Design and Development of Express Logistics Platform Based on Graph Database and Baidu Map

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***Abstract**:-* **Today, with the rapid development of global technology, e-commerce, mobile payment, online shopping and other industries that did not exist before or are still in the development stage are gradually growing and developing. Online shopping is penetrating into every aspect of people's life. Online shopping, not only lowers the price via factory outlet sales, but also allows people to enjoy convenience of staying at home. Efficient operations of logistics, reasonable route planning, distribution rules, ensure that buyers can receive the goods in the fastest time, but also intact, without damage. As a key element of e-commerce, logistics industry plays a vital role in the development of society. The efficient operation of a logistics industry, to a large extent, depends on whether its process is appropriate, whether the logistics system is simple and effective, whether the allocation algorithm is reasonable and efficient. Therefore, we build an express logistics platform with a group database and Baidu map, in which, Floyd-Warshall algorithm is used for efficient allocation. A more optimized logistics delivery route is built with an industry solution integrating information entry, allocation, query and delivery.**

Keywords:- Graph Database, Express Logistics Platform, Baidu Map API, Neo4J, Floyd-Warshall Algorithm.

I. INTRODUCTION

A. Background and Significance of the Project

With the progress of society and the development of economy, more and more people begin to shop with online platforms. The main reason is convenience. They get what they want without leaving home. The most important part of online shopping is the express logistics industry. In today's era, people's demand is not only for postal service and a letter, but also for daily necessities, even household appliances. In this context, the test of express delivery industry has also increased dramatically.

When the merchant delivers the goods to the express delivery company, how can the express delivery company deliver the goods to the customer not only timely, but also completely and without damage, which has become a crucial issue in the express delivery industry. And with the rise of the Internet, we can use more means to achieve our desired ends. A good express transportation system can make the operation of express logistics industry more smooth, reasonable and

orderly. And we can use more related technologies to assist our system.

In the information age, more and more people begin to trust express companies and deliver their goods to logistics companies for transportation. In research [1] and [2], logistics company, should make reasonable and efficient, fast integration solutions, and this is to solve the problems in the logistics company, through the secondary use map database, this system can reasonable planning express transport path, avoid overdoing transit walk to success, to ensure delivery timely, quickly to customers, also changed the original express transportation scheme, instead of direct solution, instead, transfer to other cities, ease destination city express transport pressure, reduce express transportation vehicle mileage, make express transportation industry to make further progress, It has played a certain role in promoting the development of express transportation industry.

B. Development Status at Home and Abroad

At present, most of the express delivery industry in foreign countries focuses on the logistics of international and large commodities. For example, the American logistics model emphasizes the "integrated logistics management system", which is a way of unified planning and management based on the overall logic of the logistics business, considering the overall interests first and breaking through the system divided by departments. The US government relaxed the control of the logistics industry on urban transportation and urban resources, including the express industry, transportation and aviation, etc., tried to decentralize power and reduce intervention, so as to allow the logistics market to compete freely in a nearly unregulated area and promote development. At the same time, countries like the United States pay great attention to the informatization of the logistics industry, especially in the rapid development of informatization today, the United States ranks the first in the world in the development of logistics informatization, attaches great importance to the construction and research of enterprise logistics informatization, logistics enterprise informatization, logistics information service and other aspects. Successful logistics companies and supply chain management models such as Dell, BIM and CISCO emerged. However, foreign countries have not paid enough attention to the logistics of small goods such as daily necessities, household appliances and cosmetics, and their transport efficiency and quality are not as good as those in China. And

this kind of small goods, is exactly our domestic pay great attention to express logistics industry a big aspect.

In China, the literature [3] and [4], there are nearly 1200 logistics companies in the express logistics industry, among which, large enterprises such as SF Express, Zto Express, Yto Express and Yunda Express, which have become nearly mature. There are also small logistics companies which are just starting to pour into the logistics and transportation industry. According to the 2019 China Express Development Index Report released by the State Post Bureau, the market size of China's express delivery industry is steadily pushing up. In 2019, China's express development index stood at 998.3, up 22.6 percent year-on-year. From the first-level index, the development scale index is 2207.1, with a year-on-year growth of 25.0%, which continues to maintain a high-speed growth trend. From this set of data, we can see clearly, in China, the logistics industry is in a stable rise period, and the logistics industry also has its own set of logistics management system support, and in such a steady rise period, timely make some creative changes, would be very beneficial to express logistics industry's development and progress.

