Research on Continuous Path Guidance Method Based on the City Point of Interest

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Abstract. For existing path algorithms cannot achieve more continuous search, we propose the ASSA algorithms to let the travellers access to multiple points of interest in a trip. The ASSA algorithm has optimized the network structure, greatly reducing the amount of data access, and through temporal reasoning based on point of interest associated with regional to get the best travel route. The city POI data are classified based on the information and designed more than a point of interest rules under the access mechanism and its experimental verification. The results showed that: ASSA algorithm can improve computing performance by more than 16% and to avoid the emergence of non-optimal path compared to NS nearest algorithm and it can effectively meet the different points of interest rules under the access needs of travellers.

Introduction

With the constant improvement of GIS geographic information, navigation path has got more and more attention and application. The information of interest has greatly improved easy for people to travel, before traveling to the shortest path to planned destination. In a trip, for example, travelers often need first multiple locations of restaurants, banks, shopping malls, and finally arrive at their destination. However, most of the existing algorithms in order to induce a single point of interest for inducing target, ignoring the actual trips stopover traveler needs, you cannot achieve a continuous path planning multiple points of interest [1].

In recent years, some scholars consecutive trip planning questions related to the proposed approximate query algorithm, NS optimal path algorithm orderly Sharifzadeh as proposed by Lee put forward the Nearest Neighbor algorithm, Terrovitis etc. proposed a shortest path planning and autonomy pause k shortest path planning methods, these algorithms is essentially a special case of the problem can be seen as a continuous multi-path planning point of interest, does not have a general. Chen et al described in the literature in a more orderly path query POI category problem, constrained by access points of interest sequentially, path query results obtained under different constraint rules, but its query POI data must be its internal data sets constitute topological relationship, and the proposed algorithm only data query mechanism failed to match the actual road network map. So how to effectively and quickly respond to user requests access to more points of interest and it is the basis for efficient route guidance service, but also the s route guidance points of interest in the field of research. In this paper, based on the awareness level of the city points of interest, their classification, and travel constraints based on different rules, proposed continuous nearest POI search method, designed to meet the needs of multi-access rule-bound travel under to enrich the existing path induction methods.

The definition and principal purpose of points of interest

Points of interest are based on the increase in urban characteristics of a class of basic sites is localized within the building have GI effects, including institutions (such as bureaus, hospitals, schools), street shops and units. The main purpose is to address the point of interest or events

described components, to a large extent, enhance component or event location description ability, to improve the accuracy and speed of geographic location [2].

The selection criteria of point of interest

Select a point of interest should be considered in the following five principles:

(1)Stable priority rule: the higher the stability of institutions or buildings as a point of interest in building new buildings for the preferred area points of interest, try not to choose the old buildings; courtyard cottage area to select a point and has been transformed lobes complete streets door as a point of interest; both sides of the street preference permanent building or a large door as a point of interest; unit preference government agencies, banks, hospitals, schools and so on.

(2)Load balancing principle: the distance between the points of interest will remain at about 30 m, the number of points of interest within the communities about the same to avoid uneven density.

(3)Symmetry principle: In the street boundary, border communities, should be symmetrical on both sides of the main road to select a point of interest, to avoid when describing parts or events across the street address selection, cross-community or cross the main road points of interest situation.

(4)Easy to find and visibility principles: choice can clearly see the house numbers and signs of a building or unit as a point of interest.

(5)Point and surface binding principles: Point of Interest choice should adhere to the point in the main surface to describe the point, such as Winton House, we can choose his four floor corner as a point of interest.

The category of city POI

City POI (Point of interest, POI) includes restaurants, shopping, travel and car service and other categories. These points of interest information have been widely used in geographic information services. POI information can not only help users quickly locate the desired location information, you can also use the navigation in certain rules of reasoning, get real-time location associated with the highest number of landmarks, thus achieving simple, flexible, and efficient route guidance service [3].

