Consumer-Centered Interfaces
Customizing Online Travel Planning

1. Introduction and motivation

The huge growth of the Internet, and particularly of the World Wide Web, has led to a big mass of companies participating in a global online marketplace. Although a lot of work has been done in the different areas of the electronic commerce, the existing systems are still far from using all the possible advantages of the Web, as an information and commercial medium. Currently, most electronic commerce transactions such as retailer to consumer are very simple: browse a catalog and make a selection, then pay with a credit card. Research topics mainly focus on issues related to the order processing and secure payment transactions. Only recently the personalization of the interaction with customers started to receive special attention.

Several online reservation systems exist already on the Web, allowing customers to book flights, cars, hotel rooms, vacation packages (Travelocity, Expedia, ITN, etc.). A survey (Jurca, 1999) of ten popular online reservation systems that we made during July-August 1999 came out with useful information about main aspects of consumer centered electronic commerce: the interaction protocols they use in communicating with their customers and the consumer needs they try to satisfy.

All the analyzed systems share the same interaction approach: the user has to input his/her travel preferences then choose from existing possibilities. The whole search process can be shortly described by the following interaction protocol:

"[register] – input data (travel constraints) – see results – evaluate – book & buy"

The registration step can sometimes be avoided (customers have the possibility to use the system as guests or to register only if they want to make a booking or purchase). After seeing some results, customers (without any help from the system) evaluate the existing options, choose the best of them and, if they are satisfied, buy it. This way of interaction is sometimes good for simple user demands, but when more complex travel planning is desired, it is not sufficient.

Ease of use, quality of solutions and query refinement for achieving customer's goals are some of the most common consumer needs. With minor differences, all current reservation systems have similar approaches for satisfying these needs. Help files or orientation maps are provided by some of the systems. A standard query input procedure is used, as well as free text or text tables for displaying the results. User profiles may be created to memorize personal data: name, travel preferences, payment and ticketing information. These are mainly used in the booking phase, there are no adaptive interaction or customized results presentation. Little assistance is provided for refining queries in order to get better solutions. When making air reservations, customers can ask for flights in the previous or next day; if they want to modify some other search parameters, they have to start again, from the beginning, with the query process. Price and availability are the two mostly used criteria for matching the consumers' needs, which is not always leading to optimal solutions.

Since electronic commerce applications are accessed by different users, with different preferences and needs, a flexible architecture is required, where both products and customers are modeled. In this thesis we propose to explore a number of approaches for the design and implementation of adaptive interaction in online travel planning systems.

2. Problem statement

A growing number of people are using today the Web for planning their travels. A lot of them consider that it is faster, more useful and comfortable to use the new technology, instead of calling a travel agent and try to explain him what they want, or spending even more time by personally going to a travel agency. Although, sometimes, things are not as easy as they seem.

Consider for example a professor living in Switzerland, who has a project meeting in London, on the 8th of March. After that he must attend a conference in Los Angeles between 10th and 13th of March. He must be

back home on the 15th of March, but due to personal reasons, he can't arrive home too late in the night. In order to plan his trip with the currently existing systems he must choose a system allowing multi-leg trips, then input his date constraints, then try to find the combination of flights best matching his criteria. If he will add price, airports, number of stops and total travel time criteria, he will have a real headache before finding an appropriate itinerary.

Another possible scenario could be a family (parents around 35 years old, having two children, aged 3 and 7) wanting to spend their summer vacation in a nice place near the sea. They have no idea where to go, but anyway, the trip should not be very expensive, the children need some special facilities, the water must not be too deep close to the beach. They love sailing so they would appreciate a boat rental possibility. They would like to travel in August or September. As they travel with children, they prefer flights with not too many connections and also not very long waiting times. Using existing systems, our family will have to browse a large number of vacation offers, to read them carefully and see if their preferences can be satisfied, if the time of travel is convenient, if the flight connections are acceptable. And still, they will probably not be very convinced that they found what they were looking for.

