MESHED INTERACTION DESIGN PATTERNS FOR MESSAGING SERVICES

Roman Englert
Deutsche Telekom Laboratories at Ben Gurion University
P.O.B. 653, Beer-Sheva 84105, Israel

Gregor Glass
T-Systems Enterprise Services, Germany

Frank Heidmann
Fachhochschule Potsdam
Institute of Interface Design, Germany

ABSTRACT

Today numerous telecommunication services are implemented and brought to users. Common for these services is that their interfaces differ tremendously. As a consequence users have to learn the usage of each interface. Amorelation provides the new approach of meshed interaction design patterns (MIDP) that enable service usage in a consistent way for arbitrary telecommunication services. These patterns enable the design of complex interfaces for a variety of interfaces in a convenient and similar manner. With other words, through MIDP receives the user an unified user experience for a variety of applications. A novelty of this approach is the linkage between the modeling of patterns and interface design, which is achieved by a hierarchical structuring of the patterns. The MIDP approach is applied to a Mobile Messaging Service. This application is evaluated with and without MIDP by well-known usability measures like efficiency and ease-to-use.

KEYWORDS

Consistent interfaces, interaction design pattern language, meshed patterns, new media applications, user evaluation, telecommunication services.

1. INTRODUCTION

Global companies that address the business to consumer markets have the challenge to establish their products with a unique look and feel in order to widely spread their products in the markets. Users tend to buy different products from the same (mobile) company, if the look and feel of the products provides the so-called *déjà vu* phenomena, in which people feel immediately familiar with a new item based on previous experiences with more or less similar items [Yun et al 2005]. Well-known examples are the "i"-Series from Apple© with the iPod™ and the iTune™, or the MS Office™ interfaces. The familiarity of the different interfaces is based on similarities of their functionalities and design. Nevertheless, these easy-to-use interfaces are not yet existent in many emerging markets like information technology and telecommunication [Davis 1989, Englert/Glass 2006].

In this paper we present a new approach for the modelling of interfaces with similar look and feel. The approach is based on design patterns representing interactions of a user with the system, e.g. single log-on. A novelty is that these meshed interaction design patterns (MIDP) are cross-linked like in a wire-mesh fence. Therefore, the patterns are grouped hierarchically in such a way that more complex patterns can be composed. As a result MIDP can be applied to build interfaces with a consistent and easy usage of different services.

We apply the concept of MIDP to a number of devices and services, but will focus here on a PDA-like mobile phone with picture messaging to compose, send, and receive multimedia messages including pictures,

sound and video clips. The service is demonstrated in two different implementation versions: First, the original service as implemented in the device - in a naïve manner without MIDP, and second, MIDP are applied to the implementation.

Outline of this work: Sect. 2 describes and formalizes the MIDP approach and discusses related work. The test data and settings are depicted in Sect. 3. In Sect. 4 the usability of the MIDP-based Messaging Service is evaluated and discussed. Finally, in Sect. 5 we conclude.

2. MESHED INTERACTION DESIGN PATTERNS

Alexander [Alexander 1996] invented the idea of organizing implicit knowledge about how people solve recurring problems when they go about building things. Since this time many fields of practice applied approaches based on patterns, finally reaching HCI [Borchers 2001]. Patterns communicate insights into recurring design problems, capturing the essence of the problems and their solution in a compact form. They describe the problem in depth, the rationale for the solution, how to apply the solution, and some of the trade-offs in applying the solution [van Duyne 2003].

Patterns apply to different levels of abstraction. Depending on the type of application, they can be categorized according to different UI facets, such as navigation, information/content architecture, and interaction (including forms, controls, and other input components) [Seffah/Javahery 2004]. Generally, patterns represent proven design knowledge in a much richer context than guidelines. A pattern makes both the context and problem explicit and the solution is provided along with a rationale. Consequently, compared to guidelines, patterns contain more complex design knowledge and often several guidelines are integrated in one pattern [van Welie et al 2006, Tidwell 1998 and 2006].

