WebPark: LBS in Action

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1. WebPark: LBS in Action

Learning Objectives

- In this lesson you will learn about the WebPark project. This project developed a suite of location-based services for visitors to natural and protected areas. Through this case study you will learn about analysing user needs for information, architectures for LBS and other considerations such as modelling locations.

1.1. Introduction

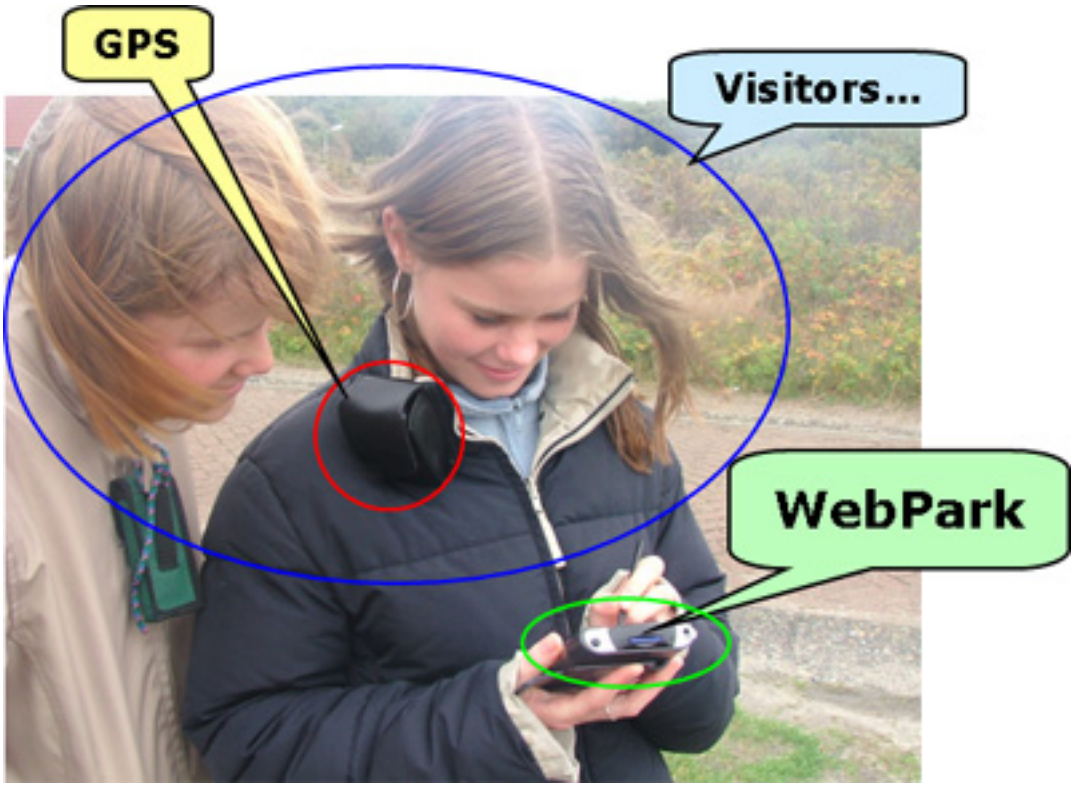
Learning Objectives

You will be able to ...

- describe the aims of the WebPark project in terms of its user group focus, its innovations and the study sites it was trialled in.
- suggest how the WebPark system could be employed in a new location (national park).

The WebPark Project

The **WebPark** project was a research and development project co-funded by the European Community. The project ran between October 2001 and September 2004, after which it was integrated into a commercial service by the company **Camineo**. The aim of the project was to develop a suite of location-based services for visitors to natural and protected areas.



1.1.1. Overview of WebPark

Project Aims

The overall aim of WebPark was to: "*identify the geographic information needs of mobile users, to provide to such users geographically relevant personalized location-based services (LBS) and to create new G-commerce value-chains* [1] *for recreation/ protected area administrations and data integrators* [2]."(WebPark 2001, p. 4)

[1] *Business management concept. Describes a chain of activities a product passes through. The value-chain gives the product more added value than the sum of added values of all activities.*

[2] *Organization which combigns variable data and databases of different functional units for a specific application area.*

WebPark therefore aimed to develop a platform and suite of end-user services, together with related *business processes* [3], that would allow visitors access to unique environmental, cultural, historical and touristic information on mobile devices. The content was to be largely drawn from existing data resources that had been captured by the park agencies and custodians for various commercial and non-commercial purposes such as research, education, and tourism. WebPark aimed to leverage these data resources within a new computational framework that contextualised access and presentation of the information according to aspects such as; the location, time, personal interests and activities of visitors.

User groups

The project sought to add value to the data resources for both the visitors and the park administration (Dias et al. 2004). For the visitors, a more informed encounter with a region could be experienced. Their questions could be answered as they arose, activities could be better planned and organised, and the area could be explored in ways beyond what was immediately visible.

