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The framework research of spatiotemporal navigation management for ecological tourism

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ABSTRACT

The contradiction between tourism development and ecological environment protection are prominent in natural scenic spot of the peak. In the peak of tourist season, a lot of scenic spots are in a state of overload reception The rapid increase of scenic tourist causes congestion, management and service quality drop, potential safety hazard are outstanding, a sharp increase in carbon dioxide emissions serious environmental damage. Therefore, in the development of tourism economy and ecological environment protection in the contradiction, the peak management is the most important problem. Spatiotemporal shunt navigation management model is proposed in this paper, and based on management entropy and information technology. This paper constructs platform for the integrated management mode to guide the balance distribution and orderly movement for tourists. So the scenic area can not only make full use of the carrying capacity of enlarging the scale of tourism to improve economic efficiency, and improve the management level, reduce the carbon footprint of the scenic spot, the guide of ecological tourism, but eliminate the safety hidden trouble and protect the ecological environment.

Key words: Spatiotemporal shunt navigation, Management entropy, Information technology, Ecological environment

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PROBLEM DESCRIPTION

Many national natural reserves (scenic area for short) have the common characteristics: the beautiful natural scenery, backward economic development and fragile natural ecological environment. The current tourism focuses on natural landscape which calls the ecological tourism. The formation of some of the tourist resources need to experience the long geological period, once destroyed, it will be hard to recover. In the development of tourism economy while protecting the natural ecological environment, is the inevitable choice for the sustainable development of scenic spots. But the two have a paradox: if the tourism resources is developed disorderly and management method is traditional, easily lead to carbon emissions and other pollutants increase, cause damage to the ecological environment, ecological environment destruction and inevitably restricts the development of tourism economy, form a vicious circle; If you set apart hills for forestry, excessive protection will hurt more and more vigorous public travel demand and restricts the development of tourism economy. The movement mechanism and relationship of the carbon environment and ecological environment is shown in fig. 1：

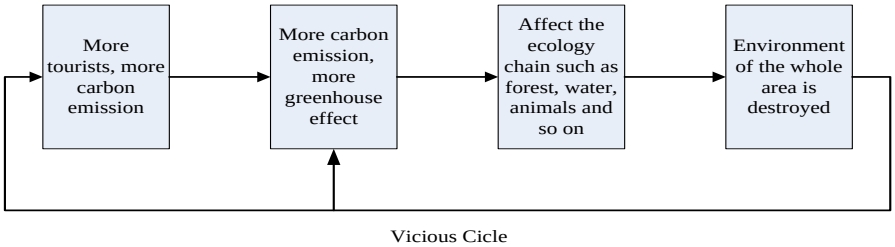

Fig.1 The movement mechanism and relationship of ecological environment

Scenic areas cannot sacrifice the ecological environment for economic development, also does not give up economic development in order to protect the ecological environment, in front of the two big choices, must make a research for the relative balance between the path of development, technology and management mode, in the economic development and ecological protection study out a harmonious coexistence between the sustainable development of "low-carbon scenic area integrated management model". Low-carbon scenic area refers to the scenic spots in the process of running through a variety of technical and management means to greatly improve the level of the scenic area energy saving and environmental protection, improve forest vegetation coverage, reduce carbon emissions of the scenic spot, carbon sequestration ability to enhance tourist area. Construction of low carbon scenic area is the development of environmentally friendly green tourism on the basis of energy consumption and low pollution. And low-carbon scenic area integrated management mode is to point to by complexity science, information technology, space-time distribution navigation management technology, ecological environment protection monitoring technique, the scenic landscape and traffic engineering methods, integration and system innovation in the development of the scenic area tourist behavior trace environmental protection norms, tracks the traceability management, greatly saving energy and reducing consumption, reduce carbon emissions (or is to improve the unit carbon productivity), to protect and improve the area of forest vegetation at the same time, improve the ability of carbon sequestration management mode. It includes the implementation of low carbon scenic area management thinking, management theory, the structure of the management system and management technology and method of integration, etc.

