Intelligent Distribution Of Fresh Agricultural Products In Smart City

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ABSTRACT_ With the construction of smart cities and the continuous improvement of people’s living standards, residents’ demand for fresh agricultural products (FAP) has increased dramatically. Therefore, reasonable arrangement for intelligent distribution of FAP in smart cities can effectively guarantee product quality, improve distribution efficiency, reduce distribution cost, and increase customer satisfaction. In actual distribution in smart city, road conditions are one of the important factors that affect the distribution. Therefore, according to the influence of road conditions on refrigerated vehicle’s (RV’s) speed, the RV’s speed characteristic models are established. Meanwhile, according to the characteristics of FAP, the penalty cost function based on the time window is constructed. According to the idea of fuzzy logic, the customer satisfaction evaluation model is established. Then, in order to minimize the distribution costs and maximize customer satisfaction as the optimization goal of intelligent distribution in smart city, the mathematical model is built. For solving this model, an improved quantum-behaved particle swarm optimization algorithm (IQPSO) is proposed. Finally, the effectiveness of IQPSO is verified by simulation. The results show that IQPSO also achieves good results, and the model constructed can effectively balance the relationship between the distribution costs and customer satisfaction when distributing FAP in smart city.

1.INTRODUCTION

WITH the continuous development of urbanization and smart cities, more and more FAP are delivered to customers through Online to Offline (O2O) mode. The consumption of fresh agricultural products (FAP) between urban and rural residents increases year by year. Meanwhile, residents put forward higher requirements for timeliness and FAP’s quality in distribution process. Therefore, how to arrange the distribution route scientifically and rationally to ensure the freshness of FAP, improve the distribution efficiency, trade off the distribution cost and customer satisfaction is one of the important problems for distribution in smart city.

The substance of smart city is to make use of advanced information technology to realize urban smart management and operation, to create a better life for people in the city. However, efficient logistics is one of the essential links to improve service level of smart city. Therefore, it is
necessary to study intelligent distribution in smart cities. The vehicle routing problem (VRP) firstly proposed in 1959 is a classical problem in logistics and transportation. Since then, many research results have been produced on this optimization problem. Pan et al. [1] established a distribution vehicle path optimization model for urban transportation based on time-dependent travel time, multiple trips per vehicle, and loading time at the depot simultaneously. Based on service time window constraints, Wang et al. [2] considered the penalty cost, obtaining the VRP model with soft time windows. Brandsttter [3] solved the distribution path optimization problem with time window through a metaheuristic algorithm. However, most of literatures only assume that distribution cost is related to distribution distance, and rarely considers the relationship between cost and vehicle speed, as well as the impact of road conditions on cost.

Aiming at the optimization model of cold chain logistics distribution path under time-varying conditions, Woensel et al. [4] considered the dynamic driving speed and proposed an improved Tabu Search algorithm to find the balance point between delivery service quality and distribution cost. Zhang et al. [5] proposed a hybrid solution algorithm combining Tabu search and Artificial Bee Colony algorithm. Ma et al. [6] studied the VRP with road constraint based on Tabu Search algorithm. As for customer satisfaction evaluation in logistics distribution, Qin et al. [7] used the punctuality of distribution as evaluation standard. In order to evaluate customer satisfaction, Ghannadpour et al. [8] used a function of fuzzy time windows when studying multi-objective dynamic VRP. Bakeshloo et al. [9] also adopted function of fuzzy time windows to evaluate customer satisfaction. However, the above literatures mainly consider a single factor affecting the distribution cost (i.e., vehicle speed, road conditions), rarely analyze the impact of weather conditions and different distribution times on the speed of distribution vehicles and distribution cost. In addition, most of literatures above only evaluates customer satisfaction based on distribution punctuality. However, the customer satisfaction evaluation of FAP should not only consider the timeliness of distribution, but also quality of products in the process of distribution. In the view of the above analysis, we analyze the following problems: 1) Under different weather conditions and time periods, how does the time-varying speed of RV affect the distribution costs? 2) Considering the main factors that affect the evaluation of customer satisfaction, how can we get an accurate evaluation value of customer satisfaction, thereby guiding the intelligent distribution in smart cities? 3) In the FAP’s distribution in smart cities, how do we rationally and scientifically formulate a distribution plan for FAP that considers both distribution cost and customer satisfaction?