Enriching the enjoyment and education of visitors to the protected areas was of course of direct importance to the park administration (Eagles 2003). The channel added by WebPark for providing information could also allow a better return on the investment of data collection. However in addition, the system also suggested a number of possiblities to support the park in their management of the natural resources. For instance, by knowing where the visitors were they could help control the distribution of visitors throughout the park and prevent them concentrating in particular areas. Likewise they could use the system to inventory species that saw during their day-to-day work.

Study sites

The project was tested for two study sites. The **Swiss National Park** and the **island of Texel**.

[3] A structured, measured set of activities designed to produce a specific output for a particular customer or market. It implies a strong emphasis on how work is done within an organization, in contrast to a product focus's emphasis on what. A process is thus a specific ordering of work activities across time and space, with a beginning and an end, and clearly defined inputs and outputs: a structure for action. Taking a process approach implies adopting the customer's point of view. Processes are the structure by which an organization does what is necessary to produce value for its customers.

	
The Swiss National Park	Dune park on Texel

Texel

Texel is the largest of the Wadden islands situated in the Waddensee off the coast of Holland. It has a resident population of more than 13,000 with an additional average of around 45,000 tourists staying overnight per day . Its landscape comprises a number of significant ecotypes including tidal flats, marshes, beaches, dunes and cultivated land. The entire dune area is protected as a national park - "The Dunes of Texel". The island is rich in flora and fauna. It is particularly well know for the variety of birds that can be found there, sometimes being called "Bird Island". In 2003 a total of 264 species were recorded by the Texel Bird Society. (Graaff 2005)

Swiss National Park

The Swiss National Park is situated in the South-East Switzerland in the Canton of Graubunden. The park is the oldest in Europe, founded in 1914 and holds International Union for Conservation of Nature and Natural Resources (IUCN) level 1 protection, the strictest category. It receives nearly 150,000 visitors every year. The landscape of the park is dominated by mountains which range up to from 1400m (Clemgia gorge) to 3173m (Piz Pisoc). The park supports 3 main types of habitat; forest, alpine meadows and high alpine.

Consortium

The WebPark consortium consisted of partners from industry; **European Aeronautic Defence and Space Company**, and **Geodan Mobile Solutions**, the sciences; **City University London**, the **University of Zurich**, and **Laboratorio Nacional de Engenharia Civil Lissabon**, and from the national parks community; **the Swiss National Park**. The industry partners were responsible for developing the technical infrastructure that supported services. The Swiss National Park provided the

perspective of the end-users both in terms of their visitors and their own needs as a host for the services. In addition, they supplied rich content such as animal and plant observations, route descriptions, and point-of-interest (POI) information. The research institutes provided GIScience expertise for modelling, analysing and representing geographic information.

Project outline

The project sought to innovate in four main areas:

- Mobility – By creating services that could answer visitors' questions at the moment when they were most relevant, for example when the user was mobile and outside, and by providing information that would otherwise only be available from a static context, e.g. a CDROM, kiosk or over the Internet
- Ubiquity – By providing services available at any time and in any location, not dependent on the available technological infrastructure such as the mobile communications network
- GI and Multimedia content business processes – The project needed generate design processes for the storage and handling, integration, and commodification of geographic content for location-based services
- Spatio-temporal intelligence in coastal, rural and mountainous landscapes – The service needed to be responsive to the context of use. Taking into consideration not only where and when the service was being accessed (position and time), but also what the user was interested in, the past and future space of their activities, and their personal preferences, for example for types information and language

1.2. Explore WebPark

In this unit you will explore the WebPark services using a demonstrator of the system. The demonstrator illustrates the main services provided by WebPark, the types of information the service integrated and the different modes of interaction that could be employed to navigate around the system.

Learning Objectives

You will be able to ...

- describe the main services offered by the WebPark system
- describe the types of data integrated within the WebPark system
- describe the types of interactions afforded by the WebPark system

1.2.1. WebPark Demo

The interaction below contains a demo version of the WebPark application. You should explore this to get a feel for the WebPark system. While you do so, think about different aspects such as: the different services being offered, the types of data and how they are presented, the forms of interaction and types of interface, and the different ways that information can be searched for.

Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed. [link]

What types of service did you find?

- Mapping and navigation - This service allows the user to orientate themselves with a topographic map showing where they are on it. It is provided through the main map interface. In addition the Visitor can see where they are on a height profile (Advanced Search -> Search Routes -> View as list OR Top5 -> Things to see and do)
- Geographic bookmarking - This service allows the user to make notes about where they are and things they have seen. It is provided through the "Create new bookmark" item. The book marks can be shared with other or kept only for the visitor to see (marked as private)
- Points of interest search - This service provides information about interesting locations to the user. The locations are shown as points on a map that can be interacted with. It can be accessed through Advanced Search->Search Info OR from within the Top5 interface.
- Flora and Fauna Search - This provides information to the user about plants and animals that can be found in the park. Both descriptive and spatial information is available. The informaiton can be accessed through either Advanced Search -> Search Species OR Top5

What were the different types of data you came accross?

