

TARGET LOCATION SEARCH METHOD AND APPARATUS

This application claims priority to the Chinese Patent Application No. 201610213235.8 filed on April 7, 2016 and titled “TARGET LOCATION SEARCH METHOD AND APPARATUS”, the entire content of which is incorporated herein by reference in the entirety.

Technical Field

This application relates to the field of search engine technologies, and in particular, to a target location search method and apparatus.

Background

The range of current location-based target searches (e.g., for businesses) typically use city as a dimension. However, this approach often leads to excessive or insufficient returned search results. If there are too many results returned by a search, for one aspect, the search results will have a large influence on system performance; for another aspect, excessive returned results may often include a considerable amount of contents not wanted by the user. Of course, if there are too few returned search results, contents needed by or of interest to the user may be left out, diminishing the user experience.

Therefore, how to precisely control the size of returned search result set in target location searches is a technical issue that urgently needs to be addressed.

Summary

The objective of the embodiments of this application is to provide a target location search method and apparatus, to precisely control the size of returned search result sets and improve the user experience.

To achieve this objective, for one aspect, the embodiments of this application provide a target location search method, comprising the following steps:

- determining a location designated by a target search request;
- determining a grid corresponding to the location in a pre-set gridded location area; and
- determining the grid's corresponding optimal search radius from pre-set correspondence relationships between grids and optimal search radiuses, and using the optimal search radius to perform a search for the target and obtain returned results.

For another aspect, the embodiments of this application also provide a target location search apparatus, comprising:

- a location determination module, configured to determine a location designated by a target search request;

- a grid determination module, configured to determine a grid corresponding to the location

in a pre-set gridded location area;

a search range determination module, configured to determine the grid's corresponding optimal search radius from pre-set correspondence relationships between grids and optimal search radiuses; and

a returned results acquisition module, configured to perform a search for the target using the optimal search radius and obtain returned results.

In the embodiments of this application, because popular locations are mapped in advance as a gridded location area based on historical search data, and the optimal search radius is calculated for each rectangular grid in the gridded location area, for each rectangular grid, the optimal search radius represents the optimal search radius for all the locations within the rectangular grid. Thus, because the correspondence relationships between popular locations and their optimal search radiuses are determined in advance, when a search for a given popular location is received, it is possible to quickly determine the optimal search radius for the popular location based on this correspondence relationship, such that ideal search results can be obtained when using this optimal search radius to perform searches. Therefore, the embodiments in this application effectively control the size of returned search result set, improve the user experience, and vastly improve search engine performances.

Brief Description of the Drawings

The accompanying drawings described here are used to provide a further understanding of the embodiments of this application. They constitute a part of the embodiments of this application, and do not constitute a limitation to the embodiments of this application. In the accompanying drawings:

FIG. 1 is a flow diagram of the target location search method of the embodiments of this application;

FIG. 2 is a diagram of the gridded location area in the target location search method of the embodiments of this application;

FIG. 3 is a diagram of the advance performance of a target search using an incrementally increasing radius, from the embodiments of this application;

FIG. 4 is a structural block diagram of the target location search apparatus of the embodiments of this application.

Detailed Description

In order to illustrate the objectives, technical schemes, and advantages of the embodiments of this application, in conjunction with embodiments and accompany drawings, a more detailed description of the embodiments of this application is given below. Here, the

illustrative embodiments of the embodiments of this application and their descriptions are used to explain the embodiments of this application, and do not constitute a limitation to the embodiments of this application.

In conjunction with the accompanying drawings, a more detailed description of some implementations of the embodiments of this application is given below.

As shown in FIG. 1, the target location search method in the embodiments of this application comprises the following steps:

Step S101, determining a location designated by a target search request.

In the embodiments of this application, the target search request can be initiated by a user based on a personal computer or mobile terminal (e.g., a smart phone or tablet).

For example, the target search request can be a business search request. Generally, the target search request will include a designated location.

In one embodiment of this application, the designated location may be specific latitude and longitude data. In another embodiment of this application, the designated location may be a location name or identifier (e.g., Beijing Subway Line 1 Xidan Station), then detailed latitude and longitude data can be acquired based on this location name or identifier.

Step S102, determining a grid corresponding to the location in a pre-set gridded location area.

