Poster: An integrated System for Indoor and Outdoor Location-based Services (MapBiquitous)

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ABSTRACT

Within the last decade, outdoor location services have developed to be ubiquitous and generally available to the majority of users, be it on desktop pcs or on mobile devices such as smartphones and tablets. However, these types of services are limited to outdoor areas, e.g. navigation between two buildings. The logical next step was to expand to the indoor area, for which recently different indoor location services, especially navigation services, have emerged. Up to now, these solutions lack global coverage, since most of them operate in a proprietary and isolated manner.

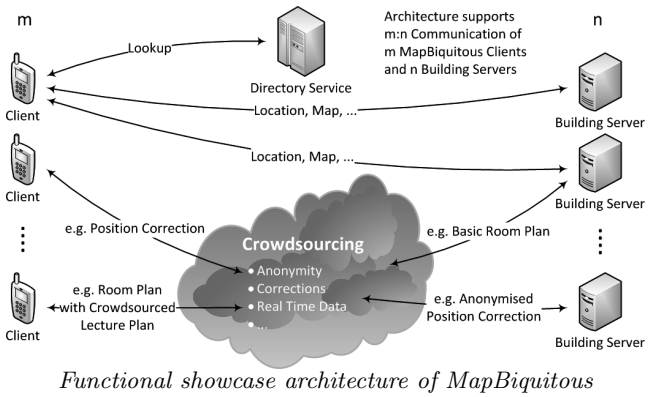
This fact makes the integration of outdoor and indoor location based systems a very topical area of research. Major challenges are the provisioning of building information in an interoperable and scalable manner, the support of heterogeneous technologies (e.g. based on various technologies like Wifi, RFID, or smartphone sensors) for indoor positioning and the cross-building navigation with pathes inside and outside buildings.

MapBiquitous* addresses these challenges by providing an integrated system for indoor and outdoor location-based services. The basic principle envisages a decentralised client/server architecture with building servers providing the necessary building information, e.g. ichnography, floor plans and navigation information. Clients are able to discover building servers using a location-based directory service and load building information at the granularity of floor plans with separate layers for navigation and positioning.

To ensure interoperability of building information, open standards for accessing and representing building information are used. We particularly use the Web Feature Service (WfS) and the Geography Markup Language (GML) specified by the Open Geospatial Consortium (OGC). Floor plans contain geometric information representing rooms and floors as polygons as well as semantic information like room numbers and room descriptions.

Clients store that information in a local model and project floor plans onto the map information based on overlays. Since WGS 84 coordinates are used, no coordinate transformation is required to match positions provided by GPS.

To determine the position we support multiple positioning methods. In addition to GPS two modes are supported: On the one hand, multilateration based on WLAN access points can be utilised. On the other hand, building servers can provide a service for positioning based on WiFi fingerprints. Furthermore, mobile device sensors (particularly magnetometer, accelerometers and barometer) are used to determine orientation and distance of relative movements as well as the floor level.



Functional showcase architecture of MapBiquitous

The concept for calculating navigation paths is based on the shortest path algorithm by Dijkstra. The calculation is carried out by the involved building servers. For outdoor paths Google Maps Navigation API is used.

Ascertainment and correction of information is supported by a distributed crowdsourcing architecture that makes users and their submissions anonymous towards the building servers while maintaining retroactive cancellation of submissions as well as anonymous user ratings.

Building servers are implemented based on GeoServer and WfS. An Android App serves as MapBiquitous client. Crowdsourcing is ought to be a self-organising P2P network.

Our research includes feasible methods of positioning by smartphones, combination of different approaches (e.g. angulation with pace models) as well as possibilities of correcting data and ascertainment of real time information. The focus remains on mobile computing and offline availability.

Categories and Subject Descriptors

H.5.4 [**Information Interfaces and Presentation**]: Hypertext/Hypermedia—*Navigation*; C.2.4 [**Computer Systems Organization**]: Distributed Systems—*Client/Server, Distributed Applications*

Keywords

Location-based Services, Indoor Positioning, Building Model, Indoor Navigation, MapBiquitous

* Project description and comprehensive list of references at http://goo.gl/eqJkG

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