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Authoring Tools for Archaeological Mobile Guides

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Abstract

Mobile tourist guides are increasingly useful once the visitors are in the archaeological sites. They are capable of providing huge amount of information about the sites. As it is easily understood, the selection of such information is a task that must be conducted by cultural institutions. Therefore, this paper aims at simplifying the provision of useful multimedia information in a user-friendly and attractive way. In order to achieve this goal, an authoring tool for non-expert users has been implemented, so that they will be able to contribute to mobile guides independently from the structure and the type and formats of the contents that will be added.The tool includes the possibility of defining several layers to provide the information with a split architecture, so that the creator of the guide can decide which contents to include and the languages in which the guide will be provided. This tool has been validated in several archaeological sites in order to build interactive multilingual mobile guides based on the J2ME standard.

Categories and Subject Descriptors (according to ACM CCS): I.3.3 [Computer Graphics]: Line and Curve Generation

1. Introduction

Cultural production and entertainment centres are among the major industrial leisure resources. However, archaeological sites and ancient monuments are usually perceived by non-experts as fragmented, partial, difficult to interpret and understand, and out of the contemporary age context. This results in a frustrating and limiting experience for many visitors.

The curators of archaeological sites have tried to improve the experience making textual information, drawings showing how the site looked like in ancient times and physical models of ancient monuments available to the public. These are all very limited attempts to overcome the lack of information and context experienced by visitors, who also require a significant amount of time (mainly reading) with questionable results.

On the other hand, new Information and Communication Technologies (ICT) have not been fully exploited to increase the awareness and the engagement of the general public visiting the site. Current visitors look for interactive and mobile tools to access data on demand about the cultural background of the site, its artistic aspects and historical context, and other valuable information that enrich their experience. At the same time, visitors should relate their visit to other culturally similar or related archaeological sites in order to build a wide picture of cultural and stylistic interrelations between various sites in Europe.

Given current technology trends, mobile communication devices are playing an increasingly important role in the development of services for handheld devices. With the growing boom in the use of mobile devices, providing cultural contents to a large number of potential users will allow accessing relevant information at the moment when they are living the experience. Therefore, mobile guides are increasingly useful once visitors are in the archaeological sites and cultural institutions, as they are capable of providing huge amount of information about Points of Interest (PoI).

However, some limitations have been detected within the field of mobile guides that prevent its use. Many mobile guides are developed as applications which are addressing the requirements of a specific scenario of use. Further on,

they are developed for a specific device (e.g. a device, which is given out to the visitor of a museum), both being circumstances demanding a non reasonable effort to port the application to other devices. Moreover,the development of the mobile guides is carried out by programmers. However, and as it is easily understood, the selection of such information should be a task conducted by curators.

Therefore, this paper aims at simplifying the provision of useful multimedia information in a user-friendly and attractive way. In order to achieve this goal, an authoring tool for non-expert users has been implemented, so that they will be able to contribute to mobile guides independently from the structure and the type and formats of the contents that will be added. Moreover, the second objective of the developed work is the implementation of a multilingual tourist guide for mobile devices of the users. The achieved results have been validated within the NETConnect project, which is supporting this vision of a cohesive culturally interconnected European Heritage using the available new technology, and creating a central hub for accessing archaeological content, which also will support more engaging communication and visualization means than 2D static content.

The rest of the paper is structured as follows. Section 2 presents some related work in the fields of authoring tools for mobile guides and mobile applications in archaeology. The following section deals with the objectives and description of the NETConnect project, which will be used as the validation scenario. Section 4 presents the description of the implemented prototype, including its two different and complementary components. The two following sections describe two scenarios used for the validation of the implemented application: the archaeological site of Locri (Magna Graecia) and the IronAge Glauberg. Finally, some conclusions and further work are presented.

2. Related work

2.1. Authoring Tools for mobile guides

Authoring is the tradition of collecting, structuring and presenting information in the form of a document rendered in some medium or media. Until recently, the document has been static, in the sense that once rendered, it is fixed for all time and for all readers. Promising new technologies have recently come into existence that could alleviate some of the limitations of this difficult undertaking.

