# Adaptive Mobile Museum Guide for Information and Learning on Demand

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## 1 Goal

The paper describes a nomadic information system under development by GMD in the HIPS[1] project that supports nomadic activities adapted to the individual visitor of a museum. The world-wide Web, wired and wireless connectivity to networks, and small mobile devices allow for supporting nomadic activities by information and communication technology to an extensive degree. Mobile information technology is a chance to support the process of activities from the beginning to the end, distributed over time, across space and between actors.

The paper describes a nomadic information system designed to support adaptive information and adaptive learning of visitors during art excursions. An information system is said to be nomadic when the user has access to his or her personal information space from all places independent from specific devices. The art domain is attractive for a nomadic information system because art excursions require nomadic activities from visitors and art can best be enjoyed when the recipient has access to information about an art object when he or she is in front of the art object. In front

1 The project Hyperinteraction within Physical spaces (HIPS) is an EU-supported LTR project in ESPRIT I3. The partners of the consortium are University of Siena (co-ordinating partner), University of Edinburgh, University College Dublin, ITC, SINTEF and GMD, CB&J, and Alcatel.

of an art object the motivation to learn more about the object can be assumed to be higher than without the authentic impression of an art exhibition. We want to use the effect of situated learning known in *task contexts* in order to support situated learning in an *interest context.*

## 2 The system

The system described in this paper was implemented for the art collection in the castle of Birlinghoven, the headquarter of the GMD in Sankt Augustin near Bonn – see http://hippie.gmd.de:8080/ (A second exhibition domain, the CeBIT 99 with 20 exhibits at the GMD-booth, has been used to show the generality of the prototype.)

In the museum the system supports a mini-laptop with infrared for location identification and wireless LAN for data transmission to and from the server and touch screen and headphones for user input/out. For the shortcomings of user control of audio presentation auxiliary visual presentations are designed to complement the understanding of or the navigation through the audio information. Besides a standard audio player lists of exhibition items with several sort options are presented in a content overview and buttons for attributes of the exhibits allow for directly requesting specific information.

The information selection and presentation follows the user's movement in the physical space. The user can also move through the information space. Both kinds of control are combined and to be communicated to the user to avoid confusion or to limit information access. The system tries to combine the movement in the physical and the information space by presenting visual and audio cues when the visitor passes exhibits identified by the user model to be relevant for him or her. A sound icon and a blinking visual icon indicate a new exhibit without interrupting a current presentation. The user is free to select a new presentation whenever he or she wants but is not patronised by automated presentations. The same is true for adaptive suggestions. The system evaluates the seen exhibits and suggests a tour with exhibits of the same group of exhibits the visitor seems to like, i.e., a particular type of an artwork (like painting), a particular period (like renaissance), a particular genre (like mythology). The system also evaluates the attributes of exhibits the visitor selects (like historical background or the composition and form design of a painting) and adapts the default sequence of attributes to the visitor's interests.

## 3 Needs of nomadic users

Nomadic information systems need particular presentation, interaction and adaptation. Presentation modalities reflect the specific conditions of the nomadic scenario. The user's visual attention is directed toward the physical environment and can be complemented by audio presentation of the information system via headphones. A mobile device of a museum visitor does not allow for extensive command input with classical input techniques but needs simple input by primarily deictic commands (clicking on a touchscreen) or speech input (cf. Oppermann and Specht 1999).

Adaptations have to reflect the current user's local environment (contextualisation) and interaction history (individualisation). Activities at different places need different interaction with an information system. At home when preparing an excursion the information system is the central focus of the user's attention. He or she is sitting in front of the system, selecting, reading and writing information presented on the screen. Outdoor the user interacts with objects within a physical space and the attention is directed towards the physical and social environment. A nomadic information system should adapt to the different phases and places of activities.

Nomadic adaptive systems require both a user model where the information according to user interests, knowledge, and preferences is evaluated and a usage model where the information about the user's environment and client hardware and software is held up-to-date. To achieve this, mobile information technology can be combined with technologies to identify the users' environment and his or her position in the physical space (Abowd et al. 1997). Infrared or the General Positioning Satellite system (GPS) allows for localising the device of the user. The position and the movement in the physical space can be observed and evaluated for required information. The navigation in the physical and in the information space can be used as indicators for the user's interests, preferences, and the knowledge acquired so far.

For information in general and for learning in particular it is preferable in terms of effectiveness, efficiency and satisfaction for the person to learn new elements embedded into a familiar frame. Repetition is a reinforcing factor for learning. Combining new and familiar items can augment not only learning results. Also the enjoyment of attraction environments can be increased when the person gets new aspects of an already known topic. The system evaluates the knowledge of the user in terms of seen-entities and presents information about the exhibit in question by its name and a thumbnail representation with additional information that fits the inferred visitor's interests but has not been presented earlier.

## 4 Situated learning with a nomadic system

Studies show that learning embedded in the task context is more effective and efficient than separate learning organised before task accomplishment (Norman and Spohrer 1996, 26). Situated action (Suchman 1987) and contextualised learning (Lave and Wenger 1991; Vosniadou 1994) are keywords to describe a situation as an important motivational and cognitive factor for successful learning. The idea of situated learning in the task context goes back to the constructivistic assumption that learning is not a passive reception or a transfer of knowledge from one subject (teacher) to another subject (student) but learning is an active (re-)construction of knowledge by the student. The teacher can be seen as an organiser of the knowledge construction process by providing learning material and learning methods. Situated learning helps people to acquire the knowledge necessary to solve a problem or to understand a situation without switching mentally to a separate learning activity.

Learning with a nomadic information system allows for exploring art exhibits more extensively in front of the artwork than classical media (and more individually than a human guide). Not only descriptive data like artist, dateline, style, or motive but also formal art analysis like composition or form and colour design can be supported. The visitor has the chance to consult the system to understand the background of a painting and understand how the painting is designed. He or she can apply the interpretation to the perception of the current painting on the wall. The visitor can progressively learn to understand paintings more and more competently.

Situated learning is process oriented learning (Mandl, Gruber and Renkl 1995). In case of unsolved problems or incompletely understood situations later learning support has to take into account previous efforts of the learner. A nomadic system connects several sessions of the learner by providing access to questions and notes the visitor stores for subsequent phases of excursions. At home, for example, the user can enter questions for the museum to view details of form or colour design. In the museum when information provided by the system is insufficient for a historical interest of the individual the visitor can enter a question to be analysed later at home with more extensive access to external information bases.

## 5 Evaluation

Evaluations of the system have been started with domain experts, i.e., artists, art educators, and museum curators during a one-day demonstration and feedback workshop.

The experts confirmed the added value of the nomadic information system both for the process support of preparing, conducting, and evaluating a museum visit and for the understanding of the artworks with respect to the wide spectrum of information provided by the system. The participants pointed out that the user-system interaction of a mobile guide has to be designed for specific requirements of the exhibition domain. On the one hand, in technical exhibitions a mix of automatic offers and active requests of information might have a stimulating effect. On the other hand, in art exhibitions, perceiving art might be limited by a conflict between promenading and searching information. The permanent offer of structured information might obstruct the visitor to get involved in a silent conversation with an artwork and to develop an individual understanding. Providing personalized views and individual tours was appreciated. Especially personalized information for visitor interests and knowledge was considered important. Adaptive information selection reduces redundancy and information overload. The overall feedback was very positive expecting that new media guides increases the attraction of museums.

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