Research on the Development Mode of Intelligent Logistics Based on Internet of Things and Cloud Computing in Big Data Era

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Abstract
With the rapid development of big data, internet of things, cloud computing and the logistics industry has gradually become an important part of promoting social and economic development, and has been constantly moving toward with a brand of new intelligent information visualization. The rise of intelligent logistics information management system, also gradually led to a new way of digital development of logistics information data. In this paper, in view of the current trend of economic and social development, through the analysis of the logistics industry, we established an intelligent logistics information management mode based on the Internet of things and cloud computing, which can provide intelligent users with different privileges according to the needs of system users with query logistics information. At the same time, according to the characteristics of the logistics company's work, this paper studies and learns the genetic intelligence algorithm to reasonably arrange the logistics and distribution path for the logistics enterprises, and reduces the actual expenses of the daily work of the enterprises and increases the economic benefits.

Key words: Big data, Internet of things, Cloud computing, Intelligent logistics

1. Introduction

In the current society, with the rapid development of high-end technologies such as big data, internet of things and cloud computing, the intelligent logistics system has gradually become the new favorite of the economic development of all countries in the world. The rise of intelligent logistics system for the traditional logistics industry is not only the new reform and update, but also the inevitable trend of development of the times. Intelligent logistics system includes all of the traditional logistics links, including ordering, delivery, operations, and inquiries. The rise of intelligent logistics can reduce the traditional logistics of human resources, with the use of management methods based on big data more for businesses to bring more benefits.

At the stage of the emergence of intelligent logistics information system, it is making the original logistics work with a new development. By introducing technologies such as big data, internet of things and cloud computing, a more scientific and intelligent management of the logistics management system will be achieved. This management can not only make the original logistics process operate efficiently, but also improve the accuracy of the logistics company in actual operation, and reduce the loss of corporate property due to negligence of personnel and reduce the personnel management cost. At the same time, with the increasingly complex of modern logistics industry, the traditional logistics industry has been unable to meet the needs of the work of modern logistics enterprises, and modern logistics enterprises should be based on the needs of consumers as the main goal for a series of markets. The situation is united as a strategic measure for joint discussion. The rise of modern logistics system is under the era of network economy and e-commerce while driving the development of the information industry chain. Only by continuously developing high technology, adapting to new technologies and constantly improving system functions, such as big data, internet of things, cloud computing and artificial intelligence, can we gradually penetrate into the logistics system.

2. Theoretical model of intelligent logistics development model based on Internet of things and cloud computing

2.1. The functional structure of intelligent logistics development model

The development process of intelligent logistics development model is divided into the following stages, including the system planning phase, the system demand phase, the design phase, the system implementation phase and the system operation and maintenance phase. The functional structure of intelligent logistics development model consists of four parts, namely, data sources, information and data processors, the user's personal information and enterprise intelligent logistics managers. Data source is the basis of intelligent logistics development mode. It is the place where data information is generated. The information data processor is mainly responsible for the transportation, processing and storage of intelligent logistics data and information. The work of intelligent logistics development mode is to serve users. The intelligent logistics development model gives...
the data to make the appropriate strategic decisions. The main goal of intelligent logistics company managers is to ensure that intelligent logistics development model can operate efficiently and speedily, as shown in Figure 1.

![Figure 1. The functional structure of intelligent logistics information development model](image)

### 2.2. Intelligent logistics routing model in big data perspective

According to the definition of routing problem of intelligent logistics and the problems studied in this paper, the problem of intelligent logistics routing model studied in this dissertation is decomposed into the following steps:

1. Set the initial point for the smart logistics station, and set the smart logistics station number 0; then each vehicle starting from the smart logistics point to each smart customer point of delivery of goods, and then the final needs to return to the smart logistics station.

2. There are a total of \( k \) vehicles, and each vehicle with a capacity of \( Q \).

3. There are \( n \) smart customer points, and smart customer points are numbered by 1, 2, 3, and so on, and the distance between smart customers point \( i \) and point \( j \) is \( C_{ij} \).

4. Suppose that \( n \) clients are involved in the smart distribution of goods, and the demand of goods and materials of smart customer \( i \) is \( q_i \), and \( q_i < Q \).

