A UNIFYING APPROACH FOR INTERFACE ADAPTATION

Mathieu Barcikowski, Jean-Charles Marty, Laurence Vignollet
Laboratoire SYSCOM, Université de Savoie (France)
Campus Scientifique
73376 Le Bourget du Lac Cedex
Mathieu.Barcikowski@etu.univ-savoie.fr, Jean-Charles.Marty@ univ-savoie.fr, Laurence.Vignollet@ univ-savoie.fr

ABSTRACT

It is sometimes a challenge to untangle the large amount of information on the Web. We thus need to adapt this information to a given user in a particular context. This adaptation is performed thanks to the user preferences, of course, but also by exploiting the context of use of the system (the device, the location of the user, the group the user belongs to). The generation of the adapted user interface can be seen as the generation of an adaptive document where the result is obtained through the combination of the adequate fragments of information. Our generic approach is based on constraints generated from the user preferences, group preferences and from the context (*e.g.* depending on the device, some fragments are displayed differently). As an example, a web server's architecture is briefly presented in which we explain how we adapt the information (selection of what to present – content; and decision on how to present it – display).

KEYWORDS

Adaptive Hypermedia, User Model, Context, Constraints

1. INTRODUCTION

With the evolution of the WWW, several adaptive systems have been developed. Usually, they are user-centred. Sometimes, the context of use is also taken into account. However, the current systems tend to be more and more collaborative, raising new problems. For instance, when a user belongs to a group, it is not possible anymore to adapt the information taking only into account the user model. The group preferences or recommendations should also be considered. Thus, if we want to consider adaptivity in the new generation systems, we should propose a more generic approach, allowing to make a system adaptive based on many sources of constraints (the user and the context, the group, …). Thus, starting from the work on adaptive hypermedia, we propose new ideas to make the adaptation as generic as possible. These ideas are illustrated through the specification of a web server.

In most adaptive systems, *e.g.* AHA ! (De Bra & Ruiter, 1999), the approach is user-centred, and the adaptation is thus performed through the user's characteristics and preferences. Furthermore, in these systems, the adaptation rules are either hard-coded, such as in PowerBookmarks (Li & al., 1999), raising the problem of reuse and extension of the software; or they are based on the event-action paradigm, such as in XAHM (Cannataro & Pugliese, 2001), introducing the ending and non determinism issues.

Moreover in the adaptation phase, we are faced with the problem of selecting the appropriate information: what is best suited to a given user in a given context? Providing the user with an adequate list of items is closely related to the automated document generation. Several document composition systems use constraints to generate the appropriate documents. These constraints unfortunately only apply to the contents of the document (Boukottaya & al., 2002) and are mainly issued from a user model (Iksal & Garlatti, 2002). Our approach aims at considering constraints more generally, in order to take into account not only the content of the information but also its display; and to use not only the user model, but also the context (device, location, ...), the adaptation policy given by the group the user belongs to, or any other parameter needed to generate the different constraints.

Our paper is organised as follows: Section 2 describes what can be adapted, the pieces of information on which the adaptation should be performed. In the third section, we explain what can be used to help the adaptation, namely the user model and the context in general. Section 4 details these data and shows how

they can be unified through constraints. Section 5 summarises how the constraints are used to generate the adapted interface.

2. THE DOMAIN DATA

The domain data are constituted from pieces of information (that we call "fragments"). In our example domain, a web server provides the user with the interesting cultural events. These fragments can be for instance a textual description of an event, pictures of this event, interviews related to this event, etc... The use of fragments, as can be found in other systems (Abrams et al., 1999), offers a large number of adaptation possibilities.

Fragments are created and managed by external applications. The adaptive system sends requests to these applications in order to obtain the different fragments to be displayed. These elements should then be displayed according to the user's and group's preferences and according to the device in use. The adaptive system is in charge of modifying the appearance of the results in order to do so.

In order to select the appropriate fragments (the best suited fragments according to the constraints), external applications need to have meta-data on these fragments. For instance, a fragment is aimed at young children; or a fragment is an abstract of an event, ...

