I like it – An Affective Interface for a Multimodal Museum Guide

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ABSTRACT
The optimal multimedia tourist guide should support strong personalization of all the information provided in a museum in an effort to ensure that each visitor be allowed to accommodate and interpret the visit according to his own pace and interests. We claim that an interaction based on expressing affective attitude may improve usability of an interface in particular when, like in museums, the technology should not hinder the "real" experience. In this paper, we discuss an affective interface based on the explicit signal of interest to guide the amount of details presented about the museum exhibits.

We discuss an initial design, two user studies and a second design that is better understood by the user.

Keywords
Affective interfaces, adaptivity, control delegation, multimedia, museum guide, user studies.

INTRODUCTION
Museums and cultural heritage institutions recreate an environment conducive to exploring not only the exhibited objects and works of art, but also new ideas and experiences. A museum visit is a personal experience encompassing both cognitive aspects, such as the elaboration of background and new knowledge, and emotional aspects that may include the satisfaction of interests or the fascination with the exhibit itself. Despite the inherently stimulating environment they create, cultural heritage institutions often fall short of successfully supporting conceptual learning, inquiry-skill-building, analytic experiences or follow-up activities at home or at school [7].

The value of multimedia for a museum mobile guide is discussed in [4] where they present an extended user study conducted at Modern Tate in 2002. Yet the optimal multimedia tourist guide should support strong personalization of all the information provided in a museum in an effort to ensure that each visitor be allowed to accommodate and interpret the visit according to his own pace and interests. Simultaneously, a museum guide should also provide the appropriate amount of impetus to foster learning and self-development so as to create a richer and more meaningful experience.

In the context of the PEACH project, we are building and evaluating a number of prototypes aiming at providing the visitor with a personalized experience. The evaluation of a previous multimedia guide [1], showed that many subjects would have liked to access follow-up information during the presentation. At the same time, this option should not cause awkward interruptions to the flow of the presentation.

In [5], we discussed a prototype that exploits automatically tailored video presentations for a frescoed room in the Castle of Buonconsiglio in Trento. In an attempt to provide an easy-to-use interface on the small estate of a PDA, we designed the interaction around the idea of a "wow" button, which allows the visitors to signal their interests in the topic being presented. This knowledge is then used by the system to provide more information on that topic. The appropriateness of the delegation model, at least for some categories of visitors, was confirmed by an attitudinal study discussed in [2].

Yet, the first evaluation against a standard-menu based interface failed to show any relevant benefit of our concept design. Think-aloud-based investigations made it clear that this was so because the visitors were misled by the interface, which did not properly conveyed the intended metaphor. We therefore engaged in a full redesign of the interface replacing the "wow" button with a new widget, the "like-o-meter". It allows visitors both to a) express their degree of satisfaction with respect to the current presentation by pressing a smiley or a sad face, and b) monitor the user model, in particular the system's hypotheses about the user's interest on the current topic, by showing the estimated degree of interest. Preliminary user

studies conducted on a partially implemented mockup showed that the design is clearer than before, and that the underlying conceptual model is correctly managed by the visitors.

We believe that an interaction based on expressing affective attitude, namely letting the user express their satisfaction through the interface, may improve usability in particular when, like in museums, the technology should not hinder the "real" experience.

The Requirements for an Affective Interface with Delegation of Control

We stipulate the following major requirements for our affective interface based on a delegation of control interaction paradigm.

1. The system should enable the visitor to easily express her feelings towards what the system is presenting, without interfering with the presentation itself, or disrupting the overall experience.
2. The system should be proactive and autonomous. It should not rely on inputs from the user in order to work properly. The role of the user should be limited to express her feelings, in case she wants to do so.
3. The system should transmit the underlying conceptual model (i.e. delegation of control together with the expression of interest) in an intuitive manner, leaving the user free to focus on the presentation and the exhibits.
4. In order to allow a fluent visit, the system's processes aimed at assessing interest, and generating the adaptive video presentations should be transparent to the user.

Expressing users feelings - Peach first user interface

The PEACH User Interface implemented just two buttons: *WOW*, on the upper right side of the PDA screen, and *BASTA!* (enough!) on the lower left side of the screen.

