Designing an Agent to Support Interactive Access to Museum Information

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Abstract

If we consider most applications accessible through the Web, we can notice a lack of support able to adapt to the different information needs that different users may have regarding a certain topic. Adaptive support, by which an application provides different information taking into account the users' interactions, can provide useful assistance. However, completely automatic adaptive support can still be confusing for users who may not understand the reasons for the dynamic change in behaviour of the application. Thus, users may benefit from the introduction of agents aiming at providing interactive support to access information of interest. In this paper, we present an approach that provides an agent (a virtual assistant) able to implement adaptive behaviour in such a way as to support a Web visit to museum information.

Keywords: Agents for Human-Computer Interaction. Virtual guides. Applications for Interactive Museum Systems.

1. Introduction

In the human-computer interaction field the advent of graphical user interfaces was based on the use of a wide variety of interaction objects provided by user interface toolkits. The use of instances of such interaction objects (often called widgets) has allowed many developers to obtain direct manipulation user interfaces where users can interactively select and modify the objects of interest on the screen. This has allowed designers to improve the usability of many applications. However, many users have still problems to interact with software applications. For example, the advent of the World Wide Web (WWW) has introduced a new and powerful communication tool that allows people to easily access information related to any type of event, activity or interest. But, it was soon recognised that different people can be interested in receiving different information concerning the same topic because they have different goals and different background knowledge. This raised the issue of furnishing different information with different presentation and interaction styles at the user interface level. One goal is to reduce the complexity of accessing huge amounts of data by providing only that information most related to the user's goal, and then allowing selection of that which is deemed most pertinent with the support of some agents [4].

This has stimulated interest in agents for user interfaces able to adapt to external factors (the user, the tasks to support, the available devices, and the context of use). Adaptation has been used in a number of application areas, for example learning systems, on line help systems, multimedia information retrieval systems, and personalised views. Adaptation is traditionally classified into adaptivity or adaptability. In the former case the application is able to automatically modify its behaviour depending on the user interactions (often this is done with the support of some user model). Whereas in the latter case the application changes its behaviour according to a small set of predefined options.

Adaptable interfaces are easier to implement for developers and to understand for end users whereas adaptive interfaces are more flexible because can react in a wider set of modalities depending on the user interactions. This gives them the possibility of supporting the needs of users in a more tailored way. However, there are two main risks. Wrong deductions can be inferred so that the tailored reaction does not match the user interest or the user does not understand the reasons of the change of behaviour and has a sense of disorientation and frustration. Thus, currently a strong interest has risen in how to provide agent-based support that is still under full control of the user. In [2] there is a proposal to use multiple anthropomorphous agents that know the users' preferences and interactively point at the content the user will be interested in.

An application area where agent-based techniques can be particularly suitable is the museum field. The growth of the Web has changed the way in which people access information and spend their free time. Curators of museums have realised the need for supporting the requests of these new users as well as traditional visitors.
Museum web sites can benefit from the introduction of adaptivity because they address a wide set of types of users. One of their goals is to improve learning of related concepts and they usually have a large mass of information with consequent risk of disorientation for end users. However, most current user interfaces of museum applications are not adaptive at all and they provide the same support for every type of user and every user interaction.

A few research prototypes have been developed to use agent support in museum applications. An example is in [3], a work that addresses the problem of how to find information interesting for the user. It allows users to express interest on a set of topics. Then, using a predefined network that associates the topic according to their semantic closeness, a mediating agent identifies further information that can be interesting for users, although at the beginning they are not explicitly aware of it.

2. The Design Criteria

Adaptive techniques are flexible and able to overcome some limitations of previous approaches, especially when they are supported by agents oriented to provide interactive support. However, a completely automatic adaptive support can be rather confusing for end users that may find a system changing dynamically its behaviour without understanding the reasons for such changes. Thus, when designing adaptive support through an agent it is important to allow users to clearly understand:

- When the agent can be activated;
- How the agent provides information;
- Which criteria drive the generation of information provided by the agent.

