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Exploring Hierarchically Organized Georeferenced Multimedia Annotations in the MobiTOP System

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Abstract

We introduce MobiTOP, a map-based interface for accessing hierarchically organized georeferenced annotations. Each annotation contains multimedia content associated with a location, and users are able to annotate existing annotations, in effect creating a hierarchy. MobiTOP's interface was designed using a participatory design methodology to ensure that the user interface meets the needs of potential users. A pilot study to compare the MobiTOP interface with a space-filling thumbnail (SFT) interface suggested that participants preferred the MobiTOP design for accessing annotations even though the SFT interface was conceptually easier to understand resources.

1. Introduction

Social tagging systems such as del.icio.us and Flickr allow users to annotate a resource, such as an image, a physical location, or a web page with a freely chosen set of keywords or tags. Tagging is a tool not only for categorizing but also for searching and constructing social knowledge [10]. Users share their content with their tags, generating an aggregated tag index or a folksonomy [13], which is a form of user-generated metadata or annotation.

With the increasing popularity of mobile devices with GPS capabilities, the tagging or annotating of locations with multimedia content is becoming common [4]. For example, users may annotate a location with images and text captured using their camera phones, and share these with other users. In the spirit of social computing, a system supporting the sharing of georeferenced multimedia content should also allow other users to include annotations to existing content as well. This collaborative annotating process forms a threaded discussion on a topic, allowing a community of users to exchange and explore content and ideas. Put differently, these annotations form a hierarchical structure in which a node is an annotation resource and the edge is the relationship between two annotation resources. By publishing such annotations attached to a location, we create a visible “buzz” of “interest clusters”.

Existing tagging systems only allow users to employ keywords or tags to annotate content. Here, tag clouds are the main means to access the content. A tag cloud provides a good overview of the tags in a social tagging system but is not well suited for accessing hierarchical annotations since users may wish to drill-down a particular annotation and would only like to view tags associated with that branch of the hierarchy. In addition, tag clouds do not give a visual indication of the locations of georeferenced content. For the latter, map-based visualization techniques are suitable,

and systems such as Flickr allow users to mark the locations of content on the map with icons or thumbnails. However, such map-based interfaces do not provide sufficient features to explore the available tags that lead to relevant content, making it difficult to understand the distribution of tags over different locations. Taken together, social tagging and map-based visualizations are ideal tools for exploring content and have been used successfully separately.

To the best of our knowledge, little work has been done to combine these two concepts for exploring hierarchically organized georeferenced annotations. We investigate this idea in this paper by proposing and evaluating a user interface derived from a participatory design workshop.

2. Related Work

There is a growing body of research in the use of tagging for managing and accessing content. For example, [5] evaluated the effect of different properties that can be utilized in presenting tags, including alphabetization and font size. Further, the tag cloud is a commonly used technique to provide access to content in systems that employ social tagging. For example, [8] uses a tag cloud to summarize web search results, while [6] improves on tag clouds by reducing the semantic density of the tag set, grouping tags by similarity based on clustering techniques. While promising, these systems do not effectively present georeferenced content, which we aim to address in this present work.

In terms of displaying georeferenced content, the map-based interface is a popular technique employed in many systems. In [11], a system known as TagNSearch clusters geographically nearby photos, and each cluster is associated with a tag cloud that presents an overview of the photos' tags in that cluster. Two other existing systems that support access to georeferenced content include Flickr and World Explorer [1]. Both systems allow users to assign locations to photos on a map, and display them using a map-based interface. These systems adopt clustering techniques that summarize the types of tags appearing in a specific location. However, no provision is made for adding and displaying hierarchical content, which we attempt to support in the present work.

3. Participatory Design Workshop

A participatory design workshop was conducted to synthesize ideas for interface design to help users

manage and seek information through a hierarchical system of annotations. Participatory design is a collaborative design process where potential end users and the development team come together to apply their knowledge and experience with a useful and usable end product in mind [9]. This approach calls for the active participation of the users and compels system developers to understand users' needs from a different standpoint. Since current tags visualizations are flat, users might not be able to understand and learn the hierarchical aspect of the tags if presented. Our approach would allow users to determine how they would want to view the hierarchy of annotations.

3.1. Participants and Workshop Organization

Four participants took part in our workshop. There were three males and a female participant with ages ranging from 18 to 30. Participants were students and working adults, and a majority had a technical or engineering background. Most of the participants had heard about social tagging but were not entirely familiar with the concept. They also did not visit social tagging sites frequently.

