Be Your Own Curator with the CHIP Tour Wizard

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Abstract

Web 2.0 enables increased access to the museum digital collection. More and more, users will spend time preparing their visits to the museums and reflecting on them after the visits. In this context, the CHIP (Cultural Heritage Information Personalization) project offers tools to the users to be their own curator, e.g. planning a personalized museum tour, discovering interesting artworks they want to see in a 'virtual' or a 'real' tour and quickly finding their ways in the museum. In this paper we present the new additions to the CHIP tools, which target the above functionality - a Web-based Tour Preparation Wizard and an export of a personalized tour to an interactive Mobile Guide used in the physical museum space. In addition, the user interactions during a real museum visit are stored and synchronized with the user model, which is maintained at the museum Web site.

Keywords: Personalized museum tour, mobile, interactive, PDA, user modeling, Semantic Web.

1. Introduction

In recent years, the purpose of museum Web sites has shifted from merely providing static museum information to providing personalization services to various users worldwide, with different personal characteristics, goals, tasks and behaviors. Personalization enables changing the museum mass communication paradigm into a user-centered interactive information exchange, where the "museum monologue turns into a dialogue", and personalization is "a new communication strategy based on a continuous process of collaboration, learning and adaptation between the museum and its visitors (Bowen, 2004). In this context, the goal of the CHIP research team is to demonstrate (i) how novel Semantic Web technologies can be deployed to enrich the museum vocabularies and metadata and providing semantic browsing, searching and semantic recommendations; and (ii) how personalization and user modeling techniques can be explored to enhance users' experiences both on the museum Web site and in the physical museum space.

As a first step, we illustrated our approach with the Rijksmuseum ARIA (Amsterdam Rijksmuseum Interactief) database by mapping it to the external art-related vocabularies of Getty ULAN, AAT and TGN vocabularies and IconClass (Aroyo, 2007). The use of common vocabularies provides the new repository with a relational and hierarchical structure. Based on the semantic data model, we designed the first component of our demonstrator, Artwork Recommender. It is realized in the form of an interactive dialogue quiz that helps the user to find what interests her in the Rijksmuseum collection for her to rate. Based on her ratings, the Artwork Recommender generates content-based recommendations for both artworks and abstract topics about the artworks. To store the user's ratings, we built an interactive user model. It is an overlay of the semantic data model (Wang, 2007) and extended by importing the user's FOAF RDF profile, which includes additional information (e.g. name, interest, knows people).

In this paper, we report on the implementation of two new components a Web-based *Tour Wizard* and a PDA-based *Mobile Tour* both aiming at providing personalized museum tours as a way to enhance user's museum experience between the Web and the real museum space in a more intensive, long-lasting and engaging way.

The Tour Wizard automatically generates personalization museum tour(s) on the Web. The recommended tour contains recommended artworks according to the user's art preference, which is initialized in the Artwork Recommender and stored in her user model. The user could also edit the tour and add interesting artworks by using the semantic search in the Tour Wizard or getting recommendations from the Artwork Recommender. Each tour can be visualized on the Rijksmuseum map or on the historical timeline.

The Mobile Tour is offered on a PDA and it converts virtual tours created with the help of the Tour Wizard to actual tours in the physical museum space. In this transformation a number of constraints can be setup, e.g. filter unavailable artworks, order artworks, set number of artworks and time duration. Moreover, it synchronizes/updates the user model on the Web server and on the PDA.

The paper is organized as follows: first, we present an overview of the current museums tours mostly in the Netherlands and discuss the requirements we derived for building museum tours. Secondly, we explain the rationale of the museum tours and describe the overall architecture. Next, we discuss each of the three different CHIP components the Artwork Recommender, the Tour Wizard and the Mobile Tour. Following, we describe in detail how a virtual tour is mapped to the physical museum space and how to synchronize the user profile between the Web and the PDA. Finally, we present conclusion and future work.

2. Overview of the Museum Tours and the Requirements

In the exploration phrase, we participated in a number of museum tours, mostly in the Netherlands: (i) the multimedia tours in the Van Gogh Museum, Frans Hals Museum, Kröller-Müller Museum and Boijmans van Beuningen Museum; (ii) the audio and human guided tours in the Rijksmuseum Amsterdam; and (iii) the on-line museum tours outside the Netherlands, e.g. the 'Explore Tate Britain' from the Web site of the Tate Britain and the 'Virtual Reality Tour' from the Web site of the Metropolitan Museum of Art. Below we give an overview of some of the museum tours, see Table 1.