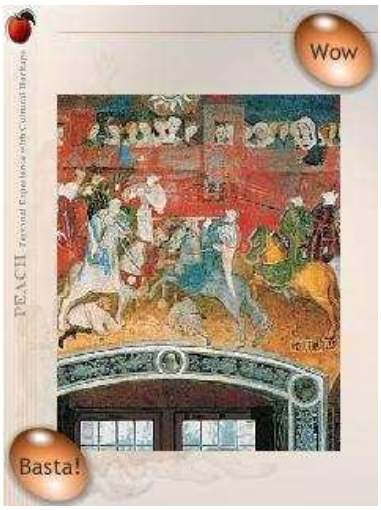

Fig. 1, The first design of the "I-like-it" interface

The *WOW* button should reflect the affect of the user whenever she is impressed by a fresco or by a specific topic related to it. The *BASTA!* button is to be used whenever the use is not interest by current topic. As a side effect, this button stops the current presentation. It is worth noting that, a presentation can be stopped also by moving away from the current fresco to approach another one. The central part of the screen was used to show the video presentation (See Fig 1.)

Peach Architecture

The underlying architecture that supported the first PEACH user interface comprised the following components (see Fig. 2):

- A **repository of templates**, encoding rules for the composition of multimedia presentations;
- an **adaptive video composer** that can query the **user model** (UM) component, to get user interests [6];
- a **UI manager** that handles messages from and to the mobile devices. For example, it updates the **UM** about the user's location and the buttons pressed;
- a tree-based **topic taxonomy**, which represents the contents of the pictures at three levels of abstraction (from the specific content to abstract concepts such as "aristocratic leisure activities");
- a **User Model** component. It receives the notification from the **UI** about the buttons pressed by the user, the themes and details of presentations delivered to her as well as her current position. Based on this information, the UM computes the current interest level on each topic, and propagates it to more abstract levels according to the topics' taxonomy.

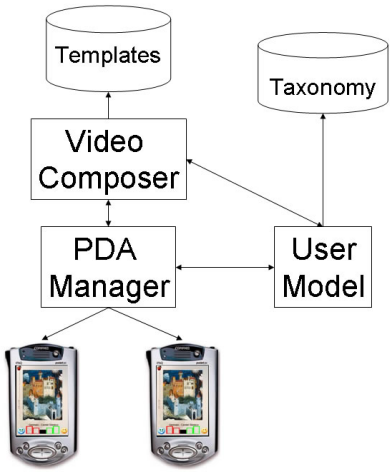

Fig 2. High level design architecture of PEACH I.

First user study

The first user study included a pilot on 8 users in the museum premises using the implemented visitor guide. Users were given a short introduction about the guide followed by a real visit of four of the available frescos. The experimenter observed the users during the visit. At the end of the visit the user was interviewed, in order to assess her impressions along four adaptive dimensions: (a) Location awareness (henceforth *location*) – the system autonomously starts presenting material on a given fresco whenever the user is in front of it. The user's position is captured through sensors located at the sides of each fresco. (b) Follow-ups (henceforth *FU*): Based on the number of times the WOW button was pressed and on the current topic, the system prepares the next presentation, stopping it if the BASTA button was pressed. (c) Content adaptation with respect to user interests (*interest*) based on the current state of the user interests model. (d) Content adaptation with respect to the history of the interaction, extending to all the frescos visited that far. (*history*).

The results of this evaluation cycle showed that the users did not understand the two-button interface. In general, they seemed to perceived the WOW button as the key element of the whole interface, often using it to start the interaction (not needed at all) and requesting for another.

To study users' perception more in depth, we resort to an action-protocol and retrospective-interview qualitative study; in particular, we targeted the expression of the affect and the delegation of control paradigm implemented through the WOW button. This technique is similar to think-aloud; the main difference is that the user's does not provide her comments during the execution of the task, but later on, while she and the experimenter are watching a video recording of her interaction [8].

The study was conducted on three users, in a room equipped with posters of the originals frescos, and with sensors to detect the positions of the subject with respect to the frescos. The room was also equipped with two cameras to record both users' behavior and speech during the visit. The subjects performed the visit by using the guide; the study was limited to four frescos (instead of the original eleven ones). At the end of the visit, each subject was interviewed by the experimenter while both were watching the video of the visit. The interview focused on the subject's understanding of the WOW button. We also recorded the interview, this way providing additional important material for the research and design teams to discuss during the post-study phase. The results of this study can be summarized as follows.

