WEBMOZIS – WEB-BASED AND MOBILE ZOO INFORMATION SYSTEM
- A CASE STUDY FOR THE CITY OF OSNABRUECK -

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ABSTRACT:

The use of modern electronic media offers new ways of (environmental) knowledge transfer. All kind of information can be made quickly available as well as queryable and can be processed individually.The Institute for Geoinformatics and Remote Sensing (IGF) in collaboration with the Osnabrueck Zoo, is developing a zoo information system, especially for new media (e.g. mobile devices), which provides information about the animals living there, their natural habitat and endangerment status. Thereby multimedia information is being offered to the zoo visitors.The implementation of the 2D/3D components is realized by modern database and Mapserver technologies. Among other technologies, the VRML (Virtual Reality Modeling Language) standard is used for the realization of the 3D visualization so that it can be viewed in every conventional web browser. Also, a mobile information system for Pocket PCs, Smartphones and Ultra Mobile PCs (UMPC) is being developed.All contents, including the coordinates, are stored in a PostgreSQL database. The data input, the processing and other administrative operations are executed by a content management system (CMS).

1. INTRODUCTION

The use of modern electronic media offers new ways of (environmental) knowledge transfer. The possibility of user interaction makes the exploration of certain topic more attractive. The internet, nowadays one of the most important tools for information delivery, is utilized by all major institutions and business companies to reach a wide audience in the most efficient, attractive and clear way. Unfortunately, websites are often limited to a preset of information. The content of these websites is presented normally as texts or pictures, with little or no topicality. As a result, these websites show a lack of interactive elements. Furthermore, even "simple" options for systematic enquiries, such as text-based search are deficiently implemented. Three-dimensional content is virtually nonexistent in web presentations.

This paper describes a new project of the Institute for Geoinformatics and Remote Sensing at the University of Osnabrueck, funded by the DBU (Deutsche Bundesstiftung Umwelt, www.dbu.de).

One goal of this project is to develop a mobile zoo information system for Pocket PCs and Smart phones (Michel, U., 2007). Visitors of the zoo will be able to use their own mobile devices or borrow Pocket PCs from the zoo. The zoo information system will provide additional multimedia-based information such as audio material, animal video clips and maps of their natural habitat. To this end, we are currently collecting a large amount of information, such as, species facts and characteristics and any additional background information. Once the information is incorporated users will have access to the project at the zoo via wireless local area network or by downloading the necessary files using, for example, their internet connection at home.

In contrast to the standard information often provided at the zoos by information boards or brochures, in our project the visitor will be able to obtain a very comprehensive set of information (texts, maps and multimedia elements such as photos, audio and video streams) about the zoo's specimens, which will significantly contribute to environmental education.
Our software environment mainly consists of non-proprietary software solutions, which will be used to develop a capable, reliable and flexible application. Within the system we will develop a 2D/3D zoo information system, available online, by means of modern mapserver technology and 3D visualization procedures such as VRML (Virtual Reality Modeling Language) (Michel, U. und T. Bockmühl, 2006). Furthermore, we will use a consistent database and a content management system (CMS) for data entry, processing and other data management operations.

All contents (including coordinates) are stored within the object-relational database PostgreSQL, which supports geographic objects through the database extension PostGIS. The objects and their attributes can be easily administered online by the CMS and are displayed as well within an adapted Mapbender application. The combination of WebGIS and CMS is a very innovative and effective method for the project's purposes. The interactive mapping application comprises fundamental necessary GIS functions and allows the digitalization of geo-objects that can be administered immediately by the CMS. It is no longer necessary to edit attribute tables of geo-objects laboriously. The (geo)-data can be updated at any time even by non-experts. All information about selected (geo)-objects can be generated dynamically so that they are always up to date.

A three-dimensional zoo information system is a modern and innovative way of external representation. Its technical

implementation is only one aspect of this. The key factor is ultimately determined by the intention of institutions and companies to represent themselves as open-minded, modern and resourceful and in this context to let people partake in occurring events and happenings. A virtual reality zoo provides an information platform for all interested visitors. Users have access to current information and high-quality multimedia material. Web presentations with virtual reality content are still very uncommon. This is particularly based on the fact that the creation of 3D worlds requires a great effort if not done automatically.

