Using Wearable GIS in Outdoor Applications

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German Abstract

Traditionelle GIS-Anwendungen wie Liegenschaftskataster, Raumplanung und Leitungsdokumentation gehen von einer statischen Umgebung aus, in der ein Benutzer an einer Workstation arbeitet. Seine Aufgabe löst er mit einem GIS, das seine volle Aufmerksamkeit in Anspruch nimmt.
In vielen weiteren Anwendungen sind raumbezogene Informationen sehr nützlich, wenn sie »nebenbei« benutzt werden können und die Bedienung des GIS nicht die volle Aufmerksamkeit des Benutzers voraussetzt. Anwendungsgebiete dieser Art sind Wartung von Rohrleitungen im Feld, wissenschaftliche Anwendungen wie archäologische Ausgrabungen, aber auch Freizeitvergnügen wie Segeln, Wandern oder touristische Exkursionen.
Wir entwickeln ein wearable GIS, das einen Touristen bei der Besichtigung historischer Bauwerke begleitet.

Introduction

Geographic Information Systems (GIS) are tools for acquiring, managing, analyzing, and presenting spatially related information. GIS represent parts of our world by digital maps or images. They facilitate the access to multimedial data using criteria such as geographic location or spatial proximity.

Today, GIS are being used in all areas where spatial data need to be managed and analyzed. Three major application areas of GIS technology are

- public administration, where GIS are used to generate and update spatially related data,
- planning, where GIS support spatial decisions, e. g. in urban and regional planning,
- research, where GIS help to analyze and describe spatial processes, e.g. in electoral research and environmental management.

In all these applications, the GIS architecture focuses on a static environment in which a user sits at a workstation to perform spatial analysis. Computing is the main task.

However, there are many application areas where spatially related information is very useful, but computing is not the main task. In these areas, there are tasks to be done outdoor, like maintenance of pipes or archeological excavations; and even hiking, sailing, and tourist excursions, e.g. visiting ruins of a castle or other historical sites could make use of this information. For example, to explore the virtually reconstructed castle of Heidelberg in a museum is nice for tourists. But to visit the ruins of the real castle in Heidelberg and to get additional information like a reconstruction of several buildings while visiting the castle is much more impressive.

Current GIS do not yet support these outdoor applications because the available hardware is too intrusive and the systems also lack of appropriate interaction techniques. Due to new technolo-

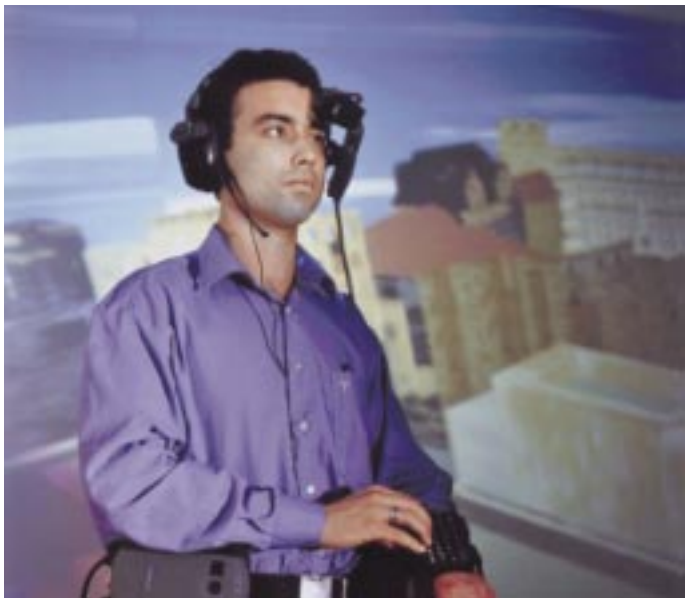

Figure 1: Wearable GIS accompany tourists while visiting historical sites

gies, mobile hardware will shrink in size and become more handy. A first step in this direction are wearable computers like the Xybernaut®. We have to build usable next-generation GIS for these wearable computers. In the Deep Map project (cf. article in this edition), we are developing such a wearable GIS which accompanies the tourist in the historical city of Heidelberg.

Figure 2: Digital Castle of Heidelberg

Wearable GIS

S. Mann defines a wearable computer as »a small body-worn computer system that is always on and always ready and accessible«[1]. From the human point of view, he describes wearable computing with the following six attributes:

- unmonopolizing the user´s attention: it does not cut you from the outside world like virtual reality. It is built with the assumption that computing is a secondary activity
- unrestrictive to the user: he can do other things while using it
- observable by the user: it can get the user's attention continuously if he desires
- controllable by the user: he can grap control of it at any time he wishes
- attentive to the environment
- communicative to others.

Especially the attributes unmonopolizing, unrestrictive and controllable are essential for the use of GIS in outdoor applications.

Software for wearable computers has to be developed taking into account these attributes. Traditional GIS are impracticable for wearable computers because they lack of the above attributes of wearable computing, e.g. they monopolize the user´s attention. Innovative GIS front ends and interaction techniques have to be developed to make use of the geographical information on wearable computers. In the following, we call these next-generation GIS wearable GIS.

With wearable GIS, the user will be able to access on demand geographical information any time at any location. Egenhofer and Kuhn[2] foresee several wearable GIS applications like

- smart horizons, which allow a user to actually look beyond his or her field of view,
- magic wands, pointing devices to identify geographic objects by pointing to them, and
- smart glasses to augment reality by superimposing a digital image into the field of view.

With a wearable GIS, the user does not only get access to the geographical data which is locally stored on the system. Such systems must be able to deal with highly distributed data and even distributed GIS functionality. Advanced computational models are needed to integrate different geographical data sources and to respond in near real time.

Wearable Tourist Information System

The wearable Tourist Information system should be able to give information about historical buildings and other objects of interest at any time. Therefore, it has to register the user's location and his line of vision. To solve this task, GPS is used to get the approximate location. For a more exact localization and the line of vision, we strive for a video-based approach. A video picture taken by a camera is matched to a digital 3D model of that specific area, e.g., the castle of Heidelberg, to get the exact location and the line of vision of the tourist.

The ideal pointing device in a wearable tourist information system is a camera, because it is a device nearly every tourist is familiar with. It can also be used as an output device to superimpose the user's field of view with additional information. Looking through that camera, the tourist may open a window into the past, for example.

However, such a device is not yet available. Our emphasis is on developing wearable GIS software, not on designing hardware. Therefore, we are using commercial hardware, the Xybernaut® Mobile Assistent, as a test environment for the system. This body-worn personal assistent uses 233 MHz processor speed, 32 MB RAM, 2.1 GB storage, a fully developed speech recognition engine and Windows 98 operating system.

References

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[2] M. J. Egenhofer, W. Kuhn: »Beyond Desktop GIS«, Proceedings of GISplanet 98, Lisbon, Portugal, 1998.

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