Therefore, according to temporal and spatial characteristics of RV’s speed, we establish the speed model. Then, according to the nature of on-time delivery and the product quality in the FAP’s distribution, we proposed a novel customer satisfaction based on fuzzy logic. Finally, the multi-objective optimization problem is constructed, which is solved by an improved quantum-behaved particle swarm optimization algorithm (IQPSO). The main contributions of our work are as follows:
1) Based on the description of the space-time characteristics of the distribution vehicle speed, the influence rates of the distribution vehicle speed, which is under different weather conditions and different time periods, are established.

2) The evaluation of customer satisfaction is generally a subjective description, not an accurate value. Therefore, by adopting the method of fuzzy logic, the accurate value of customer satisfaction evaluation is obtained.

3) An improved quantum-behaved particle swarm optimization algorithm is proposed, which can effectively solve the multi-objective optimization problem that are minimizing distribution costs and maximizing customer satisfaction.

The remainder of this paper is organized as follows. In the next section, the system model will be described in detail. In Section 3, the composition of distribution costs will be analyzed one by one. In Section 4, another optimization index, customer satisfaction, will be analyzed. In Section 5, a formal mathematical description of the problem is given and we describe the algorithm proposed in detail. Thereafter, in Section 6, the simulation and experiment are carried out. Finally, some conclusions are drawn in Section 7.

2. LITERATURE SURVEY

In this study, we investigate a routing problem in urban transportation which considers time-dependent travel time, multiple trips per vehicle, and loading time at the depot simultaneously. Its objective is to minimize the total travel distance while satisfying the time windows, vehicle capacity, and maximum trip duration constraints. We model the problem as a multi-trip time-dependent vehicle routing problem with time windows (MT-TDVRPTW). We formulate the time-dependent ready time function and duration function for any segment of consecutive nodes as piecewise linear functions and develop an iterative algorithm to derive them efficiently. Then, these two functions are embedded in the segment-based evaluation scheme to accelerate the local search operators. Based on them, we design a hybrid meta-heuristic algorithm to solve the problem, leveraging the adaptive large neighborhood search (ALNS) for guided exploration and the variable neighborhood descend (VND) for intensive exploitation. Moreover, we propose problem-specific local search operators and removal operators to enhance the effectiveness of the algorithm. Extensive experiments are conducted to assess the performance of the algorithm on instances of varied sizes. The algorithm is shown to be robust and efficient under different speed profiles and maximum trip duration limits. Finally, we evaluate the performance of the algorithm on a special case: the multi-trip vehicle routing problem with time windows.


In order to reduce the cost pressure on cold-chain logistics brought by the carbon tax policy, this paper investigates optimization of Vehicle Routing Problem (VRP) with time windows for cold-chain logistics
based on carbon tax in China. Then, a green and low-carbon cold chain logistics distribution route optimization model with minimum cost is constructed. Taking the lowest cost as the objective function, the total cost of distribution includes the following costs: the fixed costs which generate in distribution process of vehicle, transportation costs, damage costs, refrigeration costs, penalty costs, shortage costs and carbon emission costs. This paper further proposes a Cycle Evolutionary Genetic Algorithm (CEGA) to solve the model. Meanwhile, actual data are used with CEGA to carry out numerical experiments in order to discuss changes of distribution routes with different carbon emissions under different carbon taxes and their influence on the total distribution cost. The critical carbon tax value of carbon emissions and distribution cost is obtained through experimental analysis. The research results of this paper provide effective advice, which is not only for the government on carbon tax decision, but also for the logistics companies on controlling carbon emissions during distribution.


