The role of human Web assistants in e-commerce: an analysis and a usability study

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Abstract

Electronic commerce has recently shown enormous potential to take over a significant share of the sales market. There is a need to provide services that can reach individual computer users with different information profiles and levels of expertise. In this article the concept of Web assistants, human assistants working in an electronic Web shop, is presented. This human-computer collaboration provides intelligent and adaptive services via an integrated communication media. A prototype of a Web assistant system has been implemented. While browsing through the system the user can call for human assistance should the need arise. Presents the results of a usability study performed on the prototype system. Recent commercial moves in the direction discussed in this article increase the importance of the usability study. The results are encouraging, especially when it comes to the attitude aspects of usability. The subjects were extremely enthusiastic about the concept of Web assistants and its implications. The human Web assistant who participated in the field trial highlighted the importance of user modelling. Although the system is mainly in the context of electronic commerce, it can be used in many other contexts. These include home automation, digital libraries, and technical support, to name a few.

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Introduction

Web-based electronic commerce is just in its youth. Still, the amount of shopping on the Web in the USA has been estimated to be US$7 billion US dollars for Christmas 1999. These figures illustrate the existence of a huge potential market for electronic commerce. Consequently the improvements on the service provided by Web commerce systems will have large impact on sales figures and customer satisfaction.

In spite of the apparently warm reception for electronic commerce, most people are not willing to base serious decisions on information or recommendations provided by a computer program. Thus, trust is an important issue (Hoffman *et al.*, 1999; Ratnasingham, 1998). For example, in services for bank (Mols, 1998) or insurance matters customers need highly qualified help to make decisions. In such cases, when customers are about to make risky decisions the opinion of a human assistant may be very important as guidance (Friberg, 1998). One reason for this is that automated services are not intelligent enough. They are very limited and do not allow the customer to have a dialogue and ask follow-up questions or ask for explanations (Mertens and Schumann, 1996). People also tend to trust humans more than machines, at least when it comes to taking advice. Some experiments have shown that users have problems in placing the right level of trust in advice systems (Bonsall and Joint, 1991). In a study of a route guidance advice system it came out that the users had a very high initial trust that dropped quickly once the system made a mistake.

Another issue of importance is responsibility. Taking advice from a human assistant, the user at least has a name of someone to contact if anything goes wrong. Taking advice from a machine means that the responsibility situation is unclear.

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Social factors are of importance for customer services. This is indicated in (Petrelli *et al.*, 1999), where the results of an empirical study about visitors to three museums in Italy are presented. It turned out that visitors to the museums preferred human assistance compared to other forms of assistance. Petrelli *et al.* argue that this can depend on social aspects and the possibility of having intelligent interactions with humans.

Sales assistants in ordinary shops have the ability to adapt to a customer's personal information needs and requirements. An example of this is when a salesperson recognises a customer's decision style (Driver *et al.*, 1993), and adapts his/her assistance accordingly (Perrault and Brousseau, 1989). Another example is a salesperson in a local convenience store who knows the customers well, and can anticipate their needs and serve them in a personal manner.

A general problem with Web shops is that many people do not like computers or electronics in general. These people are not good at using the equipment since they do not understand how it works and they are afraid of the consequences of their actions. Therefore, the interface aspects of Web shops are important, and the interface needs to be flexible. This flexibility can come from the integration of several interface styles, such as natural language and hypertext browsing, but also from different kinds of services such as recommender systems and search engines. This way the user can choose the interface style or information service that is most appropriate for his/her personality or for the information need currently at hand. This kind of adaptive and intelligent system with a flexible user interface is lacking in the Web shops of today, and is what we are aiming at creating.

To summarise this discussion, we see a clear need for improvements in future Web systems. In the following list we identify important characteristics of such improvements.

- The system should be intelligent in the sense that the service provided is flexible and has a human touch.
- The system should be adaptive, meaning that the service is tailored to the information needs and requirements of the user.
- The system should support many interaction techniques. Several interface possibilities should be present to suit users with different needs (e.g. different interaction styles like natural language interfaces for voice or text chat together with the more common hypertext browsing and the typical Web forms and menus).

We have designed, implemented and evaluated a system intended to be a first step towards these improvements.

In the following we will sometimes refer to the concept of a Web site. We define a Web site to be a collection of related Web information pages with a common purpose or domain together with the functions available from these pages. The pages are distributed to users through a number of Web servers.