Common to most approaches is that the patterns are provided as a collection, or with other words, independently from each other [Yahoo 2008, SAP 2008, van Welie 2008]. As a consequence, if someone has decided to apply a certain pattern, then there is no guidance which pattern to consider subsequently. As an example take a pattern that describes the single log-in to a PC. Having performed a single log-in, the user may want to execute another action like initiating an application. For the system designer there is now an open choice between all patterns that enable a further action. Alleviation to this situation can be brought by linking the patterns to each other resulting in meshed patterns. Referring to the above example, the pattern selection can be eased by providing an order of patterns where the subsequent pattern to the single log-in pattern is the pattern for executing an application. In the following we provide definitions of meshed patterns for interaction design.

The meshed interaction design pattern (MIDP) approach is based on reusable components, known as interaction design patterns, that considerably simplify the development of consistent and ergonomic multiple user interfaces. MIDP is characterized by two special features: Firstly, MIDP separates the description of a process that the user executes from its representation on the user interface. This separation has the advantage that the patterns can be structured both according to the prevailing design paradigm and also in line with the specific features of the device, such as a large monitor on a PC or a small screen on a PDA. Secondly, the approach only works if generic user interface solutions are found for generally applicable, or "generic", tasks - after all, the intention is to be able to use one pattern for a large number of applications. Both interaction discourse and graphical design patterns of the user interface can be mapped in a nested "decomposition hierarchy", that is, simple elements can be combined to produce more complex ones.

Definition 1: *Interaction Discourse Patterns* (IDP).

Interaction discourse patterns represent a sequence of interactions between a user and a telecommunication system annotated in abstract, technology-free, implementation-independent terms using the language of the HCI (Human-Computer Interaction) domain.

Each sequence step covers a single, discrete, complete and meaningful task of interest to an external user in some specific role or roles in relationship to a telecommunication system, comprising the user intentions and system responsibilities in the course of accomplishing that task.□

Figure 1. Example for using IDPs as a sequence – Basic Login & Registration can be used as a generic pattern in different contexts

As an example consider Fig. 1: The IDPs for basic login and registration can be used as a generic pattern in different contexts. Therefore, particular connections that are not listed in the IDP Basic Login & Registration can be added, if necessary (see also below the hierarchical model). In contrast to IDP, a graphical design pattern (GDP) is a named, reusable solution to a recurrent problem of GUI design in a particular context of usage. Thereby graphical design patterns communicate insights into design tensions, capturing the essence of the tensions and their solution in a compact, formalized form. Graphical design patterns deal with all types of issues relating to the interaction between humans and telecommunications systems, and apply to different levels of abstraction.

Definition 2: *Graphical Design Patterns* (GDP).

A graphical design pattern is a reusable solution to a recurrent problem of graphical user interface design in a particular context of use. Thereby graphical design patterns communicate insights into design tensions, capturing the essence of the tensions and their solution in a compact, formalized form.□

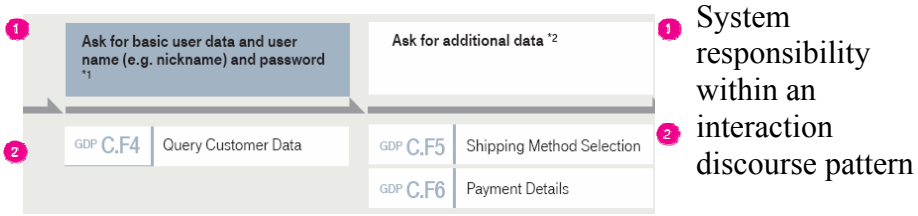

Figure 2. Graphical Design Pattern for user query in order to receive user data and password

