

MULTIMEDIA VISUALISATION OF GEOINFORMATION FOR TOURISM REGIONS BASED ON REMOTE SENSING DATA

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ABSTRACT:

The tourism and leisure industries are currently exploring the potential of new presentation strategies that will maximise the promotional appeal of tourism regions and their main assets, which include a unique landscape and scenery, an impressive cultural heritage, and a wide range of sports facilities and other tourist amenities. Further, publishers of tour guides and maps similarly have expressed a strong interest in the new technologies. The EU Travel Study carried out by Sloggett (1997) revealed that major travel and tourist companies and organisations take an increasing interest in satellite technology, and in the development of a Travel, Leisure and Tourism Information Service. The kind of innovative Information Service they envisage will provide information on a resort and the region, entertainment possibilities and will also allow business transactions.

Online and offline data visualisation for tourism topics have to be optimised for the different output devices related to the software, the hardware requirements and the display design. This paper will briefly discuss the current situation in the tourism industry regarding currently available modes of information presentation for specific target groups, and will further present proposals for a novel interactive multimedia information system focusing on the various components of such a system. The system will integrate satellite images, GPS data, GIS information and other information on leisure activities and tourist facilities. Aerial and satellite images will be used to implement the visualisation of a tourist region for multimedia CD-ROMs, display on the Internet and also on mobile devices.

1. INTRODUCTION

There are many different ways of presenting information for tourists. In the past, tourist regions largely relied on analogue media. Over the last few years, tourist offices and hotels have increasingly started to use the Internet, especially for online booking services. However, most websites are still largely modelled on the analogue products which were used for advertisements and brochures. Only a small number of companies within the travel, tourism and leisure industries make full use of the varied range of Internet services that are available today. In the travel and tourist industries it is important that potential customers can quickly find all the information they need. Everywhere there is strong competition between the different tourist regions, especially in the Alps. Therefore, the tourist boards are increasingly looking for new ways of presenting their main assets drawing on the full range of analogue and digital media. One of the main attractions that tourist regions in Alpine areas have to offer is their often spectacular landscape. Logically, therefore, tourist information about these regions will use digital media like the Internet, CD-ROMs, DVD, mobile devices, video and TV, and include 3D visualisation techniques based on remote sensing data for maximum effect.

Electronic media can store not only more but also more accurate information, and they permit interactivity, which printed media are unable to provide. 2D and 3D maps and virtual flights on Internet and CD-Rom are seen by the tourism boards as an opportunity to upgrade and expand their business and also enhance their image.

The fast developments within information technologies and communication have in common a huge impact on product deliveries and consumption.

Today and increasingly more in the future mobile devices such as cellular phones, personal digital assistants (PDAs), palmtops and GPS devices are used to get mobile access to information. That is why in this concept mobile devices play a crucial role. PDAs in connection with GPS function allow to relate the information to the user's present position ("Location Based Services") so that unlike regular Internet users he is offered a geographically interesting piece of information via a mobile device (Fritsch, 2001).

Information systems are generally created for people who need directions that can guide them to the desired destination. Therefore, the most important customer groups for Alpine tourism comprise mountain bikers, hikers, high mountain skiers, and cross country skiers. Tourist information systems have to offer a broad range of orientation and information tools.

In order to guarantee a comprehensive planning of holiday activities 3D maps, virtual flights, guide books, height profiles, photographs, etc. are provided on the Internet for hiking or biking tours and it is also possible to download the route to a GPS device or print out a description of the desired tour.

2. REGION

In the framework of two research projects a close co-operation with the "Dachstein-Tauern" tourism region was suggested. (Almer et al., 2000). This region includes such well-known skiing resorts as Schladming (host to world skiing

championship events) and Ramsau (world championship in nordic skiing 1999) and is one of the most attractive tourist regions in Austria (see <http://www.dachstein-tauern.at>). The region's impressive range of hotels and guesthouses, which offer a total of 22,300 beds, and excellent overnight figures (over 2.2 million overnight stays in 1998) make the tourist industry an important factor which contributes massively to the regional economy. The region boasts a total of 88 cable cars, chair and tow lifts, 170 km of ski runs, and 300 km of cross country ski trails. In recent years, the area's many opportunities for hiking, mountain-biking and relaxation (wellness centres) have attracted an increasing number of summer visitors. The "Dachstein-Tauern" region also has a wide network of bike routes and mountain trails. Therefore, the region was a very strong partner for the research projects which have been realised in the last two years. The results of these projects will be presented in the framework of this paper.

