PERSONALIZATION OF USER INTERFACES IN E-COMMERCE AND M-COMMERCE APPLICATIONS

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ABSTRACT
E-commerce and m-commerce consist of transactions conducted over (wired or wireless) computer networks, either by users purchasing goods, information and services, or directly between organizations. Given the existing limitations and enhancements on the mobile Internet, the preferences of users are noticeably affected. Among other factors, context-sensitivity of mobile devices emphasizes the importance of personalization technology. Personalization involves software that learns behaviors, inclinations, and patterns. It is an important step in the direction of alleviating information overload, creating a friendlier environment for each individual user and thus establishing trustworthy relationships between organizations and users. In our work we focus on the customization factor of e-/m-commerce interfaces and we outline how the main interface design choices (related to content, presentation, community and commerce), can be personalized.

KEYWORDS
Personalization, m-commerce, e-commerce, user interfaces, context-awareness, customization.

1. INTRODUCTION
Electronic commerce (e-commerce) and mobile commerce (m-commerce) consist of transactions conducted over wireless or wired computer networks, either by users purchasing goods, information and services, or directly between organizations. Today’s computers are satisfactorily powerful to support the multipart software that drives e-commerce, and communication networks are now fast enough to send/receive the large volumes of the required information between communicating computers in almost real time conditions [Davis and Benamati, 2003].

In m-commerce environments however, things are different: First, m-commerce is not just e-commerce using cell phones. There is no doubt that both e- and m-commerce are network-enabled and computer-assisted activities. Moreover, both of them are for the most part technologically driven trends which rely on Internet and Web technologies. Consequently, each of them shares features of the other. But there are also distinctive qualities that are capable to define their diverse status and functionality. E-commerce is mostly about supporting and realizing transactions, while nowadays m-commerce focuses on the facilitation of enhanced information network access [Stafford and Gillenson, 2003]. Second, there are seriously dissimilar underlying infrastructure components. Typical m-commerce client devices such as mobile phones or personal digital assistants (PDAs), are certainly provide limited capabilities compared to e-commerce clients.

These constraints elevate the importance of complementary technologies. Among them, personalization technology holds a key role. Personalization is the use of information about a particular user, to provide tailored user experiences for that user. In Web environments, personalization involves automatic customization of browser-type interfaces to accommodate individual users’ needs, interests, knowledge, tasks, or goals [Alpert et al., 2003]. User interfaces in e-commerce and m-commerce applications need primarily to be efficiently and properly accessible for each individual. In our work we study e-commerce and m-commerce interfaces and we outline how the main interface design choices (related to content, presentation, community and commerce), can be personalized.
2. WIRED INTERNET AND E-COMMERCE

E-commerce applications are rapidly expanded. One reason was the development of new networks, protocols, software, and specifications. The Internet (mostly the World Wide Web) created a new, inexpensive, public infrastructure that quickly replaced the private, proprietary networks used by early inter-organizational applications. The other reason was the increase in competition and other business pressures [Turban et al., 2002]. Thus, defining e-commerce as simply buying/obtaining and selling/offerings services, information and products on the Internet and the Web, is not giving the right dimensions of the whole situation. The real potential of e-commerce is improved efficiency, not revenue generation [Davis and Benamati, 2003].

E-commerce applications are continually developing and evolving as people identify new uses for increasingly complex and flexible networks of computerized organizational systems. In general, e-commerce applications tend to have the following characteristics [Carter, 2002]:

- They cross organizational boundaries (both within an organization and even with other organizations).
- They involve multiple distinct groups of users (each with their own distinct sets of requirements).
- They adapt to changes (both within the competitive marketplace and in technology in general).
- They include information from external sources (which may be freely obtainable, may be rewarded, may be bought or may require special efforts to obtain).
- They recognize information as a commodity (to which value can be added and from which value can be extracted).

As e-commerce matures and its tools and applications improve, greater attention is given to its use to improve the quality of services. Sophisticated business computing applications (e.g. customer relationship management systems, supply chain management systems or enterprise-wide computing systems), are actually build as complementary software engineering technologies upon the core of e-commerce, and are capable to provide new ways of transacting business. Among the several dimensions of e-commerce technology [Laudon and Traver, 2004], we underline the following, because these features are related to m-commerce issues discussed in the next paragraphs:

- **Ubiquity** – e-commerce is available just about everywhere, at all times. A direct consequence is e-commerce ‘global reach’ characteristic, regarding the total number of users an e-commerce business can obtain.
- **Universal standards** – the technical standards for conducting e-commerce are shared by all nations around the world.
- **Information richness and density** – Web can deliver complex (with text, video and audio) messages and can increase the accuracy, currency and timeliness of information (thus prices, costs and user preferences become transparent).
- **Interactivity** – technology that allows for online, two-way communications between organizations and users.
- **Personalization/Customization** – technologies that permit changes on delivered information, service or product, based on a user’s preferences or prior behavior.

