DESIGN AND IMPLEMENTATION OF DYNAMIC UPDATE SYSTEM FOR GEOGRAPHICAL NAMES AND ADDRESSES

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ABSTRACT:

In order to solve the problem of the long update cycle of geographical names and addresses, this paper puts forward a dynamic update technique of mobile & PC integration. The combination of related services of NewMap software and mobile APP can effectively improve the speed and accuracy of updating geographical names and addresses. Taking the mobile & PC integration model as a starting point and comprehensively using GIS-related technologies, mobile positioning technologies, offline map technologies, etc., the dynamic update of geographical names and addresses has been successfully implemented and has been successfully applied to the dynamic update of geographical names.

1. INTRODUCTION

Geographical name and address data is an important part of the geospatial framework of the "digital city". It plays an important role in linking data of different topics and improving the level of spatial data sharing (Chen et al. 2016). In recent years, Chinese government departments and all sectors of society have been increasingly demanding the timeliness of basic geographic information data, which can no longer be met by updating once a year. At the same time, in order to save financial funds for basic surveying and mapping, basic surveying and mapping data shall be updated by the combination of dynamical update and regular update (Xiang et al. 2016). However, the current needs can no longer be met by traditional data acquisition methods, which poses a challenge to the departments that require an accurate and prompt update of the data. How to transfer and share the updated geographical name and address information between collection personnel and management personnel is an important step in solving the dynamic update of geographical names and addresses.

With NewMap Software as a basic platform, this paper has comprehensively used mobile positioning and GIS related technologies to design and develop a system of mobile PC integration mode. The system has realized the function of geographical names and addresses collection and review, and is characterized by accuracy, efficiency, convenience, and integration. It provides a convenient tool for data collection and management personnel.

2. GEOGRAPHICAL NAME AND ADDRESS DATA

Geographical name and address database is logically divided into geographical name database and address database (Zhang et al. 2010). The designing of address database can follow the requirements of the Chinese national standard *Rules of coding for address in the common platform for geospatial information service of digital city* (Address coding. 2009). Table 1 list the field attributes in the geographical name and address database. But the address data classification has none no unified standard in China, in practical work, we can classify the address data according to some relevant Chinese national standard, such as *Industrial classification for national economic activities* (Industrial classification.2017)*, Classification and coding of geographic information points of interest* (Points of interest. 2017).

Field meaning	Type	IF Necessary
Map sheet number	Char	No
First-level classification	Char	Yes
Type of points of interest	Char	Yes
Standard name	Char	Yes
County code	Char	Yes
County name	Char	Yes
Standard address description	Char	Yes
Old address description	Char	Yes
Industry category	Char	No
Phone number	Char	Yes
Alias	Char	No
Time of collection	Timestamp	Yes
Image	Blob	Yes
X coordinate	Number	Yes
Y coordinate	Number	Yes
Post office	Char	No
Collection personnel	Char	No

Table 1. Structural table of geographical name and address data

3. SYSTEM DESIGN AND KEY TECHNOLOGIES

3.1 Map Gridding

In order to facilitate the collector to timely and accurately obtain the update of the geographical name and address data, the map is first gridded, that is, the map is divided into square grid cells of the same size. In order to satisfy the query and search of the map grid, the partitioned grid is encoded (Li et al. 2003). Each grid will be allocated with a collector that is familiar with the grid area and the area is required to be checked regularly so that

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the geographical name and address data can be updated accurately and promptly. Since the map is divided into grids and each grid is under the responsibility of a dedicated collector, the update efficiency of the geographical name and address data is greatly improved.