3. SYSTEM CONCEPT

In Austria as well as in the neighbouring German speaking regions (Bavaria, Switzerland) there already exist some big providers of touristic information systems with very extensive data bases. All systems tested within the scope of a market analysis (Almer et al., 2002), however, showed clear shortcomings concerning visualisation, above all in the field of 3D visualisation, as well as in the storing of spatial and thematic information. So as to avoid such shortcomings the presented concept is based on a comprehensive geo-multimedia information pool, out of which end-user applications can be provided on different output media such as world wide web, CD-ROM, info terminals and mobile terminals. In spite of the different technical possibilities and restrictions the fundamental navigation elements and possibilities are offered on all media by means of which a far reaching customisation of interactive contents is made available. The basic elements for the complete system pursued in this project are shown in the following figure.

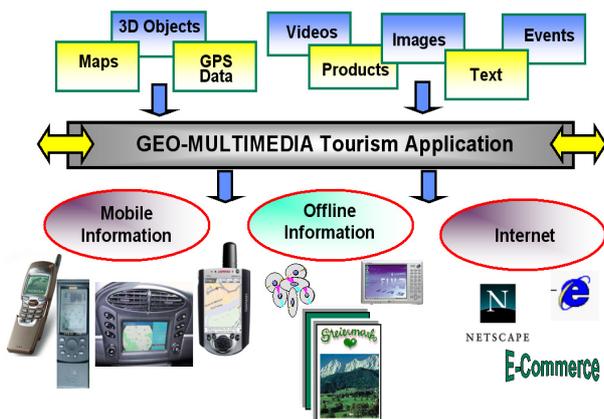


Figure 1: Product Definition

The development of a thematically and geographically related data base is integrated into an interactive multimedia information system and allows an optimised online and offline presentation of tourist information on a variety of digital media. The system will integrate satellite images, GPS data, GIS information, terrestrial images and will also include tourist information and offer multimedia, 2D and 3D visualisation technologies and interactive navigation. Tourism information is basically location based information and provides information on a tourism region on the Internet, on CD-ROMs as well as on

mobile devices and is therefore of high interest for tourists. When developing an interactive multimedia information system for a tourism region, work has to proceed in several stages. For economic reasons the whole system has to be planned as a long-term concept.

4. PRODUCT DEFINITION

Multimedial presentation of tourist information signifies improved conveying of information by means of a well-aimed combination of different media, like text, sound, picture, video and animation. This presentation must not be restricted to one or two output media, but should work with every sort of existing technology like CD-ROM, Internet and mobile devices. Tourist information is modelled on the topographic conditions, so the application of remote sensing data for landscape visualisation is particularly appropriate for this purpose. The combination of digital elevation models (DEMs) with aerial and satellite images is the basis for the development of 3D views, virtual flights and panoramas. When combining this with tourist information in the form of texts, photos and videos a comprehensive information system emerges, which offers the tourist optimum access to the region of his choice. This access is marked by a high degree of interactivity, regarding the realization of multimedia CD-ROMs as well as Internet solutions.

