The PersonaCheck System for Personalizing M-Commerce Checkout Processes

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***Abstract*—This demonstration paper presents a Web-based adaptive interactive system for personalizing the checkout process of M-Commerce Web environments, coined PersonaCheck. In particular, the system personalizes the visual and interaction design aspects of a mobile Web-based checkout process based on users' cognitive style theory which argues that individuals have differences in the way they process and organize information, as well as experience their context and environment in different manners and perspectives. The PersonaCheck system consists of three main components: i) an M-Commerce environment for creating and managing the checkout process designs; ii) a user modeling component in which explicit user data collection methods are performed for eliciting the users' cognitive processing characteristics; and iii) an adaptive user interface that is responsible for performing rule-based mechanisms for deciding and communicating the "best-fit" checkout process design to the users based on their cognitive styles.**

Keywords—M-Commerce; Personalization; Individual Differences; Cognitive Styles; Checkout Process

I. INTRODUCTION

Nowadays, M-Commerce has become a routine activity for a high number of users and making purchases online is a fairly standard process [1]. In this context, the *checkout process* is one of the basic components of any commercial Web-site whose purpose is to gather the customer's personal, shipping and payment information for performing an online purchase.

With the advent of new and heterogeneous interaction device types, practitioners and researchers alike seem to readily embrace a number of different approaches for personalizing the interaction design of M-Commerce environments, e.g., the structure and content of the user interface adapts depending on the users' interaction device type (i.e., responsive design). However, a common practice with regards to existing checkout processes is that they adapt the content and functionality of the system solely on technology factors (e.g., the users' interaction device), rather than human factors, i.e., users interacting with the same devices receive the same checkout design, although users have unique characteristics, needs and preferences. In addition, recent research underpins the necessity for designing more user-friendly commercial Web environments since studies have shown that today's E-Commerce and M-Commerce Web environments entail a high number of usability issues which decrease the overall user experience and acceptance of such interactive systems [2-5].

In this realm, aiming to improve the experience of users' interactions within commercial Web environments, this demonstration paper presents an alternative approach to current checkout design practices by personalizing the interaction design of checkout processes based on users' individual differences in cognitive processing. The approach is primarily driven by existing theory on cognitive styles which argues that individuals have differences in processing and representing incoming information, as well as experience their context and environment in different manners and perspectives. The theoretical basis of this research is based on a widely accepted and accredited cognitive style dimension, Wholist/Analyst [6, 7], which distinguishes individuals as *Wholists* that prefer and tend to structure incoming information as a whole to get the big picture and experience surroundings of the environment in a relative passive and global manner, or as *Analysts* that prefer and tend to structure the incoming information in detail and experience surroundings in an active manner and with an internal perspective.

The proposed approach has been realized in a Web-based adaptive interactive system, coined PersonaCheck that personalizes the visual and interaction design aspects of a mobile Web-based checkout process based on users' individual differences in cognitive styles. In the rest of the paper we present the motivation for designing and developing the PersonaCheck system and consequently we present the main components of the system. Finally, we describe the demonstration setting and demonstration scenarios.

II. MOTIVATION

The motivation of this work is primarily driven by existing research findings on the Wholist/Analyst cognitive style dimension which has been related to the way individuals navigate within hypermedia environments and the way hypermedia content is structured [8, 9]. Studies have confirmed that the Wholist/Analyst dimension affects search and browsing behavior of users in interactive systems [10, 11]. For example, in the context of Web-based search and navigation, studies revealed that Wholist users prefer to follow a top-down approach in navigation, and tend to search for general information and then for specific information. On the contrary, Analyst users follow a bottom-up approach in navigation, use a high number of search terms and prefer scanning the search results than reading [10, 11].

In this context, we investigated the checkout designs of popular commercial Web-sites [4, 5], and concluded that the majority of them utilized two broad checkout designs that could be categorized as follows: i) a *single one-page checkout design* that contains all the necessary information for performing the purchase within a single page; and ii) a *guided step-by-step checkout design* in which users have to fill out their information in multiple steps, usually across multiple pages or sections. Based on theory of cognitive styles, the single one-page checkout design could be related to the analytical approach that Analysts follow since it enables users to freely access all sections of the checkout process in a single page. On the other hand, the guided step by step design could be related to the Wholist dimension of cognitive styles since it presents content through a constrained and guided environment.

