PRESERVING CULTURAL LANDSCAPES AND ARCHAEOLOGICAL INFORMATION WITH THE HELP OF MULTIMEDIA CARTOGRAPHY

M. Jobst

Jobstmedia Präsentation Verlag, Welzeneggerstrasse 84, A-9020 Klagenfurt, Austria
markus@jobstmedia.at

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ABSTRACT:

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. With this technologies it is much easier 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.
Archeology 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 determined 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 shows new ways of the preservation of cultural landscapes and their archeological information with techniques of multimedia cartography, highlights the main requirements to datasets and mainly describes the role of multimedia cartography in the field of cultural heritage. With the help of the latest developments in the project „Carnuntum 3D“ the suitability for experts, for a general public and for the enduring documentation of cultural heritage should be discussed.

1.INTRODUCTION

The cultural environment is changing during time. It is influenced by human beings, their way of living and nature. In the end the result is either the destruction or, in case of human influence, the restoration of cultural representatives, depending on its importance for a political leadership.

Historical sciences deal with the reconstruction of ancient cultures via their preserved remainings and try to show us an understandable general view of these. The regional connections and the topography are playing an important part for a comprehensive presentation of a cultural environment. The usage of objects or buildings is strongly connected to the topography of the earth surface and the relation to adjacent objects of the same period.

Once the dependencies within a cultural period are discovered, they need to be communicated to expert groups on the one hand and a wide public on the other. For this reason multimedia cartography provides powerful tools and digital techniques. These should be open for the embedding of recordings and reconstructions of cultural objects done by other disciplines like photogrammetry. These high quality, large scale reproductions need a lot of storage memory and a special treatment for visualisation.
Stepping back – to a smaller scale – to show an overview, simplifications and algorithms for memory management are needed to use the available memory on existing computers more efficiently.
Of course, there are high end computers which have no problem with large data volumes, but a cultural theme should be accessible for a wide public – using personal computers in a standard configuration.
In addition dealing with different scales requires new algorithms for displacement, aggregation, omitting and symbolisation. Especially in the field of 3D very few work has been done.

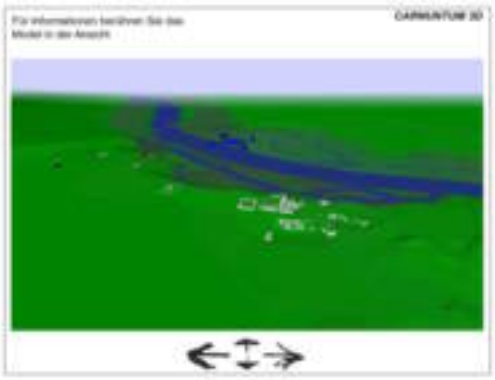
The 3rd dimension plays an important role in multimedia cartography facing the consideration that the quality of the presentation is set by the perception and the thinking of the user, whose reference throughout the evolution is the 3D space.

The following article describes the project “Carnuntum 3D” from the very first beginning until today. The importance of cartography for the geo-communication of the cultural heritage can be shown by this project and its outstanding region. Choices of programming techniques will be mentioned as well as demands on data.

1.1The term “multimedia”

For a better understanding short description of the term “multimedia” and its characteristics should be given [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 possible to show different media and processes at the same time - *multitasking*.



Picture1: screenshot of the application "Carnuntum 3D"

Picture2: screenshot of the application "Carnuntum 3D"

- The media are manipulated and combined by *interactivity*.
- The information uses different types of coding (or media) – *multicoding*.
- The media are combined according 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 topographic data creates a new integrative media – multimedia cartography.

2.CARNUNTUM 3D – THE PROJECT

2.1History of Pfaffenberg

The project Carnuntum 3D started a few years ago, after having finished the documentation of epigraphs with small format cameras [CIPA 1999, Olinda, Brazil] for the museum Carnuntinum in cooperation with the Institute of Photogrammetry at the Technical University in Vienna.

The district of temples, where the epigraphs came from, is situated between Hainburg and Bad Deutsch Altenburg, two small cities lying about 50 km east from Vienna, and was a part of the Roman town Carnuntum, one of the most important Roman cities at the Austrian limes.

Starting in 1908 the mining of gravel gradually removed the ridge of Hundsheimer Berg, whose impressive appearance toward the town is called Pfaffenberg.
In the year 1935 the result of excavations by Swoboda was that there was nothing important left on the top of the Pfaffenberg. In the 1970´s this report was revised, the area was checked again and finally led to in an intense exploration of the sanctuary.
In the mid 1980´s all scientifically important parts had to be saved in deposits in Bad Deutsch Altenburg because the mining reached the district of temples.