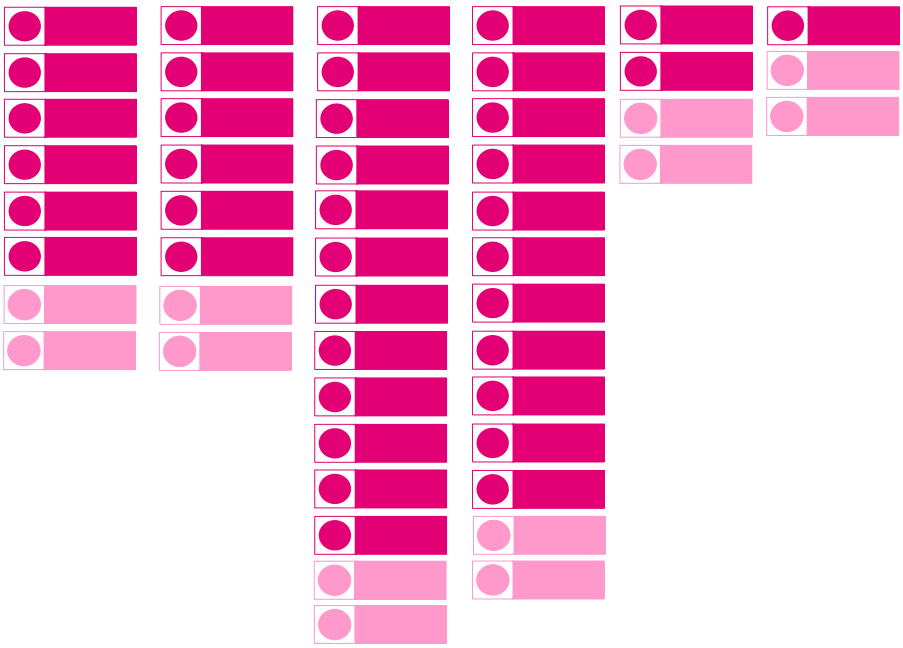

Figure 3. Hierarchical model of MIDP – cluster map

As an example consider Fig. 2 with a GDP for asking a user to input authentication and authorization data. Graphical design patterns address very large-scale issues that comprise a user's complete task (e.g. e-commerce shopping), they can address smaller-scale, slightly more concrete topics that describe the style of a certain interaction part (e.g. browser style), or can deal with low-level questions of user interface design that look at individual user interface objects (e.g. drop-down-list). GDPs are grouped into clusters according to well-establishes interface elements like "Navigation", "Search", and "Forms & Controls" as is depicted in Fig. 3.

The hierarchical model of Fig. 3 is based on clusters that consist of generic and specialized interaction discourse patterns. An example is the following: cluster "Login" contains the generic Login pattern plus the specialized patterns "Login (standard)", "First Login", "Web Login", "Flexible Login" (Fig. 4).

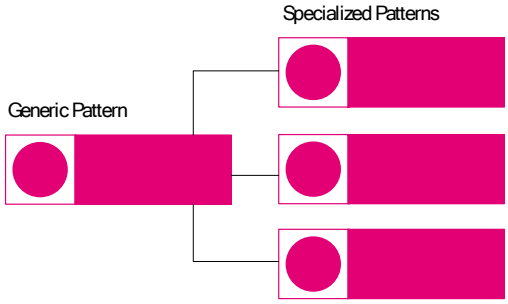

Figure 4. Cluster „login" with generic and specialized patterns

Interface design requires different levels of guidance: ergonomic principles, standards, guidelines, patterns, and style guides (Fig. 5). Within this model patterns are the connection between guidelines and style guides. They enable the consistent design of recurring tasks. Additionally, MIDP offers the solution to the design challenge of choosing the appropriate patterns. In the following section an application of MIDP to mobile messaging service is shown.

	Scope	Examples
Ergonomic Principles	▪ Abstract design rules, with high generality and low authority	▪ Learnability (Predictability, Familiarity etc.) ▪ Flexibility (Dialog initiative, Multi-threading etc. ▪ Robustness (Observability, Recoverability etc).
Standards	▪ Specific design rules, high in authority and limited in application	▪ ISO 9241-110, ISO 9241-151, ISO 9241-171 etc. ▪ Suitability for the task, Self-descriptiveness, Controllability, Suitability for individualization
Guidelines	▪ Guidelines tend to be lower in authority and more general in application	▪ Research-Based Web Design & Usability Guidelines (Usability.gov) ▪ IBM Web design guidelines
Patterns	▪ Patterns as invariant solutions to a recurrent problem within a specific context, capture design practice and provide a generative structure to support the design process.	
Styleguides	▪ Styleguides give a corporate "look and feel" to all corporate services; high authority	▪ T-Mobile Web Styleguide 2.0 ▪ t-zones style guide