INTRODUCTION

Hence we try to design a new universal architecture of the resources management information system with the idea of autonomic computing. It is possessed of stronger applicability and generality, improved service quality with intelligence, can be applied with most kinds of managerial functions in parks, regions, provinces, even nation coverage.

The British government in its energy white paper ‘Our energy future - creating a low carbon economy’ in 2003 proposed ‘low carbon economy’, pointed out that the low carbon economy is through the less natural resources consumption and less environmental pollution, more economic output; Low carbon economy is to create a higher standard of living and the way to a better quality of life and opportunities, for the development, application and output advanced technology created opportunities, but also can create new business opportunities and more chances of employment. Derivative with low carbon economy concept, low carbon economic development model is established, the scholars have launched the research of low carbon economy. Foreign scholars concentrated on the study early [1] and had obtained the comparatively abundant research results. The initial research mainly concentrated in a small number of industries, such as transportation industry, cement industry, etc. The researches draw a conclusion that the transportation industry are the biggest businesses in carbon emissions industry in members of the organization for economic co-operation and development countries [2], and cement industry is a major industry for greenhouse gas emissions[3]. On this basis, more focus on the research on national and global carbon emissions, etc., such as Britain, Germany, respectively, by the middle of this century to achieve emissions of carbon dioxide and other greenhouse gases by 80% on the basis of the discussion of possibility 1990 [4] [5]; The United States, Turkey's energy consumption, the study of causal relationship between GDP and carbon emissions [6][7]; Global GDP, quantitative analysis of the relationship between energy consumption and carbon emissions [8]; Describe the Japanese city scale method of low carbon economy long-term development situation of Shiga [9]; On the impact of population structure on U.S. and global carbon emissions determined [10][11]; The United States exports and per capita carbon emissions to explore the relationship between [12]; Different parts of the temperature time series analysis and prediction [13]; In the process of transition to a low-carbon future strategies adopted by the article [14].

With scenic environment deteriorating, the ecological damage problem is more and more highlights in tourism development. Many scholars pay close attention to ecological tourism, the research focuses on ecological tourism, ecological tourism and environmental pollution, etc. Such as the research thought to develop ecological tourism is a nature reserve, the inevitable choice of tourism resources reasonable development and effective utilization of [15], and points out that in the process of ecological tourism, such as visitors, scenic areas within the service unit behavior, cause water pollution, solid waste pollution, noise pollution, vegetation destruction, and species reduction environment problems [16], based on this, addressed tourism ecological compensation has become a hot spot, its meaning, interests subject, standards, and channels and mechanisms of is the core content, etc.

Through the analysis of the above literature, we can find that low carbon ecological tourism lack of organic related and integrated among low carbon economy, low carbon tourism, eco-tourism aspects, and there is no unity understanding of low-carbon eco-tourism concept. Geared to the needs of the advent and development of the era of low-carbon economy, this paper argues that the low carbon ecological tourism should merge together the core idea

of energy saving and emission reduction and the activities based on the nature, should not only reflect the protection of the natural landscape development, and to reflect the response to the measures to reduce carbon emissions for climate warming, some combination. Namely in under the background of low-carbon economy, it is necessary to develop low carbon ecological tourism, and use the concept of low carbon economy, advocate in the process of development and utilization of natural landscape, with low energy consumption, low pollution of new tourism mode and management concept. Promoting the low-carbon ecological tourism way, reduce travel process and carbon emissions in the process of management of scenic spots, tourist scenic spot of low carbonization development is the trend of the current and future. But, the research above, from the view that combines low carbon environmental protection and sustainable development theory and open complex giant system comprehensive integration of modern information management, does not make study for the scenic complex giant system of social economic system and environmental ecological system of organic and integrated research. Although a lot of literature concerned with the problem of the bearing capacity of the scenic area, but the most study pay attention on static, little on dynamic, some scholars put forward the idea of intelligent transportation system, but there is no feasible solutions and ideas.

