

The Application of Heuristic Algorithm in the Location of Shared Bicycle Parking

Xiaofeng Yan and Jie Zhao

Foreign trade college, Chongqing Normal University, The No. 9 Xuefu Road of Hechuan District, Chongqing, China
da68da68@163.com.

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Abstract: With the development of the shared economy and the advocacy of green travel, the shared bicycle has emerged as the times require, and it is popularized rapidly in all big cities. However, the popularity of sharing a single bicycle will also bring many problems, especially in the problem of vehicle management. If it is not handled properly, it will affect traffic and travel. This article through analysing the factors influencing the location, establishment of relevant indicators, under the premise of ensuring the user convenience, which cost minimization as the objective function, take the example verifies the feasibility of the scientific location based on the location of the heuristic algorithm. The experimental results show that the algorithm is effective.

1 INTRODUCTION

The emergence of the shared economic platform is changing the traditional consumption concept under the tide of the Internet. In recent years, sharing bicycles has become a new hot spot of China's shared economy, and it is deeply loved by college students. As of the end of 2016, the third party data research institutions released the "2016 China bike sharing Market Research Report" shows that the number of bicycle market overall user China share has reached 18 million 860 thousand, It is expected that the bicycle market share subscribers will continue to maintain substantial growth in 2017, It will reach 50 million users. With a large number of bicycle bike sharing on the sharing, there are many "urban diseases" in the management, such as shared bicycle companies closed down unable to return the deposit, because users sharing bicycle parking blocking traffic, vehicle damage to a series of problems faster and increase the number of other damage. About sharing parking problems, Beijing, Shanghai, Changsha, Shenzhen and other places have issued sharing parking regulations, but all of these provisions do not all assign special parking area to shared bicycles.

Now many problems in planning theory, people always tend to use firefly algorithm, simulated annealing, genetic algorithm and ant colony algorithm to seek the optimal solution, but in reality,

many problems are related to the complex system of many factors, so we always cannot accurately find the optimal solution. Heuristic algorithm is a technology that can find one or even multiple understanding within the scope of problem constraints. The solution obtained by this algorithm is not able to describe its similarity with the optimal solution in most cases.

The sharing of bicycles cannot develop blindly, if the parking is not order, it will bring great trouble to the city management. In order to make the shared bicycles able to park properly, this paper will analyse the main parking places and surrounding environment of the shared cars, and consider the feasibility and cost of sharing the single car, so as to find a reasonable parking address.

2 SHARED PARKING LOCATION MODEL

2.1 Problem description and index selection

2.1.1 Description of the problem

Because Chongqing is so special, so sharing bicycle is not completely universal, but the Chongqing city east area 470 km long, 450 km wide from north to

south, covers an area of 82402.95 square kilo-meters, 23 under the jurisdiction of the District, 11 counties and 4 autonomous counties, the urban built-up area of 647.78 square meters of 1000. There are 55 colleges and universities in Chongqing. There are about 200000 college students in the university town. In order to cater for the needs of college students, currently, the main area of sharing bicycles in Chongqing is near the schools and the places where people flow more. According to the position set easily, convenient maintenance, not hinder the public space principle, seeking cost costs less and profitable bicycle parking sharing address, this paper argues that the Ardalan heuristic algorithm can consider the main influencing factors of parking location, which has a certain guiding significance.

2.1.2 Selection of indicators.

As a means of transportation, the related factors that affect the parking location of shared bicycles are users, convenient locations, demographic characteristics, scalability, vehicle maintenance and recovery costs.

Since the characteristics of the heuristic algorithm are the selection of indicators, on this basis, this paper selects a new index. The goal is to share the lowest cost of the parking address.

Table 1: The index symbols in the model

Index name	Symbol
Population flow	$P_i(i = A, B, C)$
Sharing rate of single vehicle	V
Fixed cost of parked address	M
Total cost of parked address	Y
Damaged vehicles	$t(t = 1, \dots, X_i)$
Maintenance cost of damaged vehicles	$a(a = 1, \dots, n)$
Population weight	W
The distance from the door to the parking address	d

2.2 The basic hypothesis of the model and the establishment of the mathematical model.

2.2.1 Basic assumptions

Suppose one, the sharing of the bicycle user quality is good, after the use of the car, all will be parked to the designated location and lock.

Suppose two, The 80% of the traffic in the shared parking place will be used, and the use rate of

the single vehicle, the damage amount of the single bicycle and the traffic flow are linear functions.

Suppose three, each shared bicycle parking place capacity and number are limited, a total of N alternative parked points, the maximum capacity of $X_i(i = 1, 2, \dots, n)$, as a result of the sharing of single vehicle operating costs, the location of a single parking place is up to Y .

Suppose four, the variable cost of a shared parking place is a convex function of the function of its traffic.

Suppose five, the level of the shared bicycle scheduling is not limited, and the instantaneous distribution of the vehicle between the disequilibrium points of demand can be completed.

2.2.2 Location model based on VRP theory

Dantzig and Ramser put forward the vehicle routing problem (VRP) in 1959 for the first time. A certain number of users, because each has a different amount of demand for goods, so when the center of distribution to provide customers with goods, we should choose the appropriate route and distribute the goods by a team, our goal is to satisfy the needs of customers, and under certain conditions, to achieve the shortest distance, minimum cost and time the purpose of the shortest...The definition of VRP model in this paper is: suppose the function relation of known user volume, parking location distance, fixed cost and variable cost, it is required to choose suitable parking address for shared bicycle under the premise of satisfying constraints, so that users and operators will have the lowest cost and the same cost.