Figure 5. Different levels of guidance for interface design

3. USABILITY TEST SETTING WITH AND WITHOUT MIDP

To evaluate the effect of the afore described approach with meshed GUI patterns, comparative usability tests of an original live service, namely Mobile Messaging, against a pattern-based, interactive GUI mockup is conducted. The Messaging Services enables someone to compose and send a text message including pictures, videos, and sound on a mobile device.

In the following the usability findings of the original device-based Messaging Service provided on the smartphone MDA III (without MIDP) [TMO MDA 2008], Additionally, those of the final macromedia flash GUI prototype (with MIDP), that has been developed in a user-centered way [ISO 13407] applying MIDP, are reported. Fig. 6 shows both implementations without (left) and with (right) MIDP.

Figure 6. Screens of the original services (left) – and the final consistent MIDP screens in neutral visual style on four device classes (right)

The implementation of MIDP is done based on several classes of MIDP. Fig. 7 shows the start screen of the text messaging application of the final mockup for the MDA III. The applied patterns are highlighted, numbered and named. The "vocabulary" of the pattern language, e.g. "Search in full-text" is already elaborated and currently consists of approximately 170 meshed patterns with production status for certain devices and services

Figure 7. Examples of the applied graphical design patterns and their naming scheme

As indicated in Sect. 2 and illustrated by Fig. 3, the patterns are sorted hierarchically into clusters. Their naming scheme reflects their type and category to allow easy identification of the appropriate pattern. Fig. 8

shows an example, how through the MIDP application a "unified user experience" may be visualized overarching over different device types.

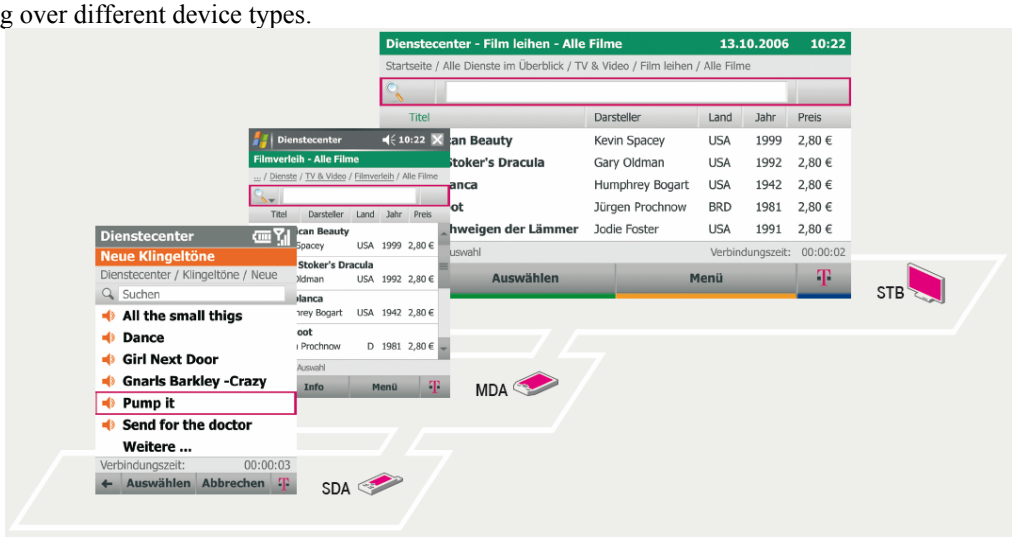

Figure 8. „Unified User Experience" demonstrated by product lists on different terminals: Cellular phone (SDA), Mobile Digital Assistant (MDA) and Settop-Box (STB)

In total 24 test persons were screened and acquired by telephone, aiming for an even distribution of age and gender. While the gender is evenly distributed, 70% of the candidates are between 14 to 40 and 30% between 41 to 64 years. The resulting age average for male subjects is 32,8 years and 34,4 for female test subjects.