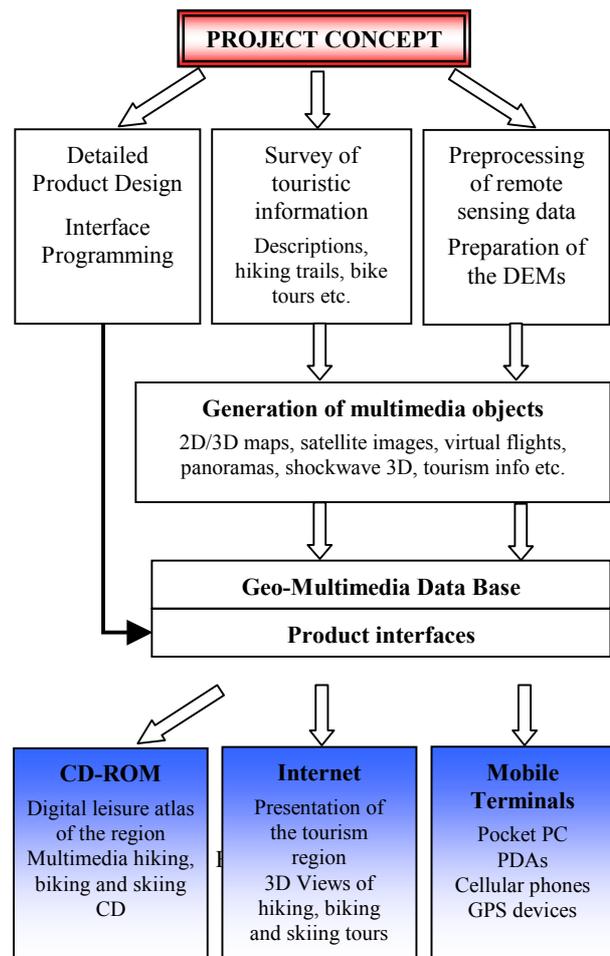


Figure 2 gives an overview of the product development for a comprehensive multimedia presentation of a tourism region. The following chapter treats the particular products in detail except the implementation of the geo-multimedia data base.

5. MULTIMEDIA PRESENTATION OF LEISURE & TOURISM INFORMATION

5.1 Preprocessing of remote sensing data

For the visualisation of a tourism region three-dimensional landscape models are very suitable, as they give the user a particularly realistic impression. In order to design such 3D models as realistically as possible, satellite image data are used in the scope of the project. For the scale required within the framework of the project the resolutions of the sensors of Landsat TM (30 m multispectral) and SPOT PAN (10 m panchromatic) are most suitable.

5.1.1 Preparation of the DEMs

Digital elevation models are not only required for the geocoding of remote sensing data, as described in chapter 5.1.2., they also play a vital role in 3D visualisation. They are the core piece of every 3D model, regardless if 3D views, virtual flights or panoramas are calculated. The required gridsize of the DEMs depend on the desired scale of the depiction. A digital elevation model is a gray scale image which is assigned a determined resolution and a determined map projection with geodetic datum. For geocoding as well as for 3D visualisation the DEMs are to be converted into the required reference systems and the required resolution. This transformation consists of the conversion of a pixel's rectangular coordinates into geographic coordinates, with reference to the respective ellipsoid, further of the datum transformation into the desired reference datum and the subsequent projection into the requested new rectangular coordinate system. For this conversion the bilinear resampling is very useful, since it possesses a slight smoothing effect whereby the formation of edges is avoided.

5.1.2 Geocoding of satellite image data

For the application of remote sensing data it is essential to geocode them into a determined reference geometry. This is accomplished by a parametric imaging model of a satellite sensor. The imaging model is generated with the sensor data and optimised with the aid of ground control points (Raggam et al., 1999). The accuracy in the generation of an imaging model for Landsat TM 5 and SPOT PAN is approx. ± 0.5 pixels. On using a digital elevation model with a gridsize of 25 m the satellite image scenes are geocoded into the requested map geometry. To achieve an optimum visual depiction the bi-cubic convolution resampling is applied for the process of geocoding. The geometric accuracy of the geocoded image is examined by comparing and superimposing with the reference data, i. e. with topographic maps and digital orthophotos. The accuracy of the geocoded image has to equal the accuracy of the generated model.

5.1.3 Data fusion

In the context of the works a Landsat TM scene (30 m resolution multispectral) was fused with a SPOT PAN scene (10 m resolution panchromatic) in order to obtain true colour images at a resolution of 10 m (see figure 3). Precise geocoded remote sensing data are a precondition for such a data fusion, so as to receive an accurate fusion result.

The applied method is based on the principal component transformation and supplies high resolution true colour images.

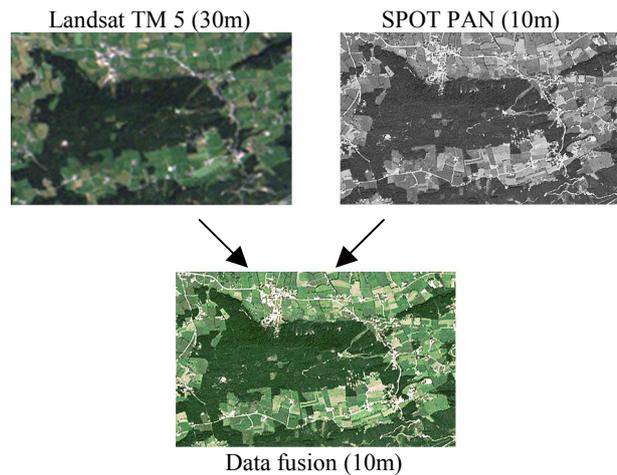


Figure 3: Data fusion

5.2 Generation of multimedia objects

5.2.1 Generation of 3D views

3D views are calculated from the combination of the fused 10 m RGB images and the DEMs. A precondition for this data generation is the exact geometric concordance of geocoded satellite images and the DEMs (Patterson, 1999).