In this work, we aim to design a virtual assistant considering museum systems as application domain. The main goal is that the adaptivity of the resulting environment should be easily understood by users and it should enrich and facilitate the navigation in the available information. Thus, users must have full control on when activating adaptive navigation. Then, users should be supported, during their visit, by an agent using a number of techniques. More precisely, we want that the information delivered can be adaptive according several logical dimensions [8]:

- *introduction information*, whenever a new topic or aspect is accessed the agent should provide introduction information on that topic;
- *summary information*, the agent should be able to provide some summary information concerning the items that have been accessed in the current session;
- *comparison information*, where the purpose is to compare the current information with that previously accessed for some common aspect;
- *difference information*, in this case the purpose is to describe an attribute that was not present in the previous information;
- *curiosity information*, indicating related information that can raise the interest of the user.

Thus, we aim to obtain a richer set of logical dimensions to discuss and present information than that considered in previous works such as [5] that mainly focus on an articulated set of comparisons (illustrative, clarificatory and direct).

3. The Application

We are developing the introduction of an agent-based support in a virtual museum we developed beforehand. The application that we have considered is an adaptable system [7] that was designed following a model-based approach [6]. This application supports three user models (tourist, student, expert). At the beginning of the session, the user has to select one of them. According to the user model selected, the application provides different support mainly in three aspects: access to the information available, presentation of the information selected, modality of navigation.
To give full control to users on the adaptive support, when the choice of the user model appears we give the user the possibility of selecting how the agent-based support should be activated. Users can choose among three options: activation of the virtual guide, keeping disabled the virtual guide, possibility to activate the virtual guide during the navigation. If the last option is selected, when a work of art is presented there is also an additional button that allows the user to activate the virtual guide at any time.

When the agent is activated, beside the presentation of a work of art, there is a part of the main window dedicated to the comments of the virtual guide (Figure 1). The additional information provided through the virtual guide aims to make the users' visit more interesting and pleasant.
Another goal is to provide additional dynamic information that help users link the standard information associated with each work of art, in a manner similar to when a

visitor is accompanied by a real museum guide. Thus, at any time we have both standard information that is provided in any case associated with the work of art selected, and the agent-based support that provides additional information taking into account the user model and the interactions performed.

Figure 1: The space dedicated to the adaptive support.

The virtual guide provides the types of information introduced before with a content tailored for the application considered:

- *Summary information*. After having visited a number of works of art, it can be useful to provide the user with a summary of the most important aspects that have been considered. For example, if the user visits several works of the same historical period this can be interpreted as a strong interest for works belonging to that period. Then, a summary of the most important aspects of that historical period can be provided.
- *Comparison Information*. They allow users to relate works of art or compare them, for example comparing dimensions, chronology.
- *Difference information*. In this case, the purpose is to highlight the difference between a work those previously accessed. This information is useful for the user to better learn and remember the descriptions of the works of art.
- *Additional curiosity information*. They are additional peculiar information that can increase the involvement of the visitor highlighting the features of the work that can raise the user's interest.

For each of this type of information, it is important to clearly identify when triggering the agent; how it can retrieve the necessary information; and how such information should be presented.

3.1. Summary information

The purpose of this information is to highlight the most important aspects common to the works of arts visited. The summary should help a further assimilation of notions already exposed to the user.
The analysis depends on the current user model. Thus, for the tourist the summary will be related to the museum rooms visited whereas in the case of expert and student users will be related to the historic period considered.

More specifically, in the case of the tourist the analysis first checks for each museum room which and how many

works of arts have been visited (Figure 2), and in which order. Thus, the movements in the museum are analysed trying to identify the user's interests. The basic assumption is that a tourist user of the virtual museum wants to gather information useful for a future visit and, in any case, he wants to memorise the museum in terms of rooms and works contained in them. Whereas, in case of a student or expert user, the aim is to enrich a personal research, thus the summary in terms of historical periods help him to relate works of arts to their historical period.