Nowadays all the regional connections and impressions from and to the temple are destroyed. It is impossible to imagine the impressions of this district and its dominating landscape and to add it mentally to the still existing parts of old Carnuntum, like the theatres, the civil town or the canabae legionis.

2.2Motivation

The historical development of the past 100 years of the Pfaffenberg, the wish of the goverment of Lower Austria to visualise the landscape at the Reoman period and personal intensions were the motivation to start this cartographic project using the latest technologies of multimedia and 3D. This undertaking is still at its beginning.

Especially digital technologies are thought to be able to deal with the developments in the work of archaeological science and to update new discoveries more cost effective.

In addition the expanded presentation forms of the digital cartography – mainly the 3rd dimension – are promissing better results for the geo-communication of the archaeological site and its adjacent regions.

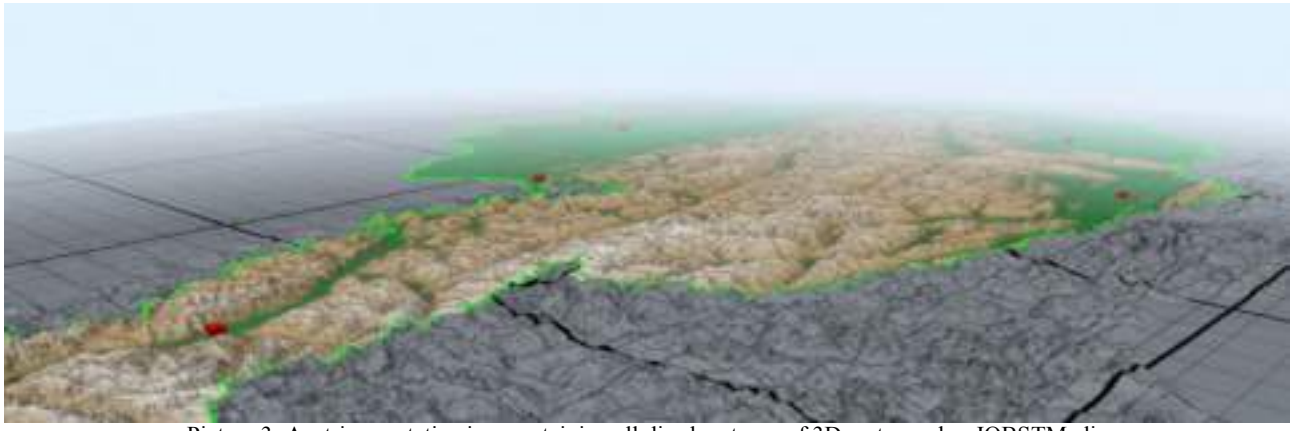
Nevertheless the developement of technology, the changing of standards and file formats call for a well considered programming technique on one hand and a more semantic exploration of a 3D application in cartography on the other.

3.PROGRAMMING TECHNIQUES FOR A 3D CARTOGRAPHIC WEB VISUALISATION

A cultural cartographic information system should be mainly accessible via the internet. The requirements restrict the usable programming standards and file formats for visualisation. Generally all available tools need a PlugIn or a preinstalled runtime environment.
In fact there are only two main standards that may be used: VRML and Shockwave3D. [Riedl et al. 2002]

3.1VRML

This open source virtual reality mark-up language was published 1995. It is standardised and runs on every computer



Picture 3: Austria – a static view containing all disadvantages of 3D cartography, JOBSTMedia

platform. Based on this first VRML 1.0 standard new developments completed some multimedia elements and resulted in VRML 2.0 and VRML 97 versions.

Virtual worlds in VRML may consist of interactivity, animation, media implementation and texture mapping.

The dynamical development stopped before the new version GEOVRML was released. In this version it was said that different geodetic coordinate systems are also taken into account.

The release of a XML based VRML language called X3D generated new aspects in object oriented programming and let us expect an exceptional standard.

The main disadvantages of VRML are the existing problems of rendering, streaming and synchronisation which lead to a loss of performance.
VRML needs a PlugIn to run in a webbrowser. There is the possibility that this PlugIn is programmed in Java and the user does not need to install a PlugIn, but as a result of the Microsoft policy the support of Java has to be installed as well.

3.2Shockwave3D

In opposite to the free available and programmable VRML, shockwave3d is an appropriate format released by the company Macromedia in 2001. The programming of an application has to be done in the authoring software Director, which uses its own programming language Lingo and is specialised for multimedia applications. The intention of enabling the 3D was to become a standard for online gaming. That is why all the needs for a 3D online game are treated, including streaming, bones animation, particle systems, physical behaviours, etc. .

The main disadvantages of this format are its dependance on the development and policy of the company and the high price for the authoring software.
For instance the downloadable PlugIn was free available a few years ago. Today the PlugIn is only installable via Macromedias website – a local storage is prevented. Maybe the PlugIn will not be free in future anymore.