1. The time necessary to load the relevant information at the beginning of each presentation might take few seconds. The subject gets disoriented because she doesn't know what to expect, doesn't understand what (if anything) she should do. Since the WOW button is the only visible thing the subject could act upon, she presses it, probably to get information. Clearly, the instructions she received did not prepare her well to face that situation.
2. At the end of the presentation for a given fresco, the system delegated the continuation of the visit to the user. This discontinuity in the conceptual model confuses the user who, again, resorts to the WOW to get some instructions, receiving, as a response, another presentation because the interest model was reinforced.
3. When all the content about a fresco was presented (including extended presentations retrieved on the basis of the user model) the system expects the user to move on. However the user doesn't know the system status therefore s/he still awaits something to occur. Again, the only available button is the WOW.
4. The BASTA! button is interpreted as a 'stop'. The intended meaning of "I don't like this" is not understood. This is also an incoherent behavior: given the conceptual model, the system should not allow the user to take any action, but simply to express her feelings.

In other words, the WOW button is often used as a 'last resort' resource, to communicate with the system in case of problems. This shows that the intended conceptual model is not clear to the subject, and that the system itself has too often an incoherent/unexpected behavior. In particular, the presentation should not abruptly stop but invite the user to move to another fresco; it should give feedback about the system status, and inform the user about its estimation of her interests; it should skip uninteresting presentations, and focus on more interesting ones, or suggest to move to more interesting frescos. Finally, we maintain that if the visitor does not express any feeling (i.e., if she never presses any button), she should receive a fair amount of information about the museum's exhibits.

Expressing users feelings – Redesigning PEACH affective user interface

Based on the results of the pilot study we defined the following requirements for the new guide:

1. The PEACH affective user interface should clearly and intuitively enable the user to express her feelings towards the exhibits during the museum visit.
2. The interface should be coherent and consistent; reflecting for all four adaptivity dimensions the delegation of control interaction paradigm.
3. The interface should be proactive, in order to avoid user disorientation.
4. The user interface should give visual feedback to the user relating its understanding of the user's interest and its own current status (preparing presentations for display for example), without disturbing the user's attention.

5. The information provided by the system must to be structured differently. Each presentation should contain an *abstract* that briefly summarizes the information to be provided in the *main part*.

Figure 3 displays the new PEACH affective interface.

Location Dimension: User Action: A user stops in front of a fresco. Interface Effect: The user is shown an introductory presentation to the fresco. As long as she remains at the same location, the system plays all the presentations for all the details of the same exhibit. Figure 4 presents the template diagram.

Follow up Dimension: The WOW button is changed into a slider appearing at the bottom of the PDA screen (see Fig. 3). During the presentation, the visitor can express on a scale her degree of interest: "I like it", by moving the slider towards the smiley face (two degrees of liking), or "I don't like it", by moving the slider to the sad face on the left (two degrees of disliking). Those are the only User Actions. We call this widget the "like-o-meter". When the user sets his/her liking about a presentation, the system updates the user model and the liking is propagated along the templates' network.

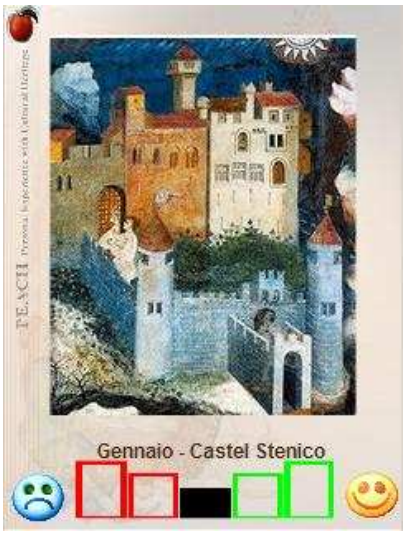

Figure 3 – The new design of the PEACH "I-like-it" interface

If the user signals some degree of "liking", the system activates the main part of the presentation, this way providing more information about the current topic. The overall goal here is to give the visitor a clear indication that her actions do have an effect on the presentation, while avoiding that she could interpret her own actions as a request for more information.