In the embodiments of this application, the gridded location area can be obtained in advance in the following way:

1) Within a set area, determining latitude and longitude information specified by all target search requests received by a system within a set historical time range. For example, using an ODPS (Open Data Processing Service) system to acquire, while offline, the PV (page view) logs for all business searches in Beijing within the past 7 days, and tallying, from the 7 days of PV logs (i.e., historical search data), the designated latitude and longitude information for all business searches in Beijing during that period of time.

2) based on a Geohash algorithm, mapping the latitude and longitude information to the gridded location area with square grids of equal length and width.

In one embodiment of this application, as shown in FIG. 2, the latitude and longitude information of popular locations in a set area and designated in the target search requests received by a system within a set historical time range can be mapped to the gridded location area with square grids of equal length and width. By this way, the target search demands for most locations are satisfied with little system overhead. Here, the popular locations can be places with a high search volume. During implementation, popular locations can be

determined using a set threshold.

In another embodiment of this application, a map of a set area can be uniformly gridded according to set rules. But using this approach, storing the grids of unpopular locations will waste system resources such as storage space. Here, the unpopular locations can be places that have not been searched or that have a very low search volume. During implementation, unpopular locations can be determined using a set threshold.

Step S103, determining the grid's corresponding optimal search radius from pre-set correspondence relationships between grids and optimal search radiuses.

In the embodiments of this application, the optimal search radius is obtained in advance in the following way:

Respectively making the center point of each of the grids in the gridded location area as a center of a circle, and performing a target search using an incrementally increasing radius, to obtain a minimum search radius for the each grid corresponding to the returned results when reaching a pre-set returned number threshold; and using the minimum search radius as the grid's optimal search radius.

Using grid WX4G0 in FIG. 2 as an example, WX4G0 is the geohash code of a certain grid in a gridded location area. Using the center point of this grid as the origin, it is possible to perform a cyclic search using 100 meters, 200 meters, 300 meters, and the like incrementally increasing from small to large as the search radius (as shown in FIG. 3). Thus, it is possible to calculate the minimum search radius corresponding to the returned results when grid WX4G0 reaches a pre-set returned number threshold, and use the minimum search radius as the optimal search radius for this grid. In a similar fashion, it is possible to calculate the optimal search radius corresponding to the returned results when all of the geohash codes in FIG. 2 (i.e., all the grids in the gridded location area) reach the pre-set returned number threshold. Therefore, the embodiments of this application can obtain in advance the correspondence relationships between all grids within a set area and in a gridded location area and their optimal search radiuses, i.e., obtain data for which geohash codes are keys and optimal search radiuses are values, as shown in Table 1:

Table 1

key	value
WX4ER	500m
WX4G2	600m
WX4G32	700m
WX4EP	800m
WX4G0	900m
WX4G1	1000m
WX4DZ	400m
WX4FB	1200m
WX4FC	800m

In another embodiment of this application, it is possible to employ another mode (e.g., search radius going from large to small) to perform cyclic searches. However, with this approach, finding the optimal search radius may require a higher number of cyclic searches, and in terms of efficiency, generally it is not as good as the aforementioned incremental increase from small to large.

Step S104, using the optimal search radius to perform a search for the target and obtain returned results.

In the embodiments of this application, using an optimal search radius to perform a search means: using the designated location of the searched target as a center of a circle and using the searched target's optimal search radius as the search radius to perform a search.

Because the business sets within the optimal radius range of popular locations can change, after Step S104, another embodiment of this application can comprise the following steps:

determining whether a number of returned results is less than a pre-set lower limit of returned number; if the number of returned results is less than the lower limit of returned number, using a gradually expanding search radius for the searched target to perform the search, until the number of returned results reaches the lower limit of returned number, to improve the accuracy of returned results.

In addition, in another embodiment of this application, the pre-set gridded location area and the correspondence relationship between the grids in the pre-set gridded location area and their optimal search radiuses can be regularly updated (e.g., updated once a day or once a

week, etc.), to adapt to changes in target information near popular locations (e.g., changes in business such as shopping malls, supermarkets, and restaurants), thereby helping to improve the accuracy of returned results.

In the embodiments of this application, because popular locations are mapped in advance as a gridded location area based on historical search data, and optimal search radiuses are calculated for each rectangular grid in the gridded location area, for each rectangular grid, the optimal search radius represents the optimal search radius for all the locations within that rectangular grid. Thus, because the correspondence relationships between popular locations and their optimal search radiuses are determined in advance, when a search for a given popular location is received, it is possible to quickly determine the optimal search radius for the popular location based on this correspondence relationship. This makes it possible to obtain ideal search results when using this optimal search radius to perform a search. Therefore, the embodiments in this application effectively control the size of returned search result sets, improve the user experience, and vastly improve search engine performance.

