

Geo-Data Presentation on Mobile Devices for Tourism Applications

Patrick Morris Luley, Alexander Almer
and Thomas Schnabel, JOANNEUM RESEARCH, Austria, Graz
Rudolf Massimo, University of Innsbruck, Austria, Innsbruck
Wolfgang Herpolsheimer, RuFHer/Herpolsheimer OEG, Austria, Bludenz

Abstract

Tourism information mostly is geographically related information and therefore, a multimedia presentation of tourism information in spatial context on different digital platforms will offer the opportunity for a comprehensive information service. Based on the rapid developments of the telecommunication industry, several handheld devices are available which allows realising a mobile information system including location aware services.

This paper will briefly describe a prototype of a mobile multimedia tourism information system for outdoor activities and user oriented data management tools. A PDA (Personal Digital Assistant) in connection with GPS device allows us to guide tourists to the desired sights or along hiking and biking tours of a tourism region. For a multimedia visualisation of tourism information pictures, sound, text and video elements were integrated in order to record the effectiveness of the mobile device. Cartographic illustrations using satellite images and digital maps are the base for an innovative presentation of tourism information in their spatial context. Mobile devices offer the possibility of an innovative presentation of tourism information with a high usability and fulfil user desires for information provision.

1 Introduction

The ongoing competition in tourism economy demands new and innovative strategies for the presentation of the tourism regions. The existing tourist information systems of Central Europe showed clear shortcomings concerning the existing technical opportunities for the presentation of spatial information (Zeiner H. et al., 2002). An innovative tourism information system has to offer the opportunity to present information on different output devices and has to consider the spatial context of the relevant data in order to reach important tourist target groups. The rapid technological progress in the telecommunication industries supports in a strongly way the integration of mobile devices in the daily life of the people. Therefore, handheld mobile applications will become a driving economic factor both for further developments of telecommunication industries and for the acceptance of and public response to the EU initiative Galileo.

User-related presentation (“Customisation“) and location awareness will play a crucial role in the acceptance of the digital tourism information services (Fritsch D. (2001)). Therefore, today and increasingly more in the future mobile devices such as cellular phones, PDAs and GPS devices are used by many people to get mobile access to information. The combination of PDA

with GPS devices allows the user to relate information individually to his present position and to obtain, unlike a regular Internet user, a geographically interesting piece of information and offers him a “Multimedia Location Based Service”.

In order to achieve a broad acceptance for such a mobile system by the addressed target groups e.g. tourism boards and tourists, the data management for the geo-multimedia information should be easily feasible by non GIS experts. Therefore, a management system has to be designed as a user-friendly and also adaptable tool which fulfils the data handling and the data pre-processing for the presentation on a mobile device.

Both the development of the concept presented in this article and the creation of the prototype were realised in close cooperation with the company “RuFHer” and within the 5th EU Framework Programme project “ReGeo” (Multimedia Geo-information for e-Communities in Rural Areas with Eco-Tourism).

2 User requirement analyses

In order to develop a user friendly mobile information system a study was carried out to analyse the user demands for such a system. The study was guided by the idea of the company RuFHer to develop a mobile multimedia tourism information and safety system. The basic concept behind the system is that people engaging in out-door activities need various (actual) information about the region for making their hobby safely and enjoyable.

However, as the ideas about specific features of the system were vague and primarily built on individual experiences of the RuFHer group a PINN-Project¹ was assigned to get a market perspective on that issue (Eder, M. and Eder, H. (2003)). The aim of the research was the determination of relevant information domains, problem areas and specific system functions from the perspective of possible users and important stakeholders.

Because of the primary applied focus of the study and the limited timeframe the study it was not designed to satisfy academic standards. Nevertheless it can be argued to reflect good new product development standards as the well established method of semi structured qualitative interviews was used with a mix of various techniques like sequence oriented problem identification, critical incidents technique, laddering and open probing (for review see i.e. Easterby-Smith, Thorpe et. al. (2002)).

The selection of potentially relevant users (skier/snowboarder, biker, and hiker), and stakeholders (hotels, refuges, tourism-boards, rescue services, lifting and tourist experts) rested on personal knowledge and experiences of the involved persons. For this investigation 45 users and 25 stakeholders in three major tourism regions in Austria were interviewed. The interviews lasted from 20 to 40 minutes and all were recorded, transcribed and content analysed. Table 1 summarizes the major information requirements of the three target groups.