Using a traditional travel agency instead of online systems would have probably helped in the previous scenarios. When arranging busy business travels, the amount of information to search and compare is anyway big, but at least the travel agent is doing it! In the vacation planning case, the travel agent might help with some suggestions, having previous family customers with similar preferences that booked a particular holiday.

As many real world advantages (like the agent's knowledge or the direct human-human interaction) are missing, online systems must include tools which not only substitute but also improve the travel agent's abilities and the real life interaction protocols. We saw in the previous scenarios two possible cases of totally different trips. The online travel planning systems must adapt themselves to the needs of each customer, give him appropriate tools for defining his plans, provide him the good information in an appropriate form and use customized interaction protocols.

The social interactions of the real world play an important role in people's search for information of any kind, including travel information. Online travel systems should not ignore this aspect. When customizing the interaction with a user, different sources of information must be considered: the user's own profile and also the current and past interests of users with similar profiles.

3. Research approach

The main goal of this thesis is to improve the interaction between customers and online travel planning systems. As seen in the scenarios described above, planning a trip might be a very difficult task and existing online planning systems are not always providing tools for really helping their customers.

Trip configuration and decision support

An alternative to the current travel planning techniques could be to give users the power of configuring their own trips, starting from existing basic blocks. Artificial intelligence methods, like constraint satisfaction techniques, are employed for solving configuration problems. User-interface interaction protocols for allowing easy manipulation of configuration blocks, criteria and algorithms are to be investigated. A text-based approach (using text tables for displaying results and text pup-up menus for configuring the travel parameters) and a graphic one (graphic representation of the solution space and graphic tools for parameters manipulation) will be implemented and tested. Appropriate visualizations of solutions according to predefined or user-defined tradeoff criteria will also be implemented for helping customers in the decision process. Several types of visualization will be tested with real users, in order to identify relationships between the user profiles and the structure of solution presentations.

Customizing the system

As users differ in many parameters, like status, expertise and preferences, all these should be taken into account to improve the usability of online planning systems, by providing customized interactions with their customers. The customization of an online travel system involves many tasks, which range from the characterization of the services and products and their grouping into classes, to the identification of the special features of the customer segments. In particular, the knowledge about customer preferences (regarding both interaction style and the product selection) is fundamental to the personalization task and must be accurately defined.

User models will be implemented by adapting the existing techniques (Brusilowski, 1998) to our specific domain, online travel planning. Each user will be classified in one of the stereotype families identified for the travel domain. The representation formalism of the user models will include a classification part (for classifying the user in a stereotype) and a predictive part, containing information about the user's features inferred by the system. Some of the research questions and tasks:

- What customer features should be modeled (e.g. user's knowledge, goal, experience, preferences, etc.)?
- How to model the customer features?
- Development of stereotype user models.
- Integration of stereotypical information with individual customer profiles.
- Monitor user actions for dynamically updating her/his profile.

The interaction with the user and also the presentation of possible solutions must be customized. Constraint satisfaction techniques will be used for finding solutions to match user preferences. Two main directions will be explored for content adaptation:

- The form of presentation. How to display the possible itineraries (text, table, graphical presentation).
- The adaptation of content itself. What type of information should be presented – more or less details, accent on some parameters of more interest to the user (time, connections, etc.).

For the design and implementation of adaptive interaction, the following topics must be addressed:

- Investigate alternative metaphors for interaction.
- Investigate different types of techniques for guiding the user in the interaction with the system: direct guidance, hiding, annotation, etc.
- Design and implement adaptive comparison tools, with the possibility of evaluating the suitability of the chosen trip and eventually suggesting better ones.

Two different approaches for customization will be considered. The first one will be the implementation of a library of Java graphic objects and groups of objects to be used during the interaction with the user (for finding user preferences, for dialog, for displaying and manipulating results, etc.). Choosing the display of one or another object in the interaction process will depend on the user model. The user model must be dynamically updated, depending on the user's previous behavior, for deciding which type of interaction to follow.