3. MOBILE INTERNET AND M-COMMERCE

3.1 Mobile Internet

Traditionally separate technologies of the Internet and mobile telephony have now started to converge, bringing promises of a new era of portable networking. Keys to this convergence are sophisticated wireless data services providing mobile access to the Internet. Mobile Internet (or the Internet “in your pocket”) has many potential applications, including email, games, shopping, banking and real-time news [Barnes and Huff, 2003]. Mobile Internet is emerging even faster than e-commerce, in part because providers, content partners, customers, and investors are leveraging lessons from wired Internet. So, universal standards characteristic is an uncontested topic in mobile Internet environments, a goal in which all participating parts are dedicated.
Mobile devices are opening up new design challenges, new conveniences for users, and new business opportunities. As new technology becomes mainstream, designs and business models that work for the target user population are a critical success factor. Mobile Internet limited computing and communicating platforms, challenge application developers to reinvent design methods and principles. The physical capabilities of the different devices are varied: screens of different aspect ratios and sizes; soft buttons (one, two or three); a menu button (or none); one font size (or several); directional buttons (four-way, two-way, or none) [Holtzblatt, 2005].

On the other hand, mobile devices may be used from a variety of locations and places [Deitel et al., 2002]. Ubiquity and global reach characteristics are emphasized in mobile Internet environments. Hence, mobile new platforms create the possibility for new applications to support and enhance user lives. Because of their mobility, many researchers ([Chae and Kim, 2003], [Lee and Benbasat, 2004], [Pascoe et al., 2000]) underline two facts: First, mobile Internet users have limited attention as they operate their mobile devices. This is because mobile users usually are involved at the same time in other tasks (e.g. car driving). Second, they emphasize the fact that mobile users treat their mobile devices in a quite personal way.

3.2 Mobile Commerce

Cellular carriers have made significant advances to enable next generation data (or wireless Web services) and m-commerce. Broadly defined, m-commerce involves an emerging set of applications and services people can access from their Web enabled mobile devices [Venkatesh et al., 2003]. According to the level of perceived risk during an electronic transaction, m-commerce users always favor to acquire low-risk more willingly than high-risk products or services [Chae and Kim, 2003]. The main reason is that there is no need for extra information when someone orders a simple product. This leads to minimal search cost for users. On the other hand, when acquiring high-risk products, the requirements of essential related information (for comparing prices, characteristics etc.) are bigger [Bhatnagar et al., 2000]. In many cases limited capabilities of mobile devices lead to restrictions on all previously referred necessities. In addition, the usual limited user concentration during mobile devices operations increases the “uncertainty” associated with most high-risk products/services.

Besides, m-commerce users prefer low-intensity content (e.g. ring tones, weather reports and screen icons). This is not only because of the limitations of mobile computing platforms. Users demand further individually customized content on the mobile Internet because its personalization level is higher than that of the wired Internet [Chae and Kim, 2003]. That makes the personalization/customization characteristic more significant in m-commerce area than in e-commerce.

4. Personalization and User Interfaces

4.1 Personalization Issues

Web users have vastly different needs and their skills and cognitive abilities are also vary widely. As a result, one-size does not fit all its users on the Web, either wireless or wired. Personalization is a particular e-commerce and m-commerce technology which aims to tailor Web-based applications to provide the users what they want and how they want it, instead of providing the same content in the same style to all diverse range of users [Murugesan and Ramanathan, 2001]. It is a large area, also covering recommendation systems, customization, and adaptive Web sites [Cingil et al., 2000], [Mulvenna et al., 2000].