3.2 System Framework Design

The purpose of the system design is to help the personnel of relevant departments to achieve a dynamical update the geographical name and address data and to ensure the accuracy of data collection and the timely update of data, so as to meet people’s demands for the accuracy and efficiency of geographical name and address data, and also to lay a good foundation for the development of smart city. As the dynamic update of geographical names and addresses features small and complicated work and painstaking and specific links, it is difficult for the personnel of relevant departments to update the data accurately and timely in the traditional way (Gong. 2014). In order to achieve the accurate and timely update and storage of geographical name and address data, this paper has designed the organic cooperation of the two subsystems of the Personal Computer (PC) management terminal and the mobile collection terminal, and achieved data collaboration between the multiple mobile collection terminals and the PC management terminal by using the server as the medium. The mobile collection terminal locates the geographical names and addresses to be updated, collects the update information and writes it into the local database, and writes it into the server data base in the data synchronization mode of transmitting XML file in Socket communication. The PC management terminal creates and allocates a mobile collector account, creates a database of standard geographical names and addresses in the server, connects the Socket communication with the server, uses the Restful architecture to perform a create, read, update, delete (CURD) operation on the server database, and immediately feeds the updated information back to the mobile connection terminal so that the updated data can be transferred in real time between the administrator and the collector. The specific implementation framework is shown in Figure 1.

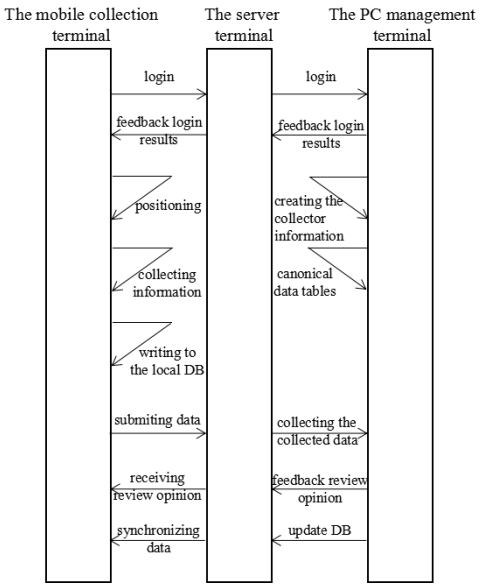

Figure 1. Mobile & PC integration working mode

Considering the practicability of dynamical update system of geographical names and addresses, the system is built on the Browser/Server (B/S) model. At the same time, in view of hierarchical design concepts, the system is divided into three components: data layer, service layer, and presentation layer. The overall architecture is shown in Figure 2.

1. Data layer. The data layer mainly includes spatial database, attribute database, and local file. The spatial database mainly stores basic map data, image data, geographical name and address data, grid data, path data, etc. The attribute database mainly stores user data information such as user name, password, and access; the local file mainly includes materials such as forms and documents, pictures, and videos.
2. Service layer. The service layer implements interaction, processing and analysis of the data layer mainly through the NewMap Service interface, which mainly includes services such as the query, modification, spatial positioning, spatial intersection and filtering of the data attribute of the geographical names and addresses.
3. Presentation layer. The presentation layer mainly implements the client-side functions of the PC management terminal and mobile collection terminal, and satisfies the requirements for the flat design of the interface and the simplification of user operations.

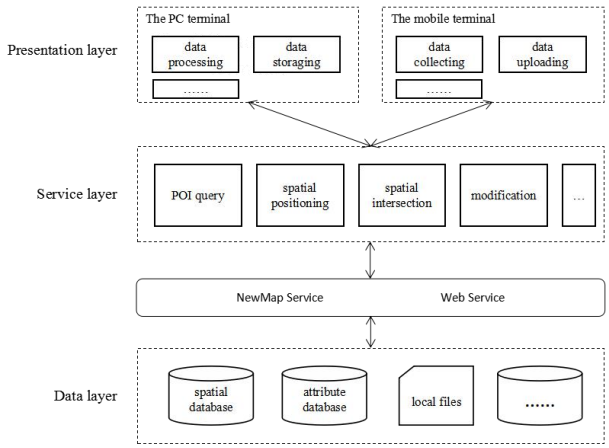

Figure 2. System Architecture

3.3 Process design of dynamic update

The collection personnel carry the mobile collection equipment, log in to the collection personnel account assigned by the system, collect the geographical names and addresses that needs to be updated, and then use the GPS location function of the mobile collection terminal to locate the address on the map and click “Collection” to enter the changed geographical name and its attribute information into the attribute list, and its changed photo or video information is recorded for review by the review personnel. Finally, the collection personnel click "Upload" to upload the changed information collected to the PC management terminal for review by the review personnel.

The review personnel can review the data to be reviewed, which is submitted by the mobile terminal, on the PC management terminal, and write the approved data into the database, and feedback reasons for the review failure to the collection personnel. The specific process is shown in Figure 3.

