Presenting archaeological information with the help of multimedia cartography

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Abstract *>>view the application*

Digital media are best suited for the presentation of regional, urban and specialized topics. Especially the field of multimedia-cartography creates new ways of expressing information and transferring discoveries. It is much easier with this technologies to make maps comprehensible to a wide range of persons. Maps are no longer an élite tool of a small number of professionals, but enable the discussion and information in geographical and thematical aspects.

Archaeology as a scientific discipline explores and tries to find and visualize dependencies of non visual connections of findings and building remains. The aim is to receive an understandable general view. For this reason multimedia cartography provides a powerful tool for the communication among scientists and for the presentation to a general public. The consideration that the quality of presentation is set by the perception and the thinking of the user, whose reference throughout the evolution is the 3D space, should define the way of processing and visualizing information.

This article explains the work of multimedia cartography, shows up the main requirements to datasets and mainly describes the role of multimedia cartography in the field of archaeology. With the help of the latest developments in the project *Carnuntum 3D* the suitability for experts and for a general public should be discussed.

Introduction

In the last two decades new possibilities in the communication with the help of maps have been developed caused by the digital technologies. It is now very common to use interactive maps, combined with pictures, video, sound and three dimensional views. Due to these extended modalities it should be easier to present information with its regional context more effective.

Therefore the major job of cartography is to find an efficient way to present and communicate thematical information in context with geographical one. In this paper and the developed prototype *Carnuntum 3D* this thematical information, which can be political, economical or cultural, concentrates on archaeological and cultural themes.

Archaeology as a scientific discipline explores and tries to find and visualise dependencies of non visual connections of findings and building remains. The aim is to receive an understandable general view of a culture in a specific epoch and region. For the communication of these spatial related information among scientists and for the presentation to a general public, multimedia cartography provides a powerful tool. During the creation of a multimedia system, the user-interface, the functionality and the visualisation of information is influenced by the perception, knowledge and thinking of the user (Dransch 1999).

There are a lot of examples using digital presentation technologies in archaeology. Products like “Virtueller Rundgang durch das antike Carnuntum” (Schrenk et al. 2000), “Troia - 3000 Jahre Geschichte im Modell” (Zöller 2001),papers like “Digital Archaeology Reconstructions from Egypt on the WWW” (Shiode 2002) or projects like “3D-Murale” (Hynst 2002) use digital reproductions of ancient objects, buildings, districts or towns. These virtual worlds present a realistic impression of objects in a very large, detailed scale. In addition to excavation maps these reproductions and documentations may be used to communicate discoveries of archaeological work and thus to save cultural heritage.

Technical developments in data acquisition and data management extend the way of documentation and enable new possibilities for the implementation of these data in digital cartographic products. An efficient presentation and Geo-communication with the help of 3D multimedia maps, resulting from these implementations, creates the imagination that new discoveries, which were not visible until now, can be made by experts.

The importance of cultural heritage is the reason for this work and article, in which a theoretical explanation of the notion “multimedia” will be given, the main problems with data will be shown and the first steps in designing a prototype of a three dimensional cartographic exploration system will be presented. This paper is based upon the thesis “Der Einsatz multimedialer Technologien in kartenverwandten Darstellungen am Beispiel Carnuntum” (Jobst 2003).

