

Adaptive user interfaces for on-line shopping

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Abstract

With the increasing popularity of on-line shopping, the personalization of the front-end of Web stores has become a critical issue: these systems are accessed by customers with different backgrounds, expertise and preferences; therefore, their usability can only be improved by tailoring their interfaces to the needs of each specific user. In this paper, we present the personalization features offered by SETA, a prototype toolkit for the creation of adaptive Web stores, developed at the CS Department of the University of Torino. The Web stores created using SETA suggest the items best fitting the customers' needs and adapt the layout and the description of the store catalog to their preferences and expertise.

Introduction

The popularity of Web shopping is increasing and different types of (home and business) customers purchase goods by accessing Web catalogs without relying on intermediaries. Noticeably, this trend does not only concern traditional domains like the market of movies and music, but also other newer domains, such as the electric power trade (Ygge 1999). In all these cases, the user needs information about the alternative products/services and their advantages and limitations, to identify those satisfying her needs and constraints at best. As discussed in (Benyon 1993), the users of software systems differ in their characteristics (e.g., status, expertise, preferences), which should be taken into account to enhance the usability of such systems.

In several commercial tools for the creation of Web stores, like Microsoft Merchant, IBM's Net Commerce and ATG's Dynamo, the personalization of the interaction with the customer has been enhanced, in order to establish a long-term relation with her (in contrast to the typical one-shot interactions supported by the first systems). These tools tailor the suggestion of goods to the user's preferences (Resnick & Varian 1997). However, they adopt quite simple (if any) techniques for personalizing the presentation of items.

Although the suggestion of goods is a very important functionality, we believe that the interaction with the user can be further improved by customizing the presentation style, as well (Brusilovsky 1996): in fact, Web catalogs typically fail to provide the information relevant to the customer's interests and, especially in technical sales domains, they challenge the user with complex descriptions, understandable only by experts.

We have addressed the adaptivity issue in electronic commerce, dealing with both the selection of items suited to the customer and the personalized presentation of Web catalogs. In this paper, we describe the personalization features offered by SETA, a prototype toolkit for the creation of adaptive Web stores developed at the CS Department of the University of Torino.

Management of the user profiles

SETA exploits user models (Wahlster & Kobsa 1989; Chin 1993; McTear 1993) to customize the pages of the Web store. Since the user of a Web system has to be modeled both as the user of a Web system and as a customer, the user models contain information describing preferences towards the interaction style, as well as requirements on product properties.

When a customer accesses a Web store created with SETA, her model is initialized either by retrieving her record from a users database, or by exploiting stereotypical information about customers. In this way, a first model can be quickly created for users visiting the store for the first time. However, as stereotypical information is not precise enough to characterize the individual customer, the system also exploits dynamic user modeling techniques to update the user model in an unobtrusive way, on the basis of her behavior.¹

The user model is dynamically updated by monitoring the user during the interaction. We identified the

¹When a new store is created, the store designer can choose the user modeling techniques to be used: the stores can be configured to handle: a) a single, generic user model; b) individual, static user models instantiated by exploiting stereotypical information; c) individual, dynamic user models, updated during the interaction with the user. Options b) and c) can be combined, as in our prototype Web store (Kass & Finin 1988).