This topic mainly improves the direct scheme in the previous transportation process of express delivery industry, uses Neo4j to establish the relationship between city nodes. Research [5] proposes Floyd-Warshall algorithm to realize appropriate "detour" in the inter-city transportation process, so as to reduce the express pressure at the end point of express transportation and reduce the mileage of logistics vehicles in the transportation process. At the same time, the use of Baidu map API, real-time view logistics transport routes and the arrival of the location and other letter

II. FEASIBILITY ANALYSIS

A. Technical Feasibility

This project was developed in Eclipse2020-03, Java language was used, JDK version 1.8 was selected, Tomcat was used as the server, Maven3.6.3 version management JAR package was used, project algorithm was Floyd-Warshall algorithm, Baidu map API was used in the project, and neo4j graph database was used in the database, which could play a role in reasonably planning path information.

Baidu Map provides an interface that can be called to the outside world. Developers can apply for AK (authorization code) on Baidu Map developer platform to access the interface that Baidu Map opens to the outside world to realize and develop their own functional modules.

The front end uses CSS +JavaScript to develop the JSP front end interface, and the JQuery framework and Sweet alert plug-ins are introduced as auxiliary functions. In research [6], JQuery is a front-end framework that provides a variety of functional plug-ins, and you can easily find its instructions on the Internet and some practical examples on blogs, so the technical feasibility is guaranteed.

The back end uses MVC three-tier architecture to make the project structure more concise and make management more convenient and faster. The literature [7] and [8] illustrate Servlet+ Java bean + JSP development, so that the software more efficient operation, Servlet is the front-end JSP transmission of the first-hand processing mechanism, by its processing into the service, service calls the database to complete the relevant operations.

B. Feasibility of Operation

Members for the users, through the front interface of the software system detailed user was considering the possibility of all accidents, and at the right time and place to make the right message, let the user feel the smoothness of operation, human nature, to the user's wrong operation, system will also be timely to give tips, and display the information, allow the user to repeat operation. At the same time, malicious operation of user is also taken into account, including malicious input box, such as SQL injection, the system will be on guard to improve the user's operation experience.