¹ PINN (Patenschaftsmodell Innsbruck) is a transfer center at the faculty of social and economic science of the University of Innsbruck. For more information see http://info.uibk.ac.at/c/cb/cb19/haupt_e7.html

Information needed	Skier	MTB	Hiker
Tour Destination			
Tour	+ ++	++ +++	+++ +++
Characteristic of the Tour / Aerea			
Variety	+++	+++	+(+)
Beautiful Surrounding	+(+)	+++	+++
Rest / Silence	+	+++	+++
New Tours	++	+++	+++
Number of Visitors	+++	++	+
Route / Ski-run Info s			
Difficulty	+++	+++	+++
Duration	+	+++	+++
Altitude	+	+++	+++
Profile	-	+++	+++
Steep	+	+++	+++
Distance	-	+++	+++
Condition	+++	+++	++
Open / Closed	+++	++	+++
Marking	+	++	++
Securing / Protection	+	-	++
Variants (Alternatives)	+++	+++	+++
Weather			
Forecast / Long Term	+++	+++	+++
Actual	+++	+++	+++
Regional	++	++	++
Orientation			
Position / Location (Determination)	++	++	+++
Destination	+	+++	+++
Tour Description (howto come there)	+	+++	+++
Remaining Distance	+	+++	+++
Needed (Accessories) Equipment	+	+	++
Way Up Aids			
Open / Closed	+++	++	+++
Office (Working) Hours	+	++	+++
Waiting Period	+++	-	-

Starting Point	+	+++	+++	+++
Approach / Arrival	+	++	+++	+++
Public Transportation	++	+	++	++
Cottage / Refuge / Shelter				
Contact	-	++	+++	+++
Position / Location	+	+++	+++	+++
Howto Reach	+	+++	+++	+++
Overnight Stay	-	+++	+++	+++
Open / Closed	+	+++	+++	+++
Equipment	+	++	+++	+++
Service	++	+	++	++
Prevention / Safety				
Avalanche Situation	++	-	-	-
Refuges / Shelter	-	+	++	++
Emergency (actual)				
Call for Help	+++	+++	+++	+++
Shelter	-	+	++	++
Alpine Registration Office	+	+	++	++
Emergency Way	+++	+++	+++	+++
Warning Information				
Bad Weather Warning	+	++	+++	+++
Avalanche (Danger Zone)	++	-	-	-
Falling Rocks	-	-	-	+
Information / Hints				
Closed Areas	+++	++	+	+
Alpine Ground / Terrain	+	+	+++	+++
Nature Information				
Peak Notification	++	+(+)	+++	+++
Regional Plants	-	+	++	++
Regional Animals	-	+	++	++
Speciality of the Region	+	++	++(+)	++(+)
Documentation				
Altitude	+	+++	+++	+++
Distance	+	+++	+++	+++
Tour / Route Profile	-	+++	+	+
(@) Speed	-	+++	+	-
Pulse Rate / Heart-beat	-	+	+	-

Legend: - not relevant; + rarely important; ++ important; +++ very important information

Tab. 1 : Information requirements of target groups

The Table above indicates specific information requirements of the three target groups. In addition the relative importance of each information is indicated. The red circles highlight areas of major differences between skiers and the other two target groups. Apparently skiers consider information regarding to the tour/route, orientation, cottages etc., emergencies, and documentation as not really important. One reason for that might be that relevant information in “organized areas” such as ski-arenas is readily accessible. The respondents clearly indicated that in organized areas such as ski- arenas multiple information sources such as signs, cell-phones, flyers, info channels, etc., and slope maps are already available and easy to access. This seems to be in contrast to less organized areas in the back country where hikers and hikers commonly pursue their activities. In these areas the information search seems to be more effortful. Accordingly, it has been concluded that hikers and bikers need more information and have less options to obtain them which makes them a more attractive target group for the NavIs system.

The major outcome of the study is that a mobile tourism information system needs to provide, in order to fulfil user desires, the following information:

- Actual Tour Description & Guide
- Route / Tour Characteristic & Infrastructure
- Refuges - Location / Facilities & Open Time
- Weather Report - Forecast
- Actual Regional Weather – Warning
- Emergency & Safety Information
- Orientation / Positioning & Location
- Location Based Services

To overcome user desires and to gain customer amazing, the system has to additionally provide the following information:

- General Tourism Information
- Events / Entertainment.....
- Hotels / Restaurants / Special Offer etc.
- Transportation / Schedule
- Points of Interest
- Natural Environment
- Tour Recording

The realisation of a prototype for demonstration purposes focused on the target group hikers, the one with the highest potential, and especially for this user group functionalities were implemented to present a subset of the above mentioned information. The developed prototype is designed to show the effectiveness of the RuFHer mobile multimedia tourism information and safety system.