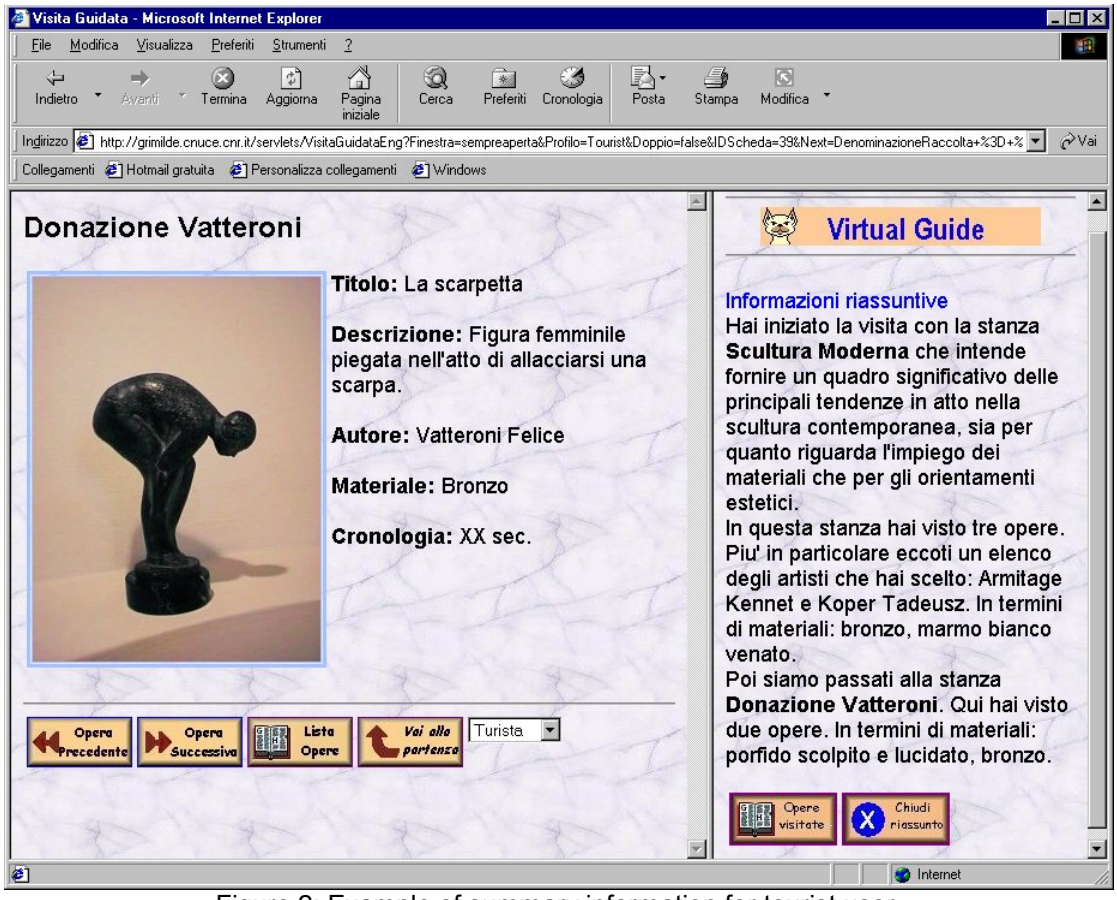

Figure 2: Example of summary information for tourist user.

3.2. Comparison and Difference Information

The purpose of the virtual assistant agent is to stimulate the user to spend more time on the application receiving more effectively information and thus improving the learning. To this end, when the adaptive comment is generated it is important to take into account what the user has already seen and the current user model.
There are different ways to connect a work to those previously seen. Comparison is a good tool for supporting learning and can be easily memorised by the user. Whenever a new work is accessed, we want to highlight differences and similarities with the previous one. More specifically, for every current user model we want to consider change of artist, historical period, and material used. Additional changes, more specific to the user model will be considered in the sequel.