- Topographic base maps: These provide general spatial information for orientation and context for other types of foreground data.
- Three dimensional paths: These are linear spatial data providing height and plan profiles of paths for navigation
- Wildlife distributions: These describe the distributions of particular species within the park
- Points of interest: These are spatial data describing interesting locations
- Text descriptions: These are textual data that provide detailed information about plants and animals and points of interest
- Images: These depict plants and animals
- User defined data: These are point based spatial data that the visitors add to the system

What form of interaction and searching did you encounter?

- Spatial search: This was provided mainly through the "What's around me?" item, it allowed users to find out quickly everything of interest that could be found near them.
- Tree search: This allowed information to be searched by selecting semantics from an expandable tree. It was used for searching for species, info and routes.
- Free text searching: This was not available in the demo but could be seen in the "Search by terms" option
- Identify: This was found through the listed items for example those of Top5 and "View as list".
- Interactive Select: This was allowed for points of interest shown on the maps which could be clicked for more information.

1.2.2. Apply WebPark

Image from Wikipedia

Image from Wikipedia

WebSafari

In this activity you should discuss within a small group how you would apply the WebPark model to a new park with its own unique conditions. Feel free to draw the applications you come up with as a 'storyboard'. In this activity we will consider the example of the famous Kruger National Park in South Africa. The Kruger national park covers 18,989 sq kms of north-west South Africa (Wikipedia). It is famous for its diverse landscapes and rich variety of wildlife including the so called "Big Five"; Lions, Elephants, Buffalo, Leopard, and Rhinoceros. Visitors stay overnight in the reserve usually moving between the various rest camps. Movement around the park is strictly by car. Visitors may not leave their vehicles except at a few designated points or if accompanied by an armed guide. The reasons for this should be obvious! Have a look at the Kruger national park **website** to identify types of data and activities that that might be included in the WebSafari system. In addition look at the public sighting information such as the **sightings maps** of the big five and the **sightings gallery**. Think about how this information could also be included and managed in you system. Review the following questions:

- How do your ideas extent beyond those found in WebPark? (for example, you might focus more on sighting information from visitors, on providing management functions, or on providing real time data.)
- What additional information would you need to find in WebPark? (for example accomodation)
- How do the constraints of Kruger affect your ideas for the service? (for example visitors needing to stay in their cars)

