Self-creating 3D mobile tourist guides

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Abstract

Mobile tourist guides are increasingly useful once the tourist is in the destination. They are capable of providing huge amount of information about Points of Interest. As it is easily understood, the selection of such information is a task that must be conducted by Destination Management Organizations. 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. 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, a cultural institution or even Town Halls. Moreover, if the device has Internet connection, the contents will be automatically updated

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. 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. Although several projects have tackled the impact of 3D Geographical Information Systems (GIS), some mobile devices have several limitations for the correct implementation of such systems. Therefore, we have chosen a 2D map as a more general approach regarding the technical limitations of mobile devices. Our main motivation in developing this application is reaching the largest number of potential users, thus we have made a special effort in designing a device-independent, portable application.

Additionally to the offered tool and to make it more attractive to final users, a 3D graphics rendering engine for the visualization of 3D objects within the tourist guide has been developed. Generated 3D models can be easily integrated in the tourist guide using the implemented authoring tool. Visualizing and interacting with 3D objects provides a real added-value to the tourist experience, so tourists can watch buildings and monuments that may not be longer in the destination they are visiting.

Self-creating 3D tourist mobile guides

Given current technology trends, mobile communication devices and 3D applications 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 tourist information to a large number of potential users will allow accessing relevant information at the moment when they are living the experience. However, some limitations have been detected within the field of mobile tourist guides that prevents its use. Thus, the work presented in this paper tries to overcome some of the most challenging bottlenecks in the field of mobile applications:

- There are many mobile guides, but many of them are not portable to any type of mobile devices, such as PDA or mobile phone.
- Many mobile guides are made for a specific destination, so that they are not reusable for other environments.
- The development of the mobile guides is carried out by programmers However, content providers should be provided with a tool that allows them creating multimodal multilingual guides in an easily and user friendly way on their own.
- Although some mobile guides provide users with guidance, advanced location techniques are required to exactly detect the position of the user.
- Many tourist guides tackle 3D Geographical Information Systems (GIS). However, they consume a lot of resources and they are not suitable for the mass market mobile devices.

This paper presents the technological challenges targeted within the MUGI 3D project, which aims at designing, implementing and testing a framework for the creation, management and use of multimedia multilingual tourist guides for mobile devices. These guides include innovative multimedia contents such as 3D objects. The system has two main objectives: the design and development of an authoring tool for the creation of multimedia multilingual guides; and the implementation of a multilingual tourist guide for mobile devices of the users.

Section 1 presents some related work in the fields of tourist mobile guides, 3D graphics on mobile devices and authoring tools for the development of tourist guides. The following Section deals with the objectives and validation scenario of the MUGI 3D project. Section 3 presents the description of the implemented prototype, including its two different and complementary components.

Related work

Tourist mobile guides

While tourists are visiting a city, they can be interested in different kinds of information (history, culture, art, entertainment, shopping). Therefore, they often take with them paper guides to be consulted when needed. However, this is not always a convenient and efficient way to obtain the required information. In recent years, indeed, there has been a growing interest towards the development of mobile tourist guides. These guides can be used on lightweight mobile devices, providing easy (partially automated) access to the various classes of information. Moreover, they can manage multimedia information, enriching the tourist experience and providing many other useful services for the tourist, such as tour planning, weather forecasts and so on. By exploiting

the physical location of users, mobile guides are often able to provide up-to-date contextual information while traveling and give the possibility to access the most useful services for a given location.

There are already too many mobile guides- either commercial ones or research prototypes- to describe them all in this paper. For example, there are several EU funded projects such as CRUMPET (creation of user-friendly mobile services personalized for tourism) or PEACH (personal experience with active Cultural Heritage) that aim at building navigational assistant systems.

Abowd et al (1997) developed the Cyberguide system, which provided simple schematic black and white maps and information services about predefined indoor and outdoor locations. All maps and other information were static and stored on the mobile device. Indoor positioning based on infrared beacons, and GPS was used outdoors.

The second project in this summary is the GUIDE project (Cheverst et al, 2000). The system provides information about the city of Lancaster. The mobile component is connected wirelessly to an information server. Based on the closest 802.11 Access Point (AP), the mobile guide detects its approximate location and provides guidance and information services through a browser-based interface.