Multimedia authoring can be used to create anything from simple slide shows to full-blown games and interactive applications. Although many implemented projects have dealt with authoring multimedia files, there are not many applications regarding the possibility of creating guides on mobile devices.

For instance, Scherp and Boll (2004) [SB04] have implemented a software framework for the development of customized mobile multimedia applications taking into account user preferences, his/her current position and the endpoint terminal. The module generated is applicable to any tourist destination, which is a big advantage of reuse. The tourist information supplied consists of a map of an outstanding area along with a set of PoI located on the map. When the user clicks on one of these points, it receives a multimedia presentation with more information about it. The authoring tool allows the editor to manage the guide in a limited way, as the behavior (map-select POI-viewing info multimedia) is fixed regardless the input content.

A more complete tool has been presented by Bulterman and Hardman (2005) [BH05] for the generation of a structure which fixes the presentation of a guide for a tour in New York City. Both audiovisual objects and the temporal relationships between them can be configured within the editor. Although the authoring tool generates documents compatible with SMIL, there could be problems to interpret SMIL files by the mobile devices. Neither of the two works previously mentioned previously supports the inclusion of 3D graphics.

2.2. Mobile applications in archaeology

During the last decades, a great number of projects related to the application of innovative technologies to Cultural Heritage have been implemented. Some European projects have assessed some of the most outstanding technologies: 3D digitalization and scanning techniques have been used for the reconstruction of historical objects, Virtual and Augmented Reality technologies allow new interaction ways for users and experts, mobile devices and multimodal interfaces provide intuitive and personalized access to scientific information from museums and archaeological sites.

Multimedia guides must support important personalization of the content owned by a cultural institution in order to provide users with a visit in accordance with his/her background. At the same time, a guide for a museum or an archaeological site should encourage learning and personal enrichment. Therefore, information should be displayed taking into account the physical location of the visitor as well as the position of the artworks in their natural environment. The overall experience can be optimized by the connection between the information of the exhibition and the presentation to the visitor in a coherent way depending on the location.

The ARCHEOGUIDE project provided access to information in Cultural Heritage sites in a compelling, user-friendly way through the development of a system based on advanced IT techniques, including Augmented Reality, 3D visualization, mobile computing and multimodal interaction ([VIK*02]). Visitors are provided with a see-through Head-Mounted Display, earphone and mobile computing equipment. A tracking system determines the location of visitors within the site and audio-visual information is presented in context with his/her exploration, allowing more insight into

relevant aspects of the site. Particular emphasis has been given to virtual reconstructions of the remains while insight is provided about the changes that the site has undergone over the years.

Scianna et al [SVAC04] have developed a multimedia guide by which it is possible to define the position of visitors in real time in an open archaeological site in Sicily, and to give them additional information on goods of visited areas. Several investigations on typological and dimensional features of archaeological sites have been performed in order to establish the needs and the suitable equipments to carry out the project.

Finally, recent advances in the availability of 3G-cellular phones with imaging, multimedia and GPS capability and the development of new mobile telephone networks opens completely new horizons for the development and fruition of innovative IT tools in the domain of Cultural Heritage (archaeological sites and museums). In addition, the support of rendering 3D-scenes on a mobile device allows the exploration of three-dimensional objects and scenes on the mobile device [BCE06], [Nur06]. Archaeological finds (like e.g. coins) can be explored from the visitor of an archaeological site as well as a digital reconstruction of this site.

The European project Agamemnon will establish the preferences and level of knowledge of the visitor by creating a profile of the visitor. Based on the profile and time constraints, Agamemnon will schedule a route through the site to include the most interesting points. Moreover, the installation of Agamemnon will not require any special hardware (totems, palmtops, wireless network infrastructure), as it will take advantage of multimedia 3G-handsets and networks.

Further on, research work in the area of Location-based gaming allows the use of mobile devices to impart knowledge about cultural information in a 'playful' way, thus addressing people, which might be less interested in cultural information [BEH07].

3. The NETConnect project

NETConnect (http://www.netconnect-project.eu) is a project promoted by the Culture 2000 European Programme ([BCB*07]). The project will develop a sustainable methodology for connecting three major EU archaeological sites: the Magna Graecia of Calabria, in the south of Italy, Glauberg in Germany and Biskupin in Poland. These three sites will thus become the main core of a network of interconnected cultural scenarios.