Multimedia cartography – a theoretical explanation

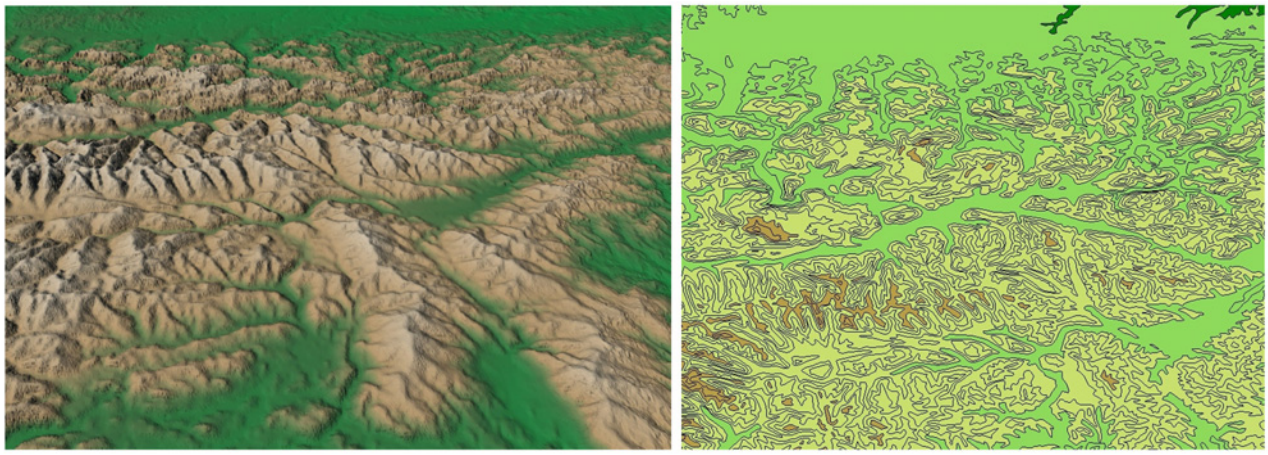
Multimedia cartography may be seen as an extension to the traditional cartography. Instead of dealing with paper based maps, its working place is the digital world. Several ways of communication are combined with the help of computers. The aim is a better communicating presentation of the world to help users cognition.

The use of “multimedia” serves as support to the cartographic communication process (Cartwright et al. 1999) if the task of cartography is the communication of spatial related information (Gartner 2002b). Multimedia is characterised by several attributes (Dransch 2002):

- The manipulation , presentation and communication of information is done on the computer - all actions are *digital*.
- The different media are not related to one another – they are *independent*.

- It is able to show different media and processes at the same time - *multitasking*.
- The media are manipulated and combined by *interactivity*.
- The information uses different types of coding (or media) – *multicoding*.
- The media are combined due to their functions and content – *combination of media*.

The term ”media” stands for writings, pictures, sound, video, interactivity and movement. Like in the case of video, where the combination of picture and sound created a new media, we are thoroughly convinced that the independent combination of all media with spatial data creates a new integrative media – multimedia (Dransch 2001).
An important part of the communication process is the intuitive recognition of information. In case of multimedia cartography, dynamic 3D views support the intuitive recognition of topography, which is useful for 60 % of users of topographic maps, who have problems in retrieving a spatial impression – according to surveys of the university of Dresden (Buchroither 2002).



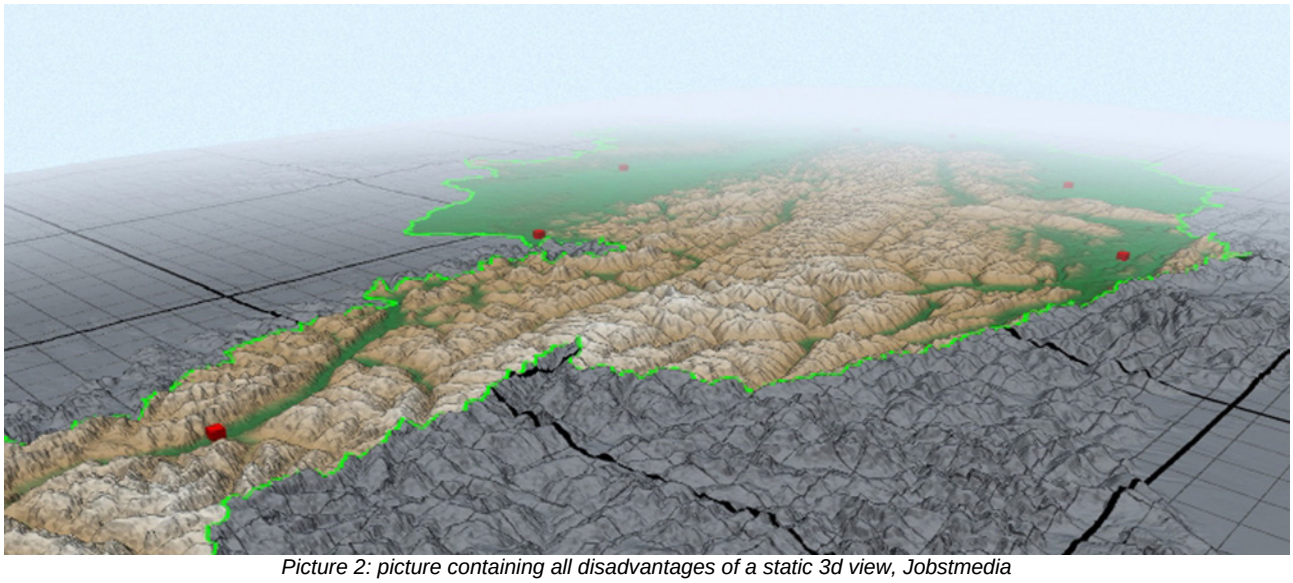
Picture 1: Comparison of a 3D and 2D view of the same area, Jobstmedia

