Mainz Mobile 3D - A PDA based OGC Web 3D Service Client and corresponding server

Manuel Fischer, Jens Basanow, Alexander Zipf

Abstract

The work presented deals with the implementation of a prototype for a location based urban information system. Based in that an application has been developed for mobile navigation purposes, based on-Pocket PCs or PDAs (Personal Digital Assistant). Data from the ALK (German official automated property map) as well as topographical official data are used as data base for. One of the system's specialities is the implementation of a 3D scene information by a web server query according to the OGC Web3D Service Recommendation. A Web3D Server has been developed with example data for the City of mainz and is currently being extended regarding fuctionality and with data from the City of Heidelberg, Germany.

Introduction

The Mainz Mobile 3D prototype is developed in C # on the Net Compact Framework 2. At the moment among others the following functionalities are realiezd already completely:

- positioning by means of GPS
- 2D map display using multiple generalization stages
- XML based configuration of the map display (being extended to support SLD at the moment)
- 2D map functions (zoom, pan etc..)
- search and visualization of POIs
- search function for object information / Touristic information
- distance measurement tool
- GPS configuration & display (Skyplot, Skyview, coordinates etc..)

- 3D scene information as on-line 3D Webclient based on the OGC Web3D service Specification

For a useful map representation the spatial data needs to be processed cartographically and adapted to the needs of the mobile clients. In addition to the mobile client we have developed a Web3D Service server in Java, which we also want to introduce shortly.

State of the art in Mobile Navigation

Many commercial applications for PalmOS / Pocket PC PDAs are existing, which display the current position on a map in combination with a GPS receiver and facilitate a routing calculation. A lot of these applications are targeted towards car navigation, but they can also do justice in a limited way for pedestrian navigation in a city
In commercial car navigation systems often a 3D view can be activated, but this one does not deliver a real 3D representation of the map content. The map is rather represented vertically lower in order to introduce a 3D impression. For urban pedestrian navigation such systems have the big deficit to be based exclusively on routing data which are usually not suited for pedestrians. Pedestrian zones or private streets etc can be used by them, but are gernerally not particularly taken into consideration within such systems. Furthermore, the relative low information level of such a system constitutes another disadvantage. Although POIs are represented and it can be searched for them, no comprehensive information to the objects are given.

Special considerations of „Mobile“ Maps

The mobile terminals are showing some technical particularities such as a small display size, resolution, computing power and capacity of resources and these have to be respected doing the data preparation. Moreover, resulting from the “mobility” of the maps (respectively of the user) special consequences [Reichenbacher 2004, Zipf 2003] arise for mobile cartography, summarized roughly as follows:

- Changing places and contexts by change of position

- Locomotion by different velocities requires variable scales, degrees of generalisation as well as different levels of details
- The user is quite often under stress and has to come to a fast and contemporary decision.
- The user's attention is limited by surrounded influences
- Charms from the surrounding reduce the cognitive capacity
- The usage of the map happens parallel to other activities
- The user is mostly in an unknown space
- Resources are from a limited extent