The audiovisual content used within the project includes several formats and types of multimedia such as images, text, videos, maps, physical models and 3D reconstructions. Such information has been indexed, stored, managed, retrieved and visualized using state-of-the-art technology such as Virtual Reality (VR) on desktop computers, mobile devices, Internet and Geographical Information Systems (GIS) technology.

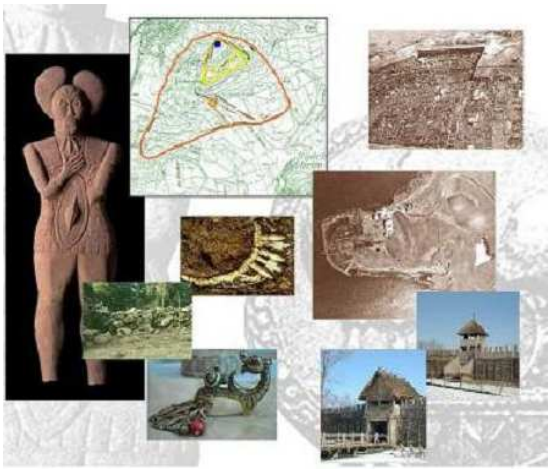

Figure 1: *Main archeological sites of the NETConnect project.*

The use of VR techniques is key in order to achieve high quality visualization and interactivity between the user and the 3D models. VR gives the user the possibility to explore new means of expression and cognition, through innovative ways to interact with content and to learn in informal scenarios. NETConnect uses standard desktop set-ups instead of immersive and expensive virtual environments, encouraging low-cost robust approaches, usually more suitable for large number of visitors as in the case of archaeological sites.

Moreover, Internet technology is used to remotely access content both for expert and non-expert users. Therefore, it is possible to browse material and content from one archaeological site about the other related sites. GIS technology is used as new means to present cultural content to European citizens in a more engaging way, stressing intercultural aspects at the territorial level at the same time. For this reason, the project explores the combined use of GIS systems and mobile technologies to allow in-situ access to GIS-based information.

Due to the rapid development of mobile technologies and the increasing capabilities of mobile devices, this information is not only available for experts but also for visitors on the own mobile phone, thus bridging technical obstacles in the access to cultural information.

Throughout the project, archaeologists will ensure historical accuracy of the virtual reproductions of the scenarios working in close collaboration with the technological partners during the virtual reconstructions and the implementation of mobile guides. The three archaeological sites have provided audiovisual content and are responsible for assessing the effectiveness of prototype applications by setting the

Figure 2: *Some achievements of the NETConnect project.*

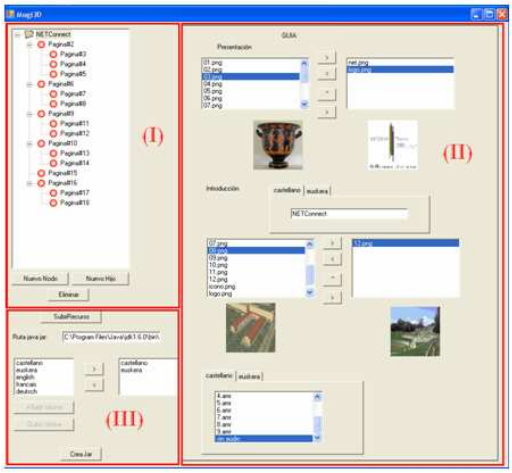

Figure 3: *Interface of the authoring tool for the development of multimedia multilingual mobile guides.*

requirements and by providing relevant feedback during test phases. Moreover, the formalization of the interconnection between scenarios will become the base of the technological experts work.

4. Description of the implemented prototype

The implemented prototype includes two different and complementary components: an authoring tool for the creation of multimedia multilingual guides by the personal from the archaeological sites and cultural institutions; and the application to execute the multimedia guides on the mobile clients.