The final solution of this model is to find the optimal route for intelligent logistics routing and transportation, which satisfies the shortest total distance and the minimum number of vehicles for intelligent logistics operation. The above definition of the mathematical model can be summarized as follows:

\[
\min z = \sum_i \sum_j \sum_k x_{ijk}
\]

### 2.3. Heuristic intelligent logistics development model based on Internet of things and cloud computing

After finding feasible solutions, optimal improvement is achieved through a global or local optimization method, which is the most forward-looking heuristic search strategy at this stage. The idea of this approach is to first select randomly a served customer spot as the initial smart path with only one service object on the initial smart path. While other customers meet the time window and load weight on their way to the initial smart path, they are inserted one by one into the current customer spot. For customers who do not satisfy the constraint, a new intelligent path is initialized. We should continue to repeat the above solutions until the completion of all customers of the service. Therefore, two different variables need to be set when setting the cost evaluation function and one is to select the cost function of the initial sub-patron, and its corresponding setting is:

\[
\cos t(c_i) = -\alpha t_0 + \beta b_i + \gamma \left[ \frac{|p_i - p_j|}{360} t_{oi} \right]
\]

Another customer's insertion cost function that does not satisfy the criteria is:

\[
\cos t(c_i) = D_k + \varphi w_i + \eta O_k + kT_k
\]

Where \( D_k \) is the total logistics time of smart logistics k, and \( w_i \) smart logistics k, and \( O_k \) is the overload of intelligent logistics k, and \( T_k \) is the total delay waiting time of intelligent logistics k.

From the above formula we can see that in choosing the initial customer point, the best choice should meet three points: trying to keep away from the intelligent distribution center, short time window setting and the closer distance between customer points.

The weight factor is equal to 1% of \( D_k \), the overload penalty factor is set to 10% of \( D_k \), and the delay penalty factor is set to 1% of \( D_k \). The basic idea of intelligent logistics development model is as follows:

1. **Step 1:** The initial smart path satisfies \( r=0 \);
2. **Step 2:** Define \( r=r+1 \). The initial smart path for the customer point to is calculated by the formula (2), in which the smart logistics route is assigned, and the customer point with the lowest cost is selected as the seed to insert the current smart route. If it does not meet the formula (2) then we enter the step 3.
3. **Step 3:** Enter the formula (2) to calculate the number, if we cannot find a feasible point, and then jump into step 2.
Step 4: Update the optimal route of intelligent logistics of \( r \), and the update idea is to insert the customer into the set smart logistics route \( r \) for the customer, who chooses the minimum points to insert the fee. For the unallocated intelligent logistics, enter step 3 to modulate, otherwise terminate the intelligent logistics development mode.

2.4. Intelligent path model based on Internet of things and cloud computing

The intelligent path decoding method used in this study is based on greedy construction method. This method can effectively avoid the problem that the randomly generated individuals cannot be inserted into the current intelligent path due to the complexity of the constraints. When decoding, this method provides the maximum possible insertion of all the customer points represented by the gene bits into the current intelligent path. When the customer point is unable to satisfy the time window and the weight constraint, a new intelligence is re-opened and inserting the path to this point. The purpose of fitness function setting is to ensure the optimal solution of the intelligent route of intelligent logistics routing, which needs to be set for the two objectives of intelligent logistics running distance and intelligent logistics number. Its function is:

\[
\begin{align*}
\min z_1 &= \sum_i \sum_j \sum_k c_{ij} x_{ijk} \\
\min z_2 &= \sum_i \sum_j x_{ijk}
\end{align*}
\]

(4)

(5)

The first goal of intelligent logistics is running shortest total number of paths, and the second goal is to make the use of intelligent logistics at least.

3. Intelligent logistics based on Internet of things and cloud computing to realization steps and verification

3.1. Realization steps of intelligent logistics

The basic steps of intelligent logistics in the multi-target intelligent logistics development mode of routing intelligent distribution path are as follows:

With the Floyd intelligent logistics development model, the shortest distance matrix of \( A \) and the corresponding shortest intelligent path matrix of \( p \) and the intelligent path matrix of \( p \) between any two points are calculated. Through the research and study of the Floyd intelligent logistics development model, we can calculate the matrix \( a \) of the shortest distance between different intelligent delivery customer points, and find the matrix \( p \) of the optimal one relative to the optimal path. We can set the distance matrix between any two customer points to \( p \). The intelligent logistics development model can use the language of c, and use MATLAB software to help achieve the function. When faced with multiple tasks waiting for the distribution of the situation, we can use SWP intelligent logistics development model. Smart customer point distribution is shown in Figure 2.

![Figure 2. Intelligent node distribution diagram of intelligent logistics model](image)

The figure has set a total of 10 customer points, of which 6 is the origin, and it is the total smart distribution center, and the other is the customer point, and the corresponding amount of cargo demand is shown in Table 1.