1.3. Analysis of user needs

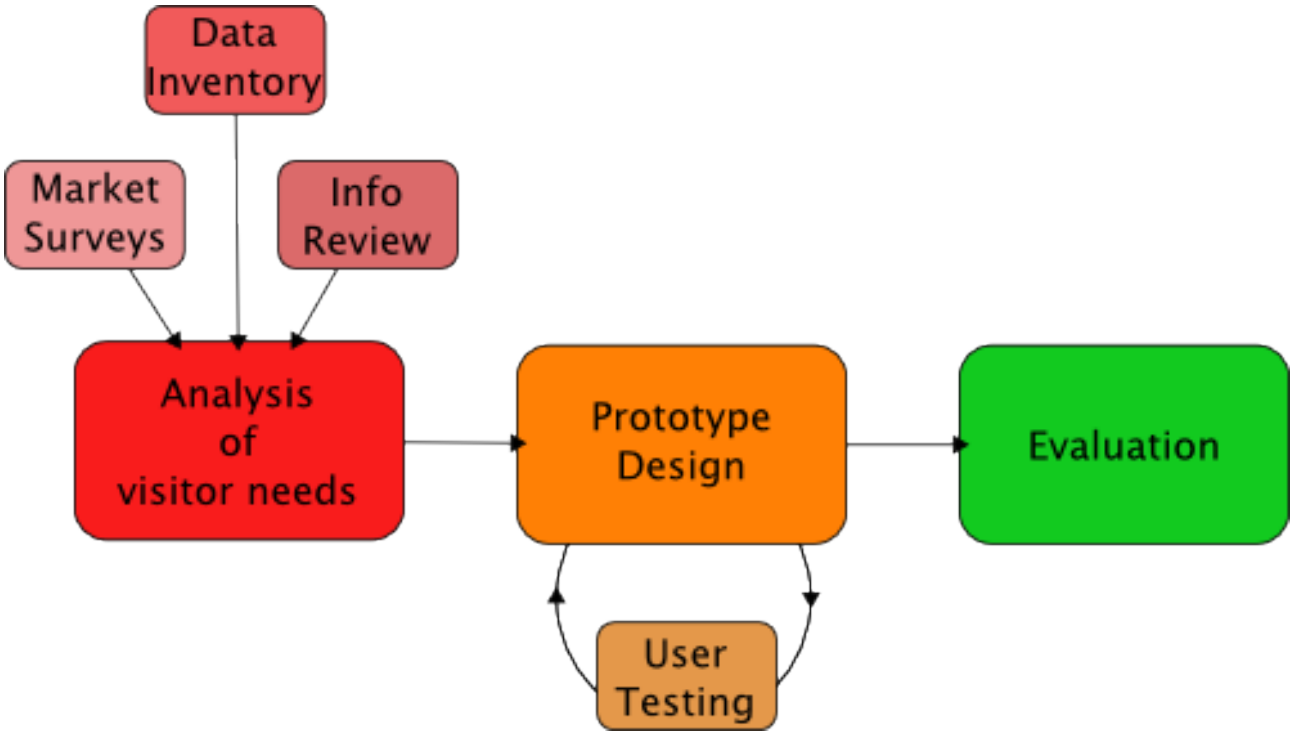
Learning Objectives

You will be able to ...

- describe what substitutions services are, and suggest examples that affect location-based services
- describe different methods for eliciting user needs for information
- formulate an analysis and design program for guiding the development of a location-based service

Perhaps the most important issue in developing a location-based service is to know what users want to obtain information about and as the service develops how well it is meeting these needs. In the WebPark project a continuous program of user needs analysis and evaluation was employed to achieve these goals. This program consisted of four main activities:

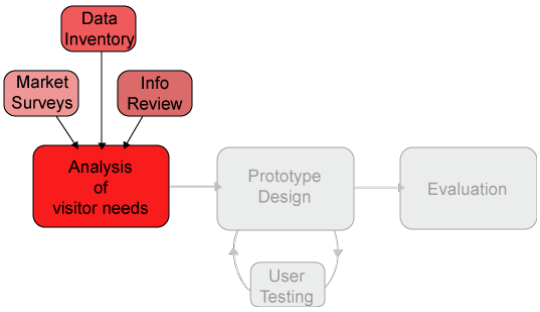
1. The analysis of visitor needs for information and services.
2. The inventory of existing information sources, so called 'substitution service'
3. The evaluation of prototypes during the development of the platform with respect to usability
4. The evaluation of the final platform with respect to needs



Analysis and design plan

In this unit you will look at each of these steps in turn and relate them to the design of a location-based service more generally.

1.3.1. Market Analysis



Analysis of visitors needs

The initial step in the WebPark project was to determine the types of information and service that visitors would find compelling. To understand this better surveys of potential user groups were carried to elicit the sorts of information that visitors would like to recieve. For the SNP surveys were sent out to 2420 address contained on the SNP database which included customers of the park shop and subscribers to the park magazine, "Cratschla". A copy of the mailed questionaire can be found **here**. In addition the survey was made available on the park website. In total 1597 were completed. For Texel a similar survey was carried out using websites, and email as well as direct contact with visitors to the Texel nature centre, **"ecomare"** and people taking the ferry to Texel from mainland Holland. A total of 179 were completed (Krug K. 2003). The survey considered a range of issues including demographics, exposure to new technologies and digital media, use of media (e.g. maps and guidebooks) when visiting the sites currently, and preferences and needs for different types of proposed services. The two tables below show you the results for the Swiss National Park and Texel respectively

n=1000	% very important	% important	% less important	% not necessary		% no statement
3.9 Safety information such as severe weather warnings, unuseable paths etc.?	51.2	26.7	8.9	4		9.2
3.6 The locations of particular animal species and how to get there?	36.1	37.3	7.3	8.6		10.7
3.1 Maps and other information for orientation purposes based on your actual position (similar to the car GPS-system)?	20.5	37.4	12.8	17.2		12.1
3.5 Actual information about vegetation (e.g. important flowers in blossom)?	20.1	45.3	13.2	8.7		12.7
3.3 Thematic maps, for example geological maps, vegetation, slopes etc.?	15.4	45.4	16.3	10.4		12.5
3.7 Local information about current research projects?	8.7	40	26.5	11.9		12.9
3.2 Information on your route, such as quality, steepness, distances and narest/next picnic areas?	15	37.3	18.6	18.2		10.9
3.4 The nearest possibility of personal information?	12	34.6	26.1	14.8		12.5
3.8 A virtual, interactive instruction trail guided by a mobile/PDA?	2.5	19.8	28	35.4		14.3

up to 20%
20 to 30%
30-40%
> 40%
no statement

User needs for information in the Swiss National Park, Krug et al. (2003)