The remaining parts of this article are structured as follows. In the next section we describe the design of a flexible system that allows adaptive and intelligent service for electronic commerce. After that we present a usability evaluation of a prototype implementation of our proposed system and a discussion of the results and the lessons learned. Next, we give an overview of related work, and finally we conclude and give directions for future work.

Web assistants

Until the day a machine or program is produced that can pass the Turing test successfully (Michie, 1993), humans' role in personal interactive services cannot be underestimated. We thus introduce the concept of a Web assistant. The task of a human Web assistant is to assist and collaborate with the customers of a Web shop. Web assistants will bring the flexibility and human touch to services that today's technology is nowhere near. Web assistants can provide adaptive assistance by having access to knowledge about the customers, for example knowledge gained from conversations with customers (Elzer *et al.*, 1994; Perrault and Brousseau, 1989). For brevity we will sometimes refer to Web assistants simply as "assistants" in the following.

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In Figure 1 we illustrate the structure of our proposed system. The Web shop is a Web system for electronic commerce (a typical example is Amazon.com). The user model contains information about customers. The assistant's role is to support the customers of the Web shop. Many assistants can work at the same time, helping different customers.

The communication between the customer and the system takes place via a single user interface. The customer can choose to use the system as a traditional Web shop, and ask for assistance if he/she wishes.

The assistant has access to the Web shop as an information source to deal with enquiries. The assistant can also follow the customer's actions in the Web shop. This gives interesting possibilities for collaboration between a customer and an assistant.

User interface

In Figure 1 we illustrate the primary interface functions of our system. The customer can interact via the browser, a chat window or via a phone or any combination of these. Chatting with an assistant while browsing is possible and also very useful for the collaboration between a customer and an assistant. The phone, in combination with the browser, can be a particularly useful option for a beginner to the system. Then an assistant can guide the customer to use the system as well as to look for the items in the shop. Other interface functions can also be incorporated, for example by adding functionality for voice chatting or video.

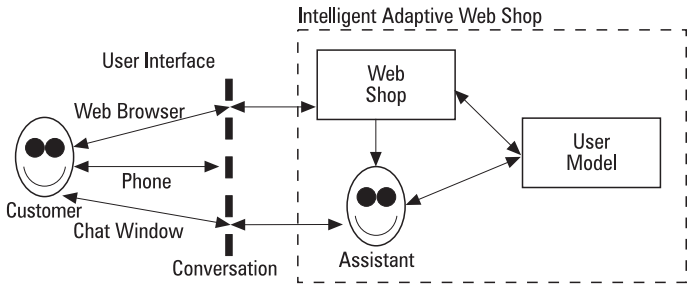
User modelling

To be able to give adaptive service, information about the user is needed. A user model contains information about the user that is useful for system services. Aspects of the user such as the goals, interests, preferences, and knowledge can be modelled. A survey of user modelling for adaptive systems is given (McTear, 1993). Information in the user model can be used by an assistant in a conversation with a customer. The information can help the assistant to assume the correct communication level, and make suggestions to fit the preferences and goals of the customer. It can also be used for the computer-based help functionality in the Web shop. For example, preference information in the model can be the basis for a recommender system (Resnick and Varian, 1997).

A very important aspect of user modelling is the acquisition of the information about users to be represented in the user model. An overview of many different acquisition techniques are given in Chin (1993). The task of recognising and utilising a user's preferences in consultation dialogues is studied in Elzer *et al.* (1994).

Our proposed system provides many different interaction possibilities for the user. This means that there are also many potential sources for user model acquisition. In the Web shop, questionnaires and explicit feedback forms on preference for products can be used to collect user data. Also implicit data can be useful, such as the purchase history and browsing patterns of the user. The conversations between a customer and an assistant also provide a valuable source for personal information about the customer. In Elzer *et al.* (1994) different situations where a user provides information about his/her preferences in a consultation dialogue are identified. Volunteered information from the user is often more reliable than implicitly gathered information. However, some findings clearly point out the potential usefulness of implicit acquisition techniques (e.g. Konstan *et al.*, 1997; Nichols, 1997).

