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Research Article

Based on GIS Technology of Urban Gardening and Greening Layout Optimization Model

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Abstract: With the accelerated process of urbanization, city environment problems are highlighted, city landscape and city modernization phase matching. However, the urban gardening and greening is difficult to optimize the layout, with the new city landscape green area increased every year, which will make the City Landscaping Administration difficulty. In this study, detailed analysis of GIS technology development trend as well as in the city green space applications, which is supported by GIS technology, integrated distribution of population, manpower, material resources and financial resources, city greening planning design, construction, transportation cost and the maintenance management and other comprehensive factors, application technology based on GIS mesh accessibility calculation method, exploring the construction of urban gardening and greening layout optimization model of city landscape green space, spatial distribution characteristics and verify the layout optimization model is feasible and practical, in order to strengthen the city landscaping work play a role.

Keywords: GIS, grid division, optimization model, urban gardening and greening

INTRODUCTION

Development trend of GIS technology: The information age makes use of the scientific management of information resources. It requires a high degree of the modernization of geography, both for territorial regulation, river basin development and providing the decision information (Haala *et al*., 1998; Jing and Wensheng, 2010), but also for geological work to provide microscopic aided design specific data. Therefore, the geographical information collection, management and analysis, put forward higher request, this is the geographic information system the inevitable historical background. Geographic Information System Based on the map, which is a kind of acquisition, processing, analysis, representation and in different system, different locations and different transmission between users of digital spatial data of the computer application system (Yeh and Li, 2003). Geographic information system is mainly composed of four parts, namely, computer hardware, computer software system, geographic spatial database and management system.

GIS technology is flexibility and intelligence, the DPS, GPS, RS and GIS has become important data sources, to ensure the timely of GIS database (Zhou and Zhang, 2004; Rudenko *et al*., 2012). Es combined with GIS can imitate the expert reasoning logical, intelligent analysis and use of geographical information, form can find knowledge, establishing knowledge base of intelligent. GIS consisting of components, the GIS's major function module is divided into several controls, each control to complete different functions (Batty *et al*., 1997). All between GIS controls and a GIS control and other non between GIS controls, can be conveniently by the visual development tools are integrated to form the final GIS application of component technology in software development is long behind the hardware development problems and put forward solutions, it has fundamentally changed the traditional software development ideas, build a by multiple independent software components, components of coordinated working system, realize the software reuse and robust update, is software industry along the direction of the major trend of the development of the society (Luo and Wang, 2003; Romero, 2004). Open GIS is to make different geographic information system have good interoperability, as well as in heterogeneous distributed database to realize the information sharing way, it needs to incorporate GIS technology, distributed processing technology, object oriented method, the database design and the real time information acquisition method more effectively combine (Harvey, 2000). GIS standard is defined in the GIS project from first to last to follow a series of norms and standards, from data classification explanation and definition to encode data, from data acquisition to data exchange, from the engineering construction technology process to GIS results and so must have unified regulation.

GIS application in the urban gardening and greening planning: Urban gardening and greening is a measure of city comprehensive quality (Sheen, 2005). Therefore, city green land survey data and the accuracy of analysis are methods of scientific essential. Along with the Geographical Information System rapidly development, it has become a simple and effective use of and access to city greening data essential tools. GIS basic functions can be summarized as follows:

- Synthesis, storage and management of geographic information
- Accords to specific application need to display geographic information
- Query, retrieval and analysis of geographic information (Riesman Van Eck, 1999)

Under the support of GIS remote sensing technology makes the city greening research both in theory and in the method has a great development. GIS combined with RS, is information spatial analysis integration, integration trend. In addition, access to the city green land cover information and other information such as population statistics can be combined for analysis and evaluation of city green space distribution, can derive other valuable results, such as green space distribution rationality, for the reasonable city green space planning to provide decision support. To sum up, the GIS as an integrated science, its system more and more complete, its research content relating to the military, land, planning, traffic, post and telecommunications, electricity, environmental protection, agriculture, forestry, geology and other aspects.