Even though the process flows described by the preceding text comprise multiple operations appearing in a given sequence, it should be clearly understood that these processes may comprise more or fewer operations, and these operations may be executed sequentially or in parallel (e.g., using a parallel processor or multithread environment).

As shown in FIG. 4, the target location search apparatus of the embodiments of this application comprises:

A location determination module 41, configured to determine a location designated by a target search request.

In the embodiments of this application, the target search request can be initiated by a user based on a personal computer or mobile terminal (e.g., a smart phone or tablet).

For example, the target search request can be a business search request. Generally, the target search request will include a designated location.

In one embodiment of this application, the designated location can be specific latitude and longitude data. In another embodiment of this application, the designated location can be a location name or identifier (e.g., Beijing Subway Line 1 Xidan Station), then specific latitude and longitude data can be acquired based on this location name or identifier.

A grid determination module 42, configured to determine a grid corresponding to the location in a pre-set gridded location area.

In the embodiments of this application, the gridded location area can be obtained in advance in the following way:

1) Within a set area, determining latitude and longitude information specified by all target search requests received by a system within a set historical time range. For example, using an ODPS system to acquire, while offline, the PV (page view) logs for all business searches in Beijing within the past 7 days, and tallying, from the 7 days of PV logs (i.e., historical search data), the designated latitude and longitude information for all business searches in Beijing during that period of time.

2) Based on a Geohash algorithm, mapping the latitude and longitude information to the gridded location area with square grids of equal length and width.

In one embodiment of this application, as shown in FIG. 2, the latitude and longitude information of popular locations in a set area and designated in the target search requests received by a system within a set historical time range can be mapped to the gridded location area with square grids of equal length and width. By this way, the target search demands for most locations are met with little system overhead. Here, the popular locations can be places with a high search volume. During implementation, popular locations can be determined using a set threshold.

In another embodiment of this application, a map of a set area can be uniformly gridded according to set rules. But using this approach, storing the grids of unpopular locations will waste system resources such as storage space. Here, the unpopular locations can be places that have not been searched or that have a very low search volume. During implementation, unpopular locations can be determined using a set threshold.

A search range determination module 43, configured to determine the grid's corresponding optimal search radius from pre-set correspondence relationships between grids and optimal search radiuses.

In the embodiments of this application, the optimal search radius is obtained in advance in the following way:

Respectively making the center point of each of the grids in the gridded location area as a center of a circle, and performing a target search using an incrementally increasing radius, to obtain a minimum search radius for the each grid corresponding to the returned results when reaching a pre-set returned number threshold; and using the minimum search radius as the grid's optimal search radius.

Using grid WX4G0 in FIG. 2 as an example, WX4G0 is the geohash code of a certain grid in a gridded location area. Using the center point of this grid as the origin, it is possible to perform a cyclic search using 100 meters, 200 meters, 300 meters, and the like incrementally increasing from small to large as the search radius (as shown in FIG. 3). Thus,

it is possible to calculate the minimum search radius corresponding to the returned results when grid WX4G0 reaches a pre-set returned number threshold, and use the minimum search radius as the optimal search radius for this grid. In a similar fashion, it is possible to calculate the optimal search radius corresponding to the returned results when all the geohash codes in FIG. 2 (i.e., all the grids in the gridded location area) reach the pre-set returned number threshold. Therefore, the embodiments of this application can obtain in advance the correspondence relationships between all grids within a set area and in a gridded location area and their optimal search radiuses, i.e., obtain data for which geohash codes are keys and optimal search radiuses are values, as shown in Table 2:

Table 2

key	value
WX4ER	400m
WX4G2	500m
WX4G32	600m
WX4EP	700m
WX4G0	800m
WX4G1	1000m
WX4DZ	900m
WX4FB	1100m
WX4FC	800m

In another embodiment of this application, it is possible to employ another mode (e.g., search radius going from large to small) to perform cyclic searches. However, with this approach, finding the optimal search radius might require a higher number of cyclic searches, and in terms of efficiency, generally it is not as good as the aforementioned incremental increase from small to large.