3 Test-area and content for the prototype

In the framework of two research projects a close co-operation with the tourism board “Ramsau am Dachstein” tourism region was suggested. (Almer et al., (2000)). This region is a well-known skiing resort (world championship in Nordic skiing 1999) and is one of the most attractive hiking regions in Austria. The region offers a wide network of hike routes and

mountain trails and therefore, this region was an ideal test-area for the development of a prototype system.

The presentation of geo-data on a mobile device, and tourism information is mainly spatial information, requires a geographical reference. Depending on the desired scale the reference data for a demonstrative and interactive presentation can be created on the basis of aerial and satellite images as well as of existing maps.

In order to produce coloured ortho-images with a high resolution, panchromatic data with a high resolution (e. g. ortho-photos, SPOT PAN, IRS-1C/D PAN, etc.) are fused with multi-spectral data (e. g. Landsat TM) with a lower resolution. For a data fusion different algorithms can be used depending on the original data. Useful visual results are produced, for instance, with the help of a data fusion on the basis of satellite data of SPOT PAN and Landsat TM (see Figure 1), the result of which is a 10m true colour image (ref. Almer A., Stelzl H. (2002)).

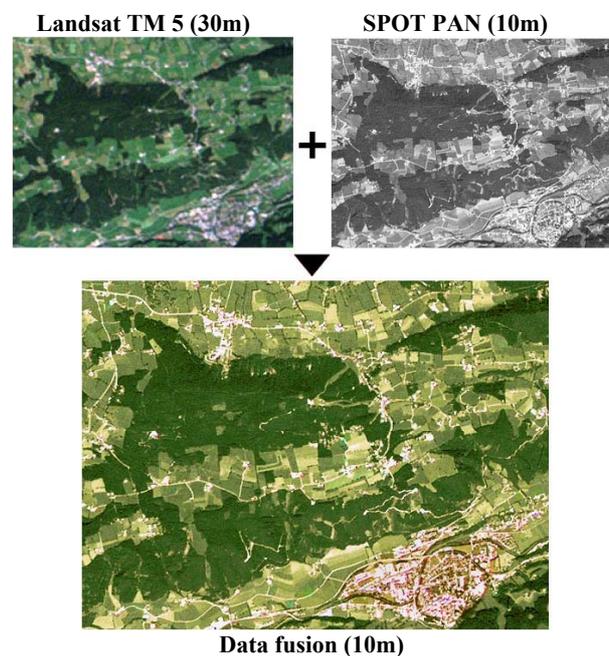


Fig. 1: Data fusion



Fig. 2: Data fusion vs. digital map

The maps and satellite images mentioned above form the background for an innovative spatial presentation of tourism information. For data acquisition a close cooperation with the local tourism boards is essential. Depending on the orientation of the information system the following data are relevant:

- Tours and tour points: the coordinates of a hiking or biking tour, the most important waypoints, refuges and viewpoints along the route.
- Tourist infrastructure: info points, public facilities, sports facilities, etc.
- Places of interest: castles, palaces, museums, excavations, etc.

These examples demonstrate the fact, that tourism information is mainly spatial information, which can be split into point, line and polygon information. In terms of the presentation every object is a point with coordinates, which can be linked with a great number of multimedia information. Such data range from texts and photos to videos and 3D animations. This link makes possible the interactive presentation of a tourism theme as well as a fascinating journey through a tourism region. The acquisition of the coordinates of single objects can be realised by means of GPS measurements (single point positioning with pseudo ranges) or digitalisations on precise reference data, such as ortho-photos.

4 Technical concept

In order to design a detailed technical concept for a mobile location based information system, the technical framework including the potentials and restrictions of modern information technology as well as customers demands have to be considered. Two different customer groups have been identified: Operators like tourism boards, which want to offer a user friendly location based service in rural areas, and end users. The following focal points have to be considered: *Data presentation* on a PDA with multimedia capabilities, individual *data acquisition* with the PDA in combination with a GPS device and *data management* with a desktop application which provides import and export functionalities for the PDA.

Data presentation contains the presentation of geo-multimedia information on a mobile device. The application to present data on a mobile device is based on a geographical information system with basic functionalities like map browsing and zooming but implements additional features such as multimedia data integration, GPS navigation functionalities as well as visualisation of tours and infrastructure.