Urban gardening and greening layout optimization problems: At present, the city changes a course accelerate, city land shortage, how in the limited land resources, to the city green space planning, optimization of the spatial layout of the city green space, green space and better play its ecological benefits and the use of function, it is a problem. Seek truth from facts to a comprehensive understanding of the current situation of city landscape green space attribute, is the scientific establishment of city green space system planning based on. Our country's original city green land survey and data collection, analysis by means of high intensity, cycle is long, already can't adapt to the needs of the rapid development of city. Therefore, in order to use the limited land resource, realize the reasonable layout of city green areas, optimizing spatial structure of green space, make the city green space effectively play its ecological benefit and function should use new technology, new method, rapid access to timely, accurate, high quality of the city green space planning information.

GIS MESH ACCESSIBILITY ANALYSIS

Urban garden green space accessibility calculation:

- Accessibility calculation with 3 factors:
- Transportation cost, generally with two traffic time or distance as calculated on the basis of traffic
- Endpoint location attraction, to provide some accessibility service ability
- Endpoint location demand refers to accessibility service requirements J

We think, influence of city public green space accessibility factors are: the city traffic network, city land utilization situation, city population density distribution, landscape quality itself, residents of habits and psychology, which a few factors and accessibility calculation of closely related. Its service effect is higher, accessibility is higher, if the population density of the area, landscape and the area residents to obtain green landscape must overcome more traffic cost of acquiring other areas of green space landscape services. Following each grid accessibility calculation formula:

$$A_i = \sum_{j=1}^{n} P_i M_j \Big/ \sum_{j=1}^{n} P_i C_{ij}$$

A_i = i grid on all public green landscape accessibility
P_i = i grid of population density
M_j = j piece of green land landscape service force, M_j for the green space landscape area
C_{ij} = i grid to j piece of public green landscape of minimum traffic cost

Urban garden green grid elements calculation: City road network density is a measure of a city road traffic integral development of the important indicators. City gardens greenbelt each mesh shall be determined by the following equation:

$$D_i = \frac{\sum_{j=1}^{n} f_j L_j}{area(G_i)}$$

m = Grid type, L_j said fell on the grid in class the length of j the road,
f_j = The j influence factor.
D_i = Grid road density, area(G_i) says the area of the grid, Due to the mesh equal area.

So simplified formula for: $D_i = \Sigma^n_{j=1} f_j L_J$, C_i, Says each grid bearing capacity: $C_i = [\mathrm{Norm}(D_i)]^{-\lambda}$, Between two adjacent grid traffic cost for two grid all points between the average of the transportation costs. Grid 1 and 2 adjacent grid, the grid 1 to grid 2 transportation cost: $(C_1+C_2)/2$, the grid mesh 1 to 3 traffic cost for: $(C_1=C_3)\sqrt{2}/2$.

Since each grid conveys different, how to calculate any grid to another grid overcome space resistance minimum value is the key to the problem. Figure 1 by the grid is a center of adjacent weight meshing.

Urban landscape green space landscape design accessibility calculation: The spatial distribution of population is the green landscape accessibility

Table 1: The classification of residential elements

Factor and weight	Score	91-100	71-90	51-70	31-50	0-30
	Evaluation and classification	Actor	Good	Can be	Difference	Inferior
	Residential density	0.26-0.35	0.21-0.25	0.16-0.20	0.11-0.15	<0.1
	Residential area	>0.2	0.15-0.20	0.10-0.15	0.05-0.10	<0.05
	Living level	>10.0	10.0-6.0	6.0-5.00	5.0-4.04	<4.0

Table 2: City point attribute and information classification coding model

Code	1	2	3	4	5	6
Class	Class	Population (10^4)	GNP (100 million)	Area (km^2)	Income	Consumption
1	National level	>1000	>1000	>100000	>50000	>30000
2	Provincial	100-1000	100-1000	1000-10000	25000-50000	15000-30000
3	County-level	10-100	10-100	100-1000	10000-25000	8000-15000
4	Town class	1-10	1-10	10-100	5000-10000	5000-8000
5	The township	<1	<10	<10	<5000	<5000

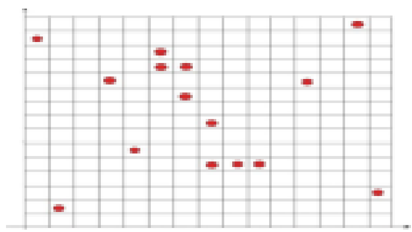

Fig. 1: Grid center network division

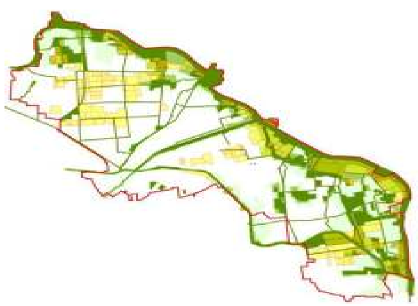

Fig. 2: The urban landscape green space layout accessibility spatial distribution

