Mobile Mountain Mapping

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Abstract

Map visualization is an important tool to make mountainous areas easily understandable to visitors. This article suggests to turn from classical printed maps to the digital cartography presented on PDAs (Personal Digital Assistant) or on handheld GPS (Global Position System) device. Nowadays mountaineers and hikers have many possibilities to plan their excursions, instead of going to the bookshop, they make their plans by using internet. As an example, the following tools are already available on the net: Google Earth, free online map or for more expert cartographers - the currently spatial data infrastructure (SDI) which allows to visualize an image of multi-sources cartography through WMS services (web map services). Nevertheless, it is most fashionable for current adventurers to take their GPS device and all the tracks available, and perhaps why not to get some additional information about the interesting sites, they will pass through.

This article deals with mobile mountain cartography and its representation on portable electronic devices, where due to the factors: size of the screen, location based services (LBS) and current customers of mountain cartography, new solution should be considered for an innovative design. Additionally a pilot project of mobile mountain cartography has been designed for the project "La mirada circular" (www.lamiradacircular.com).

1. Introduction

The implementation of many projects proves the importance of mountain cartography and its scope within different environments which it is related to. Moreover mountain cartography has a great range of application and its demand is not only focused on the developing countries. A list of the thematic variety related to the mountain environment is presented in Hurni et al. (2003).

The solutions and developments in mountain cartography have been several in the last years. Today it is possible to go for a walk without a printed map. Moreover much of the geographical technology, which was not specially designed for mountain cartography, may be used for it, like for example GoogleEarth or VirtualEarth. Many tracks, photos, mountain huts are included on the web and they can be easily founded by googling. Even new terms are commonly used like geovisualization. Geovisualization provides methods and tools for the visual exploration and presentation of the geographical information. Altogether, these new approaches enlarge the idea of mountain cartography.

2. La mirada circular

The opened variety of mountain cartography, together with the currently range of geovisualization opportunities have made possible to create this project called "La Mirada Cir-

	Castilla y León	Greek	Poland	Germany
Population density (inhab/km2)	26.1	82.8	122	231
Rural areas	95%	97.1%	93.2%	80%
Population on rural areas	45%	64.4%	38.6%	40%
Agricultural	53.2%	40.9%	60%	53%
Network Natura2000	26.1%	26.4%	15.5%	13.5%

Fig. 1: Geographical location and data of Castilla y León

cular". La Mirada Circular is a project of sustainable and intelligent tourism based on the beauty and isolated rural areas of a region called El Bierzo.

El Bierzo is a region in the Northwest part of Spain which belongs to an autonomous region called Castilla y León. Fig. 1 describes the location of El Bierzo and some geographical features of this region compared with other EU countries. Some conclusions from Fig. 1 are the low population density of the region and the big areas of natura2000 network. Based on this data El Bierzo is a good area for relaxing and forgetting the stress of crowed cities as well as a sightseeing place to be in contact with nature.

Mountain paths and roads have always been the base on economy and partnership between cultures. This idea is the starting point of "La Mirada Circular". By renovating these lost roads and following these old traces a walking route has again become a solution for the economy of the region.

As an important part of the project the cartography is not only the spatial information but also the use of many others technologies; like animated maps, videos, and an attractive web design. One of the main functions of the web-mapping is the real time access to a great scale of information. Tourists nowadays collect information through the Web; at this stage they are called virtual tourists. They visit the earth just by being in front of their computer. By navigating through www.lamiradacircular.com as a virtual tourist you will understand more all the geographical aspect of the region as well as you will feel like coming to visit us. Comments through the webpage are always welcome to improve the project.

Belinchón (2005) proposes that rural tourism is an effective tool for the promotion and conservation of the rural heritage. As soon as the virtual tourist decides to come to visit El Bierzo, one of the main objectives of this project is already fulfilled. At this point a new stage of the project begin, the virtual tourist become and active tourist by visiting the region. New technological approaches are still on design to satisfy the expectancies of the active tourists on El Bierzo.

