

An Empirical Study of Web Personalization Assistants : Supporting End-Users in Web Information Systems

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Abstract

Currently, the two main techniques for achieving personalization on the Internet involve direct manipulation and software agents. While both direct manipulation and software agents are aimed at permitting end-users to finish tasks rapidly, efficiently, and easily, their methodologies differ. The central controversy involving these personalization techniques derives from the amount of control that each grants to – or withholds from – the end-user. Direct manipulation interfaces afford control and predictability to end-users[6]. Alternatively, the use of software agents captures or records user's personalized preferences by employing artificial intelligence techniques[2]. In this empirical study, two end-user Web personalization tools are evaluated. One of them, WebPersonalizer[4], is an agent-based end-user personalization tool; the other, AntWorld[3], is a collaborative recommendation tool which provides direct manipulation interfaces. The purpose of this study is to determine the strengths and weaknesses of each opposed technique—direct manipulation and software agents—as a Web personalization assistant. In addition, we suggest the hybrid paradigm for EUP (End-User Programming).

1. Introduction

The Internet has become a single, global database that can be accessed easily and widely. However, with the increase in the number of accessible sites, it becomes a very important – as well as a difficult job – to retrieve from tens of thousands of organizations, as well as millions of personal pages, the kind of accurately tailored information we as users need. Sometimes reaching this goal requires tremendous time and effort. If the intelligent software components, the agents, can assist end-users by recommending

related pages based on their personal histories or behaviors, the job of quickly and conveniently retrieving necessary information can be more effectively accomplished. According to Pattie Maes, as computers and networks reach a larger population of users, the current dominant metaphor of direct manipulation – which requires the user to initiate all tasks explicitly and to monitor all events – might be considered inconvenient by new, untrained users[2]. The alternative, complementary style of interaction, called “indirect management,” would engage the user in a cooperative process with agents, computer programs which have become known as the intelligent personal assistant.

Against Maes' opinion, it is argued that direct manipulation user-interfaces have shown their usefulness for over two decades and still have dramatic potential for bringing greater comprehensibility, predictability, and control to advanced Web information systems[6]. At the 1997 CHI Conference, for example, Shneiderman suggested that he is skeptical that user intentions are so easily determined by agents. However, if users can specify what they want with comprehensible actions selected from a visual display, then they can more often and more rapidly accomplish their goals while preserving their sense of control and accomplishment[7].

If the goal of any Web personalization assistant system is to support end-users, the key question that must be asked of it is how well – how effectively and efficiently – it can retrieve each person's individualized preferences in regard to information and knowledge. A personalization tool should offer modeling of Web objects (documents, etc.) and subjects (users), categorizing of objects and subjects, matching between and across objects and/or subjects, and determining the set of actions to be recommended for personalization[4]. Humans have the capability of determining another person's tastes merely by observing behavior. A Web assistant system should also identify the user's

preferences in an effective way, either through a direct manipulation interface or with the aid of software agents.

Ideally, results of the empirical study represented by this paper would give some idea how end-users tend to feel about those two approaches, direct manipulation and software agents.

2. Background

2.1. WebPersonalizer[4]: an Agent-Based Personalized Recommendation Tool

The WebPersonalizer[4] system relies on the Web server log files and the hypertext structure of a site. The WebPersonalizer's recommendation agent uses the normalized cosine similarity measures for vectors. Given a profile C and an active session S , the profile matching score is calculated as follows:

$$match(S, C) = \frac{\sum_k W_k^C \cdot S_k}{\sqrt{\sum_k (S_k)^2 \times \sum_k (W_k^C)^2}}$$

Essentially, WebPersonalizer[4] is a personalized recommendation tool that makes the process both automatic and dynamic by using data mining techniques.

2.2. AntWorld[3]: a Direct-Manipulated Collaborative Recommendation Tool

AntWorld[3] provides a direct manipulated interface to ask end-users' evaluations about whether the recommended documents are beneficial to their goals, and utilize this feedback for other user's future queries. With AntWorld[3], a small "console window" floats on top of the Web browser. This console window provides two-way communication with the Organizational AntWorld[3] Server, with various utility menus. Those menus permit the end-user to perform a variety of tasks. Also, the console window explicitly solicits the user's judgment (and, optionally, annotation) on the relevance of the sites being visited. This directly manipulated feedback technique separates AntWorld[3] from other popularity-ranking systems.

AntWorld's quest-matching method is largely based on Vector Space Model. Using a vector model, the relevance of document d for query q is computed as

$$Sim(d, q) = \frac{u(q) \cdot v(d)}{\|u(q)\| \|v(d)\|}$$

The design of the actual document-ranking method defines how vectors $u(q)$ and $v(d)$ are computed.[3].