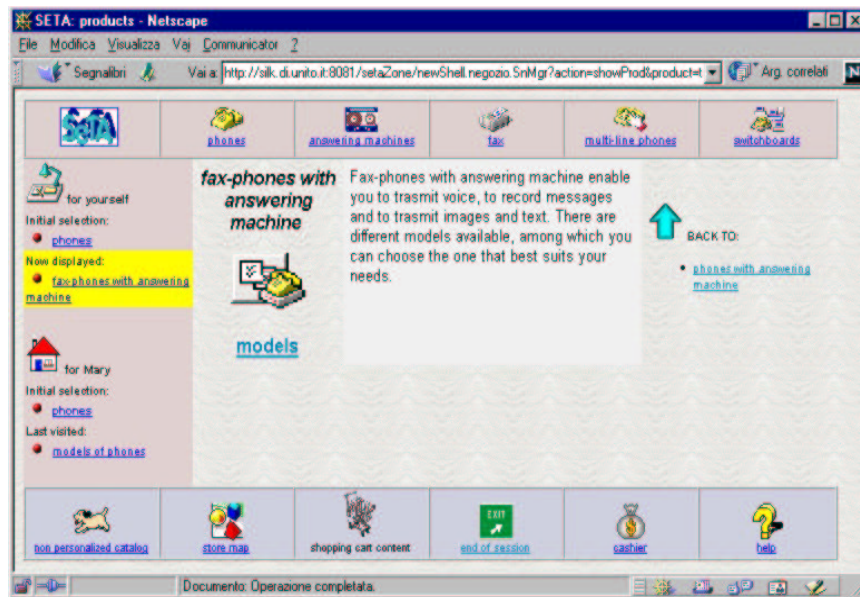


Figure 1: A page generated by our prototype for the presentation of the “fax-phone with answering machine” product.

information about the user’s interests carried by each type of action she may perform (e.g., asking for technical information about an item, adding an item to the shopping cart, etc.). During the navigation of the catalog, the system maintains in its working memory all the relevant actions and periodically analyzes this event history to revise the user model. The collected information is fed as evidence to a Bayesian Net that models the dependencies among the user’s behavior and her interests, domain expertise and features.

The pages of the Web store catalog

The goods are presented by means of two main types of page: the pages characterizing the product categories available in the store and those showing the items available within each category. Figures 1 and 2 show two example pages produced by our main prototype, which presents products of the telecommunication domain.

The description of the product categories (e.g., phones, answering machines, and the integrated products) is aimed at providing the user with basic information about the offered functionalities. Instead, the description of the items (e.g., the phone models that can be purchased) is focused on the specific features offered by the items and on their properties. Both types of information are important to the description of the catalog: in fact, the characterization of a product category helps the user to identify the kind of product she needs, while the description of the items enables her to select the particular model suiting her needs at best. Although the description of product categories may seem trivial in simple domains, it is essential in domains where the user’s expertise may not support her in the identification of her own needs.

Pages describing product categories

A page describing a product category provides the user with information about the main functionalities of the items belonging to the category itself. For instance, Figure 1 shows a page describing an integrated product: the “fax-phones with answering machine”.

This type of page is organized in several areas, displaying the contextual information, the navigation and control buttons and the description of the product category. More specifically:

- The topmost bar provides the links to the main product categories available in the store.
- In the leftmost portion of the page the system displays the active interaction paths and enables the user to switch among them. Each path represents a dialog context, that specifies:
 - The target of the product: the user may consider products for home or business use (this information is displayed by means of an icon); moreover, she can look for a good addressed to herself, or to somebody else. In this example, the user is looking for a product for her own office, and for another product, addressed to Mary, for home use.
 - The initial selection: when entering the store, the user is asked to select the main product categories she is interested in. The system keeps track of this choice by providing the label “Initial selection” and a link to the category itself. In our example, the user initially selected the phones category.
 - The last visited page (in each dialog context): while browsing the catalog, the user can move from the page showing the initial product category to pages describing other products or showing the

