

April 25, 2014

# Web Mapping Service for Mobile Tourist Guide

Nikolay Teslya

Laboratory of Computer Aided Integrated Systems

St.Petersburg Institute for Informatics and Automation of RAS (SPIIRAS)



# 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

	Google Maps	Microsoft Bing Map	Yandex.Maps	OpenStreetMap
Coverage	All World	All World	All World	All World
Routing	+	+	+	+ (libraries and applications)
Geocoding	+	+	+	+ (libraries and services)
Restrictions and limits	2500 per 24 hour for each function (100000 for business users)	100000 requests for all functions per 24 hours	25000 geocoding requests per 24 hours	Services limitations (about 1 query/sec) or developer's hardware limitations

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

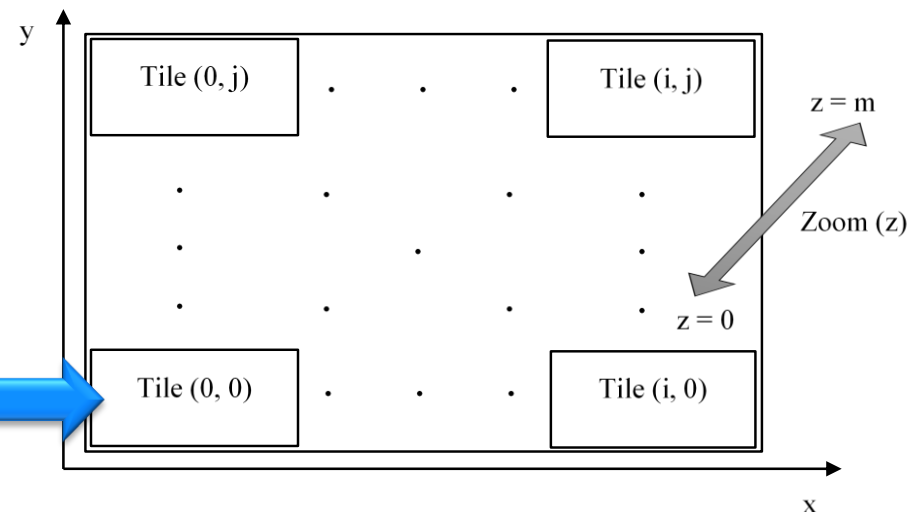


- All planet data in one XML-file (planet.osm) – **515.9 Gb !!!**  
(12.04.2014).
- Database with map data is required for high performance;
- PostgreSQL with PostGIS extension;
- Import is lossy and imported data requires about 250 Gb.

# 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 countries;
- 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



Without road type filtering		With road type filtering
8.4	Distance, km	8.8
135	№ of points	112
342	Time, ms	130





# 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

- Grant KA322 «Development of cross-border e-tourism framework for the programme region (Smart e-Tourism)» of Karelia ENPI programme, which is co-funded by the European Union, the Russian Federation and the Republic of Finland.
- The presented results are also a part of the research carried out within the project funded by grants # 13-07-00336 and 13-01-00286 of the Russian Foundation for Basic Research.
- Also author wants to thanks all companies, who provide their data for research: Google Inc., Microsoft Inc., Yandex, OpenStreetMap, and all projects, based on the OSM data.

**Thank you for Attention  
Questions are Welcome**



Tourist  
Attraction  
Information  
Service



E-mail: [teslya@iias.spb.su](mailto:teslya@iias.spb.su)