Proxemic-Based Collocated Interactions at the Museum Environment

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Abstract
Many visitors arrive to the museum in small groups, and social interaction between group members has been shown to be an important factor affecting visitor's experience. However, the majority of technologies developed to support museum visitors focus on the individual visitor and do not support collocated interaction. We describe our initial efforts and ideas in supporting collocated interaction at the museum, based on proximity and contextual information of visitors. We describe the environment in which we conduct our research, our initial work and prototypes and the challenges we plan to address in this research.

Author Keywords
Collocated interaction, Mobile museum guide, Museum Technology, Multi-Display environment, Situated displays.

Introduction
Cultural Heritage (CH) sites, and specifically museums, are public spaces in which people come to learn and engage in a cultural and social experience. Visitors' experience in CH sites tends to be personal, self-motivated, self-paced, and exploratory; they choose what, where and when to learn [7]. Personalized,

context-aware multimedia content provides new opportunities for the museum's curators to enhance this experience. In order to provide visitors with personalized and context-aware information, museums often use handheld devices such as smart phones as mobile visitor's guides that provide various services such as delivery of information, navigation and more (see [2] for a survey).

Many visitors tend to visit museums in small groups mainly of family and friends [Falk and Dierking, 2000]. Interaction among visitors is important and may enhance learning in the museum environment, as well as enriching the entire visit experience [12]. Bitgood and Shettel [4] report that "the overwhelming percentage of visitors come in groups - usually with families or friends" and see the social contact as a significant aspect of the informal learning setting and often as the most important part of the experience. Although the social context of a museum visit is well established, most existing mobile guides at museums today are designed as a single person device that supports a personal rather than a group experience. Many works have looked at how to utilize a handheld device as a single person mobile visitor's guide for information delivery, interpretation, navigation and other services [1, 5, 9, 13]. However, it has been shown that a single-person mobile visitor's guide, when used by each member of a small group, causes a decoupling effect, dissocializing rather than enhancing the group experience [11].

Recently, researchers have started examining tools for communication to increase group interaction and hence contribute to the visit experience. A few research prototypes of museum mobile guide applications provide some means of communication among visitors such as synchronous listening [8] or context-aware messaging between group members [9].

With the pervasiveness of technology in museums, many museums employ a multitude of technological devices and displays in addition to the use of personal devices. In the future museum, we expect that users will be able to get information seamlessly on desk mounted displays, tabletop surfaces, wall mounted large displays, steerable projectors and more. The main objective of our work is to examine how technology can be used to enhance the social context of the museum visit experience. Since group interaction is a critical component of the visitor experience, the current work explores ways to support small collocated groups in a museum environment. This may include at first, using proxemics information of visitors to provide collocated services. In addition, situated large displays located within the public space of a museum, can be used to support group activities. Our main objective is to use technology in such a way that technology would support rather than inhibit group interaction. As such, we look at proxemics as a way to better understand visitor context and thus, better enable us to provide meaningful group interaction mechanisms.

PIL project and museum infrastructure

We examine proxemics collocated interaction at the museum environment within scope of the PIL project. PIL is a research project focusing on exploring the possibility to use novel technologies for enhancing the museum visit experience [9, 11]. In the framework of the project, a research prototype was developed and then converted into a working museum visitors' guide. Technology has been experimented and used by

visitors at the Hecht museum[1], a small to medium sized museum containing both archeological and art exhibits located on the campus of the University of Haifa, which contains both archeological and art exhibits. The system provides multimedia presentations about selected museum exhibits in three languages. The system is location aware and its positioning is based on proximity detection. Fixed *Beacons* are placed in points of interest in the museum and the visitors are carrying mobile sensors called "*Blinds*", as illustrated by Figure 1. A more detailed description of the positioning system can be found in [10]. Once a visitor is detected at a point of interest (the *Blind* detects the *Beacon* and reports this event to the server), the system presents the user with a selection of nearby objects on the handheld device. The user then selects a specific object of interest which prompts a list of questions. Once the visitor selects a question of interest, a one-minute multimedia presentation is played, providing an answer to that question.

[1] http://mushecht.haifa.ac.il/Default_eng.aspx

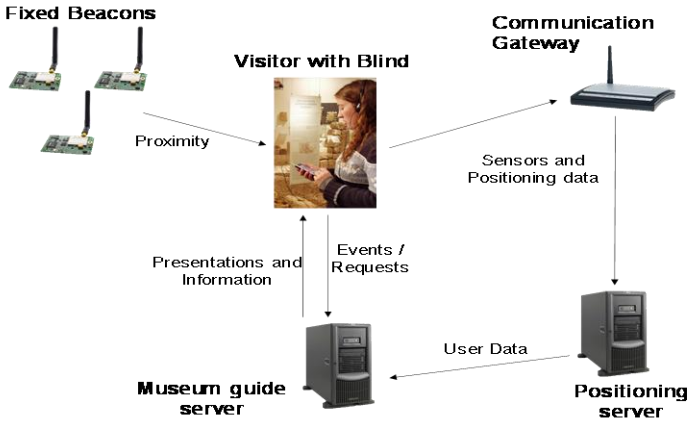

Figure 1 – PIL system architecture

Exploring proxemics collocated interaction using handhelds and large displays at the museum

We have looked at how to perform automatic detection and identification of the social context of small groups at the museum. Using sensor data as described above, including proximity to other visitors, proximity to museum points of interest, and visitor orientation, we are able to detect social synchronization, attention to the social companion, and interest of the museum exhibits [6].