The next major part of the mobile tourism information system apart from the spatial visualisation of tourism relevant information is the opportunity of *data acquisition*. The implementation of data gathering functionalities enables the user not only to get access to spatial information but also to integrate his personal tourism information such as places of interest and tours into the system. The opportunity to gather geo-referenced tourism information is essential for a seamless data build-up in such an information system and demonstrates the systems high efficiency.

The third part of the system is, as mentioned above, *data management*. The data management tool represents the link between data acquisition and data presentation, as it provides functionalities to integrate and update geo-referenced tourism information.

The overall concept of a mobile tourism information system is shown in the following figure.

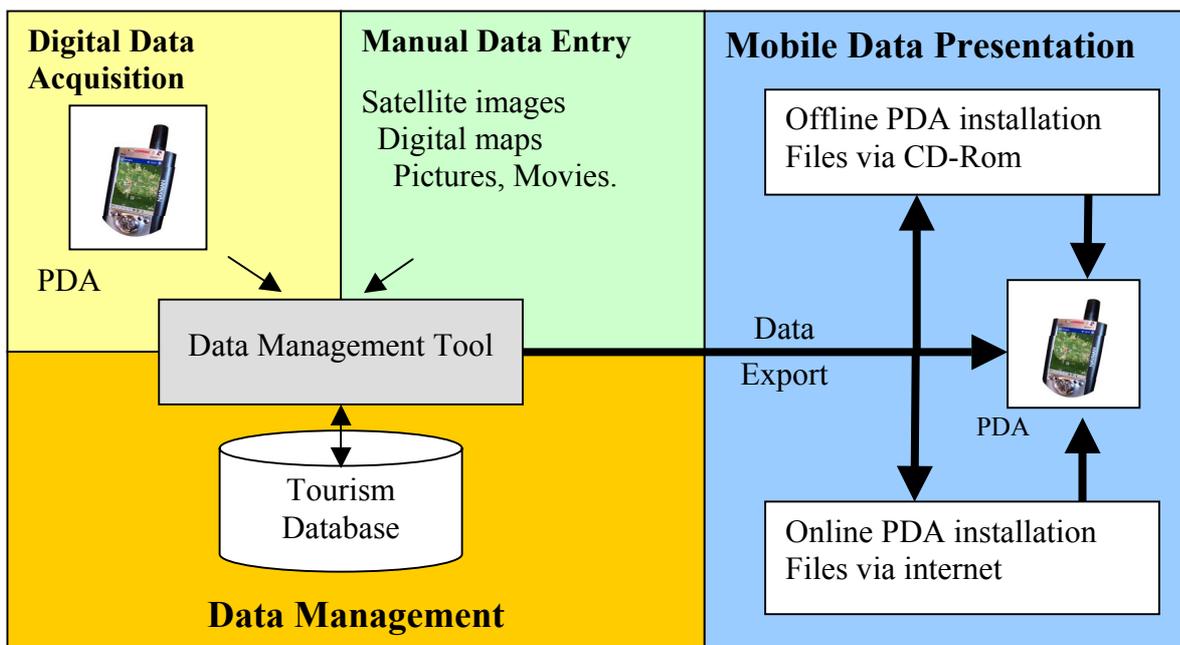


Fig. 2: Overall concept for a mobile tourism information system

5 Data management tool

An important prerequisite for the usage of a mobile information system is a user interface which allows non experts the data handling and the data pre-processing for the presentation of geo-multimedia information on a mobile device. Therefore, the Data Management Tool (DMT) was designed as a user-friendly, easily adaptable, offline tool in order to provide all essential functionalities to fulfil the task of managing the contents of a mobile tourism information system. In an ongoing second step of the development of the DMT, relevant themes for the web presentation will be integrated to realise an online data access based on wireless technologies as well as the opportunity to download actual data via internet on the PDA.

DMT was written in Macromedia Shockwave in combination with server-side running PHP scripts and allows the user to view and manipulate different multimedia information of two dimensional objects (hotels, sights, etc.) and tours (e. g. hiking and biking tours). This application bears the advantage that it is completely customisable. Depending on available maps and themes it can be adapted for different areas of application by editing the configuration XML file, allowing thus a wide range of applications. Although being an offline tool, it can be updated via the Internet or a CD ROM so that the customer may use the latest available data.