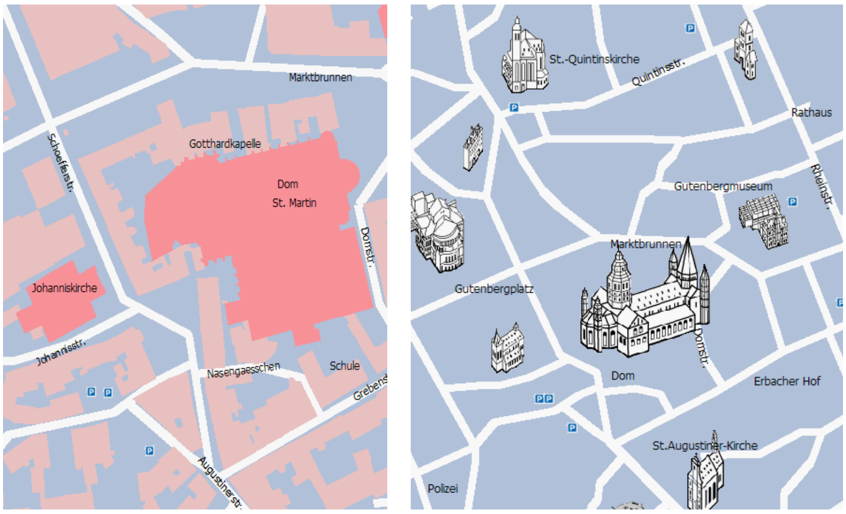
Those consequences have to be taken into account in a cartographical preparation as well as when desiging the information system, in order to guarantee a map design meeting the above mentioned problems. In addition to that two more important aspects emerge for the map design: a relevant issue for the map design is the task, which shall be solved with the help of the map. Furthermore the question arises, how to focus the users attention to certain for him relevant objects inna given context. Therefore its necessary to typecast respectively filter the relevant spatial objects and to evaluate them according to their meaning for the user. For this purpose some interesting models respectively procedures have been propsed. We believe that the map's task and usage should have the most pregnant influence on the map design. For example it is obvious, that other factors are relevant for navigation maps than for topological overview maps. Similarily pedestrians need different information than vehicle drivers. So the focus is targeted on different objects according to the task of the map. For the navigation of drivers first of all traffic routes and landmarks are important. Those have to be styled in a special way, while other objects can be represented quite simplified. Pedestrians on the other hand need much more detailed information to be able to orientate in a map. As basic map specific assignments for mobile terminals have to be mentioned the navigation and orientation as well as the search of certain places. As the database contains too much information, a data filtering with regard to information, which are relevant for pedestrians is necessary. The following list summariezes some for information important for tourists "on food":

- all ways and streets walk on by pedestrians

– name of the streets and squares
– sights (with high priority)
– buildings
– water bodys

Maps in Mainz Mobile

When the map is being designed a graduation into different levels of details is needed in order to deliver to the user the corresponding scale adapted information. A further task is to design a clear map configuration in accordance with each particular scale. This method also brings advantages concerning the computing time, because the loading and drawing of objects is limited to a minimal extent. Especially when using less powerfull mobile devices this results in a better performance while according map interactions. In the following paragraph some possibilities are summarized, regarding the map design for mobile terminals. Reichenbacher (2005) examines some methods putting important places (POIs) and particular map areas into the foreground with the help of suited graphical means and with it guiding the user’s attention on such areas. These methods are using similar effects, already exposed by Zipf and Richter (2002) regarding mobile focus maps. Within focus maps are utilized, different levels of generalisation and effects of fading colours to emphasize particular areas and objects of interest.



In Reichenbacher's work are, beside the evaluation of the relevance of geo-objects, techniques demonstrated how to display geo-objects with different relevance and how to highlight them accordingly. Following some of this techniques are introduced further: Using the hot-cold metaphor the different relevance of AOIs (Area of Interest) is marked by cold respectively warm zones. The different graduation of red and blue shades represents here the warm respectively cold zone. Another method shows the POI's symbols by a different transparency in conformity with their relevance. Important and relevant POIs are drawn with a high opacity, while less relevant POIs with lower opacities. Reichenbacher explains some more techniques of cartography to stress objects especially or less especially. Some samples are sketched in the following enumeration:

- Accentuation of a symbol by an enlarged representation
- Focusing of an object by adding fuzziness to the other objects
- Rotated representation of an object in the opposite to other objects of the same type
- Object accentuation by a well-fed colouring

Structure of Mainz Mobile 3D

The following figure displays the program structure when the application starts as well the co-operation of single 2D map application components introduced in previous sections. The figure depicts an reduced and schematized diagram of the program structure.