For instance, when the user accesses the work of a new artist, the system should be able to provide the description of the main features taking into account the current user model and the works previously accessed.

In the case of the tourist user model the information generated should be useful also to organise a future real visit. Thus, it should ease users in remembering a new element in terms of location so that the user can create a mental model indicating where it is possible to find works of a specific artist, material, or historical period. Thus, the introduction of a new artist highlights how many works of that artist are contained in the museum and where they are located, specifying whether in a single or multiple rooms and the name of such rooms. Historical periods and materials are handled in the same manner. Another

element considered when the tourist user model is active, is access to a new museum room. In this case, the system generates an introduction to the main features of the artworks considered in the room.

When the student user model is active, the system generates introductions mainly in terms of definitions, thus helping users to create the association work-definition. Whenever a student accesses a new definition the system provides general concepts, describing materials used to process that definition, the artists that worked for that definition and the historical periods when it is possible to find them.

Figure 3: Example of adaptive clarification information.

In the case of an expert user model the introduction of a new artist has to take into account that the user is interested in a detailed search among the information contained in the museum. In this case, the user should have already a good background so it is useless to introduce additional information that can distract or confuse the user. Thus, it is preferable to avoid providing additional comments and, rather, giving additional information concerning chronological motivations, observations, critiques, and historical notions.
After having introduced a new subject with general information, the system links the new work of art with the previous works taking into account both the user model and the works previously accessed.

When there is a change of artist, before comparing two artists, the system controls what are the topics that the user is familiar with considering the works previously accessed and the current user model. Based on this analysis, the system decides whether to apply the comparison, if there is an item with which to compare the two artists, which parameters to use for the comparison. If the comparison between the two artists has already occurred in the session then it is not repeated. Regarding the aspects to consider in the comparison, the system has to consider the main features of the artist (techniques used, preferred material, …) derived from the information contained in the application so as to be able to compare them. The access to a new artist can occur along with the access to a new material, historical period, or definition. Thus, the additional comments have to consider all the changes occurred.

The agent retrieves information inquiring the knowledge base at each user access to a work of art. Thus, for example, if the only new aspect is the material then the system has to compare the two materials. Thus, the knowledge base is inquired to obtain all the works

elaborated by the previous material and all the works obtained by the current material to compare the related information.

All the information concerning the introduction of a new subject or comparisons between items (highlighting similitude and differences) are presented in the space reserved for the agent. Thus, all the descriptions of a work will be accompanied by additional comparison comments and links to previous works.

3.3. Curiosity Information

The purpose of the curiosity information is to increase the interest and the attention of the user. This type of information is generated whenever a work that is unique under some aspect is accessed. For example, if the current work of art was made with a material that has not been used for any other work included in the application then the system highlights this feature. The uniqueness can concern the material, the artist (the unique work done by a certain artist), the historical period, in case of all the user models. In addition, only for the student model, the system considers other aspects, such as definition.

Even this type of information is generated when there is a change of work accessed and, as its purpose is to raise interest from the user, it is introduced at the beginning of the additional information.

4. Conclusions

We have described a system supporting an integration of an agent with adaptive behaviour in a previously adaptable application. This allows us to obtain a flexible environment with an agent able to adapt its behaviour and the information provided to different types of users depending on their interests and goals.

The system has been implemented with servlets which are java program running on the server side and generating html files that are presented on the user side. The advantage of this solution is that the user browser has to process simple information thus requiring little time to be interpreted and visualised.

The agent-based support has been designed to be under full control of the user that can determine when to enable or disable it. Such support follows a set of clearly understandable criteria and the information provided makes the users' visits more pleasant, increases their involvement, and better matches their interests. The example provided is specific to the museum field but the approach can be applied to other application areas that share similar features as well.

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