III. DEMAND ANALYSIS

A. Functional Requirement Analysis

The express logistics platform is divided into administrators and members, among whom members can register the system, log in, recharge the balance, view personal information, modify personal information, including address and other details, send express, view the sent express logistics information, view the received express logistics information.
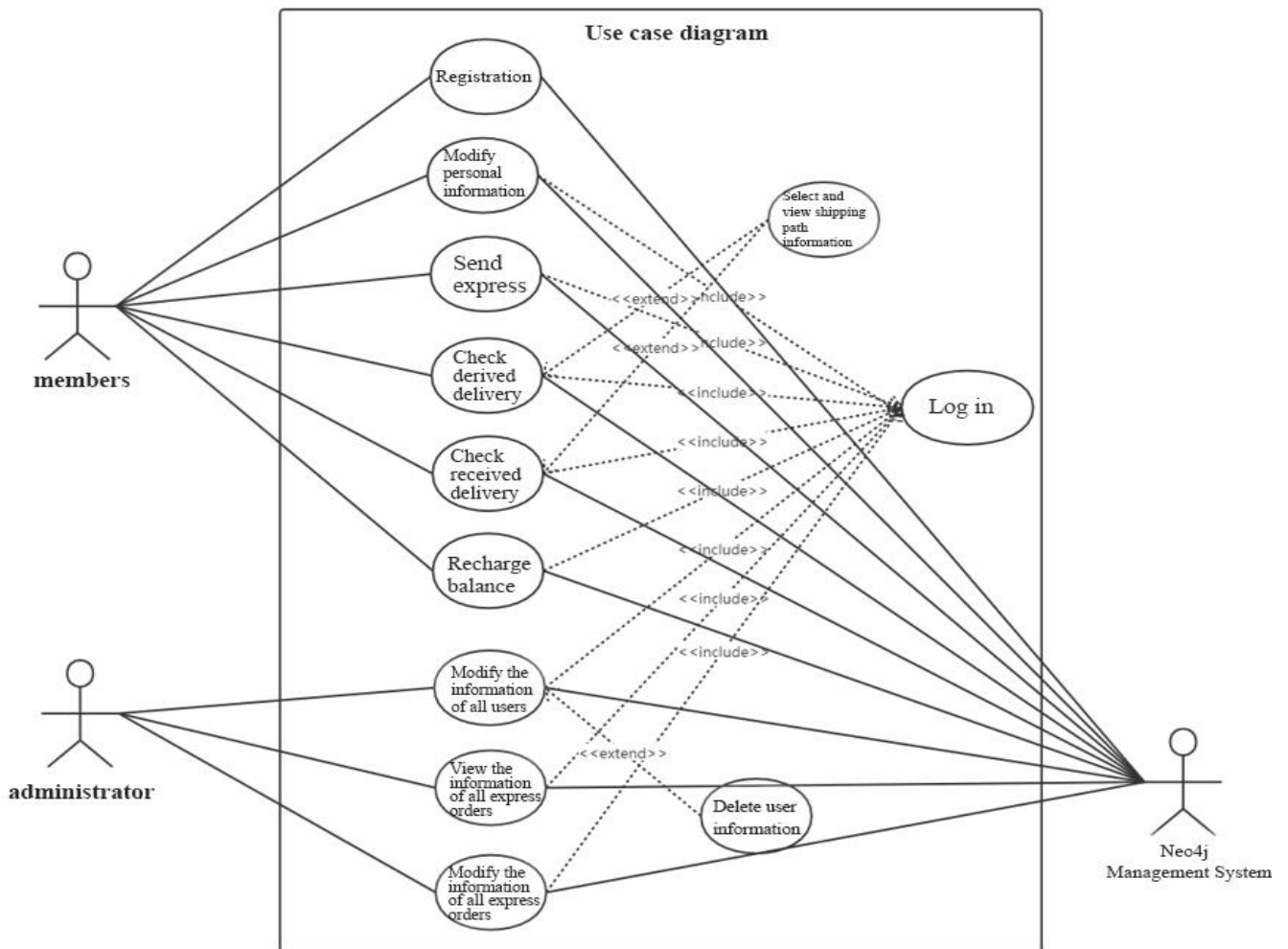
Fig 1:- A Case Diagram of Delivery System

B. Business Process Analysis

Express logistics system is divided into member module and administrator module.

The administrator module is mainly used by administrators, including entering the welcome interface and selecting different operation tasks, such as viewing and modifying all user information, viewing and modifying all express bill information, etc., and entering different operation processes and interfaces.

C. Data Flow Analysis

The purpose of data flow analysis is to find and solve problems in data flow, and abstract the flow, transformation and storage data in the system. The data flow of the logistics information system of this project is as follows: the user clicks registration, the registration modal box pops up, fills in the corresponding information in the modal box, passes it to the background processing program Servlet, which requests the corresponding service, and the service invokes the database operation to add the new user information to the database. Users click on send it special delivery button, enter the corresponding send it special delivery information to fill in

page, fill in the corresponding delivery information, including changing the sender information, such as the sender's name, address, telephone, etc., to fill in the recipient information, such as the recipient's name, address, telephone, etc., select article type is submitted, pay the freight, and then the JSP pass data to the Servlet processing background, and its request corresponding mail Courier service, service call database operations, express a single information can be added to the database. At the same time, users can view their own express logistics information, that is, take out the corresponding information from the database, and display in a specific way on the JSP page.

IV. SYSTEM OVERALL DESIGN

A. Overall function structure of the system

The main functions of the express logistics system are divided into members and administrators. The functions of the member terminal include members' personal information view, members' personal information modification, members' balance recharge, express delivery, express delivery, express delivery, express delivery received, and express logistics details. The functions of the administrator are to view all the

user information, view all the express logistics information, modify the express logistics information and so on.

B. Design and implementation of Neo4j database

When dealing with associated data, graph database has three outstanding technical advantages compared with relational database:

Efficiency: With the increase of data volume and correlation depth, traditional relational databases are constrained by the join operation between multiple tables during retrieval, and foreign key constraints are also considered when writing data, which will cause a lot of extra overhead and serious performance problems. And the efficient implementation of its ability to benefit from the image database query, he is not a query the database, but the execution of the query, related to work only on the result part of the node and link, this makes the efficiency are obtained by the graph database operations, compared with the data index structure inherent to the graph model, figure data query and analysis of the model more quickly.