4.1. Authoring tool for the implementation of multimedia multilingual guides

An authoring tool for the implementation of multimedia multilingual guides for the mobile clients has been designed and implemented. The tool targets non-expert users from cultural institutions and archaeological sites. Therefore, its interface has been designed in a simple and user-friendly way. The authoring tool allows simplifying the development process for creating mobile clients, reducing the learning curve of programming. The creator, and user of the authoring tool, only has to decide the structure of the guide and the multimedia multilingual contents for the mobile client.

The interface of the authoring tool is divided into three parts (Figure 3): the navigation control on the upper left part (I), the editing window in the central part (II), and the configuration control (III) in the lower left part.

The navigation control presents the structure of the guide through a Tree-like control, enabling the creation and elimination of nodes. The root node represents the guide as a whole, providing access to the definition of the contents associated with the introduction and presentation with all its associated nodes, which are shown in the edition window when clicking on the root node. The remaining nodes represent the various pages of the guide hierarchically. The edition of the multimedia features and contents for each node is carried out in the editing window (II). Finally, the configuration control allows importing the multimedia resources (images, audio and videos) that are used in each of the nodes of the guide.

The authoring tool is based on the automatic creation and edition of some text files, which control the structure of the guide. When a change is made, the tool automatically updates the corresponding files. These files are in charge of the operation of the guide and include information about the decisions taken by the designer in aspects such as the structure of the guide, the languages offered or the multimedia information displayed at each moment.

It must be mentioned that the file in charge of the hierarchical structure of the guide uses a similar paradigm to XML files, although XML has not been used due to the restrictions of the mobile environment. Each node of the guide begins and ends with a special character, and has an associated text file where all the related information is specified. All the resources and configuration files required are stored in a specific folder.

Once the multimedia multilingual guide for mobile clients has been implemented with the authoring tool, the staff of the archaeological site can select the languages that will be available in the downloadable version of the guide. Therefore, the management of the languages of the guides is centralized and the languages of the provided guide can be selected in real time.

Finally, the authoring tool includes a further folder to store the Java classes for the proper execution of the client. The required files and folders are included automatically in a .jar file that can be copied and installed on the mobile device.

4.2. Multimedia multilingual guides for the mobile client

In order to achieve reusability, Java ME (formerly known as J2ME (Java 2 Micro Edition) and available under the terms of GNU General Public License (GPL)) has been selected as the development and implementation platform. Applications developed in Java can run on nearly any type of device and operating system, as long as they have a "virtual machine", which is the program that interprets the bytecode generated. The very small computational and graphics capabilities of mobile devices such as cell phones or PDAs have forced the use of a subset of Java, called Java Micro Edition (ME). Java ME reshapes the main Java libraries to adapt them to an environment with limited memory capacity, low processing speed and small screens.

Another reason for choosing Java as the development platform is the fact that there is a wide variety of phones that offer a Virtual Machine (KVM). This is a very important advantage, as the mobile phone is the most universal device, thus being able to offer the service to a larger number of users.

On the other hand, a J2ME configuration defines the minimum set of Java libraries that a Java runtime environment has to support. There are various configurations, each of them being focused on a family of devices with similar capabilities A J2ME configuration includes three main elements: a Java virtual machine to execute Java bytecode; native code to interface to the underlying system, and a set of core Java runtime classes.

Currently, there are two configurations defined for mobile devices: the Connected Device Configuration (CDC) configuration, which is suited to the needs of more powerful devices; and the Connected Limited Device Configuration (CLDC) configuration, for devices with strict limitations as memory, processing power, battery consumption and connectivity to the network. The programme has been implemented for the CLDC configuration, so that it can run on mobile phones.

As it has been mentioned before, the multimedia guide follows a tree-like structure, so that each of the branches may contain new branches or a leaf type object, as shown in Figure 4.

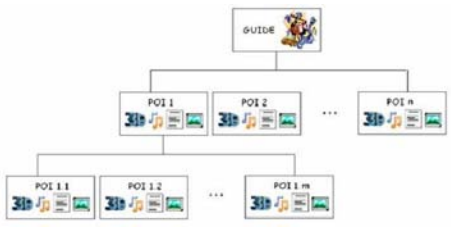

Figure 4: *Tree-like structure of the guide.*

Each of the objects in the diagram represents a page that is displayed on the mobile device. Pages can be of various types, displaying different formats of contents. Before displaying these pages, the guide starts with an overall presentation. Afterwards, the user can select among the languages in which the multimedia tourist guide is provided (English, Italian and German). The number of languages available is a decision of the creator of the guide. Once one of the languages has been selected, the introduction displays a sequence of images that could be synchronized with recorded voices or music.