<table>
<thead>
<tr>
<th>Customer site</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
</table>
| Different customers demand for the amount of intelligent distribution of goods

Table 1. Different customers demand for the amount of intelligent distribution of goods
The core idea of intelligent logistics development model is that from the starting point of origin 6 as the initial point, and we choose a customer point randomly, which is starting from this point and clockwise scanning in the process of scanning by Floyd intelligent logistics development model, and calculating each smart point of delivery customers point. According to the size of the angle of order, we can launch a sequence of 1,3,5,9,7,8,4,2,10. Therefore, the load of intelligent logistics cannot exceed the maximum total load Q previously set. This condition is introduced into the development mode of intelligent logistics. After scanning, a set of 9 groups is obtained, and that is \{6,7,10,2,4,3,6 / 6,9,8,6 / 6,5,1,6\}. The distance between different customer points through Floyd intelligent logistics development model can find the final result. After running in MATLAB software, the calculation results are shown in Figure 3.

![Figure 3](image_url)

**Figure 3.** Calculation results of FLOYD intelligent logistics development model

According to the type of research object, this paper has made a targeted setting. The set size of the initial data is set to 35, and the genetic intelligence method is 99, and the replication probability is 0.7, and the cross-intelligence method is 0.6, and the mutation intelligence method is 0.11.

### 3.2. Numerical experiments and analysis of intelligent logistics model

In this paper, we have studied the multi-objective intelligent logistics development model, based on Floyd intelligent logistics development model and intelligent logistics development model, and studied the specific test data to prove that the use of intelligent logistics development model is superior to other intelligent logistics development model designing. Suppose an intelligent logistics company receives a list on a certain day, which requires it to distribute goods for 13 customers. The company owns the disposable property of four smart logistic units, with all loaded with 200 units. In this case, the smart logistics industry considers unilaterally the total operating distance of smart logistics, which they think the total transport costs are related to the total distance traveled by smart logistics. Therefore, when designing a route, we should only unilaterally design a shorter route. The corresponding design is shown in Figure 4.

![Figure 4](image_url)

**Figure 4.** Customer location and demand intelligence map

As is shown in the above table, we know that this is a 3×13 dimensional matrix space. Even if we do not
take into account the overall size of the customer's order and the weight of each vehicle load, just a simple calculation can run the program to achieve 13! times. In this solution similar to infinite solution, it is almost fantasy to choose an optimal intelligent logistics route, and let alone the other constraints. Although the ultimate net company has come up with a solution called a saving matrix, it is partially limited, as shown in Figure 5.

The research project of this thesis is a multi-objective intelligent logistics development model. It is also taking into account the total number of intelligent logistics and intelligent logistics operation of the total distance. The encoding of the choice is simpler than natural number encoding. The set size of the population is 49, and the end of the population is 100. The probability of crossing intelligent method is 0.59 on average, and the maximum is 0.93. The probability of mutation intelligent method is 0.011 on average, and the maximum value is 0.049. In setting these initial values, we can also set a desired optimal value according to the lesson plan solution, and this paper tentatively set is 175. When the program starts running after many iterations of intelligent logistics development mode, the output is lower than the result of 175, and it will terminate the operation of the program and output the optimal result. If the genetic operation reaches the end value of 100, it still cannot output optimal results, and then the final data is the optimal solution, and program examples is shown in Table 2.

<table>
<thead>
<tr>
<th>Logistics car</th>
<th>Itinerary</th>
<th>Length of travel</th>
<th>Each logistics car load</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DC,11,12,DC</td>
<td>42</td>
<td>170</td>
</tr>
<tr>
<td>2</td>
<td>DC,5,4,2,DC</td>
<td>50</td>
<td>184</td>
</tr>
<tr>
<td>3</td>
<td>DC,3,6,7,6,9,DC</td>
<td>36</td>
<td>194</td>
</tr>
<tr>
<td>4</td>
<td>DC,10,14,13,DC,</td>
<td>55</td>
<td>181</td>
</tr>
</tbody>
</table>

Comparing the data in the two tables after the solution is obtained, we can modify the expected value, and the other parameters are unchanged and then run 13 times. The research program of this intelligent logistics development model has obtained a better solution than the existing one. It concludes that the solution studied in this paper is much better than the existing methods in the material and the result is more excellent. Thus we have verified the availability of the given method.

4. Conclusion

In recent years, with the continuous development of technologies related to big data, Internet of Things and cloud computing, the computing power of information technology has been greatly improved. In particular, technologies such as smart processing are constantly optimized for complex computing, which are enabling us to train more intelligent model. The research topic of this dissertation is the intelligent logistics development model based on Internet of Things and cloud computing in the era of big data, especially the research and implementation of intelligent logistics model optimization, which is very meaningful for the current social environment. The traditional logistics industry has also gradually stepped into electronic information era.
Intelligent logistics system is also becoming more and more mature, and this paper has studied a smart logistics information management mode, which can provide different users with corresponding intelligent data information inquiry service. At the same time, the conclusions of this thesis can provide scientific basis and guidance for the decision-making of the intelligent distribution of logistics by senior managers in the enterprise.

References


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