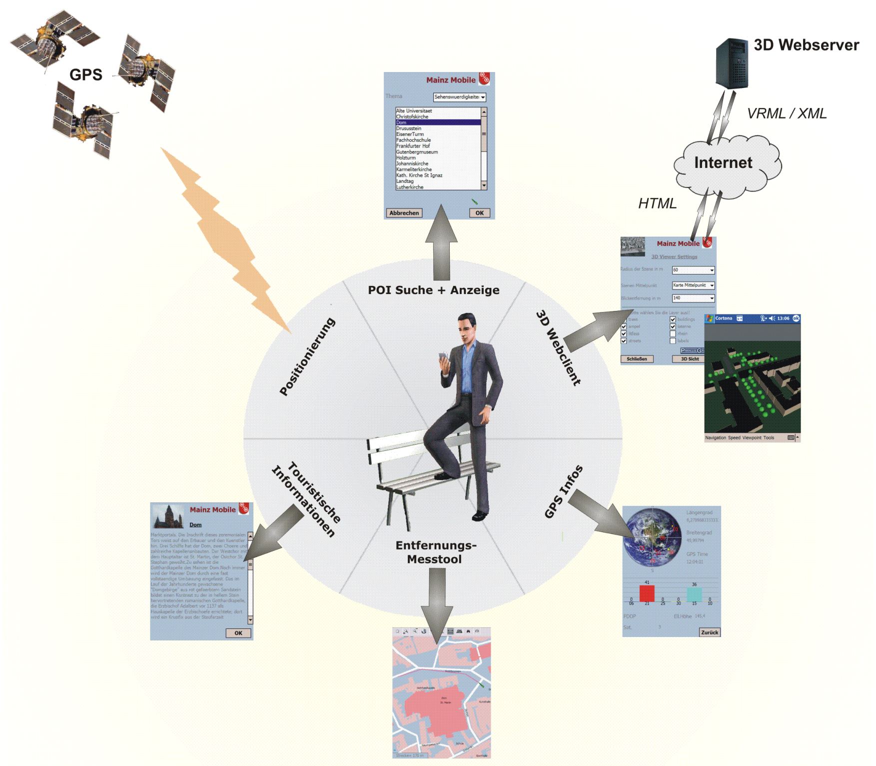


Figure x Schematized representation of the structure of the mobile application, when the systems is initialized and loaded as well as of the spatial visualisation

Mobile PDA-based Web 3D client

Using the mobile Web 3D client it is possible to query 3D scenes of a defined area from a Web 3D service. The server had been implemented by Jens Basanow and yields 3D scenes in the standard VRML-Format for the area of interest. For the visualisation of the resulted VRML scenes on the mobile PDA the software Pocket Cortona from “parallel graphics” has been used. In order to communicate with the web server an internet connection is needed. This is realized in the first Mainz Mobile 3D prototype through WLAN (Wireless Local Area Network).

OGC Web 3D Server implementation

The interface of our server application is based on OGC W3DS (Web 3D Service)[Quadt, Kolbe 2005]. The W3DS has been developed as an extension of OGC WTS (Web Terrain Service) and offers additionally the possibility to visualize 3D scene graphs [Basanow 2006]. In contrast WTS only provides the representation of static views as bitmaps.
As data for the first proptoype have been used 2D shapefiles of the city of Mainz. From these 2D features in the shapefiles 3D objects are being constructed on the base of attribute information and converted into a VRML-Format. The VRML scenes are then made available by a servlet embedded in Apache Tomcat. The provision of the VRML-scenes happens in conformity to OGC W3DS and yields by that a standardized interface to the client – server communication.
The folowing figure sketches the structure of the web 3D server schematically:

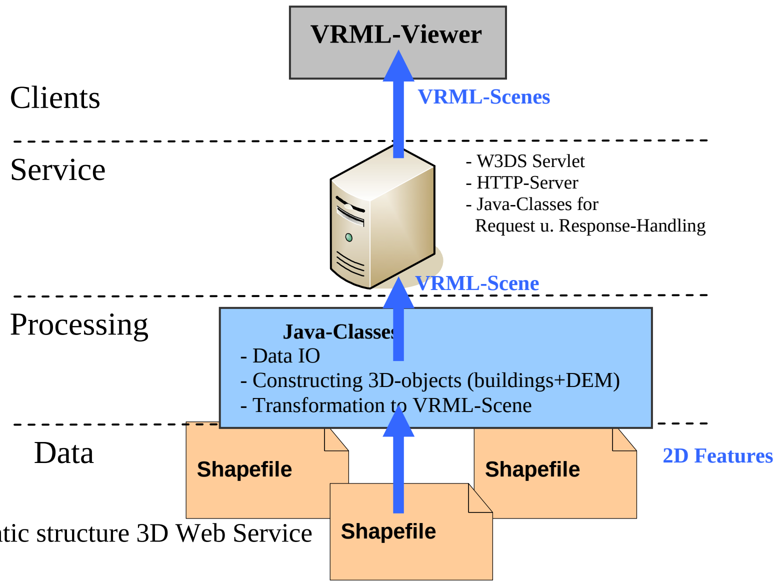


Figure Schematic structure 3D Web Service

Mobil User Interface

Resulting from an initial GetCapabilities-request to the W3DS all presently available layers are listed dynamically with checkboxes-from the capabilities-file on the generated user interface. In individual checkboxes for each layer the desired layers can be switched on or switched off..

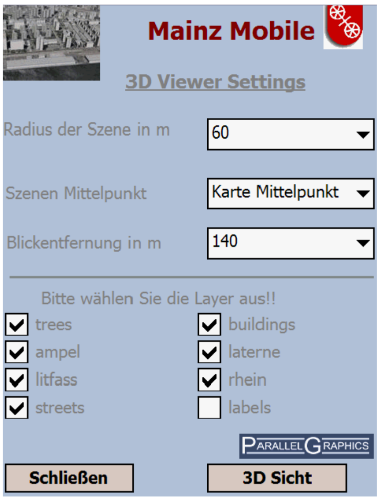


Figure 22 *3D- Settings* graphical user interface

When the user pushes the button „*3D Sicht“(3D View)*, the web 3D client calculates the parameter of the *getScene*-Request by means of the chosen values and assembles the HTTP-Request. An example of a *getScene* Request is given below:

```
http://myserver.org/wvrs?VERSION=0.1.0&REQUEST=GetScene
&FORMAT=model/vrml&POI=3448393.0,5540315.0,10&bbox=3448270.00,554
0239.00,3448466.00,5540404.00&DISTANCE=100&layers=vegetation,buil
dings,ampel,laterne &styles=tree,house,Campel,laterne;
```

If the *getScene*-Request is put together, it is sent to the web 3D server and the web 3D client receives the VRML-scene as response. The VRML-scene is saved in the persistent memory of the mobile terminal and the application *Pocket Corona* is activated with the specification of the data path to the VRML-scene. *Pocket Cortona* is started as process out of the web 3D client. In order to open VRML-scenes within the VRML-Viewer *Pocket Cortona* it is compulsively necessary to file this one before in the persistent memory, because unfortunately currently *Pocket Cortona* does not support the processing of data streams.

After *Pocket Cortonais* has been successfully started, the scene is displayed there and the user can navigate in the scene and has likewise the possibility to view the scenes from the different, in the VRML-scene saved viewpoints. In the following figure a sample scene is pictured viewed from three different default viewpoints.

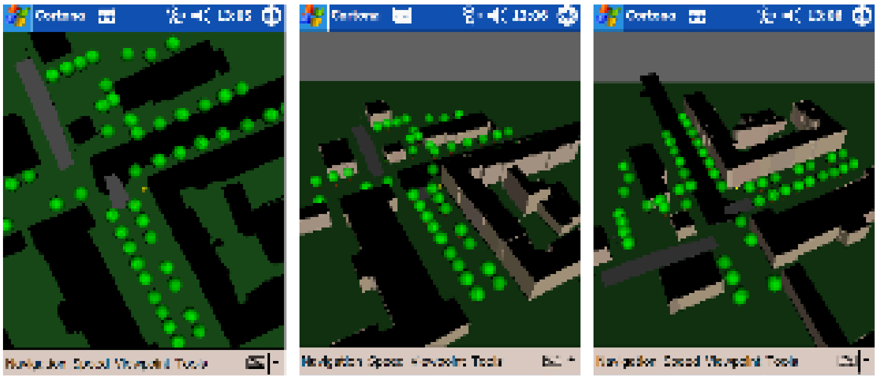


Figure Pocket Cortona scene view; (right) top view; (middle) from north to south; (links) from east to west

