

DESIGN AND IMPLEMENTATION OF A PORTAL SITE FOR THE OLYMPIC GAMES 2008 IN BEIJING USING GOOGLE MAPS

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ABSTRACT:

The games of the 29th Olympiad will be held from August 8th to the 24th in Beijing and Peking. The 2008 Olympic Games are one of most important events to happen in China in recent years. To attend the avalanche of guests coming from all over the world, 100s of thousands volunteers are set to help take care of countless activities and tasks every day to make sure the 16 days are an enjoyable experience for all. Many of those tasks involve the transportation and geographical orientation of the guests. A portal site for displaying the 2008 sporting events happening in and around Beijing would be very useful. Most portal sites supply an e-map function for guiding and searching based on established methods. They always look like "plane paper" maps. The newer methods and techniques used in online virtual maps, on the other hand, give users more and better options. For example, Google Maps offers three viewing modes by default: Map (street map views), Satellite (satellite and high-resolution aerial photographs) and Hybrid (street maps overlaid on satellite and high-resolution aerial photographs). The first one is similar to a traditional map, but the last two models let users look at the same world through a different perspective. In addition, these maps can be combined with other data. The suitability of this technology to provide useful geoinformation for an important event, such as the 2008 Olympics in China, will be assessed.

1. INTRODUCTION

1.1 Motivation

To meet the needs of guests from around the world wanting to visit the Games of the 29th Olympiad and the accompanying Paralympics a corps of 100,000 volunteers during game-time, and another 400,000 city volunteers and more than 1 million social volunteers are needed to support the visitors during their stay (Hongjiangm 2008). Support for visitors' transportation and orientation while in China's capital could be provided by modern geo-browsers. These provide geocoded content from one of the mapping providers such as Google, Yahoo!, Microsoft, or MapQuest. A quick look to Google's mapping portal, however, reveals that the content such as street data or venues is only marginal. Therefore, additional efforts to create a portal site which provides detailed and useful information for the Olympic Games 2008 in Beijing is needed.

Technological developments during recent years, evident in popular online mapping tools, such as Google Maps and Google Earth, provide a functional framework for further development. Additionally, such applications also helped people throughout the world become familiar with GIS technology and geospatial information in the Internet.

Google Maps is almost entirely written in ECMAScript (ECMA 1999) and discloses its classes, variables, and internal structure in an application programming interface (API). Thereby, developers can produce client-side scripts and server-side hooks which allow users to use expanded and customized features, so

called mashups, based on the Google Maps interface (Purvis et al. 2006, Brown 2006). For example, using Google's core mapping engine and the map/satellite images hosted by Google, such tools can introduce custom location icons, location coordinates and metadata, and even custom map image sources into the Google Maps interface.

The Google Maps API lets user-embed Google Maps in their own web pages with JavaScript. Users can add overlays to the map (including markers, polylines and polygons) – even WMS layers – and display shadowed "info windows" with arbitrary additional information content.

Similar to the aforementioned methods, it is possible to construct a portal site using GIS data based on a web mapping server, such as Google Maps. And one of the most useful aspects of these services is the availability of a variety of geographical datasets for free on the web.

1.2 Related work

When this research project was launched in 2007, most portal sites supplied only e-map function for guiding and searching based on the traditional techniques. Such sites always look like a "plane paper" map. Since then, the situation has changed. For example, the official site for the 2008 Olympics, <http://en.beijing2008.cn/emap/>, provides cartographic information in a way similar to commercial cartographic clients.

The blog <http://googlemapsmania.blogspot.com/> contains a whole range of links to mashups for travel and tourism as well

as sporting events, but without helpful pointers to the Olympic Games in Beijing, with the exception of Google's release on April 10, 2008 of the route of the Olympic Torch Relay (<http://maps.google.com/help/maps/torchrelay/> or, for Chinese-speaking people, <http://ditu.google.com/help/maps/torchrelay/>).

Concerning transit and transportation a lot of mashups exist and are listed on [Googlemapsmania](http://www.googlemapsmania.com/).

1.3 Objectives

The main aim of this research project is to construct a portal site for tourists for the 2008 Olympic Games and also present, at the ISPRS meeting (<http://www.isprs2008-beijing.org/>) in Beijing, an assessment of online mapping APIs of the general suitability of such information portals. Today, developers face an important challenge in having to develop applications for the Internet which differ from other poorer-quality web sites. Making the combination of interesting, valuable, customized information available in Google data sets offers new possibilities for geo-data presentation and exploration.