The predefinition of the contemplator's position results from the definition of the image acquisition parameters, i. e. camera position and view direction. These parameters may be modified interactively in order to get the best visual 3D view of a landscape. After predefining the parameters the 3D views are rendered with a defined resolution (see figure 4). For visualisation on CD-ROM the resolution of e. g. 1200 x 800 pixels proves useful (Questar Productions, 1998).

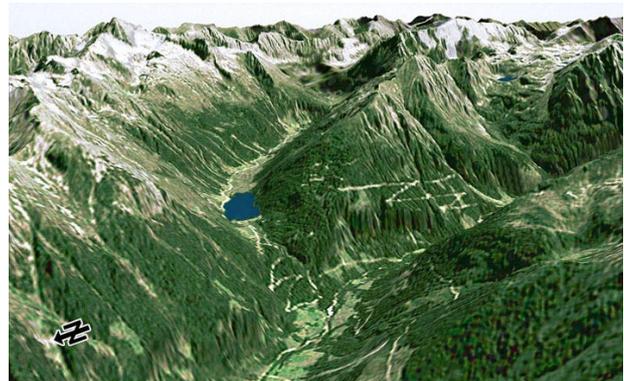


Figure 4: 3D view

The generation of 3D views as well as the following description of flights and virtual panoramas are treated in the animation software "World Construction Set". This software is highly suitable for the animation of geo data, in particular for the procession of large DEMs and satellite image textures.

5.2.2 Virtual flights

For the generation of a virtual flight some thousand separate images are rendered and combined to an animation file (mpg-file), depending on the projected flight duration. For a flight animation it is vital to define a flight path and to determine the variable view direction along this flight path and the equally

variable flight height. Starting from a standardised frame rate of 30 images per second 1800 separate images have to be calculated for a one minute animation. In order to avoid flickering in an animation, antialiasing-techniques are applied. For the generation of an animation file separate images are coded into a compressed format. For this, the mpeg-1-format has proved useful, because it possesses a high compression degree and yet a high quality.

5.2.3 Virtual panoramas

The generation of 180° or 360° panoramas offers an impressive possibility to visualise a region. These panoramas can be generated both from separate images and from virtual 3D views of satellite images (see figure 5). Thus, the user is able to navigate and zoom the panoramas as well as to use links to other panoramas and to receive further touristically relevant information.



Figure 5: Virtual panorama with map

The combination of different panoramas with maps permits the realisation of a “virtual stroll” through the region. The user may move interactively through villages and towns, enter buildings, such as hotels and shops, and on the general map he may always see his position and perspective.

5.3 Design and programming

The integration of the above described multimedia objects into different applications is realised by the definition of concrete projects like multimedia CD-ROMs, Internet performances or applications on mobile terminals.

The design for the user interfaces is realised by means of graphic programmes such as Photoshop or Coreldraw. The programming of the multimedia surroundings is performed using Director, Shockwave, Flash and other products of the software company Macromedia. Further, data base solutions (Microsoft Access, SQL etc.) and data base interfaces (DataGrip, etc.) are applied.

On developing the user interface special attention is paid to uncomplex and logical user guidance and the system’s software and hardware requirements are adjusted to the target group.

5.4 Data integration

In the framework of the visualisation of tourist information large data from existing archives and newly surveyed data flow in. For multimedia hiking or biking guides these are data of tours (GPS routes), photos and descriptions, as well as general tourist information. For the visualisation of tourism regions the whole tourist infrastructure (hotels, info points etc.) plays a crucial role. Partly, these data are already available within

existing Internet solutions and need to be enhanced and completed.

The above described multimedia objects emerge as novel sources of information, visualising outstandingly a region’s topographic conditions. Above all the high degree of interactivity, which distinguishes the products described below permits the user a completely new access to touristic and topographic data.

5.5 Products

5.5.1 Multimedia mountainbike guide

The bike CD-ROM “Salzburg-Steiermark” (“Salzburg-Styria”) is a multimedia mountainbike guide, which describes 42 bike tours in the regions of “Dachstein-Tauern”, “Lungau” and “Sportwelt Amadé”, using 3D views and 3D animations. For each tour the CD comprises exact descriptions and road books with all waypoints, height profiles and photos. The tour description allows the user to select bike tours according to individual demands and convenience. It is possible to enter fitness and technical parameters for an optimum choice. 3D views and virtual overflights show the tours in the most impressive way giving a true impression of the terrain’s features and the changes in elevation along the bike tour.