Conversely, the expression of disliking prevents deeper explanations and even stops the presentation in case the visitor expresses the greatest dislike.

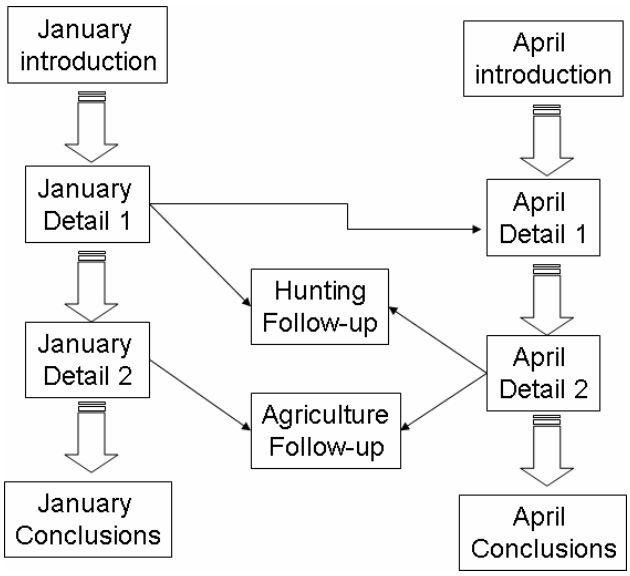

Fig. 4 – Templates' Network (simplified).

Interest Dimension: Interest is computed in terms of explicit or inferred liking of the content of a template. The interest on a template is set when the user adjusts the *like-o-meter*, during the actual presentation of the information contained in the template. Then, a propagation model on the templates' network allows the system to infer the interest on closer templates.

The system also informs the user about its own assessment of her interest on the current presentation, by pre-setting the *like-o-meter*. Thus, this widget is at the same time an input device and an output device that the system exploits to inform the visitor about the user model. This satisfies the necessity for the users to control the User Model, as pointed out in [3].

History Dimension: The system performs another type of content adaptation with respect to the history of the interaction. The UI component keeps track of the users visit, enabling the comparison of the current presentation with the previously seen ones. Users are free to perform a flexible visit according to their preferences, patience, reception capability and time. Their actions are recorded in the UM. If the user goes back to an already seen fresco, the UI component presents the same topics of interest in a different manner, e.g., by establishing comparisons with other seen frescos.

Peach New Architecture

In order to support the new interface few architectural changes were needed.

1. We added a general structure to each template, based on the *abstract*/*main part* distinction. We believe that this new generic structure facilitates the process of authoring the templates and that it is generic enough to

accommodate the requirement of any museum exhibition not just for the specific exhibition at Torre Aquila.

2. We divided templates into different types: introduction, presentations of details, conclusions (which are played when the system does not have any more information about a particular exhibit, the role of these templates is to suggest the visitor to move to another exhibit) and follow-ups (which provide insight on general topics; they are not linked to a particular exhibit, rather they provide connections among different exhibits). In this way, the whole information presented about each single exhibit might be well structured other than adaptive.
3. We dropped the topic taxonomy, and we relied on the template network to propagate the interest (see Figure 4). Each template can be linked to others. For example, two templates describing the same activity (e.g. hunting) in different frescoes are connected.
4. The algorithm for the selection of the details' templates is based on the interest as computed from the user's interaction with the device. The algorithm organizes a sequence of presentations as a stack; the topics in which the user is more interested are presented first, and the main information is automatically included. The topics with a lower level of interest are present at the end and minimal information is selected. The introduction is instantiated when the fresco is visited the first time.
5. The title of the presentation is displayed close to the *like-o-meter*, in order to remind the idea that the user is expressing his/her liking about the presentation itself (of course, we understand than in other setting, like for example in a modern art exhibition the visitor can reasonably express her liking about the exhibit itself; for the future we will consider various ways of providing information and receiving feedback along both dimensions).

To have an early evaluation of the new concepts and architecture, we realized a partial mockup using Macromedia Flash. The mockup employs a hand-coded template network and a hand-coded propagation mechanism for one specific exhibit only.