A further example is the Hippie/HIPS project, which has developed an exhibition guide, which provides guidance and information services (Oppermann and Specht, 2000). The mobile device detects infrared beacons installed near all the exhibits. From these observations about the visitor's journey through the exhibition, the system creates a user profile and suggests interesting exhibits augmenting them with background information.

Within the SmartKom framework as presented by Wahlster (2002), where a multi-modal dialogue system allows for speech, gesture and mimic interaction, a mobile communication assistant has also been developed. The mobile assistant offers information and navigation services using GSM/UMTS for communication and GPS for positioning purposes. The information presentation combines maps, natural language and an anthropomorphic presentation agent.

Finally, TellMaris is a prototype of a mobile tourist guide that was developed at Nokia Research Centre (Kray et al, 2003). It is one of the first mobile systems that combine 3D graphics with 2D maps, and that runs on a mobile device. The maps and 3D models used are statically stored on the phone and are synchronized while being displayed. The first prototype was developed for the city of Tonsberg, Norway to help boat tourists in finding locations of interest.

3D visualization in mobile devices

Traditionally, 3D graphics applications have been developed for either desktop computers or dedicated gaming consoles. However, with the increasing popularity and capabilities of mobile computing devices such as PDAs and cellular phones, many 3D graphics applications such as gaming, GPS-based maps and animate chats have emerged as possible applications for current and future mobile platforms. Since the mobile market far exceeds the PC market, a very large volume opportunity exists for 3D graphics.

Recently, some attempts have been made at exploring 3D graphics for tourist mobile guides. Rakkolainen et al (2001) have propose a system that combines a 2D map of an area with a 3D representation of what users are currently seeing in the physical world, studying the effects of 3D graphics on navigation and way finding in a urban

environment. They found that 3D models help users to recognize landmarks and find routes in cities more easily than traditional 2D maps. Unfortunately, the prototype was implemented on a laptop computer, not on a PDA.

3D city models for route guidance have been tested also by Kulju et al (2002) who obtained similar results, but highlighted the need for detailed modeling of buildings and additional route information such as street names. Unfortunately, their prototype uses only predefined animations and sequences of pictures, not interactive 3D worlds.

The system LAMP3D (Kray et al, 2003) provides tourists with the 3D view of the environment they are exploring, synchronized with the physical world through the use of GPS-based information. The user can easily obtain information of the existing objects in the real world, directly selecting them in the VRML world displayed on the screen of his device. Despite the support of navigation requires the use of a positioning system, such as GPS, LAMP3D allows the user to navigate through the 3D environment using the PDA stylus, or even watch a previously recorded virtual tour by any user.

Authoring tools for mobile guides

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) 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) 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.

Description of the MUGI3D project

Objectives

MUGI3D aims at designing, implementing and testing a framework for the creation, management and use of multimedia multilingual tourist guides for mobile devices. These guides include innovative multimedia contents such as 3D objects. The system has two main objectives: the design and development of an authoring tool for the creation of multimedia multilingual guides; and the implementation of a multilingual tourist guide for mobile devices of the users.

Among the technological objectives of MUGI3D, the following ones can be highlighted:

- Implementation of a 3D visualizer in mobile devices, taking into account the geometric resolution, texture usage, or size of objects. The visualizer has been implemented based on emerging standards for the representation of 3D graphics on mobile devices.
- Design, implementation and validation of an authoring tool for the generation of multilingual multimedia guides for DMOs. The tool will be based on user-friendly interaction metaphors and an on-line help.
- Tourist information system optimized for mobile devices taking into account context-based data. Personalized content provision combined with context-based information will be crucial in the acceptance of digital tourist services.
- New interaction interfaces based on multimedia contents including 3D objects on mobile devices to provide added-value services. Therefore, 2D maps based on ortophotos will be combined with pictures, videos and 3D models to enhance the description of Points of Interest.