Raubal has put forward any elements in the city, as long as it's a higher awareness of the people, which can be seen as a well-known place. In this paper, the process of people's daily travel needs frequently visited locations as POI, and according to the literature, the definition of a basic selection of various types of POI categories.

Table 1 is defined in the 12 points of interest are classified as {Ci}, each Ci satisfies {POIs}∈Ci; in addition, because of the POI database appears redundant data, such as large shopping malls, buildings, or overlapping departments and units and so on, so should be removed before the data path computation list of redundant data, but at the same time to ensure that deleted data is not part of the user's query POI category in any one, so this set of data is stored in the form of a point of interest for {Category Name , Longitude, Latitude}, and by matching interest points Mapinfo7.0 achieve real road network.

The research and development of route guidance method

Route guidance system is to improve the urban transport situation is more direct, effective fastest way, is based on electronic, computer, network and communications of modern technology, the use of global positioning system (Global Position System, GPS), electronic traffic map (Electronic Map of traffic Network), computers and advanced communications squeeze technique, making on-board computer to automatically display vehicle location, transportation network map and road conditions. Also it is available according to the start and end point of travel to the user optimal route guidance instructions and a wealth of real-time traffic information, or to obtain real-time traffic information

to help drivers find a starting point to a destination from the optimal path. Its characteristics are the people, vehicles and road taken together.

Table 1: POI classification

Shopping places	Commercial import shops, department stores and large supermarkets
Hotels	Offers accommodation in hotels and star hotels
Vehicle service	Vehicle maintenance and fuel / gas / power plants, etc.
District-level government	Agencies or above national executive
Hospital	National / provincial general hospitals and specialized hospitals
Park	Parks and squares open to the public
Casual places	Sports stadiums, theaters and cinemas
Restaurants	Restaurants and hotels of various grades
School	Major, medium and small institutions and other
Transport	Hub stations, airports and ports, etc.
Large office	Buildings and commercial buildings
Famous landscape	Monuments and memorials

Therefore, the dynamic route guidance system can give full play to the role of information technology in many high-tech fusion of different disciplines, reflecting solve the traffic problems "smart" sex. Real-time optimal path selection system has features to find the optimal path from the current location to the destination via the urban traffic control center to provide information for the driver to reduce the residence time of the vehicle on the road, so that you can ease pressure on urban traffic and reduce urban traffic congestion, and ultimately achieve a reasonable distribution of traffic on the road network in the various sections. Moreover, the dynamic route guidance system can also bring tangible benefits to the driver, so the system has become a domestic hot ITS research and development [4].

Dynamic route guidance system has gone from a static to a dynamic route guidance system route guidance system in the process, the difference between the two is that the former uses a historical record database or GIS past traffic situation route guidance, which uses real-time traffic route guidance information. In general, the dynamic route guidance system consists of the following three parts:

(1)Traffic control center, the control center is the main center of dynamic route guidance system, the main function is to obtain real-time traffic information from a variety of sources of information, and further processed to produce traffic data to be published;

(2)Communication system, is responsible for data exchange vehicles and traffic control centers. The control center via the communication system continues to send to all vehicles travel time, traffic incidents and associated data, each vehicle can be sent back to the information control center information;

(3)Vehicle induce cell, the vehicle-mounted device mainly consists of inducing computer, communications equipment, and vehicle positioning equipment. Positioning device is for GPS receiver or other pointing device beacon signal receiver and speed, direction sensors. The module's function is to receive, store and process traffic information, providing a good user interface for the driver, the driver easily induced to enter information and access instructions. Induction of instruction is generally three ways: text, sound and graphical way.

The continuous point of interest query under different constraint rules

Nearest POI path search. In fact Interest path search is similar to the database object pruning and refining process recently. But unlike the traveling salesman problem, the algorithm does not need to traverse the existing points of interest on each map, but only point of interest is calculated in advance for a given user to access the desired category can be [5].