In a pre-test questionnaire the subjects are asked to answer questions regarding their ownership of common multimedia devices (PC, mobile phone, PDA) as well as to their daily use of this technology and the internet. This is done in order to collect self-assessments of their level of technological competence.

Although most candidates claim at least medium, if not expert level of competence (but for the MDA III), 13 deny to be early adopters, who "always have to try out new technologies" (see Table 3). Only 1/6th of the respondents agree that this is true for them. In order to minimize artifacts and learning effects a completely randomized within-subject design is applied, so that each subject evaluates two versions. This set-up of test groups set-up leverages a number of advantages: It empowers a direct comparison of the old and new service versions, a sufficient control and minimization of perturbation.

Regarding the tasks for the user testing of the Mobile Messaging Service, four main tasks are defined according to main goals using such a service:

- Start "Picture Message" application on the device
- Write new message
- Add pictures to message
- Send message.

The test persons were monitored and video filmed in an usability lab with one instructor. After reading through a written briefing, the instructor gives verbal instructions for each task and encourages the test subject to solve the task while thinking aloud. Having completed each task, the test person gives a short subjective rating on a 6 point scale (according to German school grades "1"= very good, "6" = complete failure) for the ease of use and the time needed for the solution. Such a session lasts between 50 and 70 minutes per candidate including debriefing and final questionnaire.

4. USABILITY EVALUATION OF THE MESSAGING SERVICE WITH AND WITHOUT MIDP

Besides the qualitative results, which also emerge, the quantitative results for the user testing of both versions of the messaging services (old and with patterns) are described here. The subjective rating of the school grade after each task is measured in a simple ordinal scale and given in their means.

In presenting his Technology Acceptance Model (TAM) Davis [Davis 1989] defines the perceived ease of use as "the degree to which a person believes that using a particular system would be free from effort" and perceived usefulness as "the degree to which a person believes that using a particular system would enhance his or her job performance". Perceived ease of use also affects the perceived usefulness.

Additionally to the question “How easy is it for me to do what I want to do?” also the “How much time do I need to do it?” and “How much is it?” are two further aspects for user acceptance of a service / product. They play a vital role in the GUI design effort: Reduce number of clicks, make it quick and convenient, and also fun-to-use if possible. Why should the user pay for using something cumbersome, clumsy and time consuming? They will choose a different offer as soon as they can. Therefore we focus the per task subjective ratings on the ease of use and the perceived expenditure of time – with a ‘guerilla measurement’ in school grades: The ease of use and also the duration to complete the tasks of the original service is rated as overall satisfactory. While the users are not quite as pleased with the usability of “Send”, they seem to be most uncomfortable with the time needed to “Write” a message.

Contrary to this, Table 1 shows that the pattern-based version of the service on the MDA III is perceived as quite an improvement: The subjective “ease of use” ratings report a jump by more than a whole grade and more in nearly all functional aspects – “very good” for “Send“ and “Start”, and good for “Add” and “Write”. This last task, tough rated as “good” concerning the ease of use, is only rated satisfactory with respect to the time needed to complete it. This seems to be due to the constrained text input capabilities of this device.

Table 1. Subjective rating of ease of use and expenditure of time – in German school grades (scale: “1” = very good; “6” = complete failure)

Subjective Rating: Means of school grades for Mobile Messaging				
	Ease of Use		**Expenditure of Time**	
Task	**original**	**MIDP**	**original**	**MIDP**
Start “Mobile Messaging”	2,58	1,38	2,17	1,15
Write new message	2,75	2,07	3,41	3
Add pictures to message	2,41	1,61	2,17	1,38
Send message	3,09	1,31	2,58	1,61
Overall mean	**2,71**	**1,59**	**2,58**	**1,79**

Table 2. Willingness to use new service instantiations with meshed GUIs

"If you have not used these services so far, would you use them now?"		
Willingness to use	**n**	**in %**
yes	14	58,3
no	10	41,7
total	24	100

This overall positive perception of the pattern-based messaging service also has a considerable effect on the acceptance of the service. Asked if the test persons would use the service now, although they have not used it before, 58,3 % agreed to do so (see Table 2).