Validation scenario

The prototype is about to be validated in the rural environment of Ataun in the Goierri Region in Gipuzkoa (Spain). Ataun is a small rural town located in the historical territory of Gipuzkoa in the Basque Country. Ataun is at the heart of a large Natural Park called Aralar, which is famous due to its fascinating skyline of huge limestone outcrops, meandering rivers and streams, rich vegetation and fauna. Intriguing myths and legends captivate all visitors. Of special geomorphologic interest is the basin at Ataun, where the erosion of the soil has left the surrounding cliffs exposed. Fauna is typical of mountainous areas.

Therefore, this mountain range is a favorite haunt for mountaineers and pot-holers. Moreover, the variety of megalithic monuments in the area, and the fact that it has the largest number of dolmens in the Basque Country, are evidence that man has inhabited this area for thousand of years. A profound respect for traditional values is an essential feature of life in Ataun. Basque people have always established strong links with their surrounding environment: the sea and the land. These two elements have played an important role in shaping the Basque way of life, their distinctive culture and their sports and games.

MUGI3D is part of a new local development project based on the comprehensive balance of natural resources, craftsmanship and industrial activity. The main objective of the new development project is to shape and consolidate Ataun as a single tourist destination: the Basque Outdoor Mythological Museum.

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 DMO; and the application to execute the multimedia guides on the mobile clients.

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 developed. The tool targets non-expert users from the DMO. 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. Once the multimedia multilingual guide for mobile clients has been implemented with the authoring tool, the staff of the DMO 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 tool automatically creates a .jar file that can be downloaded and executed directly on the mobile client.

The authoring tool is divided into three parts, as shown in Figure 1: 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.

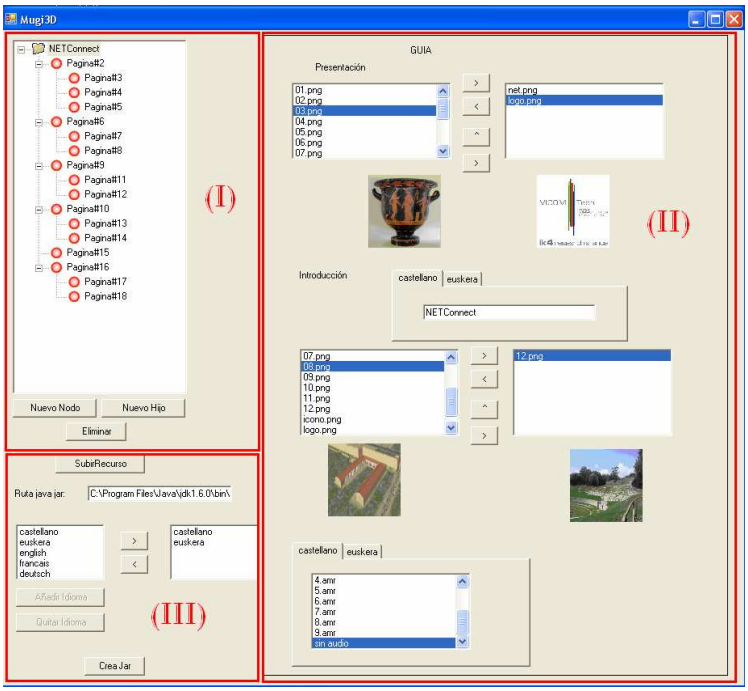

Figure 1: Authoring tool interface.

The navigation control presents the structure of the guide through a “tree-like” control, enabling the creation and elimination of its “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. Finally, the configuration control allows importing the multimedia resources (images, audio, video and 3D models) that will be used in each of the nodes of the guide. Moreover, the personal of the DMO can select the language in which the multimedia tourist guide will be provided.

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. In addition, 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.

Multimedia multilingual guides for the mobile client

MUGI3D 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, videos and 3D objects) is rendered on the mobile device.

Tourists are usually interested in buildings, monuments and PoIs in their surrounding area, while the information of other elements could be interesting in a further phase. MUGI3D simplifies accessing and retrieving information about the closest PoI, filtering the contents on the basis of the location data provided by GPS techniques. However, these guides are also ready to be supported by mobile devices without location sensing capabilities.

In the following subsections, several aspects about the mobile client are more deeply analyzed, such as the development platform and a brief description of the implementation of the guide.