According to the above hypothesis, it can be obtained:

$$V = k_1 P_i + b_2 \quad V = k_2 P_i + b_2 \quad (k_1 > 0, k_2 > 0)$$

The objective function can be expressed as:

$$\min Y_i(\max V) = M + W * P_i * d + \sum_{i=1}^{X_i} \sum_{a=1}^n X_{at}$$

2.2.3 Based on the analysis of Ardalan heuristic algorithm model.

Firstly, a n filter, consider the alternative address for each m combination, a total of nm options, each alternative address set by T , the maximum capacity of each group contained one by one to calculate the alternative address $X_i(i = 1, \dots, n)$. The filtration

conditions are as follows: $\sum_{i=1}^i X_i \geq \sum_{j=1}^j D_j$ (D is the total demand for a single bicycle), If it is set up, the combination of T can be discussed; otherwise, the combination of T is filtered, not to be considered.

Then conditional filtering can be made to obtain less than or equal to C_n^m feasible subsets, and the corresponding sub-problems will be simplified. At this point, there will be no 0-1 variables in the sub problem, and the continuous variable will also be greatly reduced. Except for the convex function in the objective function, the rest are linear and constant functions. The number of sub-problems is less than that of the original one, and the difficulty of solving the problem is greatly reduced.

Finally, the first convex function is separated by the final processing, weight calculation, the complex function is simple to cost as the goal function to solve the linear programming solution, after adding convex function value, qualitative analysis, which is the location of the total cost sharing of bicycle.

3 EXAMPLE SOLUTION

In this paper, a university in Chongqing is taken as an example to study the location of shared bicycle parking. Because part of the data is large and cannot be measured accurately, the real proportional data is used. There are many other schools and residential areas near the school. There is more flow of people. There are three access doors in the school. They are recorded as the main gate A, the side door B, the back door C, and the bus stop near the three gates. According to the volume of people's traffic from low to high, they are ranked as C, B and A, and C is near the residence. In the people's District, we are ready to set up 4 shared parking places near the school, with a fixed cost of 1000 ¥ each.

4 CONCLUSIONS

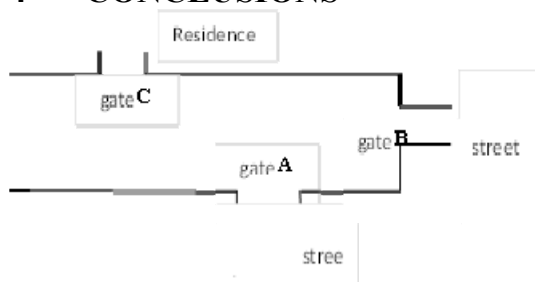


Fig. 1. Sketch map of simple distribution in a university

Table 2: Initial assumption of related data

	The distance from the parking point to the door				Nearby	Population
	parking1	Parking2	parking3	parking4	population(X)	weight
Gate A	0	2	16	6	20	0.8
Gate B	4	0	2	4	10	1.0
Gate C	30	20	0	25	4	1.2

Step 1: according to the data of the above table, the weighted distance of the population near the door is calculated. The formula is weighted distance = near population * distance * population weight. The results of the calculation are shown in the following table:

Table 3: Initial assumption of related data

	The distance from the parking point to the door			
	parking1	parking2	parking3	parking4
Gate A	0	20	100	60
Gate B	64	0	32	64
Gate C	144	96	0	120
Σ	208	116	132	244

Step two: calculate the sum of every column number in the upper table, select the smallest area from it, which means that the weighted distance between users in each area to share parking places is the shortest, that is, the total cost of users (mainly the school's students) is the lowest, and the B gate of the school is selected.

Step three: one by one compare the distance from the B door to the parking point and the value of each row. If the former is large, the value remains unchanged. If the former is small, replace the value in the table to the distance between B door and single parking point. The final results are as follows:

Table 4 Compare B gate distance and door distance and replace results

		The distance from the parking point to the door			
		parking1	parking2	parking3	parking4
Gate A	0	20	20	20	20
Gate E	0	0	0	0	0
Gate C	95	95	0	95	95

Step four: repeat step two, the C gate is selected.

Step five: repeat step three or four. Combined with the traffic condition near each door and the vehicle repair and recovery cost brought by the use of single car, the reasonable shared parking place is determined to be B gate, C gate and A door.

5 CONCLUDING REMARKS

Based on qualitative and quantitative analysis, heuristic algorithm is applied to modelling and analysing the location problem of shared bicycles. With examples, the heuristic algorithm is proved to be scientific and effective. With the development of the times, the heuristic algorithm is also applied to all walks of life, especially in the location of logistics centers. The algorithm can be used in some complex system modelling, which simplifies the elements in the system, and its innovation is mainly based on the selection of the indexes.

The starting point of popularizing shared bicycles is not only to get economic benefits, but also to facilitate the public, and to share bicycles is also a form of green economy. It has made great contributions to the urban environment and accords with the strategy of urban sustainable development promoted by the government. As a fast developing city, there are still some obstacles in the popularization and sharing of bicycles. Chongqing cannot completely block the market share of bicycles in the future. A new industry wants to develop healthfully, and its management system must be followed up gradually, and more efforts should be made in this respect.

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