The participants were divided into two groups. One group had technical knowledge, while the other was had varied backgrounds. This was to ensure that designs would reflect the perspectives from both technically inclined people and lay users. Participants were first introduced to the purpose of the workshop. The importance of an original user interface which is able to effectively present a hierarchical annotation structure was stressed to the participants.

Scenarios were given to both groups to help with the design process. They were provided stationery to sketch their designs. There are two reasons for choosing a low fidelity approach. First, we were still in the early stages of the development process, and second, this was the participants' first time being involved in such a process. Thus, a low-fidelity approach was more accessible for the participants as it enabled them to sketch their ideas quickly. After the briefing, the participants took about an hour to develop with their designs. Each of the groups then presented their designs and everyone involved in the workshop, including the developers, discussed the merits of the two user interfaces. Based on the comments, refinement of the designs was then done before a final design was chosen for implementation.

3.2. Design Outcomes

The figures shown below are the design outcomes of the workshop. Figure 1 was designed by the group with participants from different backgrounds, while Figure 2 was by the other group comprising participants with technical/engineering backgrounds. Both designs had their strong points and this sentiment was shared by everyone who participated in the workshop.

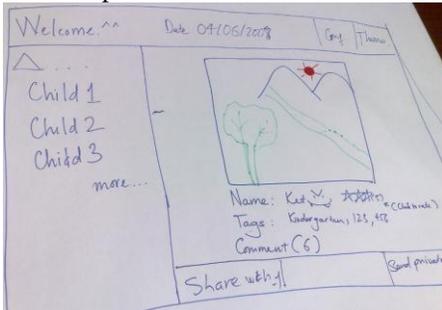


Figure 1. Varied background design (Design A).

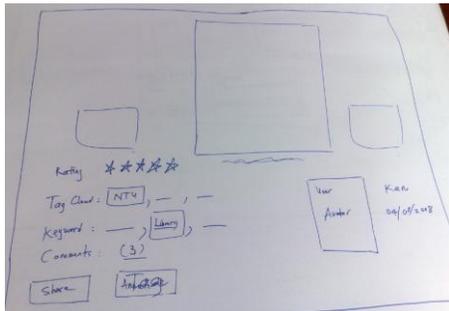


Figure 2. Technical/engineering background design (Design B).

The participants liked the layout of Design A as it was simple but yet informative. The participants managed to incorporate the hierarchical aspect of the tags in their design. The hierarchy is shown with two levels, one parent and many children, at any time. For Design B, participants felt that being able to browse the images linearly is a good way to show what other pictures are related to the current picture. Based on the two designs above, a refinement of the designs was made. We made use of the linear browsing feature of Design B integrated with the layout of Design A.

3.3. The MobiTOP User Interface

In this section, we describe the implementation the user interface based on the outcomes from the participatory design workshop. Our system, MobiTOP (Mobile Tagging of Objects and People) is designed to support the collaborative creation, sharing and access of multimedia content generated using mobile devices

and desktop computers. Our focus in this paper is on the Web/desktop MobiTOP interface derived from the participatory design workshop.

Here, the MobiTOP interface uses the Google Maps API together with custom AJAX code to allow to users interact with the system through a web browser. The server is implemented on a Linux system using an Apache web server. Content is managed using a MySQL database and PHP is the programming language of choice. Figure 3 provides an overview of the architecture of the MobiTOP system.

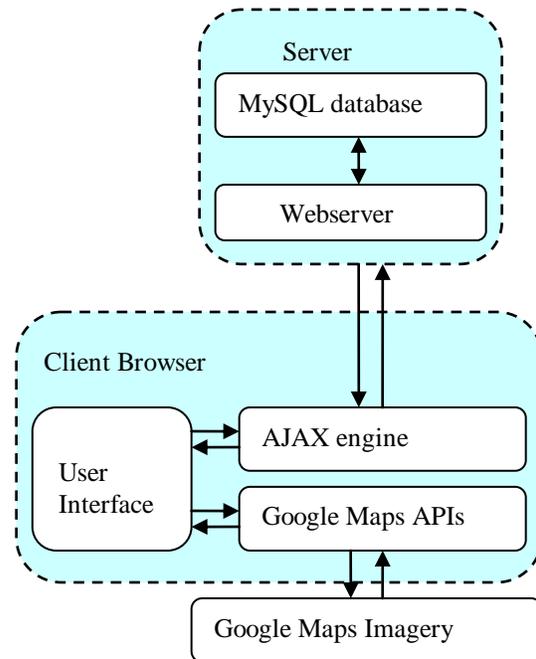


Figure 3. The architecture of the MobiTOP system.