Personalization comprises a variety of functions ranging from simple user recognition to more advanced functionalities such as performing certain tasks on behalf of the user. These functionalities are offered according to a personalization policy that specifies the manner in which personalization benefits will be delivered to the final user [Pierrakos et al., 2003]. Key features of Web-based applications which influence their effectiveness in providing expected services to users are: the content provided and its “sense” or “look and feel”. The structure itself of the entire Web site is an additional important aspect [Mulvenna et al., 2000]. It is defined by the layout of the individual pages and the existence of links between them. In the following paragraphs we will examine these issues in more detail.
4.2 Personalization Tasks and Approaches

In last years, we have experienced considerable development in sites that can personalize content delivered to individual users. Using rich profile information, they are capable to provide valuable services. **Data collection** is considered as the backbone task of personalization, because customization will be based on the collected data, either explicitly or implicitly.

In **explicit user profiling**, users know what information they provide about themselves. Explicit methods include Web forms, surveys, interview, and users’ rating on certain services. On the other side, **implicit methods** for user profiling include click-stream analysis, cookies, Web log data and Web site stay time [Murugesan and Ramanathan, 2001]. Third-party legacy data sources, such as demographic data and previous purchases data of people, are also used besides to the information collected or inferred from the users.

**Data analysis** is the main task of personalization. Using a variety of methods, the goal is to infer user needs and preferences. The most influential data analysis approaches regarding personalization are [Chiu, 2001], [Pierrakos et al., 2003], [Murugesan and Ramanathan, 2001]:

1. **Rule-based filtering** is based on a domain-specific rule-base. User’s action triggers the rules that their conditions meet. Typically, static user models are obtained through a user registration procedure and a number of rules are specified manually concerning the Web content that is provided to users with different models. The disadvantage of this approach is that rule engines do not handle dynamic data or they can not be made flexible to fit into the future use.

2. **Content-based filtering** is done by grouping all the contents of a Web site/application into categories and then matching the users’ interest against these categories. It offers tailored contents of Web, by applying machine learning methods to Web content, in order to discover the personal preferences of a user. Predictions of this approach are the best when the content can be easily categorized and when the users’ interest is without difficulty matched against these categories.

3. **Collaborative filtering** aims to provide personalization functionality without requiring the analysis of the actual content. Personalization is achieved by searching for common features in the preferences of different users. Collaborative filtering works by building a database of preferences for items by users. Each new user is matched against the database to discover “neighbors”, which are other users who have historically had similar taste to him [Sarwar et al., 2001].

4.3 User Interfaces for E-Commerce and M-Commerce

User interfaces in e-commerce and m-commerce applications focus on the elements provided on Web pages in order to support navigation and information acquirement. To take advantage of the full potential of Internet, Web interfaces and Web applications, either wired or wireless, have to be customized to suit an individual user or a group of users [Murugesan and Ramanathan, 2001]. The importance of interface design has been commonly acknowledged, especially regarding mobile devices adoption: interfaces characteristics had been identified as one of the two broad factors (along with network capabilities), affecting the implementation and acceptance of mobile phones emerged [Sarker & Wells, 2003]. Devices adoption is considered as a critical aspect for the future of m-commerce, because without widespread proliferation of mobile devices, m-commerce can not fulfill its potential.

5. **DESIGNING PERSONALIZED USER INTERFACES IN E-COMMERCE AND M-COMMERCE APPLICATIONS**

5.1 The 7C Framework

In [Rayport and Jaworski, 2004], a detailed framework is presented for e-commerce customer interfaces (the 7C framework). It studies the design of e-commerce user interfaces, based on certain factors. This paper focuses on **Customization, Content, Context** (meaning presentation), **Community** and **Commerce** factors. Future extension of our work will include the remaining factors of the 7C framework:
• **Connection** refers to the degree of formal linkage from the site to other sites. Different kinds of connections are:
  
  o **Outside links** - Links that open in the same browser window but users need to leave the source site and to enter into another one.
  
  o **Framed links** – The same browser window is also used (like the outside links). The difference is that the new site is exactly framed in some way by the source site.
  
  o **Pop-up windows** – Links that open up the new site in another browser window while the original site stays in the background.
  
  o **Outsourced content** – Users do not leave the source site in order to view the content.

Based on the type of connections they feature, sites can be classified as destinations, portals or hubs (combining self-generated content and selective links to related sites). Given the importance of the interoperable distributed systems and the constant dissemination of Web service-oriented approaches, we believe that the connection factor is a well-promising personalization factor.

• **Communication** focuses on the type of dialogues (interactivity) between sites and their users. Interactivity characteristic of e-commerce technology is amplified in m-commerce, because after all mobile phones are devices constructed principally for online communication and interaction. For that reason, customized communication is expected to attract researchers’ attention in the near future, both for wired and wireless Internet.