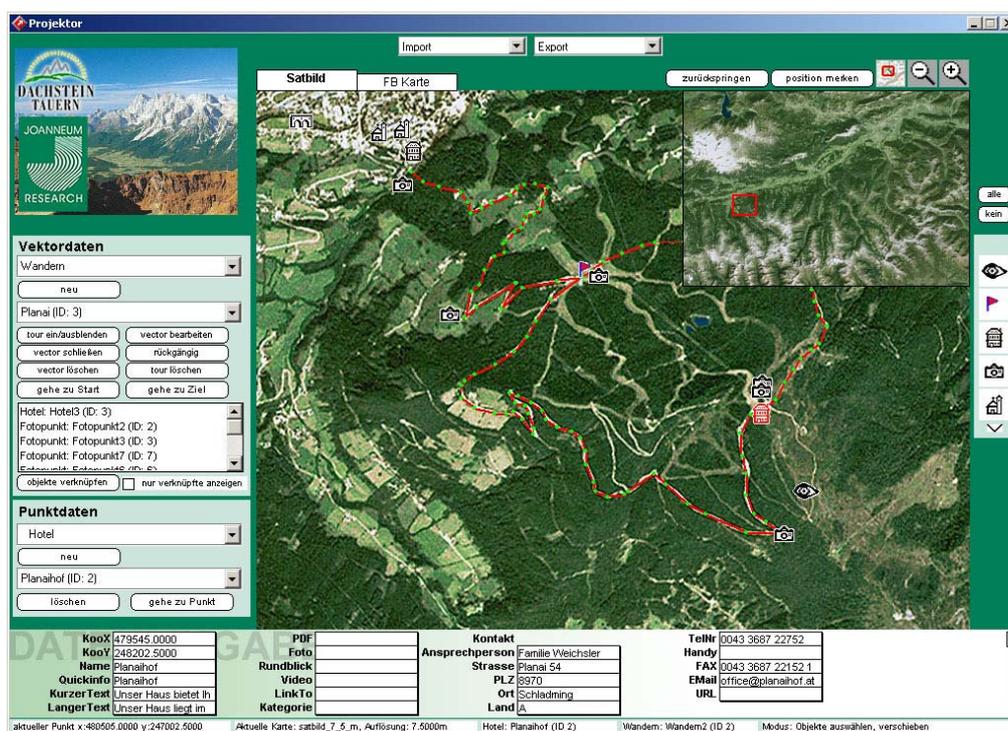


Fig. 3: Data Management Tool

The DMT can be split into the following three main modules:

- The data-import/export module (interfaces for connecting the mobile device and other external databases)
- The data-visualisation module (including the 2D map an ortho-images with different information layers)
- The data-manipulation module (includes tools for adding and editing geo-multimedia data e.g. tracks, points, text, images, audio, video)

The data import and export module provides interfaces to the mobile device, GPS devices and external databases. Thus, data acquired via a mobile device can be integrated into the database of the tourism information system. In addition, the user may export existing data to a hand held device, and GPS devices can be accessed to transfer stored points and tracks into the DMT. In order to be more flexible the DMT uses an XML structure for storing all relevant data. With the implemented interfaces it is possible to connect other external databases and exchange data easily. By using the data visualisation module the user can view available tourism information on two dimensional maps. As shown in Figure 3, different types of maps are available. An overview map shows the user's current position within the accessible area. The different themes are visualised by the employment of symbols, and which symbols are used can be set in the configuration file. In order to get an optimal view of particular objects, the user can easily navigate on the map, zoom in and out as well as cycle through the available maps. Another important module is the data-manipulation module as it allows the user to incorporate new information into the system and to edit or delete existing multimedia information. Besides point objects also tracks can be digitised on the map and in addition it is possible to associate points with specific tracks.

6 Mobile device – application

The prototype of the mobile tourism information system was developed for a Pocket PC (HP's iPAQ) in connection with a GPS device (a receiver in the "iPAQ" jacket format) and a mobile camera (see Figure 5). Pocket PCs are high performance mobile multimedia computers with high resolution colour displays working with the operating system "Microsoft Pocket PC 200x". In addition, a memory card was used to expand the internal memory of the Pocket PC.

Since the deactivation of "Selective Availability" the accuracy of the GPS positioning is more than sufficient for outdoor navigation and the European program "Galileo" will realise a perfect availability of positioning information over Europe. Within the private sector of GPS devices we distinguish basically three different types of GPS receivers, which can be used in combination with a PDA:

- GPS receivers as a jacket plugged directly to a PDA or connected via a cable
- GPS receivers with wireless interfaces (e.g. Bluetooth) and a own power supply
- Handheld GPS receivers with a display and map information

The mobile system has, as discussed in the technical concept in chapter 4, to cover two focal points of the overall concept. Firstly, data presentation and secondly data acquisition.