Modal value

n = 77	Important	Nice Have	toLess important	Not necessary
i) Maps and other information for orientation purposes based on your actual position	38.0%	33.8%	14.1%	14.1%
ii) Information on tidal flats, mudwalking possibilities	33.8%	41.6%	10.4%	14.3%
iii) Information about vegetation and animals	16.7%	43.6%	24.4%	15.4%
iv) Local information about current research projects	7.0%	23.9%	39.4%	29.6%
v) Thematic maps, for example geological, tidal maps	16.7%	41.7%	18.1%	23.6%
vi) Safety information such as severe weather warnings, shelter harbours	62.5%	26.4%	2.8%	8.3%

User needs for information from Texel, Dias et al. (2004b)

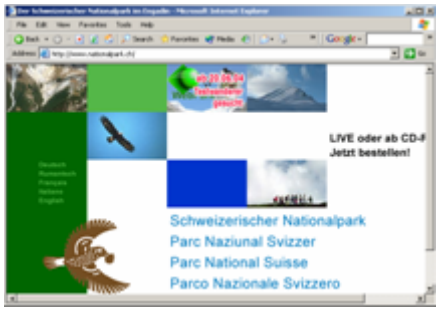
What similarites can you see between the two groups?

- Both groups considered saftey information the most important information to have.
- Both groups were very interested in recieving information about wildlife.
- Both groups were interested in recieving information for navigation and walking opportunities.

1.3.2. Information audit

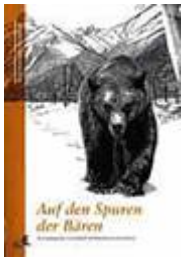
Substitution services

Substitution services are sources of information the location-based service aims to replace. Examples are web sites, field guides for flora and fauna (e.g. bird books), CD-ROMs, and paper maps. On the one hand the LBS needs to go beyond what these can supply, on the other they need to integrate information found in these sources to provide a new channel for presenting them. Examples for WebPark are shown below



The Swiss National Park website

The Interwad (Waddensee) website

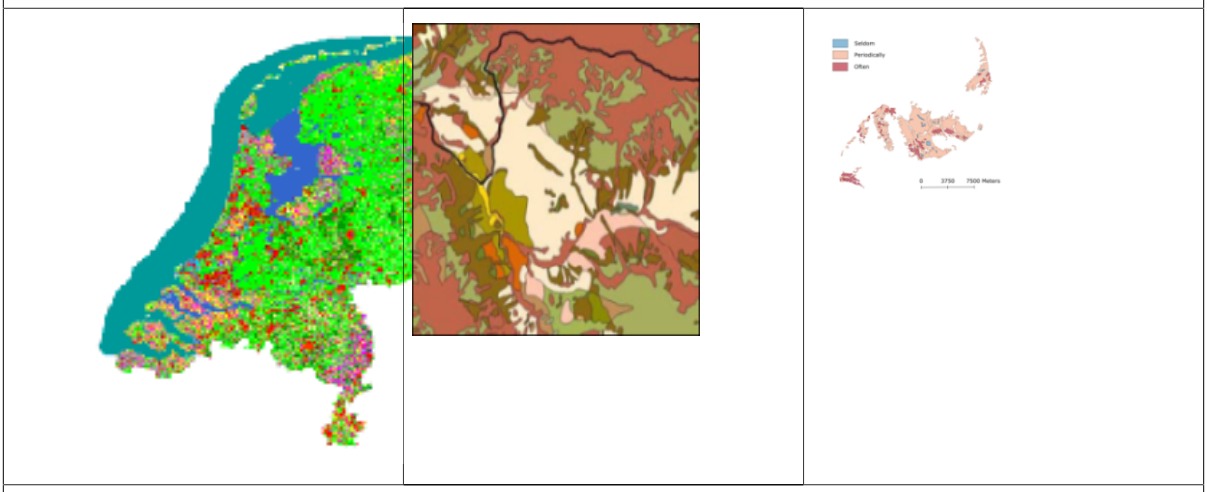


Guide books and CD-ROMs for the SNP and Texel

Spatial data

In addtion to the more descriptive information found in the substitution services, an audit of the available spatial data for the different sites was also made. The following provide examples of the types of data available.