### 5.2 Personalization Aspects for E-Commerce and M-Commerce User Interfaces

We are concerned mainly for customizing e-commerce and m-commerce interfaces. We believe that personalization demands a more holistic approach: it is not just a simple factor among the others. We use personalization as the crucial perspective for analyzing the interface’s influence on application effectiveness. Two higher-order design principles are particularly helpful in understanding how to combine successfully the 5Cs. Fit (or consistency) refers to how well each of the 5Cs individually supports the organization’s model. Complementarity (or reinforcement) refers to the degree of consistency between each of the 5Cs.

Regarding m-commerce, standardized directions for interfaces’ design, have not been established so far. But several research studies ([Chae and Kim, 2003], [Elliot and Phillips, 2004]) acknowledge that the design rules of wired Internet interfaces should not be directly adopted in m-commerce area, because of the considerably different user requirements and device constraints. Thus, we have to identify what does not apply to m-commerce of the existing e-commerce practices. Significant influences of mobile Internet environment to the 7C framework can be found in [Lee and Benbasat, 2004], and they are also taken into consideration in our work. Let us reconsider the main factors (content, presentation, community and commerce) of the 7C framework from a customization viewpoint:

• **Customized Content**: Content includes all digital information, including video, images, audio and text, and according to 7C framework, the following approaches can be used to evaluate it:
  
  o **Multimedia Mix** is the designer’s choice of how to combine the multimedia components.
  
  o **Offering Mix** refers to the importance given to each type of content: product, information and services.
  
  o **Timeliness Mix** refers to the designer’s preference of time-sensitive material.
  
  o **Appeal Mix** refers to the organization’s promotional message (cognitive or emotional).

A site provides customized content when it uses a recommendation engine to adapt to each user’s profile and to vary its offering mix (of products, information and services), or any of the previously referred content approaches. It must be noticed that in both cognitive and emotional appeals, personalization factor is critical: cognitive appeals focus on functional factors (such as low price, availability, reliability, customer support, etc.) and the degree of personalization is considered as one important functional factor; emotional appeals focus differently (using e.g. humor, novelties or stories) on personal ties to the product or brand [Rayport and Jaworski, 2004].

In m-commerce interfaces, one of the greatest challenges is the absolute lack of screen space. M-commerce interfaces can not present the same amount of content as the e-commerce ones, because of the device constraints or because it costs too much. However, mobile devices may offer task-relevant information and services. They are capable to detect the user’s setting (such as location and resources nearby)
and consequently to offer this information to the application in order to adapt the interface. This capability, namely context-awareness, and especially its dimension of proactive context-aware retrieval (e.g., detecting user’s location and providing maps relevant to it) may have noteworthy impact in building mostly the content (but not only that) of a personalized m-commerce interface. Personalization can be seen as a filtering mechanism which allows the delivery of low-intensity and low-risk content that mobile Internet users appreciate.

- **Customized Presentation:** Presentation can be evaluated by both usability and aesthetics criteria.
  - **Usability:** A well-designed interface is capable of organizing massive amount of information into sets of pages and helps users navigate naturally among topics. Relative design and performance elements of great importance can be categorized as navigation tools, section breakdown, linking structure, reliability, speed, media accessibility and platform independence.
  - **Aesthetics:** Visual (graphics, colors, fonts, etc.) and audio (sounds, melodies, etc.) designer’s choices are responsible for the atmosphere that interfaces create.

The aesthetic nature of interfaces is an obvious personalization parameter. But also usability design and performance elements can be customized for more personalized interfaces. Very popular among Web site designers are presentation enrichment tools, able to create multimedia effects such as video, animation, audio and images [Lee and Benbasat, 2003]. The effectiveness of these interface enhancements is, however, open to discussion, especially in the mobile environment.

Visual and audio characteristics of low-intensity content (such as color schemes, screen icons, ring melodies etc.) have been proved for mobile users as a favorite way of making their phones more personal. But, frequently users are disappointed by the performance of Internet applications over wireless links [Hung et al., 2003]. Probable causes for this situation include unreliable connections, high costs, slow speeds, burdensome applications and awkward interfaces [Schultz, 2001]. This discussion also stands for the multimedia mix approach of customized content. Fulfilling multimedia requirements is not as simple as it seems. An effective multimedia personalization technique is considered the dynamic adaptation of the media quality to the level admitted by the network and user’s mobile device [Georgiadis et al., 2005].