Active tourist involves mobility around the territory, personalization of activities and hobbies and context awareness. One solution gathering theses ideas is the development of mobile cartography for the region, as it is shown in Fig. 2.

3. Mobile Cartography

After the success of the Internet, web mapping is a further step for the traditional use of geographical information. The importance of Internet is undoubtedly enormous. La Mirada Circular is already included in this wide web world.

Geographical technology is nowadays easier available but at the same time this technology is rapidly changing from the classic desktop applications into web mapping and into the latest applications based on mobile computing. Mobile devices such as Personal Digital Assistants (PDA), mobile phones or GPS handhelds are some examples of appliances used in mobile environments.

This evolution on cartography brings new terms and the discussion to implement solutions. Telecartography and the Location Based Services (LBS) are terms related with mobile cartography. Telecartography means the exchange and transmission of spatial information through cartographic products that are transmitted by telecommunication technologies and are accessible by mobile query and display devices (Gartner 2000). Location Based Services (LBS) are wireless ‚mobile content' services to provide location-specific information to mobile users moving from location to location. Within the LBS concept a cartographic visualization is already understood. Finally mobile cartog-

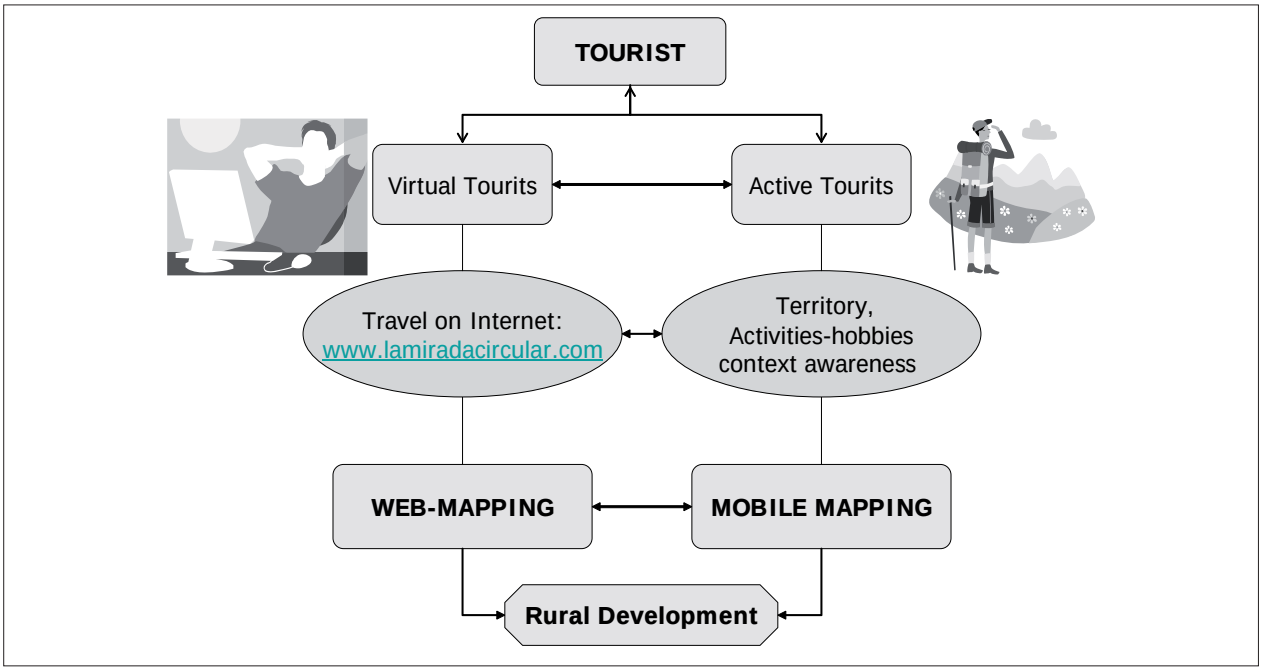

Fig. 2: Workflow from virtual tourists to an active tourist

raphy deals with theories and technologies of dynamic cartographic visualization of spatial information on mobile devices. Mobile cartography is the geovisualization on LBS devices (Reichenbacher et al. 2003)

Fig. 3 describes the characteristics of the main map groups. It shows the complexity of mobile cartography as it contents all the characteristics of digital and printed maps.