Flexibility: graphic database has a flexible data model, the user can adjust the data model according to the business change, such as any to add or remove vertices, edges, expand or narrow the graph model, which makes us in the process of development do not need to completely write on all the relationship from the start and contact, but at the time of need, feel free to add this information can meet our needs, and relational database can't very well to support frequent Schema changes.

Agility: Agile Database chart model is very intuitive, it supports test-driven development mode, each building can be a functional test and performance test, this is consistent with the popular agile development needs, and it also benefited from the figure database provides a unified database language and corresponding operational guidelines for school official cites use of the help, can satisfy all kinds of application software developers the use of agile figure database development, help to improve the efficiency of production and delivery.
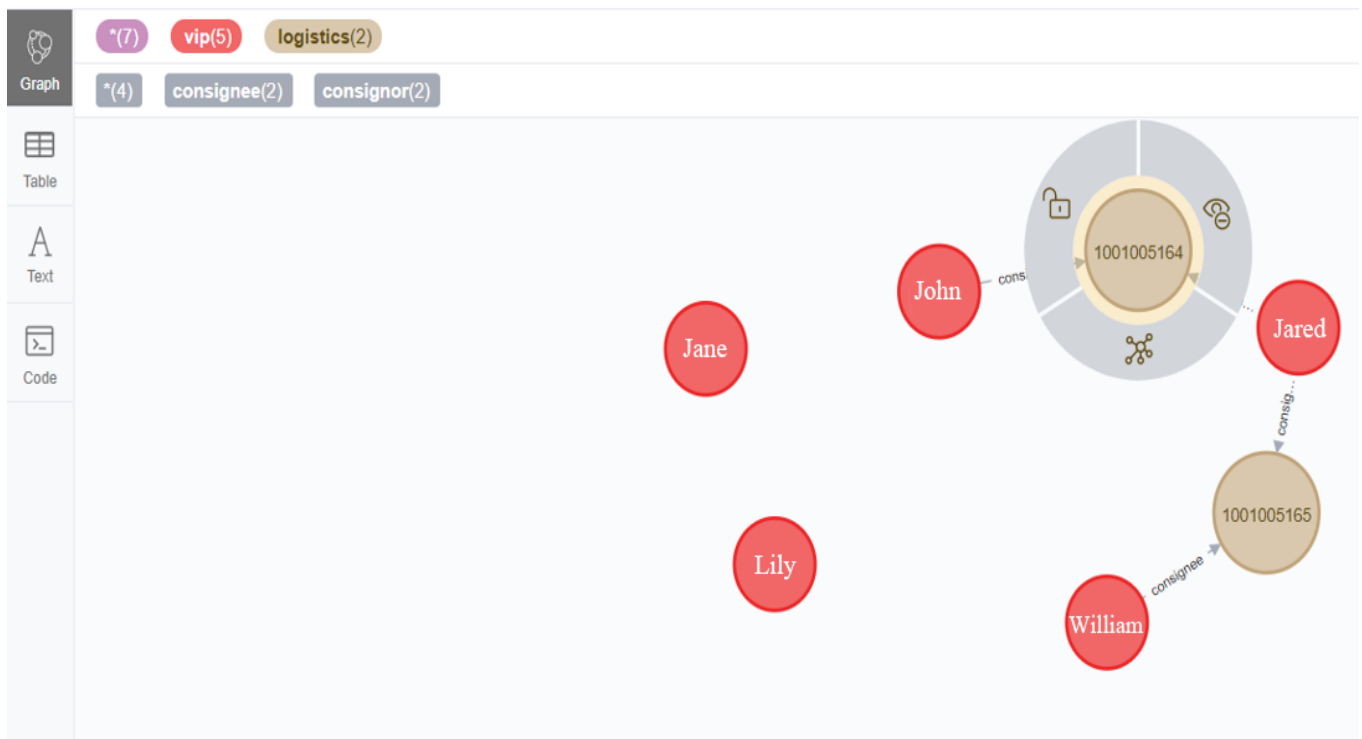

Fig 2 :- Node Data Modeling of Delivery

C. Neo4j Database

At present, Neo4j is the most familiar and widely used graph database in the technology community and business market. Basing on the comprehensive requirements and task consideration of this project, Neo4j is selected as the database base of this project.