The specific objectives of this research are focused on:

- an assessment of information needs for further collection and digitization of relevant data
- a combination of self-collected data and available data
- a construction of a geo-database using MySQL DBMS
- applications and integration of Google Maps API
- the design and implementation of the portal site based on PHP, AJAX, HTML and JavaScript.

The project should also be a practical test for the application of this new technology.

1.4 Hypothesis

According to Andrews (2007), the GIS field today is dominated by a combination of web usage and usage of web mapping services, such as Google Maps, Yahoo Maps etc. Years ago, few professionals were capable of implementing this technology. Many professional GIS companies, for instance, ESRI, MapInfo, were known by few specialists. This situation is changing day by day. Since Google Maps and Google Earth were first launched, increasing numbers of people use these web services and software solutions. While not being the first company to offer such web mapping services, Google Maps is rapidly growing in popularity (Hopkins 2008) and helping to popularize the usage of geo-information.

A number of hypotheses can be drawn from the above observations on the web mapping trends. For instance, providing information about sports events is going to be redefined by these newer web mapping services. The new standard is more attractive and better understood by most Internet users, and without any professional knowledge. This is a critical factor in popularizing GIS through the Internet. However, an increased awareness of users and a growing demand for these technologies means software developers need to gain more GIS knowledge than ever before.

Today, a greater emphasis is placed on user convenience when operating browsers or manipulating content. In addition, the quality of map imagery must be good and the response time for information updates short.



Figure 1: The entry page shows the general site design

2. THE SOLUTION

2.1 Technological Background

Usually, most geographic data belongs to one of three main geometry types: point, line and polygon, as described in OGC's Simple Feature Specification (Herring 2006). These types are also supported by Google's API and those of other vendors. Point features in the context of this project include, among others, points of interest, hotels, and bus and railway stations. Linear features include street, subway, and bus lines. Polygon features includes Olympic and ISPRS venues.

Google Maps API provides many classes, types, and functions. In order to represent plentiful features and to supply different functions on the map, many classes, types, and events have been defined in API by Google. And the Google Maps API also lets user embed Google Maps in their own web pages with JavaScript. The user can add overlays to the map (including markers, polylines and polygons), even WMS layers and display shadowed info windows, just like Google Maps.

2.2 General design

The design of the portal site is dominated by a three column CSS based layout (see Figure 1). Along the top the silhouette of Beijing is set against the blue sky. Styling properties have been selected carefully to be largely compatible with modern browsers. On the left side, navigation and search capabilities are positioned. During map display the right column is used as a side panel with content updated according to the information visualized. The side panel supports easy access to single map features such as single venues, streets or hotels.

The web site is designed to be attractive and make a good impression on web visitors at a first sight. It will clearly and briefly explain its purpose to visitors and provide target groups with indications on what information is available.

2.3 AJAX

AJAX, an abbreviation for Asynchronous JavaScript and XML, originally coined by Garrett (2005), is an architectural concept for providing a more interactive user experience while browsing the World Wide Web: The web page will be faster and more interactive by applying AJAX technology.

AJAX, as a web application development technique, combines several modern web technologies:

- XMLHttpRequest object (W3c 2008): sends requests to a web resource defined by an URL and receives a response asynchronously; with this object, ECMAScript can obtain updated data (like map data) without reloading the entire page.
- XML (among other formats): used for data transfers between browser and web server.
- Document Object Model (DOM): hierarchical, internal structure, allowing programs and scripts to dynamically access and update the content, structure and style of documents.
- JavaScript / ECMAScript: the client's scripting language to parse, analyze and interact with the information obtained.
- XHTML (HTML) and CSS: used to display and to stylize information.

Google, for example, uses AJAX technologies for Google Maps and for Google Suggest. Its API exports a method for creating XMLHttpRequest objects that are compatible with new versions of IE, Firefox, and Safari.

