Research of E-map System Based on Baidu Map API for University Campus

Yingjian Cai¹, Lishuan Hu¹,* and Caihong Xiang²

¹College of Urban Rail Transit and Logistics, Beijing Union University, Beijing 100101, China
²TAIJI Computer Corporation Limited, Beijing 100101, China

*Corresponding author

Abstract. With the rapid growing of universities, the campus infrastructure continues to expand. Visitors are not clear the position of their destination. Traditional online mapping service updating not timely can only supports customers to browse and query incomplete description of the destination. In this paper, a spatial information inquiry system of campus is designed based on Baidu map API with JavaEE technologies. The system can provide the basic map function for almost all important things on campus. Based on this method, Beijing Union University campus E-map has been developed successfully, which demonstrates the feasibility of this solution.

Keywords: E-map; spatial information; campus navigation; Baidu Map API.

1. Introduction

With the rapid development of Chinese colleges and universities, various new buildings and departments have been constructed in their campus. Where is the teaching building 1? Where is the second dormitory for girls? These are all common questions asked by freshmen and visitors. People usually use the online map on their mobile phones to find target locations in new area. But, online maps for mostly campus are usually very simple and can not marked new point coordinates in time. Only few main buildings and the outline of the campus can be seen. Information of campus online map is not accurate enough, some buildings have been renamed or some department moved to somewhere else, online map still no use the old logo to mark them. What is more, we can only see a block or a point for a campus building on online map, and there is not better reflected for customs who want specific detail. To solve this problem, many customers develop their own information system based on commercial GIS components [1]. Zhang et al. utilize panorama technology and location services to research and design campus navigation system [2]. Baaser et al. built a campus navigation system based on ArcIMS[3]. Guang-cao Wen et al. built a campus navigation system used based on SuperMap[4]. With the widespread use of open Map API, it is now easy to obtain free mapping data, and the developer’s workload is greatly reduce. Building campus e-map for university campuses is becoming more easy and economical. This has seen many such applications become available. Yang et al. developed a campus e-map for Xinjiang University based on Google Maps [5]. Rickt et al. used open map platform to build a campus guidance system for international conferences [6].

Baidu Maps API is an open map platform provided by Baidu Inc. Baidu Maps API is composed of a set of JavaScript functions which can help programmers to build their own map application [7-9]. In this paper, we collected geographic data of the main buildings and other attractive objects, and save them to the local database, and then we use Baidu Maps API to create a campus guidance system.
2. System Architecture
In this paper, we develop a guidance system for university campus based on Baidu Map API. The system architecture is shown in Figure 1.

As is shown in Figure 1, MySQL is the local database. The spatial and attribute data of the attractive objects on campus are storage in the database. These data are manipulated directly by the system administrator.

Steps to use the E-map system of campus are listed follows:
Step 1. When a user browser the university e-map system, an http request is send to local web server.
Step 2. According to the user’s request, the local web service collected attribute data and spatial from local database, and return script code composed of Html and Baidu Map API back to users’ browser for display.
Step 3. The user’s browser resolve the script code and send the map request to Baidu Map Server.
Step 4. Baidu Map Server receive user’s map request, then send the map result to user’s client browser.
Step 5. The user’s browser finally display the E-map of the campus.

3. Our Proposed Campus E-map System
(A) Creation of Map data
The Beijing Union University (BUU) with 15 colleges and 8 campus has been used as case study by using the Baidu Map API to provide a whole campus E-map System. First, we identified the various buildings and points of important within the university campus. This list units based on the location of building is divided into seven class: locations of colleges, buildings, offices, teaching and research, dormitory and canteen, shops and logistics, social services, navigation within campus, and so on. To display these locations simply, we organize spatial data and attribute data of these important things together into one table, whose structure is shown in Table 1.

As shown in Table 1, spatial data of these displayed units are stored in field polygon. Each unit can be seen as a series of points, and the coordinate of each point can be achieved from Baidu map platform. As Figure 2 shows, latitude and longitude of one point are shown on the Baidu map.
Table 1. Table of display things spatial and attribute information.

| Field Name   | DataType | Description                                                                 |
|--------------|----------|-----------------------------------------------------------------------------|
| unitID       | Int(8)   | Identification of the display unit; primary key                             |
| unitName     | varchar(20) | Name of the unit                                                               |
| parentID     | Int(8)   | The class the unit is belong to: Foreign key reference to class table           |
| dispalyType  | varchar(20) | Display types of units are shown as follows: 1. Point; 2. Polygon; 3. Picture; 4. InfoWindow |
| polygon      | varchar(500) | A series of Longitude values and latitude values of points consisted of the outline of unit buildings; Longitude and latitude are separated by commas; points are separated by semicolons. |
| picURL       | varchar(100) | the picture is shown at the unit location                                    |
| title        | varchar(50) | the title information of window                                               |
| content      | varchar(200) | the information of the unit                                                   |
| other        | varchar(200) | other things of the unit                                                      |

Figure 2. Coordinates of one point.  
Figure 3. A point with red marked.