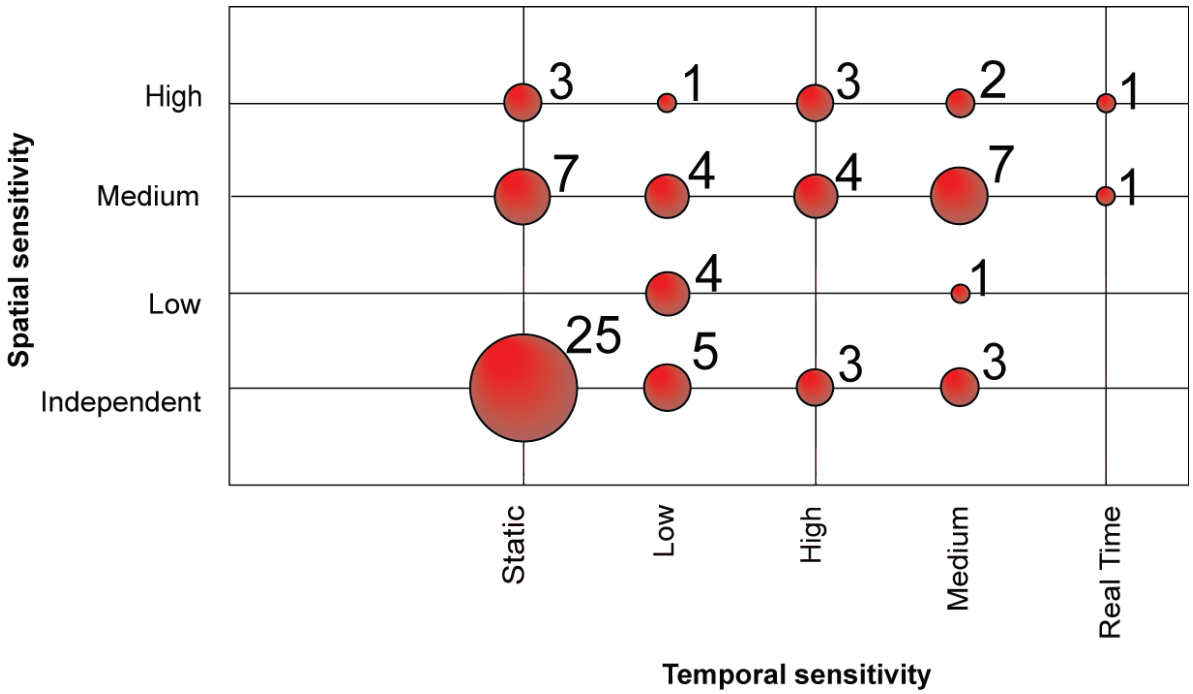
Topographic spatial data



Examples of various types of special purpose spatial data

Spatial and Temoporal Sensitivity

The different information sources were evaluated with respect to their spatial and temporal resolutions the illustation below describes this.



Analysis of information according to spatial and temporal resolutions (Dias et al, 2004b)

One of the main conclusions that came out of this evaluation was that there was a clear mismatch between the data available and the information needs of visitors. As can be seen in the above illustration most of the information sources where static in time and independent of a specific geographic reference. Information that did have a spatial component was generally very specialised for example being obtained for research purposes, whilst visitors were more interested in recieving more general and easily comprehendible information that was sensitive to the time and place it was being used in. This justified the needs for a location-based service that could provide information at an appropriate level in a way that was sensitive to its context of use.

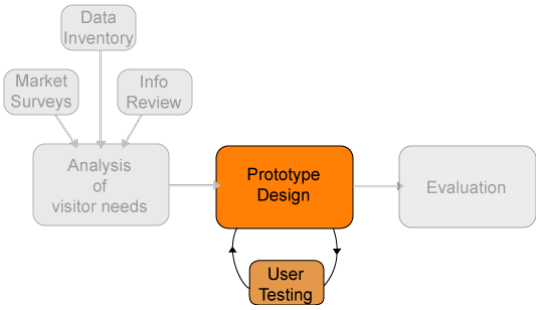
1.4. Prototyping and testing

Learning Objectives

You will be able to ...

- describe different methods for evaluating the usability of a location-based service and discuss the relative advantages of each
- summarise the important consideration required to develop structured techniques for assessing usablity

In this unit you will learn about different techniques employed during the WebPark project to test the system as it went through cycles of development. Testing was performed continuously during the project to ensure that the final system met the needs and expectations of the users.



Prototyping and testing

1.4.1. Testing techniques

Testing Aims

The aim of the usability testing was to evaluate how usable the system being developed was and how closely it matched the needs and expectations of users. The testing was carried out at regular intervals, each summer, during the life time of the project, with the results feeding into back into the prototypes being developed. The aims of the testing were:

1. Is the device suitable for mobile use in terms of it size, weight, display clarity?
2. Is the application performance fast enough for the users?
3. Is the data transfer rate sufficient for the users?
4. Does the location determining technology provide a position with in a time acceptable to user?
5. Is the information logically organized and grouped? Can the user easily locate the information they are looking for?
6. Are the graphics used and the icons recognizable to users and do they facilitate ease of use/understanding?
7. Are the maps sufficiently, clear to use for orientation, navigation and obtaining information?
8. Can users successfully navigate through the application? Is the system status clear to users at all times? Is the navigation intuitive?
9. Could the user obtain information to answer their questions? (pull services)
10. Is the information timely and useful to the users activity? (push services)
11. Is the user able to get support / help in using application when required?
12. Is the user able to personalise the applications?
13. Are there tasks that users will want to perform that are not currently supported by application and services?

These concerns were examined through a four complementary testing techniques. Techiques were selected because of their suitability to a mobile system, they ability to support quantitative analysis, and because they invited new ideas from the participants.