Museum & Tour Type	**Tour Description**
Van Gogh Museum Amsterdam *(Multimedia tour)*	The visitor walks through the museum following a timeline which leads the user through Van Gogh's life. Artwork information can be seen on a PDA by selecting an artwork from a list.
Netherlands Architecture Institute Rotterdam *(Multimedia tour)*	The visitor walks through the exhibition. Some artworks have sensors which can be scanned using a PDA. If a sensor is scanned, the corresponding artwork information is presented to the visitor.
Frans Hals museum *(Multimedia tour)*	The visitor walks through the museum, visiting the rooms with the artworks in a non deterministic order. On a PDA, the user must manually select the room from a list of rooms and then select an artwork to receive information about the artwork.
Rijksmuseum Amsterdam *(Audio tour)*	The visitor can determine his or her own path through the museum. Most artworks are labeled with a number, which are coupled to an audio track on the visitor's audio device. On the audio device, the visitor enters the number on the labels next to the artworks to receive audio information about the artworks.
Rijksmuseum Amsterdam *(Human-guided tour)*	The visitor follows a human guide, which selects the artworks that are shown to the visitor. When arriving at any of these artworks, the guide gives information about artworks to the visitor using speech, gestures or extra material.
Tate Britain *(On-line virtual tour)*	The visitor sees a virtual representation of the museum on a map. Rooms can be selected and each room contains a set of artworks from which the user can receive information.
Metropolitan Museum of Art *(On-line virtual tour)*	The visitor can select six different virtual reality rooms and then navigate the virtual rooms and the objects inside the rooms.

Table 1. Overview of explored museums tours

Besides the tours mentioned above, there are numerous additional examples of museum applications that explore adaptive multimedia museum tours in mobile devices. For example, the wearable computer, developed at MIT Media Lab delivers audiovisual narration adapting to the user's interest from her physical path in the museum and length of stops (Sparacino, 2002). In the PEACH project a museum guide application was developed to provide to the individual visitors an educational environment adaptive their art interests and needs (Rocchi, 2004). Finally, as a result of this exploration, a set of criteria and requirement were outlined for building personalized museum tours within the CHIP demonstrators. Multiple languages, support of multiple platforms and limited use of the hardware controls of the device, as well as context sensitive help appeared to play an important role in the efficient and effective use of interactive mobile tours by a large audience from various countries. With respect to the content of the museum tour, critical factors for achieving flexibility and sufficient user control are: (i) maintaining a good (and adjustable) balance between the number of artworks and time duration spent in the museum; and (ii) providing various types of information about museum artworks. For the overall satisfaction of the museum visitors a significant aspects are the adaptivity of the user guidance trough the museum and the customization of the tour itself. To achieve these it is essential to apply methods to determine user and artworks position in an overall wireless locator mechanism.

3. CHIP Overall Architecture

The goal of building museum tours within the CHIP demonstrator is to enhance the user’s museum experience in a more intensive, long-lasting and engaging way (see Figure 1). In other words, to keep the users ‘stick’ into the immersive museum environment, which includes the virtual (museum Web site) and the real museum.

