Construction of Tourism Planning Information System Based on Ant Colony Algorithm

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Abstract. Tourism planning is a vital link in tourism. Compared with the traditional tourism planning based on experience, it is more scientific and reasonable to formulate through mathematical modeling methods. This paper mainly studies the construction of tourism planning information system based on ant colony (AC) algorithm. In the solution process, for the problems with more attractions, you need to divide the area first, then solve each area separately, and then transform the result of the solution into the regional self-driving tour route planning, and finally form a self-driving tour route planning. The experiments in this article found that most of the area tour time is closer to 15 days, which reduces the number of outings in a year and effectively reduces the round-trip time. In this paper, the system construction of self-driving tour route planning problems and ideas for solving specific problems are suitable for route planning in scenic spots or scenic spots, and have certain reference value.

Keywords: Ant Colony Algorithm, Tourism Planning, Tourism Planning Information System, System Construction

1. Introduction
China has abundant natural tourism resources and humanistic tourism resources. The potential advantages of tourism resources have gradually been transformed into economic advantages in which the Chinese can survive. Over the years, China's tourism industry has made remarkable achievements in terms of number of visitors, foreign exchange earnings, and construction of tourism infrastructure. However, with the continuous improvement of the national economic strength, the people's demand for tourism consumption has also gradually increased, and the number of inbound and outbound tourism has also increased, and more and more people are blind Consumption of travel abroad is a burden on the national economy, and at the same time it has a certain impact on China's sustainable development and social stability. Therefore, we need a feasible domestic tourism planning information system to make more tourism enthusiasts willing to travel in their own country and bring the national economy to a higher level.

Tourism Planning Information System (TPIS) is a technology that uses geographic information system (GIS), remote sensing technology (RS), multimedia and other technologies to collect, store, analyze, manage, maintain and assist decision-making in tourism planning Support system [1, 2]. Based on the universal geographic information system, some simple tourism planning tasks can be
directly implemented, and the construction of TPISs is a high-level goal of geographic information systems in tourism planning. To achieve the purpose of automatically or semi-automatically completing the complex tasks in tourism planning [3, 4]. The perfect TPIS can enable the integrated planning functions of TPIS. The basic software platform and core technology for the construction and application of TPISs is GIS [5]. In recent years, the application of geographic information systems in tourism planning has mainly focused on the development and application of tourism geographic information systems. The construction and application of TPISs is one of the important new areas.

Based on the basic principles of tourism planning, geographic information systems, and databases, this paper proposes the main technical links for building a tourism planning information database. This paper discusses several spatial mathematical models commonly used in tourism planning, such as the establishment of overlay analysis, buffer analysis, and network analysis. Based on the GIS spatial analysis method, the automatic extraction of terrain factors in tourist areas, the analysis of terrain and the evaluation of the suitability of tourist areas are realized. The idea of constructing a TPIS platform was proposed, and the overall structure and main functions of the system were preliminarily designed. Furthermore, the visualization function of the TPIS is applied to the analysis of the source market, the network model and the suitability model are introduced into the selection of tourist facilities, the network model and the overlay model are applied to the route design, and the space calculation is applied to the environmental capacity. In the planning process, the plan can be quantified, modeled, and informatized.

2. Method

2.1 AC Algorithm

For the AC algorithm to solve the TSP principle, just assume that the entire AC contains m ants, and the number of scenic areas is n, and the distance between scenic area i and scenic area j is $d_{ij}(i, j = 1, 2, \ldots, n)$, at a certain time t scenic area. Initially, the pheromone concentration between the various scenic areas is the same as $\tau_{ij}(0) = \tau_0$. Ant k ($k = 1, 2, \ldots, m$) can determine the next scenic area to be visited by the concentration of pheromone between the connecting paths of each scenic area. Here $P_{ij}^k(t)$ means that ant k is from scenic area i at time t. The probability of transfer to scenic area j is calculated as follows:

$$P_{ij}^k(t) = \left\{ \begin{array}{ll} \frac{[\tau_{ij}^k(t)]^\alpha [\eta_{ij}(t)]^\beta}{\sum_{S \in allow_k} [\tau_{is}^k(t)]^\alpha [\eta_{is}(t)]^\beta}, & s \in allow_k \\ 0, & s \notin allow_k \end{array} \right. (1)$$