2.4 Information content

The information provided by the portal site can be categorized as follows (see Table 1):

- Street network: more than 1800 streets are overlaid to Google's satellite imagery. Single streets can be accessed by the street name list in the side panel. Additionally, a search form is offered with AJAX based auto-completion.
- Beijing subway network: The subway network with its stations is displayed.
- Competition venues: Olympic venues like the National Stadium, the National Aquatics Center, or the Beijing University Gymnasium are displayed in several categories. The side panel supports direct zoom and pan to the location selected. Additional information and photographs are displayed in an info window which pops up automatically (see Figure 2, Figure 8). Also venues outside Beijing's city centre are accessible like the Triathlon Venue at Ming Tomb Reservoir. Using buttons it is possible to directly "jump" from a location to the next one.
- Star-rated hotels: hotel locations have been digitized and integrated into the map. Single hotels can be accessed by a list in the side panel. Additionally, a search form is offered with AJAX based auto-completion. Photographs and hyperlinks to hotel web sites are provided in the info window (Figure 4 and Figure 7).

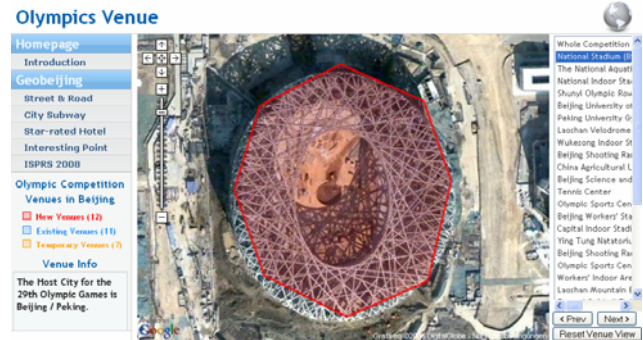


Figure 2: Olympics Venues like the National Stadium (the "bird's nest") are directly accessible. Google's satellite image shows the landscape before the building is completed.

- Points of interest: a number of points of interest have been digitized and are available through the side panel. Additionally, the expressways encircling the city centre are visualized for better orientation of the tourists.
- ISPRS 2008 venues and public bus infrastructure: As seen in Figure 9, corresponding features are displayed on the map and can be accessed by the side panel.

2.5 Formats used

Several data formats used in this project are briefly explained.

One format, which is closely related to AJAX technology, is Extensible Markup Language (XML, <http://www.w3.org/XML/>) which can be understood as a meta-language to define other geo-related languages like Geography Markup Language (GML) or GeoRSS. Data can be easily XML encoded because most of currently used programming languages support creation and parsing of XML data. XML has been selected to encode subway and venue information.

Another format in which data can be transferred to the client is called *JavaScript Object Notation* (JSON, <http://json.org/>) which uses conventional JavaScript notation to define objects such as, as in the present case, to define geographical features. JSON has recently become quite intensively used throughout the web. For example, several of Google's web-based applications and services can provide feed data in JSON format as well as in Atom and RSS formats.

Similar to XML, hierarchical structures can be modelled by JSON. Each nested element or attribute is represented as a name/value property of the object with native ECMAScript data types. The principal advantage, as compared to XML, is the compactness of data representation. On the other hand, certain security aspects must be considered, especially the need to take precautions with user-entered data since it could contain malicious code which then could be executed.

JSON has been extended by the geospatial community to a geographic dialect, GeoJSON (Schaub et al. 2008), intended to standardize the way spatial data is represented in JSON. In this data-interchange format a variety of geographic data structures are defined by OGC's Simple Features Specification (Herring 2006).

In order to load geo-data dynamically, the API function `GDownloadUrl()` can be used to retrieve a resource identified by a URL:

```
GDownloadUrl("ISPRS.json", process_it);
```

This function encapsulates the AJAX request to the server by sending an asynchronous GET request to the server. The first parameter (here `ISPRS.json`, listed in Appendix A) denotes a relative URL to the document which contains the data (see Appendix A). `process_it` is a the name of a callback function which is called automatically as soon as the asynchronous data transfer is finished. This function parses and instantiates objects of Google's `GMarker` class in a for-loop as overlay based on values for latitude, longitude and name:

```
process_it = function(doc) {
  // Parse the JSON document
  var jsonData = eval('(' + doc + ')');
  // Plot the markers
  for (var i=0;
    i<jsonData.markers.length; i++) {
    var point = new
    GLatLng(parseFloat(jsonData.markers[i].lat),
      parseFloat(jsonData.markers[i].lng));
    var marker = createMarker(point,
      jsonData.markers[i].label,
      jsonData.markers[i].html,
      jsonData.markers[i].icontype);
    map.addOverlay(marker);
  }
}
```

The key statement is the `eval()` function which evaluates the string contained in the parameter `doc` and executes it as if it was script code. So all the geographic features defined in the JSON string are instantiated.