From the study above we can see that, little researches involve how to develop economy at the same time, protect the ecological environment, and no study relates to the peak tourists and ecological environment of low carbon and harmonious sustainable development of the complexity of the integrated scientific management mode research, to solve the decision, control and management of the peak season in a state of disorder and carbon emissions increased rapidly. Clearly, this state contradiction between economic development and ecological environment protection, hampering system harmonious sustainable development of scenic spots, on the basis of a vicious circle will eventually make the scenic area, the ecological environment and tourist economy may be irreversible damage.

This article applies the research method of complexity science, the information technology and other multi-disciplinary comprehensive integration, and regards the scenic areas as open complex giant system which is organic composed by the social, economic, and ecological environment, innovate for the sustainable development of tourism and ecological environment harmonious low carbon integrated management model research of scenic spots, especially in the peak of tourists, harmony of ecological environment and management and control of the sustainable development etc., we make a further research.

THE RESEARCH FRAMEWORK OF INTEGRATED THEORY BASED ON MANAGEMENT ENTROPY AND INFORMATION TECHNOLOGY

In this paper, based on the low carbon area social, economic and natural ecological environment organic composition of the research on the basis of open complex giant system, through large-scale field survey and data mining, the use of 3S, 3G and the RFID (Radio Frequency Identification) information Technology, through the peak of tourist flow and distribution of Spatiotemporal shunt Navigation Management Technology (STSNMT) and system research of the protection of environmental monitoring management information Technology, solving structural deficiencies, big security hidden danger and the ecological environment destruction, which caused by the shortage of carrying capacity of scenic spot in peak of tourists. On the basis of balancing distribution of tourists and orderly movement, the scenic area can not only make full use of the carrying capacity of enlarging the scale of tourism to improve economic efficiency, and to improve the management level, reduce the carbon footprint of the scenic spot, guide the ecological tourism, and eliminate the safety hidden trouble and protect the ecological environment.

Spatiotemporal shunt navigation management theory model based on management entropy and information technology

The so-called Spatiotemporal Navigation based tourists' management means the system design several optimization tour routines according to the relative space locality and time dynamical as well as the RFID monitoring information and the space-time conditions of the scenic spots. The routines can help distribute the tourists with the elapse of time and make the tourists be balanced among different spots and the exchange between around spots is highly ordered. So we can solve the problems such as crowed tourists in the peak time and the speed destruction of the ecological environment.

Its theoretical basis is according to the space is relatively static and dynamic of time, make the same principle of space with different time distribution of stream of tourists, in the scenic area and the attractions of the cluster, under a certain space-time condition, monitoring and controlling of the information technology condition, through mathematical reasoning, we design several optimization of tour routes, using time moving form relatively 'empty' space, to tourists and scenic spot vehicles relative equilibrium distribution and orderly movement of decision-making, planning, scheduling, navigation, through a large number of tourists evidences of actions effective guidance, monitoring, and scientific management, make the scenic spot vehicles run efficiently, energy conservation and emissions, so that the scenic area management entropy minimization, ordering, reducing carbon dioxide

emissions, and thus realizes the natural ecological environment and tourist economy and the sustainable development of scenic area community harmony. The theoretical model is as follows:

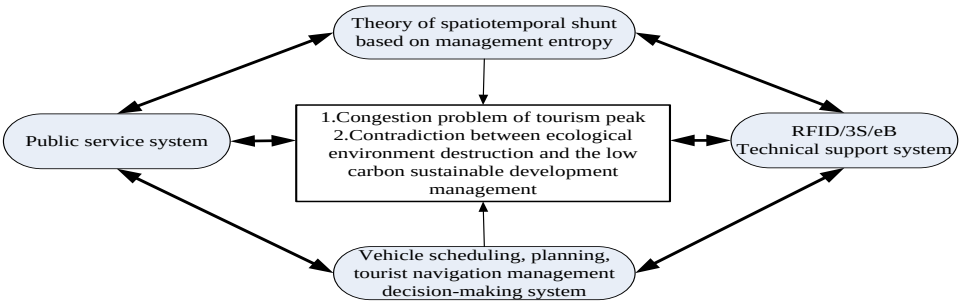

Fig.2 The theory model of spatiotemporal shunt navigation management

Optimal Hamilton loop model of spatiotemporal shunt navigation management

In order to solve the problem of path optimization of the scenic spot system and tourist balanced distribution, we transformed traveling salesman problem into Hamilton loop problem, and transformed the multiple traveling salesman problem into a single traveling salesman problem, and proposed the general mathematical model and accurate solution method. On the basis above, we constructed the optimal visit navigation path and balanced distribution management, and under the support of management theory and satellite information integrated technology (3S), RFID, e-B technology, to achieve spatiotemporal shunt navigation management for the tourists and vehicle etc. In order to achieve the goals that minimizes the value of management entropy, highest the order degree of the system and the sustainable development of the scenic area. First, this method can eliminate congestion and safety concerns. Second, it can make full use of the bearing capacity of the scenic area, expanding the tourism scale and bring more economic benefits. Three, under the condition of a large number of tourists behavior controlled ordering, protect the ecological environment effectively. Mathematical model is as follows:

$$\min F = \sum_{i=1}^{n}\sum_{j=1}^{n} C_{ij} X_{ij}$$

$$\sum_{i=1}^{n} X_{ij} = 1, \forall j$$

$$\sum_{i=1}^{n} X_{ij} = 1, \forall i$$

$$X_{ij} + X_{ji} \le 1, (i \ne j)$$

$$X_{i_1 i_2} + X_{i_2 i_3} + \cdots + X_{i_{n-1} i_1} \le n-2, (i_1 \ne i_2, i_2 \ne i_3, \cdots, i_{n-1} \ne i_1)$$

$$X_{ij} = \{ \begin{matrix} 0 \\ 1 \end{matrix}, i, j = 1,2,\cdots,n$$

The Simulation Model of Spatiotemporal Shunt Navigation Management

The focus of this management is distribution of the tourists among spots in the scenic region and examination of overloaded spots. Then we can set up mathematical model aiming at balanced load distribution among different spots and complete tasks schedules with dynamic prediction of the load of every spots. Therefore, we can eliminate the overload condition of every spot in one hour field and get the whole region's load balancing. Under this mode, we can guide several tourists to travel A routine firstly while the others B routine firstly with the help of RFID information monitoring and tourists dispatching. And then exchange the routines with each other in order to distribute the tourists to different spots in time dimension and space dimension. As follows are the mathematical model used to solve the problem.

i) Problems

The tourists in the scenic region in different time period will form some kind of distribution. If the time period be reduced to a point, the spatial distribution remains. Ideally, if the load of every spot is balanced in any time t, we can think the load of every spot is balanced in the whole period composed of several continuing time point t. Therefore,

our main problem is set up the model that makes the load of all the spots be balanced in any time point t.

ii) Suggestion

The model is based on the suggestions as follows:
The capacity of every spots and the ways around these spots are large enough;
The capacity of the other resources such as travelling bus and resting place are large enough;
The travelling time of every tourist in the same spot is same.

iii) Parameters

In this model we use the parameters as follows:
A-Assembly of the scenic spots;
B-Assembly of the tourists;
C-Assembly of the vehicles;
n-Number of the scenic spots;

c_j-Capacity of the scenic spot j;

xj-Capacity of passengers accommodated by spot j;

t_j-Staying time in the scenic spot j;

s_{jh}-Distance between spot j and spot h;

l_{kh}-Distance between the dispatching vehicle k and spot h;

p_{jh}-The probability that tourist will choose spot h in spot j;

r_{ij}-The probability that tourist i will take travelling bus in spot j;

t_{ij}-The entering time into the scenic spot j of tourist I;

v-Speed of vehicles.

iv) Variables:

In time t, we define the variables as follows:

$$x_{ij} = \begin{cases} 1, \textit{tourist i at spot } j \\ 0, no \end{cases}$$

$$y_{kjh} = \begin{cases} 1, \textit{vehicle k take tourists in spot } j \textit{ spot h} \\ 0, no \end{cases}$$

$$q_{ij} = \begin{cases} 1, \textit{tourist i complete travelling in spot } j \\ 0, no \end{cases}$$

v) Mathematical Model:

$$z = \min \frac{1}{n-1} \sum_{j \in A} (R_j - \bar{R})^2 \qquad (1)$$

$$\bar{R} = \frac{1}{n} \sum_{j \in A} R_j \qquad (2)$$

$$R_j = \frac{\sum_{i \in B} x_{ij}}{c_j} (0 \le R_j \le 1; j = 1, 2, ..., n) \qquad (3)$$

$$\sum_{j \in A} \sum_{h \in A} y_{kjh} \le 1 \qquad (h \ne j) \qquad (4)$$

$$0 \le p_{jh} \le 1 \qquad (5)$$

$$0 \le r_{ij} \le 1 \qquad (6)$$

Equation 1 presents minimizing the variance of the load of different scenic spots to act as the goal function. Equation 2 presents the average load of all the spots. Equation 3 presents the load of spot j. Equation 4 presents one

vehicle can only take one way in some certain schedule. Equation 5 and Equation 6 present the probability of tourists' choice. In fact, for the variation of x_{ij} and the scale of the variations' value, this model cannot be solved use precise algorithm. So we transform the question into find the best schedule plan as balancing as most at any time point.

Construction of the platform based on management entropy and information technology

In the management entropy theory, RFID, satellite information system(GPS, RS/GIS) and the support of environmental monitoring technology, monitoring the scale of the tourists, tourists behavior character, natural ecological environment and collecting and analyzing data for offering supports to the scientific use of resources, improve the efficiency of decision making and management, spatiotemporal separation of shunt (Stsnmts) for scenic spot planning, scheduling, control and management to provide technical support for energy conservation and emissions reduction. System built into the base layer, application system layer and management decision-making. Implementation of atmospheric environment, forest, grassland and wetland ecological system of data collection, monitoring and management, and analysis of the tourist crowds, vehicle distribution scheduling and decision support. System as below:

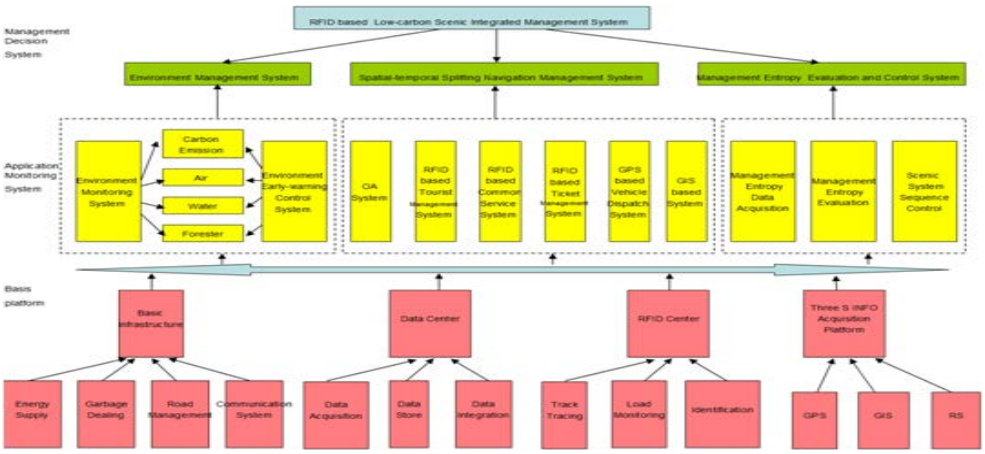

Fig.3 Application Architecture of the RFID based Scenic Management System

CONCLUSION

In many famous scenic places, the development of economy is usually at the cost of destroying of the environment. To avoid the developing way like this, we propose spatiotemporal shunt navigation management model. In this paper, we present the detail process of constructing the framework. We try our best to protect the environment and at the same time make full use of the carrying capacity of the scenic area to improve the development of the economy as possible. The purpose of the paper is to explore a new management mode to contribute the sustainable development of the scenic area and ease the contradiction between ecological environment destruction and scenic economic development.

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