Synchronisation in vehicle routing is a rather new field of research and naturally new problems arise. One of these problems is the Line-haul Feeder Vehicle Routing Problem (LFVRP). It uses a fleet of small and large vehicles to serve two types of customers. The first type provides additional parking space and can be visited by both vehicle classes. The second type can only be visited by the small vehicle class as these customers provide only limited parking space. The main characteristic of the small vehicle class is the limited capacity. To overcome this particular disadvantage, the small vehicles can use the large vehicles as virtual depots. In other words, a small and large vehicle can meet at a parking lot or at a customer with enough space (type-1 customer) and perform a transfer of goods. For a successful reloading operation, both vehicles must be present at the same place at the same time. Thus, both vehicle tours must be synchronized. After using the large vehicle as virtual depot, the small vehicle can proceed immediately afterwards because it does not need to go back to the physical depot. Consequently, less time and distance is required which results in a reduction of the overall costs. The advantage of the LFVRP over classical variants of the Vehicle Routing Problem has been shown in previous papers. Yet, customer time windows have been neglected so far and as time windows play an important role in vehicle routing research, they need to be addressed properly. Therefore, we aim to close this gap by introducing the Line-haul Feeder Vehicle Routing Problem with Time Windows (LFVRPTW). We discuss the complexity of customer time windows for the LFVRPTW and adopt the previously introduced algorithm for the LFVRP. Furthermore, we provide a thorough computational analysis on the impact of different time window characteristics and show the advantage of the LFVRPTW over other variants of the Vehicle Routing Problem with Time Windows.
3. PROPOSED SYSTEM

The main contributions of proposed work are as follows:

1) Based on the description of the space-time characteristics of the distribution vehicle speed, the influence rates of the distribution vehicle speed, which is under different weather conditions and different time periods, are established.
2) The evaluation of customer satisfaction is generally a subjective description, not an accurate value. Therefore, by adopting the method of fuzzy logic, the accurate value of customer satisfaction evaluation is obtained.
3) An improved quantum-behaved particle swarm optimization algorithm is proposed, which can effectively solve the multi-objective optimization problem that are minimizing distribution costs and maximizing customer satisfaction.

3.1 IMPLEMENTATION

Admin

In this module, the Service Provider has to login by using valid user name and password. After login successful he can do some operations such as Login, View All Users and Authorize, View All Datasets, View All Datasets By Distribution Chain, View Distribution Type Results in Chart, View Distributor Name Results in Chart, View Distribution City Results.

View and Authorize Users

In this module, the admin can view the list of users who all registered. In this, the admin can view the user’s details such as, user name, email, address and admin authorizes the users.

End User

In this module, there are n numbers of users are present. User should register before doing any operations. Once user registers, their details will be stored to the database. After registration successful, he has to login by using authorized user name and password. Once Login is successful user will do some operations like Register and Login, View Profile, Upload Datasets, View Uploaded Datasets, Find Distribution Type, Find Distribution Type By Hash code.

5. CONCLUSION

In the era of the construction of smart cities, intelligent distribution will become an important part of people’s daily life, especially the FAP’s distribution with higher requirements. This paper aims to study the FAP’s intelligent distribution in smart cities. In order to formulate distribution routes scientifically and reasonably, which balances the relationship between distribution costs and customer satisfaction, we establish a mathematical model. By using IQPSO for related experiments, the effectiveness and stability of the algorithm are verified. The results show that the established model and the algorithm used can effectively balance the relationship between distribution costs and customer satisfaction. Therefore, it provides a new solution for balance the relationship between distribution costs and customer satisfaction in FAP’s intelligent distribution in smart cities. In our future works, we will study the mathematical model of VRP with multi supply points and multi demand points. In addition, we will arrange different types of vehicles to provide distribution services for customers with different demands.
REFERENCES