For bulk loading of geo-data into the database, CSV format (comma separated values, implementation of a delimited text file) is used. Because this format is quite simple and supported by almost all spreadsheets and database management systems, it has become a pseudo standard even for GI systems.

In this project, some data has been encoded in a two-fold way. After digitization with MapInfo Professional, the geometrical properties are converted to WKT format. The resulting string is embedded in a CSV encoded string together with information about id, name, layer name, geometry type and bounding box:

```
Road_0001;Aimin_Jie;Road;Polyline;116.376;39.930
9;116.376;39.9266;116.376;39.9317;LINESTRING(116
.375686 39.931674,116.375683
39.931593,116.375747 39.93026,116.375806
39.926574)
```

2.6 Digitization Methods

The content of this website focussed on the 2008 Olympic Games. Plenty of information can be collected through the Internet and literature research. But information is not simply equal to data; additional data – points, linear and areal features – have to be digitized. Two technologies were applied to digitize such data:

- Professional desktop GIS software (i.e. MapInfo Professional) to digitize features based on georeferenced scanned maps)

- Mashups based on Google's API (see Figure 3), which can export data in a format suited for further processing.

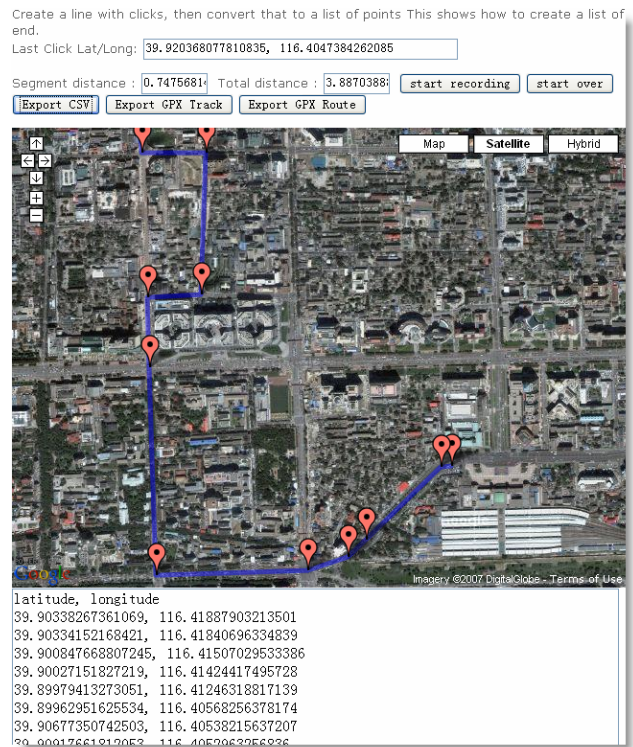


Figure 3: Data Digitization using Google Maps based Mashup (<http://www.meulensteen.nl/maps/>)

Data				
Layer	Digitization	Feature Type	Number of Data	Database / format
Road	MapInfo Professional	Polyline	> 1800	MySQL
Hotel	MapInfo	Point	> 150	MySQL
Metro	MapInfo Mashup	Polyline Point	3 > 50	XML
Venue	Mashup	Polygon	31	XML
ISPRS 2008	Mashup	Points, Polylines, Polygons	12	JSON

Table 1. Data sets and formats used.

2.7 Implementation

Since the portal site is based on Google's API, JavaScript and AJAX are applied on the client side (Flanagan 2002). PHP is the corresponding server-side scripting language for creating dynamic web pages and for database access (Appu 2004). MySQL (<http://www.mysql.com/>), since February 2008 owned by SUN Microsystems, Inc., is used as a database management system (Williams & Lane 2002).



Figure 4: Sidebar Function in Hotel Search

3. CONCLUSIONS

The major result and principal benefit of this project is the design and implementation of a portal site that includes a map for guiding guests in Beijing during the 2008 Olympics and helping them search for relevant information. The map is based on Google Maps satellite images and overlaid with additional useful information, such as points of interest (hotels, restaurants and other locations), linear features (roads, bus lines etc.) and aerial features.

