Optimization of E-Commerce Logistics Distribution Path Algorithm under the Background of Big Data

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Abstract. In recent years, online shopping has become a major development trend of shopping. The traditional e-commerce logistics distribution mode has played e-commerce by taking advantage of the advantages of the distribution path algorithm. However, with the increase of the order quantity, the previous path optimization algorithm is no longer efficient. This paper makes an in-depth investigation on the main problems existing in China's e-commerce logistics. Through the analysis of the survey results, we can see that there are mainly problems such as low degree of data application and imperfect function of logistics information platform. Aiming at these problems, this paper optimizes the logistics distribution routing algorithm according to the actual demand. Through the establishment of three-dimensional constraint model, the problem of low efficiency in the traditional model is effectively improved. In contrast with the genetic algorithm, the distribution mileage of the optimization algorithm is reduced by more than 25% compared with the genetic algorithm, which improves the comprehensive performance of the model. Constraint model established in this paper makes up for the shortcomings of the current e-commerce logistics distribution path algorithm to a certain extent, and makes a contribution to the development of China's e-commerce logistics distribution field.

Keywords: Electronic Commerce, Logistics Distribution, Path Optimization, Optimization Model

1. Introduction

With the rapid increase of orders, the corresponding information data is also increasing, but the previous information processing methods cannot make better use of data [1-3]. However, big data technology can do a good job in data collection and analysis, help logistics enterprises make scientific decisions, optimize and improve the logistics distribution mode, so as to reduce costs and improve service quality [4-6].

The so-called big data refers to the large amount of information, good real-time performance, which cannot be processed by conventional technical methods for a period of time, and has the
characteristics of large amount, high value, fast generation and diversification. Social network, cloud computing, Internet of things and other Internet tools are gradually applied in people's life and work, and various data are also in explosive growth [7-8]. According to a survey by International Data Corporation (IDC), the average annual growth rate of global data is multiple. It is estimated that by 2020, the total amount of global data will reach 30 times as much as it is now. It can be seen that we have entered the era of big data [9-10].

In this paper, the current situation distribution is deeply investigated. Through the analysis of the survey results, it can be seen that China's e-commerce is in a period of rapid development. With the rapid growth of orders, it puts forward a huge test for China's e-commerce logistics distribution mode, especially in the aspect of path optimization, which needs to be upgraded urgently. Therefore, this paper establishes the optimization research of e-commerce logistics distribution path algorithm under the background of big data. In the research process, according to the development requirements of e-commerce logistics distribution, and combined with the actual distribution situation, this paper constructs a new three-dimensional constraint model. By simplifying the algorithm and optimizing the structure, the model can effectively improve the calculation accuracy and the competition ratio of the calculation results. The advantages of the algorithm are further verified, especially in the calculation of mileage has been greatly reduced. Analysis shows that the path optimization algorithm not only reduces the distribution cost [11].

2. Big Data and E-Commerce Logistics Distribution

2.1 Connotation of Big Data
The so-called big data refers to large information, strong real-time, cannot be processed by conventional technology in a certain period of time, with high value, rapid generation and diversification. Internet tools are gradually applied to people's life and work, and all kinds of data are growing. According to the survey of International Data Corporation (IDC), global data is a multiple of growth every year. It is estimated that by 2020, the total amount of global data will be 30 times as much as it is now.

2.2 Definition of E-Commerce Distribution
This shows that the logistics and distribution enterprises need to use the network technology, equipped with modern hardware equipment, software system and advanced management means to deliver goods according to customers' order requirements. The system will collect the information data of each sub point to form a large centralized database. In order to shorten the mileage of distribution and reduce the cost, scientific decision-making should be made in the statistical transfer.

3. Questionnaire Survey on the Main Problems of E-Commerce Logistics in China under the Background of Big Data
In the previous e-commerce distribution mode, e-commerce logistics enterprises usually only deal with the orders with personal experience and management habits, lacking of data analysis. However, after using big data analysis technology, it can effectively predict the market demand and prospect, understand the development direction of logistics distribution, so as to make better and scientific decisions, select the optimal distribution mode, provide better services, and maximize the profits of enterprises.

This survey adopts the method of questionnaire survey and on-the-spot interview, and conducts a survey on 500 e-commerce enterprises. The purpose of the survey is to deeply understand the main problems existing. A total of 500 questionnaires were distributed and 495 questionnaires were collected. The main problems were sorted out according to the survey results. The results are shown in Table 1. According to the survey results in Table 1, under the background of big data, China's e-commerce logistics mainly has low data application degree, imperfect logistics information platform function, lack of cooperation between logistics enterprises, unreasonable resource allocation, easy
disclosure of user information, and lack of big data logistics talents. The analysis shows that the development of big data e-commerce logistics in China is still in the early stage, and more efforts should be made in core technology and personnel training.

Table 1. Survey results of main problems in China's e-commerce logistics under the background of big data.

| Serial number | Main problems                                                                 |
|---------------|-------------------------------------------------------------------------------|
| 1             | Low degree of data application                                                 |
| 2             | The function of logistics information platform is not perfect                   |
| 3             | There is a lack of cooperation between logistics enterprises and the allocation of resources is unreasonable |
| 4             | User information is easy to leak                                               |
| 5             | Lack of big data logistics talents                                             |

4. Discussion

4.1 Comparative Analysis of the Simulation Experiment between the Algorithm and Genetic Algorithm in this Paper

In order to verify the actual effect of the optimization path, this paper compares the genetic algorithm with the optimization path algorithm in this paper, and carries out simulation test on the e-commerce logistics task of enterprise a.