5. CONCLUSION

The MIDP approach to present patterns hierarchically and the application to a Mobile Messaging Service are described. It is shown that a pattern-based development achieves the intended goals of interaction harmonization and of a subjective usability increase. As experiments the MIDP approach has been applied to the Mobile Messaging Service. The analysis of the experiments demonstrated that the user-centered & pattern-based development increases subjectively perceived usability considerably. Furthermore, within a user-centered development, patterns have proven to be a feasible and efficient way to build services which are regarded as highly usable and ahead of the state of the art in the aspects of quality of use.

The usability evaluation demonstrates that the subjective "ease of use" ratings reported a jump by more than a whole grade. The MIDP GUI for the messaging service is really compelling, since more than 50% (exactly 58,3%) of the test users would you use it, even they have not used it before.

In future the usability evaluation will be expanded by applying the Software Usability Measurement Inventory (SUMI) [Kirakowski 1998, Cavallin et al 2007], which measures the perceived quality of use from the view point of the user and compares it with 2500 other applications. Furthermore, the MIDP approach will be enhanced to implement an interactive tool with collaboration support for the pattern-based development community.

REFERENCES

Alexander, C., 1996, The Origins of Pattern Theory, the Future of the Theory, and The Generation of a Living World. ACM *Conference on Object-Oriented Programs, Systems, Languages and Applications (OOPSLA).* California, U.S.A.

Borchers, J., 2001. A pattern approach to interactive design. Wiley series in software design patterns; Sussex, UK.

Cavallin, H. et al, 2007. How relative absolute can be: SUMI and the impact of the nature of the task in measuring perceived software usability, *Journal of AI & Society*, vol 22, no 2, pp. 227–235.

Davis, F., 1989. Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quartely*, no 13, pp. 319-339.

Englert, R. and Glass, G., 2006, An Architecture for Multimodal Mobile Applications. *20th Symposium on Human Factors in Telecommunication (HFT 2006)*. Sophia Antipolis, France, ETSI.

ISO13407, 2004. http://www.usabilitynet.org/tools/13407stds.htm.

Kirakowski, J., 1998. *SUMI User Handbook*. 2nd Edition, Human Factors Research Group, University College Cork, Ireland.

SAP, 2008. http://www.sapdesignguild.org/community/design/patterns_sap.asp (accessed March 2008).

Seffah, A. and Javahery, H., editors, 2004. *Multiple User Interfaces*. Wiley. Chichester, UK.

Tidwell, J., 1998. *Common Ground: A Pattern Language for Computer Interface Design*. http://www.mit.edu/~jtidwell/common_ground.html.

Tidwell, J., 2006. *Designing Interfaces: Patterns for Effective Interaction Design*. O'Reilly, California, USA.

TMO MDA, 2008. T-Mobile MDA III with camera; first cellular with PDA and WLAN http://www.t-mobile.de/business/allehandys/0,12827,14772-_2924-761-1-0,00.html (accessed March 2008).

Yahoo, 2008. http://developer.yahoo.com/ypatterns/ (accessed March 2008).

Yun, D. et al, 2005, Customer Expectation Level in Mobile Data Services. *Proceedings of the 7th International Conference on Human Computer Interaction with Mobile Devices and Services*. Salzburg, Austria, pp. 259-262.

van Duyne, D. et al, 2003. *The Design of* Sites. Addison-Wesley, San Fransisco, U.S.A.

van Welie, M. et al., 2006: *Patterns as Tools for User Interface Design*. http://www.welie.com/patterns/literature.html.

van Welie, M., 2008. *Interaction Design Pattern Library.* http://www.welie.com/patterns/ (accessed March 2008).