Once the introduction is over, the guide shows a list with the names of the main pages of the tree-like structure, previously created with the authoring tool. Beyond this point, the hierarchy of each guide will be different depending on the structure of the guide. The user has the ability to navigate through the structure, moving up and down on the hierarchy of the guide.

The mobile application combines 2D maps, representing the location of the user, with the possibility of directly interacting with the guide in order to select certain Points of Interest (PoI) that are highlighted. Therefore, it is only necessary to select the PoI and a complementary screen including multimedia contents (text, pictures and videos) is rendered on the mobile device.The system simplifies accessing and retrieving information about the closest PoI, filtering the contents on the basis of the location data provided by GPS techniques.

Location of the user will be automatically detected by satellite-based positioning systems such as GPS, in case these capabilities are included in the device. Location will be displayed on a 2D map so that the tourist can know in real time his/her position and the Points of Interest around him/her. The map will be dynamically adjusted to the position of the user, who will also be able to navigate through the whole map using the buttons on the mobile device. However, these guides are also ready to be supported by mobile devices without location sensing capabilities.

The application has also been tested on devices with bigger capabilities, as last generation PDAs. Although these devices have a different virtual machine, included with Windows Mobile 6, they are able to execute the guide. The list of devices used during the tests include the following ones: Nokia 6280, Nokia N95, Htc Advantage 7500, O2 Flame, Sony Ericsson 123, and Motorola v360.

5. Case 1: The Magna Graecia scenario

The archaeological site of Locri Epizefiri has been chosen as a first validation scenario (Figure 5). Back in IV century b.C. Locri Epizefiri was one of the largest Greek "poleis" (city state) of Calabria. Today, the polis is the most famous for its numerous historical references handed down by the ancient

literary sources as well as for its important archaeological evidences.

Several environments (theatre, agora, house, temple, Pythagorean coterie, etc.) have been selected for the promotion of the cultural heritage of the area, with particular reference to the Calabrian colonies of Magna Graecia: Sybaris-Thurii-Copia, Locri Epizefiri, Kroton, and Hipponion.

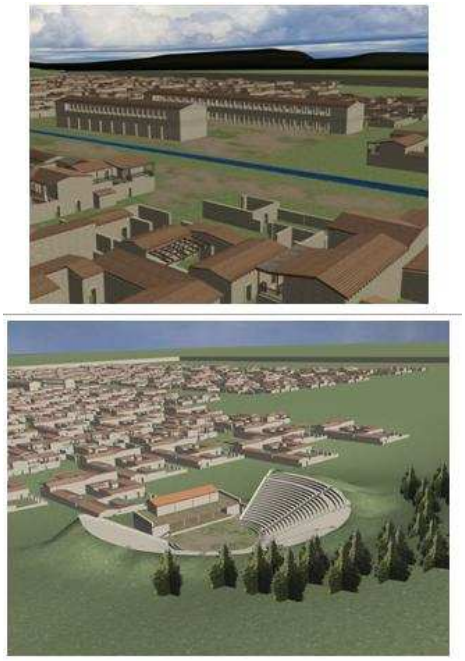

Figure 5: *Virtual reconstruction of the Lokroi settlement.*

Up to six PoI have been selected for the mobile application. As an introduction, there is a brief explaination of the Lokroi settlement. Legend says that the settlement of Lokroi is linked to a trick of the Greeks played to detriment of the inhabitants of the zone. Figure 6 displays some of the PoI that have been defined and implemented.