Neo4j has the following features and advantages:
1) Use Native Graph to store and process data: provide optimal relational traversal execution efficiency, and Neo4j is thousands of times faster than the table join of relational database.
2) A model based on (label) attribute graph: it supports rich data semantic description. The display and description of the graph give developers a refreshing feeling, intuitively and accurately represent the correlation between various data, and has high flexibility.

3) It is based on a pure Java implementation, supporting the widest range of operating systems and the most convenient deployment, cloud deployment, and container deployment.

4) Cypher provides a declarative query language for graph analysis and pattern matching, which is intuitive, concise and easy to understand.

5) They want to offer the complete ACID (Atomicity, Consistency, Isolation, Durability (), and offer great compatibility to guarantee data Consistency, so they're ideal for both transactional (OLTP) and analytical (OLAP).

6) A distributed database based on Causal clusters with high availability, failover, data redundancy and scalable throughput is provided.

D. Floyd-Warshall Algorithm

Floyd algorithm is an algorithm based on the idea of dynamic programming. Floyd-Warshall algorithm, also known as interpolation method, is an algorithm that USES the idea of dynamic programming to find out the shortest path between multiple sources in a given weighted graph.

Its essential idea is the idea of dynamic programming, that is, a big problem can be divided into small problems one by one, and the solution of the original problem can be derived from the solution of these subproblems, and the problem to be solved also needs to meet two properties:

1、 Optimal substructure: a large problem can be divided into small problems, and the solutions of these small problems can lead to the solutions of the total problem.

2、 Overlapping subproblems: The subproblems generated each time are not new problems, but repeated problems with different data, so the results obtained each time can be used again to derive the next subproblem.
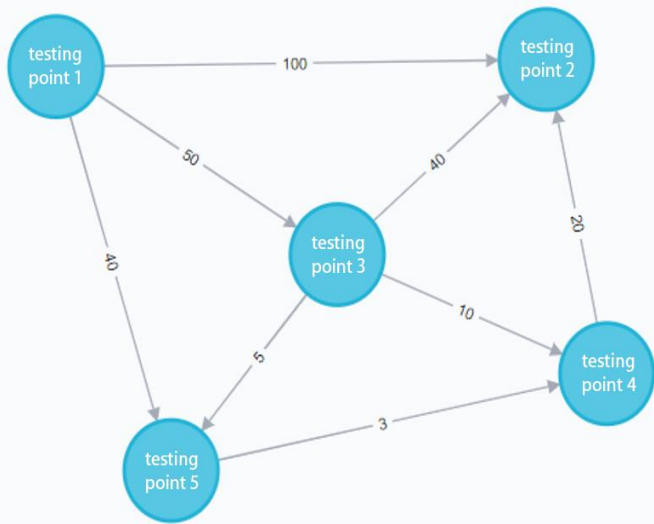

Fig 3 :- Test the Node Graph of Floyd Algorithm

E. Baidu Map API Call

Baidu Map API is a set of application call interface launched by Baidu Map for developers to develop application software, which can conveniently provide developers with a variety of services, including local map display, route navigation, location, address coding, route planning, search location and so on. Baidu Map API is suitable for the development of various applications, including IOS, Android, Web applications, computer desktop software, etc., and also suitable for the use of a variety of operating systems. Baidu Map JavaScript API is a set of application interfaces written by a set of JavaScript language, providing users with an interactive interface during the construction of the website, providing a variety of data processing services and a variety of service interfaces, which simplifies the complexity of development.

V. SYSTEM DESIGN AND IMPLEMENTATION IN DETAIL

A. Funtions of Welcome ,Registration and Login

Logistics delivery system on the welcome screen in this case are adopted to simulate the company logo is given priority to, the top left-hand corner has the name of this example simulation company, on the right is the account password input box, to the user input errors, will be realized in login box below the message of red, let users change information in time, ensure that the user experience, the overall interface simple quietly elegant, relaxed and clean.

B. Member Mail Express Module

Click "I want to send express", and the "send express" page pops up. After users fill in the corresponding sender information and recipient information, click "submit" to complete the "send express" function. Among them, the sender information (including the sender's name, sender's provinces, address, the sender's address, the sender's phone) are the user login information, such as user has the need to change, to change information in the sender information area, however, sender's phone number is not allowed to change, because the sender's phone number is the only sign of login.

Recipient information must be complete and accurate fill in the recipient information (including the recipient's name and address of the recipient provinces, detailed address, the recipient, the recipient phone) are regular expressions, if any illegal input data, will display error message behind the red information in the input box, guide users to make changes, fill in the correct data.