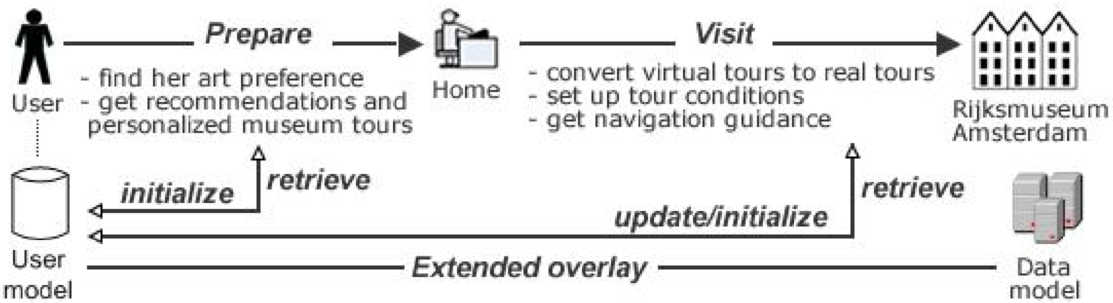

Figure 1: Use case of museum tours

Imagine the following scenario, the user wants to visit the Rijksmuseum Amsterdam but has no clue about what to see in the vast museum collection. So she first prepares her knowledge at home by using the Web-based Artwork Recommender and Tour Wizard, which helps her to find her art preference in the Rijksmuseum collection (Artwork Recommender) and recommend personalized museum tours based on her art preference/user profile (Tour Wizard). After the preparation, the user goes to the real Rijksmuseum to start a real visit. The PDA-based Mobile Tour could load all her tours via the internet/wireless connection and give detailed information (text, audio and images) about artworks in the tour. Moreover, it provides navigation guidance (e.g. shows the current position and route direction). The user could also directly visit the museum without any preparation. In this case, the PDA will only offer standard tours to her. After the user's visit, the PDA will send back the user's real behavior information (e.g. time spent, route) to update the user model on the Web server preparing better personalized services.

To understand different components (tools) of the CHIP demonstrator and the relations among them, below in Figure 2 we give an overall architecture diagram.

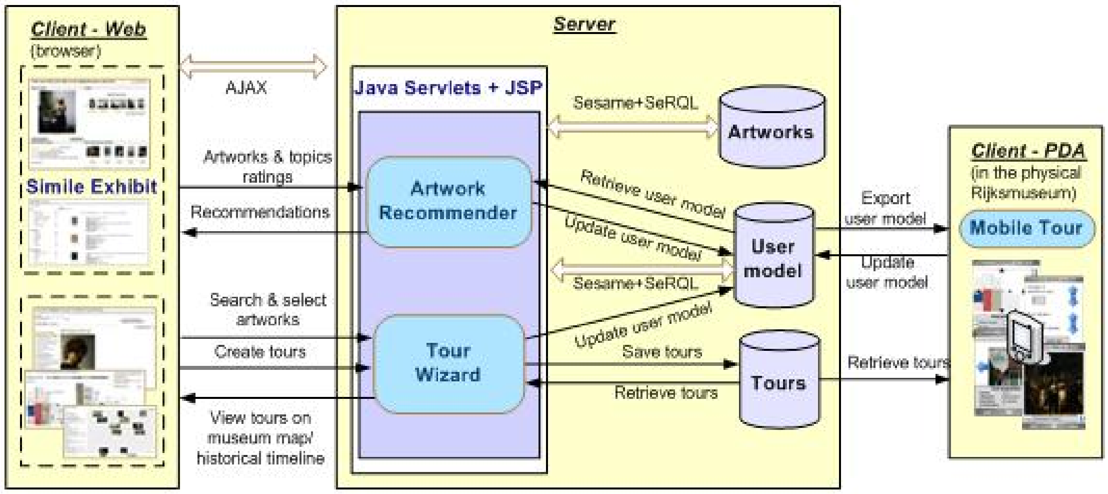

Figure 2: Overall architecture of the CHIP demonstrator

A client-server architecture with Java Servlets is running on the main CHIP server. The semantic data model and the overlay user models represented in RDF are also stored there. Sesame and SeRQL are used for RDF data processing between the data model, Artwork Recommender, Tour Wizard and the user model. More details of the semantic-enriched data model can be found in Aroyo, 2007. Next to the two Web-based components of the CHIP demonstrator, Artwork Recommender and Tour Wizard, a PDA-based Mobile Tour converts museum tours from virtual to real tours in the physical museum space and in the meantime gives useful guidance to users. In this way, by offering better personalization services based on their updated user models, we aim at enhancing and extending the user's museum experience and triggering follow-up visits to the virtual or real museum.

4. Web-based components: Artwork Recommender and Tour Wizard

The Artwork Recommender provides the users an interactive rating dialog of artworks/topics and generates semantic-driven recommended artworks and topics based on the ratings. From several user studies, a comprehensive usability feedback was gathered (Wang, 2007) and resulted in an improved user interface and interaction (see Figure 3). For example, a sequential visualization of a set of artworks to rate; and a clearer distinction between different frames (e.g. rate artworks/topics, recommended artworks/topics) was achieved.

