

# Supporting Small Groups in the Museum by Context-Aware Communication Services

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## ABSTRACT

Visitors often tend to visit museums in groups, mainly with family or friends, yet most of the today mobile museum guides focus on supporting the individual visitor. The technology described in this paper allows supporting groups of visitors in addition to individuals by providing context-aware services aimed at supporting the whole group. These include context-aware communication and alerting services that are provided by the museum visitor's guide system developed in the framework of the PIL (PEACH-Israel) project, as an example case of a larger variety of possible context-aware services.

**ACM Classification:** H5.2 Interaction styles, Screen design.

**General terms:** Design, Human Factors

**Keywords:** Context-Aware Communication services, Multimedia Museum Visitor's Guide.

## INTRODUCTION

Many visitors tend to visit museums in small groups, mainly with family or friends [9]. The learning experience that takes place in museums nowadays is free-choice. It tends to be personal; it is self-motivated, self-paced, and exploratory by nature. The visitor chooses what, where and when to learn [2]. In this context, interaction among visitors may increase learning in the museum environment [2]. New tools for communication may increase interaction and hence contribute to the visit experience. Various museum visitors guide applications provide means of communication among visitors [4], but without an underlying systematic approach. This work proposes a framework for context-aware communication services integrated with the presentation capabilities. The paper presents a museum visitors' guide system augmented with

two such services, specifically targeted for sharing the museum experience, namely intra-group communication and system-visitors communication.

## MUSEUM VISITORS' GUIDES APPLICATIONS

Museum visitors' guides have evolved from providing information about the exhibits on demand to personalized, location aware systems that at best are able to provide a coherent presentation during the visit (see for instance [8]). The next step is to take into account the small group (e.g. a family or a group of friends) that the visitor may be part of, and facilitate interaction among members to stimulate further interest.

What we discuss in this paper is an initial step toward the ambitious goal of having technology stimulating conversation about the museum contents within the group, during and after the visit. In fact, according to [6] conversation is a key factor for enhancing learning and the quality of the museum experience in general. Specifically regarding communication services, it is worth mentioning that some experimental museum visitor's guide systems were extended to also provide means of communication among visitors. One example is the "Guide" project, developed in the city of Lancaster, UK, that provided an electronic handheld guide enabling visitors to Lancaster to access information about the city, to create tailored tours of the city, to access interactive services, to send and receive messages to/from their companions, to let other members of their group know their location and to leave virtual stick-on notes at specific locations in the city so they can share their experiences with other tourists [1]. Another example is the "guidebook" in the Exploratorium in San Francisco. The guidebook prototype combined the functions of informing, suggesting and remembering. The researchers concluded that their remembering service may have value for personal and social uses. They also concluded that people seem to enjoy helping each other and discussing the exhibits, and this seemed to encourage additional interaction with the exhibits [3].

It seems that the above examples combined some means of communication as part of the application, assuming and concluding that this may improve the visit experience.

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A different example is the InfoRadar project. It provided a novel radar interface for accessing messages, desktop-like temporal storage for messages, location-independent message threading, filtering functionality, contextual audience addressing, multimedia messaging, social activity indicator, and voting. InfoRadar attempted to combine both public and in-group messaging into one system [7]. The researchers concluded that such services have an enormous contribution to the visitor's experience while touring.

The unique aspects of our work are that a) communication with members of the group is integrated with presentations while the focus is mainly kept on the exhibit and the system presentations; b) the communication is context-aware, taking into account at least some information about positions, models and state of other members of the group.

### THE PIL MUSEUM VISITOR'S GUIDE SYSTEM

The PIL museum visitors guide is a first step to extend the research results of the PEACH project (<http://peach.itc.it>) from the individual to the group level. A museum visitors' guide system has been developed (using PEACH technology) for demonstrating and experimenting inter-group communication and overall group visit support.