The project is ideally suited to enable zoo visitors to achieve an understanding of duties and responsibilities of zoological gardens and to create public awareness and interest in environmental issues.

2. AREA OF INVESTIGATION

Our area of investigation is the zoo of the city of Osnabrueck in Lower Saxony, Germany (Figure 1). Osnabrueck is the third largest city in Lower Saxony with 164,000 inhabitants. It is the only German city situated in a national park – the 'UNESCO Geo park TERRA.vita', which includes the Teutoburg Forest and the 'Wiehengebirge'.

Osnabrueck is a university and a diocesan town. The German Foundation for the Environment and the German Foundation for Peace Research are also based here. Osnabrueck is the cultural centre of the western part of Lower Saxony and the vital centre of an economic region with around 780,000 inhabitants, which includes not only Lower Saxony but also parts of North Rhine-Westphalia. Its geographical location is 8° 3' 2" Longitude east and 52° 16' 28" Latitude north.
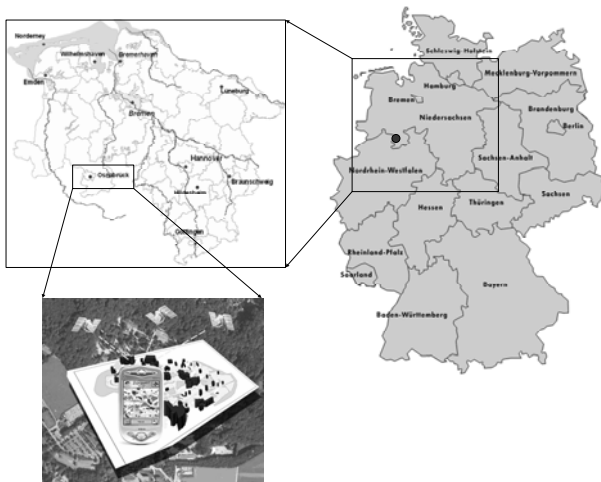

Figure 1. Area of investigation

3. GOALS

The project goal is to test and apply new media for environmental education. In collaboration with the Osnabrueck Zoo information about the zoo animals, their natural habitat and endangerment status are to be presented clearly. For that purpose two popular media types are used. On the one hand information is presented in advance via a three-dimensional web-based tour to the zoo. On the other hand it is available via a mobile electronic zoo guide during the visit.

The information to be offered to the zoo visitor will go beyond the already existing information boards attached to the animal cages. The visitor will be able to access for example a map displaying the natural distribution area of the animal, to see pictures of this area, short video clips showing the animal in action and/or in his natural environment, hear animal sounds, or listen to interviews with zoo keepers or veterinarians.

4. SYSTEM COMPONENTS AND APPLICATIONS

Figure 2 shows the general structure of the zoo information systems and its components.

Figure 2. System components and applications

The core of the system is the content management system and its database underneath (see section 5). For accessing the system environment a conventional web browser could be used. This works not only on desktop PCs but also on mobile devices like Pocket PCs, Smartphone's and Ultra Mobile PCs (UMPC), which could be connected by LAN or wireless via WLAN or UMTS. Our software environment mainly consists of non-proprietary software solutions, which will be used to develop a capable, reliable and flexible application. We will develop within the system a 2D/3D zoo information system available online by means of modern mapserver technology and 3D visualization procedures such as VRML (Virtual Reality Modeling Language). Furthermore, we will use a consistent database and a content management system (CMS) for data entry, processing and other data management operations.

5. CMS – CONTENT MANAGEMENT SYSTEM

The in-house developed bilingual CMS for the administration of the animal data (Figure 3) is the central part of the Zoo Information System. It is already installed on a server and in

use. The PHP-based CMS allows the access and manipulation of the data stored in the spatial database PostgreSQL/PostGIS.