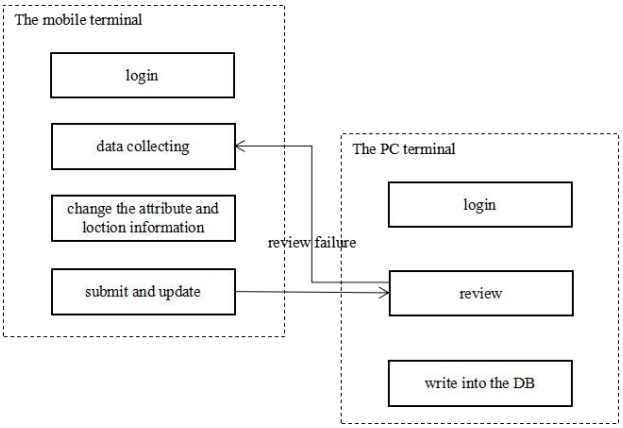

Figure 3. Dynamic update process

3.4 Optimization strategy of map caching technique

Map cache technique exchanges space for user browsing time so as to efficiently solve the network bandwidth limitations, network load and delay (Zhang et al. 2015), thereby reducing the burden on the server and optimizing the data collection speed of the mobile terminal. While the core value of the map lies in its realism, that is, the map must reflect the actual humanities, nature and other geographic elements to the maximum extent, and ensure the authenticity and timeliness of various geographic elements. The timeliness requirements of the mobile collection terminal system on the map are relatively high, but the traditional reading of server map data has a relatively high requirement on the network environment, which greatly reduces the data collection efficiency of the mobile collection terminal. In order to better solve the above problem, the mobile collection terminal reads the local cache file and judges the cache time of the map data. If the cache time of the map data is later than the server updating the map data, then the local data cache is considered to be within the freshness period. If the freshness period is exceeded, the local cache cannot be loaded, and it is required to acquire the map data again from the server to overwrite the local cache file. By optimizing the map cache of the mobile collection terminal via judging the freshness period, both the efficiency of data collection and the timeliness of map acquisition are taken into account.

4. EXPERIMENTAL COMPARISON AND SYSTEM IMPLEMENTATION

4.1 Experimental comparison

4.1.1 Comparison of data update process: Traditional manual collection of field operation and collection and review of office operation are based on serial process technique. However, the design of the system adopts parallel process technique that the multi-mobile collection terminal submits in real time with the review by the PC management terminal. The data update process implemented in this system have the following advantages.

1. Positioning by mobile GPS / Beidou can accurately locate the address information to be updated, thus avoiding manual errors.
2. parallel process technique can reduce the reporting process of traditional data updates, realizing the digital office of data transfer between collection personnel and review personnel in real time.

In addition, the use of this process can also effectively shorten the time of data update and improve the efficiency of data update. The above advantages all provide strong support for ensuring the accuracy of geographical names and addresses.

4.1.2 Comparison of map cache efficiency: Although the traditional mobile terminal caching method improves the reading efficiency of map data, it does not guarantee the timeliness of the map data. Though setting the freshness period to optimize the map cache, the system has significantly improved the interaction efficiency between the server and the mobile collection terminal. Through testing the two programs on the map scaling, roaming, full map and other operational functions in the mobile collection terminal, the results show that the average system response time of the optimized program has increased slightly, but the map accuracy rate has been greatly improved, which better reflects that the system has greatly optimized the map cache efficiency, the comparison as the Table 2 shows.

Program	User load number	Average response time(second)	Map accuracy rate(%)
Traditional program	50	3	50
Optimized program	50	4	90

Table 2. Comparison of test results before and after map cache optimization

4.2 System implementation

The system adopts the B/S architecture design, in which the PC management terminal adopts the JavaScript+Flex+PHP mode, the mobile collection terminal adopts the Java language, and the database adopts SQLite+MySQL. The system mainly provides the following functions.