We wish to use the information of the visitor's social context in order to provide and support meaningful social interaction. For example, if we detect that visitors are walking together at the museum, but there is not much interaction between them, the mobile guide can proactively suggest joint activities. Or for example, if we detect that visitors have drifted apart, and are no longer in proximity for a long time, we can suggest

meeting places where visitors can rejoin and reflect on their experiences.

Another direction that we are currently exploring is supporting small groups at the museum using situated displays located at various locations at the museum (for example, near major exhibits). We have developed an initial prototype for a system that uses proxemics to conduct interaction with a large situated display, currently only supporting a single user (Figure 2). Interaction of the user with the display is done using both the mobile device, and touch when the user is close to the display. When a user approaches a display, the system automatically recognizes the user and presents a personalized message on both the large screen and the handheld device (state 2 in Figure 2). After the user initiates interaction on the handheld, the content to choose from is presented on the large display (state 3). The user then chooses the content on the handheld, and the content is seen on the large display (state 4). The user can then pause, stop or go to the next presentation using the handheld device.

There are several challenges we face when converting this prototype to support multiple visitors. First, *attention of visitors should be drawn to the large display*. How to interrupt museum visitors in order to present information with minimum disruption is an issue we looked at for the individual visitor [3], but not for a small collocated group. Enticement of visitors would be done by showing different information according to proximity of visitors to the display. The proximity-related information would be used to entice far away users and to interact with close by users. In order to provide seamless use and transition between personal and large displays, interaction techniques that shift attention of the visitors from their personal devices to the situated display will be designed and used.

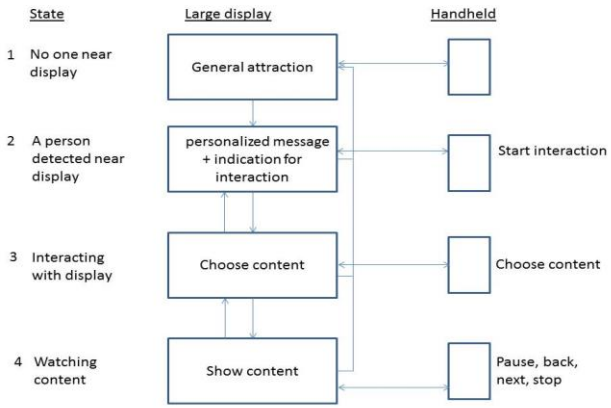

Figure 2 – state machine for users choosing content to view on the large display using a handheld

Second, *group decision making processes should be considered*. Assuming we have multiple multimedia presentations that could be collaboratively viewed, how do we decide which one to show? With a personal museum guide, the visitor simply chooses the presentation topic that seems most interesting. In a group scenario, we have multiple people with multiple interests and opinions. Various policies can help the group determine what content to view. For example, we can allow group members to vote on their handhelds for the presentation(s) that will be seen on the shared screen. Another possibility is to rely on social interaction between group members to dictate what is seen without electronic mediation. Third, *the*

display should support both a single person and a small group of people approaching the display. Furthermore, the display should enable easy transitioning between a single person using the display and a group of people watching. For example, a single person might prefer to watch information on the large display, simply because of the better resolution that this display affords. However, if other members of the group approach the display during a presentation, we wish to get them involved. This will be done by providing mechanisms of interruptions and change when the system detects that people arrive or leave the vicinity of the display. Forth, *the system should support both users using the mobile guide (using the personal handheld device) and users that are just passing by (using touch)*. The system should also support users who do not use the mobile guide, but approach the screen. This should be supported by touch (or gesture interaction).

Finally, a third direction that we plan to explored will look at synchronizing the views of group members. In the Sotte Voce project [8], eavesdropping from one mobile device to another was enabled as a way to share audio information by hearing each other's activities and thus synchronizing between the audio content of the two devices. This idea can be extended by exploring various synchronization methods for viewing presentations together. From our experiences in deploying the PIL guide at the museum, many visitors, arriving together asked to receive a single device (rather than individual devices) as a way to have a shared experience. Providing various mechanisms for synchronizing the views of multiple devices, each held by a member of the group can enable better group support and ultimately, a better group experience. Proxemics in a key factor in deciding how to enable these synchronization mechanisms.

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