Recipient provinces, and the sender's provinces are not allowed to fill in separately, must be in the system of the given selection box select provinces, information, the aim is to prevent illegal input and city information not accuracy, this system all provinces, data information data from the civil affairs Ministry of Civil Affairs of the People's Republic of China website (see download the latest version of the February 2020 "code administrative division at or above the county level of the People's Republic of China, and one by one, into the database.

The express transportation fee of this project adopts the new document "2020 Billing Standards of Yunda Express" issued by Yunda Express in 2020, in which the user can click the button "View Billing rules" at the bottom of the interface.

VI. SYSTEM TEST AND EVALUATION

A. Software Testing

In a complete software development process, we have the software necessary to test this step, in general, a complete software development process, should have the following process: requirements analysis phase (according to requirements to write the software requirements specification) - > design phase (divided into general design and detailed design, profile design should output the summary system design specification, the detailed design should be output system detailed design specification) - > coding phase (this stage should complete all coding area including the front and back) - > test phase.

B. Purpose of Testing

By testing the software, the first purpose is to detect whether the completed functions of the software are completely required, whether each functional module can run normally, whether the security can meet the requirements, and whether the software performance can run normally when the data is large and when the users execute concurrently.

C. Main Contents of the Test

Testing process is generally divided into the following several parts: the beginning of a given demand is analyzed, according to the requirements to test plan, test personnel to write test cases, stages of software testing, find the problems existing in the software, the problem for the document, the problem to the developers to solve the problem, after waiting for developers to solve the problem, then regression testing.

Testing stage is an essential stage in software development. It is generally divided into unit test, integration test, functional test, performance test, security test, interface test and system test. Unit testing is the testing of each program unit or module. Generally, when coding, module should be tested after each module is written, which can lay a good foundation for the next several tests and reduce errors. An integration test is a test that combines several modules together, generally testing whether the interface and data types are consistent and reliable. Functional test is the test of a complete function, and it is generally the most important test stage. Whether this stage can be successfully tested depends largely on the results of the first two tests. Performance testing is the testing of software performance, such as testing when data volume is large, testing when users execute concurrently, and so on. Security test is the operation when the user performs illegal operation and writes illegal data. Generally, it mainly considers the operation to the database and prevents and prompts the user to mis-operate. Interface test is the test of whether the interface can be displayed as expected, including pictures, plug-ins, drop-down boxes and other front-end modules. System testing is the final test of software testing, which is the complete test of all functional modules and other items.

D. Features and Advantages of the System

In today's increasingly progressive society, the rise of the express logistics industry, I think logistics companies need to gradually optimize their own architecture, including the transport path, this case according to Floyd algorithm, express transport path to a certain degree of optimization, and the use of Baidu map API interface display.

Although the system seems to have few functions, but each function is carefully made to ensure a perfect user experience for users, including the user's wrong operation, illegal input and other unconventional operation reminder, to prevent SQL injection database security management. The interface of the system USES CSS + JS free development, the interface is simple, clear, fresh color is not grandiose, for the use of users to bring a good experience.

E. Deficiencies of the Systems and Solutions

Before the system development, I did not think of a specific implementation plan. At the same time, due to my own reasons, Time was very tight, and there were many deficiencies.

For example, the member recharge interface, did not really scan the code to pay, but a picture of the TWO-DIMENSIONAL code, there is no real payment software and pick up. Due to my postgraduate entrance examination and limited time, I did not thoroughly study some frameworks. Instead of using a powerful framework like spring MVC to build this system, I used a familiar MVC framework to build this system.

In the subsequent process, it is necessary to gradually improve the deficiencies in the system, learn the principle and use mode of spring MVC, and improve some extended functions, including the payment system.

VII. CONCLUSION

With the rise of the express industry, more and more express logistics industry has entered the society. This system uses Java Web technologies to complete the construction of the express logistics system. The core of the system is the express logistics distribution based on the graph database, which is realized by Floyd algorithm, and the results are shown in Baidu map API. Neo4j database is adopted to provide powerful support for the query, addition and search of transportation routes of system data. Besides, the application of Floyd-Warshall algorithm decomposes the instantiated express request into subproblems by using its idea of dynamic programming, and then plans the shortest path.

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