Following viewpoints are generated by the 3D web server:
– Top view on the scene
– View from each point of the compass (north, south, east, west)
The request-parameter *Distance* (within 3D web client = view distance) determines the distance between the viewpoint and the POI. Now the viewpoint is generated based on the corresponding viewing direction (top view, points of the compass), the seeded range and a fixed vertical angle of 45 degrees. Having closed *Pocket Cortona* by the user, the process as well the saved VRML-file is deleted. The user gets displayed again the 3D-settings-view and can request a new scene or finish the 3D web client and go back to the 2D scene.

Conclusion and Future Work

Derived from some tests a maximum size of a VRML-scene was determined about roughly 1.5 MB. This corresponds to an averaged bounding box of 200 x 200 metres in the chosen data set. Using bigger scenes *Pocket Cortona* have had considerable difficulties to

visualize them. Therefore the choice of the scene radius is limited to 100 metres within the graphical user interface 3D-Settings.
Both systems, server & client are being extended currently in several ways within a new project on interoperable 3D visualiszation of 3D city models. In addition we have several diploma thesis at the moment that deal with the extension of the mobile client to support focus maps, a authoring tools for geodata for mobile clients (using SLD among others), tour planning support, as well as extending the server functionality (e.g. better automation of roof generation etc.).

References

Basanow (2006): Basisimplementierung *eines OGC-W3DS-konformen Servlets für 3D-Szenen zur Unterstützung von 2D- Stadtinformationssystemen.* Diplomarbeit an der Fachhochschule Mainz, Standnummer: 1680.

Reichenbacher (2005):The concept of relevance in mobile maps. Symposium Location Based Services and Telecartography. Technische Univesität Wien.

Quadt und Kolbe (2005): *Web 3D Service*, OGC Discussion Paper, OGC Reference number: OGC 05-019, Version: 0.3.0

Lindemann, M. (2006)(in Arbeit): Ein Autorenwerkzeug für SLD-basierte Konfiguration mobiler Stadtinformationsdienste. Diplomarbeit. FH Mainz.

Dyck, A. (206)(in Arbeit): Online-Visualisierung von 3D Stadtmodellen. Diplomarbeit. FH Mainz. (Arbeitstitel)

Neis, P. (2006)(in Arbeit): Tourenplanung für einen Emergency Route Service auf Basis der OpenLS Spezifikation. Diplomarbeit. FH Mainz. (Arbeitstitel).

Schuler, V. (2006)(in Arbeit): Personalisierung mobiler Karten. Diplomarbeit. FH Mainz. (Arbeitstitel).

Schifani, E. (2006): Google Earth goes geographic. Evaluierung von GE für GIS Anwendungen in der Geographischen Forschung und Lehre. (Co-Superviser). Magisterarbeit. Geographisches Institut. Universität Heidelberg.

Fischer, M. (2006): Mobiler Stadtführer 3D für PDA. Diplomarbeit. FH Mainz.

Löhr, S. (2006): Thematische 3D Kartographie mit Google Earth. Diplomarbeit. FH Mainz.

Zipf (2003): Mobile Kartographie in: Kartographische Nachrichten (K/N), Ausgabe 1/2003, Seite 6-11, Kirschbaum Verlag

Zipf, A. and Schilling, A. (2003): Generation of VRML City Models for Focus Based Tour Animations. Integration, Modeling and Presentation of Heterogeneous Geo-Data Sources. 8th Int. Symp. on Web 3D Technology. Web3D 2003. 03/2003 Saint Malon. France.

Zipf, A. and Richter, K.F. (2002): Using Focus Maps to Ease Map Reading. Developing Smart Applications for Mobile Devices. In: Künstliche Intelligenz (KI) (Artificial Intelligence). Special Issue: Spatial Cognition. 04/2002. 35-37.