CO-067

IMPLICIT USER LOGGING AS A SOURCE FOR ENHANCING THE USABILITY OF WEB-DELIVERED CARTOGRAPHIC APPLICATIONS

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BACKGROUND

Today's scientific engagement requires a rapid flow of information to users and decision makers. Modern information technologies such as the Internet, database management and mobile communication offer possibilities for collecting, analysing and communicating important information and for publishing results practically in real-time. With the steadily increasing amount of information from various sources, the need for efficient and profound processing and communication is rising. In order to fulfil this task, theories and methods of communication science have to be brought into focus.

By incorporating spatial and temporal information and cartographic expertise into scientific work environments, relevant facts can be depicted in an even more effective and visually understandable form. The determination of the unique attributes of geo-located artefacts is required as a substantial part of various research projects, in order to better facilitate the design of communication systems in terms of content management, analysis and synthesis.

Furthermore, methods and concepts for visualization and communication processes are examined with regard to topics like information access, usability, engineered serendipity (where the user is able to 'browse' through a web-delivered interactive integrated media repository) and the differences between various interdisciplinary expert/non-expert user groups. This shift from a mere content provision towards more personalized and individualized geo-repositories has great potential for facilitating international and transdisciplinary collaboration on various levels.

However, there seems to be a lack in the implementation of these considerations within most cartographic online systems [Pucher, 2009]. Furthermore, very often basic user requirements are not considered or ignored at all. Since both spatial as well as thematic content are complex themselves, the usability of such systems should assist the users, instead of confuse them. This paper presents a possible way to monitor systems as well as their users in real-time, in order to identify possible usability weaknesses. The basic prerequisite although to avoid these issues already in the scope of the development phase is however to follow a User-Centred Design approach.

USER-CENTRED DESIGN AND USABILITY

User-Centred design is a design philosophy that puts the end user in the focus of all design considerations. By designing a product on the basis of iterative prototypes that are all subject to real user testing, it can be assured that user requirements, usability and user satisfaction of the end product can be met at a very high level. Over the last years an increasing number of cartographic application designers have committed themselves to these principles.

Usability is defined by the International Standardization Organization as the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" [1]. This definition implies that application designers have to clearly specify the user group and usage scenarios for which the future system is intended. Major factors of system usability are learnability, efficiency, memorability, errors (low error rate, easy error recovery) and user satisfaction [Nielsen, 1993]. However a system can never reach a high degree of usability when the requirements of prospective user groups are not fully incorporated into the application design criteria in the earliest concept stage.

OBJECTIVES

In recent years, methods and techniques of studying the use and usability of products, and thereby following at User-Centred Design in the fields of geoinformation and cartography have been increasingly adopted among the scientific community. Developers of cartographic online applications can no longer afford to avoid the involvement of potential future users (their requirements, expectations and use contexts) during the design process. A variety of methods are available to assist the development process from the planning and requirement analysis stage to design and implementation and the post release evaluation. Usability.net [1], as one prominent providers of resources related to practical usability offers a variety of tools and methods for the involvement of usability testing throughout the development process of a system. However, virtually all common methods can be considered as explicit and thus comprise the

awareness of the acting persons involved (e.g. stakeholders at a strategic meeting, users in surveys or test scenarios). Furthermore, direct access to the user is required by a lot of methods. The methods are subdivided into six sections from 'Planning & Feasibility' to 'Post Release'. Out of the list of 39 methods, 19 require direct user access. Even more notable, all but one method ('Heuristic evaluation') in the Section 'Test & Measure' are not applicable without direct user access. In the section 'Post Release', all methods require direct user access.

This concludes to the fact, that especially in the phase after the implementation and market launch of a system, direct user access is highly needed to monitor, test and measure the viability and effectiveness of a system.

APPROACH

There is however a very powerful tool to gather information about the use, users and usability behaviours of a system without getting in direct contact with the user. User logging, often also referred to as user tracking, is a common method used by nearly every professional website developer and provider. A variety of analytic reporting tools are available on the web, both as freeware as well as proprietary systems [2]. Their main objective is to parse standardized web server log files in order to gain as well as present information about common features of web site visits.