A returned results acquisition module 44, configured to perform a search for the target using the optimal search radius and obtain returned results.

In the embodiments of this application, using an optimal search radius to perform a search means: using the designated location of the searched target as a center of a circle and using the searched target's optimal search radius as the search radius to perform a search.

In another embodiment of this application, the target location search apparatus can also comprise:

a returned results optimization module 45, configured to determine whether a number of returned results is less than a pre-set lower limit of returned number after the returned results acquisition module 44 obtains returned results; and if the number of returned results is less than the lower limit of returned number, use a gradually expanding search radius for the searched target to perform the search, until the number of returned results reaches the lower limit of returned number.

Additionally, in another embodiment of this application, the pre-set gridded location area and the correspondence relationship between the grids in the pre-set gridded location area and their optimal search radiuses can be regularly updated (e.g., updated once a day or once a week, etc.), to adapt to changes in target information near popular locations (e.g., changes in business such as shopping malls, supermarkets, and restaurants), thereby helping to ensure the accuracy of returned results.

In the embodiments of this application, because popular locations are mapped in advance as a gridded location area based on historical search data, and optimal search radiuses are calculated for each rectangular grid in the gridded location area, for each rectangular grid, the optimal search radius represents the optimal search radius for all the locations within that rectangular grid. Thus, because the correspondence relationships between popular locations and their optimal search radiuses are determined in advance, when a search for a given popular location is received, it is possible to quickly determine the optimal search radius for the popular location based on this correspondence relationship. This makes it possible to obtain ideal search results when using this optimal search radius to perform a search. Therefore, the embodiments in this application effectively control the size of returned search result sets, improve the user experience, and vastly improve search engine performance.

A person skilled in the art can also understand that the various illustrative logic blocks, elements, and steps listed in the embodiments of this application may be achieved through hardware, software, or a combination of the two. The question of whether hardware or software is used for implementation depends on the specific application and overall system design requirements. A person skilled in the art can use various methods for specific applications to achieve these functions, but these implementations should not be understood as exceeding the scope of protection of the embodiments of this application.

All of the various illustrative logical blocks or elements described in the embodiments of this application can achieve or operate the described functions using a general processor, digital signal processor, application specific integrated circuit (ASIC), field programmable gate array, or other programmable logic apparatus, discrete gate or transistor logic, discrete

hardware unit, or any combination of the above. A general processor can be a microprocessor, or it can be any traditional processor, controller, microcontroller, or state machine. Optionally, a processor can also be achieved through a combination of computation apparatuses, e.g., a digital signal processor and microprocessor, multiple microprocessors, one or more microprocessors joined with a digital signal processor core, or any other similar configuration.

The steps of the methods or algorithms described in the embodiments of this application can be directly embedded into software modules executed by hardware or processors, or a combination of the two. The software modules can be stored in RAM memory, flash memory, ROM memory, EPROM memory, EEPROM memory, registers, hard drives, removable discs, CD-ROM, or a storage medium of any format in this field. As an example, the storage medium can be linked to a processor, making it possible for the processor to read information from the storage medium and write information into the storage medium. Optionally, the storage medium can be integrated into the processor. The processor and storage medium can be installed in an ASIC, and the ASIC can be installed in a user terminal. Optionally, the processor and storage medium can be installed in different units of a user terminal.

In one or more exemplary designs, the functions described by the embodiments of this application can be achieved through hardware, software, firmware, or any combination of the three. If they are achieved through software, these functions can be stored in a computer-readable medium, or can be transferred in the form of one or more instructions or codes to a computer-readable medium. Computer-readable media comprise computer storage media and communication media enabling the transfer of computer programs from one place to another. Storage media can be any media accessible by a general computer or specialized computer. For example, this type of computer-readable media can comprise but is not limited to RAM, ROM, EEPROM, CD-ROM, or other optical disc storage, magnetic disc storage, or other magnetic storage apparatus, or any other medium that can be used to carry or store program code in the form of instructions or data structures, and other forms readable by general or specialized computers, or general or specialized processors. In addition, any connection can be appropriately defined as a computer-readable medium. For example, if a piece of software is transmitted from a website, server, or other remote resource through a coaxial cable, fiber-optic cable, twisted pair, or DSL or using infrared, wireless, or microwave wireless modes, this is also included as the defined computer-readable media. Discs and magnetic discs comprise zip discs, laser discs, optical discs, DVDs, floppy discs, and Blu-ray discs. Magnetic discs typically use the magnetic replication of data, whereas

discs typically use lasers to perform the optical replication of data. The aforementioned combinations can also be included as computer-readable media.