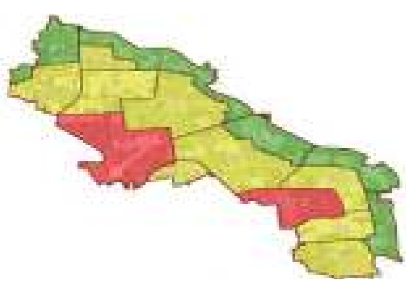

Fig. 3: Urban landscape green space layout optimization model output results

calculation of important factors, average assigned to each grid, can be roughly as population spatial distribution of calculation basis, a green space landscape area will cover multiple grid, the grid was covered in one's field direction +1 expansion operation, get map shadow grid, because public green space landscape is either open or, in the east, south, west and north all directions have entrance, do not need to consider to the direction of the path. From any other local governments according to the principle of minimum transportation costs to a shadow Yin grid, then as arrived in the green space landscape.

URBAN GARDENING AND GREENING SPACE LAYOUT OPTIMIZATION MODELS

Urban landscape green space layout accessibility calculation: The study district is Xi Gang of Da Lian as an example to establish urban landscape green space layout optimization model. According to the above method, using the Arclnfo secondary development tools of the urban landscape green space landscape accessibility calculation procedure, Table 1 and 2 as parameters, calculate each grid of public green space landscape accessibility index. And the calculated results were divided into five grades; finally draw the green space landscape accessibility index of the spatial distribution, as shown in Fig. 2.

And the calculated results were divided into five grades; finally draw the green space landscape accessibility index of the spatial distribution, as shown in Fig. 3. Xi Gang district population density, traffic density is big, the central region of the accessibility index generally high, has the very strong green space landscape space attraction, the south of regional accessibility index grade V or IV level, but west, north of the area traffic density is small, the density of population is small, away from the central area gradually far, therefore, accessibility index decreases gradually from the south to the north.

Urban landscape green space layout optimization models: In Super Map Desktop 2003 software rendering these entities should pay attention to when a data set named to have representative meaning, in case of late data set causes too much confusion. For every evaluation factor are divided into different categories of indicators. Therefore each evaluation factor are corresponding to a set of attributes v_i, $v_i = [v_{i1}, v_{i2}, L, v_{ij}]$ i = 1, 2, L, m, type of i is influence factor:

$$T = \{(x_1, y_1), \ldots, (x_k, y_k)\} \in (X \times Y)^k$$
$$x_i \in X = R^n, y_i \in Y = R \ , i = 1, 2 \ldots, k \ ,$$

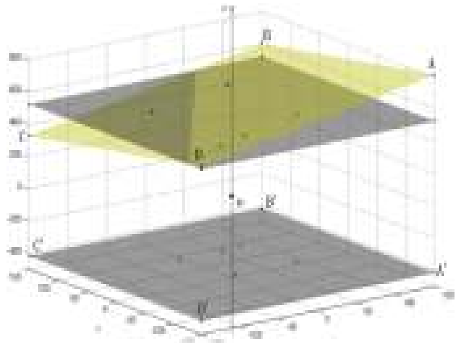

Fig. 4: Optimization model space attribute data coupling

Fig. 5: Urban landscape green space layout optimization status chart

$$\left|y-f(x)\right|\xi=\max\left\{0,\left|y-f(x)\right|-\xi\right\}$$

$$\min J=\frac{1}{2}w^{T}w+C\sum_{i=1}^{n}\left(\xi_i+\xi\right)$$

$$s.t\begin{cases} y_i-w^{T}\varphi(x_i)-b\le \xi_i+\xi \\ w^{T}\varphi(x_i)+b-y_i\le \xi_i^{*}+\xi \\ \xi_i^{*},\xi_i\ge 0 \end{cases}$$

$$\max W\left(a_i,a_i^{*}\right)=-\frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n}\left(a_i-a_i^{*}\right)\left(a_j-a_j^{*}\right)<\varphi(x_i),$$

$$\varphi(x_j)>-\xi\sum_{i=1}^{n}\left(a_i+a_i^{*}\right)+\sum_{i=1}^{n}y_i\left(a_i-a_i^{*}\right)$$

In the composite structure of space database cases, with space position data using file management mode, the application can directly access the operating system file storage, able to quickly input and output space database and attribute database to realize the seamless combination. Application of ArcGIS realize attribute combination to establish urban landscape green space layout optimization model, by adjusting the attribute complete optimization configuration, as shown in Fig. 4.