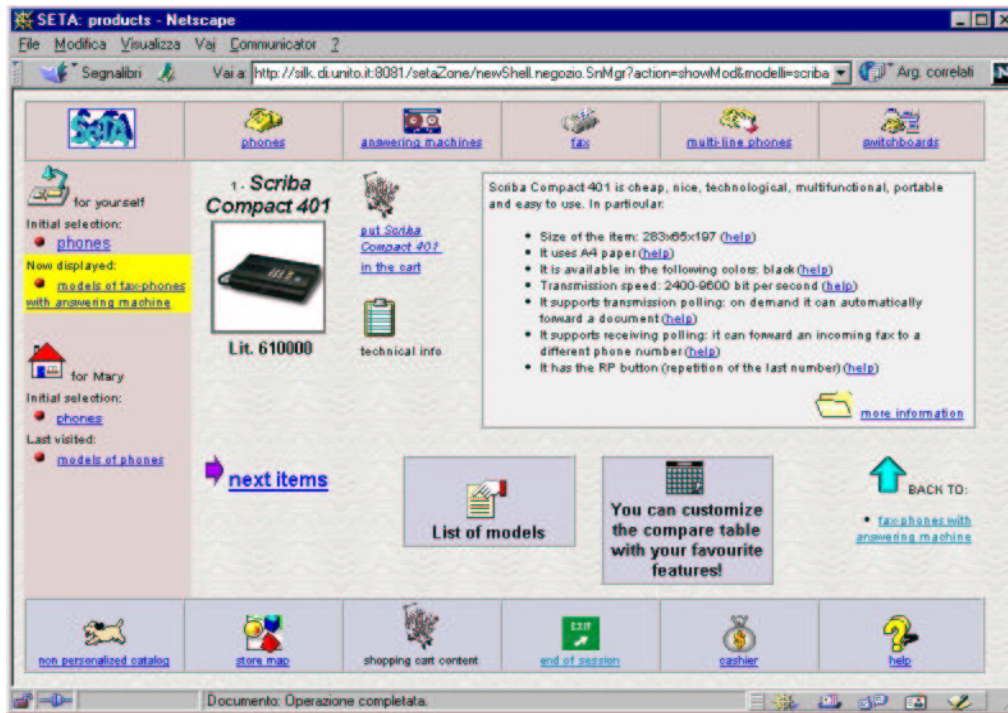


Figure 2: A page describing the “Scriba Compact 401” item.

available items. The system displays this information under the “Last visited” label. The current context is highlighted and specifies the content of the page (“Now displayed” label). In the example, the user is looking at a page presenting the models of fax-phones with answering machine.

- The central area describes the functionalities offered by the product category in the focus of attention and contains the link which the user can follow if, on the basis of the description, she decides to analyze the related items (“models” link). This area also contains the link to view other product categories. As described in (Ardissono *et al.* 1999b), the catalog is internally represented as a conceptual network where product categories are related to one another on the basis of their functionalities. Thus, browsing the catalog has a direct correspondence to browsing the nodes of such network. In this example, the system is displaying the most specific product category which integrates the functionalities of phones, faxes and answering machines; therefore, the user is only allowed to move to simpler products, by means of the “BACK TO” link. When intermediate products are displayed, a second, “GO TO” link is shown, leading to more complex products.
- The bottom bar contains general control buttons, such as the one for inspecting the content of the shopping cart, or the “end of session” button.

The description of the offered functionalities is an efficient way to sketch the product categories, so that the

user can read a summary of the type of service offered by the items belonging to the category. When a product has to be presented, the system retrieves the linguistic description of each functionality offered by the product and composes such descriptions by means of a template, forming the complete natural language sentence which is included in the central area of the page.

Pages describing items

The pages describing the items of a product category display specific information about the available models. See for instance Figure 2, which presents the “Scriba Compact 401” fax-phone with answering machine.

This type of page is organized in several areas, some of which are the same as those in the pages describing products; e.g., the top and bottom bars, and the left-most portion of the page. Moreover, the following areas contain differences:

- The central area describes the properties and features offered by the displayed items. For each model, the area devoted to its description contains:
 - The name, a picture and the price of the item.
 - A button to add the item to the shopping cart, in order to buy it later on.
 - A button to display the technical details.
 - The description of the properties and features of the item. If the system shows only a subset of the features, a link (“more information”) is added to see the whole list.

- The lower area of the page, below the description of the items, contains several buttons and links. In particular:
 - The links for browsing the list of available models (“previous items” and “next items”; only the second link is shown in the figure, which presents the first item of the list).
 - A button to display the list of the models available for the current product category; the user can use this list to request the description of a specific item in a direct way, without browsing all the pages, via the previous/next items links.
 - A button to create a customized comparison table, by selecting the goods and the features to be examined.
 - The link for going back to the page describing the product category of the displayed item (in the figure, fax-phones with answering machine).