- **Customized Community:** Community builds a sense of membership through shared common interests. The following aspects of communities, according to 7C framework, can be used to evaluate its importance:
  - **Motivation** – Community members have in general different reasons for joining online communities. Sometimes the motivation is specific, e.g. joining an auction site. On several occasions, users just want to lightly socialize with others. Also, several times, users are seeking emotional support by joining such groups.
  - **Benefits** – Participants frequently receive emotional (and not only) benefits such as inclusion in plans and activities, mutual influence, better prices (sites with demand-sensitive pricing policies), need fulfillment, and shared information and experiences [Adler and Christopher, 1999].
  - **Level of Participation** – Members can be classified as passives (those who just attend a community), actives (those who take part in conversations), motivators (those who plan activities, initiate conversations and set conversation topics), and caretakers (those who act as intermediaries between members).
  - **Interaction Tools** – The development of the community is greatly influenced by community’s decision whether to use interactive or non-interactive communication.
  - **Characteristics** – The more advanced the community, the more likely it is to have features such as effectiveness (the group has an impact on members’ lives), language (members develop specialized abbreviations that have a unique meaning within the community), consistency (individuals feel a sense of belonging), help (members feel comfortable asking for help from other members), self-regulation (community develops a system for policing itself and sets rules for its communication) and relationships (interaction between individuals leads to friendships) [Adler and Christopher, 1999].

Supporting communities is an advantageous personalization mechanism. Mature communities will generally include members at all levels, with different motivations and with various characteristics. Interface assistance that facilitates the creation of customized communities and the interaction among users in a similar wired setting surely will be appreciated by certain users and it will increase their satisfaction. Furthermore, in m-commerce environments the context-sensitive nature of mobile devices may support personalized interfaces that improve the perception of quality of the interaction tools, the level of participation, the benefits, the consistency and almost all of the previously mentioned aspects of communities.
Customized Commerce: Commerce features can be characterized e-commerce functional tools such as shopping cart, credit card approval, one-click shopping, orders through affiliates, registration, security (encryption and authentication technologies), order tracking, delivery options and configuration technology (helping users to line up products and services together in a variety of ways, which allows for analysis of performance/price tradeoffs and interoperability among complex components within a system [Rayport and Jaworski, 2004].

Customized commerce features depend on security issues related to the data collection personalization task. Explicit profiling is considered a tough task because users should have to be convinced to provide the required information about themselves and that their privacy would be protected [Murugesan and Ramanathan, 2001]. Furthermore, users should always be aware of the way in which personal information is being collected and used [Pierrakos et al., 2003]. Hence, when implicit profiling methods are used, though the users are not aware of the data collection, they should be properly told about what, how and why this information is obtained and used. Another example of security-oriented considerations related to customized commerce features is the promotion (to each individual user, if possible) of the most suitable for him method to use any of the existing electronic cash systems and the approaches to model check their atomicity properties (money atomicity, goods atomicity and certified delivery) in the presence of potential site or communication failures and all possible unilateral transaction abort cases [Katsaros et al., 2005].

In m-commerce environments, all these features must be designed taking additionally into account not only the different conditions of mobile Internet, but also the preferences of mobile users for low-intensity content and low-risk transactions. Also, given the distracting user setting in mobile Internet, the interface should call for only minimal attention in order to complete successfully critical transaction steps (such as the checkout process or the choice of the payment method).

6. CONCLUSIONS – FUTURE WORK

The mobile Internet has exclusive strong points over the wired Internet: users can access the Internet content wherever and whenever they want; mobile devices are used, which are context-sensitive to users’ environment. But there are also certain disadvantages: low-resources of devices and mobile setting’s distracting environment. Another aspect is related to the more personal characteristics of the mobile Internet: users prefer to access more personalized services when are involved in mobile operations.

According to our analysis, all previous considerations argue for the importance of personalization technology both in e-commerce and m-commerce systems. Especially the user interface design process should be considered as a privileged application sector of personalization technology. Based on the 7C framework, a well-accepted set of design guidelines for customers’ interfaces, we analyze the implications of personalization mechanisms on it, in order to achieve effective and convenient user interfaces in e-commerce and m-commerce applications.

Future work includes analyzing the influences of security issues on designing personalized user interfaces. Additionally, we plan to focus more on issues concerning advanced filtering mechanisms for m-commerce user interfaces.

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