Figure 4 shows the MobiTOP user interface. To view a group of annotations at a particular location, users only need to click on its corresponding marker on the map. A popup window will appear, displaying the information needed. The content within the popup window is organized as follows:

- At the top, a thumbnail place holder is available for displaying thumbnails of annotations associated with the current location. When user clicks on a tag on the tag cloud, the system searches and returns all the annotations associated with that tag. The results then are displayed as thumbnails. Each thumbnail represents an annotation. Users can browse the thumbnail by clicking on the left and right arrows. When a thumbnail is selected, the content of the respective annotation is displayed and the selected thumbnail is shifted to the center.

- On the left, a tree view of the hierarchy of annotations is displayed as a series of thumbnails. This tree includes the parent annotation and its children. The parent is the currently selected annotation while the children are those that annotate the current annotation. Besides a thumbnail image, we also associate each annotation in the tree with a partial set of tags that describe that annotation. Due to space limitations, a tooltip facility is provided that presents the entire set of tags when a particular annotation is moused over.
- The right panel below the thumbnail holder is the content panel. It displays information such as the author of the selected annotation, date of contribution, the ratings received from the community, a description of the annotation, and related tags. The related tags are presented as a tag cloud, which shows the tags associated with that annotation and its children. Each tag in the tag cloud will lead to a search action which lists all resources associated with it.

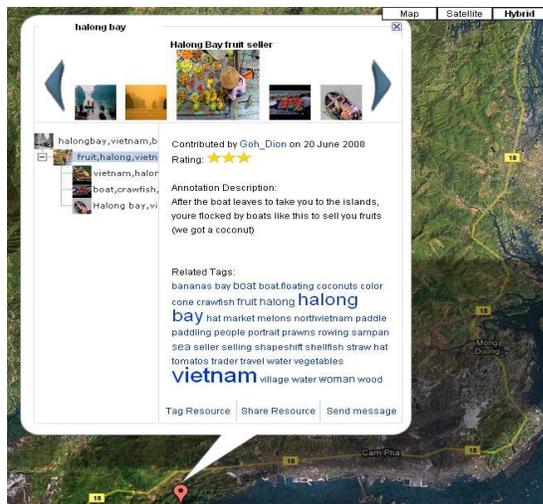


Figure 4. MobiTOP's main user interface.

4. Evaluation

A pilot evaluation of the MobiTop user interface was conducted to determine its usability by comparing it against a Space-Filling Thumbnail (SFT) interface. This section will describe the SFT user interface, the profile of the participants, evaluation setup and the results obtained

4.1. Space-Filling Thumbnails User Interface

The Space-Filling Thumbnails (SFT) technique is an approach to document navigation which eliminates most scrolling by allowing users to switch between a detailed view of a single result item and an overview of the entire result set [2,3,7]. Different from the MobiTOP user interface, when users click on a tag in the related tags list, a new page showing the result set of annotations are displayed as thumbnails. Clicking on a thumbnail will show the details of the annotation. Our implementation of the SFT interface is shown in Figure 5 and Figure 6. As described, the SFT interface has two display modes: a thumbnail view (Figure 5) and the annotation detail view (Figure 6).



Figure 5. SFT thumbnail view mode.

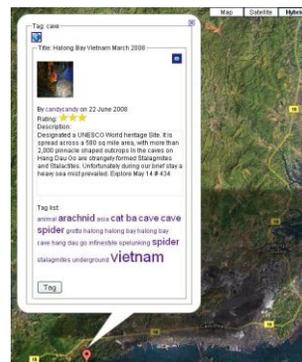


Figure 6. SFT page view mode.

4.2. Participants

A total of eight participants took part in the evaluation. There were an equal number of male and female participants. The majority (4) of the participants were within the 25-30 age group, while three of the participants were younger than 25 and one was more than 30 years old. There were a mix of both students (3) and working adults (5). Five of the participants had a computer science background and the rest were from other areas. Five of the participants had been using the Internet between six to ten years while two of the participants had used the Internet for

less than six years. One participant used the Internet for more than ten years. All participants were aware of online social community web services like blogs, video sharing sites and photo sharing sites.

4.3. Evaluation Setup

Participants were first briefed on the concept of an annotation and were introduced to MobiTop system as well as the SFT version of the system for comparative purposes. Each of the participants was then assigned tasks in order to compare and evaluate both user interfaces. The tasks focused on the different aspects of information seeking strategies, namely search and browsing. The first task asked the participant to locate frequently used tags that are associated with a given location, while the second task required the participant to search for annotations describing a particular location and activity that a user had contributed previously. The user interfaces to be evaluated were given in different order to the participants. That is, half of the participants evaluated the baseline user interface first before moving on to MobiTop interface vice-versa. This counterbalancing was done to remove the transfer of learning effects.

