Walking on the Web - Combining User-driven Location Mapping and Mobile Visualization

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Abstract. Today's georeferencing approaches and Location-Based Services (LBS) are primarily closed, domain-specific applications. In this paper, we introduce our vision of an 'Open Spatial Repository' as a first step towards loosely coupled LBS. To illustrate this idea, we present a novel location-aware Web browsing metaphor: according to a user's location and her current surrounding, the 'Real World Web Browser' allows the visual discovery and access of georeferenced services and thereby enables new use cases beyond common tourist guides and static points-of-interest (POIs).

Keywords: Mobile Web, Location-Based Services, Visualization

1 Introduction

'Volunteered geographical information' (VGI) [6], the Web-based creation of geographic information by individuals, has recently attracted enormous interest. Countless Websites make use of map mashups and provide ways to annotate digital information with related geographic identifiers - a process also referred to as georeferencing or geotagging. Wellknown examples include photo community sites such as Flickr[1] or Panoramio[2] with hundreds of thousands of geotagged user-submitted photos, Wikimapia[3] assigning articles of the famous online encyclopedia to the place of action or OpenStreetMap[4] creating a free source of map data. Even commercial navigation solutions providers such as TomTom[5] build on the user's knowledge to keep their map content accurate and up-to-date. Similarly, semantic approaches to mark spatial information in plain HTML such as Microformats, Dublin core and RDFa are increasingly applied.

At the same time, the technical access to such geotagged resources is simplified by the penetration of location-aware devices such as latest mobile phones equipped with built-in GPS receivers. In recent years the rendering quality of mobile Web browsers offered for such devices increased as well making them well-suitable for visualizing online content.

[1] http://www.flickr.com
[2] http://www.panoramio.com
[3] http://www.wikimapia.com
[4] http://www.openstreetmap.com
[5] http://www.tomtom.com/mapshare

Combining these developments, we argue for a more efficient and consistent usage of VGI, striving for a loosely-coupled engineering approach to realize the 'Locative Web' [9]. This paper introduces the vision of the 'Open Spatial Repository', a catalogue where geographic identifiers can be attached to arbitrary online resources pioneering the way for novel location-aware applications. As an illustrating example we present a mobile application called 'Real World Web Browser' suggesting a new location-based metaphor for browsing the mobile Web. Finally, we draw some concluding remarks about potential limitations and future work.

2 The Open Spatial Repository

In order to realize our idea of location-aware mobile Web browsing, we introduce the concept of the 'Open Spatial Repository' (OSR). Already mentioned tagging approaches to mark location-related information in HTML are a first step towards semantic meaningful Web content. But to efficiently execute spatial queries we need an external public accessible catalogue of Web resources mapped to their corresponding real world coordinate(s). Current geotagging practices on user-driven Web sites such as Wikimapia suffer from two main drawbacks.

First, most of them pursue a domain-specific purpose as for example mapping articles of the online encyclopedia to the described real world objects (Wikimapia and Placeopedia[6]) or geotagging uploaded photos (Flickr and Panoramio), other services like GeoURL[7] or GeoSearch[8] are restricted to Website-location mappings. Our proposed repository is supposed to support arbitrary types of online data connected to a real world position, e.g. any type of a Uniform Resource Identifier (URI), whether it identifies a Web page, a photo, a file download or any form of a Web service. This feature enables novel location-aware applications beyond current POI-based tourist guides.

Second, current geotagging Web applications usually collect user-generated annotations but do not make these data available for external software limiting the possible usage of this information. What is needed is the access to user-generated applications by an extensive interface for adding and querying data records. To increase the end-user's interaction possibilities and to take full advantage of existing data sources, location data and referenced resources have to be completely separated from actual applications and made available for public use. The proposed OSR is a first step towards this vision.