Among the most common indicators, web log analysis software feature are the following:

Number of visits and number of unique visitors	Operation systems and browser used
Visits duration and last visits	Search engines, key phrases and keywords used to find the analyzed web site
Authenticated users, and last authenticated visits	Hosts list
Days of week and rush hours	Domains/countries of host's visitors

Table 1: Common Web log analysis features [3]

These features deliver valuable information for website operators on technical, operational and economic basis. However they lack information about the usability and behavioural aspect of the users visit to a certain website. The bare number of visitors to a site might be interesting for commercial reasons, but does not give any implications to the quality of a site in terms of usability. The distribution of operation systems and/or browsers used is important to optimize the system towards full compatibility with all common software in use, it does however not indicate any errors in the information architecture of the website. In the special case of internet sites with cartographic content, this fact is even more important, since we do not have to deal with text only, but also with (often complex) graphic visualizations as well as functionalities to interact with the system.

There is a need to better understand the behaviour of the users in terms of step-by-step interaction with the system. Such knowledge would enable us to follow the thoughts and considerations of the users in a much more effective way than with the above mentioned web log file based approach. Logging every user's interactions offers an implicit way to gain information about their behaviour as well as application strengths, limitations and weaknesses. Through this approach, it is possible to obtain knowledge about user interaction patterns.

METHOD

Implicit user logging can be understood as the consecutive recording and storing of all user interactions with the application interface. It shows how the users interact with an application. This kind of information is not offered by the user on purpose. [Atterer et.al., 2006] However, recent client-server architecture offers the possibility to collect such information. In addition to well-known systems (e.g. Google Analytics [4]), it does not exclusively record technical parameters (e.g. user origin, browsers used), but also includes detailed information of every single human-computer interaction. Since all systems are different, common features of log file analysers cannot be applied in this case. Based on the varying characteristics of each system, the logging tools must be adapted to the current context.

The leitmotif of the implicit user logging is to record every single user interaction. This comprises mouse clicks, as well as text input and JavaScript actions such as mouse over etc. Besides the identification of the interaction, the time factor is crucial in this approach. Time can give very helpful insight into the user's interaction with the system. Rapid sequences of reoccurring interactions are highly desired, whereas delays could indicate confusion and misunderstanding [Wnuk,2005].

Every single interaction of the user with the interface along with the current timestamp is stored in a database. Furthermore, additional information about the action, such as the coordinates of a map panning, is added.

The table below shows a typical user session along with the sequential list of actions:

Nr.	Time	Action	Value
0	2011-01-14 22:36:24	Event	login
1	2011-01-14 22:36:24	Tab	kartelink
2	2011-01-14 22:36:24	Tab	basis
3	2011-01-14 22:36:25	Tab	links
4	2011-01-14 22:36:25	tourlist	reset
5	2011-01-14 22:36:26	Event	updateScrollbar
6	2011-01-14 22:36:28	pan	566047.19, 427957.31
7	2011-01-14 22:36:29	map	01_winter_801.jpg
8	2011-01-14 22:36:30	map	finished loading
9	2011-01-14 22:36:41	tooltip	3,70,69,62,61
10	2011-01-14 22:36:48	pan	566047.362144597, 427957.31
11	2011-01-14 22:36:51	tooltip	12
12	2011-01-14 22:36:56	tooltip	74
13	2011-01-14 22:37:03	pan	566047.017855403, 427957.31
14	2011-01-14 22:37:03	tooltip	76
15	2011-01-14 22:37:07	tooltip	0,5,63,64,68
16	2011-01-14 22:37:16	tooltip	58
17	2011-01-14 22:37:19	tooltip	60,88,59
18	2011-01-14 22:37:21	Event	showDetails
19	2011-01-14 22:37:22	Tab	detaillink
20	2011-01-14 22:37:22	DetailAnsicht	5.3
21	2011-01-14 22:37:22	Event	reloadMilkbox
22	2011-01-14 22:37:32	DetailAnsicht	6.14
23	2011-01-14 22:37:32	Event	reloadMilkbox
24	2011-01-14 22:37:32	Event	logout

Table 2: Log file content

Gathering such personal information about the user's behaviour with the system raises ethical, privacy and legal issues. To avoid such concerns, users must explicitly accept the collection of this information by agreeing to the terms of use. Furthermore, it should be pointed out clearly that all gathered information is made anonymous before storing it in the database. Through this, no conclusion can be drawn about individual users and in no way will the collected information be linked to individual users or IPs!