These results support a further usage of 3D views in multimedia cartography. In this case a 3D view is meant as map related presentation, which is defined by an oblique position of the projection plane in space. The traditional map may be seen as special case, which uses a projection to a horizontal plane (Hake et al. 2002).
In principle a map related presentation – a 3D multimedia map – is part of the presentation model within the cartographic communication process, which serves for the communication of the information. Objects from this presentation model are coming from the primary model, where measured data like photogrammetric models are administrated. They are modified with techniques of generalisation and symbolisation to enable an “effective” communication (Kelnhofer et al. 2002).

In opposite to these encouraging aspects of an intuitive information transfer, there are three main disadvantages from a cartographic point of view:
- Due to the perspective, it is not possible to compare geometrics.
- One view consists of many different scales, depending from the distance. So it is not possible to read distances between different points without a helping tool.
- Elements of the map may be hidden by other elements. Then some information may not perceived.

It is impossible to solve these problems in static views, but in multimedia cartography an appropriate programming minimises these disadvantages. A camera movement as exploration tool may prevent hidden

areas. Measurement tools allow an active distance measurement or orthographic camera projections may support an intuitive distance comparison.
In case of the prototype Carnuntum 3D a map related presentation is combined with objects – photogrammetric models – from the primary model. The advantage of this technique is the combination of different scales, containing different simplifications, and thus the visualisation of relations between large scale – virtual real – objects, like an excavation object or area, and the smaller scales symbols, e.g. districts of a town, in the background.
The difficulty of this multimedia presentation is the information extraction of the user and the communication form, which are barely considered yet. A useful combination of media and their use in three dimensional views has to be explored in future research projects.



Picture 2: picture containing all disadvantages of a static 3d view, Jobstmedia

Demands on data

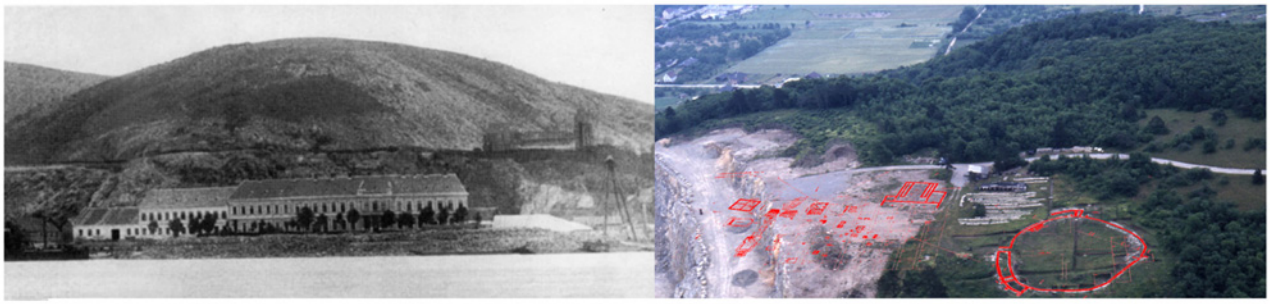
An enormous amount of data is needed to create this 3D multimedia map. It would be nonsense to build up the data for each project again – this would be too cost effective. Instead a global available data pool should be used.
At the present there are free available datasets. Most of them cannot be used for large scale applications. But they form a useful small scale basis to show an overview before going into detail.
Two classifications of the data can be made. There are height – digital terrain models – and feature – vector – data. The sources and formats are different. Very common are “*.bin” files (readable in GIS systems) or 16bit grayscale heightfields for the height and “shape” or “*.dxf” files for feature. In the step of data-combination mistakes may occur by different scales or map projections of the data. The effect becomes apparent in the resulting map with inhomogeneous point, lines or areas. These mistakes may be avoided by considering metadata, if they are available.

