database connections. Specifically to achieve the following:

```
Connection con;
private void init(){
try{
InitialContext ic = new InitialContext();
DataSource    ds    =    {DataSource)ic.lookup    ("j
ava:comp/env/j dbc/mysql");
conn = ds.getConnection();
} catch(Exception e) {
e.printStackTrace(); }}
```

B. SQL Statement Optimization

Fulltime table query filter large amounts of data need to be joint. In the abnormality detection diagnostic localization of abnormal information query can be optimized for this specific implementation as follows:

```
String sql—limit = "and unix—timestamp (xjrq) between
unix ⌐ timestarup (' " +
aFirstDay +"') and unix_timestamp('"+ aLastDay +'"）";
String sqll4 = "select distinct.
    yichang—sbjc.baseName,
longitude,latitude,yclx,yccs,yc
z from yichang ⌐ sbjc,base where "sql_limi
+yichang_sbjc.baseName=base.baseName ";
```

The time is determined when the query statement on where the most left, so a large amount of data can be based on time conditions yichang_sbjc sieve, and then re-use the base station equal conditions two tables joint inquiry. This optimization reduces the number of records were connected.

Alternative use NOT EXISTS NOT IN. Specifically to achieve the following:

```
String sqll="select baseld,baseName,level from base
where baseld notexits 《"+sql+")";
```

In sub-query, NOT IN clause will perform an internal sorting and merging. In either case, NOTIN are the least efficient because of its sub-tables in the query to perform a full table traversal.

Optimization of conditions where the statement sequence. Specifically to achieve the following:

```
String    sql="select    *    from    dljc    where
basename='"+basename+"'AND
checkername='"+checkername+"'‘"+" and
presentchecktime >= ‘ "+starttiine+" ‘ " + " AND
presentchecktirae<= ‘ "+endtime+"‘";
```

In MySql, the order of execution where conditions for the statement from left to right, the detailed conditions on the left, you can filter out most of the first data record. In the latter condition is determined, the data records to be scanned less greatly improves access efficiency.

In statistical anomaly detection query before the query, the query needs to determine whether the conditions given exception type. If given, simply query a table, if not given, you will need all the tables were joint inquiry.Specifically to achieve the following:

```
String temp=null；
String sql="SELECT * FROM "+ temp;
if (ycName.equals ("Room environment"）)
{
teinp=" yichang_j fhj ";
}
```

C. Index Optimization

The index is the primary means to speed up queries, especially for queries involving multiple tables especially. Index fields can be queried column is sorted, so do not scan the entire table will be able to query the desired query result record.

Indexing can be performed directly in the database system, in particular to achieve the following:

```
CREATE   INDEX   dljc_presentchecktime   ON   dljc
(presentchecktime)；
CREATE INDEX yichang_j fhj_yccs ON yichang_jfhj
(yccs)；
CREATE INDEX yichang_j fhj_ycz ON yichang_j fhj
(ycz);
```

D. Data Dump Optimization

Data dump can be closed in order to optimize the number of database access objects in advance, to save system resources. System queries the database to obtain data typically stored in a ResultSet object, and data dump refers to the ResultSet data record set dump among close the ResultSet object database access, and other objects.

```
List<Elec> eleclist = new ArrayList<Elec>()；
while (rs.next ()) {
Elec elec=new Elec()；
elec.setBasename(rs.getString("basename")；
elec.setBaserank(rs.getString("baserank")；
elec.setPower(rs.getDouble ("SUM(lastchecknum)"),
rs . getDouble ( "SUM (presentchecknuin")）；
eleclist. add (elec) ；
```

E. Optimization Results

Before SQL optimization, time-consuming database queries are shown as follows:

TABLE I. LONG TABLE BEFORE OPTIMIZING DATABASE ACCESS

Query times	Abnormal localization	Abnormal inquiry
First query	7455071ns	31299913ns
Second query	5941944ns	48438644ns
Third query	5018518ns	41609301ns
Fourth query	5652080ns	49544982ns
Fifth query	5364277ns	51086694ns
sixth query	5370344ns	47062113ns
mean query	5599826ns	46227503ns

After performing SQL optimization, time-consuming database queries are shown as follows:

TABLE2. LONG TABLE AFTER OPTIMIZING DATABASE ACCESS

Query times	Abnormal localization	Abnormal inquiry
First query	3308750ns	18002384ns
Second query	3361478ns	18707435ns
Third query	3614848ns	19878168ns
Fourth query	3876618ns	23158921ns
Fifth query	3318967ns	24927360ns
sixth query	3815443ns	24989349ns
mean query	3554537ns	21804318ns

Through comparative analysis shows that running speed greatly improved after SQL optimization.

V. CONCLUSIONS

On the basis of the detection station management system and database-access performance, this article discussed careful optimization for database design. Nowadays, with the amount of data increases and the increasing size of the database, the database access performance caused a great impact. In order to ensure system stability and efficiency, optimized database is imperative.

This article is mainly based on the system requirements and detailed designed the base station detects the access database management system function module, and realized by Java Web technologies.this paper, combined with Java Web database integration technology proposed optimization scheme.It is that through a database connection pool database connections to optimize the management, through SQL statement optimization to optimize the database query process and through the data set dump technology to optimize the database query results.

At this stage, the amount of data presented herein database design database optimization program has to meet the inspection system. But with the inspection process proceeds, it will only become more and more large-scale database, database optimization. There are many places to be improved,such as SQL statement optimization. Since the correlation function of the system so strong, the resulting of a database table design system is very complicated, and lead to the system when a database query SQL statement bloated. There is still much room for optimization in the contingency to further SQL statements table queries and sub-table queries are to be further optimized.

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