Suppose a small A current travel plans, she wanted to get to the station before, go to the bank to withdraw money, and then were to other shopping centers, gas stations and restaurants in four locations, then the travel route has the following two small A: ① starting point → Banks restaurants, shopping malls →station gas station. ② starting point → Banks → malls → restaurants →station

gas station. Users can customize their own travel accessible point of interest rules, such as restaurants → mall or shopping malls → restaurants, then the length of travel time under two different paths will become an important basis for decision-making aid travelers.

Continuous search algorithm based on ASSA's. In the nearest POI search path algorithm considers the end of the information set by the user, by calculating the shortest distance to the start and end point P of interest (such as formula (1) below), get (distance) to travel the path of least total cost, to avoid the emergence of non-shortest path which is shown in Figure 1: These individuals in the population are sorted based on non-domination, the fast non-dominated sorting algorithm is adopted as follows:

$$L_{OD} = Min_{i,j\in(1,n)}\left\{Dist(S,P_i)+Dist(P_i,P_j)+\cdots+Dist(P_{j,}D)\right\} \quad (1)$$

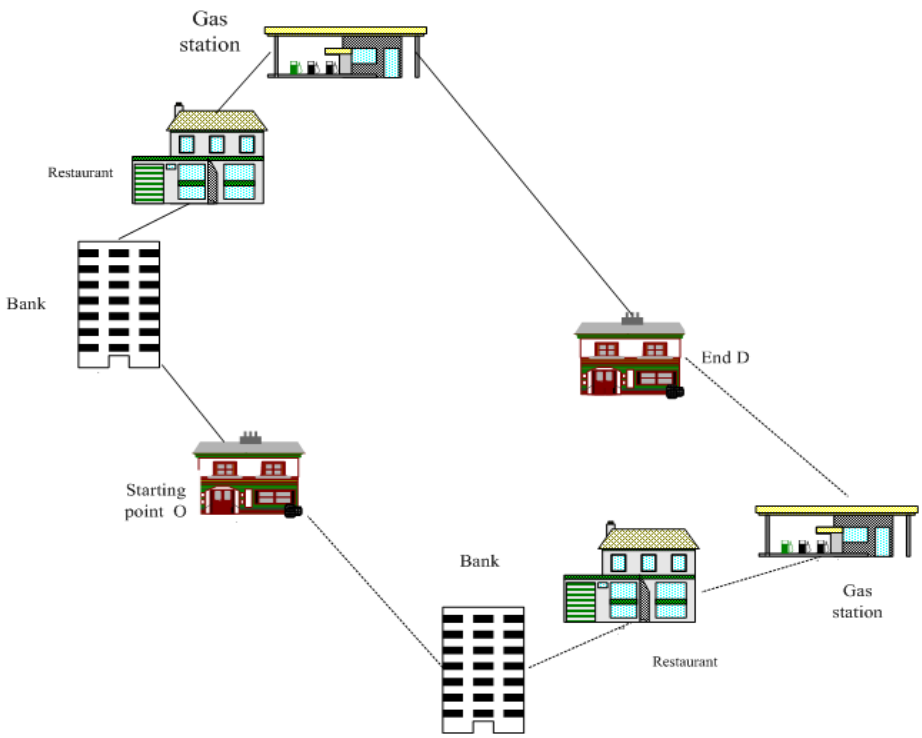

Fig.1: Comparison of travel routes under Bank-to Restaurant rule

The dashed line in Figure 3 is not considered representative of the travel path of travel when the end point D, the solid line is the travel route after considering D point. As can be seen, does not consider the case of the travel distance D is much larger than the latter [6].

Take the classical heuristics similar valuation methods set *(s, d)* for ASSA algorithm selected points of interest include p_i to p_j driving route between points of interest, so that *f (l) = ω (s, pi) + c (pi, d)*, where *ω (s, pi)* from the starting point for the right to reach a point of interest and value of p_i, *c* (p_i, *d)* as a point of interest pi cost function, it is predicted from p_i to the destination *d* price. *f (l)* determines whether the value of the points of interest can be first search.