A preliminary controlled user study was initially conducted that explored the impact of the Wholist/Analyst dimension on user preference and task performance of the aforementioned different checkout designs within real-life M-Commerce and M-Commerce settings (Nordstrom.com, Discovery.com and Amazon.com) [12]. Analysis of results suggested that Wholist users perform more efficiently in checkout processes that follow a guided approach, whereas Analyst users are more efficient and prefer a single page checkout design which does not follow a guided approach but rather provides more flexibility while entering information. A detailed analysis of results is out of the scope of this paper. Instead, the main aim of this demonstration paper is to present the main components of the PersonaCheck system and a demonstration scenario of a mobile Web-based checkout process in which different users (Wholists or Analysts) will perform the checkout process through different designs that will be adapted at run-time according to their cognitive styles.

III. THE PERSONACHECK SYSTEM

A. Architectural Design Overview

The PersonaCheck system is a Web-based adaptive interactive system that consists of three main components; the *M-Commerce Environment* component, the *User Modeling* component, and the *Adaptive User Interface* component. Figure 1 illustrates the architecture of PersonaCheck. The system implements a client-server architecture, where the aforementioned components act as clients. On the server-side, a Database Server acts as the back-end of the system and an Apache Web Server is used to host the M-Commerce Environment component and the User Modeling component. We next describe each component of the system.

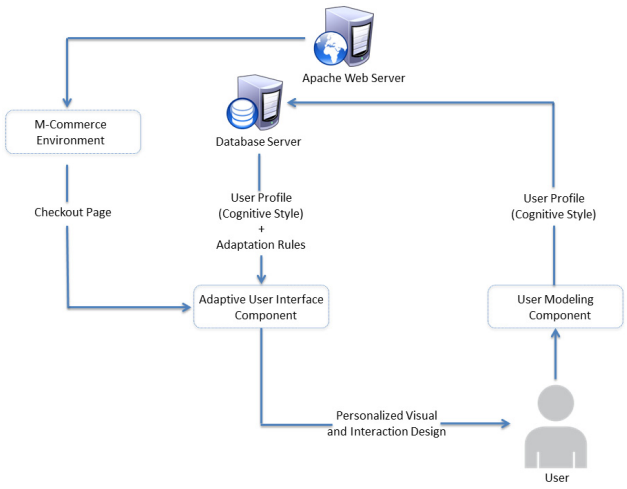

Fig. 1. Architectural desgin of PersonaCheck.

B. M-Commerce Environment

The M-Commerce Environment is a Web-based system that was developed as an extension within the WordPress Content Management System[1]. For the purpose of this research, a checkout design creation page has been developed as a WordPress plugin[2]. This page enables Web administrators to create a checkout page of the M-Commerce Environment through two main functions. First, the Web administrator creates the main sections (e.g., Shipping Information Section) and corresponding fields (e.g., Shipping Address field) of the checkout process which are stored in the system's database. Then the Web administrator assigns the visual and interaction design aspects of the checkout page. The visual and interaction design of the checkout page is developed utilizing cascading style sheet (CSS3) language that describes the formatting and the visual aspects of the checkout designs.

C. User Modeling

The User Modeling component is responsible to generate the user models of the system which are vital for performing the adaptation process. Explicit user data collection methods are performed for creating the user account in the system and for eliciting the users' cognitive processing characteristics. The users' Wholist/Analyst cognitive style is extracted through a specially designed psychometric test. In particular, users' cognitive styles are elicited by exploiting Riding's Wholist/Analyst Cognitive Style Analysis test (CSA) [6]. As reported in Peterson et al. [7], the reliability of the test is r=0.81, p<0.01. The psychometric test highlights individual

[1] *Wordpress Content Management System. https://wordpress.org/*
[2] *Wordpress Plugins. https://wordpress.org/plugins/*

differences in Wholist/Analyst cognitive style by requiring from users to respond to 40 questions as true or false. In particular, 20 of the questions ask whether a pair of geometric shapes is identical or not (*"Is shape X the same as shape Y?"*), and the remaining 20 questions ask whether a single geometric shape is part of another complex geometric figure (*"Is shape X contained in shape Y?"*) (Figure 2). It is assumed that Wholists respond faster in the task that involves the comparison of two figures than Analysts. On the other hand, it is assumed that Analysts respond faster in the task that requires dis-embedding the simple geometric shape from the complex one than Wholists. Depending on the response time and provided answer to each of the stimuli type, users are classified as Wholists or Analysts [6, 7].