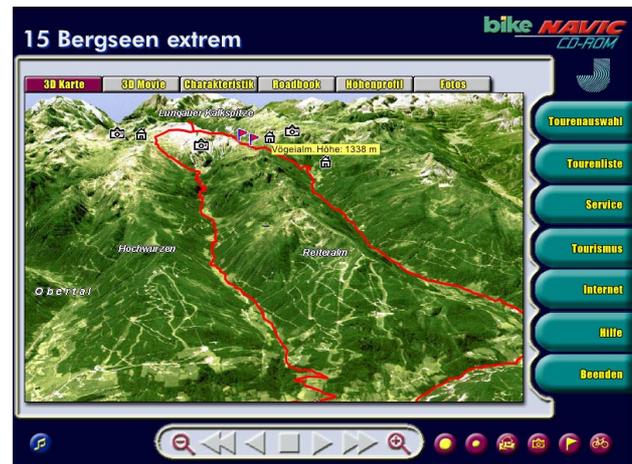


Figure 6: 3D tour visualisation with additional information

The 3D maps comprise a variety of additional information which can be loaded by the user (see figure 6). In this way huts, waypoints or villages and towns as well as points where photos are available appear on the screen by a mouse click.

In addition, the three tourism regions are presented with detailed descriptions of how to get there, where to stay, cultural highlights, sports facilities etc.

5.5.2 Multimedia hiking CD-ROM

The digital hiking CD-ROM “Dachstein-Tauern“ is a multimedia hiking and tourism guide. It offers the description of 43 hiking tours in the “Dachstein-Tauern“ region with detailed texts, maps and unique photos, completed with multimedia objects such as virtual overflights and 3D maps for each tour.

Each tour is visualised by means of a 30 to 120 seconds overflight. During the overflight the user may manipulate the visual display of the film. These overflights give the user a particularly realistic and exciting impression of the hiking tours (see figure 7).

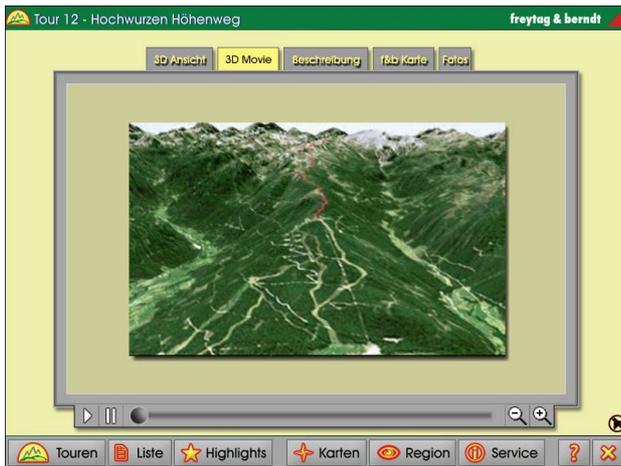


Figure 7: Virtual flight over a hiking tour

The structure of the hiking tours is adjusted to the requirements of different target groups. The CD offers many various kinds of tours ranging from extreme hiking tours to adventure trails for children, in addition comprehensive information on history, myths, legends, geology and pasture economy. The combination of text, video and audio material permits the observer to contemplate geography and history of the mountains with new eyes. In order to offer a navigation aid for mountaineers all the hiking routes are also provided to the Garmin GPS devices, the user being able to select between guided routes and detailed tracklogs.

5.5.3 Global presentation of the tourism region

The global presentation of the tourism region on Internet and CD-ROM is a multimedia tourism guide for the “Dachstein-Tauern“ region.

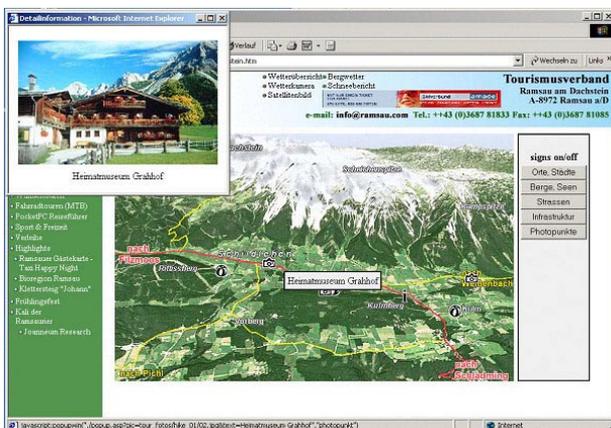


Figure 8: Touristic infrastructure in a 3D view

For visualisation 3D models, virtual panoramas, digital photos and satellite images are used. The digital tourism guide contains up-to-date information on infrastructure (see figure 8), geographic position, sport and events, as well as detailed infos on accommodations with the corresponding photos and a virtual stroll through buildings (see figure 9).