Shadowing

The aim of shadowing (also called monitoring or participant observation) is to observe a user with the application in the envisaged context of use. In shadowing, a researcher follows a user during their time with the system, observing and recording any problems and questions the user has. The researcher never offers any information but only answers the questions of the shadowed visitors.

A visitor being shadowed in Texel

In the WebPark testing the research was provided with a form to fill it that allowed different types of problem to be easily identified. An example of the shadowing form used in the first testing is provided below.

Test No		Name of test person:		
Test Seq. (tag all its added)				
Weather conditions				
Date/Time				
Handling of the device	**Audio/ Video**	**Orientation: landscape**	**Text display**	
☐ Size of the device	☐ Blue display	☐ Photos of interest	☐ GPS	☐ Intuitive
☐ Size of display	☐ Progress in map	☐ Video	☐ Gestures (transport)	☐ Map or small screen
☐ Ease of operation	☐ User's position	☐ Photos of interest		☐ Info on small screen
☐ Weight	☐ Zoom	**Menu**		
		☐ Menu: Overall menu		
Grip			**Route profiling**	
	☐ Pan	☐ Understandability	☐ Understanding the route information	☐ Lack/ease of space
		☐ Interactive Menus	☐ Application/system interaction	☐ Lack of detail (zoom)
Comfort	☐ Pleasing	Graphics		

A shadowing form

Questionaire

The main advantage of the questionaire was that it provided a structured method to quantify the usability of the system and compare these result over subsequent years. Questionnaires differ from surveys in that they are written lists, not ad hoc unstructured interviews. They require a high degree of question structuring to ensure a logical narrative thread for the user to follow. This must be matched with simple, unambiguous questions to maximise the number of respondents. The principles of (Schnell et al. 1998) were adhered to when designing the questionaire. These are:

- The layout of the questionnaire needs to be clear and concise to lead the respondent through the questions and to make it easy for the to differentiate between the instructions/explanations on the one hand and the questions themselves on the other
- The first few questions should be given as an introduction to lead attention and thoughts to the topic in general
- Several questions should be given for each thematic group with filter questions at the beginning of a new question complex to make it possible to jump to the next question that applies for the respondent
- Personal questions to provided a demographic background should be asked at the end of the questionnaire in order not to provoke an early break off by the respondent

A copy of the questionaire used for WebPark can be found **here.**

Interviews
Interviews are ad hoc conversations with users, where a set list of questions is asked and the user`s responses recorded. Interviews differ from questionnaires in that they are interactive and are not rigorously structured. The general form of the interview followed the structure of the questions outlied previously for the aims. One of the main advantages of interviews is that they suggest new ideas that can be employed in the subsequent design revisions.

Thinking aloud
The Thinking Aloud protocol is a technique used during usability testing. During the course of a test, where the participant is performing a task as part of a user scenario, the participant is asked to vocalize their thoughts, feelings, and opinions while interacting with the application. The participant, the product to be tested and a scenario in which the tests are to be perform are selected. The participant is asked to perform the tasks using the product, and explain what they're thinking about while working with the product's interface. The chief advantage of thinking aloud is that it provides a picture of the users mental model of the new technology.

1.4.2. Experimenting with techniques

In pairs try out one of the techniques described for yourself. One of you should act as the participant and the other the researcher. Use the documentation provided together with the WebPark demonstrator shown again below.

Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed. [link]

1.4.3. Prototypes of WebPark

Prototype development
Below the prototype used at different stages of the the project are shown

Prototype used for summer 2002 testing based on "off-the-shelf" software - Arcpad

Prototypes used in 2003 and 2004 (final) summer testing

Product commercialised after the end of the project

1.5. WebPark Architecture

Learning Objectives

You will be able to...

- describe the main difficulty for location-based services to access online information resources and describe an architectural pattern to overcome this
- describe how the WebPark client operations are organised and give examples of the modules that perform different types of processing functionality

1.5.1. Extended Client-Server Architecture

Thick and Thin Clients

The WebPark platform was designed around the so-called "Client-Server" architecture. The idea of this is that a client, which might be a web browser on a mobile device or personal computer, accesses data over the internet from a server which acts as a repositiory for the information. The client and server communicate using agreed standards such as those defined by the OGC. Refer to the lesson **OGC Standards and WMS** for more information about this. Clients can have different "thicknesses" depending on how much processing work they need to do to present the data provided by the server. A thin client might request data that is returned as a graphical image file (e.g. png or jpeg). In this case it needs to do little work except display the image to the user. Instead the server will have performed all the processing necessary to draw the data correctly. A fat client will access raw data and need to perform much of the rendering operations itself. The problem for location-based services such as WebPark is that they cannot rely on a continuous internet connection. This makes it difficult to employ a straight forward client server architecture. WebPark uses the *caching technique* [4] to dissove the problem. To decide which data to display the WebPark client needed to be little fatter than in an always online scenario, but not so fat that it needed to perform large amounts of processing to render the data. The illustration below describes the basic pattern, together with some of the processing operations performed on each side.

Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed. [link]

1.5.2. The WebPark portal

A set of operations needed to be implemented on the client to allow it to present the cached information from the server to the users. These were encompassed within a three-tier architecture that was implemented on the client. The lowest tier consisted of the different types of cached information harvested from the server. In the middle tier were a set of plugable low-level modules that provided basic units of functionality. These modules collectively comprised the WebPark Portal. By glueing these modules together in different ways (the so-called 'business logic') end-user services could then be created. You have seen examples of these services already in the WebPark demo.
Explore the interaction below to better understand the client architecture of WebPark.

[4] Caching is a technique widely used in computing to increase performance by keeping frequently accessed or expensive data in memory. In the context of a Web application, caching is used to retain pages or data across HTTP requests and reuse them without the expense of recreating them. There are different types of caching is used in a web application, ASP.Net e.g. supports the following: Output caching, which caches the dynamic response generated by a request.Fragment caching, which caches portions of a response generated by a request.Data caching, which caches data programmatically.

Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed. [link]

1.6. Summary

In this unit you learned about the WebPark project that implemented a suite of location-based services for visitors to protected and natural area. In particular you learned:

- What the WebPark system looked and felt like and explored how this model might be employed in other nature reserves
- How the needs of potential users of WebPark were elicited through surveys and the evaluation of existing sources of information
- How a testing plan was developed that provided continuous input into the development of prototype platforms
- The different techniques employed to evaluate the usability of the system during these testing phases
- How the architecture of the WebPark system was designed so as to take into consideration the limitations of the client-server architecture when employed in a mobile setting
- How the WebPark services was developed using a modular systems of functional units

While the system described here was developed for a particular project, you should have noticed that many of the techniques have been previously touched on in the previous LBS lessons. Likewise, the solutions described here will be of use in analysing and designing many other location-based services.
If you are interested to know more about the WebPark project and system, you can visit the Swiss National Park yourself and try it for real. The system currently in use there has been continuously developed since the end of the project and so you will find many new services and types of presentation.

1.7. Glossary

business process:

A structured, measured set of activities designed to produce a specific output for a particular customer or market. It implies a strong emphasis on how work is done within an organization, in contrast to a product focus's emphasis on what. A process is thus a specific ordering of work activities across time and space, with a beginning and an end, and clearly defined inputs and outputs: a structure for action. Taking a process approach implies adopting the customer's point of view. Processes are the structure by which an organization does what is necessary to produce value for its customers. (Davenport 1993)

caching technique:

Caching is a technique widely used in computing to increase performance by keeping frequently accessed or expensive data in memory. In the context of a Web application, caching is used to retain pages or data across HTTP requests and reuse them without the expense of recreating them.

There are different types of caching is used in a web application, ASP.Net e.g. supports the following:

- Output caching, which caches the dynamic response generated by a request.
- Fragment caching, which caches portions of a response generated by a request.
- Data caching, which caches data programmatically.

channel:

One of many information sources of one application area.

data integrator:

Organization which combigns variable data and databases of different functional units for a specific application area.

market analysis:

Documented investigation of a Market that is used to inform a firm's planning activities particularly around decision of: inventory, purchase, work force expansion/contraction, facility expansion, purchases of capital equipment, promotional activities, and many other aspects of a company. (Krees et al. 1994)

modules:

Modules are those components that high level services consist of. Modules exist like mapping, positioning, attribute search etc..

portal:

A Portal is used to integrate modules of high level services and to make them accessible to the users of a service.

prototyping:

Process of quickly putting together a working model (a prototype) in order to test various aspects of a design, illustrate ideas or features and gather early user feedback. Prototyping is often treated as an integral part of the system design process, where it is believed to reduce project risk and cost. Often one or more prototypes are made in a process of iterative and incremental development where each prototype is influenced by the performance of previous designs, in this way problems or deficiencies in design can be corrected. When the prototype is sufficiently refined and meets the functionality, robustness, manufacturability and other design goals, the product is ready for production.

shadowing:

Observation of a user with the application in the envisaged context of use. In shadowing, a researcher follows a user during their time with the system, observing and recording any problems and questions the user has. The researcher never offers any information but only answers the questions of the shadowed visitors.

substitution services:

Substitution services are sources of information the location-based service aims to replace. Examples are web sites, field guides for flora and fauna (e.g. bird books), CD-ROMs, and paper maps. On the one hand the LBS needs to go beyond what these can supply, on the other they need to integrate information found in these sources to provide a new channel for presenting them.

value-chain:

Business management concept. Describes a chain of activities a product passes through. The value-chain gives the product more added value than the sum of added values of all activities.

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