Figure 3. Content Management System

6. PRESENTATION

6.1 Mobile Application

The mobile zoo guide for PDAs (Figure 4) and an UMPC version for disabled people (Figure 5) are currently in developing phase.
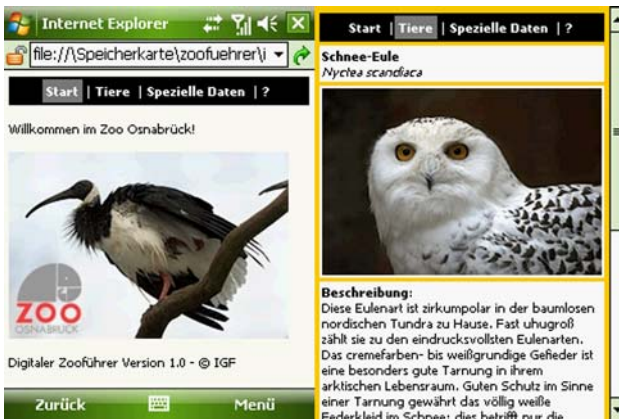

Figure 4. Mobile zoo guide for PDA

Additionally, the existing application is converted into an appropriate UMPC version for data acquisition purposes.
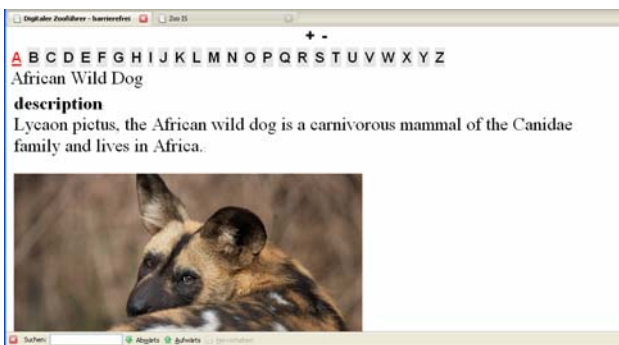

Figure 5. Zoo guide suitable for the disabled

6.2 3D Visualization

Google SketchUp is an efficient, intuitively-operated program to create complex 3D models. The basic version is free of charge. What makes SketchUp so special is its ability to integrate three-dimensional objects directly into Google Earth. A previously selected image part in Google Earth can be imported to SketchUp in one step. In this process all spatial references are retained. In this way the 3D buildings - which are to be constructed - or any other three-dimensional objects can be placed according to the air photo. The 3D models can be integrated into Google Earth directly after their construction. The following Figure (Figure 6) shows the generation of the zoo main building with SketchUp.
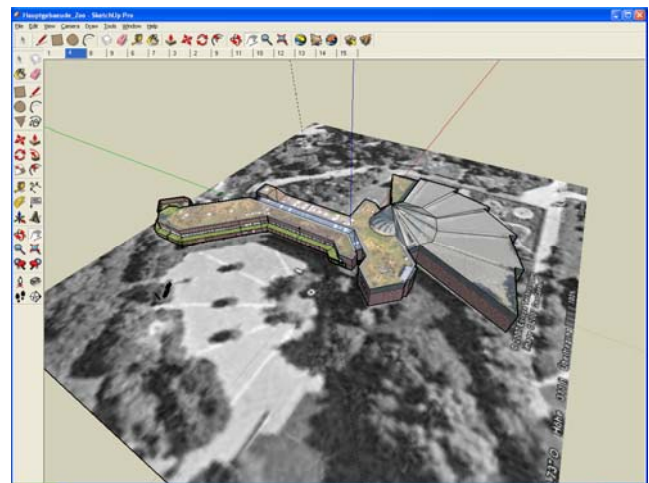

Figure 6. Modelling the main building with Google SketchUp

Up to now only the main building in the entrance area of the Osnabrueck Zoo has been modelled with SketchUp for testing and presentation purposes. The ground plan of this complex building was extracted from a Google Earth air photo. An especially authentic look of the model was achieved by placing real photo textures on all surfaces of the main building. Additionally, the roof textures were extracted from a high resolution air photo, whereas the textures for walls, doors and windows were generated from pictures taken especially for this purpose. For some areas of the building no realistic texturing could be achieved, because the respective outside facades were inaccessible or covered by vegetation.