The preceding embodiments provide a detailed description of the objectives, technical schemes, and beneficial effects of this application. It should be understood that the preceding is merely specific embodiments of the embodiments of this application, and is not used to limit the scope of protection of this application. All modifications, equivalent substitutions, and improvements made within the spirit and principles of this application shall fall within the scope of protection of this application.

Claims

1. A target location search method, wherein it comprises the following steps:
determining a location designated by a target search request;
determining a grid corresponding to the location in a pre-set gridded location area; and
determining the grid's corresponding optimal search radius from pre-set correspondence relationships between grids and optimal search radiuses, and using the optimal search radius to perform a search for the target and obtain returned results,
determining whether a number of the returned results is less than a pre-set lower limit of returned number; and
if the number of the returned results is less than the lower limit of returned number, performing the search with a gradually expanding search radius for the searched target, until the number of returned results reaches the lower limit of returned number.

2. The target location search method according to Claim 1, wherein the gridded location area is obtained by:
within a set area, determining latitude and longitude information specified by all target search requests received by a system within a set historical time range; and
based on a Geohash algorithm, mapping the latitude and longitude information to the gridded location area with square grids of equal length and width.

3. The target location search method according to Claim 1 or Claim 2, wherein the correspondence relationships between the grids and optimal search radiuses are obtained by:
respectively making the center point of each of the grids in the gridded location area a center of a circle, and performing a target search using an incrementally increasing radius, to obtain a minimum search radius for the each grid corresponding to the returned results when reaching a pre-set returned number threshold; and
using the minimum search radius as the grid's optimal search radius.

4. The target location search method according to Claim 1, wherein the pre-set gridded location area and the pre-set correspondence relationships between the grids and optimal search radiuses are regularly updated.

5. The target location search method according to Claim 2, wherein mapping the latitude

and longitude information to the gridded location area with square grids of equal length and width based on a Geohash algorithm comprises:

mapping latitude and longitude information corresponding to popular locations in the latitude and longitude information to the gridded location area with square grids of equal length and width based on a Geohash algorithm, the popular locations comprising locations for which a search volume is no less than a pre-set value.

6. A target location search apparatus, wherein it comprises:

a location determination module, configured to determine a location designated by a target search request;

a grid determination module, configured to determine a grid corresponding to the location in a pre-set gridded location area;

a search range determination module, configured to determine the grid's corresponding optimal search radius from pre-set correspondence relationships between grids and optimal search radiuses; and

a returned results acquisition module, configured to perform a search for the target using the optimal search radius and obtain returned results,

a returned results optimization module, configured to determine whether a number of the returned results is less than a pre-set lower limit of returned number after the returned results acquisition module obtains the returned results; and if the number of returned results is less than the lower limit of returned number, perform the search with a gradually expanding search radius for the searched target, until the number of returned results reaches the lower limit of returned number.

7. The target location search apparatus according to Claim 6, wherein the gridded location area is obtained by:

within a set area, determining latitude and longitude information specified by all target search requests received by a system within a set historical time range; and

based on a Geohash algorithm, mapping the latitude and longitude information to the gridded location area with square grids of equal length and width.

8. The target location search apparatus according to Claim 6 or Claim 7, wherein the correspondence relationships between the grids and optimal search radiuses are obtained by:

respectively making the center point of each of the grids in the gridded location area a center of a circle, and performing a target search using an incrementally increasing radius, to obtain a minimum search radius for the each grid corresponding to the returned results when reaching a pre-set returned number threshold; and

using the minimum search radius as the grid's optimal search radius.

9. The target location search apparatus according to Claim 6, wherein the pre-set gridded location area and the pre-set correspondence relationships between the grids and optimal search radiuses are regularly updated.

10. The target location search apparatus according to Claim 7, wherein mapping the latitude and longitude information to the gridded location area with square grids of equal length and width based on a Geohash algorithm comprises:

mapping latitude and longitude information corresponding to popular locations in the latitude and longitude information to the gridded location area with square grids of equal length and width based on a Geohash algorithm, the popular locations comprising locations for which a search volume is no less than a pre-set value.