Adaptivity issues

In the design of the structure of the catalog pages, we have focused on two main issues: on one side, the visitor of a Web store needs to be guided by the system, that should present the information relevant to the identification of the goods satisfying her needs at best. On the other hand, the user must feel that the interaction is under her control. To comply with this requirement, the system produces catalog pages containing several buttons that facilitate the execution of different actions. For example, the user is allowed to browse the catalog and to switch between different interaction contexts; she can analyze the items available for a product one by one, ask for technical information about such items, create personalized comparison tables, view the list of models available within a product and request the presentation page for a specific item. However, in order to guarantee the consistency of the interaction, the system constrains, at each step, the actions that the user may perform, by enabling only those reasonable within the specific context. For instance, actions like adding something to the shopping cart, or asking for technical details, are allowed only when the user is browsing the items of a given product category and not when the category itself is described.

The system dynamically generates the pages of the Web catalog, by exploiting personalization techniques for adapting them to the user. As far as the overall appearance of the pages is concerned, we have defined a small set of layout packages, mainly differing for their background, font size and face, and other similar parameters; the appropriate package is selected on the basis of information such as the user’s age, her life style, and other data characterizing her preferences toward the layout of the interface. Moreover, the system adapts the amount of information displayed in the pages of the catalog: the pages describing the models available within a product category may present one or more

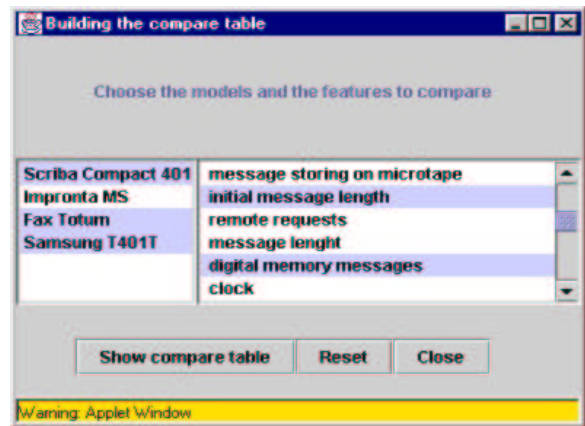


Figure 3: Creation of a comparison table.

items, depending on the user’s receptivity: if the system assumes that the user is confused when too much information is provided in the same page, it describes only one model per page, as in Figure 2; otherwise, it can list two or three models per page.

The description of the features of the items is tailored to the contents of the user model (Ardissono & Goy 1999): when the system plans the content of a page, it exploits a set of personalization rules to:

- rate the relevance of (all) the information items that could be presented, on the basis of the user’s interests and of the intrinsic importance of the features to the description of the item;
- select the amount of information to be included in the page, depending on the user’s receptivity;
- choose the appropriate complexity level for the descriptions, on the basis of the user’s domain expertise. Different levels can be used, to produce technical descriptions, or simple ones where the features are presented in an intuitive way;
- refine the layout of the features, choosing special sizes and styles (e.g., the boldface), depending on the ratings of the features.

The system selects the data to be included in the presentations, as well as the appropriate description style, from a database which contains the whole information about the items. These decisions are made at the granularity level of the single product feature, so that significantly different descriptions may be produced when presenting the same product to different users. For instance, the page shown in Figure 2 is tailored to a user characterized by a medium domain expertise; the page contains intermediate descriptions of the features, where some technical terms are included, but are explained to the user. Other descriptions would be produced for different users. For instance, consider the description of the “polling” feature: in Figure 2, the feature is mentioned and briefly explained. The description generated for a non-expert user would be sim-

models	digital memory me...	initial message len...	price	color	size
Scriba Compact 401	<input type="checkbox"/>	90 sec.	610.000	black	283x65x197
Fax Totum	<input checked="" type="checkbox"/>	60 sec.	788.000	black	270x222x83
Samsung T401T	<input checked="" type="checkbox"/>	90 sec.	860.000	black	360x105x280

Warning: Applet Window

Figure 4: A comparison table created during the interaction with our system.

pler and would contain a full explanation of the feature. On the other side, a description generated for an expert user would be more compact and would not contain any explanation of the technical terms.