With the help of this collected information, different implications can be made to enhance the usability of a system. This includes amongst others the profiling of users, the analysis of the cartographic online applications as well as the detection of usability problems.

As stated before, the core of this available information is not of technical nature, but shows the way, users navigate through the application. Typical walk-throughs can be identified by discovering repetitive sequences of actions. Such patterns are significant, since they allow the developers to monitor aspects and considerations made in earlier phases of the development process.

The following use cases demonstrate how the adoption of implicit user logging has influenced the evolution of two specific online cartographic information systems.

USE CASE: CULTURAL HISTORY OF THE WESTERN HIMALAYA FROM THE 8TH CENTURY

A first approach to implicit user logging has been undertaken within the scope of the "Cultural History of the Western Himalaya from the 8th century (CHWH)" cartographic information system [5]. Amongst other methods and techniques of user research one goal within this project was to apply automatic logging of user-system interaction. By applying this method it was anticipated that usability problems can be detected in a highly automatic way. The obtained user interaction patterns help to develop differentiated

use cases for the system. The time consumed with specified tasks gave insight on usability/performance problems.

Since 2008, the Cultural History of the Western Himalaya from the 8th century has gone through several development and refinement stages. Figure 1 shows the initial interface, heavily based on a map-database linkage approach.

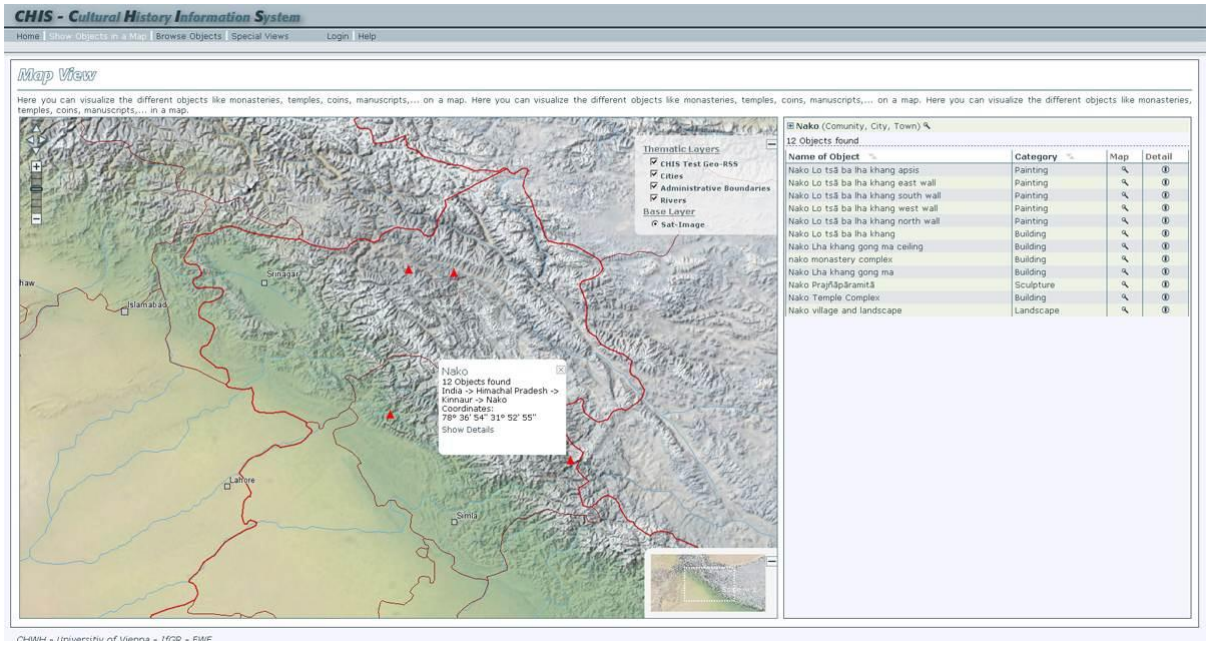

Figure 1: Cultural History of the Western Himalaya from the 8th century, Phase 1

Through the investigation of the logging information, it was obvious that most users had difficulties of logically connecting the spatial information with the thematic content. The lack of clear and visible navigation items led to a high degree of confusion, resulting in event sequences that can be considered of random, instead of traceable and comprehensible.