Figure 1 System structure



Examples

As an example of how the system works consider the following scenario. Mary is a regular customer at a Web shop. She logs in and begins to browse among the information looking for items that could satisfy her current need. After a while she needs help to decide between two items of a similar kind. She also wants to know if there are any good alternatives to the items that she simply cannot find in the

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shop. The information and the help functionality available in the Web shop is simply not enough to enable her to make up her mind. She calls for assistance by pressing the corresponding button. A chat window pops up and an assistant greets her by name. The assistant asks her if she is satisfied with her latest purchase. Mary explains what she thinks about it and she then goes on to ask some questions regarding her current problem. While Mary is chatting with the assistant she continues to browse in the shop, checking up on things that the assistant recommends. The conversation continues until she makes up her mind, and quits the chat connection to the assistant. She then goes on to purchase the items she chose.

Notice that Mary's preference for how to do shopping (e.g. lots of chatting, or just concise information exchange) can influence how the conversation proceeds. She also has the possibility to choose the communication media (e.g. chat window or voice connection).

The same scenario from the assistant's perspective could be as follows. John works as a Web assistant for a company. He gets a request from the assistant router that a customer needs assistance. He quickly checks up on the customer (evidently called Mary) and reviews the latest purchases and some other data from the user model. He then greets her by name and asks if she was satisfied with her latest purchase. Mary answers and asks some questions on a few of the products and he answers the best he can, sometimes using information from the Web shop to check up on details, and sometimes using the user model to get ideas of what Mary potentially likes. He attempts to fit his conversation style to Mary's personality. When Mary is satisfied and ends the conversation, he updates the user model with the new knowledge he has gained about Mary from the conversation. He then tells the assistant router that he is ready to help another customer.

The user modelling component reduces the risks of John making mistakes in his communication with Mary (e.g. suggesting items not useful), it also saves time by allowing the conversations to be more efficient. Note that John must be observant of how the conversation proceeds to be able to adapt to Mary's communication profile. While this kind of sensitivity and adaptability is no match for a trained assistant like John, it is completely impossible for a computer program (at least with the current technology).

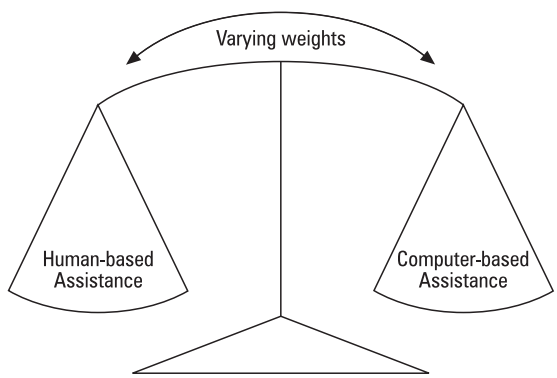
Balancing the assistance

An important aspect of our suggested Web assistant system is that the human-based assistance (in the form of Web assistants) and the computer-based assistance (in the form of help functions in the Web shop) can be given different weights. We illustrate this in Figure 2. It can be used in two main ways as follows.

First, the system can be implemented differently for different Web sites depending on the particular needs and resources available for a particular site. For example, if human-based assistance is very important in a site, perhaps because the user's trust is vital, then the human assistants can take the largest part of the assistance, by providing an extensive Web assistant support. This is of course assuming that the site has the resources needed to employ human assistants. Conversely, if the site is limited in its complexity and most of the functionality for assistance needed can be solved by a computer-based system then the human assistance can be given a smaller weight (e.g. by only answering complex questions, or question of a certain kind, and thus limiting the number of assistants employed). We call balancing of this kind for *set-up adaptation*.

Second, the assistance can be balanced over time in a site. As technology and artificial intelligence advances it will be possible to replace part of the responsibilities of human assistance by computer-based counterparts

Figure 2 Setting the balance of the assistance



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employing the new technology. This means that resources can be saved by reducing the number of assistants. An example of how the weight can shift over time between the two approaches to assistance is as follows. When a Web site is first set up with computer-based and human-based support, many questions are put to the human assistants. As time passes the questions and the answers are collected, polished, structured, and placed in a file for frequently asked questions (FAQ), that is made accessible to the users. Then, as users make more and more use of the FAQ, the rate of questions asked of the assistants is limited, and resources can be saved. We call this kind of balancing for *run-time adaptation*.

Evaluation

In an attempt to evaluate the concept of Web assistants, we have implemented a prototype system on which we have performed a usability study. The purpose of this particular evaluation is to test users' first reactions and subjective feelings towards the system after having tested it in a realistic scenario for a short time. This means that we only evaluate the first of the three goals presented in the introduction section, namely the flexibility and the human touch of the system. The relevance, efficiency, attitude and learnability (REAL) model for usability (Löwgren, 1993) has been used for the evaluation. We have also studied the system from an assistant's point of view by interviewing the assistant who participated in the experiment.

