INTELLIGENT AUTHORING TOOLS FOR ENHANCING MASS CUSTOMIZATION OF E-SERVICES: THE SMARTAG FRAMEWORK

Panagiotis Germanakos
Department of Management and MIS, University of Nicosia, 46 Makedonitissas Ave., P.O.Box 24005, 1700 Nicosia, Cyprus
germanakos.p@unic.ac.cy

Nikos Tsianos, Zacharias Lekkas, Costas Mourlas
Faculty of Communication and Media Studies,
National & Kapodistrian University of Athens, 5 Stadiou Str, GR 105-62, Athens, Hellas
ntsianos@media.uoa.gr, zlekkas@gmail.com, mourlas@media.uoa.gr

Mario Belk, George Samaras
Computer Science Department, University of Cyprus, CY-1678 Nicosia, Cyprus
{belk, cssamara}@cs.ucy.ac.cy

Keywords: Mass Customization, Adaptation, Personalization, eServices, Web Authoring tools, Cognitive Factors

Abstract: Mass customization should be more than just configuring a specific component (hardware or software), but should be seen as the co-design of an entire system, including services, experiences and human satisfaction at the individual as well as at the community level. The main objective of this paper is to introduce a framework for the automatic reconstruction of Web content based on human factors. Human factors and users' characteristics play the most important role during the entire design and implementation of the framework which has the inherent ability to interact with its environment and the user and transparently adapt its behaviour using intelligent techniques, reaching high levels of usability, user satisfaction, effectiveness and quality of service presentation. The initial results of the evaluation have proven that the proposed framework do not degrade the efficiency (in terms of speed and accuracy) during the Web content adaptation process.

1. INTRODUCTION

Peoples' lives today are more turbulent and diversified. The "one size fits all" (Stonebraker M., Çetintemel U., 2008, Brown D., 2004) model could be considered out-of-date. People now want to be seen and treated as individuals and many are prepared to pay for this. They are better educated and informed; able and willing to make their own decisions. Mass customization moves towards this direction and it aims to replace mass production, which is no longer suitable for today's chaotic markets, growing product variety, and opportunities for eCommerce. Mass customization is a broad term and could be characterized as a working and profitable business model. There is a whole spectrum of ways that mass customization methodologies can benefit companies. At the most visible end of the spectrum, companies can mass customize products and services for individual customers.

Regarding the convergence of Internet and mass customization, there is still the dispute whether could be proved successful, and perhaps more to the point: is it actually happening? (cyLEDGE Media, 2008).

For the scope of our current research, we perceive mass customization along with personalization, as a combination that together tend

to change the business information systems offering personalized service relationships as a way of connecting with customers over a number of platforms and of differentiating their services from those of competitors. Mass customization should be more than just configuring a specific component (hardware or software), but should be seen as the co-design of an entire system, including services, experiences and human satisfaction at the individual as well as at the community level.

The research that is described in this paper focuses on incorporating theories of individual differences in information processing within the context of Web-sites. Since the WWW is by definition a huge resource of information, it would make much sense that individuals' information processing characteristics should be taken into consideration. As part of our previous research, it has been demonstrated that the incorporation of related human factors in eLearning and eServices environments leads to better comprehension on behalf of the users (Germanakos et al., 2008a, Tsianos et al. 2008). This has been achieved with the reconstruction and enhancement of the quality of information presentation and users' interactions in the Web with techniques and tools aligned with their specific needs and preferences. To that direction, our efforts are focused on improving the effectiveness of Web-sites by employing methods of personalization.

In our more recent work, a framework for achieving mass customization on the Web based on human factors and the automatic reconstruction of the Web content has been developed and evaluated, called smarTag. The smarTag is an easy to use tool that enables any Web designer and developer to enhance their Web-site (technology and language independent) with adaptive Web objects that adjust according to the users' cognitive factors.

The main objective of this paper is to present the smarTag architecture and its components. Towards this direction a short review of current Web authoring tools as well as the description of the proposed framework is outlined. Finally, an evaluation of the smarTag System concludes the paper with the initial results being really encouraging for the future of our work.

2. WEB SERVICES TENDENCIES BASED ON HUMAN FACTORS

An effective and comprehensive mass production technique could be to devise a cognitive framework that could assist providers to develop Web-sites that will embrace intrinsic values of customers, tailoring their services accordingly.