3. Experiments

Data for this empirical study was gathered using a variety of methods. To determine subjects' background knowledge of recommendation systems and the frequency with which they use personalized tools, a general survey[5] was conducted during the orientation session. For the benchmark test, each subject was asked to solve four problems. The problems were divided into two groups for each software system, and each group had two sub-problems. The problems asked study participants to locate certain information on the Web with/without the help of the software. During the test, subjects were encouraged to think aloud. After the evaluation, brief interviews were conducted with each participant in order to gather qualitative data about individual preferences for and opinions of the two systems. Subjects were also asked to fill out a questionnaire related to their usage of the systems. The test sessions lasted from 45 to 50 minutes.

4. Results

Results for the average number of pages participants had to visit to complete each task are indicated in Fig. 1. For Problems $W1$ and $W2$ participants used the WebPersonalizer[4] system, while Problems $A1$ and $A2$ were tested with the AntWorld[3] system. The black bars represent the average number of pages the subjects had to visit before completing the tasks using each system; white bars represent the average number of pages without using each system. The results concur with the average task completion times. When subjects were assisted with WebPersonalizer[4], they could solve Problem $W1$ by visiting about 59% fewer pages and Problem $W2$ by 43%. However, when subjects used the AntWorld[3] system, they had to visit more pages to solve Problems $A1$ and $A2$.

The result of the questionnaires conducted after the experiments supports the poor overall performance results of AntWorld[3]. For example, in response to the questionnaire statement, "Using the system in my job would enable me to accomplish tasks more quickly," the subjects replied in the negative more times for AntWorld[3] than for WebPersonalizer[4].

5. Discussion and Future Research

As indicated by a special August 2000 issue of *Communications of the ACM* dedicated solely to the topic, Web personalization has become a critical issue in human-computer interaction. Demand for such personalization is increasing on all fronts.

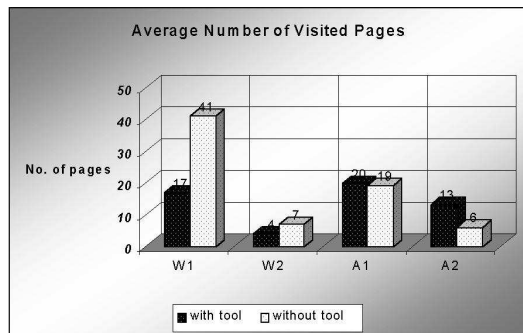


Figure 1. Average number of visited pages

In fact, the survey conducted during the orientation session for this empirical study verifies the demand for personalization. Five of the six subjects agree that it would be helpful and convenient for a web site to “remember” personal information about them. And all of them agree that they are willing to give information about themselves in order to receive an online experience truly personalized for them.

The study also reveals interesting results in the respect to the issue of system usability. The benchmark test results emphasized the importance of user interface and ease of use. While it is crucial to be able to capture user-specified information exactly, ease of use and simplicity of operations are even more important. The poor benchmark task results for AntWorld[3] largely derive from the poor design of the system. Each subject reported difficulty getting the system to perform as he or she wished. Although the “console window” of AntWorld[3] provides various utility menus, most of subjects were unskillful to manipulate those various utilities at will. As subjects gain more experience in AntWorld[3], the better results might be come up. In contrast to AntWorld[3], WebPersonalizer[4] did not impose any burdens on subjects. The subjects did not have to learn anything new or special in order to use WebPersonalizer[4]. They simply had to click on the recommended hypertext links to jump to other documents, just as they would when doing everyday browsing.

The other important point to consider regarding AntWorld[3] is that the system depends on direct manipulation to ask end-users’ evaluations whether the recommended documents are beneficial to their goals, and this feedback is then used for other users’ future queries. Although this procedure can result in highly accurate feedback and evaluations from end-users, the approach does have its drawbacks. Generally, users tend not to provide evaluation or comments, even if the effort is minimal, such as marking a check box. Because a user believes that her own contribution will be mixed with other’s and she will not be benefited

directly, she is loafing on other’s contributions. The possibility exists then, for scant feedback. In benchmark tests, only two subjects provided their evaluations for the recommended documents. Providing incentives to motivate users to provide evaluations and feedback would be an interesting topic for future empirical research.

6. Conclusion

Personalization technology ranges from commonplace use of databases, cookies, and dynamic page generation, to esoteric pattern-matching and machine-learning algorithms, rule-based inferencing, and data mining[1]. In this empirical study, we have focused on two Web personalization systems that use two different paradigms for human-computer interaction: *direct manipulation* and *software agents*. Each approach has its own advantages and disadvantages. In the respect to EUP, we believe that combining these two approaches and creating a hybrid paradigm might prove more interesting and more fruitful. Such a system would allow each end-user to program his or her own agents using a method of direct manipulation. In this way, the user can enjoy the best of both worlds.

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