Design and Implementation of Campus Spatial Information Service Based on Google Maps

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***Abstract*—Using the programmable interfaces provided by Google Maps, we create a campus spatial information service system. It uses free high resolution remote sensing images as the base map and it adopts open source software and function components. Making full use of the network data and combining Google Maps and MySQL database, it provides users with rich and interactive information such as the picture, description, link and the useful measurement tool. With a breakthrough compared with the traditional system which is manager-oriented and closed, the system uses the current prevalent B/S model and absorbs the Mashup idea on the platform architecture design .These expand the scope of service people and reduce the developing difficulties and cost remarkably. The system integrates some promising key technologies of Web2.0 and pushes forward the applying of Public Participate GIS. All these make better service of personalized and humanistic digital campus.**

Keywords-GoogleMaps API;digital campus;open source;spatial information service

I. INTRODUCTION

Campus spatial information service is a essential part of the "digital campus", which is supported by campus geographic information systems and network technology to collect, organize, summarize, storage, analysis and optimize the various campuses information, thus a variety of campus resources, ecological environment, teaching environment, entities and phenomena can be simulated, performed and analyzed. Campus spatial information service is designed for school teachers ,students and foreign visitors to provide valuable information about campus-related information, such as the layout of the campus building, location based service, school scenery introduction to help foreign visitors and the netizens to quickly understand the overall layout of the campus, etc. [1]. There have been some digital campus applications both at home and abroad and most of these systems or applications are manager-oriented and adopted component-based software tools for GIS web publishing, mainly based on vector data[2][3][4].

In this paper, the system uses the current prevalent B/S model and absorbs the Mashup idea on the platform architecture design with a breakthrough compared with the traditional system which is manager-oriented and closed. Making full use of the network data and combining Google Maps and MySQL database, it can provide users with rich and interactive information features of Xinjiang University such as the relevant features of the picture, description, link and implementation of the practical measurement. Based on open source software, the cost of the system is low and it has independent intellectual property rights.

II. SYSTEM ANALYZE

As a spatial information service system, it is necessary to break through the traditional information system model that users as passive recipients of information by providing visualization, simple, rich and useful information, so that the presentations of spatial information are actively showed to users, communicated with users and allowed users to participate into the construction and perfection of the whole system.

Traditional spatial campus information services are main for school leaders or managers with the quite narrow and limited service population and the systems are closed; Traditional systems use graphical user interface of the map as a background, which required the users have a certain map-reading skills and raise the user's threshold. While this system is web-based and uses high-resolution satellite images as a background, the user does not need that basic knowledge to understand and expand the scope of service people. All of these make spatial information quickly and easily to the user.

The characteristics of the system are:

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- Using many Web2.0 related technologies, such as the Mashup idea [5], Asynchronous JavaScript and XML (AJAX) technology, making the entire page beautiful, flexible, easy to learn and use.
- Adopting high-definition images provided by Google Maps as background image, supplemented by personalized icon and unique tab graphic display of the link, this system integrated the various spatial information and improved the quality of spatial information services.
- Improve the user interaction with the system, allowing users to participate into system construction.
- Using of the current open-source software framework, good stability, low cost, easy maintenance and upgrade are obtained.

III. SYSTEM DESIGN

A. *System framework*

The system adopts B/S architecture as show in figure1, the main calculation and the majority of inquiries are done at the server-side while the client-side is only used to make human-computer interaction. System uses a dynamic web page technology. Google Maps provides high-resolution remote sensing image as a base map while MySQL database stores the property information of the object. Using PHP language to operate on the database read and store information from the database and using JavaScript integrate these technologies that overlay feature property information on the image base map through the API provided by Google Maps. Presentation of the web page using the DIV and CSS technology makes the separation of page content and the performance.

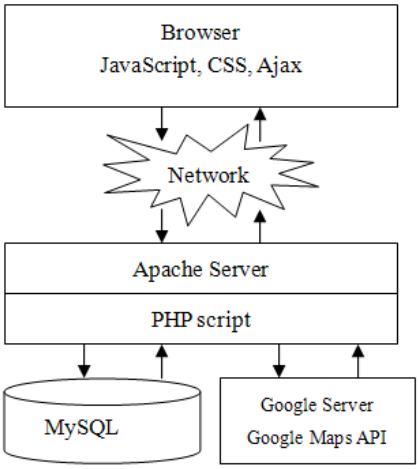

Figure 1. The architecture of the system

System integrates various popular development tools and technologies as following:

- Web2.0 technologies: DHTML, CSS, Ajax
- Population web programming language: PHP
- Web server: Apache
- Open source database: MySQL
- Map presentation platform: Google Maps API

Base on the architecture above, the system can realize the campus spatial information visualization, customization and personalization service.

