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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.

2.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.

- **Advantages**
  - To minimize the distribution costs and 2) to maximize the customer satisfaction.
  - In the intelligent distribution system of Principle of FAP Intelligent Distribution System FAP in smart cities, each customer periodically transmits the order information to the data center located at fresh agricultural products distribution center (FAPDC).

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3 SYSTEM DESIGN

INPUT DESIGN

Input Design plays a vital role in the life cycle of software development, it requires very careful attention of developers. The input design is to feed data to the application as accurate as possible. So, inputs are supposed to be designed effectively so that the errors occurring while feeding are minimized. According to Software Engineering Concepts, the input forms or screens are designed to provide to have a validation control over the input limit, range and other related validations.

This system has input screens in almost all the modules. Error messages are developed to alert the user whenever he commits some mistakes and guides him in the right way so that invalid entries are not made. Let us see deeply about this under module design.

Input design is the process of converting the user created input into a computer-based format. The goal of the input design is to make the data entry logical and free from errors. The error is in the input are controlled by the input design. The application has been developed in user-friendly manner. The forms have been designed in such a way during the processing the cursor is placed in the position where must be entered. The user is also provided with in an option to select an appropriate input from various alternatives related to the field in certain cases.

Validations are required for each data entered. Whenever a user enters an erroneous data, error message is displayed and the user can move on to the subsequent pages after completing all the entries in the current page.

OUTPUT DESIGN

The Output from the computer is required to mainly create an efficient method of communication within the company primarily among the project leader and his team members, in other words, the administrator and the clients. The output of VPN is the system which allows the project leader to manage his clients in terms of creating new clients and assigning new projects to them, maintaining a record of the project validity and providing folder level access to each client on the user side depending on the projects allotted to him. After completion of a project, a new project may be assigned to the client. User authentication procedures are maintained at the initial stages itself. A new user may be created by the administrator himself or a user can himself register as a new user but the task of assigning projects and validating a new user rest with the administrator only.

The application starts running when it is executed for the first time. The server has to be started and then the internet explorer in used as the browser. The project will run on the local area network so the server machine will serve as the administrator while the other connected systems can act as the clients. The developed system is highly user friendly and can be easily

Modules

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.

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

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 authorize the users.

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5.IMPROVE THE LOGISTICS STRATEGIES OF DISTRIBUTION OF AGRICULTURAL PRODUCTS IN SMART CITY

Firstly, reduce the logistics cost of agricultural products. Choosing a scientific path to reduce the logistics cost of agricultural products is the main problem that needs to be solved in the circulation of agricultural products present, and it is of great significance to the development of agricultural products. Only by correctly understanding, accurately calculating and rationally distributing the logistics cost of agricultural product can we continuously reduce the logistics cost of agricultural product. Taking the leading enterprise as an example, suppose that the leading enterprise provides n products or services, has m operations, consumes and uses to represent the cost of I products, then:

$$Ci = \sum MijYikQk$$

In which mij represents the number of job j consumed by product I, and Yik represents the number of k resources consumed by unit job j; QK stands for the price of k resources. It can be seen from the model that to reduce the cost of an agricultural product, we should start with the activities consumed by the product, the amount of resources consumed by unit activity and the price of unit resources. Reduce unnecessary loss and waste of resources as much as possible, reasonably control resource input, and use as few resources as possible to obtain higher quality services. In addition, from the storage cost analysis: applying the research method of economic order quantity model to agricultural product logistics can effectively reduce the storage cost and reduce the logistics cost of agricultural products. As shown in Figure, the more inventory backlog, the higher the storage cost. Therefore, applying the economic order quantity model to find the optimal order quantity is also an effective way to reduce the storage cost.

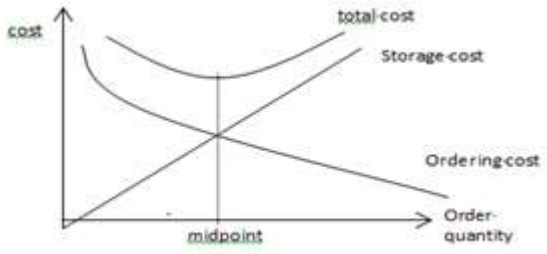

Figure. Economic order quantity model

Secondly, improve logistics infrastructure. The key to logistics of agricultural product is to have good logistics facilities. As the saying goes, "build roads before you get rich", and improving roads coverage is one of the important factors for improving logistics facilities. Increasing highway coverage can improve highway grade, service level and transportation capacity. In addition, it also includes. The construction of market research, storage conditions, transportation conditions, tools, etc. of agricultural products, as well as the construction of infrastructure such as after-sales service of agricultural products in smart city.

6.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.

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