Java ME platform

The main reason for using the Java language for the mobile client is its portability. Applications developed in Java can run on nearly any type of device and operating system, as long as they have a "virtual machine". A virtual machine 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 to an environment with limited memory capacity, low processing speed and small screens.

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 of MUGI3D. To be able to run J2ME applications, the mobile device must have a Java virtual machine installed. J2ME applications supporting devices already incorporate the virtual machine as part of the basic software, called Kilobyte Virtual Machine (KVM) because of its small size.

Another reason for choosing Java as the development platform is the fact that thre is a wide variety of phones that offer a 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.

CLDC configuration

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. MUGI 3D has been implemented for the CLDC configuration, so that it can run on mobile phones.

Implementation of the guide

As it has been mentioned before, the multimedia tourist 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 2.

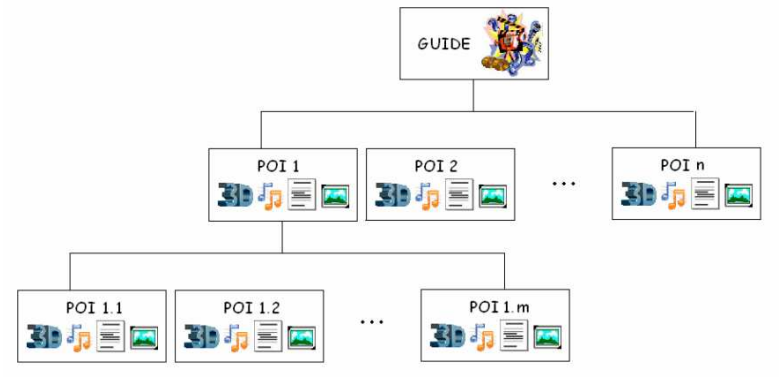

Figure 2: “Tree-like” structure of the guide.

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 types of contents. Before displaying these pages, the guide starts with an overall presentation, which includes the logos of the companies or entities involved. Afterwards, the user can select among the languages in which the multimedia tourist guide is provided (Spanish, Basque, English, French 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. Each PoI has an associated file which contains the names of the multimedia resources associated and the type of the PoI. This type determines the presentation of the content on the client device.

3D graphics on mobile clients

The visualization of 3D objects in mobile devices is still at an early stage due to their computational restrictions. Some works undertake the view of 3Dgraphics on mobile devices making the rendering remotely. The biggest drawback of these solutions is the need of a wireless network, as they can not be configured for each possible environment.

As 3D objects have a high demand of computational resources, inserting them directly on the application could degrade the performance of the application. Thus, 3D objects are only loaded when the user wants to interact with them. Rendering small 3D scenes on conventional mobile devices is possible due to the availability of the necessary APIs. These widespread APIs allow reaching a great number of potential users without modifying the application.

The graphics engine used in the Java ME platform is based on the API called Mobile 3D Graphics (M3G). This standard has been adopted by all major handset manufacturers worldwide to provide great gaming and 3D experiences to users. M3G is an optional API for 3D graphics supporting under the JSR 184 specification, which defines a set of interfaces for high and low level rendering of 3D interactive graphics on devices with limited capabilities. JSR 184 is the first specific standard for 3D graphics on

mobile devices. Although the API is used as an optional package to be used with MIDP (Mobile Information Device Profile) and the 1.1 version of CLDC, most of the devices of middle and high class support it. In addition to the API itself, a file format (. m3g) is defined for the storage and transfer of 3D content (meshes, textures, hierarchy scenes ....). The standard JSR-184 can handle large amounts of data (models, lights, camera, textures, animations…) to be easily loaded into the application.

3D graphics have been generated using 3D Studio Max, which is one of the most widely used programs for creating graphics and 3D animation. In order to obtain the .m3g format, a plug-in for 3D Studio Max, called M3G Exporter, has been used.

Results

It must be mentioned that the only available 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 tourists have been conducted by now.

Several mobile guides have been created using the authoring tool, including multimedia resources of different types (audio, video, 3D objects, pictures). 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. Even devices that are not able to visualize 3D graphics due to their lack of the necessary JSR 184 packag, have been able to execute the guides. 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.