In order to reduce road network search through the starting point O, the destination D and Euclidean distance between OD determine an ellipse, the focus of the ellipse is the O, D, so that the algorithm can effectively reduce the search. Using different forms of data storage format, algorithm execution performance will have a greater impact. In a large network, the table should be used to store data in the form and then traverse the efficiency is much higher than the storage form of adjacency matrix. In this paper, using a similar table in the form of Dijkstra for storing road network data and points of interest, namely the initial search point will be added to the s_v table, while L shortest path table is empty state. Points of interest set access rules for R and then the time complexity of the algorithm is the R^2.

Test Analysis

Test bed configuration is as follows: 2.8GHz dual-core processor, 2GB of memory, the operating system is Windows XP. Test road network selection Changchun actual road network, including a total of 3421 nodes and 5771 sections, shown in Figure 5. Stored in the form in which the nodes of {Node ID, Longtitude, Latitude} storage format, sections of {Edge ID, Strat Node ID, End Node ID}. Travel starting point data using a random number generator with uniform distribution. We use the Mapinfo7.0 + Mapx and Visual C ++ 6.0 programming algorithm to solve the questions.

CPC network layer contains 12 points of interest, this article only take hotels, buildings, vehicle service, banks, shopping malls, government, schools and leisure facilities totaling 8 points of interest in the main point of interest classification, each point of interest, such as the number of table Fig. By comparing the literature mentioned in the full range of the nearest neighbor algorithm (NS), respectively, in both analyzed under different travel constraints of the two algorithms performance computing time and search distance. NS algorithmdata traversal algorithm is more mature, a widely used data correlation search algorithm has higher practicability. For without loss of generality, travel rules for selecting a random occurrence between banks and buildings, shopping malls and car services (such as gas stations) and other points of interest in different categories. The Table 2 contains the different points of interest points of interest category [7].

Table 2: Number of POIs in different categorization

Hotels	381	Shopping	1075
Building	38	Government Office	483
Vehicle Service	407	School	407
Bank	547	Leisure venues	724

When the travel rule is constant, compared to NS full-search algorithm, the computation time is significantly better than ASSA algorithm NS algorithm, as shown in Figure 6. With increasing interest in base point, two algorithms have significantly increased computational time to NS algorithm, for example, when the number of points of interest for 3500, the calculation time when compared to the 500 points of interest increased more than three times; when increasing the travel constraints, ie user-defined access rules account for the entire increase in the proportion required to access POI category when seen though the algorithm and computation time NS ASSA algorithms have shown a linear increase, but the meter 634. To calculate time less than R / C = 0.333 at the scene, it is because, constraint rules increase, the space required for the algorithm searches through the data on the subsequent reduction, so the execution time of the algorithm is correspondingly shorter [8].

The purpose of the user to select the number of points of interest directly affects ASSA algorithm to calculate the time and route search distance. With increased access to POI categories, we can see the user's travel distance should increase, due to the algorithm needs to respond to this series of travel rules, so its path search distance and calculate the time both indexes were rising, but ASSA's computation time only 0.191s. Compared to NS algorithm, the efficiency ASSA algorithm is superior to its more than 16% [9].

Conclusions

In this paper we put forward A * consecutive search algorithm (ASSA) based on the information of points of interest in the city. The algorithm is able to quickly respond to users' requirements of multi-access interests and provide the shortest driving route. The experiment shows, ASSA algorithm runs much better than the NS-round nearest neighbor algorithm and it can avoid non-shortest path. However, due to the service concept for more information on the location of the point of interest is raised lately, the study of such algorithms is still in its infancy, factors to be considered are not comprehensive and the real-time performance to be further improved.

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