In a simple prototype we implemented the repository as a user-driven Web catalogue similar to a wiki where users are able to edit other users' entries. Via a standard Web interface contributors are allowed to assign real world locations (in terms of WGS84 coordinates) to URIs. While some URIs have exactly one real counterpart (e.g. a Website describing a monument), others may have several real world representations (e.g. a public transport service may be attached to all stations

[6] http://www.placeopedia.com/
[7] http://geourl.org
[8] http://geotags.com

and stops with different parameters). Optional attributes include validity parameters limiting the item's visibility for possible usage in specialized location-based applications: a radius may be determined in meters as well as time intervals similar to a shop's opening hours. Furthermore we suppose the attaching of arbitrary textual tags to URIs for later categorization and recommendation.

This user-based location tagging approach is thought as a complementation of large-scale automated registration techniques using data mining approaches such as presented in [1,3]. Still, for Web services such as services offered via SOAP and other digital resources, a manual registration process is necessary.

3 Real World Web Browser

This mobile application installed on a location-aware mobile phone makes use of the proposed OSR and displays Websites available in your current visible surroundings. Our 'real world Web browsing approach' follows the 'Smart Horizon' concept, which considers a mobile device as a virtual window beyond the user's current field of view [4,5]. To apply an appealing environmental visualization we build upon work done in the ongoing Austrian research project WikiVienna, where a community-based approach to reconstruct an urban model is investigated. We make use of a hosted rendering service returning an on-demand rendered panorama image according to the passed location [2] (see e.g. [7] for a similar approach offering panoramic sketches of mountain views). This image is augmented with the surrounding referenced Websites. The nearby items returned by a spatial query on the OSR passing an appropriate bounding box are limited to the currently visible ones by a visibility calculation engine [8] returning the visible items' distances and angles in relation to the passed user's position. We use the Websites' so-called Favicons or, if not available, an abstract icon to visualize the visible 'physical hyperlinks' on the rendering.

Fig. 1a. Augmented rendering

Fig. 1b. Preview zooming in

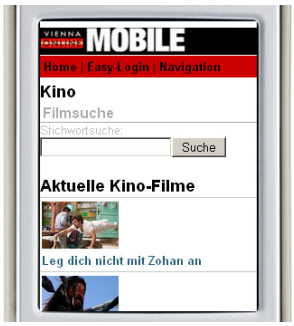

Fig. 1c. Web browsing in browser component

To avoid an annoying occultation of the rendered scene, all unselected icons are semitransparent (1a). When an icon is picked, a former generated preview of the

Website zooms in (1b). In order to best possible resemble the Websites' appearance if afterwards opened in the integrated browser component, we analyze the client's HTTP user-agent string. This common way to determine the requesting device's type allows us to manipulate the desktop browser used for rendering the preview images according to the users' mobiles. After previewing the site, the user may chose to open the Website in the integrated browser component for the common Web browsing experience (1c).

4 Conclusions

In this paper we introduced our vision of the Open Spatial Repository, where arbitrary digital resources can be mapped to corresponding real world locations. As a method to make the wealth of spatially-related Web resources around a mobile user, we proposed the 'Real World Web Browser'. The prototypical OSR can be extended in several ways. Besides the obvious integration of an automated crawling and geotagging of resources, a recommender engine providing similar nearby content to the one currently viewed would be a useful feature.

The presented preliminary mobile prototype exemplifies some general challenges arising from the real world browsing approach. A long-known but still critical problem is the insufficient adaptability of most Web sites to the restricted interaction capabilities of mobile devices. Another strong future research challenge is to manage the sheer amount of available Web information for certain places. In order to filter, sort and place the information in real world browsing user interfaces, the integration of the user context in form of a user model containing personal information, preferences and physiological data should be advanced to recommend suitable resources.

Regarding the user perspective, we are interested in the effect of georeferenced interactive services in contrast to static location-based information offered by common location-aware applications. Do they provide any additional value beyond static points-of-interest in the standard tourism scenario? Future research should help realizing the vision of bringing the Web's full interaction potential to the focus points of daily life.

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