The second approach will use dynamically generated hypertext pages for personalizing the information according to user profile. Different types of pages will be used (choosing different layouts, colors, etc.) depending on user's background (such as age or job). The way of displaying the possible itineraries will also be different, tailoring the presentation to user's interests and receptivity.

Two prototypes will be implemented, one for each of the previous approaches. User studies will be conducted for testing the usability of the prototypes and deciding, if possible, which approach leads to better results.

Some important considerations regarding the interface adaptation:

- Users must be in control of the system, they may choose if they want to be guided by an adaptive interface or not.
- The system must allow users to interact, at any time, with all the tools they want; the system is just "proposing" them a way to follow.
- The adaptive interface must be in the same time adaptable: users may customize themselves the interaction and presentation techniques.

Social travel planning

When planning a trip, people are searching for information. They want to know what choices they might have and they must evaluate these choices in order to choose the best of them. If they are going to a traditional travel agency, the agent will give them advises, based on personal knowledge or other customers' experience. If they are using an online system, besides the already mentioned possibility of using special evaluation tools, a more "social" approach, closer to the real-life interactions, might help.

Directions of research:

Indirect social travel planning

- Develop tools for memorization of user profiles and chosen itineraries. When a new user is accessing the system, consider a set of most similar profiles and use the information associated with them for proposing itineraries.
- The previous method may be augmented by e-mail messages in which previous customers describe their experience during the chosen trip. Customers must be encouraged to express their opinion, which can also be stored in their profile together with the itinerary. When an itinerary is proposed to a new customer, the associated comments (if any) are also displayed.
- Implement and test algorithms for recommendation/evaluation of travel information.

The three main research objectives described above (trip configuration and decision support, system customization and social travel planning) are not independent targets. They will be all interleaved during the design and development process. Different types of decision support techniques will be investigated in the context of adaptation; the social travel planning will use the customer profiles identified during adaptation, etc.

User studies and system evaluation

User studies will be conducted in different phases of de system development. First, for identifying the most important customer features to be modeled. Then for finding appropriate customization methods for interaction with the user and also for the presentation of possible solutions. The usability of each one of the two different approaches for customization (Java and HTML) will be evaluated. The social travel planning methods will also be tested. A final system evaluation will be conducted after incorporating all travel planning techniques.

Standard usability testing methods like performance measuring and coaching method (Nielsen 1993) will be used as well as methods for tracking the user behavior on web sites (Svensson et. al 1998). Repetitive testing with identical users will be conducted for testing the system's adaptability and observing the stability or evolution of users' goals and preferences.

To summarize, the following key issues are to be addressed:

1. The customers of online planning systems must be identified with active users and involved in the planning process, rather then reduced to passive observers. They must be in control of the system and provided with tools that allow them to configure and evaluate their trips.
2. An adaptive and adaptable interface must be designed and implemented for the online travel planning system. Customer modeling, content adaptation and adaptive interaction are some of the main research directions that must be followed.
3. A social travel planning approach is proposed. Modalities in which a virtual community of users might interact and exchange experience and information are to be investigated.

4. Usability and validation procedures must be designed. User testing with real users will be conducted to prove the efficiency of the implemented techniques.

2. Related work

This research relates to several different fields: electronic catalogs, adaptive interfaces and social information filtering.

Electronic catalogs

A number of electronic product catalogs exist today as web applications or in the prototyping phase. The main research interests are security and product selection mechanisms. The mechanisms employed in product selection include (Stolze,1999):

Filtering mechanisms: users express constraints to determine if a product is of interest to them or not. Examples include: Yahoo!Shopping (http://shopping.yahoo.com), PC-Zone (http://www.pc-zone.com), Dell online shop (http://commerce.us.dell.com).

Product information visualization: products are presented in side-by-side comparison tables. Examples: GMD Focus Tool (Spenke et al., 1996) and The Dynamic Homefinder (Williamson et Shneiderman, 1992), which is combining filtering and visualization mechanisms.