(B) Display of units
Units of the campus are displayed as four categories. (1) A unit is shown as a point with red marked, as shown in figure 3. (2) Figure 4 shows the second method that a unit is displayed as polygon. To do this, a serial of spatial data of unit are achieved from database first, then split spatial data into multiple points; finally, connect these points to form the outline of polygon. (3) Figure 5 is a information window with one picture in it. Social services are displayed at this style.

Figure 4. The display of a polygon.  
Figure 5. An information Window with a picture.

4. Campus E-map System
There are a number of requirements of an E-map system for a university campus. This paper is aimed to develop an E-map for Beijing union university which has multiple colleges and campus. The precise
positions of these college and campus are the most important things of the E-map. As shown in Figure 6, the outline of all colleges of BUU display on map, and customers can find any one college or campus by clicked the left link.

![Campus of BUU](image1.png)

**Figure 6.** Campus of BUU.

Figure 7 shows buildings of the main campus, each of them is drawn as a polygon. Visitors can see them clearly by click its name’s link in the left navigation page. For buildings only are named by serial number, it is necessary to provide the searching for them on the E-map.

![Buildings of main campus](image2.png)

**Figure 7.** Buildings of main campus.

The navigation capability is an important component for a E-map system. The E-map of BUU provide two navigation functions, one is pedestrian navigation within campus, the other is bus navigation from the railway station in Beijing to the college of BUU. As shown in Figure 8 , a navigation map from Beijing West Railway Station to the tourism college of BUU is provied on the E-map.

![Navigation from railway station to campus](image3.png)

**Figure 8.** Navigation from railway station to campus.
5. Summary
In this paper, an E-map system for university campus is developed by using JSP and Baidu Map API, combining the MySQL database. Our proposed method provides almost all points of interest on Beijing Union University campus. The system interface is simple and intuitive, easy to operate, the update of spatial and attribute data of points is very simple and fast response. In the future work, we'll make further study on extending the system to suitable for the mobile device, so that the software can bring a better experience and convenience.

Acknowledgement
This work was partially supported by Scientific Research Project of Beijing Education Commission (KM201911417006), 2019 Research project of Beijing Union University (ZK30201906), and 2019 “Qiming Xing” college student science and technology innovation project (201911417SJ082).

References
[1] Hu, Ao, He, Zhen Ming, Yin, Cai. Design and Implementation of Tourism Management Information System[J]. Modern Electronics Technique, 2014, 543-547:3083-3087.
[2] Zhanjun Si, Chen Wang. Design and Implementation of Location-Based Services on Campus Navigation System[M]. Springer Singapore, 2016.
[3] Baaser U , Gnyp M L , Hennig S , et al. CampusGIS of the University of Cologne: a tool for orientation, navigation, and management - art. no. 64211L[J]. Proceedings of SPIE - The International Society for Optical Engineering, 2006.
[4] Wen Guangchao, Deng Yinseng, Y.Y.X.J.Y.M.: Design and realization of campus navigation system for henan polytechnic university. Journal of Geomatics 33 (April 2008) 38–40
[5] Yang Yang, J.Z.: Developing campus information service system based on googlemaps. In: Proceedings of the 6th Seminar on Cartography and GIS of China, Urumqi, Xinjiang China (2008) 555–562
[6] En X D, Zhili Z. A Local Bounding Box Method for Campus Navigation Based on Baidu Map[C]// Seventh International Conference on Measuring Technology & Mechatronics Automation. IEEE, 2015.
[7] En X D , Zhili Z. A Local Bounding Box Method for Campus Navigation Based on Baidu Map[C]// Seventh International Conference on Measuring Technology & Mechatronics Automation. IEEE, 2015.
[8] Zhang Y, Wang Y, Liu M, et al. Design and Implementation of the Key Technology for Calling Taxi[M]// Information Technology and Intelligent Transportation Systems. 2017.
[9] Liu, Li, Dong, Yi Bing, Liu, Xin. Research & Development of E-Map Service System Based on Baidu Map API for Regional Seismic Network[J]. Advanced Engineering Forum, 6-7:1022-1025.
[10] Tong J, Luo W, Jia H, et al. Research on remote diagnosis system based on baidumap API and OBD II diagnosis technology[C]// 2016.