In general the Geo-data-offers are afflicted with some imperfections: (Meng 2002)

- Geo-Data of big areas are available, but they are interrupted.
- There are limited areas, where datasets are complete, but there is a lack of detail.
- There are masses of data for limited areas, but without any description of the data quality.

In case of historic archaeology the data of findings or objects were often referred to the area of discovery, the political state, the boundaries of a community or the nearest church. It is very hard, nearly impossible, with this specifications to reference the objects on an exact place on the earth.
It is very important to use geographic coordinates for the positioning of findings. If the objects for a cartographic application cannot be fixed on one place of the earth, a description of a radius around the midpoint coordinates – to describe the area of reference – and an applicable scale for this radius have to be defined. During a political and economical development boundaries change, but geographic coordinates or defined areas stay the same.

The first step to make data available for a multimedia cartographic information system and for further projects is to create a set of metadata -if possible following the international standards of metadatastructure.



Picture 3: Pfaffenberg in 1900 and in 1980, photos: Werner Jobst, mounting: Markus Jobst

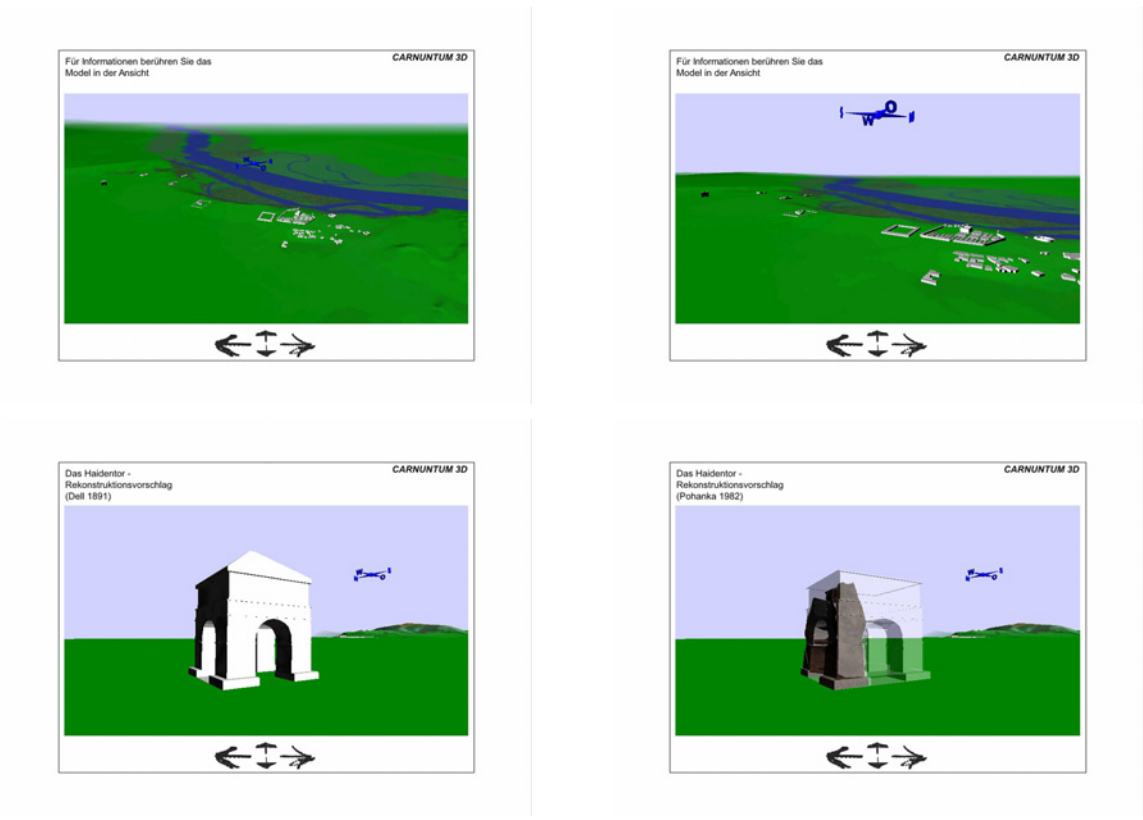
This description of data due to their quality, accuracy, date of recording etc. makes it possible for cartographers to determine the scales and combinations where and how these data and objects may be used. Only data having the same quality can result in a homogenous presentation.