Prototype system

In Figure 1 we presented the general structure of our proposed Web assistant system. The prototype we implemented for the evaluation is a somewhat limited version of this system. The prototype was implemented using the agent framework described in Kindborg *et al.* (1999). Since we want to test the first spontaneous reactions of users after only a short introduction we cannot collect sufficient data to employ a sophisticated user model. Therefore the user model just consists of personal data about the current user and is not connected to the Web shop. The data is gathered in the initial phase of the test. Another restriction of our prototype implementation is that the assistant cannot follow or guide the user's browsing (i.e. the actions the user takes in the Web shop). Thereby the assistant has no access to this potentially important source of information about the user. This kind of assisted browsing will be a future extension to our prototype.

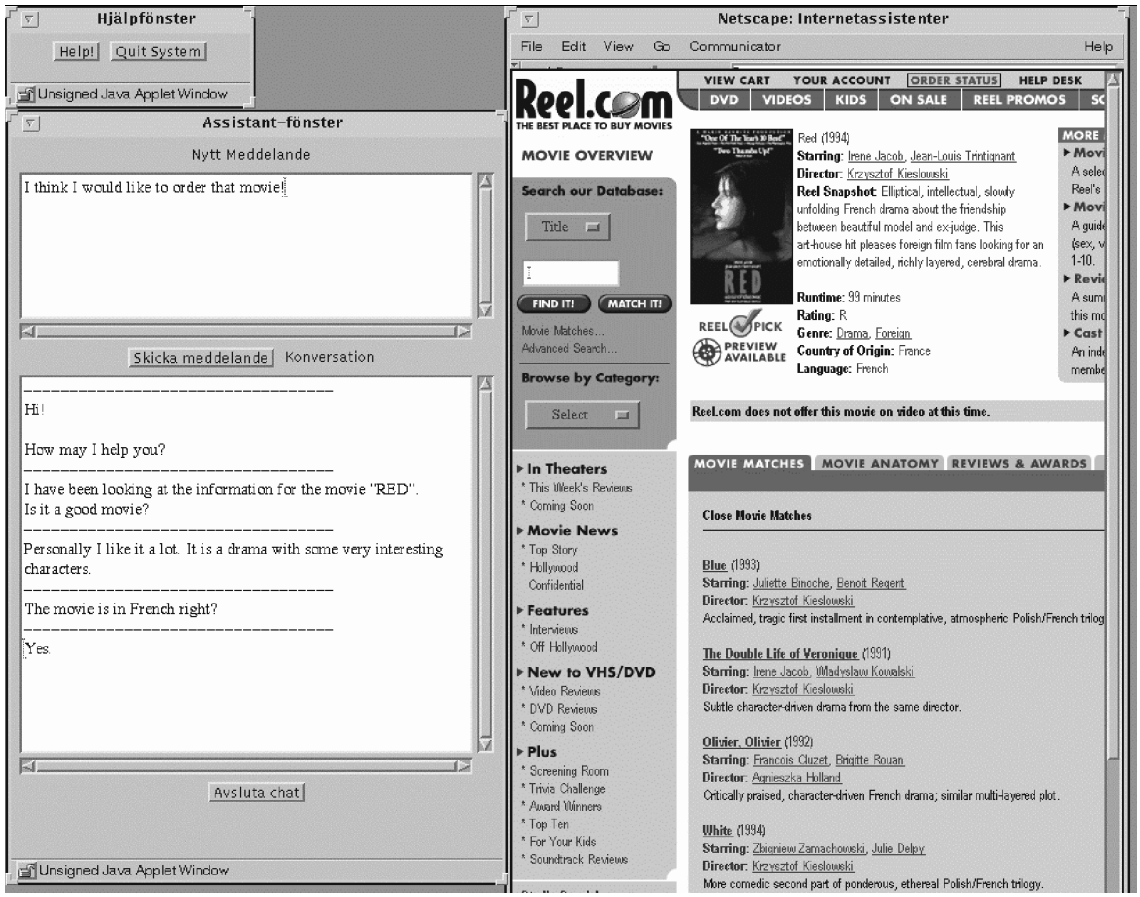
In Figure 3 we show a screen shot from the prototype implementation as it was used in the evaluation. The window to the right in the figure is the Web browser. Via this window the user can navigate the information in the site and also access the computer-based assistance provided. The little window on the top left corner of the figure is the key to human-based assistance. By pressing the help button there, the system locates an available assistant and establishes a connection between the user and the assistant. This connection is the chat window displayed to the left of the browser in the figure. In this window the user can have a real-time conversation with an assistant, and still be able to browse the information in the site and use the computer-based assistance at the same time.