In addition to the development of personalization strategies for the generation of pages tailored to the user, we have enhanced the opportunities for the customer to explicitly request personalized information about the goods. One interesting form of user-driven customization is the creation of the comparison tables “on the fly”. When the user clicks on the related button (see Figure 2), the system displays a window for the selection of the items and the features to be compared. An example of this window, referring to fax-phones with answering machine, is shown in Figure 3, where the user’s selections are highlighted. When the user clicks on the “Show compare table” button, the system creates the new table and displays it; Figure 4 shows the table resulting from the user’s selections reported in Figure 3. This mechanism greatly improves the system flexibility, since the user is not forced to inspect large precompiled tables, but she can ask the system to compare only those items and features she is really interested in.

Conclusions

The issue of tailoring the description of goods to the needs and capabilities of the user has been initially recognized in the dynamic hypermedia research area, where many adaptive systems have been developed for the personalized presentation of information; e.g., see (Chin *et al.* 1994; Jameson *et al.* 1995; Brusilovsky, Schwartz, & Weber 1996; Popp & Lödel 1996; Strachan *et al.* 1997; Dale *et al.* 1998; Milosavljevic & Oberlander 1998; Petrelli, Angeli, & Convertino 1999; A. Nill & Kobsa To appear). However, the great expansion of electronic commerce on the Web has highlighted the importance of personalization issues, such as tailoring the suggestion and the presentation of products to the individual customers, in virtual stores and recommender systems on the Web, as well.

In this paper, we have described SETA, a prototype toolkit for the construction of adaptive Web stores that assist the user by adapting the interaction and the suggestion of goods to her preferences. The personalization

of the interaction is obtained by exploiting user modeling and knowledge representation techniques, which make it possible tailoring the description of the products to the user’s interests and domain expertise. In this way, personalized Web catalogs can be displayed, on the basis of the peculiarities of the individual customer.

We have tested our prototype tuning it on the basis of the suggestions collected from about 100 users, representative of different user categories, such as psychologists, computer scientists, and people coming from the economic, administration, and humanities areas. Although a field-trial would be necessary to test the system in a complete way, the contribution of these people has been very valuable in helping us to improve the interface offered by SETA, as well as its interaction style. In particular, we have realized that there is a trade-off between the system’s degree of initiative in the personalization of the interaction and the need to respect the user’s freedom during the visit of the Web store: unlike other applications (e.g., ITS), the role of an electronic commerce system is, in our view, helping the user to obtain the information she needs in a smooth way, without overwhelming her; for instance, the system should make the catalog clearer and more understandable, avoiding useless paths to the user. Moreover, the system should offer the user a way to control the interaction in an explicit way, in order to correct the system, when it fails to recognize her real preferences and needs. To this extent, we are currently extending SETA, on one side, with more powerful user modeling and personalization techniques and, on the other side, with new functionalities which the user can exploit to request specific information, or even to change the interaction style. For instance, the generation of pages presenting the functionalities offered by the various product categories is an important way to help the user in the navigation of the catalog: in fact, it represents a way for the user to decide whether she is interested in a certain product before reading the specific features of the items in detail. Moreover, the creation of comparison tables “on the fly” is a way to let the user personalized a subset of the catalog, by selecting the information about items that she really wants to consider.

Although our main activity is focused on the proto-

type presenting telecommunication products, we have enhanced the functionalities of the system by exploiting the gained experience in the development of other prototypes, based on the same architecture. This work has given us a useful feedback for the improvement of the adaptivity of the SETA system; for instance, our prototype for the personalized delivery of news on the Web has helped us to extend the personalization strategies, tuning them to the peculiarities of a different type of application. More information about the personalized news server can be found in (Ardissono, Console, & Torre 1999) and on another paper included in the working notes of this symposium.

Technical details

SETA (Ardissono *et al.* 1999b; 1999a) is a multiagent system including a Web store shell and the tools which can be used to create a new, adaptive Web store presenting products in a specific sales domain. SETA is implemented in Java, uses the Apache Web server to communicate with the Web, and Objectspace Voyager (Objectspace) to create and distribute the agents of the system and to support communication among them. An on-line demo of our system is available at the URL: <http://www.di.unito.it/~seta>.

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