We have seen that cognitive factors have an important role in user satisfaction in identifying the products that are interested in (Germanakos et al., 2008a, Tsianos et al. 2008). However, the way cognitive factors used today in order to design and develop Web services is considered unwisely and principally based on provider's perception, without following particular rules that could achieve the appropriate mapping with selected content meta-characteristics; thus reconstructing any content to the benefit of the users.

Consequently, our research interest is whether we could develop a smart Web authoring framework that will dynamically alter a section of a Web-site by personalizing the content and the structure to specific users' cognitive preferences. This could be achieved by enriching the existing Web structures and raw content (provider's original content) with further design enhancements and specific content transformations based on the adaptation mapping rules derived from selected cognitive factors (i.e., show a more diagrammatical representation of the content in case of an Imager user, as well as provide the user with extra navigation support tools). In the event that this would be proven successful and meaningful, individuals would learn better the information that is important to them.

Fig. 1 shows the possible Web content transformations / enhancements based on the mapping process that takes place during adaptation process, the influence of human factors and the theory of individual differences. Based on the figure above, the meta-characteristics of a user profile are deterministic (at most 3); Imager or Verbalizer, Analyst or Wholist and Working Memory level (considered only when low).

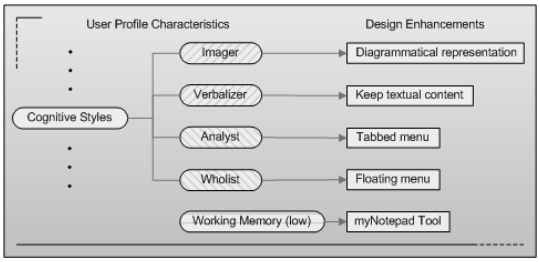

Figure 1. Web content transformations / enhancments

To our knowledge, there has not been a Web Development Editor that takes into consideration a

combination of the above issues for mass customizing Web products and services.

2.1 Current Web-based Authoring Tools

Web-based authoring tools are becoming standard issue in modern content management systems. They range from simple text editors to high powered graphical authoring tools and content management systems.

This section outlines some noteworthy research oriented and commercial Web authoring tools. Many of the editors listed below are "What You See Is What You Get" (WYSIWYG) HTML editors, some of which have the option to view the HTML source code. These are quite popular due to the low learning curve, yet it is important to get some understanding of HTML since WYSIWYG HTML editors can be limiting.

Such systems, mostly commercial, are amongst others the EditOnPro (http://www.realobjects.com/), Cute Editor (http://cutesoft.net/), TinyMCE Editor (http://tinymce.moxiecode.com/) and JXHTMLEdit (http://www.tecnick.com/).

Other, more research oriented Web authoring tools that were inspected are: Protégé (Noy et al., 2001), Swoop (Kalyanpur et al., 2005a, Kalyanpur et al., 2005b), and Ontostudio (http://semanticweb.org/wiki/OntoStudio).

3. THE SMARTAG FRAMEWORK

The smarTag Editor (see Fig. 2) is a Web Development tool enabling a content provider to create smart objects. It is composed of interrelated components, each one representing a stand-alone Web-based system.

A smart object under the smarTag Framework is conceptually similar to the traditional XML objects: they both consist of attributes and content. The content can either be in a textual or diagrammatical form in case of a Verbalizer and Imager user respectively. The smarTag attributes are special meta-characteristics (Germanakos et al., 2008b) describing the possible behavior the object can perform in its environment. All the objects are stored on the smarTag Server which are used in the mapping process of a user's profile (Tsianos et al., 2008), as well as the provider's external Web-page.

Since all the smart objects will be embedded as enhancements in an external Web-site, our main concern is to ensure openness and interoperability between the system's components and any external Web-site, as well as to ensure the Web security policies. In order to achieve this, the smart objects must be easily extendible and easy to handle. Using XML for implementing the smart objects' structure seems to be the best way to achieve this. Indeed XML (http://www.w3.org/XML/) enables the extendibility we need and enhances interoperability and integration among systems' components. We have designed a Web Service (a software system designed to support interoperable Machine to Machine interaction over a network) for retrieving the smart objects. A more comprehensive description on this concept will take place in section 3.2.