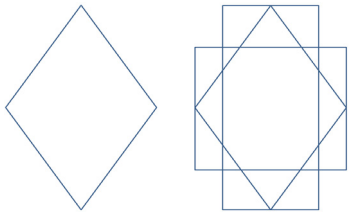

Fig. 2. Example of an Analyst-type stimulus. In this example, users are required to respond with true/false on whether the left simple figure is embedded within the right complex figure. It is assumed that Analyst users will solve this challenge faster than Wholists.

D. Adaptive User Interface

The adaptive user interface is responsible for adapting the content of the checkout process at run-time on the client's side based on specific adaptation rules for deciding which content presentation and interaction design to provide to the users based on their cognitive characteristics. The adaptation process initiates by retrieving the Web content from the database, which is further parsed for extracting the sections and fields of the checkout process from the rest of the content. The adaptation mechanism runs specific rule-based statements to decide which adaptation effect design will be applied on the content based on the users' cognitive characteristics. Figure 3 presents the rule-based mechanism for performing the adaptation effects.

Algorithm: Adaptation Mechanism
Input: Cognitive styles *cs* = { *wa* = [*wholist* | *analyst*] }, Page Content *pc* { *set of HTML5 form elements* }
Output: Adaptation Effect Design *aed* = { *wholist* | *analyst* }

```
1: procedure AdaptationMechanism(cs, pc)
2:     if ( cs{ wa } == wholist ) then
3:             aed = wholist (pc);
4:     else
5:             aed = analyst (pc);
6: end procedure
```

Fig. 3. Pseudo-code of the rule-based adaptation mechanism.

According to the decision rules of Figure 3, two main adaptation effects are communicated to the users based on their cognitive styles (Wholist/Analyst): a *simple one page navigation style (aed=analyst)* or a *guided step-by-step navigation style (aed=wholist)*.

Simple one page navigation style (analyst): users can freely enter the required information for performing the checkout process (Figure 4). All required information (shipping information, payment information, etc.) is visible in one single Web-page.

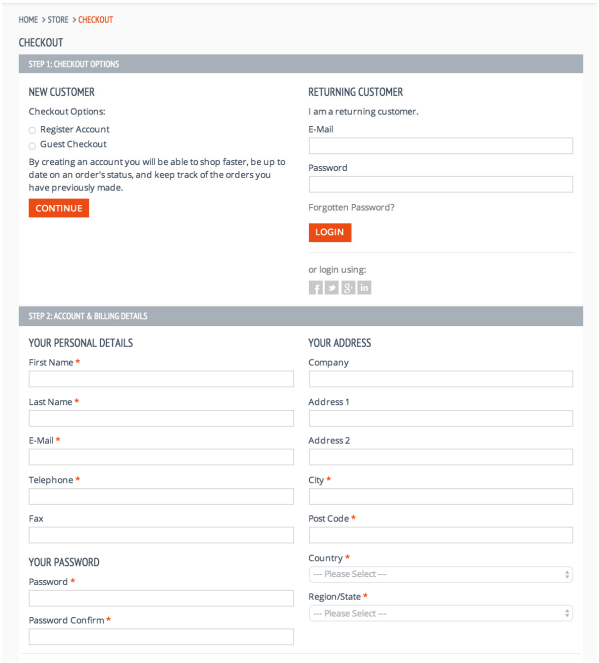

Fig. 4. Simple one page checkout design.

Guided step-by-step navigation style (wholist): users can only enter information of a particular section, and then proceed to the next section (Figure 5). Only one section can be expanded at a time.