4.2.1 Change and submission of collection information of mobile collection terminal: The collection by the mobile collection terminal is the basic step of the update of geographical names and addresses, which mainly includes the display of the space location of the original data and the change and submission of the data to be updated. When the user selects the data table to be updated, the system will locate the corresponding position on the map according to the coordinate information in the table. Click to query and change the attribute information of the point. On the map, locate the mark icon that needs to update the geographical names and addresses, or locate the point of geographical names and addresses to be added by the positioning function of the mobile collection terminal, and then click "Mark" to update the attribute information, which is shown as Figure 4. When the user packages the data changed and clicks "Submit to PC management terminal", the review personnel can perform the review and modification at the PC management terminal.

4.2.2 Implementation of reviewing information on the PC management terminal: The review of the address data to be updated is implemented through the PC management terminal. The review personnel log on to the collection system from the PC management terminal, selects the data table to be updated, and judges whether it will pass the review by checking the information in the review pending column, including the updated attribute information and the accuracy of the location information, which is shown as Figure 5.

4.2.3 Other functions: In addition to providing the dynamic update of geographical names and addresses, the system also integrates basic map operations, such as map switching, trajectory collection, route inquiry, measuring line, and measuring area.

Figure 4. Mobile collection terminal

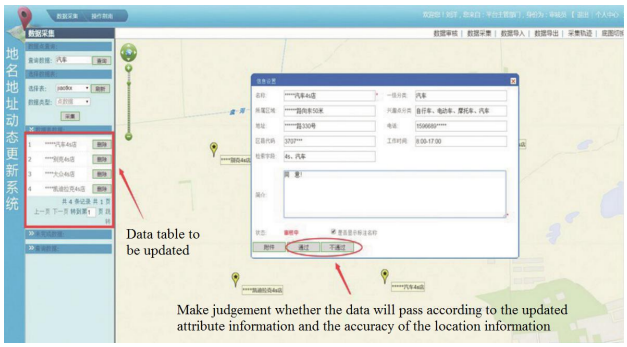

Figure 5. Reviewing information on the PC management terminal

5. CONCLUSIONS

According to the requirement of the dynamic update of geographical names and addresses, this paper redesigns the collection of field operation and the management of office operation. It adopts the design method of PC & mobile integration and designs the collection software on the mobile terminal and the review management system on the PC terminal, respectively. The system has achieved the collaborative work between the mobile collection terminal and the PC management terminal, by adopting network transmission technique, database technique, mobile GIS technique, network GIS services, etc. At the same time, the system has broken the separation between the collection of field operation and the review of office operation, making the dynamic update of geographical names and addresses more efficient and accurate, thus fully satisfying the work requirements of the surveying and mapping work on the dynamic update of geographical names and addresses. With the continuous development of the dynamic update technique for geographical names and addresses, public participation can be increased by introducing crowdsourcing in future research, and the efficiency of updating geographical names and addresses can thus be further improved.

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REFERENCES

Chen, D., Cheng, C., Tong, X., & Yuan, J. 2016. Research on the multi-scale spatial location coding model for address. *Journal of Geo-Information Science,* Vol.18-06, pp.727-733.

Xiang, H., Tan, L., Zeng, G., & Amp, C. P. 2016. Dynamic managing and incremental update of basic geographical database. *Science of Surveying & Mapping,* Vol.41-11, pp.189-193.

Zhang, X., Guonian, L. V., Boqiu, L. I., & Chen, W. 2010. Rule-based approach to semantic resolution of chinese addresses. *Journal of Geo-Information Science*, Vol.28-06, pp.9-16.

Li, D., Shao, Z., Zhu, X., & Gong, J. 2003. From digital map to spatial information multi-grid. *Geomatics and Information Science of Wuhan University,* Vol.12-01, pp.642-650.

Gong, F. 2014. Research on real-time data updating of the database of toponymy and address-taking xiamen city as an example. *Journal of Geomatics,* Vol.39-04, pp.70-72+77.

Zhang, J. W., Zhou, Y. B., & Liu, X. S. 2015. A research review of map cache technology based on web. *Geomatics & Spatial Information Technology,* Vol.38-08, pp.59-62+66.

Chinese Standards for Rules of coding for address in the common platform for geospatial information service of digital city.2009. Beijing, China. China Standards Press.

Chinese Standards for Industrial classification for national economic activities. 2017. Beijing, China. China Standards Press.

Chinese Standards for Classification and coding of geographic information points of interest. 2017. Beijing, China. China Standards Press.