Web Mapping Service for Mobile Tourist Guide

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Introduction

- Mobile tourist guide (presented by SPIIRAS on Thursday):
  - Accumulates tourist’s interests;
  - Accumulates context-related information;
  - Searches for informations about POI, attractions and transportation means;

- Web Mapping Service provides infrastructure for:
  - Showing map;
  - Searching location-related information;
  - Routing;
  - Navigation;
Motivation

- Besides of the guidance through the attractions, tourists usually needs:
  - Map with full world coverage (Where am I?);
  - Searching attractions and addresses on the map (geocoding and reverse geocoding) (Where is this place);
  - Finding distances to attractions (How far it from my current location);
  - Routing to attractions (How to reach this place);
Table of contents

- Comparison of the existing web mapping services:
  - Google Maps;
  - Microsoft Bing Map;
  - Yandex.Maps;
  - Services based on the OpenStreetMap (OSM);

- OSM-based web mapping service organization:
  - Data source;
  - Map drawing;
  - Geocoding and reverse geocoding;
  - Routing;

- OSM-based web mapping service performance test
Google Maps

- Coverage:
  - All world;

- Routing:
  - 1) Directions API (HTTP Requests for the static routing);
  - 2) JavaScript Directions and Distance Matrix API (JS API and HTTP requests to the matrix for the dynamic routing);

- Geocoding:
  - HTTP requests for the static and JavaScript API for the dynamic geocoding and reverse geocoding;

- Restrictions and limits:
  - 2500 routes per 24 hours for Directions API (100000 for business users);
  - 2500 geocoding and reverse geocoding functions per 24 hours (10000 for business).
Microsoft Bing Maps

- Coverage:
  - All world;

- Routing:
  - Via HTTP requests. Available not for everywhere;

- Geocoding:
  - HTTP requests. Also available through HTTPS;

- Restrictions and limits:
  - 100000 requests for all available functions per 24 hours period.
Yandex.Maps

- **Coverage:**
  - All world. The map has high accuracy and detail in the Russia and post-USSR region, as well as Turkey;

- **Routing:**
  - JavaScript API. Route can be built either with or without consideration for traffic jams;

- **Geocoding:**
  - Over HTTP queries or over using JavaScript API;

- **Restrictions and limits:**
  - Number of geocoding queries is limited to 25000 per 24 hours period.
OpenStreetMap

- OSM is only a geodata source.

- Coverage:
  - All World;

- Routing:
  - Provided by libraries and applications (pgRouting, GraphHopper, PyrouteLib, OsmAnd, etc.);

- Geocoding:
  - Also provided by libraries and services (Nominatim, GeoNames, etc.);

- Restrictions and limits:
  - Depends on used services or libraries.
## Comparison of Web Mapping Services

<table>
<thead>
<tr>
<th></th>
<th>Google Maps</th>
<th>Microsoft Bing Map</th>
<th>Yandex.Maps</th>
<th>OpenStreetMap</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
<td><strong>Routing</strong></td>
<td>+</td>
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<td>+ (libraries and applications)</td>
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<td><strong>Geocoding</strong></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+ (libraries and services)</td>
</tr>
<tr>
<td><strong>Restrictions and limits</strong></td>
<td>2500 per 24 hour for each function (100000 for business users)</td>
<td>100000 requests for all functions per 24 hours</td>
<td>25000 geocoding requests per 24 hours</td>
<td>Services limitations (about 1 query/sec) or developer’s hardware limitations</td>
</tr>
</tbody>
</table>

Our requirements at the current moment (by the results of the beta testing):

- about 5000 geocoding requests
- min. 20000 routing requests (more than 100000 with ridesharing functionality)
OSM-based Web Mapping Service: Map Data Source

- All planet data in one XML-file (planet.osm) – 515.9 Gb !!! (12.04.2014).
- Database with map data is required for high performance;
- PostgreSQL with PostGIS extension;
- Import is lossy and imported data requires about 250 Gb.
OSM-based Web Mapping Service: Map Rendering

- **Server-side**
  - Rendering core, based on the Mapnik rendering toolkit;
  - Apache HTTP server + mod_tile module for map sharing;

- **Client-side**
  - Leaflet and OpenLayers JavaScript libraries can be used to show for users the dynamic map received from the map-tiles server.
OSM-based Web Mapping Service: Routing

- PgRouting
  - Uses data imported to the PostgreSQL DBMS with PostGIS extension;
  - Main functions:
    - Shortest path (Dijkstra, A*, with bi-directional versions);
    - All pairs shortest path (Johnson’s and Floyd-Warshall algorithms);
    - Driving Distance (to find points in distance);
    - One-to-many shortest path;

- GraphHopper
  - Java routing engine. Works with OSM data (osm and pbf files);
  - Runs on servers, desktops and Android devices;
  - Main functions:
    - Shortest path (Dijkstra, A*, with bi-directional versions);
    - One-to-many shortest path.
OSM-based Web Mapping Service: Geocoding

- **TIGER Geocoder**
  - Work with the TIGER (Topologically Integrated Geographic Encoding and Referencing system) / Line and Master Address database export released by the US Census Bureau. Works in USA but concept can be applied to other counties;

- **Nominatim**
  - Works with PostgreSQL database with PostGIS extension;
  - Available as a web service from Internet;
  - Packaged as a web-service for own instance configuration;

- **GeoNames**
  - Uses a lot of data sources and combines them in one database;
  - Available as a web service and provides database for free.
**OSM-based Web Mapping Service: Performance test**

- Based on the routing time evaluation

<table>
<thead>
<tr>
<th>Without road type filtering</th>
<th>With road type filtering</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.4 Distance, km</td>
<td>8.8</td>
</tr>
<tr>
<td>135 No of points</td>
<td>112</td>
</tr>
<tr>
<td>342 Time, ms</td>
<td>130</td>
</tr>
</tbody>
</table>
Conclusion

- The main web mapping services have been studied and compared. All of them are powerful, easy to use, but have a lot of restrictions.
- The own web mapping service has been designed to meet mobile tourist guide requirements.
- Designed service is based on the OSM data and libraries.
- Developers may extend the functionality of this service by implementing own functions to manipulate the OSM data.
- Performance test shows high-speed evaluations of the used functions. It means that the system can work under high load and provide high service quality to users.
Future work

- Routing all over the world:
  - Importing all roads in the world to the database;
  - Configuring bounds to find routes only in the defined area;
  - Performance test;

- Public transport routing:
  - Routing based on the OSM data of public transport;
  - Using Yandex.Schedule for routing and transport schedule;
  - Using data provided by local transport companies about transport locations (eg.: Public Transport Service in St. Petersburg).
Acknowledgements

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Thank you for Attention
Questions are Welcome

Tourist Attraction Information Service

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