B. *System function*

The main service of the system providing to the customers are as follows:

- Zoom out, zoom in, pan, eagle eye and the browser of the spatial information;
- Inter query between figure and text;
- Complex path measurement.
- Custom feedback function
- Add point of interest

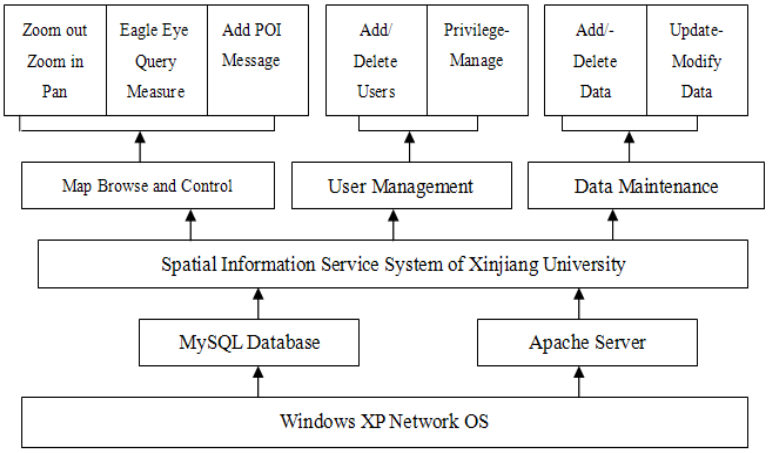

Figure 2. The architecture of the system function design

C. *Key technology and its realization*

1) *Map presentation*

Google Maps API is used as map presentation in this system, which provide multi-modal spatial information of high-precision remote sensing image free for the system and allows users to overlay their own layers. The Google Maps API embeds Google Maps in this system with JavaScript and adds content to the map through a variety of services, allowing creating robust maps applications on website. Those solve the problem that user must have their own basic geographic data. Using Google Maps API for free is just required to apply for a key, the key restricts the web directory, which contains the Google Maps API web pages can be placed only in the directory, and its schematic diagram is as follows:

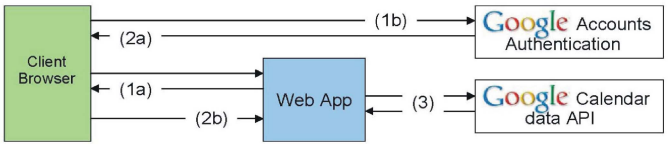

Figure 3. The schematic of Google Maps API

Google Maps API provides map service functions for the system, its services are: First of all, the client that contains Google Maps API send authentication requests (1), and then the client return application with verify code (2), finally, the application using verify code visit the GData (3) .

Adding the following code to the main PHP source file can embed Google Maps API service provided by Google in the system.

<script src="http://maps.google.com/maps?file=api&v=2&key=ABQIAAAAF6q2gj4qEL__yjIc0hbvBRjy5cnTM9yr4W61mq50OgY7uSmMxTILem8Wkg4xdZB40BIHvquXGNJBg" type="text/javascript"></script>

Code between the "key" is the key value we applied. Some codes that enable map browser are as followings [6] [7]:

```
map.addControl (new GLargeMapControl ());
//add large zoom tools
map.addControl (new GMapTypeControl ());
//add map type selection tool
GEvent.addListener (map, "moveend", showInf)  ;
GEvent.trigger (map, "moveend");
// add Event move monitor and trigger
icon.image = ". /image/tower.png";
icon.iconSize = new GSize (21, 29);
point = new GPoint (116.429424, 39.934322);
marker = createMarker (point, icon, html);
map.addOverlay (marker); //add icon marker
```

2) Property and spatial data organize

The main mission of the database design is the collection and organization of data. Attribute data including text descriptions, pictures, links and so on, are mainly obtained from Xinjiang University website and digital cameras. Among features property information, the key is to obtain the latitude and longitude coordinates. The property information combines with spatial information according to the latitude and longitude coordinates. The methods is, first of all, pointing out feature in Google Earth, and then saving the file to KML format, and then using program to extract the coordinates of the points, at last, storing the coordinates into the MySQL table.

The structure of the MySQL table is showed in table1:

TABLE I. THE STRUCTURE OF THE MYSQL TABLE

Field	Type	Memo
id	auto_increment	key
name	varchar(60)	object name
descrip	varchar(80)	object description
lat	float(17,14)	Latitude of the location
lng	float(17,14)	longitude of the location
type	varchar(20)	type of the object
website	varchar(30)	object link discription
picnum	Smallint(6)	object picture number

Tagging the feature information to the base map is provided by Google Maps API's GMarker function. The basic syntax is as follows:

var point = new GLatLng (pointData.latitude, pointData.longitude);

var marker = new GMarker (point, (icon: customIcons [pointData.type], title: pointData.height));

In which, *pointData.latitude*, *pointData.longitude and pointData.type* stand for features' latitude , longitude and type, which are stored into MySQL database reading through PHP and organized into an array for the function call respectively [6]. The *pointData.type* is the feature types, such as administration, teaching building, dormitory, etc. The *customIcons [pointData.type]* is an array of personalized icon.