- The walls. The polis was surrounded by strong walls. In fact, Magno-Greeks fixed a sacral perimeter, separating the urban town from the necropolis. Since the first half of the VI century b.C., the walls were the urban limit.
- Centocamere. In the plan, the urban districts show a regular scheme: an orthogonal scheme characterized by parallel streets crossing at right angles. This set of parallel streets, called stenopoi (the term means "narrow streets") by the ancient people, facilitated the flowing of rain water from the hills to the sea, and created districts of a lengthened rectangular shape. In Centocamere, there was an artisan quarter.
- The Stoa. It can be considered a part of the famous Persephone's temple. Archaeologists found 371 votive wells, containing pieces of little statues, ceramics and bones of animals. In the occasion of periodical feasts, the Stoà has hosted sacred ceremonies with banquets for about 200 participants.
- The temple of Marasá. Marasà was one of the most important sacred areas of Lokroi, and the temple was the symbol of the power reached by the polis. It is one of the few temples in ionic style present in Magna Graecia (Figure 6). The altar of the ionic temple was at East, at a distance of about 16 meters. The temple is considered one of the most spectacular architecture in Lokroi and in all the Magna Graecia, also for the quality of the stone (that comes from the caves in Syracuse).
- The theatre. A very important building in Lokroi was the theatre, that goes back to the IV century b.C. It was built by using blocks of sandstone in a natural valley, and it could host about 4.500 spectators. The stage had two wings, one in the left and one in the right. The ruins of four of the six little stairs that divided in sectors are still visible.

Figure 6: *Screen-shots from the mobile application.*

Two possibilities have been forseen for the use of the mobile users at the archaeological site. On the one hand, users can use their own mobile devices to interact with the application, being able to download and install the appropriate application, using a Bluetooth connection. On the other hand, visitors will be able to borrow a mobile device from the Information Desk of the archaeological site.

6. Case 2: Glauberg Time Travellers

The IronAge Glauberg is one of the best known Celtic monuments in Germany (Figure 7). The extended mountain rige of the Glauberg is situated about 30 km to the south-east of Frankfurt, at the eastern rim of the Wetterau-Basalt-Massif. It is a typical place of empowerment of a certain Celtic social group, articulated in a combination of fortified mostly hilltop settlements together with richly endowed tombs, often embedded into an impressing grave mound or other monuments, demonstrating some kind of political power and influ-

ence. Nowadays, the Glauberg is under archaeological and environmental protection, as traces of archaeology can be found in the landscape.

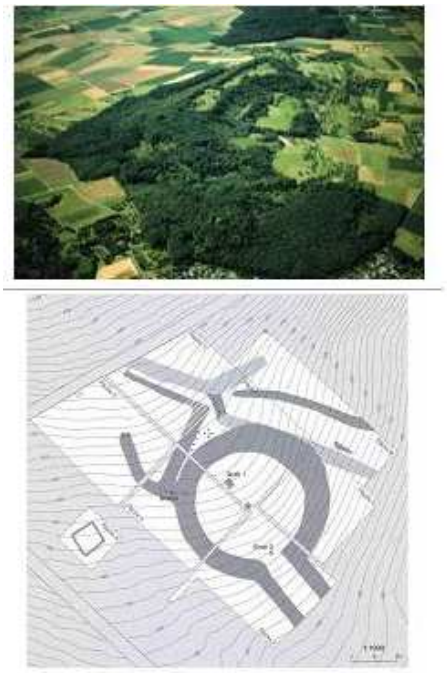

Figure 7: *Aerial views of the IronAge Glauberg.*

The Archaeological Park compromises an area about 1400m per 1000m. 21 information boards with bilingual texts (German-English) already exist in the park, dealing with many themes of different interest, such as archaeology, environmental care, natural phenomena or general tourist features. Certain Points of Interest (PoI) are the Iron Age structures, the medieval structures (cellars, castles, a font), historical wine terraces, a reconstructed part of the fortification wall, the Richter-Haus, house of the first excavator, an out-look and a panorama-platform, an a "Celtic Garden". The area of the reconstructed grave mound and the astronomica calendar will be included as well.

Several Points of Interest have been defined and implemented for the mobile application (Figure 8).