The following Figure (Figure 7) shows the final model of the zoo main building in Google Earth.

Figure 7. The model within Google Earth

In the future other buildings of the Osnabrueck Zoo, e.g. the aquarium, will be modelled this way. SketchUp offers many possibilities for this, for example, for the design of interior rooms.

6.2.1 VRML with connection to the database

At present, a first 3D test scene was developed in VRML, which, among other things, will help to better estimate future requirements regarding file sizes, resolutions, accuracies and efforts. At the same time, this first scene is used for presentation purposes, because it provides a preview, which already demonstrates one important concept of the zoo information system: the connection of a 3D object with the database.

The VRML scene shows the so-called „Africa panorama" with the impalas, Masai ostriches, common Eland, Grevy's zebras, giraffes and crested guinea fowl. In addition, a few trees and some shrubs were integrated into the 3D scene as inventory. The user, who can move around the scene freely, can access associated information in the database by simply clicking on the animals. The following screenshot (Figure 8) shows the 3D scene in the left main window and the dynamically generated animal information in the right window. In this example the giraffe is selected.

Figure 8. VRML linked to the database

One important goal in the design of interactive 3D worlds is to find the best compromise between performance and visual quality. Another aim is a semi-automated generation of the VRML code, where the dimensions of the displayed objects, among other things, play a major role.

The current 3D scene, whose underground consists of an air photo, is already true to scale, i.e. the animals are in proportion to each other and to the air photo. In this regard, there will be considerations concerning which objects are to be modelled and which not. For example there is an observation deck with tables and chairs, which belongs to the Africa panorama. Although the integration of such models increases the visual quality of the 3D scene, their realization is time-consuming and they provide virtually no information content related to the project. The following Figure (Figure 9) shows the first version of the Africa panorama from bird's eye view. The non-textured grey item is a test object, whose position corresponds to a part of observation deck.

Figure 9. Africa panorama from birds view

6.2.2 Embedded panoramic graphics

The techniques of typical panoramic videos were used (Figure 10) also for orientation and visualisation purposes. We use this technology not stand alone but embedded in our mapserver application. From there the user will be able to access the panoramic videos by clicking on a given panoramic symbol.
With this technique we are able to implement changes to the zoo's environment very quickly. For example the zoo will have also an underground zoo next year, which could be represented by panoramic views.

Figure 10. Panoramic view of the monkey house

6.3 **2D Visualization**

6.3.1 Geotagging

The term *geotagging* (geocoding) is used, for instance, when photos are 'tagged' with coordinates. This can happen directly, when the photos are taken with a GPS camera or as a second step, when a GPS track is recorded in addition to photos taken with a common digital camera (Figure 11).
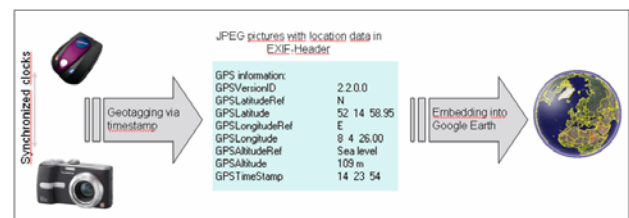

Figure 11. Geotagging operation mode

The digital photograph, containing information about its time of origin can only incorporate coordinates if the time stamps of camera and the GPS track match (Figure 9). In this case the image file can simply be extended to include the corresponding