3) Add points of interest

When users want to add their own mark, they can click on objects and then fill the pop-up tab form. When users click the submission button, the information can be submitted to the database table. The data table is a temporary and database manager will add it into the system data table when he think the data is valuable. The key codes are as follows [8] [9] [10].

```
GEvent.addListener (map, "click", function (overlay, latlng) {
if (latlng) {
marker1 = new GMarker (latlng, {draggable:true});
GEvent.addListener (marker1, "click", function () {
lastmarker = marker ;
var html = "<table>" +"<tr><td>Name:</td> <td><input type='text' id='name'/> </td> </tr>" +"<tr><td>Address:</td> <td><input type='text' id='address'/></td> </tr>" +"<tr><td> Type:</td> <td><select id='type'>" +"<option value='bar' SELECTED>bar</option>"+"<option value='restaurant' >restaurant</option>" +"</select> </td></tr>" +" <tr> <td></td> <td> <input type='button' value='Save & Close' onclick='saveData()'/></td></tr>";
marker1.openInfoWindow (html);});
map.addOverlay (marker1);
}
});
function saveData() {
```

```
var name = escape (document.getElementById ("name") .value);
var address = escape (document. getElementById ("address") .value);
var type = document.getElementById ("type").value;
var latlng = marker.getLatLng();
var lat = latlng.lat();
var lng = latlng.lng();
var url = "phpsqlinfo_addrow.php?name=" + name + "&address=" + address + "&type=" + type + "&lat=" + lat + "&lng=" + lng;
GDownloadUrl (url, function (data, responseCode) {
  if (responseCode == 200 && data.length <= 1) {
    marker.closeInfoWindow ();
    document.getElementById ("add1").innerHTML = "Location added." }
});
}
```

IV. SYSTEM INTERFACE

Figure 4 shows the system interface, including menu bar, side bar, the map window, eagle eye and measurement tool and other functional areas.

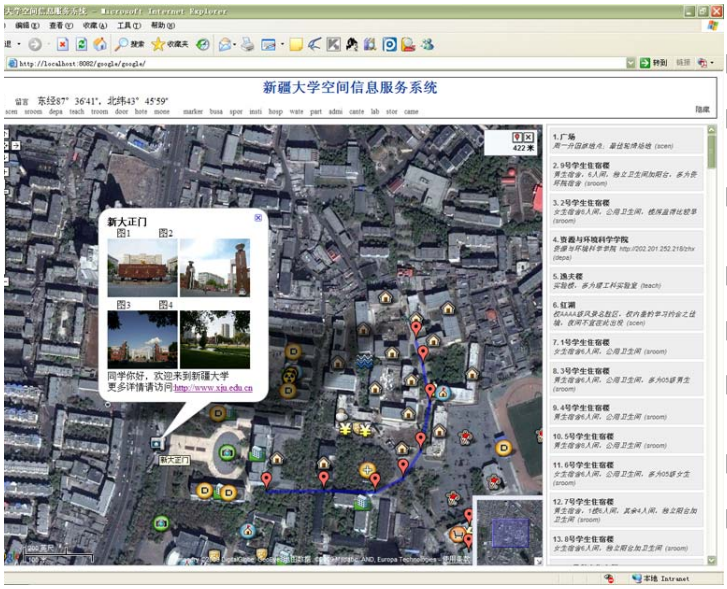

Figure 4. The interface of the whole system

The spatial information system provides service mainly through the implementation of the tags. Personalized tags vary in the attribute in the data table. System has measurement function. The straight-line distance between two points and total distance among points can be easily calculated. System allows users to add their own point of interest and it is able to better participate in system-building and practice. System provide message board, user's views can be fed back to the manager before to strengthen the user's interactive experience.

V. CONCLUSION

Campus spatial information service system is a very important part of the digital campus, which is responsible for internal and external users gets spatial-related information about the campus, help users understand the relevant information faster, and to identify features of interest. The system adopts the current prevalence of B/S model and absorbing the thought of Mashup in platform framework design. The system makes full use of the free data and completely uses open-source development tools and function of components, reducing the difficulty and cost in the system development. Some of the key Web2.0 technologies are introduced into the system, which realizes the thought of public participation geographic information system. System provides a path measurement and allows user to add points of interest. All of those personalized and user-friendly tools strengthen the digital campus spatial information service and also has bright application prospect.

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