Preliminary evaluation – Second user Study

In this second study, we focused on how well the users are able to recognize and use the *like-o-meter* widget. In particular, we investigated whether the like-o-meter communicates properly its meaning:

- Do the users recognize it as a scale with two negative and two positive values plus a neutral position?
- Do they understand that the position of the place card on the bar signals to the system their level of liking or disliking of the current presentation?
- Do they understand that their expression of liking/dislking relates to the current presentation and not the whole exhibit or to a specific utterance?
- Do they notice the user model feedback on the like-o-meter bar, recognizing this feedback as a consequence of their previous expressions of liking/dislking?
- Do they recognize that when the system provides more information this is so because of their expression of interest?

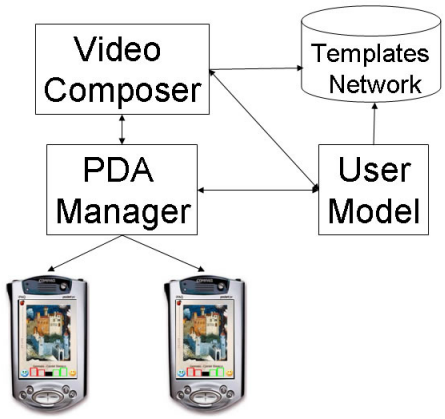

Fig. 5 – The new PEACH architecture

The user study consisted again in an action protocol with retrospection. It was conducted on two users in the same room with the panels reproducing the original fresco exploited in the pervious user study. First, the experimenter presented an introduction of the museum setting and showed a copy of the fresco used in the experiment. Then, she quickly demonstrated the functioning of the system.

The assigned task was to signal interest during the presentation and a slight dislike during the description of the first detail. They had to be enthusiastic about the description of the second detail, and to stop the presentation during the description of the third detail. This talk allowed checking the proper understanding of the 'like-o-meter' while assuring that the interaction could be handled by our partial mockup.

The results of this user study were quite encouraging, showing a high degree of understanding and satisfaction by the users. The generalization of the findings to long-term effect of the expression of liking cannot be reliably done at present, given the limited possibility of interaction our mockup allowed.

From the responses and comments of the participants the following considerations emerged:

- The participants were able to communicate their interest to the system using correctly the *like-o-meter*.

- The participants recognized that the positions +1 and +2 caused more information to be provided.
- The relationships between the standard (abstract) and the in-depth presentations (content and follow-up) were clear to the subjects. Given the limitations of this small study, we cannot reliably conclude that the delegation metaphor was properly understood by the subjects, though this seems highly likely given the available evidence. In particular, we cannot reliably conclude that they fully realized that their expression of interest on a given current exhibit also affected the presentations to come.
- The understanding of the meaning of the moderate disliking (i.e. position -1) is somewhat poorer than that of the liking. Apparently, the users come to expect that the expression of a moderate disliking should cause the system to provide less information. Indeed, in our current system, the expression of a moderate dislike only changes the user model and does not affect the current presentation.
- The users did not expect that the neutral position of the *like-o-meter* could be selected, and expected that a single button press would have moved the slider from -1 to 1. Actually, we realized that the neutral position may have two distinct meanings: according to the first, it communicates a degree of liking which is neither positive nor negative, while according to the second meaning to the neutral position corresponds to a lack of information about the user interest. Both of our users seemed to exploit the second meaning, expecting that only the system would be allowed to use the neutral position.
- One participant clearly noticed the feedback of the user model and understood that it was related to her previous behavior. Both participants understood this feedback like a system initiative.

Summing up, the participants were able to properly carry out the task with a reasonable understanding the conceptual model of the system. They both agreed that the interface is easy to use and that their expectations about the interest model were fulfilled. The real understanding of the long-term effects of expression of liking did not emerged clearly due to the limitation of the mockup used. The neutral and the -1 position may cause usability problems and they deserve some more investigations.

Discussion and Further Work

In this paper, we reported about the design of a mobile multimedia guide by which the user can express his/her liking/disliking about the information provided in order to guide the system. We discussed the problems encountered with the first design, the process of re-design and a partial evaluation of the new design.

According to the tenets of User-Centered Design, we will continue the process of re-design and evaluation using mockups and prototypes at different levels of implementation.

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