A major redesign of the application aimed at reflecting these identified problematic issues.

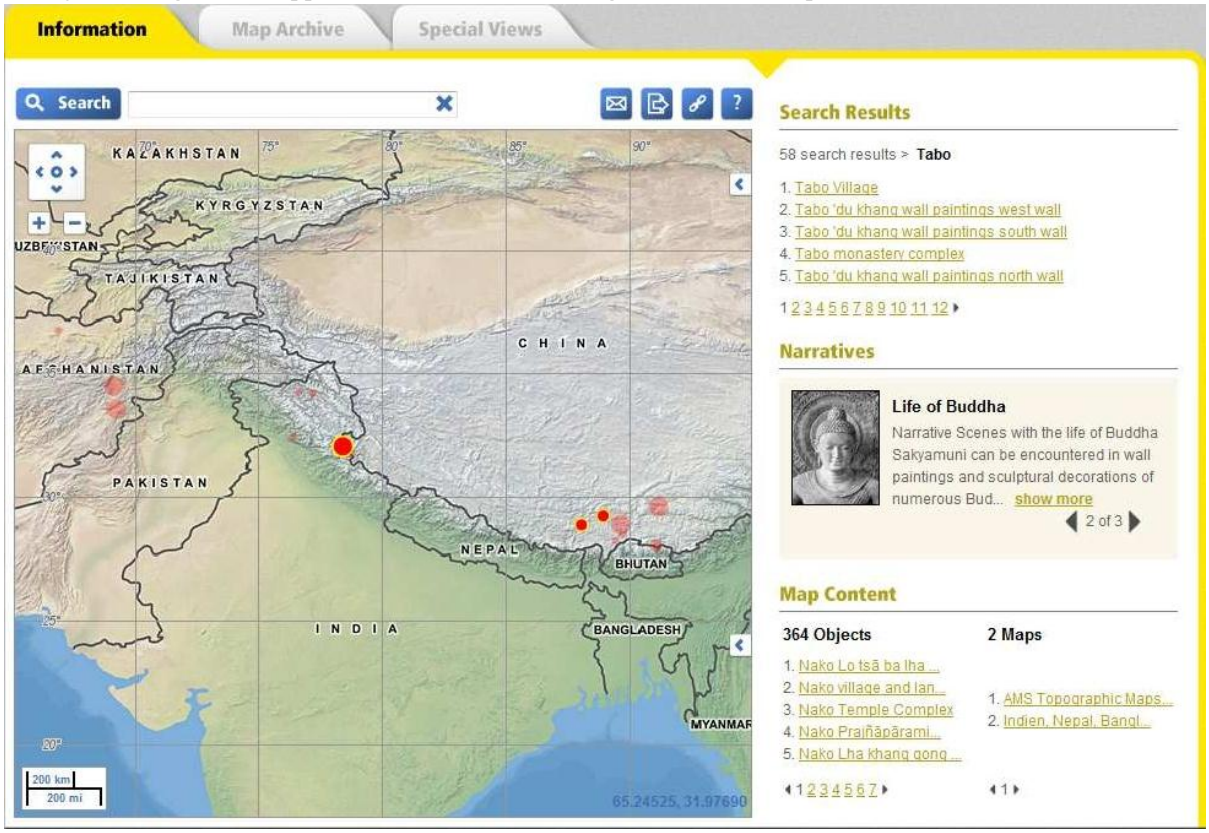

Figure 2: Cultural History of the Western Himalaya from the 8th century, Phase 2

This substantial redesign of the interface focused on clear structures, better visual appearance and a higher degree of user guidance within the system. The logged information showed a dramatic improvement in terms of usability understanding of the users. User sessions were much more ordered than in phase 1, time delays could be clearly identified after those actions that showed thematic content. In Phase 1, major time delays were rather randomly distributed throughout the session, indicating users frustration and confusion.