Method

The method used for the evaluation was a field trial. The main advantage with this method compared to a laboratory test is that we let subjects try out our system from their home or their work which is their natural Web shopping environment. We chose to connect our prototype to www.reel.com, which is an existing state-of-the-art Web shop for videos. The assistant we selected is a professional computer consultant and thus is a fast typer and is also familiar with the Web. This person also has a substantial knowledge of movies. These are two qualifications that we regard as generally important for assistants. During the tests the assistant was located in a room to himself close to the authors' offices.

There are several reasons why we chose to test our system in a setting with movies. All people know about movies and have a certain individual opinion. Still there are many different levels of knowledge about movies, from complete novices to highly addicted cineasts. Further, the number of available movies is very large and thus there is a clear risk

Figure 3 Screen shot from the prototype



of information overload (e.g. Wurman, 1989). Movies share these characteristics with many other types of objects that are available in Web sites. This means that our results can likely be generalised to many other domains.

The field trial consisted of three parts. First, the subject had to log in to the system and submit answers to personal questions such as age group, Web experience and taste in movies. This information was stored in the user model which was accessible to the assistant as a help when answering questions asked by the subject.

Second, the subject had to perform two exercises in the system in order to get a decent experience with Web assistants. The exercises were formulated in such a way that they could potentially be solved using the functionality in the Web shop, but using an assistant would probably make the exercises easier. In the first exercise the subject was asked to name three of his/her favourite movies and find three movies with similar plot and three movies with similar actors. In the second exercise the scenario was that the subject would rent three videos together with two friends (the favourite movies of the friends were provided). The requirement on the rented movies was that the subject and the two friends would all like the movies. The subject also had to decide when he/she had found movies that were good enough. The conversations between subjects and the assistant took place through a chat interface. No voice connection was used. All conversations were logged.

Third, the subjects had to answer a set of evaluation questions. The questions and the answers are presented in Table I. The questions were formulated to evaluate the different aspects of usability. The subject had to indicate his/her disagreement or agreement with each question according to a 1 to 10 scale (1 = no, not at all; 10 = yes, definitely).

The assistant only had one subject to deal with at a time. The subjects spent an average of an hour-and-a-half with the experiment as a whole. The evaluation questions took approximately half-an-hour to answer. This means that an average of one hour was spent on

Table I Questions and answers regarding usability

Usability questions according to REAL	Answers Mean	Minimum	Maximum
Questions regarding relevance			
Do you believe that Web assistants make it easier for customers in a Web shop?	8.9	8	10
Do you think that Web assistants are a good idea?	9.1	5	10
Questions regarding efficiency			
Do you think you can get flexible and good help from a Web assistant?	7.7	3	10
Questions regarding attitude			
It is fun to be able to have a dialogue with a Web assistant	9.0	5	10
Does the atmosphere become more personal in a Web shop with Web assistants?	9.1	7	10
Does your trust of a Web shop increase if you can get help from a Web assistant?	9.3	5	10
Would you want Web assistants in other Web shops too?	9.2	6	10
Questions regarding learnability			
Do you think it was easy to get started and get help from a Web assistant when you needed it?	8.2	3	10

the exercises. We noticed that the last exercise in particular was difficult for many of the subjects, and was also where they spent the majority of their time. They had to decide themselves when to stop, and thus when they had solved the exercises to satisfaction. Some subjects were self-confident and quickly decided that they had good solutions. Others spent some time in verifying that they had not missed any alternative solutions.

We had nine subjects who were geographically distributed throughout southern Sweden. Some were colleagues and students of the authors, secretaries at the department, and in some cases the subjects were recommended by friends of one of the authors. There were five female and four male subjects. They had different backgrounds, e.g. different kinds of previous experience with computers and the Web (from beginners to professionals), different amounts and types of education (junior high school, senior high school, master of science in different areas, up to PhD in computer science) and different age groups (from 16-25 up to 46-55).

