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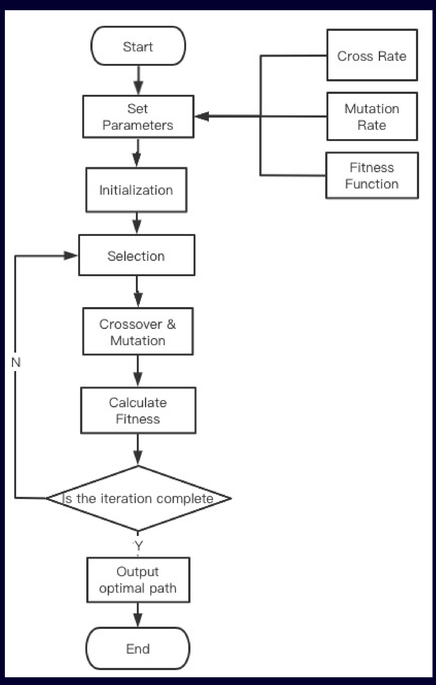
A path planning method for scrap recycling vehicles based on improved genetic algorithm

With the rapid development of e-commerce platforms and new products in China, however, the scrap products such as waste paper, used home appliances and scrap metals that come with them are accumulating in cities, affecting the environment and hygiene. Today, scrap collectors often drive electric tricycles aimlessly to carry out scrap collection. The vehicle path planning is a pressing problem in the recycling process of scrap products from user location points to sorting centers. In order to solve this problem and minimize the cost consumed in the recycling process, this paper solves and analyzes the actual problem based on an improved genetic algorithm, combined with GIS technology. Firstly, based on the characteristics of the scrap recycling process, the shortest path is solved based on GIS software, and then the spatial and distance information such as user location points and sorting points are combined to construct a GIS network to obtain the shortest path. Secondly, this paper establishes a vehicle path planning model for the sorting center considering factors such as actual scrap collectors' commuting and service time. Then, an improved and optimized genetic algorithm is designed, and then the model is solved. Finally, the solved optimal path of scrap collection is displayed in GIS software. In this paper, the effectiveness of the method is demonstrated by taking Guilin city as an example.

Nowadays, online shopping has gradually become an integral part of people's daily life, and in the process, new products are constantly introduced. However, with this comes a large amount of packaging waste paper and waste materials generated from online shopping. At the same time, some discarded metals will also exist in some homes. More than 500 million tons of hazardous toxic waste are generated annually in electronic waste. Most users will choose to dispose of these directly as garbage because they are too troublesome, or for other reasons. Instead, they will not sort it and wait for the collectors to carry out door-to-door acquisition.

In recent years, the Chinese government has introduced a series of policies to help the management related to municipal waste. For example, in 2015, the National Development and Reform Commission and five other departments jointly issued the "Medium and Long-term Plan for the Construction of Renewable Resources Recycling System (2015-2020)", and pointed out that it encourages the active exploration of "Internet + recycling" models and ways. However, domestic waste recycling still has a lot of room for development.



In this section, the above method is applied to a simulation case in Guilin city. A total of 8 user points exist for waste home appliances, waste paper, and waste metals to be recycled, where No. 0 indicates the sorting center and No. 9 indicates the location of the charging station. The locations of the sorting center, user points, and charging stations are marked on the map of Guilin city in GIS software, and the distance between any two points is calculated.

Vehicle path planning is an important problem in the recycling process of waste products such as used home appliances.

（1）Firstly, this paper analyzes the actual transportation conditions under waste recycling, establishes a vehicle route planning model, and studies the vehicle path problem with time windows.

（2）Secondly, the shortest path between two points is obtained through GIS, and the genetic algorithm is introduced to achieve more efficient search by improving the crossover operator and genetic operator, and the initial encoding is improved.

（3）Finally, the optimal path of the solved scrap collectors is displayed by GIS software. A simulation case in Guilin city proves the effectiveness of the method.

[1]Liu H, Huang T, Lei M. Research on dual-channel recycling model of waste electrical and electronic products and the role of government subsidies [J]. China Management Science, 2013, 21(02): 123-131.
[2]Wang K, Wang H, Chai M. Optimization model and algorithm of railroad station operation approach allocation [J/OL]. Railway Standard Design, 2022, 66(08): 1-9.
[3]Tang J, Zhang D, Wang M, et al. Improved chained multiple swarm genetic algorithm for air defense fire task allocation[J]. Journal of Harbin Institute of Technology, 2022, 54(06): 19-27.
[4]Gao J, Hu Z, Yang X. Express Routes Optimization with Genetic Algorithm[C]//2021 6th International Conference on Intelligent Computing and Signal Processing (ICSP). IEEE, 2021: 260-264.
[5]Huang F, Fu H, Chen J, et al. Mobile robot path planning based on improved genetic algorithm[C]//2021 4th World Conference on Mechanical Engineering and Intelligent Manufacturing (WCMEIM). IEEE, 2021: 378-383.
[6]Chen K, Zhang H, Huang X, et al. Commercial Vehicle Route Planning Design Based on Partition Coding Genetic Algorithm[C]//2020 IEEE International Conference on Information Technology, Big Data and Artificial Intelligence (ICIBA). IEEE, 2020, 1: 830-834.
[7]Li L, Gu Q, Liu L. Research on path planning algorithm for multi-UAV maritime targets search based on genetic algorithm[C]//2020 IEEE International Conference on Information Technology, Big Data and Artificial Intelligence (ICIBA). IEEE, 2020, 1: 840-843.
[8]Lu Y, Cui Y. A review of improved algorithms based on path planning techniques[J]. Computer Knowledge and Technology, 2021, 17(22): 97-99.