Clouds on the Move – Applying the Tag Cloud Metaphor to the Mobile Domain

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Abstract. Folksonomies are an effective technique to collaboratively organize today's vast amount of user-generated georeferenced data. In this paper we introduce the idea how their common visualization form, a so-called tag cloud, can be applied to the mobile domain. We present our system that analyzes an underlying georeferenced tagged dataset and creates an abstract information space describing a mobile user's current location as an alternative to usual 2D map representations. The proposed location-aware 3D tag bubble provides an innovative lunatic interface for exploring and overviewing a location and its georeferenced information, respectively.

Keywords: Mobile HCI, Information Visualization, Information Retrieval

1 Introduction

The advent of mobile devices featuring extensive multimedia, navigational and networking features fostered the growth of user-generated data in the Web. Especially the field of 'Volunteered Geographical Information' (VGI) [3], the Web-based creation of geographic information by individuals, has 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. Well-known examples include photo community sites such as Flickr[1] or Panoramio[2] with hundreds of thousands of geotagged user-submitted photos. Beside the geographic identifiers, these sites enable the assignment of descriptive textual tags in order to collaboratively classify the contributed data. A popular tag visualization and interaction form on Websites are so-called tag clouds presenting the most-assigned tag names and linking them to classified content.

Recently, tagged user-generated data and tag clouds have become subject of scientific research. Examples include the analysis of spatiotemporal photo annotations to uncover tourist streams [2] or the automated reconstruction of 3D city models based on user-generated photos in our current research project 'WikiVienna' [6]. Studies to measure a tag cloud's effectiveness for various tasks have been conducted in [9,4]. Algorithms to improve the display of tag clouds on Websites have been published e.g. in [8]. Other researchers augmented the classical tag cloud concept by

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1 http://www.flickr.com
2 http://www.panoramio.com

adding a temporal dimension to monitor changes in the cloud over time [1]. Novel visualization approaches which combine common 2D maps with tag cloud overlays resulting in so-called tag maps have been studied e.g. in [7,11].

In this paper we introduce the idea of transferring the tag cloud concept into the mobile domain applying it as an abstract visualization of a mobile user's current surroundings. Based on a tag analysis of nearby georeferenced data the presented system creates and presents an abstract information space characterizing the user's location. Thereby, our client application takes advantage of latest mobile phones' technical capabilities such as navigational features and acceleration sensors providing a lunatic interface for exploring and overviewing the location and its georeferenced content.

The paper is structured as follows. Section 2 summarizes basics about the tag cloud concept. In Section 3 and 4 we describe our current system's architecture and the mobile interface, respectively. Details about the prototypical implementation are given in Section 5. Finally, Section 6 draws concluding remarks and provides a short outlook on upcoming research.

2 From Tags to Tag Clouds

With the emergence of social software including web applications such as Flickr or Facebook[3], not only the Web-based interaction between users was facilitated but also the sharing of data amongst them. In order to classify the always increasing number of user-generated and user-contributed data in a self-organizing manner, the respective users themselves are encouraged to annotate the data with appropriate tags. This collaborative approach of assigning freely chosen keywords by nonprofessionals is called a 'folksonomy'.

To visualize the most-assigned tags on a web site, they are arranged in tag clouds: tag clouds are weighted lists of tag names whereas the textual attributes such as the text's size, weight and color as well as the word placement may be used to indicate special tag properties. In the most common implementation a tag's frequency is represented via its font size: the larger a tag name is visualized, the more often it has been assigned.

Tag clouds appear in different layouts:

- Classical layout: The weighted tags are alphabetically sorted and arranged horizontally in a rectangular area line by line.
- Spatially clustered layout: The tags are not alphabetically sorted but placed in a way to fill the available space best. Therefore, single tag names may be presented even vertically in a crossword-like style.
- Semantically clustered layout: The placement of the tags is based on a semantic measure. Tags presented close to each other are semantically more related than distant tags.

[3] http://www.facebook.com

Beside these 2D layouts, there have also been implementations of 3D tag visualizations such as the recently published project 'WP-Cumulus' [12]. WP-Cumulus provides a visually appealing animated 3D representation with tags arranged on an imaginary sphere. This work has been an important inspiration for our current mobile prototype.

Once a tag cloud has been generated and visualized, it supports a user in different tasks [9]:

- Searching: Looking for a specific object taking advantage of the tag descriptions.
- Browsing: Exploring the underlying dataset without any specific target.
- Impression Formation or Gisting: Getting an overview of the available topics and their frequency due to weighted visualization.
- Recognition/Matching: Distinguishing between two equally named entities based on their respective tag cloud's characteristic attributes.

Our idea of the 'mobile tag bubble' as explained below aims especially at supporting a mobile user in the tasks of browsing and gisting a location.

3 System architecture

Our system architecture's main components are depicted in Figure 1. They include the client application executed on a location-aware mobile device and a set of georeferenced tagged items in a data store on the server side which can be queried through a public accessible service interface. In order to relieve the mobile device of processing large amounts of data, we insert an intermediate service responsible for fetching and preprocessing the tagged information. At the same time, this plug-in enabled service acts as a proxy making an exchange of the underlying data set transparent to the mobile client.