After the field trial we conducted an interview with the person who acted as assistant in the experiments. The purpose was to get more information about the role of an assistant. The interview was carried out a few months after the actual experiment, and the assistant was offered the logs of the conversations that took place as a memory aid. According to the assistant, he still had a very clear memory of the experiments. Questions were asked about the contact with users, for example how the communication between the assistant and the users worked. We also asked questions about the work situation as an assistant, for example if it was stressful. The interview was organised as a set of questions sent via e-mail. In some cases follow-up questions were asked for clarification of the answers.

Results

In Table I the evaluation questions and the answers are presented. Below we provide a selection of the comments we received from the subjects regarding the different aspects of usability. The very large majority of the comments were positive. We attempt to reflect this in our selection of comments. We also try to present as large a diversity of comments as possible. The questions and the comments have been translated from Swedish by the authors.

> I am a bit scared of computer technology and Web assistants make me feel much more confident.
>
> Web assistants are useful when you do not have time to search for information and sometimes

when the structure of a Web shop is very complicated.

You can ask any kinds of questions without having to worry about what kind of questions the system can handle.

If you have complex problems I think a voice connection to the assistant would have been better, but for minor problems a chat interface is fine.

This was the best thing I have ever tested on the Internet.

I would have left the Web shop much earlier if there had not been any Web assistants.

Web assistants are good because then you do not get lonely while you are browsing.

It is good to be able to ask questions in natural language.

The problem with a chat system is that it takes a while before you get the answer, so it is easy to get impatient and try to solve the problem on your own. This is partly why I probably would not make use of a web assistant unless I really got stuck on some problem.

It felt like having someone to hold your hand, which feels good if you are insecure.

There are many reasons why I think Web assistants are a good idea. One is that surfing is so impersonal otherwise. Another is that it could create important jobs in the sparsely-populated areas. But first and foremost because it felt so extremely good.

I think the usefulness of Web assistants is dependent on how good the assistant is.

It was easy to get started but the assistant answered too slowly.

Even a long-time computer addict like myself actually got an aha-experience for the increased value that a living person gives. To be able to ask vague questions and to feel the presence, to feel that someone is interested in helping me is something other than surfing. But both ways are needed.

I think that Web assistants would make it easier for customers once they get used to the concept. I think that inexperienced computer users are more apt to ask for help than experienced users – we are used to manage ourselves, so there is a bit of resistance to ask.

In the following we present the questions we asked the assistant and a summary of the answers. For brevity, we have attempted to extract the most important aspects of the answers as a summary for each question. The original questions and answers were formulated in Swedish. We start with the questions related to the contact with the users.

- *Was it possible to get an impression of a user's personality based on the conversations?* Some users were more talkative than others, and some motivated their taste in movies, which allowed me to get an impression about these subjects. Any modification of my communication style with a user was probably based on the information in the questionnaire and not on the actual conversation. Maybe the fact that the scenarios that they were working with were predefined in the experiment limited the possibility of getting an impression of the subjects' personality!
- *How was the initial contact with the users?* Most often they asked very concrete questions directly.
- *Could you identify different types of users?* In some situations I drew conclusions about their computer and Internet experience based on the terminology they used.
- *Did the users communicate their problems in an understandable fashion?* Generally yes, although in a few situations there was some misunderstanding about where the user was currently located in the hyperspace of the site.
- *Did you get any impression of the users' reactions on the help they got?* I think they trusted me, and if they were not sure about my recommendations they asked follow-up questions. It is also my impression that they did not consider the chat interface to be a limitation for having conversations.

We now continue with the questions and answers related to the work situation as an assistant.

- *Were you stressed at any occasion when you received questions?* No, but sometimes I wished that the Internet connection was quicker, because I wanted to give the users answers within a reasonable amount of time.
- *What is your opinion towards extra tools for facilitating an assistant's work process?* Having a fast access to the assistant's information sources is very important. Apart from that I think that having an interested and knowledgeable assistant is enough.

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- *What is your opinion on the process of moving from helping one user to another?* I think it can be confusing and that the assistant keeps references to properties of the previous user while helping the new user. Perhaps this process can be facilitated by clearly indicating the change from one user to another in the interface.
- *What are the most important characteristics of a good Web assistant?* I think that domain knowledge is most important, because it takes a long time to search for information to users' questions. Social knowledge and skills are also of importance so that one can keep the communication on the right level, and not irritate the users with irrelevant information. The need for computer experience is less important, especially if the assistant's interface to the system is well designed.