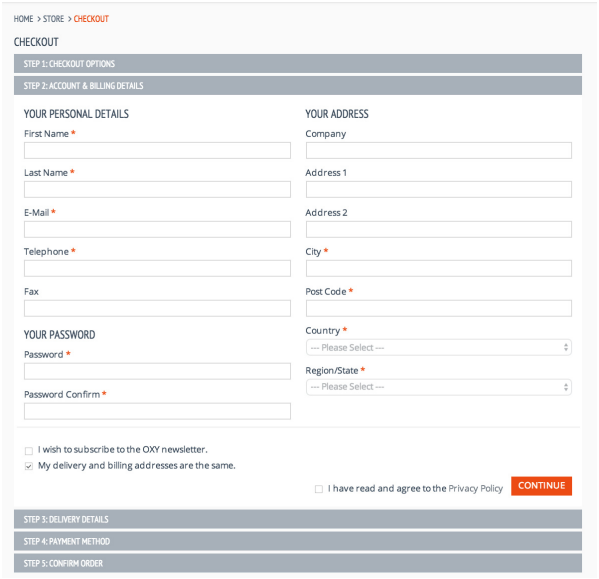

Fig. 5. Guided step-by-step checkout design.

IV. DEMONSTRATION SETTINGS

For the demonstration of the PersonaCheck system at the conference venue we will use an Apple iPad 4 with a 9.7 inch screen size. The PersonaCheck system is a Web-based adaptive interactive system and is accessible through any device connected to the Internet, having an HTML5-enabled Web browser[3]. No special equipment and hardware is needed for the demonstration purposes.

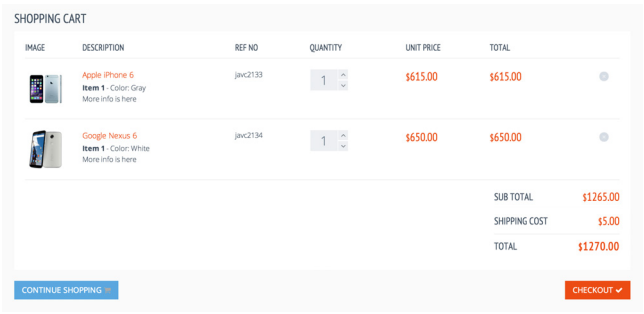

Fig. 6. Demo start screen with a shopping cart.

The main aim is to demonstrate a hypothetical interaction scenario of users buying certain products in an online M-Commerce system developed for the purposes of the demonstration. All user interaction scenarios will start with a shopping basket Web form (Figure 6) that will already include a list of products and the participants will be required to complete the purchase of products by using the PersonaCheck system. As soon the users start the checkout process they will be guided through two different screens:

Screen 1 – User Modeling: The user modeling is split in two phases: i) users will create their user model by first providing the required users' system account information (username and preferred password), personal information (full name, email, age, gender), and then ii) users will interact with the developed psychometric test for eliciting their cognitive styles.

Screen 2 – Checkout Process: Users will complete the checkout process by providing necessary information for completing the online transaction. Depending on their cognitive styles-based user model, the system will provide the "best-fit" checkout design to the users; the simple one page navigation checkout process to Analysts or the guided step-by-step checkout process to Wholists.

A. Demonstration Scenarios

Three scenarios will be presented at the venue:

Scenario 1 – New User: A new user enters the system and is required to follow the complete procedure (user modeling and checkout process). Main aim of this scenario is to engage participants in conducting the psychometric test in which they will also receive as a response their cognitive style characteristic (Wholist/Analyst). Then, depending on the elicited cognitive style, the user will complete the checkout process through the personalized design.

[3]*The PersonaCheck demo page. http://personaweb.cs.ucy.ac.cy/mdm2015*

Scenario 2 – Wholist User: An existing Wholist demo user enters the system by providing his account credentials and then performs the guided step-by-step checkout process.

Scenario 3 – Analyst User: An existing Analyst demo user enters the system by providing his account credentials and then performs the simple one page navigation checkout process.

ACKNOWLEDGMENT

The work is co-funded by the PersonaWeb project under the Cyprus Research Promotion Foundation (ΤΠΕ/ΠΛΗΡΟ/0311(BIE)/10), the Marie Curie and EU FP7 project SocialRobot (#285870) and the EU FP7 project Miraculous-Life (#611421).

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