Layout optimization model validation: The feasibility of the optimization model and practical need to adjust attribute parameter realization, suppose that each new urbanization grid contains a factor, can determine the different period land consumption, thus also identified the different period the number of levels, here a factor just reflects the proportional relation and not only represent a person or a family, on behalf of the average number of grid to accommodate. By using the model scale formation model required attribute hierarchical, because staggered distribution characteristics, this area distribution should be in the model after data generation shall be according to the regional scale make appropriate adjustment, the adjustment should ensure that the same total amount, the area of sampling survey.

URBAN LANDSCAPE GREEN SPACE LAYOUT OPTIMIZATION RESULTS

Urban landscape green space optimization status: According to the urban landscape green space optimization model output attribute data in GIS software support, through the geometric correction and image splicing, establish the research area of the digital image map and then to different types of green space remote sensing interpretation and establish green space system database, each green space types order number, perimeter, area, types and four elements. The last generation throughout the study the urban landscape green space layout optimization status chart, as shown in Fig. 5.

Urban landscape green space quantity optimization results: The per capita public green area, urban green coverage rate and urban green space index of 2D. Although these index in the evaluation of different urban greening levels comparable, but in the evaluation of different plant species and the spatial structure of green space's function, especially in the system analysis landscape comprehensive benefits, it is hard to accurately measure. It is because of green space internal structure and spatial distribution of the importance, need to use GIS this kind of information technology measure green space system important 3D index. Relative to the two-dimensional index speaking, three dimensional can better reflect the urban greening space structure differences. The application of GIS technology, through the color red piece of interpretation and determination of tree species, covering area, number, structure type and characteristic data and plane quantity, according to the measured sample plant crown height, crown diameter, crown next high data, it is concluded that regression model and then calculate the quantity of green. And with the help of green plant's environmental benefits typical test value, the green space system layout optimization.

Urban landscape green space layout optimization of comprehensive benefit evaluation: Urban green space comprehensive benefit evaluation quantified involved in ecological, social, economic and so on many aspects and various disciplines, its influence factor, spatial relation complex, a large quantity of data and various types, the traditional artificial mathematical statistics methods are not suitable for. And GIS technology has the acquisition, management, analysis and output a variety of geographic space information ability, has the spatial and dynamic, regional air q analysis, many factors comprehensive analysis and dynamic prediction ability, plus its powerful spatial data management function, can produce high level of useful information, complete artificial difficult to complete tasks. According to relevant data, the GIS technology is mainly used in urban green space system planning of suitability evaluation, urban green space landscape pattern analysis, urban green space landscape planning, etc.

CONCLUSION

The geographic model analysis method, timely offers a variety of space and dynamic geographic information and the green space present situation accurately and objectively analysis. Through the acquisition of intuitive green space analysis, in view of the green space system planning and analyzes the existing problems, this study discusses the solutions. For this kind of information technology in the present situation of the application of the green space analysis, can obtain the general analysis method have no data integrated, simulation and analysis evaluation ability, can get conventional method or general information system is difficult to get the important information, realizing the geographical space evolution process of simulation and forecast. Using GIS component technology, the establishment of the urban landscaping layout optimization model, realize the green space information management query, update and urban landscape green space index calculations, etc. Whether sufficient data storage, processing and material information space analysis, statistical analysis, path analysis, etc. Various kinds of analysis, or green space planning information database construction and management information system development, the application of GIS technology throughout the urban green space system planning process, is the urban green space management good helper. Although at present specific application is not much is not perfect, but its application prospect will be comprehensive.

Application of GIS to establish urban landscape green space layout optimization model, in the past to get rid of the planning process of the common defects, such as information collection does not reach the designated position, many important information and not sexual, etc. In addition, the green space system planning also need space information and its analysis results support, the green space system planning can provide scientific accurate basic data and project the analysis and thus draws the more convincing plan. At the same time, the technology is applied to the green management field, can better for urban greening services, improving the green space construction and management of the information level, for future green space construction planning to provide visual support tools.

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