Discussion

When analysing the results from the usability study presented above it is noteworthy that the low scores on the questions (i.e. below 5) were all motivated by the restrictive chat interface. This was not unexpected since the chat interface is rather crude and could definitely be improved. Observe though that the subjects who used the assistants most also did best on the exercises (in the sense that they got satisfactory answers quicker than the other subjects, and that they seemed more satisfied with their answers). However, these comments contradict the assistant's opinion that no subject considered the chat interface to be a limitation.

The subjects asked the assistant a range of different kinds of questions. It was common to ask questions of a simple nature like how to find information about some item in the shop, or how some particular functionality in the shop worked. It would definitely be possible to provide computer support for this kind of question. Such extensions are especially important when one considers the problems of feasibility discussed in the conclusions. Note though that even if computer support were introduced to deal with these kinds of problems, some customers would still prefer to use human assistants. This was evident from the information we got in our evaluation. One reason for this seems to be that the special human touch of a conversation with a Web assistant is very important.

Subjects also asked questions of a more complex and subjective nature, such as "Has the actor X done any movie similar to the movie Y", or "Do you think that my friend and I would like the movie X?". Finding an answer to such questions requires more effort by the assistant and having a dialogue with follow-up questions is essential. This kind of support is difficult to automate. The Web shop we used in our field trial has advanced search functionality. Still, it was not enough for the subjects to solve their exercises. In some cases the search functionality allowed them to find potential solutions, but they still wanted to verify it with the assistant. The conversations that follow these kinds of complex questions usually take several turns and can go on for a long time. We hypothesise that using an advanced user model can make these conversations shorter and more efficient. In our experiment the assistant had very limited information about the customers and basically had to start from scratch with each customer.

It is interesting to study the way the subjects tried to explain their preferences and taste in movies to the assistant. They used quite general statements of a different nature than the information typically gained by the more traditional user model acquisition methods. For example, one subject said "I like movies by John Travolta because he is so good looking". Another said "I generally like movies with sci-fi theme and UFOs, I do not mind if they are really bad, that is just cool". In Elzer *et al.* (1994) four different conversational circumstances have been identified where a user provides information about his/her preferences in a consultation dialogue. From our experiments we can confirm that all four situations do indeed occur naturally and quite frequently. This is a strong indication to the usefulness of conversations between a user and an assistant as a user model acquisition source for preferences.

There was great variety in how much the subjects used the assistants. Some of the more experienced computer users were confident in

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their abilities to solve the exercises on their own. However, they confessed that they would make more use of the assistants if they had to solve the exercises again, because they thought it would be more efficient.

As mentioned previously, we performed a small scale field trial with nine participating subjects. While the subjects had different backgrounds it is still a small number, and part of future work is definitely to continue the field trial with more subjects. However, since every single subject was very positive and gave generally high scores to most questions it is a strong indication to the usability of the concept of Web assistants.

The assistant commented that it was difficult to get an idea of the personality of a user during a real time conversation. Instead he relied on the limited user model that was available. This indicates the potential for a more advanced user modelling component. Conversational data of importance can be extracted and structured by the assistants at times when they are not assisting users. Having this data available in a structured form while assisting the user gives the assistant a better chance to adapt to the user's personality.

Related work

There have been recent commercial moves in the direction discussed in this article. Companies such as LivePerson (*liveperson.com*) and FaceTime (*facetime.org*) now offer commercial systems for human assistance in Web sites. This trend increases the importance of the kind of studies that we have described in this article. There is a clear need to analyse how users interact with the system and how to serve them the best way.

While the systems currently offered by LivePerson and FaceTime are clearly similar in spirit to the system we propose and analyse, there are some important differences. First, there seems to be no explicit connection between the live help system and the computer-based help functions available in a Web site. In this article we have argued for the potential of such a connection for providing adaptive computer-based services. Second, user modelling seems to play a rather limited part in the systems. The system by FaceTime logs all conversations and allows the human support agents to take notes about customers. This information can be used by the agents in later conversations with the same customer. This user modelling support can be seen as a first step, but there is definitely a need for more research on this topic.