Evaluation mechanisms: mechanisms which use an additive value function for computing a numerical measure of utility for each product and rank products according to this measure (Stolze, 1998, Stolze 1999). Examples include PersonaLogic (www.personalogic.com) , the Sales Assistant for TV selection (Rosswitz and Timm, 1998) and Tete-à-Tete project (Gutmann and Maes, 1998). A product scoring mechanism – soft navigation - was proposed in (Stolze, 1998).

Adaptive interfaces

Much work has been done in the past years in the area of adaptive hypermedia systems. Some example of such work are adaptive information retrieval systems, which help users to navigate in large information spaces, by limiting the navigation choice (Boy 1991;Mathé and Chen 1996) or by suggesting the most relevant links to follow (Armstrong 1995, Mathé and Chen 1996). Other popular area of research is educational hypermedia, where the user knowledge is the most important feature to be modeled (Beaumont 1994). Systems for managing personalized views in information spaces received also a lot of attention (Thomas 1996, Hohl et al., 1996).

Different approaches are employed for user modeling in hypermedia systems: automatic user modeling and collaborative user modeling. As stated in (Beaumont 1994 and Vassileva 1996), watching what the user is doing provides insufficient information for user modeling. By involving the user in the modeling process, more accurate user models are developed (Höök 1996, Vassileva, 1996).

User modeling in electronic catalog applications started to receive some attention in the last two years. In (Linden et. al 1997) a user model for describing user preferences over a set of solutions is developed, using weighted constraints. Another approach can be found in (Joerding 1999) which is proposing a temporary user model created with the help of an incremental algorithm, and based on monitoring the user behavior. As opposed to these approaches, this thesis is proposing a complete user modeling for a specific area of electronic commerce, travel planning, including user knowledge, goal, preferences, experience. Techniques from adaptive hypermedia will be combined with a constraint satisfaction approach for achieving our goal.

Social information filtering and navigation

Social information filtering systems have been developed for recommending products like movies, books, music. Some examples can be found in (Shardanand 1995, Hill 1995). They share the same approach, a user must rate first a series of products; the system is finding users with similar profiles and recommends products that they liked, but the current user didn't see (read, hear) yet. Another type of social information filtering system can be found in (Wexelblat 1998); he's approach is based on interaction history , which is to use traces left by past users to help current users find and understand information. Some design principles for social navigation tools can be found in (Forsberg et. al 1998).

References

1 Armstrong, R., Freitag, D., Joachims, T., Mitchell, T. (1995) Web-Watcher: A learning apprentice for the World Wide Web. *AAAI Spring Symposium on Information Gathering from Distributed, Heterogeneous Environments, Stanford, CA.*

2 Beaumont, I. (1994) User modeling in the interactive anatomy tutoring system ANATOM-TUTOR. *User Modeling and User-Adapted Interaction 4(1) 21-45).*

3 Boy, G. A. (1991) On-Line user model acquisition in hypertext documentation. *IJCAI'91 Workshop 'Agent Modeling for Intelligent Interaction', Sydney, Australia.*

4 Brusilovsky, P. (1998) Methods and techniques of adaptive hypermedia. *In: P. Brusilovsky, A. Kobsa and J. Vassileva (eds.): Adaptive Hypertext and Hypermedia. Dordrecht: Kluwer Academic Publishers, pp. 1-43.*

5 Forsberg, Mattias, Höök, Kristina, Svensson, Martin (1998). Design Principles for Social Navigation Support, *In proceedings of UI4All, Stockholm, Sweden.*

6 Guttman, R and Maes, P. (1998) "Agent-mediated Integrative Negotiation for Retail Electronic Commerce." *Proceedings of the Workshop on Agent Mediated Electronic Trading (AMET'98). Minneapolis, Minnesota, May 1998.*

7 Guttman, R., Moukas, A. and Maes, P.(1998b) "Agent-mediated Electronic Commerce: A Survey." *Knowledge Engineering Review, June 1998.*

8 Hill, W., Stead, L., Rosenstein, M., Furnas, G. (1995) Recommending and Evaluating Choices in a Virtual Community of Use. *Proceedings of CHI'95*.