The participants were asked qualitative questions about the usability for each of the user interfaces after completion of their tasks. These were given in a scale of 1 to 5 ranging from very easy (1) to very difficult (5). They were also encouraged to elaborate on their answers by giving qualitative comments. The last part of the evaluation required them to answer another set of questions regarding their opinion on the overall features of the MobiTop system. Overall, participants took about 45 minutes to complete their evaluation, and were given a small token for their effort.

4.4. Result and Discussion

The participants' opinions on the user interfaces are shown in Table 1. The values in the column headed by the user interfaces are the users' opinions on the usability of the interfaces in general. Because the SFT system was conceptually simpler to understand, participants indicated that it was easier to use it than the MobiTOP system, although the mean difference between preferences were relatively small.

However, in an open-ended question which required participants to state their user interface preference, all except one preferred the MobiTOP user interface. This is despite the fact that participants felt that the MobiTOP interface was harder to use than the

SFT interface, as suggested in Table 1. The major advantage of the MobiTOP interface is its ability to present annotations hierarchically. The participants commented that the hierarchy provided a new and easy way to browse the annotations. It was also easier to backtrack to previous related annotations than the SFT interface. The only participant who did not prefer the MobiTOP interface did not like to tree structure presentation.

In contrast, seven of the participants did not like the SFT interface. This was because they felt it was not sophisticated in terms of the features available when compared with the MobiTOP interface. Further, participants mentioned that it was difficult for them to get a clear idea on the relationship between annotations as well as navigating between related annotations.

Table 1. Mean participants' opinions for the different user interfaces (1 = strongly disagree; 5 = strongly agree).

| Questions | SFT | MobiTOP |
|--|------|---------|
| Was it easy to understand what the interface is about? | 2.00 | 2.63 |
| Was it useful that the application showed you all the annotations containing the specific tag in the form of thumbnails? | 1.63 | 2.75 |
| Was it easy to browse the annotations? | 1.63 | 2.63 |
| Was it easy to view the annotation's content on a popup window in the map? | 1.88 | 1.88 |
| Was it easy to use the tag list for browsing of related annotations? | 1.88 | 2.13 |
| Was it easy to understand the relationship between annotations? | 1.50 | 3.25 |

The participants overall impressions of the MobiTOP system are shown in Table 2 using Nielsen's 10 usability heuristics [12]. With the exception of two heuristics, the participants had a good opinion of the system. Some of the areas which could be improved upon are validation checks and the availability of help and documentation about the system.

In sum, participants stated that they preferred the MobiTOP user interface that presented annotations

hierarchically even though it was slightly more difficult to grasp than the simpler SFT interface. The results thus suggest that with sufficient time given to learning, participants would be able to effectively access content using the MobiTOP interface.

Table 2. Participants overall opinion of the system (1 = strongly disagree; 5 = strongly agree).

| Questions | Mean |
|---|------|
| Application keeps me updated | 1.88 |
| Application is responsive | 1.63 |
| The language used is easy to understand | 2.00 |
| The language used is consistent | 1.63 |
| It is easy to undo or cancel actions | 2.25 |
| There are enough validation checks to ensure that errors do not occur | 3.00 |
| The layout is easy to understand and navigate | 1.75 |
| Navigation controls on the digital map are intuitive | 1.75 |
| I know where and what I can click on | 1.75 |
| The screen layout is consistent | 1.50 |
| Adequate help is provided | 3.13 |

5. Conclusion and Future Work

In this paper, we present MobiTOP, a map-based interface that supports exploration of georeferenced hierarchical annotations. Using a participatory design approach, the user interface drew ideas from a group of potential users of the system. In this way, we ensured that we paid careful attention to design requirements in order to satisfy users' search experiences. We also conducted a pilot study to verify our design and the results showed that while MobiTOP was harder to learn than a baseline SFT system initially, participants appeared to prefer the former because of its ability to handle hierarchical annotations. Further, the map-based interface effectively presents georeferenced content than tag clouds. The results of this initial work therefore suggests the viability of our approach of combining social tagging and map-based visualizations for exploring georeferenced multimedia annotations.

In the immediate future, we plan to incorporate tag cloud generation algorithms that can handle reduce the number of tags to be displayed. During the evaluation, we found that there could be a potential information overload problem for popular locations with many annotations and associated tags.

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