coordinates. For that purpose various software programs exist, often accessible free of charge. Geocoded photos can be embedded in Google Earth as a data layer in the form of symbols, whereas the corresponding pictures are displayed after clicking the symbol. To realize this in Google Earth a folder with these photos, as well as a KML file is necessary. In this context, it is probably possible to implement a KML export from the database because the KML file is a kind of text file. For that, all objects and pictures have to be geocoded. Geocoded photos from objects of varying categories *(waste bin, bench, information board, miscellaneous, art / culture and animal...),* were previously generated to test possible fields of application. Figure 12 shows different embedded data layers in Google Earth (left side), the associated symbols in the background of the main window, and a linked photo, which opens after one of the symbols was clicked.
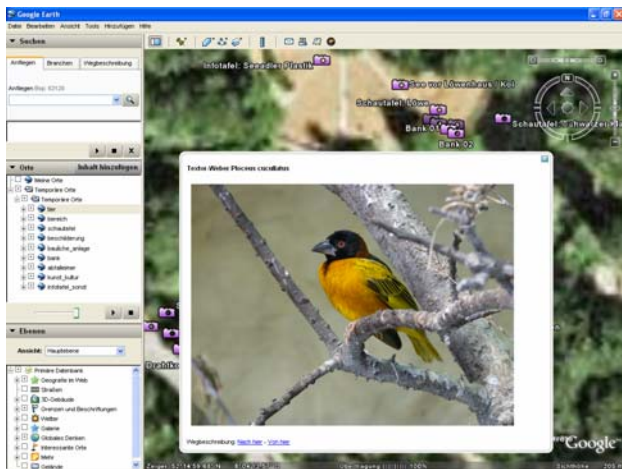

Figure 12. Geotagged objects and visualisation in Google Earth

6.4 Web-Mapping

A major part of the project is dedicated to the 2D mapping application. The visualization principle of georeferenced data is similar to that introduced in the previous section, but more complex. The data layers are displayed within an interactive environment on the basis of an aerial or a satellite photo. The mapping application, which is based on the Open Source product Mapbender (www.Mapbender.org), goes far beyond the possibilities of Google Earth (Michel et al, 2007a). This includes the use of a high resolution air photo, which contains more detail than the corresponding Google Earth image. In addition the displayed objects (species) are linked to a database and the application allows the recording of locations. Currently the map application can be launched from the CMS. Up to now, 48 species are geocoded, i.e. they have assigned coordinates, which are transferred when the map application is invoked. Thus, the animal location can be displayed immediately. As soon as the project is finished, we will have approximate 300 species geocoded. The following screenshot (Figure 13) shows the map application directly after it was launched by the CMS.
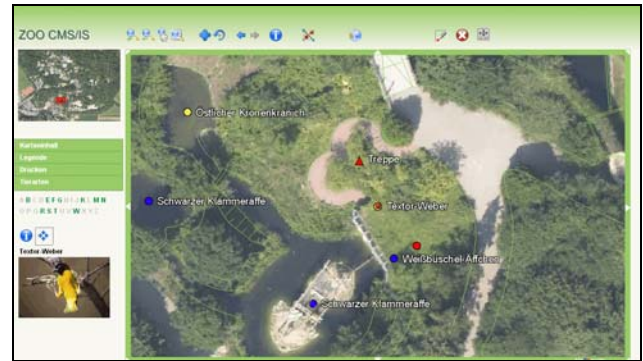

Figure 13. 2D Web-Mapping

7. CONCLUSION

The new project of the Institute for Geoinformatics and Remote Sensing at the University of Osnabrueck, was funded by the DBU (Deutsche Bundesstiftung Umwelt, www.dbu.de).

The information provided by our system to the zoo visitor is intended to represent a major step forward respect to the typical information available in zoos, which up to now consists mainly of boards attached to the animal cages and brochures. By accessing interactive maps displaying the location of the animals in the zoo; and by, for example, watching short video clips showing the animals in action and/or in their natural environment, or listen to animal sounds, or to interviews with zoo keepers and veterinarians, the visitor is able to come into closer contact with the animals and achieve a deeper and broader knowledge of their biology.

Our software environment mainly consists of non-proprietary software solutions, which will be used to develop a capable, reliable and flexible application (Michel et al, 2007b). We develop a 2D/3D zoo information system available online by means of modern mapserver- and 3D-technology. We also used a spatial database and a content management system (CMS) for data entry, processing and other data management operations.

In future developments we will have additional applications for different purposes and specific user groups, such a as zoo staff members, handicapped people (by means of ultra mobile PCs, UMPC), and teachers or students.

The project will be finished in April 2009 and its results and applications will be openly available for their use.

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