Nevertheless, some problematic items could be identified that needed further enhancement. Clearly, the 'Map Content' section was not accepted by the users. It showed a considerable lower number of interactions compared to other sections of the interface. Time delays before interactions with the 'Map Content' section were longer than others.

In an addition revision, the Cultural History of the Western Himalaya from the 8th century was brought to its current status.

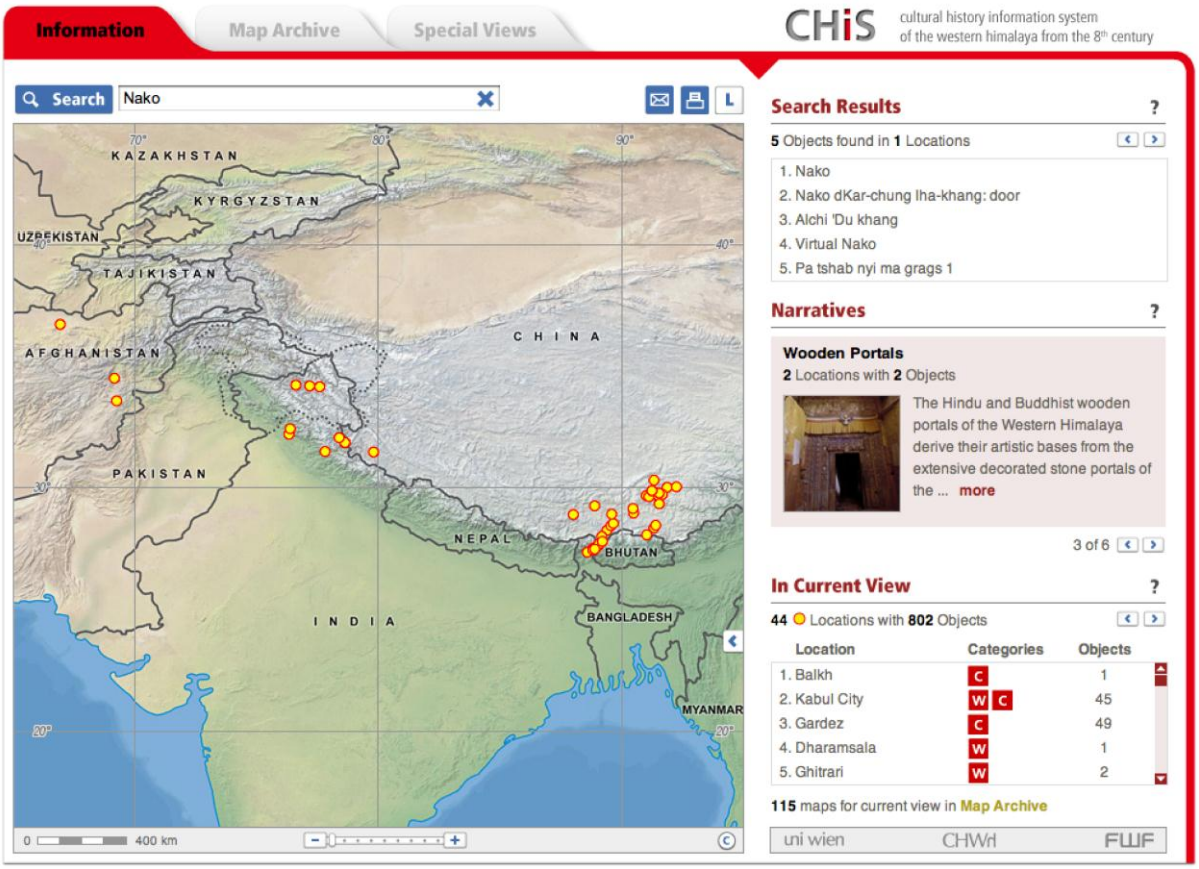

Figure 3: Cultural History of the Western Himalaya from the 8th century, Phase 3

The display of the thematic content of the application was redesigned by changing the focus to the (geographic) locations, rather than the single objects at the locations. By doing so, the interface looks much more structured and less overloaded. Additional visual features, such as a coherent colour concept by using guiding colours and the use of icons further enhanced the understanding, and thereby the usability of the application.