Figure 3: New interface of the Artwork Recommender

Based on the user's ratings stored in the user model, the second component, the Tour Wizard, generates personalized museum tours of artworks. It also allows for a semantic search facility, provided by the MultimediaN E-Culture project (Schreiber, 2006), for users to search themes or topics of artworks to add to the tour(s). For example, if the user searches "Rembrandt", the system will find concepts which all contain "*Rembrandt*" as a keyword but from three different categories (see Figure 4): (i) Creator "*Rembrandt* van Rijn"; (ii) Artwork "Old woman reading a lectionary (portrait of *Rembrandt*'s mother)", "Self portrait of *Rembrandt* van Rijn" and "Study for a statue of *Rembrandt*"; and (iii) Theme "*Rembrandt*'s cycle".

Figure 4: Semantic search in the Tour Wizard

In the Tour Wizard, museum tours can be constructed by user and viewed either on the museum map or in a chronological timeline. Figure 5 shows a screenshot of the visualization of museum tours on the Rijksmuseum map. The red line connects all the artworks included in the current tour and the number in the dot indicates how many artworks in the room are included in the current tour.

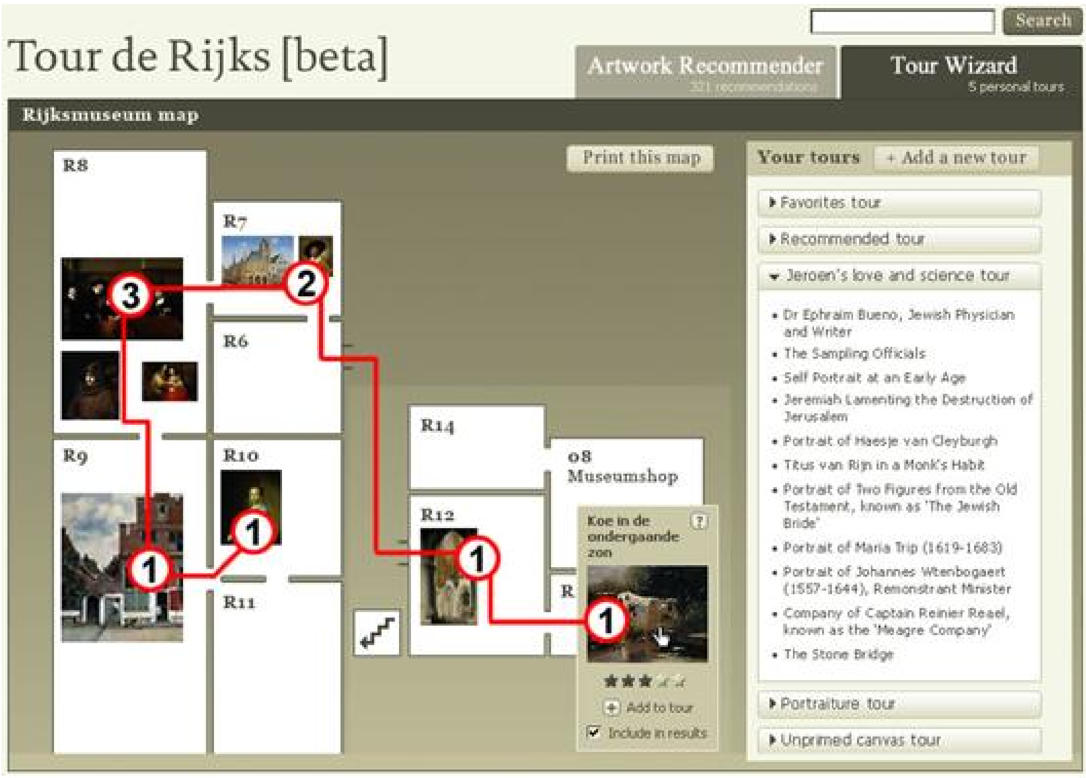

Figure 5: Visualization of museum tours in the Tour Wizard

5. PDA-based component: Mobile Tour

From the requirement study in Section 2, we derived that when the internet/wireless connection is available, the PDA Mobile Tour should be able to load/import tours created from the Tour Wizard on the Web site; synchronize the user model; set tour properties (e.g. time duration and the number of artworks); retrieve explanations of artworks by using the RFID reader; and locate the user's current position in the museum and give navigation guidance.

To satisfy these requirements, there are four main functionalities are provided: (i) download tours; (ii) synchronize the user model; (iii) apply a set of constraints for the mobile tour; and (iv) indicate the user's positioning and plan a route.