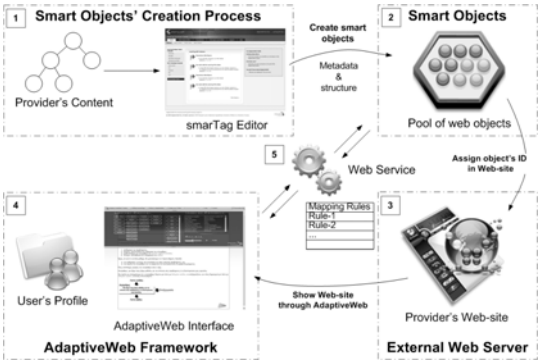

Figure 2. The smarTag Framework

3.1 Enhancing any Web-site with smarTag Editor

Our main concern was to create an easy to use Web enhancement tool that enables any Web developer / designer to enrich divisions of his / her Web-site with mass customization and personalization techniques. More specifically, the traditional methods of Web Development will take place in the process; based on the main requirements of the end-users of the Web-site and mainly on the "design taste" of the Web Designer / Developer.

Based on the Traditional Web-site development process, depending on the Web-site requirements and specifications, all the needed information (text, data, graphics and pictures) of the Web-site is collected. The Web-site's layout and Navigation is then designed by the Web Designer and all the collected information is implemented in the Web-site.

Predominantly, smarTag Editor is used in the Web Programming and Customization phase. The Web Developer will define specific divisions in the Web-site that will adapt according to individual characteristics (cognitive styles).

For a better understanding of how smarTag Editor works in practice, Fig. 3 shows a quick step process diagram for enhancing a Web-site with smart objects. An authorized Web Developer will create a new adaptive Web object by storing the object's actual content (text or image) and will characterize it based on the smarTag framework. A unique identifier will be assigned to this object and stored on the smarTag server. Based on the unique identifier, the Web Developer will map the corresponding object with a specific division in the Web-site created so far. The smarTag editor will then generate a JavaScript file based on the provider's preferences and will be embedded in the Web-site.

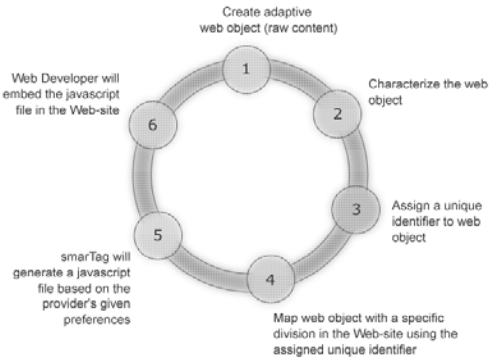

Figure 3. Enhancing Web-sites using smarTag Editor

This JavaScript file is the core element for communication establishment between the smarTag Web Service (description follows in section 3.2) and the provider's external Web-site.

3.2 Adaptation and Mapping Process

To get a better insight of the adaptation process and how data flows, we hereafter discuss how the personalized content interacts with the user profile, using specific mapping rules under the smarTag framework. For this purpose, we have designed an experimental setting in the application field of eCommerce, by authoring smart Web objects and enhancing an existing commercial Web-site. The eCommerce (Web) environment that has been developed used the design and information content of an existing commercial Web-site of IBM (http://www.ibm.com, date extracted November 25, 2008). This Web-site provides products' specifications of the IBM Company. We have developed an exact replica of the IBM System Servers section in IBM.com using smart objects.

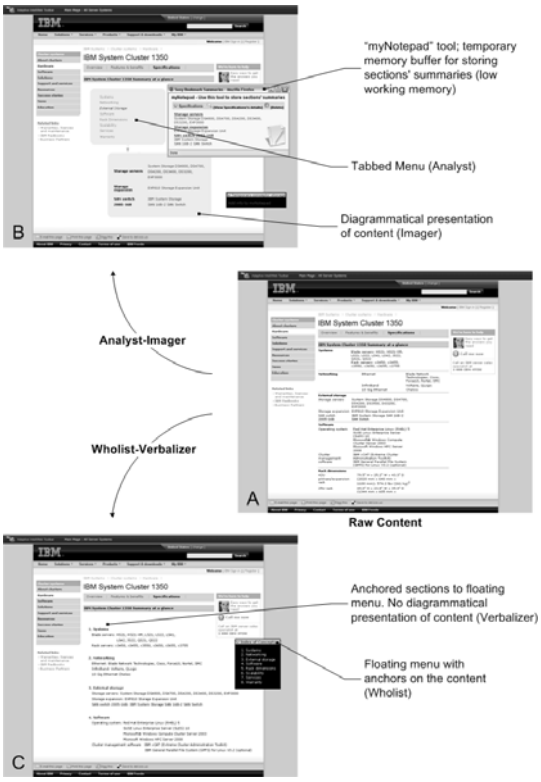

Figure 4. Content adaptation according to user's comprehensive profile

Initially, the user's comprehensive profile is retrieved. In this particular example, the user happens to be an Imager / Analyst with regards to the Cognitive Style, has an average knowledge on the subject (computer knowledge) based on his traditional characteristics, and he has a low Working Memory Span (weighting 2/7).