According to the test results in Figure 1, compared with the genetic algorithm, the data model in this paper has not changed in the number of vehicles. However, due to the reduction of distribution mileage, the distribution mileage is shortened by more than 25% compared with the genetic algorithm, resulting in the reduction of vehicle depreciation costs, maintenance costs and personnel costs. In addition, the company can increase the distribution business volume and stimulate the logistics demand. Therefore, this path optimization can not only reduce the logistics cost, but also promote the sustainable development of the company.
Figure 1. Comparative analysis of simulated path test distance between the algorithm and genetic algorithm in this paper

According to the comparison results of competition ratio in Figure 2, when the car capacity decreases, the traditional genetic algorithm has the advantage, the optimization algorithm in this paper is more advantageous. Data show that the traditional genetic algorithm is weak in dealing with large orders, and its disadvantages become more obvious with the increase of orders. The optimization path algorithm in this paper can better improve this shortcoming, and the allocation in time and space is more reasonable.
Figure 2. Comparative analysis of competition ratio between our algorithm and genetic algorithm under different orders

4.2 Three-Dimensional Constraint Model of Distribution Route Optimization
Suppose there are \(m\) distribution centers, \(n\) customer nodes and \(k\) distribution vehicles in a certain range. Then the number of vehicles available for distribution center \(p\) is \(A_p\). However, customers often need a variety of goods, so on the premise of meeting customer distribution requirements, the distribution cost should theoretically be the minimum of the calculation results as the objective function. Based on the characteristics of e-commerce logistics distribution, a two-dimensional constrained logistics distribution path optimization model with distribution time, distribution space and quality evaluation are established as follows:

\[
\begin{align*}
\min & \sum_{k \in K} \sum_{i \in E} \sum_{e \in E} c_{ij} d_{x_{ji}} + \sum_{k \in K} F_k \max (Z_k) \\
T_{ij} & \leq t_{ik} \leq T_{jk}, \forall \ K \in K (2) \\
\sum_{j \in D_k \in L} b_{ij} z_{ij} & \leq B_k, \forall \ K \in K (3) \\
\sum_{j \in D_k \in L} q_{ij} z_{ij} & \leq Q_k, \forall \ K \in K (4)
\end{align*}
\]

The objective function formula (1) consists of two parts: the first part is the distribution cost of vehicles, the second part is the one-time consumption cost and personnel cost of vehicles; formula (2) represents the time constraint, that is, the delivery time required by customers; and (3) represents the space constraint, that is, the total amount of customer goods delivered by the same vehicle should not be greater than the total amount of unit vehicle; Equation (4) indicates the quality constraint, that is, the total mass of customer goods delivered by the same vehicle shall not be greater than the carrying capacity of unit vehicle.

4.3 Optimize the Big Data Processing Strategy Framework
The data processing framework and related processing strategies relatively low, and the universality is not strong. Therefore, in the context of big data, it is necessary to apply the current big data technology to the logistics distribution and transportation of e-commerce, and play its own value. Establish a complete and mature strategic framework for big data processing. According to the deficiencies of the existing framework for big data processing, we can transform and realize innovative development. The big data existing in logistics distribution can provide effective basis for e-commerce enterprises. Therefore, in order to promote the improvement of logistics service level, it is necessary to open up and use special network to query some information to promote the effective acquisition of logistics distribution information. Through the analysis of information elements, logistics distribution information is based on data, and realizes different forms and different storage modules.

4.4 Impact of Big Data on E-Commerce Logistics Distribution

(1) Realize information docking

Using big data technology to process a large number of logistics information can meet the demand of order distribution in e-commerce logistics distribution work. Moreover, after the establishment of big data sharing platform, the distributed data in e-commerce information can be combined with each other and processed.

(2) Improve customer loyalty

In the process of continuous development and growth of e-commerce enterprises, the development of big data can improve customer loyalty. Therefore, in order to improve customer loyalty, promote brand image optimization, and promote the optimization of enterprise service quality, it is necessary to improve the service quality of e-commerce. In the traditional sense, there is still a lot of room for the improvement of logistics distribution services. After improving the corresponding customer service, customers' evaluation of logistics distribution will also be improved, and from then on.

(3) Increase the use value of data

With the continuous progress and development of modern society, e-commerce has been rapid development. There are a lot of data in every link of e-commerce. We need to transform the data structure from unstructured to structure. In the case of e-commerce, the value of distribution will be affected. However, in the context of big data, the realization of special data management can avoid the occurrence of information failure and improve the value of e-commerce logistics distribution data. The potential value of data is huge. If enterprises want to develop for a long time, they must pay attention to the use value of data.

5. Conclusions

Through the results of big data technology, as well as the current development trend of e-commerce in China. In the aspect of path algorithm, this paper establishes a new three-dimensional constraint model, which can better meet the current requirements of e-commerce logistics distribution for path optimization. The analysis shows that at present, e-commerce logistics enterprises should pay attention to the realization of information docking and data sharing, and enhance their data analysis ability while improving data transparency. Finally, in order to verify the actual effect of the three-dimensional constrained path optimization model in this paper, the traditional genetic algorithm is used as the comparison, and the simulation experiment is carried out. The experimental results show that the optimization path method in this paper has a significant advantage in both mileage and competition ratio.

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