This portal site supplies related information and links about Beijing, the Olympic Games and the ISPRS congress. It enables users to search for streets, hotels and access related information using sidebars with hyperlinks. The user interface is well designed, and the application is very responsive. The underlying technology, such as Ajax and formats used, are explained. The location of Olympic venues can be easily assessed using sidebar.

In addition, valuable information about the ISPRS Congress 2008 is included, such as the venue location, an introduction, photos, traffic information from BICC, for the airport, rail services or public bus system.

This research combines data collection in appropriate data formats, online virtual maps technology and useful information about Olympic Games in Beijing in a beneficial way:

- CSV can be easily generated and evaluated on client side.
- For larger databases, using DBMS is the preferred solution to manage and deal with separate data; for small amounts of data, directly loading data might be easier to implement and performance might be better during the web mapping process.
- JSON format is more appropriate for combining a variety of features
- XML based data transfer is very popular; parsing XML data can be done very easily and efficiently.

The results demonstrate that these technologies for providing geography information will be increasingly helpful and relevant to the broader consumer market.

However, possible improvements should also be mentioned:

- Integration of a level of details concept: roads should be classified according to their importance. Main roads should be displayed in small scale, and less important roads like Hutongs, should be displayed in larger scales in

accordance with the user's viewport and zoom level, similar to Google's GMarkerManager class. Furthermore, browser limitations can be overcome, because too many GPolyline objects may slow response times (Purvis 2006).

- Community concept: The website should be extended to integrate participatory functions, i.e. that users can integrate additional points of interests (POI) or give comments to POIs, venues or hotels.

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APPENDIX A

The following code is an example JSON file – ISPRS.json:

```
{
  "markers": [
    {
      "lat":40.07867, "lng":116.587386,
      "html": "<a
href='http://www.bcia.com.cn/en/index.jsp'>Airport</a><br/>Shoudu Guoji Jichang<br/><img
src='home/line.gif'><br/><img src='airp.jpg'>",
      "label": "Beijing Capital International
Airport", "icontype": "airport"
    },
  ],
  "lines": [
    {
      "colour": "#33FF00", "width": 4,
      "opacity": 0.8,
      "points": [
        {
          "lat": 39.903390, "lng": 116.418846, ...
        }
      ]
    },
    {
      "colour": "#FF0000", "width": 4, "opacity": 0.8,
      "points": [
        {
          "lat": 39.951192, "lng": 116.4020884, ...
        }
      ]
    }
  ]
}
```

APPENDIX B

The following figures demonstrate the user interface and information content of the www.geobeijing.info website.

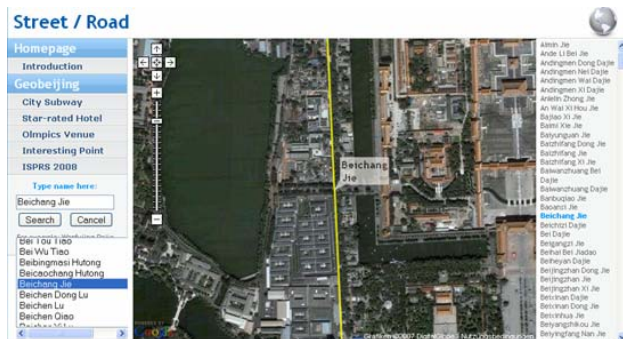


Figure 5: Streets and Roads at www.geobeijing.info



Figure 6: Subway Station at www.geobeijing.info

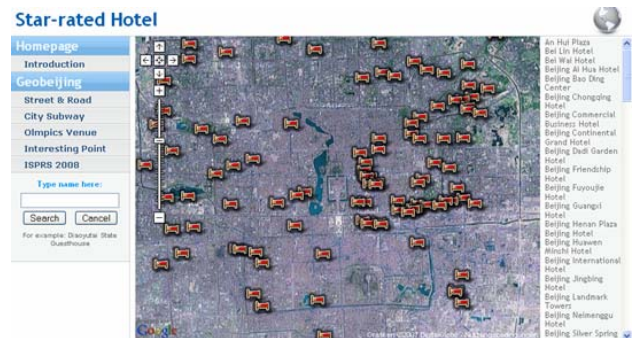


Figure 7: Star-rated Hotels at www.geobeijing.info



Figure 8: Olympics Venues at www.geobeijing.info



Figure 9: ISPRS Congress 2008 at www.geobeijing.info