Among them, $\eta_{ij}(t) = \frac{1}{d_{ij}}$ represents the heuristic function, which is the probability that the ant expects to move from scenic area i to scenic area j, and $allow_k$ represents the set of scenic areas visited by ant k. And $\alpha$ is the importance factor of pheromone, $\beta$ is the importance factor of heuristic function [5, 6].

We set the degree of pheromone volatility to the parameter $p$ ($0 < p < 1$). After all the ants have completed a cycle, that is,

$$\begin{cases} \tau_{ij}(t + 1) = (1 - p)\tau_{ij}(t) + \Delta \tau_{ij} \\ \Delta \tau_{ij} = \sum_{k=1}^{m} \Delta \tau_{ij}^k \end{cases} \quad 0 < p < 1 \quad (2)$$
Among them, \( \Delta \tau_{ij} \) represents the concentration of all pheromone released on the connection path between scenic area i and scenic area j.

In particular, the calculation formula of \( \Delta \tau_{ij} \) is:

\[
\Delta \tau_{ij}^k = \begin{cases} 
\frac{Q}{\text{dist}_{ij}} & \text{The KTH ant visits scenic spot } j \text{ from scenic spot } i \\
0 & \text{Other} 
\end{cases}
\]  

(3)

2.2 Establishment of Tourism Planning Information Database

Obtaining comprehensive and accurate information is the basis and key link of tourism planning. Its work is complicated and costly. Compared with the urban planning management information system, the data collection cost in the TPIS will account for more than 85% of the total system development cost [7, 8]. Therefore, it is of great significance to explore technology means based on GIS, RS, GPS and other methods to obtain information, and establish a tourism planning information database based on GIS to edit, process and analyze data.

Tourism planning information mainly includes four types of information: tourism resource information, natural, social, and economic conditions, environmental conditions, and tourist source information.

1. Tourism resource information mainly includes the type, quantity, structure, level, cause of tourism resources and related major historical events and literary works.

2. In the natural, social and economic conditions of the tourist area, natural conditions mainly refer to geological landforms, meteorology and hydrology, soil vegetation, etc.; social conditions refer to administrative divisions, population, culture, medical treatment, security, etc.; economic conditions include regional industrial structure and level, Type, infrastructure, reception service facilities, etc.

3. Environmental conditions, including the background values of important material elements in the atmosphere, water, upper soil, and lithosphere: including the atmospheric, water, and noise pollution caused by artificial factors such as industrial and mining enterprises and living services, and the degree of control [9, 10].

4. Customer source information, including the scope, quantity, and type of the source market, and the diversion and synergistic effects of similar resource areas in the vicinity on the source.

1) Travel planning information collection

Obtaining tourist information is the first step in establishing a tourist information database. Non-digitized information must be converted into digital form before it can be accepted by computers. In the geographic information system, information is divided into two categories: spatial information and attribute information. Spatial information is location-related information [11].

2) Classification of tourism planning information

Before entering the data into the computer, it must be classified according to the relevant standards. The classification criteria should be moderate. Excessive coarseness will affect the accuracy of analysis and excessively fine storage will be too large. Tourism planning information can be divided into four categories: tourism resources, natural, social, economic conditions, environmental conditions, and tourist source markets [12, 13]. Each category can continue to be subdivided until it can meet the planning needs.

3) Tourism planning information coding.

Coding is to represent classified information with appropriate character strings or numerical values for easy computer input and identification.