9 Höök, K., Karlgren, J., Waern, A Lemaire,B. (1996) A glass-box approach to adaptive hypermedia'. *User Modeling and User-Adapted Interaction 6(2-3).*

10 Joerding, T. (1999) A Temporary User Modeling Approach for Adaptive Shopping on the Web. *Proceedings of the 2nd Workshop on Adaptive systems and User Modeling on the WWW, 1999.*

11 Jurca, A (1999) Online Travel Planning Survey. Technical report DMT-ISR//1/1999 *Ecole Polytechnique Federale de Lausanne, Switzerland.*

12 Langley, P., & Fehling, M. (1998). The experimental study of adaptive user interfaces *(Technical Report 98-3). Institute for the Study of Learning and Expertise, Palo Alto, CA.*

13 Linden, G., Hanks, S., Lesh, N. (1997). Interactive Assestment of User Preference Models: The Automated Travel Assistant. *In Proceedings of the Sixth International Conference of User Modeling, 1997.*

14 Mathé. N and Chen, J. (1996) User-centered indexing for adaptive information access. *User Modeling and User-Adapted Interaction 6(2-3).*

15 Nielsen, J. (1993) Usability Engineering, *Academic Press 1993*.

16 Plaisant, C., Venkatraman, M., Ngamkajornwiwat, K., Barth, R., Harberts, B., Feng, W. (1999) Refining query previews techniques for data with multivalued attributes *IEEE Forum on Research and Technology Advances in Digital Libraries (ADL '99).*

17 Rosewitz, M. and Timm, U. (1998) Electronic Sales Assistance. *Proceedings CHI'98 Workshop on Beyond Internet Business-as-Usual.*

18 Shardanand, U. and Maes, P. (1995) Social Information Filtering: Algorithms for Automating "Word of Mouth", *Proceedings of CHI'95*.

19 Spenke M, Beilken C, Berlage T (1996): FOCUS: The Interactive Table for Product Comparison and Selection. *In Proceedings of UIST '96, Seattle, 1996, ACM Press, 41-50.*

20 Steiger, P., M.Stolze and M. Good (1998). Beyond Internet Business-as-Usual: Report about a CHI 98 Workshop. *SIGCHI Bulletin 30(4).*

21 Stolze, M. (1998). Soft Navigation in Product Catalogs. *Proceedings of Second European Conference on Research and Advanced Technology for Electronic Libraries, Heraklion, GR.*

22 Stolze, M. (1999). Comparative Study of Analytical Product Selection Support Mechanisms. *INTERACT 99, Edinborough, IFIP*.

23 Svensson, M., Johansson, A., Ereback, A., Höök, K., Karlgren, J., and Bretan, I.. (1998). ``Moving Usability Testing Onto the Web". *In Proceedings of the 3rd World Conference on the WWW and Internet, Orlando, Florida, November. AACE*.

24 Thomas, C.G. (1996). Basar: A framework for integrating agents in the World Wide Web. IEEE Computer 28(5), 84-86.

25 Vassileva, J. (1996) A task-centered approach for user modeling in a hypermedia office documentation system. *User Modeling and User-Adapted Interaction 6(2-3) 185-223.*

26 Wexelblat, A. and Maes, P. (1998) Footprints: Visualizing Histories for Web Browsing, *http://wex.www.media.mit.edu/people/wex/Footprints/footprints1.html.*

27 Williamson, C., Shneiderman, B. (1992) The dynamic HomeFinder: Evaluating dynamic queries in a real-estate information exploration system, *Proc. ACM SIGIR '92 (Copenhagen, June 21-24, 1992) 338-346.*