- *Download tours*

To download tours to the PDA, the Mobile Tour will invoke a Web application (i.e. Mobile data application) on the server, which is created for exporting and importing information in XML. Then, a Servlet called GetTours will be invoked to fetch the tour data from the data store using SeRQL and returns the information to the PDA as an XML file using a DOM approach as a separate component called the XML Writer (see fig. 6). The generated XML file retrieves all data from the tours and returns to the PDA.

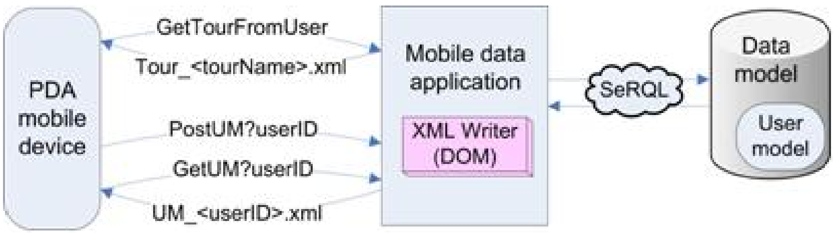

Figure 6. Download tours and synchronize the user model

- *Synchronize the user model*

To ensure no user model data is lost when synchronizing, two steps are performed (see fig. 6). The first step is to add the current pending updates from the PDA to the user model on the Web server. This is performed by the PostUM Servlet, which receives the user model from the Mobile Tour as a Post variable. The second step is to download the new updated user model from the mobile data application by invoking a second Servlet GetUM. It retrieves updated user data and overwrites the current mobile user model with the new one on the PDA.

- *Apply constraints*

Different with on-line virtual tours, mobile tours in the real museum space encounters a number of constraints, e.g. the availability of artworks, time duration, route in the big museum space, etc. In the Mobile Tour, we proposed a mapping mechanism with three steps: (i) to filter out unavailable artworks from the total set of selected artworks; (ii) to order available artworks in an optimal route; (iii) to allow users to limit the number of tour artworks to see and set up the total time duration. These two constraints are synchronized.

- *Indicate the user's position and plan a route*

In the Rijksmuseum scenario, each artwork is embedded with a passive radio-frequency identification (RFID) tag, which is connected with the PDA. We track the user's position by scanning the location of the corresponding artwork. When the user starts a tour, a trace is calculated from the current user position to the first artwork in the tour, and then from the first artwork to the second one. This sequence is repeated until a trace is calculated from the last artwork to the end point of the tour and finally all these traces are merged together, leading to a route from the start point to the end point passing all selected artworks.

(a) Import tour (b) Tour set up (c) View the tour (d) Tour route on the map

Figure 7. Screenshots of the Mobile Tour on PDA

6. Conclusion and Future Work

In this paper we have proposed an approach of exploiting personalized museum tours to enhance and extend the users' museum experience both on the museum Web site and in the physical museum space. Our approach includes the following main steps: (i) we performed a user study to derive requirements for building museum tours; (ii) we implemented a Web-based Tour Wizard to generate recommended museum tours based on the user's art preference; (iii) we converted the tours to the PDA-based Mobile Tour, which is used in the physical museum space by applying a number of constraints, used in real museum space; and (iv) we implemented the synchronization of the user model on the Web site with the model on the PDA mobile device.

As follow-up work, we are planning an evaluation to test the three faceted rationale (prepare, visit and synchronize) of museum tours by using the Tour Wizard and the Mobile Tour. The general idea is to split users into two groups (first explore the Web-based Tour Wizard and first directly visit the real museum using the Mobile Tour) and let them perform their tour(s) in a museum scenario.

We also aim to test the usability of the mobile device/PDA and the effectiveness of recommended tours. In addition, we will collect the users' feedback and their satisfaction about using the multiple components of the CHIP demonstrator.

As a long-term goal, we are preparing to extend the current user model, which allows a high expressivity of the users' interactions with the Rijksmuseum collection in a wide variety of contexts. As a first step, we have already imported the user's FOAF profile (e.g. name, email, knows people, interest, etc.) to enrich the user model and to solve the cold-start problem for first time users. As the heterogeneous population of users and their interactions with the system change very quickly, we might consider adding more dynamic and contextual properties in the user model and connect the user model with other on-line social communities in the open Web 2.0 world.

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