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 Ericsoon 123, and Motorola v360.

Conclusions

Mobile tourist guides are increasingly useful once the tourist is in the destination. They are capable of providing huge amount of information about the location. Providing this information is a task that must be conducted by DMO simplifies the creation, management and presentation 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, 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 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.

The presented framework allows quickly and easily creation of multilingual multimedia mobile guides, including the ability to display 3D graphics which provide an added value to the user. Computational limitations of current mobile devices do not allow the inclusion of 3D graphics as realistic as the ones available for desktop computers. A

tradeoff between performance and quality of the graphics has to be made to not decrease the usability of the final application.

Acknowledgements

The authors would like to thank The Movie Virtual and VILAU for funding this work through the MUGI 3D project.

References

J. Baus, K. Cheverst, C. Kray, “A Survey of Map-based Mobile Guides”, Map-based mobile services- Theories, Methods and Implementations Meng/Zipf, 2005, pp. 197-213.

C. Kray, J. Baus, “A survey of mobile guides”, Workshop HCI on mobile guides at Mobile HCI, 2003.

J. Rakkolainen, T. Vainio, “A 3D City Info for mobile users”, Computer and Graphics 25(4), pp. 619-625, 2001.

M. Kulju, E. Kaasinen, “Route Guidance Using a 3D City Model on a Mobile Device”, Workshop on Mobile Tourism Support, Mobile HCI2002, Pisa, Italy, 2002.

G.D. Abowd, C.G. Atkeson, J. Hong, S. Long, R. Kooper, M. Pinkerton, “Cyberguide: A Mobile Context-Aware Tour Guide”, ACM Wireless Networks 3(5), pp. 421-433, 1997.

K. Cheverst, N. Davies, K. Mitchell, A. Friday, “Experiencies of Developing and Deploying a Context-Aware Tourist Guide: The GUIDE Project”, Proc. of MobiCom2000, ACM Press, New York, pp. 20-31, 2000.

G. Pospischil, H. Kunczier, A. Kuchar, “Lol@: A UMTS Location Based Service”, Proc. of the International Symposion on 3G Infrastructure and Services, Athens, Greece, 2001.

S. Poslad, H. Laamanen, R. Malaka, A. Nick, P. Bucle, A. Zipf, “CRUMPET: Creation of User-friendly Mobile Services Personalised for Tourism”, Proc. of 3G 2001, London, UK, 2001.

J. Paay, J. Kjeldskov, “Understanding and Modelling the Built Environment for Mobile Guide Interface Design”, Behaviour and Information Technology 24(1), pp. 21-35, 2005.

L. Chittaro, “Visualizing Information on Mobile Devices”, IEEE Computer 39, pp. 34-39, 2006.

Andersen, Digital Content for Global Mobile Services, European Commission Directorate- General Information Society, Final Report, 2002.

Nokia, Location aware applications take off, Nokia White Paper, 2004.

M. Pääjärvi, Future Mobile Data Services for Tourism. Barriers and Enablers for Adoption of a Mobile Tourist Guide in the Tourism Industry of Norrbotten, Technical Report, 2004.

Costagliola, G., Di Martino, S., Ferrucci, F., & Pittarello, F. (2002). An approach for authoring 3D cultural heritage exhibitions on the web (pp. 601-608): ACM Press New York, NY, USA.

Bulterman, D. C. A., & Hardman, L. (2005). Structured multimedia authoring, Vol. 1, pp. 89–109.

R. Oppermann, M. Specht, “A Context-Sensitive Nomadic Exhibition Guide”, In Proc. Of Second Symposium on Handheld and Ubiquitous Computing- HUC2K, pp. 127-149, 2000.

W. Wahlster, “Smartkom; Fusion an Fission of speech, gestures and facial expressions”, In Proceedings of the 1st International Workshop on Man-Machine Symbiotic System, pp. 213-225, 2002.

C. Kray, K. Laakso, C. Elting, V. Coors, “Presenting route instructions on mobile devices”, In Procedings of the International Conference on Intelligent User Interfaces 2003 (IUI03), pp. 117-124, 2003.