- Toranlage. Remains of a two-winged medieval gate can be explored at the entrance "Enzheimer Pforte". These remains are supposed to be of the period of Staufian dynasty in 12./13. Century A.D. When excavating the wall close to "Enzheimer Pforte" in 1996, a small treasure of silver coins of the time of Henry IV. was found.
- Celtic fortification. The fortification wall of Iron Age times enclosed the whole plateau and has had a post-slit construction. Two rows of wooden posts were dug into the ground, defining the exterior and interior limits of the wall. These posts were tied together with horizontal planks. This way, stilts were built for the wall corps of local basalt stones and earth, which were then piled up in the sections.
- Staufische Reichsburg. The house of the 13th century Reichsburg is still visible in its basement. The building did not represent the typical idea of a highly fortified castle, but was constructed as a two floor comfortable dwelling house. The entrance to the ruin nowadays has been the cellar entrance in the 13th century A.D.
- Celtic approach defensive. At the north eastern small edge of the plateau, the slope is very flat. Celtic builders also dug a ditch of more than five meter width and a flat base to avoid unrequested approaches.
- Pond. The pond on the Glauberg plateau is a natural depression in the ground. The more than three tons of Iron Age finds from the plateau presume a settlement of larger size. In 1936, the pond was the centre of archaeological excavation. The excavator Heinrich Richter found a shoreline stabilisation of three concentric rings of stones.
- Historic wine terraces. In the 18th century AD, Louise Countess of Stolberg-Gedern invented the vine growing on the Glauberg in south western and southern slopes of the hill Thus, the slopes were terraced and brought into shape for wine growing.

Figure 8: *Some screen-shots of the Glauberg mobile guides.*

The mobile electronic guide is planned to be used as an added-value personalized service for interested people. It will be downloaded at the Information Desk of the museum to the mobile device of the visitor. The receptionist will ask him/her about the preferred language for the guide. Using a Bluetooth connection, the guide will be installed in the mobile phone.

Regarding the targeted profile of visitors, mobile technology perfectly fits to a younger generation between 20 and 40. This target group of people with at least finished school career and users of mobile utilities like guides will get an additional value to visit the park by using the mobile device. The visitor is meant to become a time traveller and a

researcher him/herself. He/she moves around and as soon as he/she is near a Point of Interest, he/she is provided with relevant multimedia contents, like details of construction, special features of an object or social structures for a special period.

7. Conclusions and further work

Mobile guides are increasingly useful once visitors are in the archaeological site or at a cultural institution. They are capable of providing huge amount of multimedia contents about the location. Providing this information is a task that must be conducted by curators. Therefore, the creation, management and presentation of useful multimedia information should be simplified. In order to achieve this goal, an authoring tool for non-expert users has been implemented, allowing them to create multilingual mobile guides with different structures and type of contents.

The implementation of the guide and the creation and design of the content have been decoupled. The guide is created through an authoring tool. This tool has an intuitive interface and does not require previous advanced computer knowledge. Any professional lacking programming skills could create and advanced multilingual multimedia guide. The presented framework allows quickly and easily creation of multilingual multimedia mobile guides.

The tool includes the possibility of defining several layers to provide the information with a split architecture, so that the creator of the guide can decide which contents to include and the languages in which the guide will be provided. It must be mentioned that this authoring tool is not a route generator, but it focuses on the generation of user experiences providing context-based multimedia information.

The guide for the mobile devices is based on Java ME in order to achieve the greatest possible portability. Since the vast majority of mobile phones and PDAs are J2ME-enables devices, the number of potential users is enormous.

It must be mentioned that the only available current results are related to the creation of the multimedia multilingual mobile guides with the authoring tool and the download into the mobile devices. No tests with real visitors of the NETConnect archaeological sites have been conducted by now. Several mobile guides have been created using the authoring tool, including multimedia resources of different types. These guides have been first tested and debugged with mobile emulators available for PCs. On a second step, the guides have been installed on different real mobile devices. Supporting of the MIDP 2.0 profile is the only requirement that has to be met to execute the guide. As this profile is supported by a large number of devices, this is not a severe limitation.

It must be mentioned that the tool can be also used in several application sectors. For example, in the tourist sector it may be valuable for providing information related to Points of Interest or the daily menu at several restaurants in a region. It may also disseminate the work done by a Destination Management Organization or even Town Halls.

8. Acknowledgements

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