The PersonaWeb System: Personalizing E-Commerce Environments based on Human Factors

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Abstract. This demonstration paper presents the PersonaWeb system, an adaptive interactive system that personalizes the visual and interaction design aspects of E-Commerce product views based on individual differences in cognitive processing. The PersonaWeb system consists of three main components: i) the user modeling component in which explicit and implicit user data collection methods are performed for eliciting the users' cognitive processing factors; ii) the content management component for creating and managing structured Web content; and iii) the adaptive user interface that is responsible for performing rule-based mechanisms for deciding and communicating a personalized visual and interaction design according to the users' cognitive characteristics.

Keywords: Human Cognitive Factors, E-Commerce, Personalization System.

1 Introduction

The growth in size and usage of applications and services in the World Wide Web has established Internet as the ground for commercial business. With the advent of globalized applications and heterogeneous interaction device types, there is an increased need to incorporate personalization techniques in E-Commerce systems in order to more conclusively meet the requirements and needs of individuals and their overall context of use [1, 2, 3]. Practitioners and researchers have already proposed a number of different approaches for personalizing the visual and interaction design of E-Commerce systems (e.g., recommender systems, responsive design, etc.) [1, 2, 3].

Nevertheless, existing personalization approaches in E-Commerce have primarily focused on user models describing information about the users' characteristics related to the tasks, goals and particular domains of E-Commerce systems, and not the intrinsic users' perceptual characteristics that define them as individuals (e.g., cognitive processing abilities). Furthermore, a number of theories on individual differences exist suggesting that users have different cognitive processing styles and abilities [4,

5], and various studies have shown that these differences affect task performance and user preference in various application domains of interactive systems [6, 7].

Bearing in mind that users' buying behavior and interactions in E-Commerce environments are affected by cognitive processing factors (i.e., users are required to process products' information, compare features and take decisions), this research work attempts to incorporate human cognitive differences in a user model and accordingly adapt and personalize content and functionality of E-Commerce systems aiming to improve task usability and provide a positive user experience. In this context, the purpose of this paper is to present the architectural design and main components of an adaptive interactive system, namely PersonaWeb, which aims at improving the shopping experience of users by adapting the visual and interaction design of E-Commerce Web environments based on the users' individual differences in cognitive processing.

2 The PersonaWeb System

PersonaWeb is a Web-based interactive system that dynamically adapts content and functionality of E-Commerce environments based on individual differences in cognitive processing. Figure 1 depicts the architectural design of PersonaWeb that consists of three main components; the *User Modeling component*, the *Content Management component* and the *Adaptive User Interface component*.

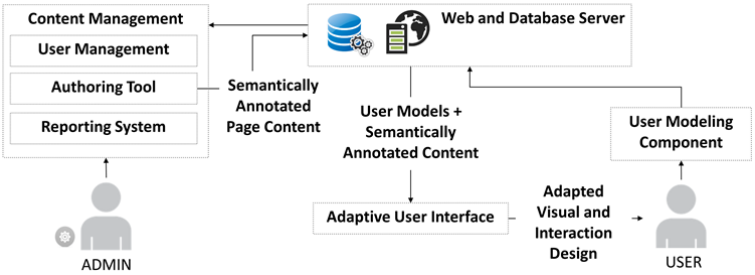

Fig. 1. The PersonaWeb System Architecture.

2.1 User Modeling

The user modeling component is responsible to generate the user models of the system which are necessary for the adaptation behavior of the system. Two cognitive factors are used for modeling the users' individual differences: *cognitive styles* and *working memory capacity*. The cognitive styles' theory is based on the Riding Cognitive Style Analysis [4] which distinguishes users based on two dimensions, the Verbal/Imager dimension and the Wholist/Analyst dimension. The working memory theory is based on Baddeley's working memory capacity model [5]. The component supports the management and maintainability of user data collected, enabling the administration and extension of methods and factors of the user model. Explicit and implicit user data collection methods are used for eliciting the user models' character-

istics. Explicit user data collection methods include accredited psychometric tests in which users are required to respond to a series of cognitive aptitude tasks. Depending on the users' responses (accuracy and speed), algorithms are applied for highlighting their cognitive processing characteristics. Implicit user data collection methods are based on a set of Web navigation metrics in which the users' cognitive factors are inferred through their interactions with specific divisions in the system [8, 9].

2.2 Content Management

The content management component provides an easy to use tool for content providers to create semantically enriched Web-pages. Providers are able to annotate particular divisions of Web-pages indicating to the system which visible aspects of the E-Commerce environment should be adapted. A WordPress[1] plugin that extends the functionality of the default WordPress Web content editor is implemented to support the functionality of creating Web-pages with semantically annotated content. Using the extended editor's methods, the content creator is able to add, edit, or delete content that is semantically annotated. The purpose of the Web content editor is to enrich the Web-pages with semantically annotated content (e.g., title of a product, features of a product) with the aim to indicate which divisions of the corresponding Web-page should be adapted and how. This adaptation is based on specific rules that are applied on the adaptive user interface which is described in the next section.

2.3 Adaptive User Interface

The adaptive user interface component takes as input the annotated content and the users' cognitive characteristics, and accordingly performs specific rules for adapting the content presentation and the interaction design of the system. The adaptation process initiates by retrieving the Web-page content from the database, which is further parsed for extracting and separating the semantically annotated sections from the rest of the content, with the use of client-side functions and selectors. The adaptation mechanism runs specific rule-based statements to decide which adaptation effect design to apply, based on the users' cognitive characteristics. Once the decision rules are applied, the page content is reconstructed in the appropriate design and is returned to the Web browser to be displayed. For each adaptation effect, predefined *CSS (Cascading Style Sheet)* classes are applied on the visual design of content, prior loading the content in the Web browser. Finally, several adaptation effects are communicated to the users based on their cognitive styles and working memory capacity levels.

3 Conclusions

The purpose of this demonstration paper is to present the architecture and main components of PersonaWeb, a Web personalization system that adapts content and func-

[1] *Wordpress, http://www.wordpress.org*

tionality of E-Commerce environments based on the users' individual differences in cognitive processing. An extended functional prototype of the PersonaWeb system has been designed and developed which is publicly available online[2].

Several user studies have been conducted to date with over four hundred users investigating the added value of personalizing content and functionality of E-Commerce systems in terms of task usability and user experience. Preliminary results provide initial evidence towards using the PersonaWeb system to model human cognitive factors and design adaptive E-Commerce Web interfaces since the studies have shown users' improvement in task completion efficiency and effectiveness [1, 8, 9, 10].

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