3.3Comparison

The decision for the main platform of the 3D cartographic multimedia exploration system was not easy. Although the open source solution VRML has a lot of pro-arguments considering the free development and programming via text editor, the proprietary format shockwave3d was the favourite.
The main arguments were the ability of streaming – which is useful for large file formats and multitasking –, the offer of several techniques that could be used for symbols, but were not explored yet – like particle systems – and the included rendering engines – a software, openGL and directX renderer. Depending on the hardware of the user, the best fitting engine will be used.

All developed processes in this proprietary language “Lingo” are going to be documented in away that a transfer to another language will be possible in future.

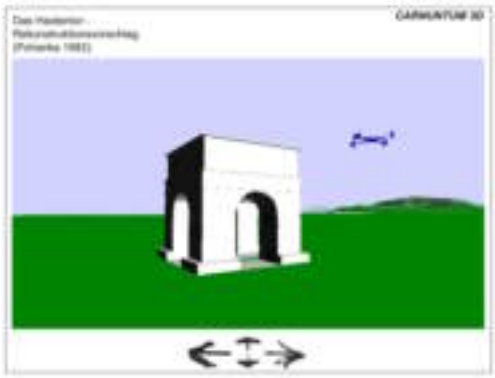
4.IMPLEMENTATION OF DATA

4.1General aspects

The characteristic of a cartographic application is the regional overview showing dependancies of thematical features. For this small scale views a lot of data in lower quality are used. High detailed features have to be simplified according to algorithms of perception and generalisation in this small scales.

The aim of the 3D exploration system is that very high detailed – large scale – models, coming from photogrammetry or archaeology, in the foreground are brought together with smaller scale features and simplified models in the background of the 3D view. There is the consideration that with this mixture of scales new discoveries, which were not visible until now, can be made by experts.

Taking the idea of a free moving camera a step further a dynamic generalisation has to be introduced. Symbols for objects have to be created in realtime or read from a database and streamed into the camera view, while keeping up interactivity.
In case of 3D building data some fundamental work is done by the institute for cartography and geoinformatics of the university Hanover [Thiemann 2002] and the institute for photogrammetry and cartography of the Bundeswehr university Munich [Forberg, Mayer 2002].



Picture4: screenshot of the application "Carnuntum 3D"

Picture5: screenshot of the application "Carnuntum 3D"

For the project Carnuntum this step is one topic of present research.

In addition there is the need for a uniform metadata structure, which would help to classify objects and their usage in specific scales.

4.2Realisation

The implementation in Director requires a conversion from the source file format, which can be VRML as well, to the shockwave3d "*.w3d" format. Several 3D modelling software packages support this export, but it must be taken into account that the converting of hundreds of files would probably take too long.
For this reason a converting and exploration tool called "deep exploration" is available for the PC platform. Apart from supporting a batch conversion tool, the camera-, light- and texture settings may be changed too.

Inside the authoring software a 3D world with a coordinate system according to the display plus a z-axis is available. The position of models must be transformed to match this local system.
For objects lying on the surface only the position coordinates are required. For the height the models´ zero height is intersected with the surface model.

Surface models may be calculated directly in the application following different algorithms, like a regular grid, taking a 8 or 16 bit grayscale image as source. The advantage of this technique is that only a small picture file is transferred via the internet, which is very time effective, also for slow internet connections.
Contrary to this a ready made model of the surface, coming from any GIS or photogrammetric application, may be streamed into the 3D world and thus does not require much power of the processor for the calculation.

A mixture of both ways is useful. The streaming method is used for high detailed surfaces, while regional overviews with less detail are calculated directly.

In the area of textures Director supports any kind of bitmaps. To activate a texture, a shader has to be created, which may consist of eight different textures. Because alpha channels are supported, the combination of different textures is possible too.

an animated texture must be programmed in a way that an actual texture member is changed with a following one.

The used objects are categorised due to their representation and scale. Beginning with the high detail model, simplifications will lead to the first symbols. At some point two different houses from the high detailed mode, will have the same shape in a low detail mode. So the symbol catalogue is getting smaller the smaller the scale and detail is.

For the project Carnuntum the creation of symbols is in progress. Until now no serious problems occurred.

5.RESUME

The main technical problems that exist at the moment are dealing with the dynamical generalisation especially by switching the scales in large scale views, when a lot of data have to be read from the database. Then the interactivity – the most important multimedial aspect – is inactive for a moment.

Another challenge is the changing from a 3D projection view to a globus view. This step has to be solved for the idea, that this application could serve as interface to a cultural heritage database.

In general there are three main questions this research is concerned with:

- 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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