3. Experiment

The construction of TPIS is an advanced goal of GIS application in tourism planning (TP). Combined with expert knowledge bases and mathematical models, fast are performed to assist planning and design, and to achieve automatic or semi-automatic The purpose of completing the complex work in TP. A comprehensive TP management information system can integrate the GIS-assisted planning
functions discussed in this article.

This system is 64-bit application software, which requires CPU PIII or higher, memory 64M or higher, hard disk 20G or higher, and Windows NT 4.0 or higher operating environment. The database management system uses a relational Access management system. The system is developed using MapX components and Visual Basic 6.0 software.

The hybrid algorithm of this paper and AC algorithm and literature were used to solve the traveling salesman problem, respectively. The problem and eil51 problem are taken as examples. The three algorithms were tested 10 times for each case, and the results of each solution were recorded.

4. Discuss

4.1 Performance Simulation Analysis

(1) Search accuracy analysis

Comparing the optimal solutions of this algorithm and the literature AC algorithm, it can be seen that the algorithm in this paper can find the theoretical optimal solution, and the AC algorithm will fall into the local optimal solution; meanwhile, comparing the average and average error can be seen. The algorithm cannot guarantee that it can converge to the optimal solution each time, but only has a small probability to fall into the local optimal solution. Comparing this paper's algorithm with the literature's particle swarm AC hybrid algorithm, it can be seen that the average error of the particle swarm AC hybrid algorithm is smaller than the algorithm in this paper, which shows that the particle swarm ant colony hybrid algorithm has a better effect. The reason is that the parameter values are fixed in the algorithm in this paper, and the particle swarm AC hybrid algorithm determines the parameters dynamically through the particle swarm algorithm.

As shown in Table 1 and Figure 1, the average error of the AC algorithm increases faster, the possibility that the AC algorithm falls into the local optimal solution may greatly increase; While the average error of the algorithm and the particle swarm AC hybrid algorithm in the city increases, but it is not obvious, which shows that the algorithm and the particle swarm AC hybrid algorithm have a better solution to the traveling salesman problem.

| Algorithm          | Optimal solution | Worst solution | Average value | Theoretical optimal solution | Average error |
|--------------------|------------------|----------------|---------------|-------------------------------|---------------|
| AC Algorithm       | 427.17           | 440.96         | 438.20        | 423.74                        | 3.4           |
| Literature Algorithm | 423.74          | 426.37         | 424.26        | 423.74                        | 0.12          |
| Literature Algorithm | 423.74          | 425.65         | 424.13        | 423.74                        | 0.09          |
Optimal solution
Worst solution
Average value
Theoretical optimal solution

Ant Colony Algorithm
Algorithm
Literature Algorithm

Figure 1. Path results of three algorithms testing Oliver30

(2) Solving time
By comparing the solution time of this algorithm with the particle swarm AC hybrid algorithm, the solution time of this algorithm is less than the particle swarm AC hybrid algorithm. The reason is that the algorithm has fixed parameter values, while the particle swarm AC hybrid algorithm uses particles. The swarm algorithm dynamically determines the parameters, so the search accuracy of this algorithm is slightly worse than the particle swarm AC hybrid algorithm, but the solution time is faster. By comprehensively comparing search accuracy and solving time, the algorithm in this paper is more reasonable for solving actual travel route planning problems.

5. Conclusion
This paper studies the basic principles of tourism planning, geographic information systems, and databases, and proposes the main technical aspects of building a tourism planning information database. It also discusses several spatial mathematical models commonly used in tourism planning, such as overlay analysis, buffer analysis, Method for establishing network analysis. At the same time, the idea of building a TPIS platform is also proposed, and the overall structure and main functions of the system are preliminarily designed. Then the visualization function of the TPIS is applied to the analysis of the source market, and the network model suitability model is introduced. The site selection of tourism facilities, network model and overlay model are applied to the route design, and space measurement is applied to the planning process such as environmental capacity to realize the quantification, modeling and informationization of the plan.

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