Figure 1 presents the core parts of our museum visitor's guide multi-agent system. Several components interact by exchanging messages through channels; this kind of architecture is very effective to experiment with flexible system (for detailed description of the underlying technology see [5]). The system contains a user-modeling component that keeps track of visitor's preferences based on their behavior (and also keeps track of the history of events each visitor was involved in), a spatial information broker reports visitor's position periodically, integrating positioning information from different sources (currently IR and in the near future also WiFi), a presentation composer provides presentations to the visitor, based on current location and taking into account visitor's inferred preferences. The novel addition is the services agent that provides communication and alerting services for both individuals and groups. This component keeps track of the state of the individual visitors and abstracts the information to an overall group state.

Regarding communication services, the initiator of messages may be the individual visitor or the system. Messages can be addressed to a specific visitor, to a group or to everybody. Messages can be delivered immediately or when certain conditions are satisfied. A general context-aware communication service should support communication with various addressees, based on contextual conditions (and as a result, offering a variety of services). For initial demonstration of the above, the services include context-aware immediate message (SMS-like) and context-aware virtual "post-it". The messages are sent either among visitors or by the system to the visitors. A visitor may send a "come here" or "you must see this" message to a partner; the message is being contextualized

by the system using the sender's and receiver's states (e.g. if the receiver has already been to the place, the system notifies the sender about that). A visitor may leave a virtual "post-it" to a colleague at a certain point, and the system will notify the visitor in case his/her partner already visited that place. The visitor may also send a message suggesting meeting at the cafeteria (or taking a break, scheduling the visit, etc.).

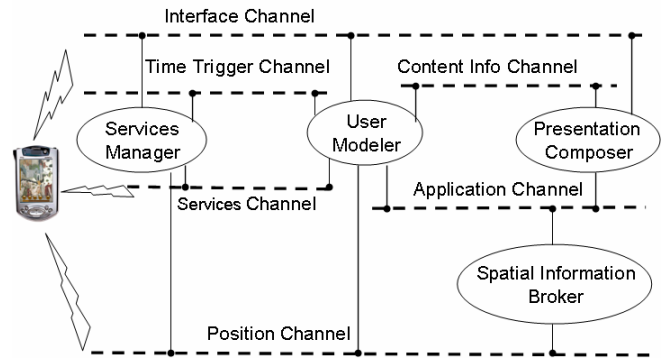


Figure 1: PIL museum visitors guide architecture.

Another set of services is time based alerting. Usually, visitors have a limited period of time for their visit. We are experimenting with services that help visitors get the most from their time by exploiting the group dimension.

We consider that people generally do not want to miss the most important exhibits (there is nothing that can take the place of being in front of the real object). But if time is limited, presentations, up to a point can be complementary, and people can integrate what has been presented to them by talking to the other members of the group later.

One case is when the system acts differently at the last phase of the visit. It sends a message to visitors suggesting them to see the "must see" exhibits. In this case the system takes an overall look of the group, making sure that individuals in the group visit all important exhibits and get a variety of relevant presentations, so they have complementary information to be possibly discussed and shared later after the visit. In this situation the user model that influences the material proposed by the system to the individual in the general modality, is less important in this phase, because the state of the group prevails.

The PIL context-aware, personalized menu-driven user interface was developed applying user-centered design. Context-aware communication services were integrated into the system in a way that they do not interfere with normal use of the guide. This means for instance that communication activities are available to the visitor only when no multimedia presentation is being played (e.g. only when moving around/approaching an exhibit or between presentations in a certain position).

Let us use the following scenario for illustrating the overall system and the integration of the new features into a mobile museum visitors' guide. The scenario envisioned relates to a small group of visitors (three – four friends or a family) that visits the exhibitions and listens to presentations, each visitor at his/her own pace. The system identifies the visitor's location and accordingly provides her/him with the relevant position illustration. The visitor chooses an exhibit and accordingly the system provides her/him the relevant menu (the order of the menu items is personalized). The visitor selects and views a presentation (Fig. 2, left to right).

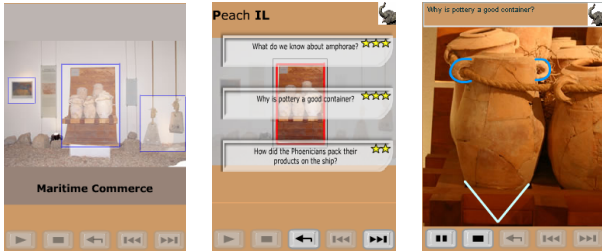


Figure 2: Museum visit guide interface.

