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INTELLIGENT DISTRIBUTION OF FRESH AGRICULTURAL PRODUCTS IN SMART CITY

M.THANGAVEL , T.THARANI

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.

I. 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.

M.Thangavel, Professor , Department of Computer Applications , Erode Sengunthar Engineering College (Autonomous), Perundurai , Erode. (Email : thangavelpamu@gmail.com)
T.Tharani , PG Scholar , Department of Computer Applications, Erode Sengunthar Engineering College (Autonomous), Perundurai , Erode. (Email : tharanitharmalingam2210@gmail.com)

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.

II. SYSTEM STUDY

1) FEASIBILITY STUDY

The feasibility of the project is analyzed in this phase and business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some

understanding of the major requirements for the system is essential.

Three key considerations involved in the feasibility analysis are

- ECONOMICAL FEASIBILITY
- TECHNICAL FEASIBILITY
- SOCIAL FEASIBILITY

1) ECONOMICAL FEASIBILITY

This study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited. The expenditures must be justified. Thus the developed system as well within the budget and this was achieved because most of the technologies used are freely available. Only the customized products had to be purchased.

2)TECHNICAL FEASIBILITY

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. This will lead to high demands on the available technical resources. This will lead to high demands being placed on the client. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.

3) SOCIAL FEASIBILITY

The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system, instead must accept it as a necessity. The level of acceptance by the users solely depends on the methods that are employed to educate the user about the system and to make him familiar with it. His level of confidence must be raised so that he is also able to make some constructive criticism, which is welcomed, as he is the final user of the system.

III. EXISTING SYSTEM

This study, taking the R fresh agricultural products distribution center (R-FAPDC) as an example, constructs a multi-objective optimization model of a logistics distribution path with time window constraints, and uses a genetic algorithm to optimize the optimal trade distribution path of fresh agricultural products. By combining the genetic algorithm with the actual case to explore, an existing system aims to solve enterprises' narrow distribution paths and promote the model's application in similar enterprises with similar characteristics. The results reveal that:

(1) The trade distribution path scheme optimized by the genetic algorithm can reduce the distribution cost of distribution centers and improve customer satisfaction.

(2) The genetic algorithm can bring economic benefits and reduce transportation losses in trade for trade distribution centers with the same spatial and quality characteristics as R fresh agricultural products distribution centers. According to our study, fresh agricultural products distribution enterprises should emphasize the use of genetic algorithms in planning distribution paths, develop a highly adaptable planning system of trade distribution routes, strengthen organizational and operational management, and establish a standard system for high-quality logistics services to improve distribution efficiency and customer satisfaction.

DISADVANTAGES

- An existing methodology doesn't implement FAP Intelligent Distribution Techniques.
- The system is aiming at the optimization model of cold chain logistics distribution path under time-varying conditions.

IV. PROPOSED SYSTEM

The main contributions of proposed work are as follows

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.

1) 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

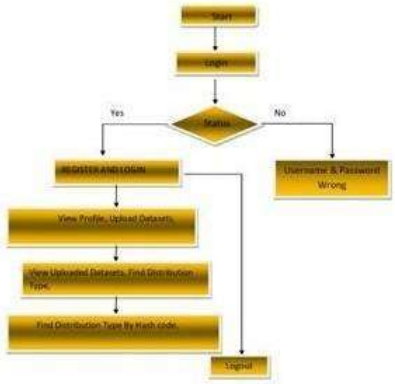
evaluation is obtained.

2) 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.

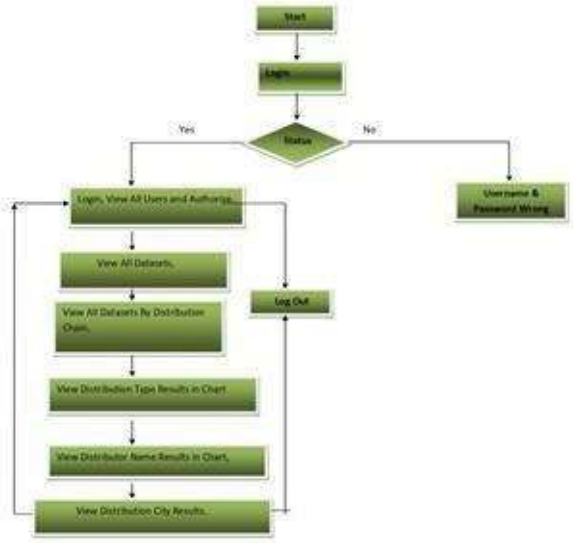
ADVANTAGES

- 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)

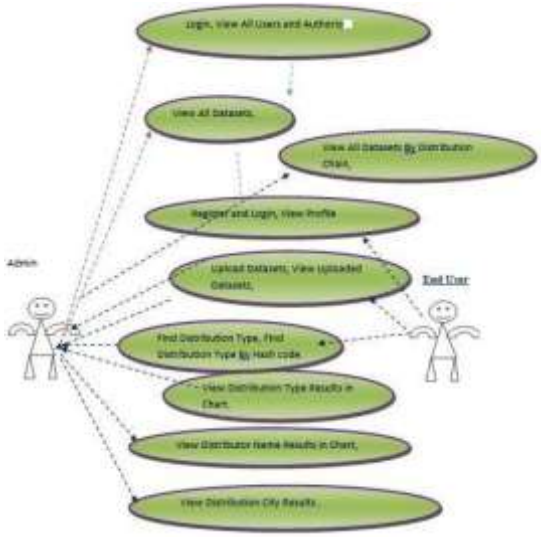
1) Flow Chart : End User



2) Flow Chart : Admin



3) Use Case Diagram:



V. 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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