First steps of a prototype – Carnuntum 3D
We decided to take the area of “Carnuntum” for the designing of a prototype. The main intention is to show that this cartographic tool is useful for the visitor of the archaeological site as well as for the expert.
“Carnuntum” was one of the most important Roman cities at the Austrian LIMES. The most interesting district of this Roman town is the arrangement of temples right on the top of a hill, called “Pfaffenberg”.
At 1908 the mining of gravel started the destruction of this hill. At the beginning of the 80´s all interesting parts of the tempel were brought to depots in Bad Deutsch Altenburg. In the mid 80´s the hill, the regional connections and impressions from and to the temple were destroyed.

The very first step of our prototype was to build up the hill again. It was a challenge to reconstruct the initial heights. Photogrammetric procedures with the help of old photographs could not help – there was only one main view, the west side of the hill, but we needed more for a 3 dimensional model. At least we were able to find some military maps of 1870, from where it was possible to digitise the heights and to put the data into location with reference points.
The next step was the digitising of the archaeological information. Most maps of the temple were only in a local system and not referenceable. With the help of one areal photography done in 1970´s we were at least able to reference these data as well.

The reconstruction of the third dimension needed the help of an archaeological architect, who uses the floor plan, the excavation documentation and the knowledge of ancient building construction to design a possible 3D reconstruction. Smaller scales of the prototype *Carnuntum 3D* used a simple extrusion of the floor plans to present “block”-models. These representations of the objects were interpreted with colour as signature and “mouse overs” to receive some text information.
The three dimensional, large scale models of the temples worked out in 1985 seemed to be scientifically wrong. According to present research, new models are in work since the beginning of 2003.
The only scientific based reconstruction was the “Heidentor”. Several interpretations were available. To demonstrate the functionality, some of the interpretations, including a photogrammetric model, were used in the application.
The ongoing development of archaeological work was the origin of the idea that the models shown in the application should be exchangeable – or better: the models should be read from a central working database in case of an internet application and from a local file on a CD-Rom. The problems of topicality in the visualisation could be solved with this demands. In addition different interpreted models could be shown too. The requirements for a solution like this are the “Geo-referencing” of the models – for the positioning – and their metadata – to use them in the right scale.

The next steps of the project “Carnuntum 3D” are already defined and consist of the designing of a symbol catalogue for the 3rd dimension, the exploring of a powerful usage of sound coding, the creation of a free camera movement with useful parameters. As soon as detailed models will be available the step to a larger scale will be done.



Picture 4, 5, 6, 7: Screenshots from the application “Carnuntum 3D”, Jobstmedia

Resume

The present investigations demonstrated that map related 3d views are suitable for the cartographic communication process in archaeological applications. The main technical problems that can be seen now are the changing of scales including the changing of the models detail and the movement from a three dimensional projection view to a topographic map.

The main important issues further work should be concerned with are:

- How can a cartographic multimedia application be developed to become an important tool for the expert? Is there a need for such a exploration tool and if yes, what kind of tools are needed?
- How can a dynamic generalisation be established in a three dimensional world? First steps are made with the Level of Detail (LoD) techniques. But the influence on how the simplification of geometry is done is limited. The possibilities of aggregation and displacement have to be explored.
- The role of the visualisation tool as an interface to a database or content management system. This essential step may enable the techniques of multimedia cartography to communicate the content of a database, which could play an important part in saving cultural heritage.

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