During the visit, the visitors are possibly moving on different paths, and may communicate with other members of their group. They can send predefined messages about some exhibits they find especially impressive, or leave post-its on some exhibit that they would like the others to eventually see (see Fig. 3 on the left, message creating icons).



Figure 3: Selectable communication services.

Once the visitor gets a message, a relevant button becomes enabled (see Fig. 3 on the right, message reading icons). Sending and reading a message is an example of context-awareness. Let us assume that the content of a message was: "Come here". The system uses the contextual position information for translating it by giving the exact name of the exhibit and attaching the relevant picture.

Another example is leaving a *post it* message with the content: "You must see this exhibit". The system uses the contextual information for interpreting it by giving the

name of the exhibit and by attaching the relevant picture (Fig. 4). It may happen that the addressee has already been at that location; in this case the system will notify the sender about that.



Figure 4: Sending and reading a message.

When the system enters into the "little time available" modality, there is a high priority to see the "crucial exhibits for a visitor" at the museum. In this scenario the system also addresses a social context. It sends "don't miss messages" to the visitors. Different messages are sent to different visitors regarding the nearest "must see exhibit", that seems to be of interest to him/her, that he/she has not seen yet. When the visitor approaches the "must see exhibit", the presentations recommended by the system for that exhibit are those that seem of interest but not yet presented to any other group member, instead of being those recommended only according to her/his specific user model.

#### PRELIMINARY AND PLANNED EVALUATION

As already mentioned, the system's user interface was developed applying user-centered design. Thus, several rounds of formative evaluation were performed to provide feedback to the development team. We have also checked in pilot studies that users understand, interact and like the current user interface.

The experimental evaluation (that is currently at an initial phase) focuses on various aspects of the system (including individual oriented aspects: interface usability, comparing adaptive and non adaptive interfaces; contribution of the multimedia presentations to individual learning). Specific evaluation is going to take place for the contribution of the communicational activities to the overall visit experience. We expect that the integration of the presentation and the communication capabilities will make the interface easy to use and especially that the social interaction between members during the museum visit will enhance and deepen the visitors' interest in the exhibits.

#### CURRENT WORK

The context-aware communication services provide initial means of intra-group interaction. To further encourage the

group interaction and let the whole group members share their experience, we are currently developing visualization support for a post visit group discussion. Sitting for instance in the cafeteria, during or after the visit, visitors will be able to become aware of the parts of the museum visited by other group members, of places that have been of special interest to a member (with images of the relevant exhibits) as reflected by messages sent, and by personal notes for remembering points that were of particular interest.

This part requires appealing graphics and good quality images of the relevant exhibits and will be provided on a good-quality large display.

Interactive functionalities will include re playing (now to all group members at the same time) presentation that has been seen in connection to a given exhibit, and access to external information.

We expect the visual context of the key points of the group visits per se will be a favorable background for discussing the exhibits and presentations seen by the group members. A novel round of experiments will be set to evaluate the overall setting.

#### CONCLUSIONS AND FUTURE WORK

The communication services implemented are only a small part of possible communication services. For the moment we decided not to enter free text or speech, to avoid problems of usability in a museum, but additional communication services may include writing memories (personal or to be shared), taking notes, pictures, and more. Such services can be generalized to a set of general communication services, where all may have in common a sender, an addressee, a set of contextual conditions for delivery and content to be sent. In fact, context-awareness may be an attribute common to other services, as demonstrated also by the alerting service, that can be regarded as a composition of time service (alarm clock) with the communication service (when time trigger fires, a message is sent by the system). Of course, this latter simple service can potentially be integrated with a more sophisticated personal or group oriented advice. In the next step we plan a generic context-aware information broker that will provide the required contextual information to different services. Such services will include, besides the communication services and time-based alerting services, additional alerting services (such as helping the visitors plan the visit and avoid crowded places), navigation

services (getting directions to specific places, group members relative positions) and more.

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