Furthermore, every Web-page is detached into standalone objects, each one having special characteristics. In our example, the user visits the "WebPage_Y" Web-page. First, the main HTML document of this Web-page is retrieved which contains all the needed information for building the Web-page; that is, (i) the HTML Web-page itself which is a predefined HTML document (designed by

the provider) keeping information of specified divisions / frames in the page for positioning each object, (ii) all objects (text, image, audio, video etc.) that comprise the content of the Web-page, and (iii) a generated JavaScript file from smarTag that is responsible for the proper integration of the smart objects into the divisions' Web-page.

Based on the abovementioned information (user's comprehensive profile and the content description of the particular Web-page) the correlation rules are created. These rules are responsible for mapping the particular implications with the Web-page's content, and consequently assembling the final adapted version of the provider's content.

The interpretation of this data-implications correlation results in the following conclusions while the user interacts with the eCommerce environment: (a) the provision of visual information (diagrammatical representation since he is an Imager), (b) extra navigation support tools (menu tabs) since he is an analyst, and (c) a "myNotepad" tool is used; temporary memory buffer for storing sections' summaries due to his/her low working memory span (see Fig. 4b).

3.3 Viewing the Adapted Content

The AdaptiveWeb User Interface (Germanakos et al., 2008a, Germanakos et al., 2007), namely AdaptiveInteliWeb (see Fig. 4a,b,c), is a Web application used for displaying the raw and/or personalized and adapted content on the user's device. This can be a home desktop, laptop or a mobile device.

The main concept of this component is to provide a framework where all personalized Web-sites can be navigated. Using this interface a user interacts with the provider's content and based on his profile and cumulative characteristics the adjusted content and particular supportive navigational tools are displayed. Fig. 4a depicts an exact replica of the IBM Web-site without any personalization made, while Fig. 4b and Fig. 4c shows the same Web-site after the personalization and adaptation process has been initiated, with the content to be adapted according to the user's comprehensive profile. As we can easily observe, the original environment has been altered based on rules that define the typologies of the users in terms of content reconstruction and supportive tools.

For example, in case a user is identified as "Wholist-Verbalizer" the content will be automatically reconstructed as in Fig. 4c, where a floating menu with anchors (Wholist) have been added so to guide the users on specific parts into the content while interacting. In this case no diagrammatical presentation will be used because the user is a Verbalizer.

4. TECHNICAL EVALUATION OF SMARTAG - SYSTEM'S PERFORMANCE

To measure the performance, functional behavior and efficiency of our system we have run two different simulations with 100 threads (users) each: (a) users retrieving raw content without any personalization and adaptation taking place and (b) users interacting with adapted and personalized content. In the second scenario, there is a significant increase of functions and modules ran, compared to the first one (raw content scenario), like user profile retrieval, dynamic content adaptation, learner control dynamic tools, navigational support etc.

Based on the simulations made (see Fig. 5) we assume the following:

(i) Deviation for raw content is 67ms and for personalized content 98ms. This difference is expected since the system uses more functional components in the case of personalized content like profile loading, dynamic content, etc. Thus, this consumes more network resources causing the deviation of our average to be greater than that of the raw content test. The deviation is not considered to be significantly greater and thus this metric result is proving the system to be stable and efficient;

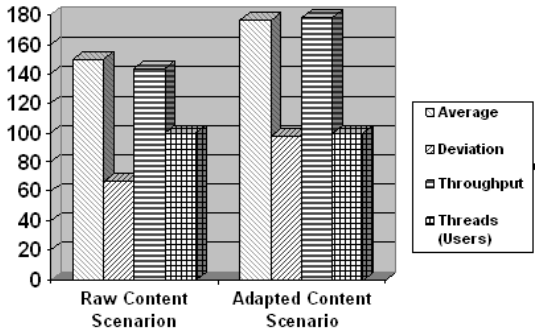

Figure 5. Raw Content and Adapted Content Scenarios

(ii) the throughput for the raw content scenario was 144Kb/min while for the personalized content was 179Kb/min. Based on the latter results, the

system is again considered efficient mainly due to the fact that the difference in throughput between the two scenarios is minimal. Taking in consideration that major component functionality is used in the case of personalized content this small difference suggests the efficiency of the system; (iii) the same arguments are true in the case of the average response times. The average response time for the raw content scenario was 150ms while for the personalized content was 177ms. This difference is again marginal that proves the efficiency of the system.