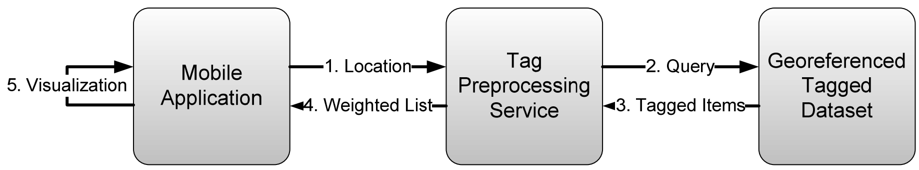

Fig. 1. Interaction of the three main components: the mobile application, the tag preprocessor and the underlying dataset.

After determining its current location, the mobile application invokes the preprocessing service passing the user's whereabout. The preprocessor builds a spatial query in respect to the underlying data set to fetch information about the georeferenced items in the user's current surroundings. Following, the tags attached to these items are extracted, grouped and counted. Depending on the data source and its available API several service invocations may be necessary to retrieve the required information. The last step is a normalization algorithm to map the tags' absolute frequencies to percent values.

Final output of the preprocessor service is a simple comma separated list containing the tags' names and their respective relative frequency. For more advanced use cases this data format should be extended, e.g. to include an action parameter per tag describing the action to be triggered when the corresponding tag is selected.

4 Mobile Interface

Once the location-based weighted tag list is fetched from the preprocessor service, the percental frequency values are converted to font sizes. Appropriate labels are created for the tag names and placed in 3D space forming an imaginary bubble. To increase the 3D effect and enhance the readability, labels farther away are faded out towards the background.

When tilting the mobile, the tag bubble behaves like a ball on a tilted surface: tilting it forward or backward rotates the bubble around the coordinate system's x-axis, tilting it to the side makes it rotate the y-axis. Supporting the mobile's acceleration sensors provides a lunatic experience exploring the presented information space. In order to use the prototype on devices without touch screen, the tag name currently closest to the user is the active one and marked with a frame. Pressing the action key might trigger the action specified for this tag such as to open a sub bubble or visit a Website.

a b

Fig. 2. The mobile 3D tag bubble representing data from Flickr's photos (a) and WikiVienna's content (b)

Figures 2a and 2b show the tag bubbles for a user located at Stephansplatz, a famous square in Vienna's first district. In Figure 2a the underlying data set were photos queried from Flickr restricted to the 15 most assigned tags. Although this tag bubble contains relevant information characterizing the location such as 'church' and 'cathedral', the labels with geographical identifiers such as 'vienna' or 'austria' (in different languages) are annoying and are visually dominating the cloud's appearance.

The tag bubble depicted in Figure 2b is based on content collected in the scope of our project 'WikiVienna'. Its database combines user-generated locative media and common points-of-interest (POIs) such as restaurants, hotels, etc., all labeled with appropriate tags. In contrast to Flickr's tagging systems, tags cannot be freely chosen but are selected from a default tag list what results in a more meaningful visualization of the area around 'Stephansplatz'. This time, the most dominant labels are tags such as 'culture', 'architecture' and 'shopping' – illustrating this location's character very well.

5 Implementation

For the implementation of the current prototypical system the Java programming language has been used. The preprocessor is based on JEE components, its functionality exposed through lightweight HTTP services.

The mobile application is written using the Java 2 Micro Edition (J2ME). The development was facilitated by its extensive support for 3D calculations and representations. Furthermore J2ME's optional sensor API (JSR 256) enables an easy access of built-in acceleration sensors. For our tests we chose the model K850i from Sony Ericsson which supports the aforementioned sensor API and comes with an external GPS enabled headset. Alternatively, a version of the mobile application based on Adobe's Flash Lite technology is conceivable. Flash Lite enables smoother vector graphics but does not support low level 3D operations natively.

The problem of an even distribution of points on a sphere is a nontrivial task and mathematicians have come up with a variety of different solutions. Currently, our mobile application makes use of the so-called spiral algorithm by Saff and Kuijlaars [10].

6 Conclusion & Future work

In this paper we introduced our idea of a location-aware tag bubble fed by an arbitrary underlying dataset of georeferenced tagged data. Furthermore, we described the necessary technical components and gave details about our prototypical implementation. The bubble acts as an abstract information space describing a mobile user's current surroundings. Rolling the tag bubble by tilting the mobile device provides a lunatic user experience and aims at supporting the bubble's purpose of location exploration. Beside this browsing feature the presented tag bubble also supports the usual tag cloud's task of providing an overview and revealing a location's character.

Our first tests with photos from Flickr showed that for datasets with freely chosen tags, more complex algorithms for creating a proper weighted tag list have to be implemented. Such approaches include the removing of geographical identifiers (e.g. using a geographical database such as Geonames[4]) and usernames as well as the

[4] http://www.geonames.org

detection and extraction of semantically redundant tags as demonstrated e.g. in [5]. Experiments with datasets using more fine-grained tags selected from a default list resulted in clear and meaningful visualizations.

Our future work is going to include possible further adaptions of the proposed tag bubble for the mobile context. Concretely, we are going to investigate the integration of more contextual attributes into the tag bubble such as user interests and time. Additionally, textual attributes of the bubble's labels may be exploited to imply geographical measures such as distances to concrete POIs. In order to gain valuable insight regarding the usability and comprehension of such an abstract information space and evaluate the tilt-aware interface, user studies are going to be conducted.

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