Furthermore, we believe that a fragment must be a multi-form object. Fragments are described at different levels of detail, different modalities, or different languages for textual information. To an image representing a film, we propose to associate a long and a short textual description summarizing the image and the vocalization of this text. Although these pieces of information are not exactly the same, they are semantically quite close. That is why we represent this example by a unique fragment representing an image of a film; this fragment has four facets corresponding to the three mentioned media. This approach is rich from the adaptation point of view. In traditional systems, when a device cannot display an image, the user is informed that there is information that can't be displayed... In our case, once the fragments are selected, the system looks for another solution, by examining the alternative media of the same fragment. The interface thus provides the user with a short text representing the image. Even if the object is not exactly the same, the user has an idea of what the system wants to transmit. It could be very interesting to study the semantic equivalence of the modalities in different contexts, but this is beyond the scope of this paper.

The multi-form approach allows to adapt the interface to the user's preferences (modality), to his/her knowledge (language), to the group recommendations (modality) or to the device limits (modality or level of detail).

3. MORE THAN USER MODEL AND CONTEXT

We have already mentioned that the adaptive systems need different kinds of data in order to know which information is more appropriate. The first source of such data is the user model. Taking into account the user preferences is now currently admitted in most adaptive systems. This kind of adaptation in adaptive systems is also called personalisation. Other systems, mainly mobile systems, take into account the context in which the human-machine dialogue takes place (Kappel & al., 2003). That includes for instance the location of the user or the device he/she is using. Our goal is to take into account the user, the group and the context to make adaptation of the interfaces as rich as possible.

The user model contains the set of information needed by the system in order to adapt the interfaces. This includes the preferences (regarding objects of the domain or interfaces themselves) and the knowledge of the user. The model of the context is formed by characteristics describing a given environment, *e.g.* the device, the time, the location where the system is used. Both the user model and the context characteristics are useful in obtaining an efficient adaptation of the interfaces submitted to the user.

We propose a formalism allowing representing both the user model and the context model, or any other information required for adaptation needs, like a group model. As mentioned by P. Brézillon (Brézillon, 2002), the context dimension is infinite and it is impossible to represent it entirely. That is the reason why our formalism allows enlarging, when needed, the number of models or the number of pieces of information contained in these models. In the case of an adaptive Web Server, we have created an application for collaborative work. We thus have added a group model to the already existing user model and context model.

This group model allows describing the adaptation policy of the group. This is useful in this context for a teacher wanting to work on the same kind of cultural events with a given class.

4. UNIFICATION THROUGH CONSTRAINTS

In the previous section, we pointed out that the context and the group's preferences can be as important as the user model in obtaining a good adaptation of the interfaces. Our approach aims at unifying the different sources of information allowing the adaptation. For that purpose, we consider that all these data can be represented as constraints on the results to be displayed. Constraints issued from the user model can set some restrictions on the information to be presented; e.g. that user doesn't like classical music. They can also be issued from the context: the user is located in Marseille; it is not possible for him to attend an event in Paris tonight. The constraints can be of different kinds: the constraints having an impact on the selection of the contents (WHAT do we need to present to the user?) and the constraints defining precisely the display of the information (HOW do we present it?). A detailed representation of the constraints can be found in (Fuselier, 2002). Here are some examples of such constraints:

From the user model on the contents:

***(fragment.type = cinema) & (user.cultural_preferences.cinema.value > 0.7*)**. This means that we will select all the fragments concerning the cinema as possible fragments to display, when the user likes the cinema. We can observe that the constraint refers both to the meta-data concerning the fragment and to some values of the user model; 0.7 represents a number between 0 and 1 (0: dislikes; 1: likes very much)

From the user model on the display:

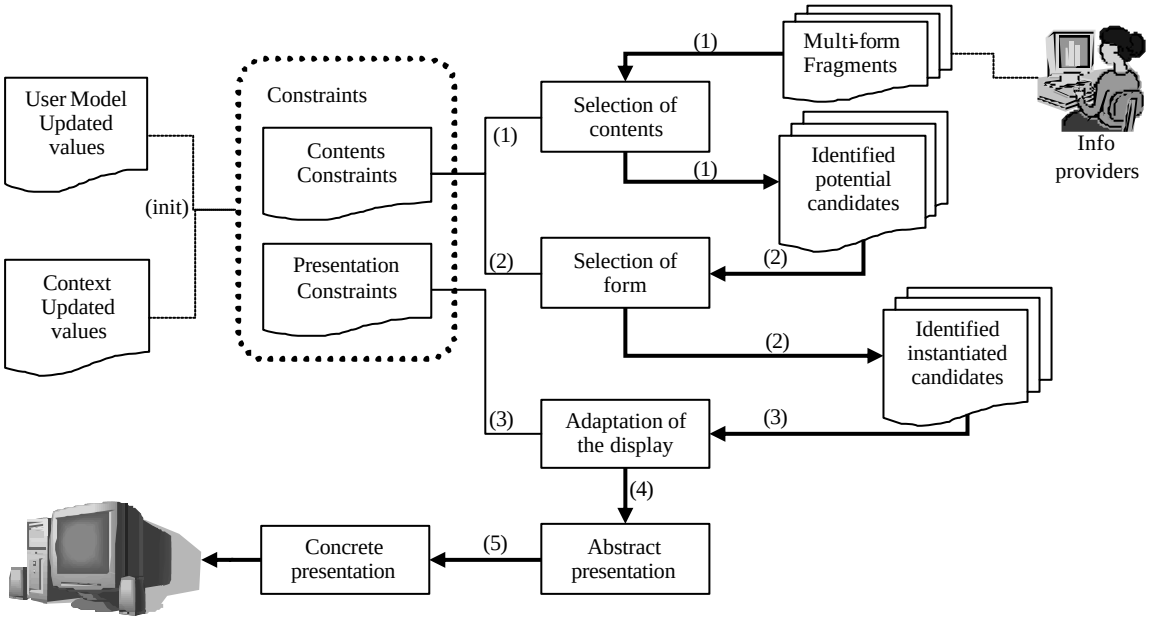
(image Î fragment.modality) & (user.media_preferences.images.value > user.media_preferences.text.value). This means that the fragment has an image modality and that the user prefers to see an image when it is possible.

From the context on the display:

(terminal.type = WAP) & (text Î fragment.modality). This means that we will display the text modality of the fragments on WAP devices.

5. ARCHITECTURE OF OUR SYSTEM

The following figure summarises the architecture of our system.



When a new page is to be presented to the user, the initialisation step is to generate the updated constraints according to the current values of the user and the context attributes. The first step is to select the appropriate

fragments from the data base of the cultural fragments according to the content constraints (1). Then, we decide on the optimal modality for each selected fragment, also according to the content constraints (2). The problem of display should thus be addressed using the presentation constraints (3). The elements to be displayed and their layout are described in an abstract language. This allows us to translate this into several languages such as HTML, WML or VoiceXML(4).

6. CONCLUSION

Our goal is to define a system that can go further than adaptive hypermedia, providing the user with generic adaptation of interfaces.

Currently, the implementation of a first version of the Web server providing adapted interfaces works. It includes a user, a context and a group models. It can provide services allowing collaborative work.

In the domain of EIAH, we are thinking of another adapted service in the electronic schoolbag: the "homework book", adapted to the student. The homework is displayed according to the group the user belongs to, the user's knowledge and preferences, and its device. Additional personal information can also be added to the interface. Interesting constraints exploiting the knowledge of the student can be added (the teacher can decide to give extra work to the students whose knowledge is not sufficient in a given subject).

Adding new services requires the utilization of a meta model that allows the extension of an existing model (User, Context, Group models) and the creation of new ones. Using constraints allows the systems to adapt the information through a declarative process. Furthermore, our adaptation process operates on a dynamic content while most other systems work on a static content. We believe that the constraints are powerful enough to adapt to other items than the user or the context. For instance, we can also adapt according to the group policy, if it wants its logo to appear in the top left-hand corner of each interfaces it proposes.

The number of the different constraint sources will thus probably increase and we will be faced with constraint contradictions, e.g. the user does not like images but the cultural partner recommends displaying an image for each cultural event. The next challenge will thus be to improve the process of resolving constraint conflicts.

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