5. CONCLUSIONS

The basic objective of this paper was to present a framework, namely smarTag, for the automatic reconstruction of any Web content based on human factors for providing a comprehensive personalized result. This approach is liable of enhancing efficiency and effectiveness of users' interaction with eServices in terms of information assimilation and accuracy of finding their cognitive targets (products or services). Based on previous findings, it has been proven that user's cognitive factors have an important impact in the information space and on specific content meta-characteristics. Accordingly, the smarTag system provides an easy to use framework for enhancing any Web-site with smart objects that take into consideration human factors for the adaptation of the content. The initial results of the system's evaluation have shown that the proposed framework do not degrade the efficiency (in terms of speed and accuracy) in the Web content adaptation process and could be efficiently used for targeting the mass market by encapsulating customers' distinct characteristics. Such a method could be considered nowadays fundamental for the provision of adapted and personalized eServices, via any medium, increasing this way one-to-one service delivery and integrity, enabling businesses to retain their customers and therefore to gain a substantial competitive advantage.

ACKNOWLEDGEMENTS

The project is co-funded by the Cyprus Research Foundation under the project EKPAIDEION (#ΠΛΗΡΟ/0506/17) and the EU project CONET (INFSO-ICT-224053).

REFERENCES

Blom J., 2000., Personalization – A Taxonomy, ACM *2000. ISBN:1-58113-248-4., 2000*

Brown D., 2004. Wave goodbye to the era of one-size-fits *all. http://seattlepi.nwsource.com/*

cyLEDGE Media, 2008. Disentangling Web 2 and *Mass Customization*

De Bra P., Aroyo L., & Chepegin V., 2004. The next big *thing: Adaptive Web-based systems, Journal of Digital Information, Vol. 5 Issue 1, Article no. 247.*

Germanakos P., Tsianos N., Lekkas Z., Mourlas C., Belk *M., & Samaras G., 2007. A Semantic Approach of an Adaptive and Personalized Web-based Learning Content - The case of AdaptiveWeb, Proceedings of the 2nd International Workshop on Semantic Media Adaptation and Personalization (SMAP 2007), London, U.K., December 17-18, IEEE Computer Society, pp. 68-73.*

Germanakos, P., Tsianos, N., Lekkas, Z., Mourlas, C., and *Samaras, G., 2008a. Realizing Comprehensive User Profiling as the Core Element of Adaptive and Personalized Communication Environments and Systems, The Computer Journal, Special Issue on Profiling Expertise and Behaviour, Oxford University Press, 2008, doi:10.1016/j.chb.2007.07.010.*

Germanakos P., Tsianos N., Lekkas Z., Mourlas C., Belk *M., & Samaras G., 2008b. Towards an Adaptive and Personalized Web Interaction using Human Factors, A chapter to appear in: Advances in Semantic Media Adaptation and Personalization, Vol.2. M. Angelides.*

Kalyanpur A., Parsia B., & Hendler J., 2005a. A Tool for *Working with Web Ontologies, In Proceedings of the International Journal on Semantic Web and Information Systems, Vol.1, No.1.*

Kalyanpur A., Parsia B., Sirin E., Cuenca-Grau B., *Hendler J., 2005b. Swoop: A Web Ontology Editing Browser, Journal of Web Semantics Vol 4(2).*

Noy N., Sintek M., Decker S., Crubézy M., Fergerson R., *& Musen M., 2001. Creating Semantic Web Contents with Protégé-2000, Stanford University*

Stonebraker M., Çetintemel U., 2008. One Size Fits All: *An Idea Whose Time Has Come and Gone*

Tsianos N., Lekkas Z., Germanakos P., Mourlas C., and *Samaras G., 2008. User-centered Profiling on the basis of Cognitive and Emotional Characteristics: An Empirical Study. Proceedigns of the 5th International Conference on Adaptive Hypermedia and Adaptive Web-based Systems (AH 2008), Hannover, Germany, July 28 - August 1, 2008, Springer-Verlag Berlin Heidelberg, LNCS 5149, pp. 214-223.*

Wang J., & Lin J., 2002. Are personalization systems *really personal? – Effects of conformity in reducing information overload, Proceedings of the 36th Hawaii International Conference on Systems Sciences (HICSS'03), 0-7695- 1874-5/03.*