Cartography Characteristics	Printed	Digital	Mobile
Mobility	x		x
Positionable			x
Adaptive/Adaptable		x	x
independent		x	x
Interactive Location	x		x

Fig. 3: Characteristics of different cartography (adapted from Reichenbacher 2004)

There are many solutions for mobile cartography, even for industry and commercial purposes. Perhaps the most success device is the navigation systems performed for the motoring market. New ways of geovisualization are established, as an example the navigation on a road network is very well accepted by many users. Fig. 4 illustrates the well-known visualization of a Tom-Tom.

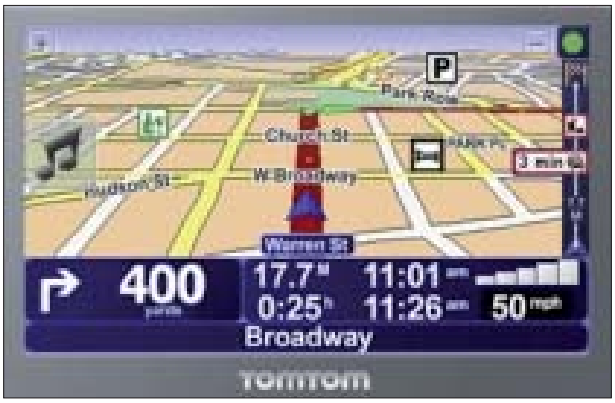

Fig. 4: Example of car navigation systems

3.1. Generalization and Adaptation

Many cartographers consider the mobile cartography a representation of the digital cartography in a small display; as a matter of fact map generalization will improve the geovisualization. Others authors consider mobile cartography a new display of cartography, and the process of generalization and adaptation are both necessary. In fact both terms overlap each other, generalization is more objective: characteristics of map elements: takes into account scale and map purpose. And the adaptation process is more subjective it implies the most relevant elements for the user and it takes into account the context of the map usage (location, time, activities, goals and etc…). (Reichenbacher 2004).

4. Mobile Mountain Mapping

Mobile mapping by means of mountain cartography has also several solutions, especially in national parks and tourist areas. A good example is the WebPark project, funded by the European Union (Webpark 2004). It consists on a mobile information system that provides visitors of natural areas and parks information about their surroundings using PDA and GPS. The success of the project has brought a new market and some companies are nowadays working on digital guides for tourisms. On the other hand there are also cartography companies commercializing their printed products on a digital raster format for desktop and mobile applications. Fig. 5 illustrates two ways of managing the cartography data.

Many of the developed projects have focused their attention especially on telecartography and the telecommunications protocols which are important for the interoperability between different platforms. However, Konecny 2001 mentions that there are many other challenges for cartography in this millennium. One of them regarding the impact of the computer is the importance on the basis of visualized spatial data in order to take the right decision.

Cartographic visualization on screens has a number of advantages over the paper maps. However, as there are a big number of different devices with their own screens and characteristics, the visualization of cartography on digital devices can not be so easy summarized.

Fig. 6 shows the differences characteristics of geovisualization between the map groups:

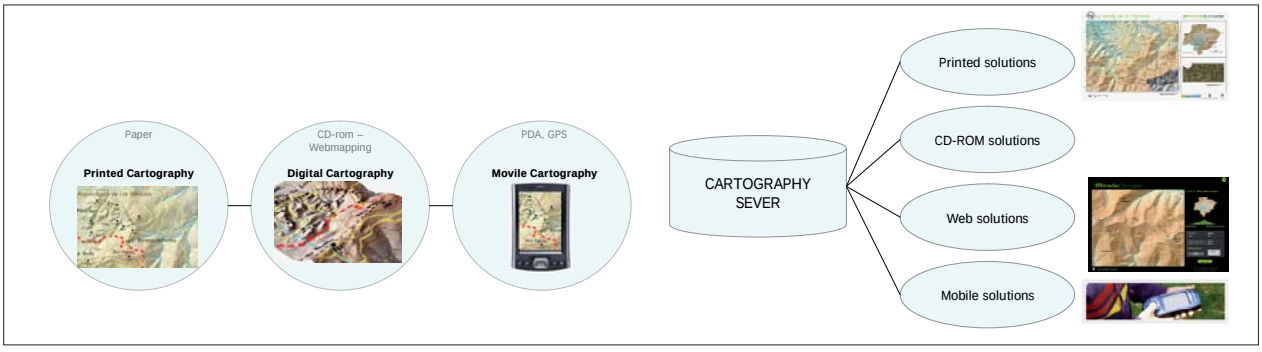

Fig. 5: Two different workflow for managing cartography information

	Printed Cartography	Digital Cartography	Mobile Cartography
Size	700 x 1000 mm	228 x 304 mm (15 inch) 1024 x 768 pixels	60 x 80 mm 240x320 pixels
Legend	Limited	Interactive	Limited/Interactive
Scale	Fixed	Scalable	Scalable
Coverage	Limited	Seamless	Seamless
Queries	Unable	Available	Available
Processing / Battery	Independent	Great capacity of processing / Electrical Energy.	Lack of processing power memory / Battery lifetime

Fig. 6: Technical characteristics of the different map groups

4.1. Devices for mobile mountain cartography

There are already available on the market several products for mountain cartography. PDAs and GPS are the combination most used but they are not the most robust solution for hard mountain terrains.

The company Magellan already commercializes robust GPS units with Windows mobile 6.

4.2. Examples and recommendations for mobile mountain cartography

The major limitation for the geographic information visualization on mobile devices is their small display. This lack of space on the map implies that auxiliary elements such as a map legend would be display only if it is demanded.

Additional design should be implemented on mobile mountain cartography. As it was discussed before visualization, generalization and adaptation have to be taking into account for the representation of mobile mountain cartography. This ideas are managed by the GUI (Graphical user interface), which provides the interaction between the computer and the user. For that, mobile mountain cartography is focused not only on the visualization of cartography but also on the design of an easily to use device.

One of the main advantages of GPS devices for hikers and alpinist is the knowledge of the direction, which guide them to their goal. However, there are more important necessaries factors to move on mountain terrain. The weather, the distance and difference in height to the goal, snow conditions, sunrise and sunset calendar, vegetation and animals are additional information that can also be implemented in a mobile mountain device.

The most commonly solution for representation objects on mobile cartography is the use of POI (Points of interest) through icons. Fig. 7 shows POI of a village placed in El Bierzo.

New algorithms to process Generalization and Labelling automatically must be implemented. It is shown on Fig. 7 the height of the contour lines automatically labelled on the screen. However, the algorithm has placed the texts on the different directions.

The displaying of the next stop of the track gives the users an idea of the direction, as it is shown on the right image of Fig. 7.

Sounds for warning or information, Photos, Route Profiles are several extra techniques available to be used in mobile mountain cartography.

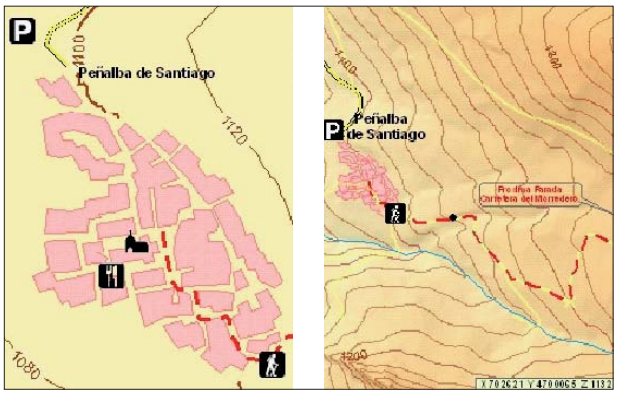

Fig. 7: POI for mobile cartography

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