At the University of Saskatchewan Jim Greer, Gordon McCalla and colleagues are working on peer-help systems (e.g. Greer *et al.*, 1998; McCalla *et al.*, 1997). A peer-help system has been used in an intelligent help desk supporting students in an introductory course in computer science. Human computer co-operation is important in the system. One component of the system supports students with electronic help in the form of a subject-oriented discussion forum and FAQ-lists. Another component provides human help by suggesting an appropriate peer that can give human help.

Kristina Höök and colleagues argue for the usefulness of combining human and machine intelligence to achieve filtered information. In Höök *et al.* (1997) they describe an approach which they call "edited adaptive hypermedia". The idea is to have a human editor who collects and structures information for the benefit of other information users. User profiles are suggested to handle the individual user interests and preferences. The editor is supposed to be an expert in the special domain and also an expert computer user and have various search tools at his or her disposal. The advantages with having a human editor in combination with machine intelligence in the form of advanced search tools are, they argue, that users find it easier to place the right level of trust in a human compared to a machine, and that humans usually have a greater flexibility and domain knowledge than machines.

The collaboration of humans and machines is a central issue in the related work outlined above. This can be seen as support for our approach of integrating human assistants in Web shops.

Call centres are similar to the Web assistant systems we propose in this article. Human agents are assisting customers via a phone connection. The agents can have so called call centre systems to facilitate the process of assisting the customers. These systems contain

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scripts that dictate the communication of the agent during the call processing. The formalisation of such scripts using petri net theory is studied in Anisimov *et al.* (1999).

Several researchers have compared the service provided in today's state of the art electronic Web shops with the service given by assistants in ordinary shops (e.g. Jörding, 1997; Schumann *et al.*, 1998). It is argued that the electronic counterpart is lacking in the kind of service that can be provided.

Conclusions and future work

Initially we set out to design and implement a system with the following three properties (as described in the introduction): First it should be intelligent in the sense that it is adaptive and has a human touch. Second, the system should be adaptive, meaning that the service is tailored to the information needs and requirements of the user. Third, the system should have a flexible interface, to suit users with different needs.

Based on the results of the evaluation we can conclude that we have clearly satisfied our first goal. The subjects were extremely enthusiastic and indicated that they got truly adaptive support and enjoyed the special human touch of the system.

We cannot claim to have fulfilled the second goal since we have not tested an advanced user modelling component. However, based on the collected data from conversations between the subjects and the assistant, we conclude that conversations is a user model acquisition source that could be valuable for fulfilling the goal of personal support and should be of interest to the user modelling community. We also have indications from the person who played the role of the assistant that an assistant could be of help when it comes to separating the important information from the noise in the conversation data.

As for the third goal we have not evaluated the interface aspects of our proposed system (we only used the chat interface to assistants in the evaluation). However, some subjects suggested improvements of the system by introducing a voice interface to the assistants, which is actually already part of our proposed system. We interpret this as an indication that we are on the right track towards fulfilling the third goal.

An important issue with Web assistants is whether it is technically and economically feasible. The chatting in itself is not much of a problem. What could be a difficulty though is if there are a massive amount of simultaneous users wanting assistance at the same time. Then some kind of routing functionality would be needed to queue up users for the assistants. Many large sales companies have call centres for customer support open 24 hours a day. Then Web assistants would be a natural extension to the electronic commerce market. Currently many sales companies are training their employees in the technique of servicing customers. This training will come in handy for Web assistants. For small companies the concept of Web assistants may be too expensive to realise.

The most important part of our future work is to design and test a user modelling component. The agent framework used for the prototype implementation has good extensibility (Kindborg *et al.*, 1999), allowing for a simple inclusion of such a component. We hypothesise that using conversations as a user model acquisition source could play an important role in this task. We are currently considering work on user modelling in dialog systems for this purpose. Testing our system with a more flexible interface such as the suggested voice connection to assistants is also an interesting part of the future work.

The problems with feasibility mentioned above need to be dealt with in real world applications. In many cases it may not be feasible to let customers have human assistance for every possible reason, for example for trivial questions. A compromise between the quality of service and the waiting time for the customers may be necessary. Therefore we would like to investigate whether assistants can help in identifying problems common to many customers. An attempt could then be made to provide automatic help with these problems (when possible), perhaps by introducing new help functionality in the Web shop or by extending the knowledge in the user model. The goal of these extensions is to improve the quality of information provided to the customers and thereby reduce the number of redundant questions to assistants.

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