USE CASE: SCHITOUREN WIENER HAUSBERGE

Besides the above mentioned cartographic information system, the Cultural History of the Western Himalaya from the 8th century, the method of implicit user logging is applied for the evaluation of a touristic information system, "Schitouren Wiener Hausberge" [Szépfalusi and Kriz,2010], [6], recently released within an ongoing research and development project at the University of Vienna. This system, offering extensive information about ski mountaineering in the vicinity of Vienna, Austria, is available both for desktop as well as mobile devices and is published along with a printed book. It offers the user the possibility to look through the complete content of the book, along with additional information such as perspective views of the respective areas, slope maps and route planning functionality.

Since this project builds up on the earlier experiences of other online application developments, such as the above described Cultural History of the Western Himalaya from the 8th century, major design and

usability issues were already considered throughout the development process. The following example demonstrates the potential of the implicit user logging in the monitoring of this cartographic information system.

Numerous log sequences showed an abrupt end of the user sessions. The log files allowed tracing back the individual session to the status of the application right before the "drop-out" of the user. Figure 4 shows the top section of the detailed tour information screen, which was identified as the last screen before the termination of the user session. Further investigation of the log files led to the conclusion, that users do not recognise any possibility to leave (i.e. close) this screen.

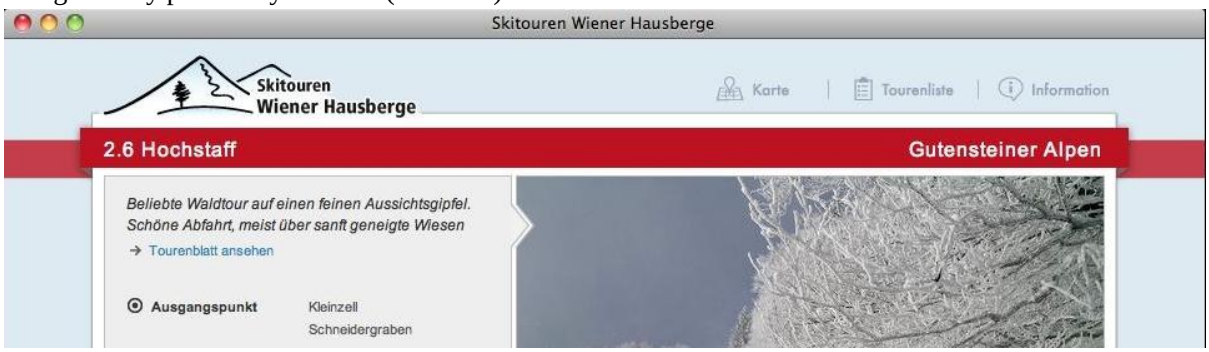

Figure 4: Top section of the detailed tour information screen

A simple revision of this screen by adding a "close button" to the upper left right of the screen solved this problem at all.