Data presentation. This first prototype is realised as a complete offline mobile solution, so only the GPS functionality can be permanently available (see Almer A., Luley P., Nischelwitzer



Fig. 4: Mobile Information System

A. (2003)). In an ongoing second step online themes like an event calendar and communication modules will be integrated, based on wireless technologies as well as the opportunity to define a user profile for an individual access to the desired information. The main theme of the prototype is the presentation of outdoor activities e.g. hiking and biking tours, etc., on the basis of ortho-images and digital maps. All pieces of information about the tours, region, impressions, infrastructure and info points are to be shown in a multimedia presentation (video, audio, animation, text, images) and to be linked to the user's current position. At present, the prototype offers the following information levels and functionalities:

- 2D visualisation of different spatial information using satellite images and common maps with the opportunity of interactive navigation and zooming.
- 3D image map for each tour to get an impression of the third dimension, which is important information for biking tours etc.
- General information about and impressions of the region – multimedia representation.
- Infrastructure database with detailed infrastructure information, thematic and geographic search functionalities for hotels, restaurants, leisure facilities, etc.
- A list of outdoor activities, e.g. hiking and biking tours with detailed information related to the tours like coordinates, descriptions, audio and movie objects, etc.
- Interactive selections of different layers for the spatial presentation, as there are tour course or infrastructure layer for the 2D representation.
- Supporting the actual position using a GPS module and shown in the 2D map and satellite image with the selected tour.

The following application screenshots show the prototype's multimedia data presentation capabilities.



Fig. 5: Data presentation on the mobile system (screenshots)

The figure above shows three examples of the “Graphic User Interface” (GUI) of the Mobile Tourism Information System. On the left side you can see the 2D map with the itinerary shown on the screen, the position marker and the opened GPS menu. The figure in the centre gives detailed information on a hiking tour and on the right side you can see a media player, which is integrated into the application, playing a video.

Data acquisition. The second focal point of the overall concept, which has to be implemented on the mobile device, is the individual data acquisition, which allows the integration of one's personal tour-tracking coordinates and detailed tour and point information including photos and videos which can be captured using a mobile camera (see Figure 5). The following application screenshots show the data acquisition capabilities of the prototype.

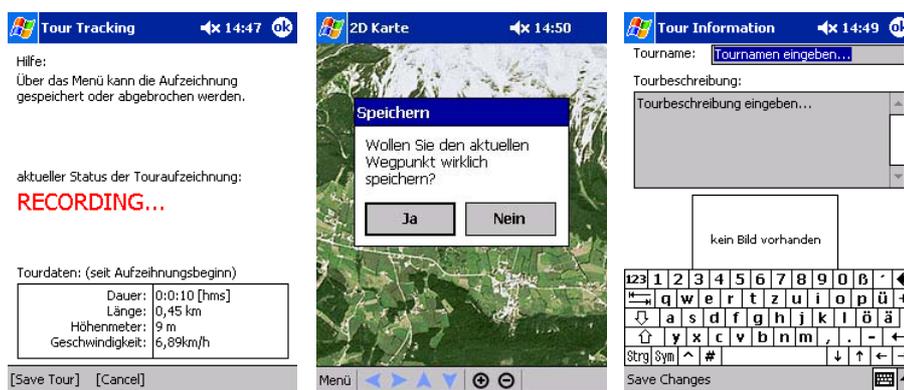


Fig. 6: Data acquisition on the mobile system (screenshots)

7 Outlook

The rapid technological progress in the telecommunication industries has strong influences on daily life. This fact is confirmed by the selling rates of PDA's and multimedia cellular phones. Location-based services appear to be a major key to the development of mobile networks and the services they provide, since a mobile user's location opens up new possibilities for creating value-added services. Therefore, an innovative and user-friendly mobile system including the location awareness is a logical step for the presentation of tourism information.

User-oriented indoor and outdoor applications on a mobile device offer a wide range of themes providing tourism information. By using current technologies such as GPRS, UMTS and WLAN both online-solutions and precise indoor-positioning have become realizable. The integration of these technologies in the described prototype offers the opportunity to provide a complete "Multimedia Location Based Service" for the visitor of a tourism region.

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