This geo-multimedia information system was combined with the region’s existing information structures, that is to say, that e. g. the existing Internet presentations were enhanced and extended. Geo-multimedia data complete the comprehensive and effective existing tourism information systems. The geo-coded gathering and administration of all infrastructure objects (hotels, sports facilities, info points, etc.) permits position and place referenced

processing. This in turn allows the tourist optimum orientation and provides regional information. In addition, download facilities are provided for mobile systems in order to download tourism information, route information etc. on mobile systems such as organizers or GPS devices.



Figure 9: Virtual stroll through a hotel

5.5.4 Interactive Alpine Skiing Visualisation

On the basis of DEMs and forest classification results emerges a virtual winter landscape with modelled trees, houses and other objects. Information on the skiing areas (lifts, runs, huts) is inserted into the landscape and animated. The implementation of the visualisation with Macromedia Shockwave guarantees a high degree of interactivity when viewing the information (see figure 10).



Figure 10: Virtual skiing area

The user may opt for the display of his individual information level, e. g. downhill runs, arranged according to their degree of difficulty, lifts, huts, guesthouses and parking facilities. Every symbol appearing on the screen provides additional information, which can be downloaded by means of a mouse over effect, and detailed descriptions and photos are available for huts, guesthouses and lifts.

5.5.5 Mobile information systems

For the potential client of a tourism region the region related information is particularly interesting. It is the combination of mobile devices with GPS devices that allows the user to relate the information individually to his present position (“Location

Based Services“) and to obtain unlike a regular Internet user a geographically interesting piece of information via a mobile device. Nearly always, tourism related information shows to a large extent geographic references. Thus, it is useful for a tourist to receive recommendations concerning restaurants and leisure facilities within close range of a hotel and not of all the establishments in the whole region. Considering the main focuses of tourism in the “Dachstein-Tauern“ region a PDA of the company Compaq (iPAQ) and a Garmin GPS device were applied for the presentation of particular topics.



Figure 11: Tourism information on an iPAQ

For a multimedia visualisation of tourism information, picture, sound, text and video elements were integrated into the PDA in order to record the effectiveness of the mobile device. Further information is obtained by cartographic illustration (see figure 11) of the site and its surroundings. The user may move on the map and different areas can be seen. Particular info points demonstrate that for an object depicted on the digital map a different information level with multimedia objects is available. For these info points descriptions, spoken texts or short video clips are available. The device's storage capacity is adequate for the realisation of a comprehensive and smooth presentation of a whole region.

In the sector of outdoor sports the use of Handheld GPS receivers is gaining more and more momentum. In particular for hiking and mountain biking the use of GPS devices in combination with routes and waypoints is highly suitable. Previous to the hiking tour points are downloaded to the device in order to orient oneself. Since the deactivation of “Selective Availability“ the accuracy of the GPS positioning is approx. ± 10 m (Hofmann-Wellenhof et al., 1997) and is therefore more than sufficient for outdoor navigation. So as to provide tourists with an optimum orientation guide it is possible to download GPS coordinates for hiking tours to Garmin GPS receivers. These routes offer a suitable orientation guide, above all when using the route mode, where the device calculates and displays the respective direction and distance to the nearest point of the route.

6. CONCLUSIONS

The existing competition in tourism demands new and innovative strategies for the presentation of the tourism regions. In order to reach important tourist target groups it is vital to prepare information in a geo-multimedia information system and to present these data on different digital media. The implementation of a geo-multimedia information system in a tourism region requires a close co-operation with the tourism

boards within the framework of a working concept which is established for various years.

The user-related presentation (“Customisation“) of information alongside the possibility to link this information to a geographic position (“Location Based Services“) will play a crucial role in the acceptance of the digital tourism information services. Because of the rapid technological progress in the telecommunications industry the integration of the mobile information systems into the multimedia tourism information concept is also of prime importance.

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