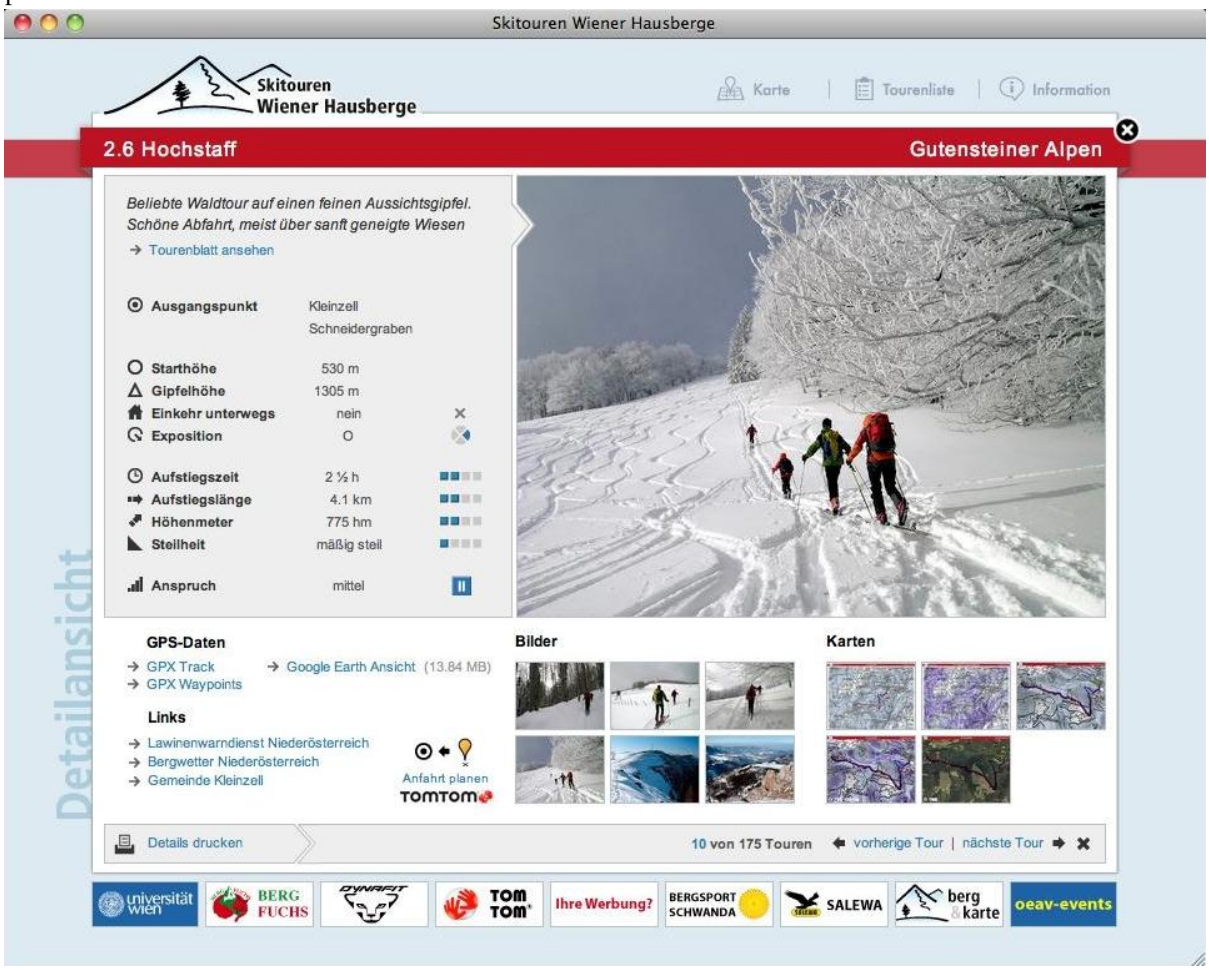

Figure 5: Schitouren Wiener Hausberge, detailed tour information screen

Figure 5 shows the detailed tour information screen in its current status. The number of unintended "drop-outs" has decreased dramatically as a consequence of the investigation of the implicit user logging.

CONCLUSION AND FUTURE PLANS

This paper covered the basic motivation and considerations behind the concept of implicit user logging as well as setup and results of case studies.

However, although implicit user logging offers a powerful tool for system and user monitoring, it must be stated that it shows its full potential only in combination with other usability testing and monitoring methods. Implicit user logging can help to better understand user's considerations as well as to review one's own design principles. The advantages are in the independence from direct user contact and the amount of information that can be gathered.

The current implementation of the implicit user logging in the use cases described in this paper can be seen as an initial stage of further investigation in this area. A finer granularity of user action events would increase the quality of the results. Besides that, automatic user action patterns recognition of predefined action sequences would help to manage the large amount of available information.

ACKNOWLEDGEMENT

The Cultural History of the Western Himalaya from the 8th Century is a National Research Network (NRN) funded for six years (2007-2012) by the Austrian Science Fund. It is dealing with the four great cultures of Asia – China, India, Persia and Tibet – which converge in the Western Himalaya.

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